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GEOMATRIX

FINAL REPORT
Geologic/Geotechnical Study for Zone 7 Water Agency – Groundwater Demineralization Project

Pleasanton, California

Prepared for:

Carollo Engineers, PC
12592 West Explorer Drive, Suite 200
Boise, Idaho 83713

May 2005

Project No. 008453.000.0

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GEOMATRIX

May 31, 2005
Project 8453.000

Mr. Tom Seacord
Carollo Engineers
12592 West Explorer Drive, Suite 200
Boise, ID 83713

Subject: Final Report
Geologic/Geotechnical Study
Zone 7 Water Agency – Groundwater Demineralization Project
Pleasanton, California

Dear Mr. Seacord:

The enclosed final report presents the results of our geologic/geotechnical study for the subject project. Our study involved reviewing available information, performing field exploration at the site, performing engineering analyses and evaluations, and developing geotechnical design recommendations suitable for design of the project. This report addresses the comments provided by Carollo Engineers (Carollo) on our draft report dated October 18, 2004.

Please contact either of the undersigned if you have any questions regarding this report or need additional assistance. Geomatrix has enjoyed working with Carollo and look forward to the construction of the project.

Sincerely yours,
GEOMATRIX CONSULTANTS, INC.

Michael L. Traubenik, G.E. 6-30-06
Principal Geotechnical Engineer

5/31/05

Joseph C. de Larios, G.E.
Senior Engineer

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Enclosure

Geomatrix Consultants, Inc.
Engineers, Geologists, and Environmental Scientists

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GROUNDWATER DEMINERALIZATION PROJECT
Pleasanton, California

1.0 INTRODUCTION

This report presents the results of a geologic/geotechnical study performed by Geomatrix Consultants, Inc. (Geomatrix) for the Zone 7 Water Agency (Zone 7) groundwater demineralization project (project) in the City of Pleasanton, California. The project consists of a new groundwater treatment facility and supply pipeline. Carollo Engineers, P.C. (Carollo) is preparing the design for the project. The groundwater treatment facility site is located northwest of the intersection of Santa Rita Road and Stoneridge Drive. The supply pipeline for the facility will extend about 800 feet to the southeast, crossing under both Stoneridge Drive and Santa Rita Road. The site location is shown on Figure 1 and the layout of the proposed structures and pipeline are shown on Figure 2.

Geomatrix understands that the groundwater treatment facility consists of a Reverse Osmosis (R/O) Building, a small wetwell, and connecting pipelines. The proposed R/O Building will have two above-ground stories and one below grade level wetwell. Based on the 90 percent design drawings (dated May 2005) provided by Carollo, plan dimensions of the R/O Building are approximately 85 feet by 140 feet. The wetwell will be a below grade, reinforced concrete basin having plan dimensions of about 50 feet by 80 feet; it will be located on the northern side of the R/O Building beneath the floor supporting the two decarbonate tank towers (Figure 3). The top of the bottom slab of the wetwell will be at about 15 feet below the existing ground surface.

Our understanding of the approximate structure loads and dimensions within the R/O Building are based on discussions with Carollo. The decarbonate tank towers will be about 10 feet square and will each weigh about 800 kips. Chemical tanks (about 6 to 10 feet in diameter and 3000 gallons capacity) will be located east of the decarbonate towers. The chemical tanks will weigh about 225 kips. The R/O membrane train units will have skid-type mounts. An electrical room will be constructed at the southwest corner of the R/O Building. Loads on the underlying soils from the RO Building itself are expected to be relatively light. Some grading/earthwork will be needed to prepare the site for the construction of the R/O Building. Over the remainder of the site, cutting and/or filling about 2 feet or less will be needed to adjust the site grades. Subexcavation and replacement of native soils will be required within the footprints of some of the proposed improvements. Asphalt and portland cement concrete pavement will provide access to the R/O Building. Existing groundwater wells, the so-called Mocho Well Nos. 1, 3, and 4, will supply the water to the RO Building. The R/O Building will be constructed adjacent to the existing Mocho Well No. 4 pump station (Figure 2).

The supply pipeline will consist of approximately 800 feet of 28-inch-diameter pipe, which will connect the new groundwater treatment facility to Zone 7's Mocho Wells Nos. 1, 3, and 4. During preliminary design, the proposed supply pipeline alignment crossed under Stoneridge Drive, Santa Rita Road and the former railroad easement (which is a corridor for several utility lines). During the later stages of design, the pipeline alignment was changed to that shown on Figure 2. Crossings beneath the roads and utilities will be made using conventional boring and jacking (trenchless) pipeline installation techniques. To avoid the numerous existing utilities installed within the roadway right-of-ways and the railroad easement, the crossings will be made relatively deep (i.e., on the order of 15 to 20 feet below the roadway surface). Elsewhere, the pipeline will be installed in an open trench and will have about 3 to 5 feet of soil cover when backfilled (i.e., the pipeline will be buried within 6 to 8 feet of the existing ground surface). Other minor pipelines will be constructed to connect the wells to the supply pipeline and to convey the treated water to the rest of the Zone 7 water system

1.1 PURPOSE AND SCOPE

The purpose of the study described in this report was to obtain geologic and geotechnical information needed to support the design of the new treatment facility and supply pipeline. It is our understanding that Carollo will use the recommendations and conclusions presented in the geologic/geotechnical report to guide design of the R/O Building foundations, site grading and pavements associated pipelines, and appurtenances.

Geomatrix's scope of services included the following tasks:

Task	Description
1	Field exploration and information gathering
2	Geotechnical laboratory testing
3	Geotechnical engineering analyses and evaluations
4	Corrosivity evaluation
5	Geologic/Geotechnical report preparation
6	Consultation and attend meeting

Environmental assessments, such as environmental sampling of soil and groundwater and analytical testing, were not included in our scope of services for this geologic/geotechnical study. Based on the known site history, it is possible that substances of environmental concern have affected the site soils and/or groundwater and that these substances could be encountered during construction. It is our understanding that environmental sampling and testing will be performed at a later date to evaluate the nature and extent of possible contaminants within the proposed construction areas.

1.2 AUTHORIZATION AND PROJECT ORGANIZATION

This geologic/geotechnical study was performed in accordance with the professional consulting service agreement between Geomatrix and Carollo dated August 4, 2004. Geomatrix received authorization to begin work from Mr. Tom Seacord, Senior Project Engineer with Carollo.

The work described in this report was coordinated with the following individuals:

- Mr. Tom Seacord (Senior Project Engineer) - Carollo Engineers
- Mr. Joseph Zalla (Project Engineer) - Carollo Engineers
- Mr. Tony Valdivia (Project Engineer, Raines, Melton and Carella, Inc.) - Zone 7 Water Agency representative

Key Geomatrix personnel who participated in this project include:

- Mr. Michael L. Traubenik - Principal Geotechnical Engineer
- Mr. Joseph de Larios - Project Manager, Senior Engineer
- Mr. C. C. Chin - Project Engineer, Seismic Parameters
- Ms. Tania Welch - Staff Engineer, Field Exploration
- Mr. Todd Crampton - Senior Engineering Geologist

1.3 REPORT ORGANIZATION

The site of the planned facilities is described in Section 2. The field and laboratory testing performed for this study are discussed briefly in Section 3. Sections 4 and 5 summarize regional geologic and seismic setting, and site geology and subsurface conditions, respectively. Geotechnical recommendations and other considerations for the design of the structures are discussed in Section 6. Geotechnical design recommendations and considerations for the project pipelines are provided in Section 7. Finally, the basis for all the conclusions and recommendations presented in this report is provided in Section 8.

The appendixes of this report are described below:

- **Appendix A - Field Exploration**
  This appendix describes the field exploration conducted for this study. Logs of exploratory borings are included.

- **Appendix B - Laboratory Testing**
  This appendix presents results of the laboratory tests performed for this study.

- **Appendix C - Corrosion Testing and Analysis**
  This appendix presents the results of testing and analysis performed by JDH Corrosion Consultants, Inc. (JDH). JDH performed in-situ resistivity measurements at the site and performed analytical tests on samples of soil obtained by Geomatrix during the geotechnical field exploration program. The original report prepared by JDH, dated October 7, 2004, is included in the appendix.

- **Appendix D - Logs of Borings from Previous Investigations and Well Logs**
  This appendix presents boring logs from a previous investigation performed at the site by Consolidated Engineering Laboratories (Consolidated, 1999) for the nearby Mocho Well Nos. 3 and 4 pump stations, and miscellaneous well logs provided by the Zone 7 Water Agency.

2.0 SITE DESCRIPTION

The project site is located near the intersection of Santa Rita Road and Stoneridge Drive in Pleasanton, California (Figure 1). The R/O Building will be constructed east of and adjacent to the Mocho Well No. 4 Pump Station, which was recently built on the northwest corner of the Santa Rita Road/Stoneridge Drive intersection. An asphalt-paved driveway enters the site from

Stoneridge Drive. The northern side of the site is bounded by the Arroyo Mocho. The entire site is encompassed by a chain link fence topped with barbed wire. The ground surface of the site is relatively flat; it appears that only minor fills were placed to construct the Mocho Well No. 4 Pump Station. The elevation of the ground surface at the site varies between about 334 to 335 feet [North American Vertical Datum of 1988 (NAVD88); Towill, 2004]. The bottom of the arroyo north of the site is about 17 to 18 feet below the ground surface elevation of the R/O Building site. The roadway surface of Santa Rita Road is about 6 to 7 feet above the site ground surface of the R/O Building site; Stoneridge Drive is about 4 to 5 feet above the site. The portion of the site where the R/O facility will be constructed is currently unpaved and is covered with a sparse growth of grass and weeds.

The supply pipeline will approach the groundwater treatment facility site from the south/southeast. From the Mocho Well No. 1 Pump Station site, the supply pipeline will cross beneath the remnant of the railroad track berm (and easement) and Santa Rita Road in a northwesterly direction (Figure 2). At the east side of the crossing, the roadway surface of Santa Rita Road is about 4 to 5 feet higher than the ground surface around the Mocho 1 Pump Station. Numerous utilities underlie Santa Rita Road and the railroad right-of-way. After crossing Santa Rita Road, the pipeline will be adjacent to the Mocho Well No. 3 Pump Station site. At this side of the crossing, the ground surface is about 8 feet below the roadway surface. The pipeline then heads north along a narrow paved access road to the Macho Well No. 3 Pump Station; numerous existing utilities and services pipelines also cross this area. The supply pipeline then crosses Stoneridge Drive. In the area south of Stoneridge Drive the paved access road surface slopes gently to the south until it is about 5 feet below the roadway surface of Stoneridge Drive. North of Stoneridge Drive, the pipeline will end near the southern side of the Mocho Well No. 4 Pump Station site.

3.0 FIELD EXPLORATION AND LABORATORY TESTING

Field exploration for this study consisted of drilling, logging, and sampling ten exploratory borings. The borings were drilled and sampled on September 8 and 9, 2004. The approximate locations of the borings are indicated on the Site Layout and Boring Location Plan, Figure 2. Borings B-1 through B-5 were used to explore subsurface conditions at the R/O Building site; borings B-6 through B-10 were used to explore the supply pipeline alignment. As mentioned in Section 1.0, the alignment of the supply pipeline was changed during design. Consequently, one boring (i.e., boring B-7) that was drilled during this study to explore subsurface conditions was not positioned along the final pipeline alignment (Figure 2).

All borings were drilled with a truck-mounted, hollow-stem auger drill rig to depths ranging from about 6½ feet to 31½ feet. Samples of soil were recovered from each boring using Modified California drive samplers. In addition, bulk samples were collected from the drill cuttings of selected borings. The samples were visually examined and logged in the field, sealed to preserve their natural moisture content, and then taken to our laboratory for further examination and testing.

Boring logs were prepared in the field by examining drill cuttings and soil samples. Final boring logs were prepared based on the field logs, examination of samples in the laboratory, and laboratory test results. The final boring logs are presented as Figures A-3 through A-12 in Appendix A.

Boring B-1(P) was converted into an open-standpipe groundwater monitoring well (piezometer) at the completion of drilling. Details showing the construction of the piezometer are presented in Appendix A. Two of the borings, B-7 and B-8, were left open for at least 24 hours. During drilling and before backfilling, free groundwater was not observed in any of the borings used to explore subsurface conditions for this study. No groundwater was detected in the piezometer shortly after it was constructed. However, approximately 1 week after construction, the groundwater level in B-1(P) was measured at about 28 feet below the ground surface. The piezometer was monitored for groundwater on two subsequent dates (refer to Table A-3 in Appendix A).

Laboratory tests were performed by Cooper Testing Laboratory on selected soil samples to evaluate their physical characteristics and engineering properties. Samples were tested for dry density, moisture content, Atterberg limits, gradation, unconsolidated-undrained triaxial compressive strength, compaction, and resistance value (R-value). The laboratory testing program is described, and graphic presentations of the test results are presented, in Appendix B. Results of moisture content, dry density, and strength tests are also presented at the corresponding sample locations on the boring logs in Appendix A.

Corrosion tests and analysis were performed by JDH Corrosion Consultants, Inc. (JDH) on samples obtained by Geomatrix from each of the borings. Sample locations for which corrosion tests were performed are indicated in Appendix C. The report prepared by JDH is included in Appendix C. The report includes a description of their field program, analytical test results, and JDH's recommendations for mitigating corrosion potential.

In addition to the borings drilled during this study, Geomatrix reviewed aerial photographs of the site vicinity in an attempt to evaluate how past uses of the site may affect the design and construction of the planned facilities. On September 15, 2004, Mr. Hans AbramsonWard, Staff Geologist with Geomatrix, reviewed 7 stereo pairs of aerial photographs of the site. The photographs were taken on the following dates: 8/9/1996, 4/20/1986, 4/27/1982, 5/26/1976, 5/15/1969, 4/16/1959, and 5/16/1957. All of the photographs had an approximate scale of 1:12,000 except for the set from 1959, which had a scale of 1:9600.

The earliest photographs showed as many as 6 small structures (each about the size of a small shed) on the site, and dirt access roads leading to these structures from Santa Rita Road. The locations of 4 of these structures approximately correspond to the locations of the old Camp Parks wells, indicated on site drawings provided by Carollo. These structures are present in all of the photographs reviewed, though it appears that two of them were demolished during the construction of Stoneridge Drive (between 1986 and 1996). Several features first appear within the Arroyo Mocho, located directly north of the site, in the 1976 photographs. On the aerial photographs, these features appear as 3 white lines that cross the arroyo (but do not ascend the banks) and 1 white line that runs down the center of the arroyo. These white lines may represent low concrete walls (or wiers), or pipelines. The features (apparent on aerial photographs) are about 200 to 300 feet long. The features are evident in the photographs from 1976, 1982, and 1986, but are not evident in the later photographs.

None of the photographs revealed any evidence of bank instability associated with the portion of the arroyo located directly north of the site. Further, none of the photographs contained evidence that suggests that large buildings, buried structures (such as cisterns), or other past disturbances or potential underground obstructions existed previously at the site. However, considering that the Camp Park wells exist (or existed) at the site, functioning (or possibly abandoned) pipelines and possibly other buried utilities may cross portions of the site. These lines, if they exist, may be encountered during the planned construction; they should be properly abandoned (or removed) if they are no longer in use.

Borings were drilled at the site during a previous investigation performed by Consolidated Engineering Laboratories (Consolidated, 1999) for the Mocho Well Nos. 3 and 4 Pump Stations. In addition, logs of miscellaneous wells that have been drilled in the project vicinity were provided by the Zone 7 Water Agency. The approximate locations of the previous borings and wells are included in the report excerpt and the Well Location Map prepared by Zone 7, which are included in Appendix D. Logs of the previous borings and wells are presented in Appendix D.

4.0 GEOLOGIC AND SEISMIC SETTING

This section describes the geology and seismic setting of the project site. Subsurface soil and groundwater conditions encountered in the exploratory boreholes drilled during this and previous studies of the site are described in Section 5.0.

4.1 REGIONAL GEOLOGY

The project site is located in Amador Valley, a “subbasin” of the larger Livermore Valley (DWR, 1966), approximately 2 miles east of Interstate 680 and 1 mile south of Interstate 580. The relatively flat-lying Amador Valley forms the eastern margin of Livermore Valley, which is a structural basin formed by an approximately east-west trending syncline that is locally bounded and crossed by faults. The valley floor is underlain by a relatively thick (700 feet locally; Kaldveer, 1991) sequence of poorly consolidated sediments of Holocene age (deposited within the past 11,000 years) that consist of interbedded sands and gravels of fluvial (stream) origin and silty clays of lacustrine (lake) origin (Figure 4). This younger basin alluvium overlies older alluvial sediments of the Livermore Formation, which may be as much as 1,500 feet thick and up to 4 to 5 million years old (Barlock, 1988).

4.2 SEISMIC SETTING

The project site is located near three mapped faults, the Calaveras, Pleasanton and Verona (Figure 5). These faults are considered active by the State of California Geological Survey (CGS), and are depicted on their Earthquake Fault Zones maps of the Dublin and Livermore 7.5 minute quadrangles (Hart, 1980). Based on these maps, the Verona fault lies approximately 3 miles southeast of the site, the Calaveras fault lies approximately 2.5 miles east of the site, and the Pleasanton fault lies approximately1.4 miles southwest of the site. The Calaveras fault is the dominant seismic source for the project site, and was the source of a ground-rupturing earthquake between Dublin and San Ramon in 1861 of estimated Richter (local) magnitude 5.9. The Calaveras fault is a major right-lateral, strike-slip fault that forms part of the boundary (i.e., the San Andreas fault system) between the North American and Pacific tectonic plates. The Maximum Credible Earthquake for the Calaveras fault is considered to be moment magnitude (Mw) 7.

The known Holocene-active trace of the Pleasanton fault is located within Camp Parks, approximately 1¼ miles northwest of the site. The fault continues to the south and is buried beneath the alluvium of Livermore Valley (Crane, 1995; DWR, 1966; 1974), where its location is not precisely known. According to mapping by Crane (1995), a buried trace of the Pleasanton fault may lie less than 1,500 feet west of the site.

The Verona fault lies about 3 miles southeast of the site, and is mapped along the southeastward projection of the Pleasanton fault. Neither the Pleasanton nor the Verona faults is known to be the source of any historical earthquakes; however, recent studies (e.g., Unruh and Sawyer, 1997) have suggested faults within the Livermore Valley may be more significant than previously thought. Despite the proximity to these faults and based on the available mapping, the ground rupture hazard at the project site due to tectonic faulting is judged to be low.

5.0 SITE SUBSURFACE CONDITIONS

This section summarizes the subsurface conditions interpreted to exist at the project site. Our interpretations of the subsurface conditions are based on the conditions encountered in borings drilled for this and the previous studies of the site, and our review of published maps and aerial photographs. Our interpretations generally confirm the regional geologic conditions described in Section 4 and provide a more detailed basis for evaluating geologic and geotechnical conditions at the R/O building site and along the supply pipeline alignment.

The borings drilled for this and previous studies of the site encountered predominantly clayey soils, with plasticity ranging from low to high, to the maximum depth explored (i.e., about 31½ feet). Where high plasticity clays were observed in the borings drilled for the present study, they were greater than 5 feet below the ground surface (bgs). Water well logs and driller reports provided by the Zone 7 Water Agency for water wells constructed within or very near the project site indicate that the thickness of these clayey native soils varies from about 44 to 55 feet (refer to Appendix D). Underlying this layer are alternating granular and clayey deposits, and various mixtures of these soils, to depths of at least 846 feet (i.e., the depth of the deepest well drilled in the project vicinity).

Near the southern end of the supply pipeline alignment (either side of Santa Rita Road), as much as 7 feet of granular soils (i.e., sandy and gravelly soils) were encountered in the upper portions of the borings. Refer to the logs of borings B-8 and B-9 in Appendix A and the logs of boring B-1 and B-4 contained in the Consolidated Engineering Laboratories report provided in Appendix D. These soils may be associated with the fill for the former railroad track berm mentioned in Section 2 and earthwork activities associated with the Mocho Well Nos. 1 and 3 pump stations.

As noted above, groundwater was not encountered in borings drilled for this study or in any of the borings drilled for previous investigations at the site. Groundwater was not immediately observed in the piezometer installed at the R/O Building site, but was observed at a depth of 28 feet bgs about 1 week after piezometer installation. This relatively slow groundwater response is likely due to the sensing zone of the piezometer being embedded in clayey soils. The groundwater level in the piezometer was measured on two subsequent occasions. Typically, the observed water level was about 28 feet bgs (refer to Table A-3).

It should be noted that the absence of free groundwater in the borings drilled for this study may not be representative of the groundwater conditions at the boring locations during other times of the year. In addition, evaluation of the moisture content and dry density tests (performed on samples from the exploratory borings) indicates that site soils are at or near "saturation" to within 15 to 20 feet of the ground surface. Because the site soils are clayey (fine-grained), this may represent "capillary rise" rather than free groundwater (i.e., saturation above the phreatic surface). In addition, it is possible that zones of coarser, more granular materials may be encountered within the clayey site soils. Such zones may contain trapped or "perched" groundwater. If encountered, these more granular zones are likely to be of limited extent and thickness.

Factors that can contribute to groundwater fluctuations include rainfall, irrigation practices, pumping rates in the nearby wells, and nearby surface water. For example, at the time of our field exploration program (i.e., September 2004), significant rainfall had not occurred for several months and significant water was not flowing in the nearby Arroyo Mocho (in the deepest portion of the arroyo, we visually estimated that only about 1 to 2 feet of water was present). Groundwater levels at the site could be affected by significant rainfalls and water flowing through the Arroyo Mocho during the winter rainy season. However, it should be noted that the observed piezometer water levels did not appear to be affected much by the significant cumulative rainfalls that occurred during the 2004-2005 winter rainy season. Water also may become trapped within the more granular soils that were encountered in the borings drilled for this and previous studies of the site. Such groundwater seepage is described in more detail in Section 6.2.2, Excavation and Groundwater conditions.

6.0 GEOTECHNICAL DESIGN RECOMMENDATIONS AND CONSIDERATIONS FOR STRUCTURES

This section presents the geotechnical engineering recommendations and considerations that apply to design of the R/O Building and other minor structures that are planned for the Zone 7 Water Agency Groundwater Demineralization Project. When appropriate, earthwork and foundation design recommendations are presented separately. The anticipated sequence of construction for the new facilities is given first, followed by geotechnical design recommendations and other considerations. Geotechnical engineering recommendations and conclusions that apply to the supply pipeline and other minor pipelines are presented in Section 7.0.

Important geotechnical considerations, with respect to the proposed construction, include the possible presence of undocumented fill, the moderate strength and compressibility characteristics for the native soils across the site, and the low to moderate expansion potential of the near-surface clayey soils. In addition, as previously mentioned, the site is situated in a seismically active region.

According to the project topographic map (Towill, 2004), the proposed R/O Building is 18 to 20 feet south of the existing Livermore Amador Valley Management Agency (LAVMA) wastewater pipeline. Across from the western end of the R/O Building, the top of the 27-inch-diameter LAVMA pipeline was measured at about 10 feet bgs. Based on our understanding of the configuration and loading of the R/O Building, the pipe depth, and the lateral distance from the face of the R/O Building to the pipeline, it is our opinion that the foundations for the R/O Building will not impose significant new loads on the LAVMA pipeline.

The recommendations and other considerations presented in this report are intended for planning and design of the various proposed facilities described in Section 1. This report may not provide all of the subsurface information that a contractor may need to construct the project. The recommendations presented herein were developed based on the 90 percent drawings (dated May 2005) prepared by Carollo and telephone conversations.

6.1 CONSTRUCTION SEQUENCE

The general construction sequence for the project, as we envision it, will consist of the following steps.

1. The construction sites are cleared of all vegetation, and topsoil is stripped. Unsuitable organic soil deposits are removed and stockpiled for landscaping. Functioning buried utilities are identified and protected. Abandoned utilities are identified and removed if they will interfere with the planned construction. The piezometer installed during Geomatrix's field exploration program is removed.
2. Grading work is performed to prepare the level building pads at the R/O Building site and other facility locations. An excavation is made for construction of the below-grade wetwell. Methods are used to support the ground where room is not sufficient for an excavation with sloping side walls. The wetwell is constructed on a pad of granular fill, an observation manhole is installed immediately adjacent to the wet well, and the structures are then backfilled.
3. The near-surface clay beneath R/O Building (and other planned surface structures) is excavated and replaced to provide a uniform pad for construction.
4. Pipelines (and other buried utilities) that fall within or near the R/O Building footprint are installed and backfilled.
5. The R/O Building (and other planned surface structures) is built. Pipelines are constructed to connect the structure(s) to related facilities.
6. Remaining excavations/pipeline trenches are backfilled. The site is fine graded and paved/landscaped.

We realize that the above sequence is a simplification of the construction activities that will be required to build the facility. Nevertheless, the recommendations and considerations in this section are based, in part, on the methods and sequence described above. Significant differences in the anticipated sequence should be brought to Geomatrix's attention so that we can evaluate their impact on the recommendations presented in this report.

The rest of this section describes the geotechnical recommendations and other considerations related to design of the facility.

6.2 EARTHWORK

This section describes miscellaneous work necessary to prepare the project site for construction of the R/O Building. Excavation and groundwater conditions, fills and backfills, and drainage requirements are discussed. Procedures that should be followed to protect the soils exposed in the required excavations are discussed in detail.

6.2.1 Clearing, Grubbing, and Stripping

The construction area should be cleared of objectionable materials, including grass, weeds, concrete, gravel piles, old construction debris, and any other material that might interfere with the performance or completion of the work. As mentioned in Section 3.0, small shed-type structures that appear to be associated with the so-called Camp Parks wells are evident in the aerial photographs that were reviewed during this study. Functioning (or possibly abandoned) pipelines (and possibly other buried utilities) that are associated with the wells may cross portions of the project site. These lines, if they exist, may be encountered during construction; they should be properly abandoned (or completely removed) during construction if they are no longer in use.

All roots, buried logs, and other objectionable material should be grubbed. Old pipes, underground structures, debris, or waste should be removed if found anywhere on the site. Any holes created by the grubbing process should be backfilled with compacted aggregate base material described in Section 6.2.6, Fill Material and Compaction Criteria. Excavations and trenches from abandoned utilities and pipelines that cross the footprint of the R/O Building and are more than 3 feet below the existing ground surface (refer to Section 6.2.5 – Building Pads for additional discussions) should be backfilled with aggregate base or controlled density fill, as described in Section 6.2.6, Fill material and Compaction Criteria. All objectionable material from clearing and grubbing should be removed from the site and disposed of at a suitable landfill.

In vegetated areas, the upper 6 inches of soil should be stripped from the ground surface and stockpiled separately for later use in landscaping. The actual stripping depth should be established in the field at the time of construction.

6.2.2 Excavation and Groundwater Conditions

As described in Section 5.0 – Site Subsurface Conditions, the borings drilled for this and the 1999 Consolidated Engineering Laboratories geotechnical study encountered predominantly clayey soils of varying plasticity to the maximum depth explored (i.e., about 31½ feet). Excavation of these clayey soils should be possible with conventional earthmoving equipment and excavators.

The 90 percent design drawings prepared by Carollo indicate that the R/O Building will have several below-grade levels (e.g., the wet well, some chemical tanks, and for facility piping). Some walls of the R/O Building will be supported at or near the existing ground surface with shallow spread and strip footings. Other walls of the above-ground structure will be supported on the walls of lower (below-grade) levels of the structure. Because of the past construction activities that have occurred at the site, it is possible that some of the upper soils may have been disturbed by these previous activities. It is also likely that the near surface soils will become disturbed during construction of the below-grade levels of the R/O Building. In addition, these clayey soils have a low to moderate potential to undergo shrink-swell behavior. Therefore, we recommend that near-surface soils beneath the part of the R/O Building that is supported on shallow spread- or strip-type foundations be removed and replaced, as described in Sections 6.2.5 and 6.2.6. The exposed foundation area surfaces also must be protected as described in Section 6.2.4, Subgrade Preparation and Protection.

The R/O Building is located near the existing pavement around the Mocho Well No. 4 Pump Station, near existing pipelines, and other improvements that must be protected. Excavations with inclined side slopes likely will be used during construction wherever possible. However, at some locations, sufficient room for sloped excavations will not exist and measures will be needed to support the adjacent ground and nearby existing facilities. Locations where such conditions exist should be identified during design and the structure excavations that could require ground support should be identified. Construction costs associated with ground support systems are sometimes underestimated when project-specific requirements are not identified.

Excavations having vertical sidewalls deeper than 5 feet will require sheeting, shoring, or other effective means to adequately support the ground and to protect workers. Excavations shallower than 5 feet may require support depending on the location of the excavation, the anticipated soil conditions, and/or the contractor's activities in the vicinity of the excavation. Project specifications should place full responsibility on the contractor for planning, design, construction, maintenance, and removal of excavation support systems.

Ground movement/settlement must be prevented to avoid damaging nearby underground utilities and other improvements. All excavations should be adequately braced to prevent failure of the excavation walls and to mitigate potentially damaging ground movement/settlement. Ground support may be needed to maintain the stability of underground utilities, adjacent pavements, and other improvements. The ground support system should be installed without leaving nearby improvements unsupported. To help mitigate ground movement/settlement, stockpiling earth and other construction materials near open excavations should be avoided. In no case should stockpiling occur closer to excavations than federal or state regulatory agencies allow.

If removal of the support system might cause an excavation wall to collapse, the support system should be left in place. Locations where excavations may be subject to caving should be identified as the excavations are being made. Soils that tend to ravel and cave while being excavated probably will cave if the support system is removed while the excavation is being backfilled. The support measures also should be left in place if their removal might cause the excavation bottom or adjacent ground to become disturbed, and/or damage a nearby structure or facility or the newly-completed structure/facility. If pressure-treated wood is used as part of the ground support system, it should be left in place and cut off about 2 feet below the ground surface. Wood that is subject to rotting should not be used.

The stability of excavations will need to be evaluated while the excavations are being made. As is the case anywhere that excavations are made in soils, unexpected caving of excavation walls and slopes could occur at any time or place, regardless of the depth.

In general, existing structure foundations bearing on soils that lie above a line projected upward at an inclination of 45 degrees from the bottom of an adjacent excavation will require underpinning during construction or the excavation must be adequately supported. Should underpinning be necessary, we recommend that the contractor be responsible for its design and be required to submit an underpinning plan for review prior to construction.

As previously discussed, free groundwater was not observed during drilling in any of the borings performed at the site for this study or previous investigations. However, free groundwater was observed in the piezometer [boring B-1(P)] about 1 week after its installation (i.e., on September 17, 2004). Groundwater also was observed during subsequent measurements (refer to Table A-3). In addition, geotechnical laboratory tests indicate that soils in the range of 15 to 20 feet below the ground surface (bgs) may be at or near saturation. At this time, we recommend that an elevation of 318 feet (i.e., the approximate elevation at the bottom of Arroyo Mocho) be assumed for the free groundwater level during construction. We recommend that a groundwater elevation of 320 feet be used for the design of structures and pipelines. Prior to construction, the contractor can use the piezometer to further assess groundwater levels. The contractor should be required to abandon the piezometer according to Zone 7 requirements during construction of the R/O Building.

Provided the excavations required to construct the R/O Building and related facilities do not extend much below elevation 318 feet, it is anticipated that only minor amounts of free groundwater will be encountered. However, if excavations are made during the winter rainy season, rainfall, surface water runoff, and possibly shallow perched groundwater could enter the excavation. Water from the nearby Arroyo Mocho also may cause water inflows or saturated soils in some of the required excavations. During our field exploration program (i.e., September 8 and 9, 2004), a minor amount of water was observed in the arroyo. During the winter rainy season, the Arroyo Mocho could contain more significant amounts of water that could locally affect groundwater levels and produce groundwater inflows into deeper excavations.

Finally, zones of coarser, more granular materials may be encountered within the clayey site soils. If encountered, these zones are likely to be of limited extent and thickness and any trapped groundwater in these zones should deplete relatively quickly. The clayey soils transmit water relatively slowly, so the rate infiltration is expected to be minor. It is our judgment that well-planned drainage ditches and sump pump arrangements commonly used in construction should be capable of controlling the anticipated flow of groundwater into the required excavations.

To minimize construction difficulties that typically occur during the winter rainy season or when groundwater is encountered, earthwork operations should be planned for the normally dry summer and fall seasons, if possible. If groundwater is encountered, measures should be taken immediately to control it. The combination of groundwater (or saturated soils) and the action of foot traffic and construction equipment will quickly disturb and degrade soil exposed in the excavations and at the ground surface. Wet or saturated clays will cause difficulty during excavation, and equipment may get bogged down in the softer deposits.

The contractor should be made responsible for the design, construction, operation, maintenance, and removal of any system that is implemented to control the inflow of surface water and groundwater. The system should be designed to prevent migration and pumping of soil fines with discharge water. The contractor must plan the dewatering and excavation carefully so that stable and dry excavations are maintained throughout construction.

Disposal of water from construction dewatering also must be planned carefully. Because of regulatory requirements, discharging pumped groundwater directly into nearby arroyo or storm drain systems may require permits from the regulatory agencies having jurisdiction over the project. As described in Section 1.1, it is possible that substances that are of an environmental concern have affected the site soils and/or groundwater and that these substances could be encountered during construction. It is our understanding that environmental sampling and testing will be performed by others. If encountered during construction, soil and groundwater containing substances that are of an environmental concern will require special handling.

Options that the contractor may use for disposal of pumped groundwater should be identified in the project specifications.

6.2.3 Temporary and Permanent Slopes

The stability of the temporary excavation slopes made at the R/O Building site will depend on the depth of the excavation, the strength and character of the soils exposed in the excavation, groundwater conditions, the construction schedule (i.e., the time the excavation or cut is allowed to stand open), and the contractor's operations and equipment, among other factors. For planning purposes and for preparing the engineer's construction cost estimates, temporary excavation slopes soil should be no steeper than 1(H):1(V). These temporary slopes apply for excavations that have a maximum depth of 20 feet. Flatter side slopes may be required (and should be anticipated) if the contractor intends to stockpile materials and/or use heavy equipment adjacent to the excavation. Flatter slopes also may be necessary if localized instability is observed during construction. Cut slopes exposed for extended periods likely will erode, slake, and/or ravel and require cleanup.

All temporary excavations used in construction should be designed, planned, constructed, and maintained by the contractor and should conform to all state and/or federal safety regulations and requirements. As is the case anywhere that excavations are made in soil, unexpected caving of excavations, temporary cut slopes, or trench walls could occur at any time or place. Workers in excavations and trenches must be adequately protected, at all times.

Permanent cut slopes in soil and fill slopes should be no steeper than 3(H):1(V). Where possible, flatter permanent slopes should be used to blend the final ground surfaces into the adjacent ground contours. All exposed ground surfaces and cut and fill slopes will be subject to wind and water erosion if not adequately protected. All cut and fill surfaces should be provided with erosion protection measures as soon as the final grades or cut and fill slopes are created.

6.2.4 Subgrade Preparation and Protection

Surfaces exposed in excavations should be protected from erosion, air or water slaking, and changes in moisture content that could cause expansion, shrinkage, and/or degradation of the exposed surface. In the area beneath the wetwell and other below-grade levels of the R/O Building, the exposed soil surfaces should be carefully trimmed to final subgrade and then covered with a geotextile conforming to the requirements of the Caltrans Standard Specifications Section 88-1.04, for Type A, woven. The fabric should then be protected by placing a minimum of 12 inches of compacted granular material conforming to the crushed rock, aggregate base, or permeable material described in Section 6.2.6, Fill Materials and Compaction Criteria.

Exposed subgrade should be protected with granular material as soon as practical but all surfaces should be protected prior to the winter rainy season. If work is done during the winter rainy season, Geomatrix recommends that the granular material be placed as quickly as possible (i.e., within 24 hours) after the foundation area is exposed in the final cut surface. Depending on excavation size, it may be necessary to excavate in sections to minimize the period that the soil is exposed to the elements. Before the granular material is placed, the exposed soil surface should be clean and dry. Under no circumstances should groundwater, rainfall, surface runoff, or construction water be allowed to pond on the exposed or unprotected soil surfaces. If left unprotected, the soil could degrade quickly; its properties will change under the action of heavy earthmoving equipment and wetting or drying caused by the elements.

6.2.5 Building Pads

Because of the past uses of the site and previous construction activities associated with the Mocho No. 4 pump station, Geomatrix recommends that the near-surface clayey soils be excavated and recompacted to create a uniform pad upon which to construct the slabs-on-grade and shallow strip- and spread-type foundations of the R/O Building. The clay should be excavated to a depth of no less than 3 feet below the top of floor slab elevation or one foot below the bottom of footings, whichever is deeper. Deeper excavation may be required if disturbed conditions are encountered. The excavation and replacement of the clay should extend at least 5 feet laterally beyond the footprint of the R/O Building's foundation.

Geomatrix also recommends that the R/O Building and associated slabs be founded on compacted granular material. The compacted granular material will help (1) protect the exposed soil/fill surfaces; (2) provide a uniform bearing surface for the completed structure or slab; (3) provide a reasonable working surface for equipment (small cranes, concrete trucks, etc.) during construction; (4) create a smooth surface upon which to position concrete reinforcement for footings and slabs; and (5) provide drainage, if required.

The compacted granular material for the below-grade wetwell should be at least 12 inches thick, as previously discussed in Section 6.2.4, and should extend at least 1 foot beyond the outer edge of the slab or mat supporting this structure. For the R/O Building, the granular material should be at least 6 inches thick. All excavation bottoms/subgrade surfaces should be cleaned of all debris and loose soil before the pad for any structure is constructed. A woven geotextile should be placed over the exposed subgrade and up the excavation sides. A geotextile conforming to the requirements of the Caltrans Standard Specifications Section 88-1.04, for Type A, woven, should be placed over the subgrade and up the excavation sides. Additional recommendations for slab-on-grade construction within the R/O Building are presented in Section 6.5.

6.2.6 Fill Materials and Compaction Criteria

It is anticipated that seven principal fill types could be used at the sites. These are (generally from coarsest to finest):

1. crushed rock
2. permeable material
3. aggregate subbase material
4. aggregate base material
5. site and select fill
6. topsoil
7. Controlled Low Strength Material.

Each type of material is described in the following text according to its (a) potential source, (b) uses, (c) typical specifications, (d) compaction requirements, and (e) special handling/processing requirements (if applicable).

It should be noted that the relative compaction requirements discussed below are based on the *maximum dry density* and optimum moisture content of the subject material as determined by ASTM Test Method D 1557 (latest edition). When the *relative density* is discussed in the text, it is based on ASTM Test Methods D 4253 and D 4254 (latest edition).

Crushed Rock

Crushed rock should be an imported material that consists of durable rock and gravel that is free of deleterious material and free from slaking or decomposition under the action of alternate wetting and drying. This material may be used to construct drainage trenches (if required), or may be placed on the bottoms of trenches excavated in unstable ground. If used in constructing drainage trenches, this material should be surrounded by a filter fabric selected to prevent the migration of fines into the gravel. Crushed rock should meet the following gradation requirements.

Standard Sieve Size	Percentage Passing
1 inch	100
¾ inch	90-100
No. 4	0-10
No. 200	0-2

These materials should have a durability index of not less than 40. If there is a concern that fines from the subgrade could migrate to the voids of the crushed rock, the crushed rock can be placed on, or surrounded by, a suitable geotextile fabric.

Crushed rock should be moistened thoroughly and compacted to a relative density of at least 75 percent using suitable plate- or roller-type vibratory compaction equipment.

Permeable Material

Permeable material should be an imported material that consists of durable crushed rock or gravel and sand that is free from slaking and decomposition under the action of alternate wetting and drying. Permeable material may be used for wall drains and/or subsurface trench drains. It also may be used beneath the slabs of buried structures if a permanent drain is required.

The material should have a durability index of not less than 40 and a sand equivalent value of not less than 75. Complete specifications for this material, which is commonly referred to as Class 2 Permeable Material, are given in the State of California, Department of Transportation (Caltrans) Standard Specifications, Section 68.

Permeable material should be moistened thoroughly and compacted to a relative density of at least 75 percent using plate- or roller-type vibratory compaction equipment.

Permeable material used behind retaining and other structural walls should have a horizontal thickness of not less than 12 inches. During backfilling, it should be placed against the wall at least 1 foot higher than the adjacent backfill to prevent contamination and should be continuous with any foundation drain system. A 2-foot-thick cap of relatively impervious fill should be placed over the permeable material at the top of the backfill to mitigate against infiltration of surface runoff.

Aggregate Subbase

Imported aggregate subbase material may be used to construct building pads for surface structures. This material should meet the requirements in the Caltrans Standard Specifications, Section 25, Class 2 Aggregate Subbase (¾-inch maximum particle size). Aggregate subbase material placed beneath structures should be compacted to no less than 95 percent of maximum dry density. The moisture content of the material should be within -1 percent and +3 percent of optimum, and the material should be placed in horizontal lifts that do not exceed 8 inches before being compacted.

Aggregate Base

Imported aggregate base material may be used to construct building pads for surface structures. It is also recommended for use as fill and backfill beneath and adjacent to structures for which settlement of trench backfill must be minimized. This material should meet the requirements in the Caltrans Standard Specifications, Section 26, Class 2 Aggregate Base (19-mm [¾-inch] maximum particle size). Aggregate base material placed beneath structures should be compacted to no less than 95 percent of maximum dry density. The moisture content of the material should be within -1 percent and +3 percent of optimum, and the material should be placed in horizontal lifts that do not exceed 8 inches before being compacted.

Site Fill

Geomatrix understands that is likely that little or no fill will be needed to adjust the grades at the R/O Building site. Required structure excavations and the excess spoils from pipeline trenches likely will be the source of fill needed to create the uniform building pad beneath the R/O Building, to backfill the walls of the wetwell, and make minor adjustments to the final site grades.

The recommendations presented in this section are intended to mitigate excessive settlement of site fill and backfill. During construction, careful monitoring and testing of the site fill and backfill will be essential to mitigate potentially damaging ground settlements. To mitigate ground settlement, fill and backfill derived from the site soils must be thoroughly mixed and moisture conditioned prior to placement and compaction, as described in this section, or should not be used. As described above, imported aggregate base may be used as fill and backfill where settlement must be minimized or when filling/backfilling must be accomplished during the winter and spring rainy season. Aggregate base may be easier to compact and test than the fill derived from the site soils; especially when the moisture content of the site soils cannot be controlled/adjusted during the winter and spring.

If the quantity of excess native soil from the required excavations and trenches is not sufficient to accomplish the desired final grades, additional site fill must be imported. Imported site fill should have the following properties or characteristics:

- All fill particles should be less than 3 inches in size.
- Less than 30 percent of the material should be retained on the ¾-inch sieve.
- No less than 15 percent and no more than 50 percent of the material should pass the No. 200 sieve.
- The fines (i.e., material passing the No. 200 sieve) should have a plasticity index (PI) no greater than 15.
- The fill material should contain less than ½ percent by weight of organics and should be free of other objectionable material (e.g., concrete, plastic, and other wastes).

Proper compaction of fill and backfill derived from the required site excavations and trenches, will depend on the fill moisture content at the time of compaction. None of the exposed soil surfaces should be allowed to dry out or become wet during or after fill placement. If it becomes wet, fill derived from the native clayey soils will soften and the fill surface may become slick. Placing and compacting site fill material should be avoided during the winter rainy season when it will be difficult to control the moisture content of the fill.

Before fill is placed on any soil surface, organic-rich soils or other deleterious materials should be excavated and removed. The upper 8 inches of any exposed soil surface upon which fill will be placed should be scarified, plowed, disked, and/or bladed until it is uniform in consistency and free of unbroken chunks and clods of soil greater than 3 inches in any dimension. The moisture content of the soil should then be adjusted to 2 to 5 percent over the optimum, and should be compacted with equipment suitable for the soil and site conditions. The soil should be compacted to not less than 92 percent of maximum dry density.

For recommendations regarding protection of exposed soil surfaces, refer to Section 6.2.4. No geotextile or fill material should be placed until an engineering geologist or geotechnical engineer from Geomatrix has reviewed the condition of the prepared surface upon which fill will be placed.

Mixing, blending, and moisture conditioning will be required to create a material that can be placed and adequately compacted. All fill should be scarified, plowed, disked, and/or bladed until it is uniform in consistency and free of large, unbroken chunks or clods of soil. The moisture content of the mixed fill should be adjusted to 2 to 5 percent over the optimum moisture content. Additional disking or blading may be necessary to obtain uniform gradation and moisture content. Chunks and clods of soil having any dimension greater than 3 inches either should be broken down by heavy earthmoving equipment (or other effective methods) or should be removed from the fill while the fill is placed.

Fill should be placed on the prepared surface in horizontal lifts that do not exceed 8 inches in thickness before compaction. The fill should be compacted with suitable equipment to no less than 92 percent of maximum dry density. The final surface of the compacted fill should be graded to promote good surface drainage. All permanent fill slopes should be overbuilt by at least 1 foot and then cut to final grade to provide adequate compaction. As previously described, permanent fill slopes should be no steeper than 3(H):1(V). Flatter slopes may be desirable to blend the fill surface into adjacent contours.

When new fill is to be placed and compacted against existing stable excavation or fill slopes, the existing cut or fill should be benched horizontally so that the new fill will be incorporated into the slope. To provide a firm foundation free of loose or disturbed material, a minimum of 2 feet normal to the existing cut slope or fill slope should be removed and recompacted while the new fill is brought up in layers. Existing fill or native material cut in this manner should be recompacted along with the new fill material.

Topsoil

We recommend that landscaping be designed by a landscape architect or other qualified professional. This designer should provide recommendations that include soil material types, soil amendments, and irrigation. For preliminary design, the following recommendations may be used. In landscaped areas, topsoil should be placed to a minimum thickness of 6 inches. Particles larger than 3 inches in diameter should be removed from topsoil placed within 6 inches of any concrete structure or pavement. Elsewhere, particles larger than 4 inches should not be allowed in the topsoil. Topsoil should be moisture conditioned to plus/minus 3 percent of optimum moisture content, placed in lifts having a maximum thickness of 6 inches, and compacted to 85 percent of maximum dry density.

To minimize wind and water erosion, the final ground surface should be planted to establish a healthy growth. Soil amendments may be required to improve the topsoil. Other methods of erosion protection (e.g., riprap) should be used in areas that are not planted.

Controlled Low Strength Material

In areas where existing pipelines that must be removed are present beneath structures or pavements, the trenches could be backfilled with controlled low strength material (CLSM) after the pipelines are removed. CLSM, which is referred to in Section 19 of the Caltrans Standard Specifications (July 1999) as "Slurry Cement Backfill," should also be considered as an alternative structure backfill, and pipe embedment and trench backfill materials. CLSM consists of a fluid, workable mixture of aggregate, Portland cement, fly ash, and water. CLSM can be batched to flow into irregularities in the bottoms and walls of trenches. The Caltrans specification for the gradation of CLSM aggregate is:

Standard Sieve Size	Percentage Passing
1½ inch	100
1 inch	80-100
¾ inch	60-100
⅜ inch	50-100
No. 4	40-80
No. 100	10-40

More restrictive gradation requirements may be desirable to limit the fines content and the size of the sand and gravel. Geomatrix recommends that (1) no more than 25 percent of the aggregate particles pass through the No. 200 sieve; and (2) the 28-day compressive strength of the CLSM be no less than 100 pounds per square inch (psi) and no more than 120 psi. If native soils are used for the CLSM aggregates, trial mixtures will be necessary to confirm the quality and properties of the resulting CLSM.

6.2.7 Drainage Requirements

Final grades should be sloped to direct surface water away from foundations and slabs and toward suitable discharge facilities. The R/O Building should have gutter and downspouts that discharge water away from the structure foundations. Ponding of surface water should not be allowed anywhere on the site.

Unless they are designed to resist the additional load imposed by hydrostatic pressure, a subsurface drainage system should be provided behind any retaining walls that may be constructed at the site (to prevent the buildup of hydrostatic pressure behind the walls). The drainage system should consist of granular backfill and a 4-inch-diameter (minimum) perforated subdrain pipe. The granular backfill may consist of either crushed rock surrounded by a geotextile or permeable material. Weep holes may be used for retaining walls, if desired.

Even though groundwater at the site is about 28 feet below the ground surface, uplift forces and hydrostatic pressures should be considered in the design of the wetwell. The wetwell will be constructed in an excavation made into relatively impervious clayey soils that are capable of trapping water/groundwater. Water percolating into the ground from the nearby Arroyo Mocho (or the ground surface) could saturate the imported granular material that should be used to backfill the wetwell (refer to Section 6.4). The trapped water could cause uplift pressures to develop beneath the wetwell slab and hydrostatic pressures to develop against the walls.

If the wetwell is not designed to resist uplift and hydrostatic pressures, Geomatrix recommends that a groundwater monitoring/relief system be incorporated into the design of the wetwell. The groundwater monitoring/relief system could consist of a pad constructed of permeable material that is drained to a sump or manhole that is positioned next to the wetwell. The manhole invert would be positioned below the wetwell slab. Water collected into the manhole would indicate trapped groundwater. If the wetwell requires draining and external uplift and hydrostatic pressures could damage the wetwell, water would be removed from the manhole (and from beneath the wetwell) by portable pumps. The monitoring/relief system would require checking, and possibly pumping, before draining the wetwell.

The bottoms of excavations should be graded (sloped) so that water will drain toward the perimeter of the structure (or toward drains or sumps). This will help prevent ponding of water on the surface of the prepared granular fill pad during construction and beneath the R/O Building after it is completed. As previously described, the contractor should implement drainage provisions during construction to divert rain and construction water away from open excavations.

6.3 FOUNDATION RECOMMENDATIONS

As previously described, the R/O Building will be constructed at or near existing grade and will be founded on a pad of imported, granular fill. The R/O Building constructed near existing grade can be supported on shallow strip- and spread-type foundations bearing on the compacted fill. The wetwell that will be constructed below existing grade upon the clayey native soils can be supported on a thick slab or mat bearing on the granular fill pad that is placed on the native clayey soil. The chemical tanks and the R/O membrane train units that will be constructed within the R/O Building can be supported on isolated mat or spread-type foundations.

Shallow spread- and strip-type foundations for the R/O Building founded on compacted granular fill should be designed using allowable bearing pressures of 1,500 psf for dead load (DL) and 2,000 for DL plus live loads (LL). Mat and spread foundations for the wetwell, chemical tanks, and R/O membrane train units that bearing on the compacted granular fill should be designed using an allowable bearing pressure of 2,000 psf (DL) and 2,500 psf (DL + LL). Spread- and strip-type footings should be a minimum of 2 feet wide and should extend at least 2 feet below adjacent grade. The allowable bearing pressures may be increased by one-third when considering seismic or other transient loads.

All subgrade and bearing surfaces should be observed by a representative of Geomatrix prior to placing any site fill, granular fill, reinforcing steel, or concrete. If unstable, soft, or weak materials are encountered in the exposed subgrades, the unsuitable materials should be excavated down to suitable materials and backfilled with compacted aggregate base.

It is anticipated that settlement of the R/O Building will be less than 1-inch under the maximum anticipated loads following construction. Anticipated settlement of the isolated mats and spread-type foundations used to support the wetwell, chemical tanks, and R/O membrane train units will be about 1 inch. Most of the settlement is expected to occur on application of the load. Variations in the water level in the wetwell and the volume of chemicals stored in the planned tanks are expected to induce less than ½-inch of elastic rebound and settlement during operations.

Lateral loads imposed by an earthquake will be resisted by the passive resistance of the adjacent soil/fill acting on the sides of the footings and buried walls and by sliding frictional forces. Assuming an allowable wall/footing deflection, the passive soil resistance recommended for seismic design should be calculated using the passive lateral earth pressure distribution shown in Figure 6 and the chart presented in Figure 7. The diagram and chart shown on Figures 6 and 7, respectively, are for the fill/backfill material derived from the native clayey soils. A coefficient of sliding resistance of $\mu = 0.30$ should be used when a footing is poured neat on the compacted native clayey soils or granular fill placed on the native clayey soils. This value assumes no factor of safety (i.e., a factor of safety equal to 1.0).

6.4 RETAINING WALLS

Lateral earth pressures recommended for the design of retaining walls and the walls of the buried wetwell are presented on Figure 7. The active and passive lateral earth pressure distributions shown on Figure 7 are for the **retaining walls** that are backfilled with site fill material derived from native clayey soils, as indicated on the figure. The walls of the buried **wetwell** should be designed to meet nonyielding (at rest) conditions, because the wetwell walls cannot deflect to develop active wall conditions. To minimize settlement, the walls of the wetwell should be backfilled with the aggregate base material or CLSM described in Section 6.2.6. The at-rest pressure distribution shown in Figure 7, however, was developed assuming backfill consisting of the native clayey soil because the extent of the aggregate base backfill (or CLSM) will depend on the means, methods, and techniques used by the contractor to construct the wetwell.

The nonyielding wall pressure distribution shown on Figure 6 assumes that no permanent surcharge loads are applied adjacent to the wetwell. Such loads may be produced by other structures, by heavy equipment, or by storing/stockpiling materials during construction. If such loads are anticipated, the design of the wetwell walls must account for additional pressures. For example, if material is stockpiled adjacent to the buried wetwell, a uniform surcharge load will produce an additional lateral uniform wall pressure equal to 0.50 times the anticipated surcharge load. Spread- or strip-type footings and slabs that may be constructed adjacent to the walls of the buried wetwell also will produce a load on the walls that must be considered in design. Walls that fall within a zone of influence defined by an imaginary line drawn from the edge of the footing or slab downward at an angle of 45 degrees should be designed to accommodate the load on the footing or slab. Transient loads produced, for example, by trucks, need not be considered in the design, unless they produce lateral pressures that exceed the pressures produced under earthquake loading conditions.

Retaining walls capable of rotating at their bases should be designed for active and passive conditions using the equivalent static fluid pressures shown on Figure 6. The active and passive pressures shown on Figure 6 assume that the walls are backfilled with the native clayey soils. As in the case of walls of the buried wetwell, the design of these retaining walls must consider additional wall pressures caused by surcharge loads if they are likely to occur. For active wall conditions, an additional uniform lateral pressure equal to 0.35 times the surcharge load should be used to account for surcharge loads next to retaining walls backfilled with fill derived from on-site excavations.

Retaining walls for sloping (upward or downward) backfill conditions must be designed using earth pressures different from those for level ground conditions (Figure 6). If the wall is backfilled with site fill derived from the native clayey soils, the slope of the backfill need not be considered when the toe of an upward slope is at a distance greater than about 1.5 times the retaining wall height. If slopes are required behind retaining walls, Geomatrix can provide lateral earth pressures for the sloping backfill conditions.

Where settlement of wall backfill must be kept to a minimum (e.g., in an area that will be paved or where pipelines go into or out of a structure), backfill placed adjacent to buried walls and/or retaining walls should consist of imported granular backfill. The aggregate base material (or CLSM) described in Section 6.2.6, Fill Materials and Compaction Criteria, can be used for this purpose. If properly moisture conditioned and placed in loose lifts less than 8 inches thick, this material will compact well using hand-held mechanical equipment and settlement of the aggregate base will be minimal.

If settlement of the wall backfill need not be limited, processed native clayey soil derived from the on-site excavations may be used. Compared to the aggregate base backfill, this fill will be more difficult to compact, especially when using hand-held equipment.

Backfill placed adjacent to retaining walls and the walls of buried structures should be compacted to at least 90 percent, but no more than 92 percent, of maximum dry density. Because over-compaction could cause excessive stresses, care should be taken not to overcompact the backfill, especially when using the fill derived from on-site excavations.

6.5 SLABS ON GRADE

Slabs for minor surface structures and equipment should be placed on a 6-inch-thick pad of compacted granular material (i.e., crushed rock, permeable material, aggregate base), as described in Section 6.2.6. Slabs should not be placed directly on the native soils. Before the granular material is placed on soil subgrades, the upper 8 inches of the native soil or fill should be scarified, its moisture content brought to within 2 to 5 percent above optimum, and the material compacted to no less than 92 percent of maximum dry density. Surfaces should be regular and free of debris. If a slab-on-grade is to be damp-proofed, it should be placed on 6 inches of free-draining aggregate base or crushed rock described in Section 6.2.6.

Exterior flatwork (e.g., walkways) may be subjected to edge effects due to the drying out of the subgrade materials, particularly where adjacent to landscape or vacant areas. Therefore, some differential movement should still be expected. Trip hazards can develop as slabs move differentially compared to fixed objects, such as at building entrances.

6.6 SEISMIC CONSIDERATIONS

A discussion of the seismic considerations is presented in this section, including the seismic design criteria and the potential for ground settlement and soil liquefaction caused by earthquake shaking.

6.6.1 Ground Motions

It is our understanding that seismic design for this project will be in accordance with the 2001 California Building Code (CBC). Input ground motions for the 2001 CBC are based on the same fault maps and formulae as the 1997 UBC. The CBC classifies sites using a Seismic Zone Factor, which identifies a level of seismic shaking based on site location. The proposed site is located in Seismic Zone 4, for which the Seismic Zone Factor is 0.40. Based on wells and borings drilled at the project site that are as much as 845 feet deep, it is our judgment that the site soil conditions corresponds closely with soil profile type S_D as described in the 2001 CBC.

As indicated in Section 4.0, the closest active fault to the site is the Pleasanton fault. Based on the definition of a "Type B" fault in the 2001 CBC, it is our opinion that the Pleasanton fault should be classified as a Type B seismic source. The nearest mapped trace of the fault zone is less than 1 mile [<2 km] west of the site. The following seismic coefficients are appropriate to the site for design in accordance with the 2001 CBC.

Description	**2001 CBC**
Seismic Source Type	B
Distance to Fault	<2 km
Seismic Zone Factor, Z	0.40
Soil Type	S_D
Seismic Coefficient, Ca	0.572
Seismic Coefficient, Cv	1.024

The acceleration response spectrum for 5 percent damping, shown on Figure 8, was developed in accordance with Chapter 16 of the 1997 UBC and the above seismic parameters. Response spectra for damping ratios of 2 and 0.5 percent were also developed. The 0.5 and 2 percent damped spectra were developed by scaling the 5 percent spectra using factors published by

Newmark and Hall (1982) and developed from in-house research on recorded earthquake time histories.

6.6.2 Earthquake-Induced Lateral Wall Pressures

During an earthquake, additional lateral loads will be applied to the walls of all buried structures and to retaining walls. The seismic lateral earth pressure is approximately proportional to the peak ground surface acceleration. The seismic lateral earth pressure increment was evaluated using ground motion criteria consistent with the 2001 CBC. The increment, equal to 20H, is a uniform pressure distribution in pounds per square foot (psf) acting on the full height of the wall (H). This pressure distribution applies to walls designed for both active and at rest conditions. If other earthquake ground motion criteria are used to design the facilities, a different seismic lateral earth pressure may apply. Additional recommendations will be provided upon request.

6.6.3 Earthquake-Induced Ground Settlement and Liquefaction

Because of the clayey nature of the site soils (i.e., within the upper 45 to 55 feet of the ground surface), and the depth to groundwater in the site vicinity (i.e., greater than about 27 feet bgs), soil liquefaction is not possible and need not be considered during design of the R/O Building. It is our opinion that the hazard posed by liquefaction and possible densification of the more granular site soils (found at depth) caused by earthquake shaking is extremely low.

6.7 PAVEMENT DESIGN

New pavements will be constructed as part of the project. Based on the low to moderate expansion potential of the near-surface soils at the site, we recommend that gravel roads or flexible pavements be used for all road improvements at the R/O Building site.

Structural design of flexible pavement is based on the strength of the subgrade soil, strength of the pavement materials, and assessment of vehicle traffic (both vehicle weight and frequency). The Traffic Index (T.I.) is used to designate the volume of traffic and weight of vehicle expected to travel on the roadways and parking areas. The T.I. is based on estimated traffic volumes projected over the economic life of the pavement (usually 20 years, with an understanding that asphalt concrete pavement generally will require some significant maintenance or rehabilitation at about 10 to 15 years of service) and the expected mix of cars and trucks. An appropriate T.I. should be selected once the usage and loading of the proposed paved areas are established.

The Caltrans method of pavement design uses the R-value test to evaluate the strength of subgrade soils and pavement materials. An R-value of 17 was measured in a test performed on a sample of the clayey soils taken from the upper 2 feet of boring B-5. For design of flexible pavements at the R/O Building site, an R-value of 15 is recommended for the subgrade soils.

The following flexible pavement sections are recommended for construction of new roadways and parking lots:

	Pavement Component Thickness (feet)	
Traffic Index (T.I.)	**Asphalt Concrete**	**Class 2 Aggregate Base**
4	0.25	0.50
5	0.25	0.70
6	0.30	0.90
7	0.35	1.10

The actual pavement section should be selected by the project civil engineer based on the estimated traffic volumes and vehicle weights. As a minimum, we recommend that parking areas used primarily by automobiles be designed for a TI of at least 5 and that parking area entrances and areas subject to truck traffic be designed for a TI of 6 or more.

When pavements are constructed at existing grade, the upper one foot of subgrade soil should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content of 1 to 3 percent above optimum (in accordance with ASTM Test Method D 1557). If filling is required for pavements, fill materials should conform to the recommendations for site fill (Section 6.2.6). The aggregate base (and subbase) materials should be compacted to a minimum of 95 percent of ASTM Test Method D 1557.

7.0 GEOTECHNICAL DESIGN RECOMMENDATIONS AND CONSIDERATIONS FOR PIPELINES

This section discusses geotechnical design recommendations and considerations for the supply pipeline and various pipelines that will be constructed at the R/O Building site. As is typical for most water treatment facilities, pipelines of different materials will likely be used in construction. We understand that the diameters of the pipes constructed for the project will range from about 6 to 28 inches. Pipe burial depths may vary greatly although we understand that, where ever possible, the pipes will have a minimum soil cover of about 3 to 4 feet.

7.1 CONSTRUCTION SEQUENCE

The construction sequence for the pipelines installed for the project, as we envision it, will consist of the following steps.

1. Traffic and pedestrian control measures are implemented to isolate the work areas. A survey of nearby facilities and improvements (such as buried utilities, surface structures, and pavements) that may be impacted by the pipeline installation work is performed to establish baseline conditions.

2. Pavements, curbs, gutters, and other surface features/improvements are sawcut and removed.

3. Launching and receiving pits are excavated where trenchless pipe installation techniques are needed to cross Santa Rita Road and Stoneridge Drive. The ground is supported where excavations with sloping sidewalls can not be excavated because of space limitations. Where necessary, measures are implemented to support nearby utilities and structures. Critical features or nearby structures are monitored for evidence of ground settlement or movement. The supply pipeline is installed below the roadways.

4. In other reaches of the supply pipeline and at the R/O Building site, pipeline trenches are excavated. In open areas, trenches with sloping sidewalls are excavated. Where trenches with sloping sidewalls are not possible, trenches with vertical sidewalls are used to install the pipe. Sheeting/shoring or other techniques are used to maintain stable trench walls and safe working conditions. Measures are implemented to support nearby utilities and structures. Critical features or nearby structures are monitored for evidence of ground settlement or movement.

5. Pipe bedding, pipe, pipe zone backfill, and trench backfill are placed.

6. Appurtenances, such as underground vaults, are constructed.

7. Pavements, curbs and gutters, and other improvements are restored.

8. All temporary facilities (barricades, fencing, etc.) are removed, and areas affected by construction are restored.

We realize that the above sequence is a simplification of the construction activities that will be required to install the project pipelines. Nevertheless, the recommendations and considerations in this section are based, in part, on the methods and sequence described above. Significant differences in the anticipated sequence should be brought to Geomatrix's attention so that we can evaluate their impact on the recommendations presented in this report. The rest of this section describes the geotechnical recommendations and other considerations related to design of the pipelines.

7.2 SITE PREPARATION

In developing the design documents for the pipeline, the methods that will be used to construct the pipeline should be carefully considered. If the pipeline must be installed near or beneath the foundation of an existing structure or pipeline, the existing structure/pipeline should be supported to prevent damage, and the pipeline should be encased in structural concrete, if necessary, to accommodate the imposed loads.

Structures or critical features/improvements that are very near the planned construction should be identified and surveyed/photographed/videotaped to document their pre-construction condition. The findings of the survey could be used to document any damage of existing structures/facilities that might result from this work. For other facilities where excavation-induced settlement may be of concern, baseline elevations and horizontal control data should be recorded.

Before trenching operations begin in paved roadways, existing pavements along the pipeline alignments and curbs and gutters crossed by the alignments should be neatly cut and removed to help minimize damage to these improvements. It should be noted that some pavements may become damaged by construction equipment especially where the pavements consist of marginally designed/constructed sections. These pavements will likely need to be replaced after the plant structures and appurtenant pipelines are constructed.

7.3 EXCAVATION CONDITIONS AND GROUND SUPPORT

Our interpretation of the subsurface conditions at the project site and along the supply pipeline alignment was described in Section 5.0 and will not be repeated here. As described in Section 1.0, the supply pipeline alignment was changed during design of the project. The new pipeline alignment follows an existing access road to the Mocho Well No. 3 Pump Station. Additional borings were not drilled to specifically explore the subsurface conditions along the new pipeline alignment. However, based on our understanding of the subsurface conditions at the project site, it is our judgment that the subsurface conditions along the new pipeline alignment will not differ substantially from those described in Section 5.0. However, restoration of the paved access road to the Mocho Well No. 3 Pump Station will be required.

In general, trenches excavated for the installation of the project pipelines at the R/O Building site and along the supply pipeline alignment likely will encounter native clayey soils and clayey fill; sandy and gravelly fill (generally cohesionless soils) likely will be encountered on the east side of Santa Rita Road (refer to the log of boring B-9 in Appendix A) and along the segment of the supply pipeline alignment that follows, or is near, the old railroad right-of-way. Because of past uses of the site and previous construction activities, it is possible that the character and composition of the soils though which trenches will be excavated may vary over short distances.

In areas where pipeline alignments are located away from structures, trenches with sloping sidewalls can be used to construct the pipeline. Where trenches with sloping sidewalls are not possible (i.e., near structures or existing pipelines), trenches with vertical sidewalls likely will required.

Equipment and procedures should be used that do not cause significant disturbance to the trench bottoms. Excavators and backhoes with buckets having large claws to loosen the soil should be avoided when excavating the last 6 to 12 inches of the trench. Such equipment will disturb the trench bottom subgrade. If the subgrade becomes disturbed, it should be compacted before placing the pipe bedding material. If the clayey soils exposed in the trench bottoms become wet, they will soften under the action of light equipment and foot traffic. In deep trenches and in launching/receiving pit excavations, clayey soils may already be saturated (even without free groundwater). Remedial measures, such as those described in Section 7.6, will be required if soft trench bottoms are encountered or result from the contractor's methods or equipment.

Excavations in soils with significant gravel content may slough/cave/ravel and will tend to have rugged, irregular bottoms and sidewalls/side slopes. It may be difficult to place backfill against the rugged/irregular excavation sidewalls/side slopes. When backfilling, care will be required to fill all voids on the sidewalls/side slopes so that excessive settlement of the backfill will not occur. Settlement can be mitigated by backfilling with granular material that is easy to compact or with controlled low strength material (CLSM). Requirements for CLSM are presented in Section 7.6.

We expect the stability of shallow excavation walls to vary depending on the soil conditions encountered in the pipeline trenches. During initial excavation, moist clayey soils may stand vertically a short time (about a day) with little sloughing. However, as the soil dries after excavation, sloughing may occur. Soils low in cohesion (i.e., sands and gravels) will be subject to sloughing, caving and raveling, especially if they become saturated. Vibrations caused by movement of equipment accelerate sloughing and caving. Where soils have less cohesion, rapid installation of the pipe and trench backfill will be desirable.

For planning purposes and to estimate project construction costs, the sloping sidewalls of pipeline trenches should be no steeper than 1½ (H):1 (V). These slopes will be subject to localized sloughing and raveling, especially when sandy and gravelly soils are exposed. To mitigate erosion due to wind and water, the exposed slopes should be protected (e.g., with plastic sheeting, netting, etc.) during construction.

Vertical sidewall trenches deeper than 5 feet will require sheeting, shoring, or other effective means to adequately support the ground adjacent to the trenches and to protect workers. Trenches shallower than 5 feet may require support depending on soil conditions and/or the contractor's activities in the vicinity of the trench. The launching and receiving pits that will be needed to install the supply pipeline beneath Santa Rita Road and Stoneridge Drive also will require effective means to adequately support the ground adjacent to the pits and to protect workers. Project specifications should place full responsibility on the contractor for planning, design, construction, maintenance, and removal of trench and excavation support systems.

Because the pipelines will be located near existing roadways, facilities, and other underground utilities, ground movement/settlement must be prevented to avoid damage. All trench excavations should be adequately supported to prevent failure of the trench walls and to mitigate potentially damaging ground movement/settlement. Bracing probably will be needed to maintain the stability of underground utilities, adjacent pavements, and other improvements. The ground support system should be installed without leaving nearby improvements unsupported. To help mitigate ground movement/settlement, stockpiling earth and other construction materials near open trenches should be avoided. In no case should stockpiling occur closer to trenches than federal or state regulatory agencies allow.

If removal of the trench support measures might cause a trench wall to collapse and the trench to widen at the top of the pipe and/or cause the pipe to move out of alignment, the support system should be left in place. Reaches where trenches may be subject to caving should be identified as trenches are being excavated. Soils that tend to ravel, slough, and cave while being excavated probably will cave if sheeting is removed while the trench is being backfilled. If pressure-treated wood is used, it should be left in place and cut off about 1.5 feet above the top of the pipe. Wood sheeting that is subject to rotting should not be used.

It is our opinion that, in general, trench shields will not be effective in mitigating ground movement/settlement while installing the pipeline. Trench shields typically are used for worker protection; trench shields often cannot prevent trench wall failure or excessive movement/settlement.

The stability of trenches will need to be evaluated while trenches and excavations are being made. As is the case anywhere that trenches are excavated in soils, unexpected caving of trench walls could occur at any time or place, regardless of the depth of the trench.

In general, existing structure foundations bearing on soils that lie above a line projected upward at an inclination of 45 degrees from the bottom of adjacent excavations will require underpinning or adequate ground support during construction. Should underpinning be necessary, we recommend that the contractor be responsible for its design and be required to submit an underpinning plan for review prior to construction.

During pipeline construction, we recommend that only a minimum length of trench be left open at one time and that the length of excavated trench not exceed the amount of pipeline that can be installed by the end of each day. All trenches and excavations in which the pipe has been installed should be backfilled at the end of the day, and the small section of trench/excavation remaining at the end of the pipe and at welding pits (where welding is not complete) should be supported to prevent cave-in. All trenches/excavations should be adequately marked, covered, and/or surrounded by barriers or fencing to prevent vehicular, pedestrian, or animal entry.

7.4 DEWATERING REQUIREMENTS

As discussed in Section 5.0, free groundwater was not observed in borings drilled for this study or the previous study of the site (Consolidated, 1999). Free groundwater might not be encountered during construction at the project site, although soils at depth may already be saturated. Limited zones of trapped groundwater and water from nearby leaking pipes or the nearby arroyo may be expected to cause water inflows or saturated soils in some of the pipeline trench excavations.

Water inflows into trench excavations must be prevented from causing caving and quick/running ground conditions of relatively cohesionless soil deposits or softening of clayey deposits. The proposed pipeline alignments may cross or parallel the alignments of other underground utilities. The trench backfill and bedding material used in construction of those utilities may have been loosely placed or may locally trap water. When crossed/cut by a new trench, loose trench backfill or bedding could suddenly run or cave and, if saturated, could flow. Significant water flows also could occur through the granular bedding material of existing utilities. Field conditions must be carefully assessed before trenches and excavations are made so that appropriate measures can be taken to prevent sloughing and caving, running and flowing ground, and excessive ground movement during construction.

In areas suspected of having groundwater, it may be desirable to pothole pipeline alignments before beginning trenching operations. If water is encountered, prudent construction practice requires dewatering the alignment before trenching. Surface water from construction operations and rainfall also should be diverted away from open trenches. As mentioned above, the soils exposed in the trench sidewalls are subject to erosion and the soils exposed in the trench bottoms will soften when they become saturated.

The contractor should be made responsible for the design, permitting, construction, operation, maintenance, and removal of the dewatering system(s) the contractor chooses to implement. The system(s) should be designed to prevent migration and pumping of soil fines with the discharge water. The contractor must plan the dewatering and excavation sequence carefully so that stable and dry excavations are maintained throughout the construction sequence. Refer to Section 6.2.2 for additional discussions.

7.5 TRENCH WIDTH

The trench section used to construct the pipeline will depend on the type of pipe zone backfill used. Recommended pipe zone backfill materials are described in Section 7.6.

When mechanically compacted granular pipe zone bedding and backfill is used, the recommended trench width should be as follows (Figure 9).

- For pipelines less than or equal to 6 inches in diameter, the minimum trench width should be the outside diameter (O.D.) of the pipe plus 12 inches.
- For pipelines more than 6 inches but less than 28 inches in diameter, the minimum trench width should be the outside diameter (O.D.) of the pipe plus 24 inches.

The trench width should be taken as the clear distance between trench walls or the inside face-to-face distance between ground support systems. These trench widths are intended to allow sufficient room for compacting the pipe zone backfill using hand-held equipment.

If controlled low strength material (CLSM) is used to bed and backfill the pipe, trench widths can be reduced from those described above. A minimum of a 6-inch-wide gap/void should be formed between the outside of the pipe and the exposed earth of the trench wall or inside face of the shoring system to allow placement of the CLSM slurry. Methods used to place the CLSM should ensure that the void is completely filled. The CLSM may need to be placed in controlled lifts, or other measure may be needed to prevent flotation of the pipe.

Where conditions allow, trenches having sloping side walls may be used to install the pipe. Where sloping side wall trenches are excavated, the minimum trench widths discussed above should apply at the pipe invert. Maximum trench widths should be specified by the designer to provide that loads experienced in the field do not exceed those assumed in designing the pipe.

7.6 PIPE BEDDING AND PIPE ZONE BACKFILL

For purposes of the following discussion, the pipe zone is defined as that portion of a trench excavation that is made to install a pipeline and that lies between a plane 6 inches below the bottom surface of the pipe (the pipe zone subgrade) and a plane 12 inches above the top surface of the pipe. The pipe bedding is defined as that portion of the pipe zone between the excavation subgrade and the bottom of the pipe. A typical vertical-wall trench section is presented in Figure 9 for conditions anticipated at the R/O Building site and along the supply pipeline alignment.

Pipe bedding and pipe zone backfill have an important influence on the distribution of the reaction against the bottom of the pipe, and therefore, the supporting strength of the installed pipe. Because the character of the pipe zone backfill materials and the manner of their placement affect how a pipe will behave under the loads it will support, pipe manufacturers often specify how their pipe should be bedded and backfilled. In general, the pipe bedding is important to the load-carrying capacity and performance of both rigid and flexible pipe; however, the quality and compaction of pipe zone backfill are not as important for rigid pipe as for flexible pipe. Because the pipelines may be constructed using pipes from different manufacturers, different materials, or using different coating systems, materials required for pipe bedding and pipe zone backfill may vary. However, to lessen the possibility of having pipes embedded in an inappropriate material, we recommend that only two or three pipe zone backfill materials be specified for the project, if possible.

Fill derived from trench excavations will not be suitable pipe bedding or pipe zone fill. Bedding and backfill material likely will consist of imported granular soils (such as sand, crushed rock, aggregate base, or fine gravel) or CLSM. For the subsurface conditions at the R/O Building site and along the supply pipeline alignment, sand, aggregate base, or CLSM can be used to bed and backfill pipe, provided the pipe is concrete or has a concrete coating. If the pipe is PVC, is wrapped with PVC, or has an epoxy coating, we recommend that only sand or CLSM be used for pipe bedding and backfill. Bedding and backfill material consisting of sand or CLSM would help mitigate damage to the pipe or pipe coating (corrosion protection) during installation. In some reaches, structural concrete encasement may be required to resist anticipated loads. Pea gravel is not recommended for pipe bedding and pipe zone backfill. Because it can "run" if exposed in future excavations, pea gravel can cause significant construction difficulties.

Limits should be placed on the maximum particle size and silt/clay content of pipe bedding and pipe zone backfill. For example, bedding material specified in Caltrans July 1999 Standard Specifications consists of sand of which 90 to 100 percent of the particles pass the No. 4 sieve and not more than 5 percent pass the No. 200 sieve. Sand with a greater percentage of particles passing the No. 200 sieve will be more difficult to compact. Some municipalities require that pipe bedding and pipe zone backfill meet the gradation and quality requirements of Class 2 Aggregate Base given in Section 26 of Caltrans, Standard Specifications. However, aggregate base should not be used if it can damage the pipe's corrosion protection. The bedding below the pipe should be a minimum of 6 inches thick. The same material used for bedding should be used to backfill the remainder of the pipe zone to 12 inches above the top of the pipe. These thicknesses for pipe bedding and pipe zone backfill will help mitigate pipe damage during construction. If used for pipe bedding and backfill, aggregate base and crushed rock should meet the requirements discussed in Section 6.2.6.

Controlled low strength material (CLSM), or "Slurry Cement Backfill" in Section 19 of the Caltrans Standard Specifications (July 1999), should be considered as an alternative pipe embedment and trench backfill material. As described in Section 6.2.6 of this report, CLSM consists of a fluid, workable mixture of aggregate, Portland cement, fly ash, and water. The use of CLSM has several advantages: (1) a narrower trench can be used, thereby minimizing the quantity of soil to be excavated; (2) the support given the pipe is generally better, and sometimes greater values of the soil modulus (E′) can be used to design the pipe; (3) no compaction is required to place CLSM, there is less risk of damaging the pipe corrosion protection system; and (4) CLSM can be batched to flow into irregularities in the bottoms and walls of trenches, such as those that may exist in trenches excavated in the sandy and gravelly soils that may be encountered while constructing the project. The requirements for CLSM are more completely described in Section 6.2.6.

Pipe manufacturers and suppliers should be consulted to establish material and compaction requirements for their pipelines. If the pipe manufacturers stipulate no special requirements, the sand or aggregate base material used for pipe zone backfill should be placed in 6-inch (maximum) loose lifts and compacted to at least 90 percent of maximum density as determined by ASTM Test Method D 1557. If the contractor demonstrates that compaction can be achieved, lifts thicker than 6 inches can be used. Precautions should be taken to avoid damaging the pipe coating (corrosion protection) with construction equipment. Trench width recommendations discussed in Section 7.5 should help minimize potential damage. Pipe zone backfill should be placed evenly up each side of the pipe to prevent displacement of the pipe during backfilling.

Because clayey soils will be encountered in the pipeline trench excavation, Geomatrix does not recommend the use of saturation or jetting to place and compact the pipe zone bedding and backfill.

In voids that are difficult to fill with bedding material (e.g., where pipelines enter or leave structures or in welding pits), the pipe should be bedded on a material that requires little or no compaction (e.g., CLSM). At locations where the pipeline enters or leaves a structure, the fill or backfill material should be placed and compacted to a level at least 1 foot above the top of the pipe. The fill should then be excavated to install the pipeline. Bedding material should be placed to provide uniform, continuous support of the pipe. Placement and compaction of fill adjacent to the pipe or bedding beneath the pipe should not be allowed after the pipeline is placed and connected to the structure/vault.

In the event that unstable soils are encountered, or if the soils become unstable because of the contractors operations, the trench should be overexcavated to firm material or to a maximum depth of 2 feet. The material overexcavated from the trench or pit should be replaced with crushed rock described in Section 6.2.6. Before the crushed rock is placed, a woven geotextile conforming to the requirements of the Caltrans Standard Specifications Section 88-1.04, for Type A, woven, should be placed on the trench bottom and up the sidewalls of the trench to at least the springline of the pipe to prevent loss of rock into the soft subgrade (refer to Figure 9). The rock should be placed in loose lifts that are no more than 1 foot thick, then compacted using vibratory techniques. The crushed rock should be placed up to the bottom of the pipe zone and should be firm and unyielding before pipe bedding is placed (70 percent relative density as determined by ASTM Test Methods D 4253 and D 4254). The geotextile should then be folded over the top of the crushed rock to mitigate the migration of bedding material. The pipe bedding material should be placed and compacted over the geotextile (refer to Figure 9). If temporary shoring, sheeting, or a trench shield is used in construction, the pipe bedding and pipe zone backfill must be compacted up against the trench wall, and all voids left by the temporary support system must be filled.

Where crushed rock or sand is used for pipe zone material, a plug of relatively impervious soil, concrete, or CLSM should be placed around the pipe at least every 300 to 500 feet to restrict the flow of groundwater through the relatively permeable pipe zone material. Such measures should help mitigate migration of groundwater and possible groundwater contamination. Additional measures or more frequent trench plugs may be required by local agencies/municipalities.

Geotechnical parameters recommended for the design of the pipeline are presented in Table 1. The modulus of soil reaction, E' in Table 1, was selected so that it applies to the "shallow burial depth" ground conditions through which most pipelines will be installed (i.e., through clayey soil conditions). The values for the parameters assume that the pipeline will be bedded and backfilled using the techniques described in this report.

7.7 TRENCH ZONE BACKFILL

Trench zone backfill is the material placed in a pipeline trench from 12 inches above the top of the pipe to finished grade or, in paved areas, to the pavement section subgrade (Figure 9). Final backfill is the material placed within 18 inches of finish grade, or, if the trench is under a road, all material within 18 inches of pavement section subgrade.

If not adequately and completely compacted, trench backfill will settle. Settlement can cause the rapid deterioration of overlying pavements/improvements and can create a safety hazard. Because of these concerns, an imported material is often specified to backfill trenches, especially when the trench lies below pavements or near other improvements. The requirements for the imported material can be specified so that the trench backfill is much easier to compact than, say, the native clayey soils. Where settlement could cause damage, the use of imported backfill material for trench zone backfill should be considered to help reduce the amount of trench settlement.

The use of imported trench backfill has several advantages, including: (1) substantial reduction in moisture conditioning and elimination of the need to mix/blend materials; (2) lower potential for delays due to processing native materials; (3) the ability to establish standard, repeatable procedures for placement and compaction; (4) better pavement patch performance; and (5) reduce trench backfill settlement.

Imported trench backfill should be a soil or soil-rock mixture free of organic material, debris, and other deleterious substances. Class 2 Aggregate Subbase (Caltrans Standard Specifications, Section 25), and Class 2 Aggregate Base (Caltrans Standard Specifications, Section 26) may be suitable trench backfills if they meet project requirements. As an alternative, CLSM may be used for trench backfill.

In the following discussions, it is assumed that native earth materials will be used to backfill the pipeline trenches.

In general, most, if not all, of the soil excavated from the trenches for the project will require processing and moisture conditioning to render it suitable for trench backfill. If excavated soils are not close to the optimum moisture content, their moisture content must be adjusted (i.e., increased or reduced) before these soils can be used as trench backfill. Processing/conditioning native soil will require that adequately sized work areas be conveniently located for spreading and mixing the soils. A water supply should be made available for moisture-conditioning dry soils.

The maximum particle size for trench backfill material should be specified at 2 inches. To facilitate compaction, trench zone backfill should be spread evenly in horizontal lifts that do not exceed 6 inches before compaction. The moisture content should be within optimum and +3 percent. The backfill should be compacted using mechanical equipment. At depths greater than 18 inches below pavement subgrade, trench backfill should be compacted to no less than 90 percent of maximum density as determined by ASTM Test Method D 1557.

The upper portion of the trench (labeled "Final Backfill" on Figure 9) must be compatible with the surface features on either side of the trench. In paved areas, final backfill must be compacted to a degree that will support replacement pavement. In landscaped areas, the final backfill must be prepared to support plant growth.

Beneath paved areas, final backfill (i.e., backfill within 18 inches of the pavement subgrade) should be compacted to 95 percent of maximum density as determined by ASTM Test Method D 1557. In unpaved areas, final backfill should be compacted to 90 percent of maximum dry density as determined by ASTM Test Method D 1557 up to the finished grade.

At a minimum, pavement sections should be replaced with a compatible thickness of aggregate base and asphalt concrete or a thick section of asphalt concrete. In off-road reaches, measures should be implemented to mitigate erosion of the final trench backfill.

7.8 CROSSINGS USING TRENCHLESS METHODS

Anticipated subsurface soil and groundwater conditions at the R/O Building site and along the supply pipeline alignment are described in Section 5.0. It is anticipated that groundwater conditions should be favorable (i.e., groundwater levels are below the elevation of the pipe, or groundwater, if encountered, can be controlled) and conventional bore and jack methods likely can be used to install the supply pipeline beneath Santa Rita Road and Stoneridge Drive. The contractor selected to construct the project should have the ultimate responsibility for choosing the means, methods, and techniques that he/she will use to install the pipeline where trenchless methods are required.

Where bore and jack methods are used, the pipeline probably will be installed in a casing pipe that is slightly larger than the supply (carrier) pipeline. After the crossings are made, the pipe will be placed through the casing and the annular space filled with grout. The following general recommendations apply to the design of this type of crossing.

- A lubricant may be used at the contractor's option to decrease frictional resistance between the casing pipe and adjacent soil.
- Because soil friction can increase with time, it is desirable to continue jacking operations without interruption until completed.
- Casing pipe should have a smooth outside surface to reduce frictional resistance.
- The leading edge of the casing should be protected with a cutting edge or head.
- Voids between the soil and steel casing may have to be grouted to prevent excessive ground settlement or excessive loads on the pipe. To prevent hydraulic fracturing of the soil, grout pressures should be limited to ½ psi per foot of depth (e.g., 8 psi at 16 feet below ground surface).

- Gravity soil loads on the casing should be computed using the modified Marston formula and assuming a cohesion coefficient of 0 and the other appropriate parameters summarized in Table 1.
- All surcharge loads should be considered when designing the casing.

The method used to advance the pipe must consider the subsurface conditions at each location. As discussed in Section 7.4, dewatering or other measures to control groundwater and potentially unstable ground conditions may be necessary.

8.0 BASIS FOR RECOMMENDATIONS

This report was prepared for the exclusive use of Carollo, the designers of the Zone 7 Water Agency Groundwater Demineralization Project. The recommendations and other considerations presented in this report are intended for the planning and design of the facilities described in Section 1.0. The recommendations are based on the assumption that soil conditions at the facility site and along the pipeline alignments do not deviate appreciably from those described herein, and encountered in the exploratory borings. If any variations or undesirable conditions are encountered during construction, Geomatrix should evaluate the effects these conditions may have on our recommendations and, if necessary, develop supplemental recommendations. Recommendations are made for the specific project described in this report. Changes in design of the structures should be evaluated by Geomatrix for their effects on these recommendations.

A Geomatrix representative should observe earthwork and foundation construction to confirm that subsurface conditions encountered during construction are comparable to those used for developing the recommendations presented in this report. Unanticipated subsurface conditions, which cannot be disclosed fully by completing exploratory borings, commonly are encountered and frequently require additional expenditures to attain a properly constructed project. Some contingency funding is recommended in case conditions encountered during construction require additional exploration, testing, or design modifications.

In the performance of our professional services, Geomatrix, its employees, and its agents comply with the standards of care and skill ordinarily exercised by members of our profession practicing in the same or similar localities. This report may not provide all of the subsurface information that may be needed by a contractor to construct the project. No warranty, either express or implied, is made or intended in connection with the work performed by us, or by the proposal for consulting or other services, or by the furnishing of oral or written reports or findings. We are responsible for the conclusions and recommendations contained in this report, which are based on data related only to the specific project and locations discussed herein. In the event conclusions or recommendations based on these data are made by others, such conclusions and recommendations are not our responsibility unless we have been given an opportunity to review and concur with such conclusions or recommendations in writing.

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Tables

TABLE 1

RECOMMENDED PIPELINE DESIGN PARAMETERS
Zone 7 Water Agency – Groundwater Demineralization Project

Parameter	Recommended Value
Total unit weight of backfill, γ_t (pcf): • Native, clayey soil backfill • Aggregate base backfill	 125 135
Load Factor	1.9[1]
Rankine's lateral pressure ratio times the coefficient of friction of backfill, $k\mu$	0.16
Modulus of soil reaction, E′ (psi) (imported granular pipe zone bedding and backfill and CLSM)	1000[2]
Coefficient of friction between bedding material and pipe • Concrete pipe with granular bedding • Smooth steel pipe and PVC with granular bedding	 0.45[3] 0.30[3]
Cohesiveness, C_S	0.0

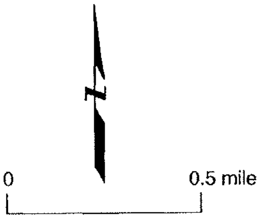
[1] Only appropriate for rigid pipelines installed in trench conditions (1 pipe per trench). Assumes method of pipe zone bedding and backfill described in this report will be used in construction.

[2] Value of E′ recommended for moderately to well-compacted pipe zone backfill (90% relative compaction).

[3] Value assumes no factor of safety (i.e., factor of safety equal to 1.0).

Figures

Base map from *The Thomas Guide, 2002 Alameda County Edition*. Reproduced with permission granted by THOMAS BROS. MAPS®. This map is copyrighted by THOMAS BROS. MAPS®. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission. All rights reserved.



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GEOMATRIX

SITE LOCATION MAP
Geologic/Geotechnical Study for Zone 7 Water Agency -
Groundwater Demineralization Project
Pleasanton, California

Project No.
8453

Figure
1

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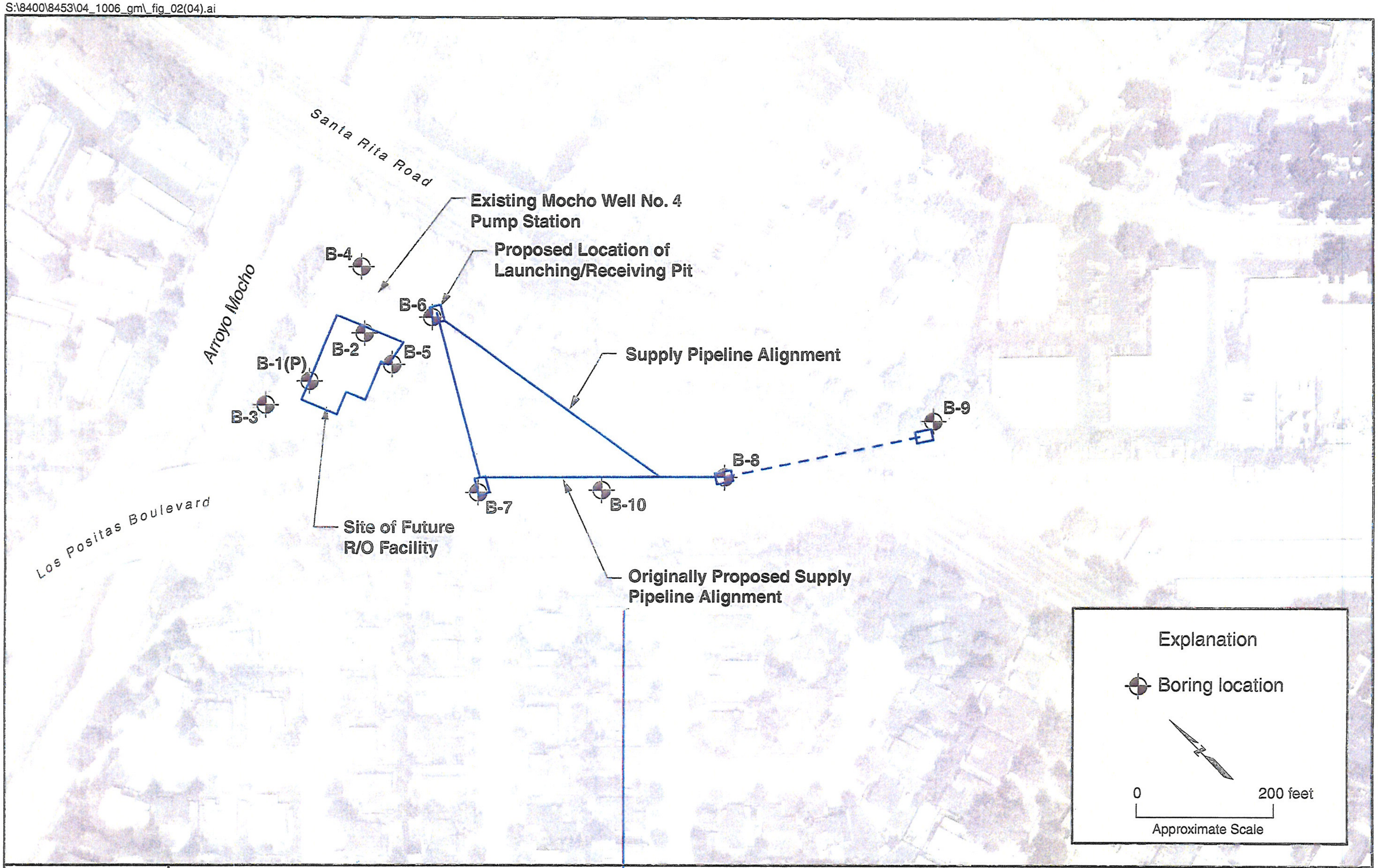


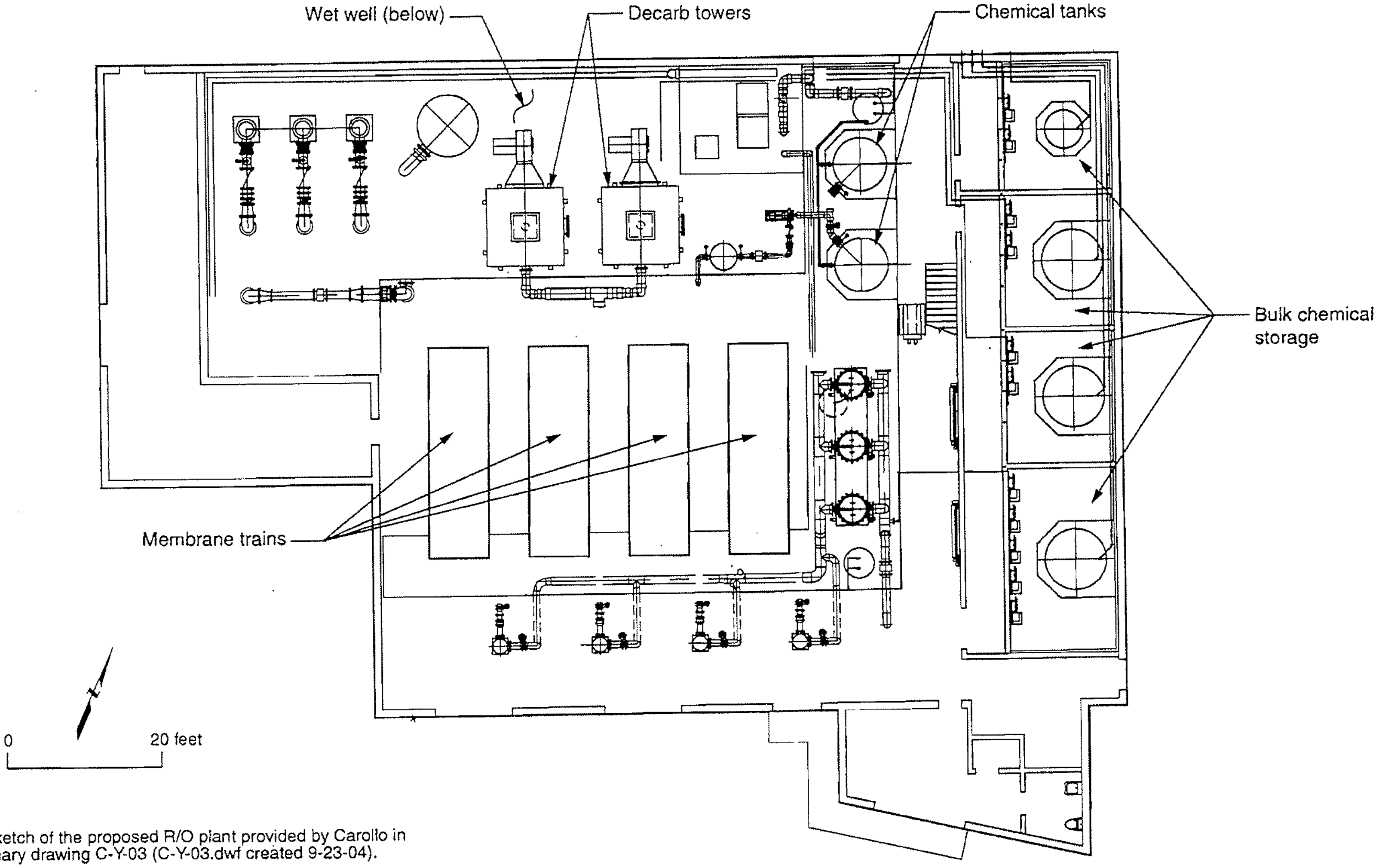
GEOMATRIX

SITE LAYOUT AND BORING LOCATION PLAN

Geologic/Geotechnical Study for Zone 7 Water Agency -
Groundwater Demineralization Project
Pleasanton, California

Project No.
8453

Figure
2



Notes:

Base sketch of the proposed R/O plant provided by Carollo in preliminary drawing C-Y-03 (C-Y-03.dwf created 9-23-04).

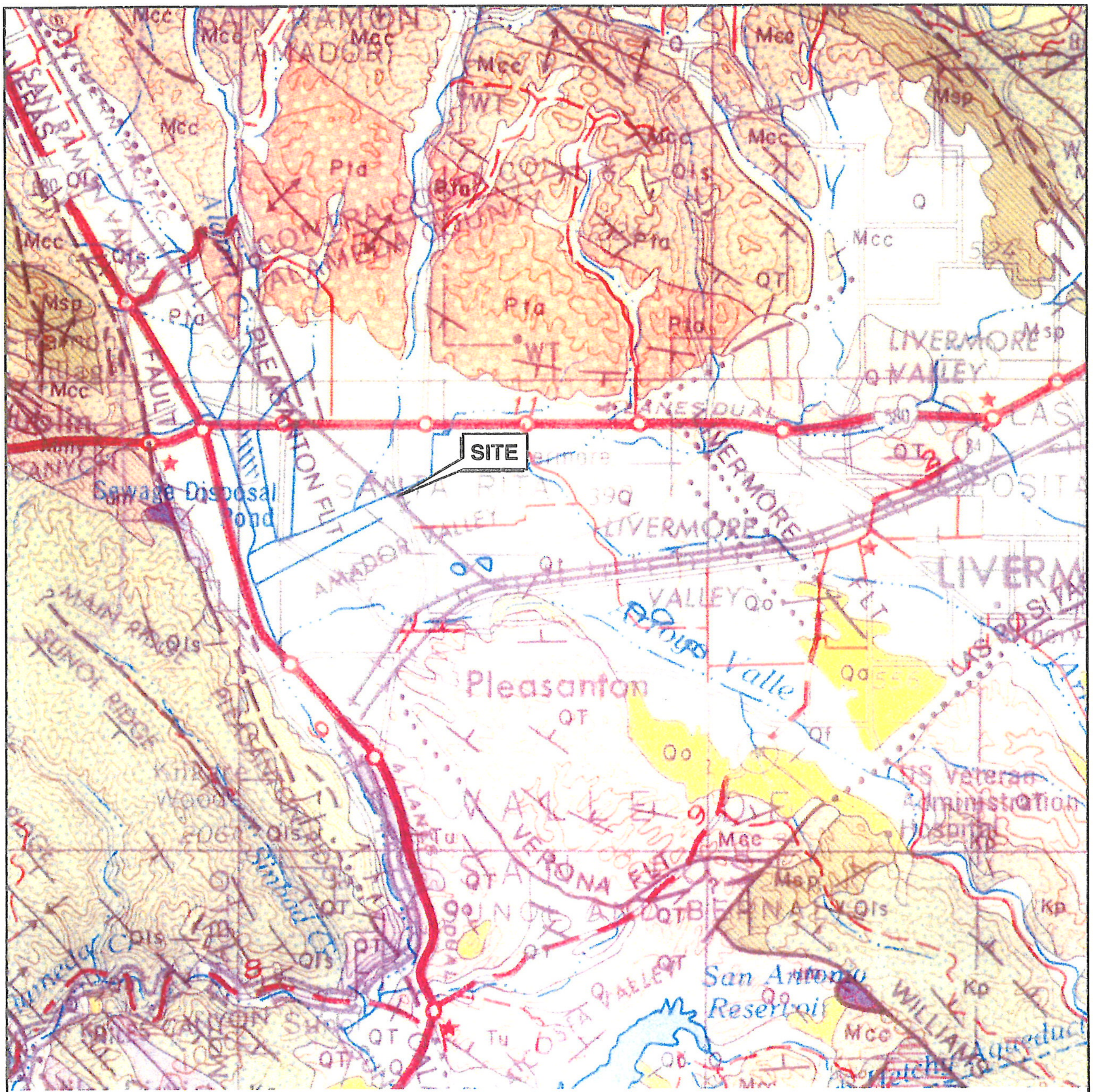
90 percent design drawings indicate a similar floor plan arrangement.

GEOMATRIX

R/O BUILDING FLOOR PLAN
Geologic/Geotechnical Study for Zone 7 Water Agency -
Groundwater Demineralization Project
Pleasanton, California

Project No.
8453

Figure
3



QUATERNARY

Q	Alluvium
Qls	Landslide deposits
Qt	Terrace deposits
Qo	Older alluvium
QT	Plio-Pleistocene nonmarine deposits

TERTIARY

Pta	Tassajara Formation
Msp	San Pablo Group
Mmy	Monterey Formation
Mcc	Contra Costa Group
Tu	Undivided Tertiary marine sedimentary rocks

MESOZOIC

Kp	Berryessa Formation
	Franciscan Complex
um	um - serpentinized unltramafic rock

0 5 Km

Geology from Wagner and others (1991).

GEOMATRIX

REGIONAL GEOLOGIC MAP

Geologic/Geotechnical Study for Zone 7 Water Agency -
Groundwater Demineralization Project
Alameda County, California

Project No.
8453

Figure
4

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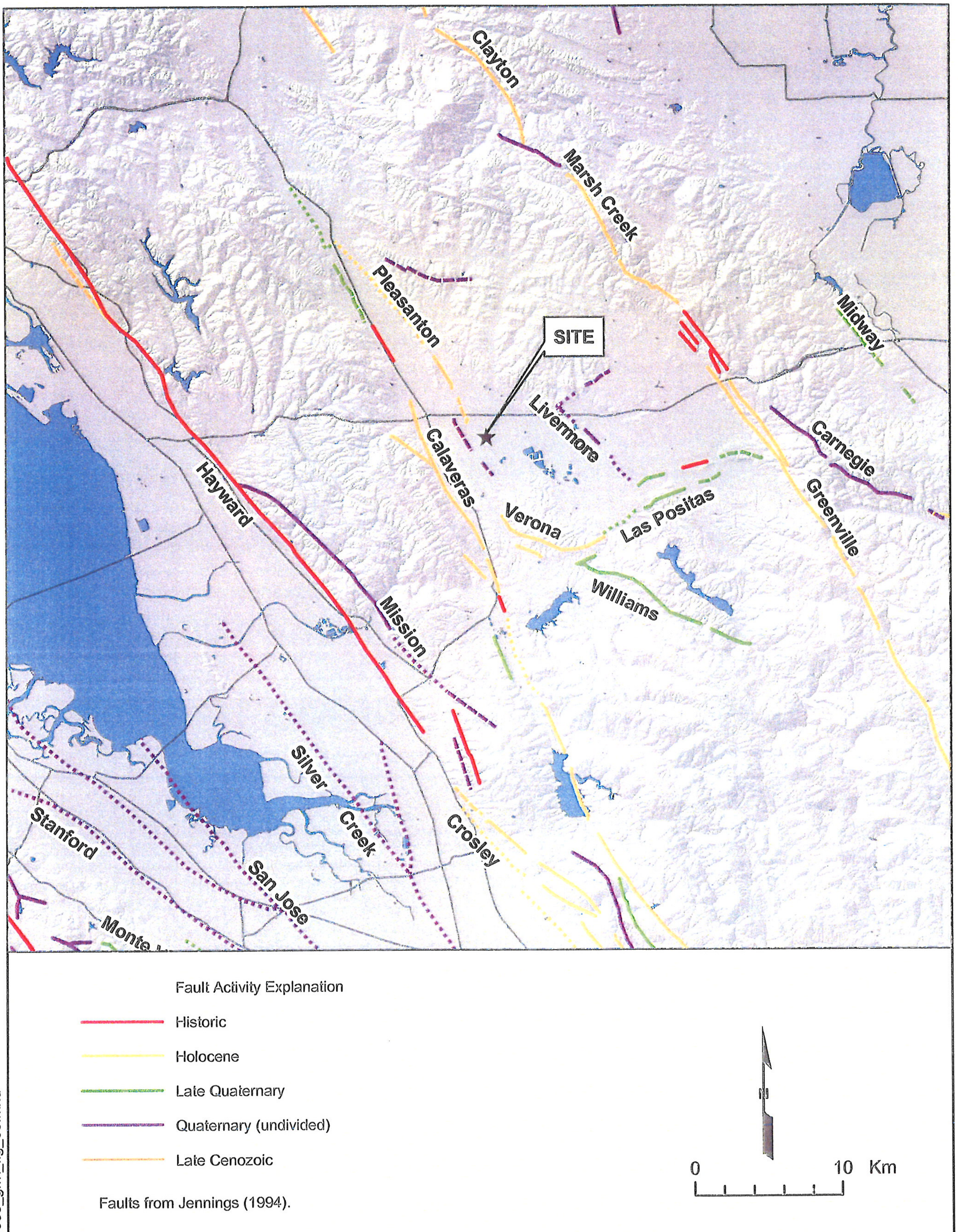

Faults from Jennings (1994).

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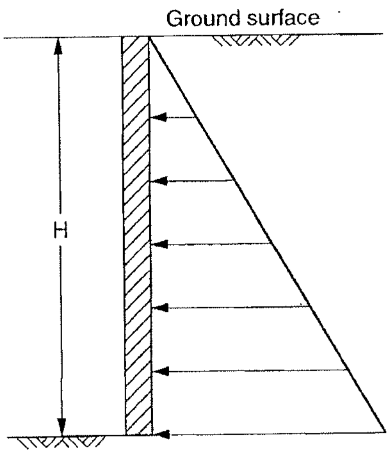
GEOMATRIX

REGIONAL FAULT ACTIVITY MAP
Geologic/Geotechnical Study for Zone 7 Water Agency -
Groundwater Demineralization Project
Pleasanton, California

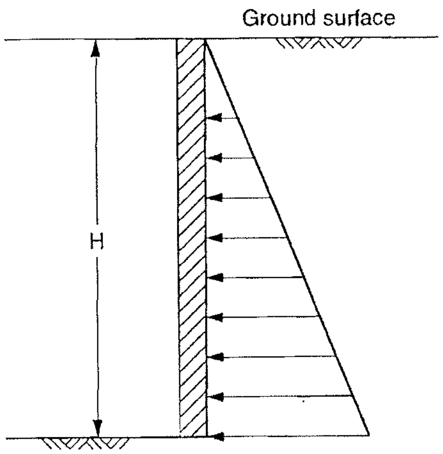
Project No.
8453

Figure
5



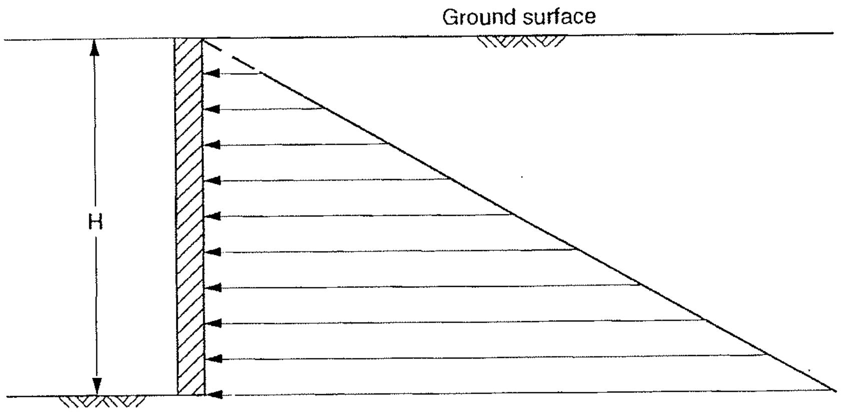
Backfill derived from native soil = 65 H

Non-Yielding (At Rest) Wall Pressure (psf)



Backfill derived from native soil = 45 H

Active Wall Pressure (psf)



Backfill derived from native soil = 400 H

Ultimate Passive Wall Pressure (psf)

Notes

1. Above distributions apply to walls that have processed native soil backfill.
2. H = height of wall in feet.
3. When multiplied by H in feet, coefficients on diagrams yield lateral earth pressures in pounds per square foot (psf).
4. Passive pressure acting on wall or footing must be calculated for assumed wall deflection using factors shown in Figure 7. Ignore upper foot of passive pressure when estimating lateral resistance of shallow foundations.
5. Pressure diagrams needed for the design of the temporary excavation support systems were not developed as part of this study.

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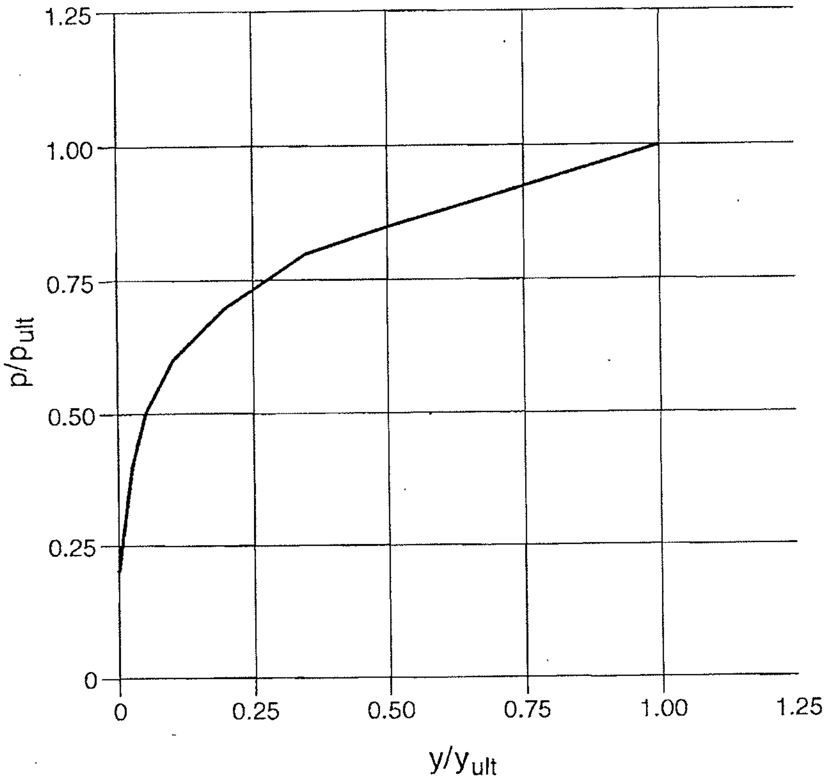
GEOMATRIX

LATERAL EARTH PRESSURE DISTRIBUTIONS FOR
FREE-DRAINING AND LEVEL BACKFILL CONDITIONS
Geologic/Geotechnical Study for Zone 7 Water Agency -
Groundwater Demineralization Project
Pleasanton, California

Project No.
8453

Figure
6



p/p_{ult}	y/y_{ult}
0.20	0
0.40	0.025
0.50	0.05
0.60	0.10
0.70	0.20
0.80	0.35
0.85	0.5
1.0	≥1.0

Notes

1. p_{ult} given by Figure 6.

2. $y_{ult} = 0.02H$

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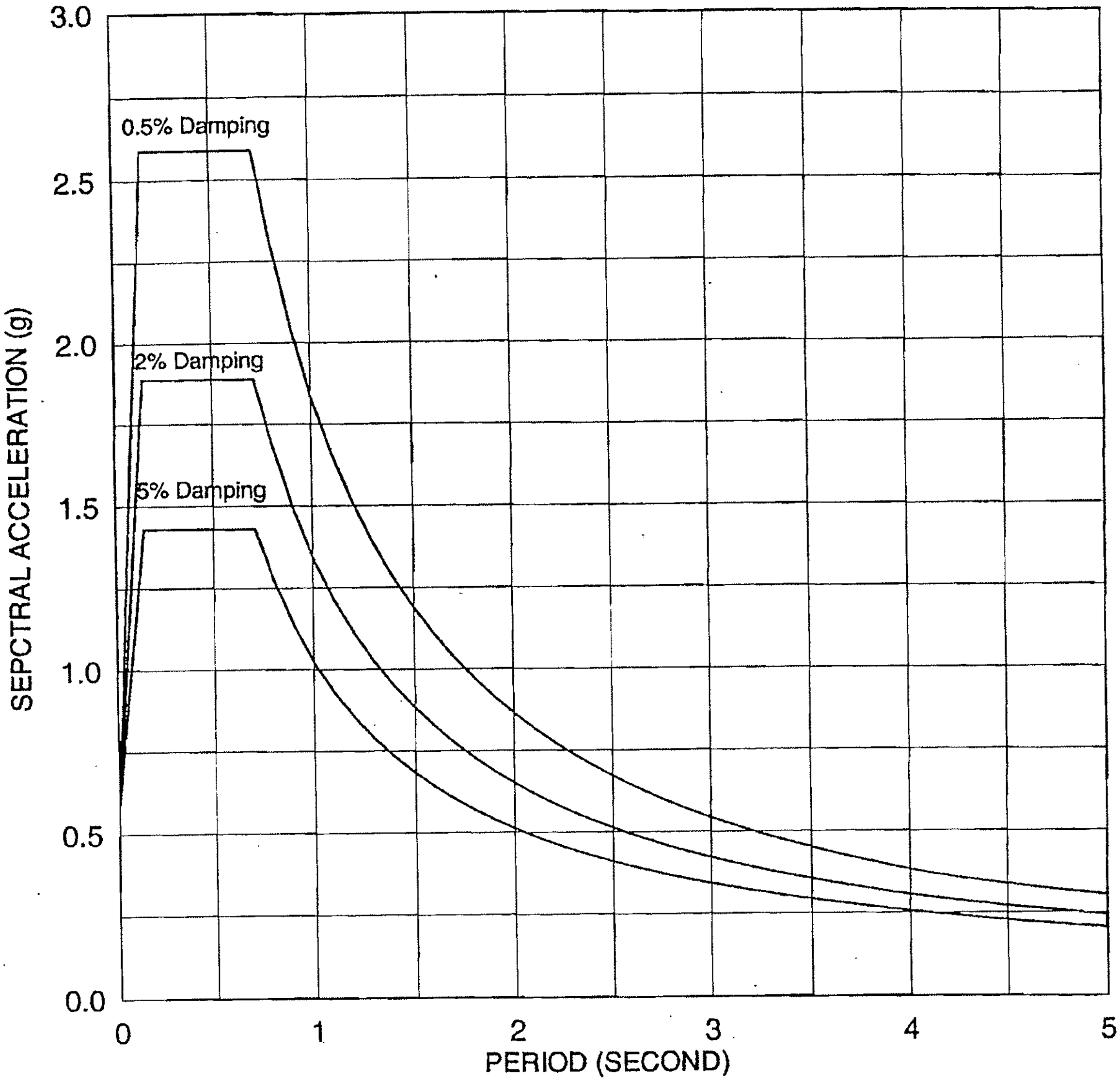
GEOMATRIX

NORMALIZED PASSIVE PRESSURE RESISTANCE VS. DEFLECTION AT TOP OF WALL

Geologic/Geotechnical Study for Zone 7 Water Agency -
Groundwater Demineralization Project
Pleasanton, California

Project No.
8453

Figure
7



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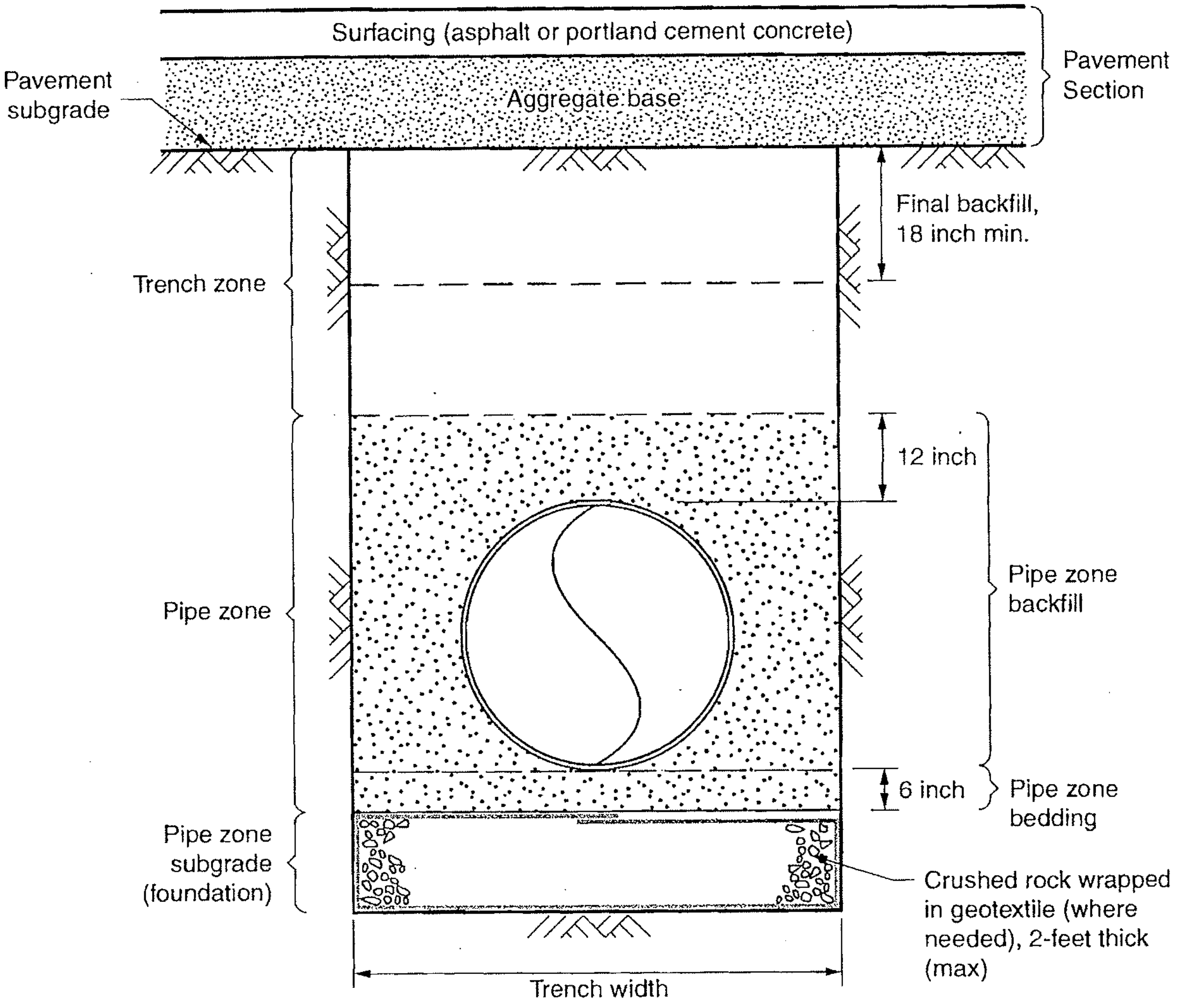
GEOMATRIX

DESIGN ACCELERATION RESPONSE SPECTRA
Geologic/Geotechnical Study for Zone 7 Water Agency -
Groundwater Demineralization Project
Pleasanton, California

Project No.	8453
Figure	8



Trench Width

Granular Pipe Zone Backfill
- Pipes < 6" - O.D. + 12 inches
- Pipes > 6" and < 28" - O.D. + 24 inches

CLSM Pipe Zone Backfill
- all pipes - O.D. + 12 inches

Note:
Trenches with sloping side walls not shown. Refer to Section 7.0 for discussion.

GEOMATRIX

TYPICAL TRENCH SECTION
Geologic/Geotechnical Study for Zone 7 Water Agency -
Groundwater Demineralization Project
Alameda County, California

Project No.
8453

Figure
9

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App. A

GEOMATRIX

APPENDIX A

APPENDIX A

FIELD EXPLORATION
Zone 7 Water Agency – Groundwater Demineralization Project
Pleasanton, California

The field exploration program for the Zone 7 Water Agency – Groundwater Demineralization Project (project) consisted of completing ten exploratory borings. The location of each exploration point was selected based on the proposed location of the new R/O facility structure and associated pavements, and along the proposed supply pipeline alignment. As mentioned in Section 1.0 of the main report, the alignment of the supply pipeline was changed during design. Consequently, one boring (i.e., boring B-7) drilled, logged, and sampled for this study was not located along the final pipeline alignment. The approximate location of each exploration point is shown on Figure 2.

The ground surface elevations recorded in the exploration logs were estimated from a topographic map of the site vicinity provided by Carollo Engineers. These elevations are reportedly based on the North American Vertical Datum of 1988 (NAVD 1988; mean sea level datum).

Prior to the field exploration program, Underground Service Alert (USA) was notified to locate utilities at the site. In addition, Geomatrix contracted with a private utility locator, Cruz Subsurface Locators of Milpitas, California, to clear the designated work areas of existing utilities. A drilling permit was obtained from the Zone 7 Water Agency (Permit No. 24098). After drilling was completed the location of each boring was marked in the field for later identification and surveying.

Ten borings were drilled at the site on September 8 and 9, 2003. Ms. Tania Welch, Staff Engineer with Geomatrix, observed the drilling operations and prepared the field logs for all of the borings. Gregg Drilling Inc. (Gregg) of Martinez, California, used hollow-stem auger drilling methods to advance the borings. All borings were drilled using a truck-mounted Mobile B-53 drill rig.

A summary of groundwater conditions observed in the exploratory borings [(B-1(P) through B-10] drilled at the site during this study is presented in Table A-1. As indicated in the table, the borings were drilled to depths ranging from 6½ to 31½ feet below the ground surface. The deepest boring [boring B-1(P)] was drilled within the planned footprint of the R/O facility. Near the R/O Building, shallow borings were drilled to explore the soils underlying planned pavement areas. Where the supply pipeline will be installed using trenchless techniques, borings were drilled deeper in the vicinity of launching and receiving pits. All borings were advanced using a 6-inch or an 8-inch-diameter, hollow-stem auger. Samples were extracted from the borings for two purposes: geotechnical soil characterization and corrosion testing. Samples of the soils encountered in the borings were obtained using a Modified California drive sampler (2.5-inch inside diameter, 3-inch outside diameter, with liners). At selected borings, composite (bulk) samples were taken from the soil cuttings brought to the surface on the augers.

The samplers were driven into the soil with a 140-pound hammer falling 30 inches. In all cases, the sampler was driven 18 inches. The number of hammer blows needed to drive the sampler through the final 12 inches of the 18-inch drive was recorded. This number (or blows per foot) is given at the corresponding sample location on the boring logs (see Figures A-3 through A-12).

Soil samples were carefully sealed to preserve the in-situ water content. Preliminary soil classifications were made visually in the field, in general accordance with ASTM D 2488. Soil colors were described using the Munsell Soil Color Chart.

Because there was a possibility of encountering contaminated soils or groundwater, Geomatrix brought a portable photo-ionization detector (PID) into the field during the subsurface exploration work. If any sign of petroleum contamination (i.e., discoloration, change in consistency, or hydrocarbon odor) had been observed, the PID would have been used to monitor the air at exploration sites and the collected samples. If the PID detected hydrocarbon levels that could pose a hazard to workers, or if evidence of other hazardous substances was observed, exploration work at that location would have been terminated.

During the field exploration program, the PID was calibrated to local conditions at the beginning of each day, and was available for use. No sign of petroleum contamination of water, soil, or air was observed during our work. Consequently, no samples were screened with the PID.

Soil classifications were refined by further examination in our laboratory and by test results. The relative density of generally cohesionless soils and the consistency of cohesive soils were evaluated using approximate SPT N-values (blow counts) estimated from the driving of the modified California drive sampler and the guide presented in Table A-2. Final boring logs were developed considering the laboratory test data and the conditions recorded on the field logs. The final logs are presented on Figures A-3 through A-12. A boring log explanation sheet is provided on Figure A-1. It should be noted that the boring logs show changes in the subsurface stratigraphy that are based on observations made by our field engineer and drill rig operator during drilling. The contacts/transitions between the various soil layers were sometimes based on changes in the cuttings and changes in the drilling operations (e.g., advance rate of the auger, sound or chatter of the drill rig, gauge pressure changes, etc).

Groundwater was not observed in any of the borings during drilling (Table A-1). Most borings were backfilled immediately after drilling. However, borings B-7 and B-8, drilled along the proposed supply pipeline alignment, were left open for about 24 hours before backfilling. Free groundwater was not observed in these borings prior to backfilling. In addition, boring B-1(P) drilled within the footprint of the R/O facility was converted into a piezometer, as indicated in Table A-1 and Figure A-2. Free groundwater was not observed on September 9, 2004, shortly after the piezometer was installed, but was observed 1 week later (refer to Table A-3). The piezometer was periodically monitored for groundwater on the dates summarized in Table A-3.

In accordance with drilling permit requirements, all borings [except B-1(P)] were backfilled with cement grout to within about 2 feet of the ground surface and topped with compacted soil cuttings. Soil cuttings generated during drilling operations were scattered across the ground surface in the vicinity of each boring, as directed by Zone 7. The cuttings from boring B-9 were transported to the R/O facility site and wasted in the area north of boring B-1(P).

One soil sample from each of the borings was provided to JDH Corrosion Consultants, Inc. (JDH) of Walnut Creek, California for corrosion testing and analysis. The depths of these samples varied from about 5 to 20 feet below the existing ground surface. The locations of samples obtained for corrosion testing are indicated in Appendix C.

TABLE A-1

SUMMARY OF DRILLING METHODS AND PIEZOMETER LOCATIONS AND MEASUREMENTS

Zone 7 Water Agency – Groundwater Demineralization Project
Pleasanton, California

Boring No.	Location of Boring	Depth of Boring (feet)	Date Drilled	Method (Drill Rig)	Depth of Water Table from Ground Surface Prior to Backfilling (feet)	Piezometer (Yes or No)	Depth to Bottom of Well Screen (feet)	Length of Well Screen (feet)	Depth to Top of Sensing Zone (feet)
B-1(P)	R/O Building	31.5	9/9/04	Mobile B-53	None detected	Yes	30	10	19
B-2	R/O Building	26.5	9/8/04	Mobile B-53	None detected	No	--	--	--
B-3	R/O Building site pavement	6.5	9/9/04	Mobile B-53	None detected	No	--	--	--
B-4P	R/O Building site pavement	6.5	9/9/04	Mobile B-53	None detected	No	--	--	--
B-5	R/O Building site pavement	7.0	9/9/04	Mobile B-53	None detected	No	--	--	--
B-6	Launching-Receiving Pit	26.5	9/8/04	Mobile B-53	None detected	No	--	--	--
B-7	Launching-Receiving Pit	26.5	9/8/04	Mobile B-53	None detected	No	--	--	--
B-8	Launching-Receiving Pit	26.5	9/8/04	Mobile B-53	None detected	No	--	--	--
B-9	Launching-Receiving Pit	26.5	9/8/04	Mobile B-53	None detected	No	--	--	--
B-10	Supply Pipeline	16.5	9/8/04	Mobile B-53	None detected	No	--	--	--

TABLE A-2

GUIDE FOR ESTIMATING RELATIVE DENSITY AND CONSISTENCY OF SOILS BASED ON BLOWCOUNT DATA

Zone 7 Water Agency – Groundwater Demineralization Project
Pleasanton, California

RELATIVE DENSITY

SPT Sampler	Modified California Samplers		Relative Density
	2-inch (ID)	2-1/2 inch (ID)	
<4	<5	<7	very loose
4-10	5-13	7-17	loose
10-30	13-40	17-50	medium dense
30-50	40-67	50-83	dense
>50	>67	>83	very dense

CONSISTENCY OF FINE-GRAINED SOILS

Consistency	Identification Procedure	Approximate SPT N-value (blows/foot)	Approximate Shear Strength (psf)
Very soft	Squeezes between finger when hand is closed	0-2	less than 250
Soft	Easily molded by fingers	2-4	250-500
Medium Stiff	Molded by strong finger pressure	4-8	500-1000
Stiff	Dented by strong finger pressure	8-15	1000-2000
Very Stiff	Dented only slightly by finger pressure	15-30	2000-4000
Hard	Dented only slightly by pencil point	30+	4000+

Note:

The blowcounts in the tables above apply to standard penetration test (SPT) samplers driven in general accordance with ASTM D 1586. The blowcounts from modified California drive samplers are generally greater than those obtained by SPT samplers because of the differences in sampler diameter and surface area. The relative densities and consistencies recorded on the boring logs were evaluated based on the estimated equivalent SPT blowcount for the sampler used and the undrained shear strengths indicated by field and laboratory tests

TABLE A-3

MEASUREMENTS IN PIEZOMETER B-1(P)

Zone 7 Water Agency – Groundwater Demineralization Project
Pleasanton, California

Date of Measurement	Measured Depth of Water Table from Top of Casing (feet)[1]	Water Table Depth Below Ground Surface (feet)	Water Table Elevation Below Ground Surface (feet)[2]
September 9, 2004	No free water observed	--	--
September 17, 2004	28.0	28.4	307
November 17, 2004	28.2	28.5	307
April 4, 2005	28.2	28.5	306

Notes:

1. Distance from Top of Casing to Ground Surface is 0.3 feet. Top of casing is below the ground surface.
2. Based on estimated ground surface elevation of 335 feet (NAVD 1988).

BORINGS

These logs of borings and related information depict subsurface conditions only at the locations shown on Figure 2 and at the time the borings were performed. Soil and groundwater conditions at other locations may differ from those observed at these locations. The passage of time may result in changes in soil and groundwater conditions at these locations.

PROJECT: ZONE 7 WATER AGENCY DEMINERALIZATION
Pleasanton, California

Boring Log Explanation

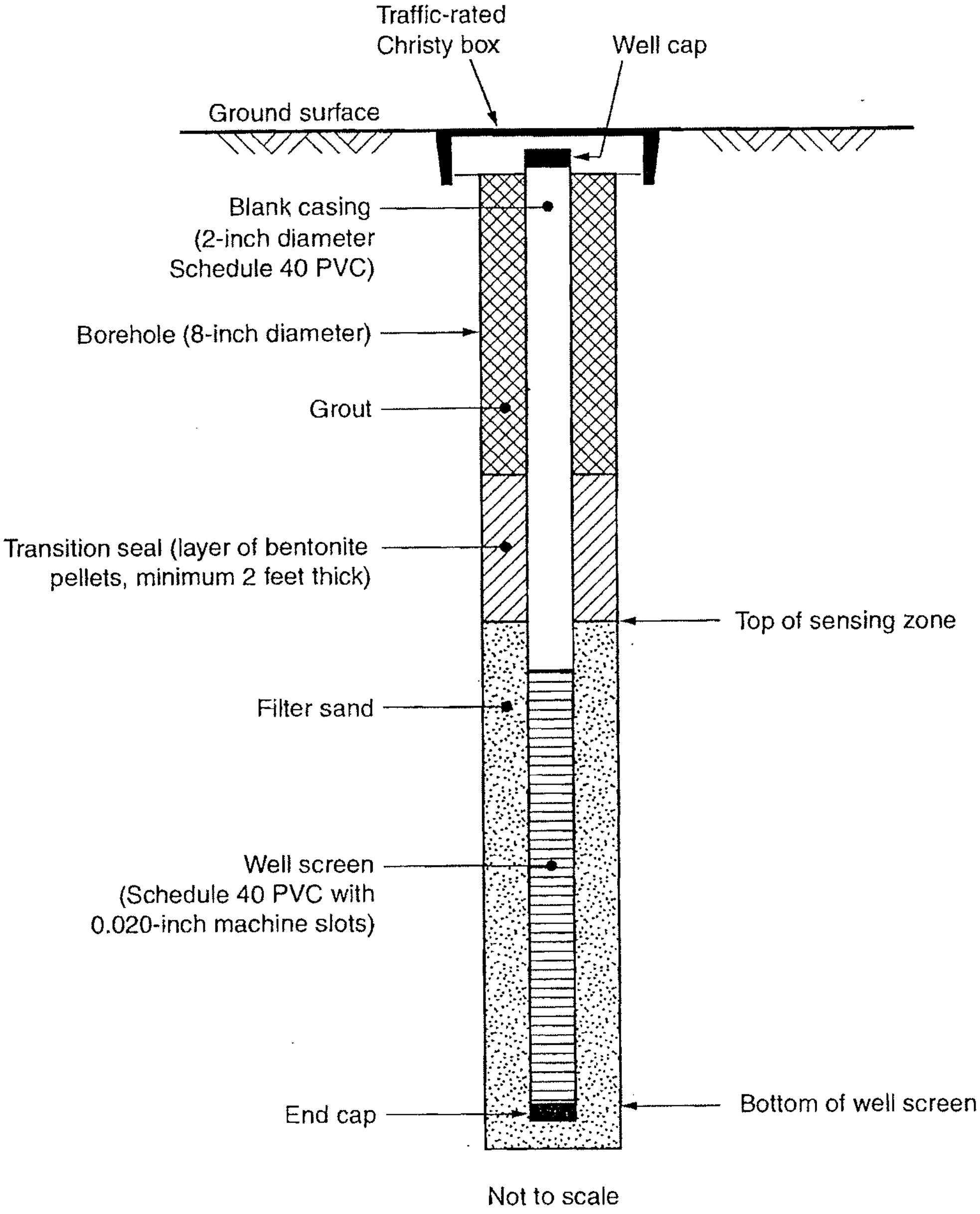
DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other
		▯		Standard penetration split-spoon drive sampler, 50 mm (2-inch) outside diameter, 35 mm (1 3/8-inch) inside diameter (without liners)			
		☒		Modified California drive sampler, 76 mm (3-inch) outside diameter, 64 mm (2 1/2-inch) inside diameter (with liners)			
		■		Bulk sample collected from soil cuttings			
			23	Blow count for last 300 mm (12 inches) of sample, or as noted			
			45* 3"	Blow count for entire drive, total drive less than 150 mm (6 inches)			
				Distinct contact			
				Gradual or uncertain contact			
				ATD ▽			
				Measured groundwater level prior to backfill or after well completion ▼			
				Fines content (percentage of soil passing No. 200 sieve)			<200=44%
				LL=Liquid limit; PI=Plastic index			LL=27 PI=4
				Grain size distribution			Sieve
				Torvane shear strength, in tsf			TV=0.8
				Pocket penetration unconfined compressive strength, in tsf			PP=1.5
				Resistance value (California Test-301)			R-Value=20
				Unconsolidated-undrained triaxial test, shear strength in psf (confining pressure in psf)			UU=500 (300)
				Direct shear			DS
				Consolidation			Consol
				Moisture-density relationship (compaction curve)			D1557

NOTES:

1. The stratification lines shown on the boring logs represent the approximate boundaries between material types. The actual transitions between materials may be gradual.
2. These logs of the test borings and related information depict subsurface conditions only at the specific locations and at the particular time the boring was made.
3. Soil conditions at other locations may differ from conditions occurring at these locations. Also, the passage of time may result in changes in the soil and groundwater conditions at these locations.
4. Soil colors from Munsell Soil Color Charts.

GT-2 (6/98)

Project No. 8453.000 | **Geomatrix Consultants** | Figure A-1



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GEOMATRIX

TYPICAL MONITORING WELL CONSTRUCTION DIAGRAM

Geologic/Geotechnical Study for Zone 7 Water Agency -
Groundwater Demineralization Project
Alameda County, California

Project No.
8453

Figure
A-2

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project
Pleasanton, California

Log of Boring No. B-1(P)

BORING LOCATION: See Site Plan, Figure 2

ELEVATION AND DATUM: ~335 ft (MSL)

DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.

DATE STARTED: 9/9/2004

DATE FINISHED: 9/9/2004

DRILLING EQUIPMENT: Mobil B-53

TOTAL DEPTH (feet): 31.5

MEASURING POINT: Ground Surface

DRILLING METHOD: 8-inch diameter hollow-stem auger

DEPTH TO FREE WATER FIRST ENCOUNTERED: Not Encountered

SAMPLING METHOD: See Boring Log Explanation, Figure A-1

DEPTH TO FREE WATER AT COMPLETION: Not Encountered

HAMMER WEIGHT: 140 lbs

HAMMER DROP: 30 in

LOGGED BY: T. Welch

DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
	Sample No.	Sample	Blows/ foot		Moisture Content (%)	Dry Density (pcf)	Other
		■		CLAYEY SAND with GRAVEL (SC) dry [FILL]			
1		■		CLAY (CL) Medium stiff, brown (7.5YR 4/2) to gray (10YR 4/1), moist, medium plasticity, contains scattered fine, angular rock fragments			
2		☒					
3	1	☒	8		30	91	TV=0.5 PP=3.0 <200=98%
4		■		CLAY (CL) Medium stiff, very dark gray (7.5YR 3/1), moist, medium plasticity			
5		☒					
6	2	☒	10		33	86	TV=0.6 PP=4.0
7							
8							
9							
10		☒		becomes grayish brown (10YR 5/2) and yellowish brown (10YR 5/6)			
11	3	☒	10		27	96	TV=0.8 PP=3.0 UU=2220 (1440)
12							
13				CLAY (CH) Stiff, gray (10YR 5/1), pale brown (10YR 6/3), infilled vertical fractures extend across sample, shiny discontinuous surfaces, not planar, red brown FeO_2 randomly stained			
14							
15		☒					
16	4	☒	14		34	85	TV=0.7 PP=2.3 UU=1840 (2160)
17							

GEES-SOIL 12/03 GINTSOIL_LOGS.GPJ GES32003-7.GDT 5/24/05

GT-1 (12/03)

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project
Pleasanton, California

Log of Boring No. B-1(P) cont.

DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
	Sample No.	Sample	Blows/ foot		Moisture Content (%)	Dry Density (pcf)	Other
18				CLAY (CH) Continued			
19							
20	5	☒	19	becomes stiff, gray (10YR 5/1) mottled with yellowish brown (10YR 5/6), moist, FeO_2 staining, medium to high plasticity	27	98	TV=0.8 PP=3.8 <200=99% LL=60 PI=37 Consol
21							
22							
23							
24							
25	6	☒	22	becomes dark gray (10YR 4/1) and dark grayish brown (10YR 4/2), shiny, discontinuous, randomly oriented surfaces	25	101	TV=0.6 PP=3.5
26							
27							
28							
29							
30	7	☒	15				TV=0.8 PP=2.5
31							
				Borehole terminated at 31.5 feet. Piezometer constructed in borehole.			

GT-2 (8/01)

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project
Pleasanton, California

Log of Boring No. B-2

BORING LOCATION: See Site Plan, Figure 2

ELEVATION AND DATUM: ~335 ft (MSL)

DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.

DATE STARTED: 9/8/2004

DATE FINISHED: 9/8/2004

DRILLING EQUIPMENT: Mobil B-53

TOTAL DEPTH (feet): 26.5

MEASURING POINT: Ground Surface

DRILLING METHOD: 6-inch Hollow-Stem Auger

DEPTH TO FREE WATER FIRST ENCOUNTERED: Not Encountered

SAMPLING METHOD: See Boring Log Explanation, Figure A-1

DEPTH TO FREE WATER AT COMPLETION: Not Encountered

HAMMER WEIGHT: 140 lbs

HAMMER DROP: 30 in

LOGGED BY: T. Welch

DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
	Sample No.	Sample	Blows/ foot		Moisture Content (%)	Dry Density (pcf)	Other
1		■		CLAY (CL) Medium stiff, brown (7.5YR 4/2), dry (upper 1 foot), moist, medium plasticity, contains rootlets, scattered angular rock fragments less than 1 inch			LL=45 PI=23 <200=84% Sieve D1557
3	1	☒	13		23	99	TV=0.6 PP=4.5
4		■					
6	2	☒	7	CLAY (CH) Medium stiff to stiff, light yellowish brown (2.5Y 6/4) and grayish brown (2.5Y 5/2), moist, medium stiff, medium to high plasticity, very fine rootlets, FeO_2 staining along rootlets	33	89	TV=0.8 PP=2.0 <200=99% LL=55 PI=35 Consol
11	3	☒	12	becomes gray to dark gray (2.5 Y 5/1 to 4/1) with yellowish brown (10YR 5/6), moist, low to medium plasticity, very fine rootlets	26	93	TV=0.6 PP=2.0 UU=2240 (1440)
16	4	☒	16	becomes dark gray (10YR 4/1) to dark grayish brown (10YR 4/2), light yellowish brown infilled very fine fractures, discontinuous shiny surfaces, not planar, possibly due to shrinkage and swelling of clay, very fine rootlets	32	88	TV=0.9 PP=2.3

GT-1 (12/03)

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project
Pleasanton, California

Log of Boring No. B-2 cont.

DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS Moisture Content (%)	Dry Density (pcf)	Other
18 19				CLAY (CH) Continued			
20 21 22	5	☒	11	SILTY CLAY (CL) Medium stiff, gray (2.5Y 5/1) and yellowish brown (10YR 5/6), moist, very fine rootlets, vesicular, likely resulting from degradation of rootlets	24	101	TV=0.6 PP=2.8
23 24 25 26	6	☒	14	CLAY (CL) Stiff, gray (2.5Y 5/1), moist	27	97	TV=0.9 PP=2.5
				Borehole terminated at 26.5 feet. Backfilled with cement grout.			

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project
Pleasanton, California

Log of Boring No. B-3

BORING LOCATION: See Site Plan, Figure 2
ELEVATION AND DATUM: ~335 ft (MSL)
DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.
DATE STARTED: 9/9/2004
DATE FINISHED: 9/9/2004
DRILLING EQUIPMENT: Mobil B-53
TOTAL DEPTH (feet): 6.5
MEASURING POINT: Ground Surface
DRILLING METHOD: 6-inch Hollow-Stem Auger
DEPTH TO FREE WATER FIRST ENCOUNTERED: Not Encountered
SAMPLING METHOD: See Boring Log Explanation, Figure A-1
DEPTH TO FREE WATER AT COMPLETION: Not Encountered
HAMMER WEIGHT: 140 lbs
HAMMER DROP: 30 in
LOGGED BY: T. Welch

DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
	Sample No.	Sample	Blows/ foot		Moisture Content (%)	Dry Density (pcf)	Other
				SANDY CLAY (CL) dry, contains fine angular rock fragments [FILL]			
1				CLAY (CL) Medium stiff, pale brown to brown (10YR 6/3 to 5/3) with brownish yellow (10YR 6/6) staining, moist, medium stiff, low to medium plasticity			
2							
3	1	☒	6		11	101	TV=0.8 PP=3.5
4							
5				becomes dark gray (10YR 4/1), moist, occasional fine rootlets			
6	2	☒	10				TV=0.5 PP=3.3
7				Borehole terminated at 6.5 feet. Backfilled with cement grout.			
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project
Pleasanton, California

Log of Boring No. B-4

BORING LOCATION: See Site Plan, Figure 2

ELEVATION AND DATUM: ~335 ft (MSL)

DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.

DATE STARTED: 9/9/2004

DATE FINISHED: 9/9/2004

DRILLING EQUIPMENT: Mobil B-53

TOTAL DEPTH (feet): 6.5

MEASURING POINT: Ground Surface

DRILLING METHOD: 6-inch Hollow-Stem Auger

DEPTH TO FREE WATER FIRST ENCOUNTERED: Not Encountered

SAMPLING METHOD: See Boring Log Explanation, Figure A-1

DEPTH TO FREE WATER AT COMPLETION: Not Encountered

HAMMER WEIGHT: 140 lbs

HAMMER DROP: 30 in

LOGGED BY: T. Welch

DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
	Sample No.	Sample	Blows/ foot		Moisture Content (%)	Dry Density (pcf)	Other
				CLAYEY SAND with GRAVEL (SC) dry, fine, contains angular rock fragments [FILL]			
1				CLAY (CL) Stiff, dark gray (10YR 4/1), moist, stiff, medium plasticity, scattered, angular rock fragments, very fine rootlets, dark reddish brown FeO_2 staining along fractures, mottled with yellowish brown (10YR 5/4) clay			
2							
3	1	☒	16		23	102	TV=0.8 PP=3.0
4							
5							
6	2	☒	12	becomes gray to dark gray (10YR 4/1 to 5/1), some mottling	27	87	TV=0.9 PP=2.5
7				Borehole terminated at 6.5 feet. Backfilled with cement grout.			
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project
Pleasanton, California

Log of Boring No. B-5

BORING LOCATION: See Site Plan, Figure 2

ELEVATION AND DATUM: ~335 ft (MSL)

DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.

DATE STARTED: 9/9/2004

DATE FINISHED: 9/9/2004

DRILLING EQUIPMENT: Mobil B-53

TOTAL DEPTH (feet): 7

MEASURING POINT: Ground Surface

DRILLING METHOD: 6-inch Hollow-Stem Auger

DEPTH TO FREE WATER FIRST ENCOUNTERED: Not Encountered

SAMPLING METHOD: See Boring Log Explanation, Figure A-1

DEPTH TO FREE WATER AT COMPLETION: Not Encountered

HAMMER WEIGHT: 140 lbs

HAMMER DROP: 30 in

LOGGED BY: T. Welch

DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
	Sample No.	Sample	Blows/ foot		Moisture Content (%)	Dry Density (pcf)	Other
1		■		CLAYEY SAND with GRAVEL (SC) Brown (10YR 4/3), dry to moist, contains fine, angular gravels			R-Value=17 Sieve LL=39 PI=21 <200=50%
2 3 4	1	☒	11	CLAY (CL) Medium stiff, dark grayish brown (10YR 4/2), moist, stiff, medium plasticity, includes tiny piece of black coal and tiny shell fragments	22	100	TV=0.6 PP=3.0
5 6	2	☒	16	CLAY (CH) Stiff, dark gray and gray (10YR 4/1 and 5/1), moist, dark reddish brown (5YR 3/4) FeO_2 staining along fractures, pale brown infilled fractures (10YR 6/3), high plasticity	40	76	
7 8 9 10 11 12 13 14 15 16 17				Borehole terminated at 7 feet. Backfilled with cement grout.			

GT-1 (12/03)

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project
Pleasanton, California

Log of Boring No. B-6

BORING LOCATION: See Site Plan, Figure 2
ELEVATION AND DATUM: ~335 ft (MSL)
DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.
DATE STARTED: 9/8/2004
DATE FINISHED: 9/8/2004
DRILLING EQUIPMENT: Mobil B-53
TOTAL DEPTH (feet): 26.5
MEASURING POINT: Ground Surface
DRILLING METHOD: 6-inch Hollow-Stem Auger
DEPTH TO FREE WATER FIRST ENCOUNTERED: Not Encountered
SAMPLING METHOD: See Boring Log Explanation, Figure A-1
DEPTH TO FREE WATER AT COMPLETION: Not Encountered
HAMMER WEIGHT: 140 lbs
HAMMER DROP: 30 in
LOGGED BY: T. Welch

DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
	Sample No.	Sample	Blows/ foot		Moisture Content (%)	Dry Density (pcf)	Other
1				CLAYEY SAND with GRAVEL (SC) dry [FILL]			
2 3	1	☒	10	CLAY with GRAVEL (CL) Medium stiff, very dark brown and dark brown (10YR 3/1-3/3), moist, stiff, medium plasticity, contains angular rock fragments less than 1 inch			PP=2.8
4 5 6 7 8 9	2	☒	7	CLAY (CL) Medium stiff, dark grayish brown (10YR 4/2), moist, dark reddish brown (5YR 3/4) FeO_2 staining along rootlet (fracture) surfaces, medium plasticity	29	92	
10 11 12 13 14	3	☒	5	SILTY CLAY (CL) Soft to medium stifff, gray (10YR 5/1) and dark yellowish brown (10YR 4/4), moist, medium plasticity	33	90	TV=0.6 PP=1.3
15 16 17	4	☒	18	CLAY (CL) Stiff, gray (10YR 5/1), moist	33	89	TV=0.9 PP=3.0 UU=2750 (2160)

GEES-SOIL 12/03 GINTSOIL_LOGS.GPJ GES32003-7.GDT 5/24/05

GT-1 (12/03)

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project
Pleasanton, California

Log of Boring No. B-6 cont.

DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS Moisture Content (%)	Dry Density (pcf)	Other
18				CLAY (CL) Continued			
19							
20							
21	5	☒	15	shiny surfaces, not planar, discontinuous, multiple orientations	24	100	TV=0.8 PP=3.0 DS
22							
23							
24							
25							
26	6	☒	18				TV=0.9 PP=3.0
				Borehole terminated at 26.5 feet. Borehole left open for 24 hours to allow water to enter hole. No free water observed after 24 hours. Backfilled with cement grout.			

GT-2 (8/01)

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project
Pleasanton, California

Log of Boring No. B-7

BORING LOCATION: See Site Plan, Figure 2
ELEVATION AND DATUM: ~336 ft (MSL)
DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.
DATE STARTED: 9/8/2004
DATE FINISHED: 9/9/2004
DRILLING EQUIPMENT: Mobil B-53
TOTAL DEPTH (feet): 26.5
MEASURING POINT: Ground Surface
DRILLING METHOD: 6-inch Hollow-Stem Auger
DEPTH TO FREE WATER FIRST ENCOUNTERED: Not Encountered
SAMPLING METHOD: See Boring Log Explanation, Figure A-1
DEPTH TO FREE WATER AT COMPLETION: Not Encountered
HAMMER WEIGHT: 140 lbs
HAMMER DROP: 30 in
LOGGED BY: T. Welch

DEPTH (feet)	SAMPLES Sample No.	 Sample	 Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS Moisture Content (%)	 Dry Density (pcf)	 Other
1 2				SANDY CLAY with GRAVEL (CL) Brown (10YR 4/3) to yellowish brown (10YR 3/6), dry, low plasticity [FILL]			
3 4 5	1	☒	15	SANDY CLAY (CL) Stiff, dark grayish brown (10YR 4/2), moist, medium plastic fines, contains angular rock fragments less than 1 inch	19	107	PP=3.8 <200=68%
6 7 8 9 10	2	☒	11		26	92	TV=1.0 PP=3.3 UU=2180 (1010)
11 12 13 14 15	3	☒	5	SILTY CLAY (CL) Soft to medium stiff, dark grayish brown (10YR 4/2) mottled with dark yellowish brown (10YR 4/6), moist, medium plasticity	30	92	TV=0.4 PP=1.5 UU=1210 (1440)
16 17	4	☒	11	becomes medium stiff, mottled reddish brown (5YR 4/4) and brown (7.5YR 4/2), moist, medium to high plasticity	33	91	TV=0.6 PP=2.5 UU=1730 (2160)

GEES-SOIL 12/03 GINTSOIL_LOGS.GPJ GES32003-7.GDT 5/24/05

GT-1 (12/03)

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project
Pleasanton, California

Log of Boring No. B-7 cont.

DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS Moisture Content (%)	Dry Density (pcf)	Other
18				CLAY (CL) Continued			
19							
20				CLAY (CL) Stiff, dark gray (10YR 4/1) mottled with dark yellowish brown (10YR 3/6), moist, medium to high plasticity			
21	5	☒	14		31	92	TV=0.7 PP=2.5
22							
23							
24							
25				becomes dark gray (10YR 4/1), no mottling			
26	6	☒	18				TV=1.1 PP=3.0
				Borehole terminated at 26.5 feet. Backfilled with cement grout.			

GT-2 (8/01)

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project Pleasanton, California	**Log of Boring No. B-8**
BORING LOCATION: See Site Plan, Figure 2	ELEVATION AND DATUM: ~336 ft (MSL)
DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.	DATE STARTED: 9/8/2004 DATE FINISHED: 9/9/2004
DRILLING EQUIPMENT: Mobil B-53	TOTAL DEPTH (feet): 26.5 MEASURING POINT: Ground Surface
DRILLING METHOD: 6-inch Hollow-Stem Auger	DEPTH TO FREE WATER FIRST ENCOUNTERED: Not Encountered
SAMPLING METHOD: See Boring Log Explanation, Figure A-1	DEPTH TO FREE WATER AT COMPLETION: Not Encountered
HAMMER WEIGHT: 140 lbs HAMMER DROP: 30 in	LOGGED BY: T. Welch

DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
	Sample No.	Sample	Blows/ foot		Moisture Content (%)	Dry Density (pcf)	Other
1				SANDY CLAY with GRAVEL (CL) Stiff, very dark gray (7.5YR 3/1), moist, mottled, medium plasticity, angular rock fragments less than half an inch [FILL]			
2							
3	1	☒	15	CLAY (CL) Medium stiff to stiff, dark grayish brown (10YR 4/2) mottled with dark yellowish brown (10YR 4/6), moist, medium to high plasticity	14	114	
4							
5							
6	2	☒	9	zone of SILTY CLAY (CL), contains fine subrounded gravels in coarse grained sand	22	102	PP=2.3
7							
8							
9							
10							
11	3	☒	10	CLAY (CH) Medium stiff to stiff, very dark gray (10YR 3/1) and brown (10YR 4/3), moist, high plasticity, slightly vesicular	31	90	TV=0.8 PP=2.0
12							
13							
14							
15							
16	4	☒	13	shiny surfaces, not planar, randomly oriented, discontinuous			TV=0.8 PP=2.0 Sieve LL=70 PI=43 <200=99% UU=1990 (2160)
17							

GT-1 (12/03)

GEES-SOIL 12/03 GINTSOIL_LOGS.GPJ GES32003-7.GDT 5/24/05

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project
Pleasanton, California

Log of Boring No. B-8 cont.

DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS Moisture Content (%)	Dry Density (pcf)	Other
18				CLAY (CH) Continued			
19							
20							
21	5	☒	15	becomes gray (10YR 6/1) mottled with yellowish brown (10YR 5/6) and locally speckled very dark grayish brown (10YR 3/2)	25	99	TV=0.9 PP=2.5 DS
22							
23							
24							
25				becomes grayish brown (10YR 5/2), slightly vesicular			
26	6	☒	15		27	98	TV=0.6 PP=2.5
				Borehole terminated at 26.5 feet. Borehole left open for 24 hours to allow water to enter hole. No free water observed after 24 hours. Backfilled with cement grout.			

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project
Pleasanton, California

Log of Boring No. B-9

BORING LOCATION: See Site Plan, Figure 2	ELEVATION AND DATUM: ~339 ft (MSL)
DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.	DATE STARTED: 9/8/2004 — DATE FINISHED: 9/9/2004
DRILLING EQUIPMENT: Mobil B-53	TOTAL DEPTH (feet): 26.5 — MEASURING POINT: Ground Surface
DRILLING METHOD: 6-inch Hollow-Stem Auger	DEPTH TO FREE WATER FIRST ENCOUNTERED: Not Encountered
SAMPLING METHOD: See Boring Log Explanation, Figure A-1	DEPTH TO FREE WATER AT COMPLETION: Not Encountered
HAMMER WEIGHT: 140 lbs — HAMMER DROP: 30 in	LOGGED BY: T. Welch

DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
	Sample No.	Sample	Blows/ foot		Moisture Content (%)	Dry Density (pcf)	Other
0				SAND with SILT and GRAVEL (SP-SM) Medium dense, brown (10YR 5/3), dry, cemented			
1							
2							
3	1	☒	38		2	111	<200=6%
4				SILTY SAND with GRAVEL (SM) Loose to medium dense, dark gray to brown (10YR 4/1 to 4/3), moist, contains rootlets, contains possible interbeds of clayey sand			
5							
6	2	☒	12				<200=33%
6				SANDY CLAY (CL) Stiff, yellowish brown (10YR 5/4), moist, contains occasional interbedded layers of coarser-grained sediments and varying amounts of fine-grained sands			
7							
8							
9							
10							
11	3	☒	12	Medium dense, CLAYEY SAND changing to SILTY SAND (SP-SM), moist, medium plasticity fines, slightly vesicular	11	95	
12							
13							
14							
15							
16	4	☒	15	becomes stiff, grayish brown and yellowish brown (10YR 5/2 & 5/6), mottled, moist, medium to high plasticity, fine rootlets, local FeO_2 staining	27	94	TV=0.6 PP=3.0 UU=3200 (2160)
17							

GEES-SOIL 12/03 GINTSOIL_LOGS.GPJ GES32003-7.GDT 5/24/05

GT-1 (12/03)

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project

Pleasanton, California

Log of Boring No. B-9 cont.

DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
	Sample No.	Sample	Blows/ foot		Moisture Content (%)	Dry Density (pcf)	Other
18				CLAY (CL) Continued			
19							
20							
21	5	☒	19	becomes dark gray (7.5YR 4/1) with yellowish brown (10YR 5/4) clay infilled fracture along root, fine rootlets, red-brown FeO_2 staining, medium to high plasticity shiny surfaces, discontinuous, not planar, randomly oriented	28	96	TV=0.8 PP=3.0
22							
23							
24							
25							
26	6	☒	14	becomes gray (10YR 5/1) mottled with yellowish brown (10YR 5/4), fine rootlets			TV=0.6 PP=2.5
				Borehole terminated at 26.5 feet. Backfilled with cement grout.			

GT-2 (8/01)

PROJECT: Zone 7 Water Agency - Groundwater Demineralization Project
Pleasanton, California

Log of Boring No. B-10

BORING LOCATION: See Site Plan, Figure 2

ELEVATION AND DATUM: ~339 ft (MSL)

DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.

DATE STARTED: 9/8/2004

DATE FINISHED: 9/8/2004

DRILLING EQUIPMENT: Mobil B-53

TOTAL DEPTH (feet): 16.5

MEASURING POINT: Ground Surface

DRILLING METHOD: 6-inch Hollow-Stem Auger

DEPTH TO FREE WATER FIRST ENCOUNTERED: Not Encountered

SAMPLING METHOD: See Boring Log Explanation, Figure A-1

DEPTH TO FREE WATER AT COMPLETION: Not Encountered

HAMMER WEIGHT: 140 lbs

HAMMER DROP: 30 in

LOGGED BY: T. Welch

DEPTH (feet)	SAMPLES			MATERIAL DESCRIPTION	LABORATORY TESTS		
	Sample No.	Sample	Blows/ foot		Moisture Content (%)	Dry Density (pcf)	Other
				SANDY CLAY with GRAVEL (CL) Brown (10YR 4/3) to yellowish brown (10YR 3/6), dry, low plasticity [FILL]			
1				SANDY CLAY (CL) Stiff, black (10YR 3/1) mottled with dark gray (10YR 4/1) and dark reddish brown (5YR 3/3), moist, medium plasticity [FILL]			
2							
3	1	☒	14		20	109	TV=0.9 PP=2.7 <200=77%
4				SANDY CLAY (CL) Medium stiff, dark grayish brown (10YR 4/2), moist, low plasticity, contains lenses of SILTY SAND			
5				zone of SILTY SAND (SM)			
6	2	☒	7		16	111	PP=3.5 UU=1640 (720)
7							
8							
9				CLAY (CL) Stiff, mottled gray (10YR 5/1) and dark yellowish brown (10YR 4/6), moist, medium plasticity			
10							
11	3	☒	13		28	95	TV=0.8 PP=2.8
12							
13							
14							
15				becomes mottled dark gray (10YR 4/1), moist, medium to high plasticity, mottled			
16	4	☒	17		27	98	TV=0.9 PP=3.0
17				Borehole terminated at 16.5 feet. Backfilled with cement grout.			

App. B

APPENDIX B

APPENDIX B

GEOTECHNICAL LABORATORY TESTING

Zone 7 Water Agency – Groundwater Demineralization Project
Pleasanton, California

Laboratory tests were performed on selected samples of soil to assess their engineering properties and physical characteristics. The following tests were performed by Cooper Testing Laboratory in Mountain View, California:

- moisture content, unit weight, and dry density
- Atterberg limits (liquid and plastic limits)
- grain size distribution
- percentage by weight passing the No. 200 sieve
- compaction
- R-value
- direct shear test
- unconsolidated-undrained triaxial strength
- consolidation

Test procedures for the soil tests performed are described herein. Results are summarized on the boring in Appendix A or in tables and figures presented at the end of this appendix (Figures B-1 through B-13).

MOISTURE CONTENT, UNIT WEIGHT, AND DRY DENSITY

Moisture content, unit weight, and dry density were determined for representative samples recovered from the borings. These tests were conducted in general accordance with ASTM Test Method D 2216. Results of moisture content and dry density tests are presented at the corresponding sample locations on the boring logs (Figures A-3 through A-12).

ATTERBERG LIMITS

Tests were performed to measure the Atterberg limits (liquid limit and plastic limit) of selected generally clayey soil samples recovered from the borings to evaluate their plasticity and aid in their classification. The tests were conducted in general accordance with ASTM Test Method D 4318. The liquid and plastic limits are summarized on a plasticity classification chart (Figure B-1) and are also presented at the corresponding sample locations on the boring logs (Figures A-3 through A-12).

GRAIN SIZE DISTRIBUTION

Grain size distribution tests were performed on soil samples to assist in their classification. Sieve analyses were performed in general accordance with ASTM Test Method D 422 on the portion of the sample retained in the No. 200 sieve. Graphic representations of the results are presented on Figures B-2 and B-3. The percentages by weight passing the No. 200 sieve are presented at the corresponding sample locations on the boring logs (Figures A-3 through A-12).

PERCENTAGE BY WEIGHT PASSING THE NO. 200 SIEVE

The percentage by weight passing the No. 200 sieve was measured for selected soil samples in general accordance with ASTM Test Method D 1140. The percentages by weight passing the No. 200 sieve are presented at the corresponding sample locations on the boring logs (Figures A-3 through A-12).

COMPACTION

A compaction test was performed on a bulk sample obtained from the upper 5 feet of boring B-2. The purpose of the test was to assess the compaction characteristics of potential backfill materials and the densities at which the materials likely will be placed during construction. The test was performed in accordance with ASTM Test Method D 1557. Test results are presented on Figure B-4.

R-VALUE

A resistance value (R-value) test was performed on a bulk sample obtained from the upper 2 feet of boring B-5. The test was performed in accordance the State of California Department of Transportation test Method 301. The results of the R-value test are presented on Figure B-5.

DIRECT SHEAR

Direct shear tests were performed on two samples in general accordance with ASTM Method D 3080, except that the samples were sheared under undrained conditions. Results of the direct shear tests are presented on Figures B-6 and B-7. The water content and dry density for the samples are presented at the corresponding sample locations on the boring logs (Figure A-3 through A-12).

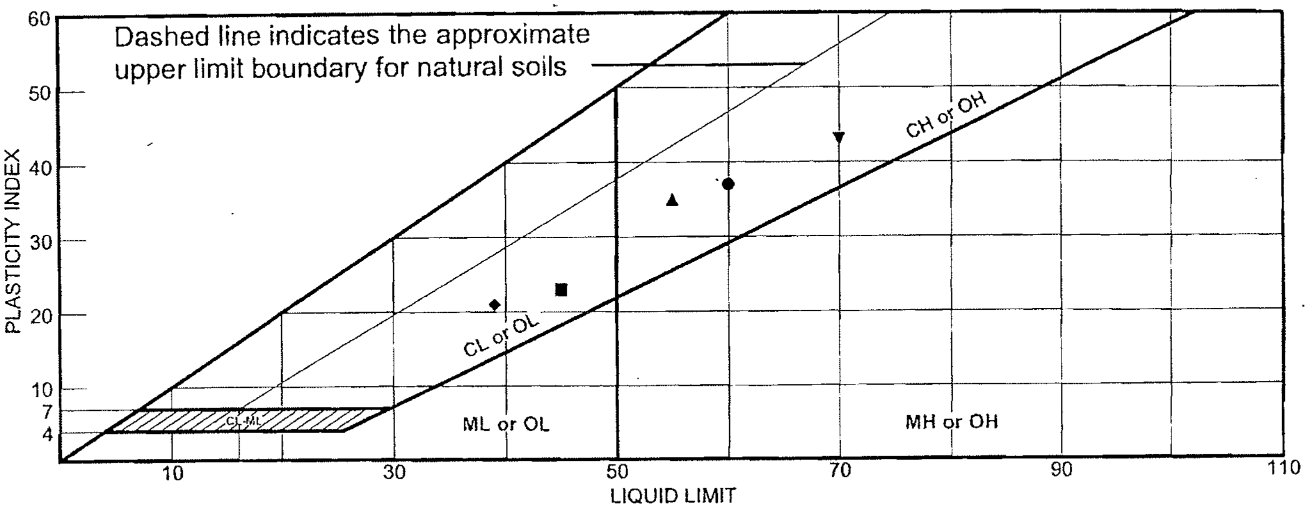
UNCONSOLIDATED-UNDRAINED TRIAXIAL STRENGTH

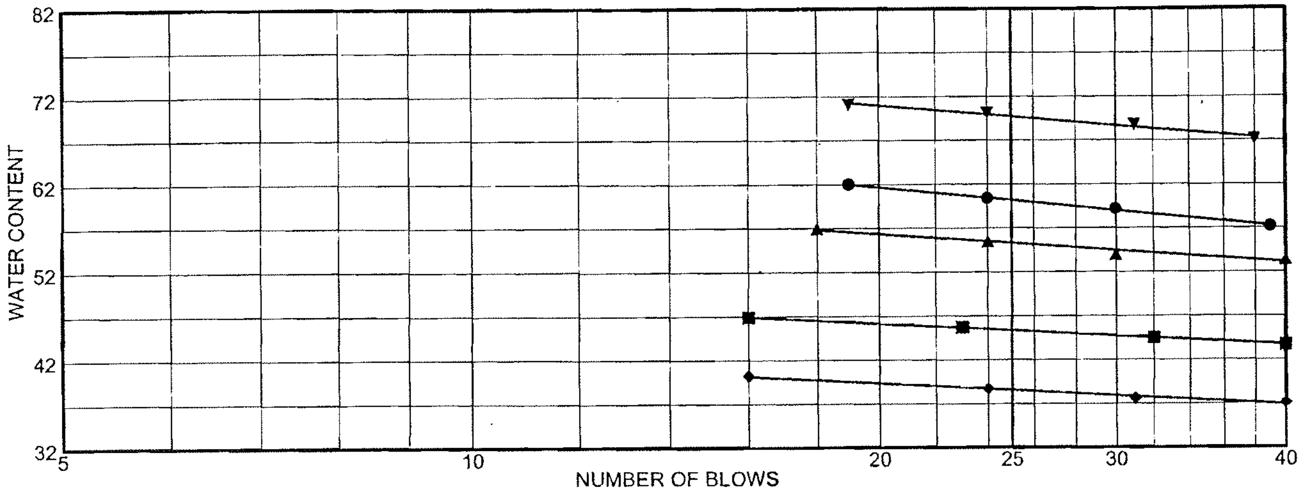
Unconsolidated, undrained triaxial tests were conducted on nine samples of clayey soil to evaluate their strength and behavior under undrained loading conditions. The procedure employed was in general accordance with ASTM Test Method D 2850. Graphic representations of the test results are presented on Figures B-8 and B-11. The undrained shear strength for each triaxial test is summarized at the corresponding sample location on the boring logs (Figures A-2 through A-7).

CONSOLIDATION

Consolidation tests were performed on two samples of clayey soils to develop parameters for use in settlement analysis. The procedure employed was in general accordance with ASTM Test Method D 2435. The results of these tests are presented on Figures B-12 and B-13.

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark Gray Fat CLAY	60	23	37			
■	Gray Lean CLAY with Sand	45	22	23	90.3	83.9	CL
▲	Gray Fat CLAY	55	20	35			
◆	Brown Clayey SAND with Gravel	39	18	21	60.0	49.9	SC
▼	Dark Gray Fat CLAY	70	27	43	99.8	99.4	CH

Project No. 109-410 **Client:** Geomatrix Consultants

Project: Zone 7 Water Agency - Groundwater Demineralization - 8453.000

● **Source:** B-1 **Sample No.:** 5-4 **Elev./Depth:** 20'
■ **Source:** B-2 **Sample No.:** Bulk **Elev./Depth:** 0-5'
▲ **Source:** B-2 **Sample No.:** 2-4 **Elev./Depth:** 5'
◆ **Source:** B-5 **Sample No.:** Bulk **Elev./Depth:** 0-2'
▼ **Source:** B-8 **Sample No.:** 4-4 **Elev./Depth:** 15'

Remarks:
●
■
▲
◆
▼

LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure B-1

L:\Project\8000s\8453\Laboratory&gINT\CooperLab-TestResult_fig_B1.ai

PARTICLE SIZE DISTRIBUTION TEST REPORT

	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		4.3	11.8			CL		22	45
□		24.3	25.8			SC		18	39

SIEVE inches size	PERCENT FINER ○	PERCENT FINER □	
1.5		100.0	
1		98.8	
3/4	100.0	96.8	
3/8	99.4	90.7	
	GRAIN SIZE		
D_{60}		0.425	
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	PERCENT FINER □	
#4	95.7	75.7	
#10	92.8	67.4	
#30	90.8	61.5	
#40	90.3	60.0	
#50	89.7	58.3	
#100	87.4	54.3	
#200	83.9	49.9	

SOIL DESCRIPTION

○ Gray Lean CLAY with Sand

□ Brown Clayey SAND with Gravel

REMARKS:

○

□

○ Source: B-2 Sample No.: Bulk Elev./Depth: 0-5'

□ Source: B-5 Sample No.: Bulk Elev./Depth: 0-2'

COOPER TESTING LABORATORY

Client: Geomatrix Consultants

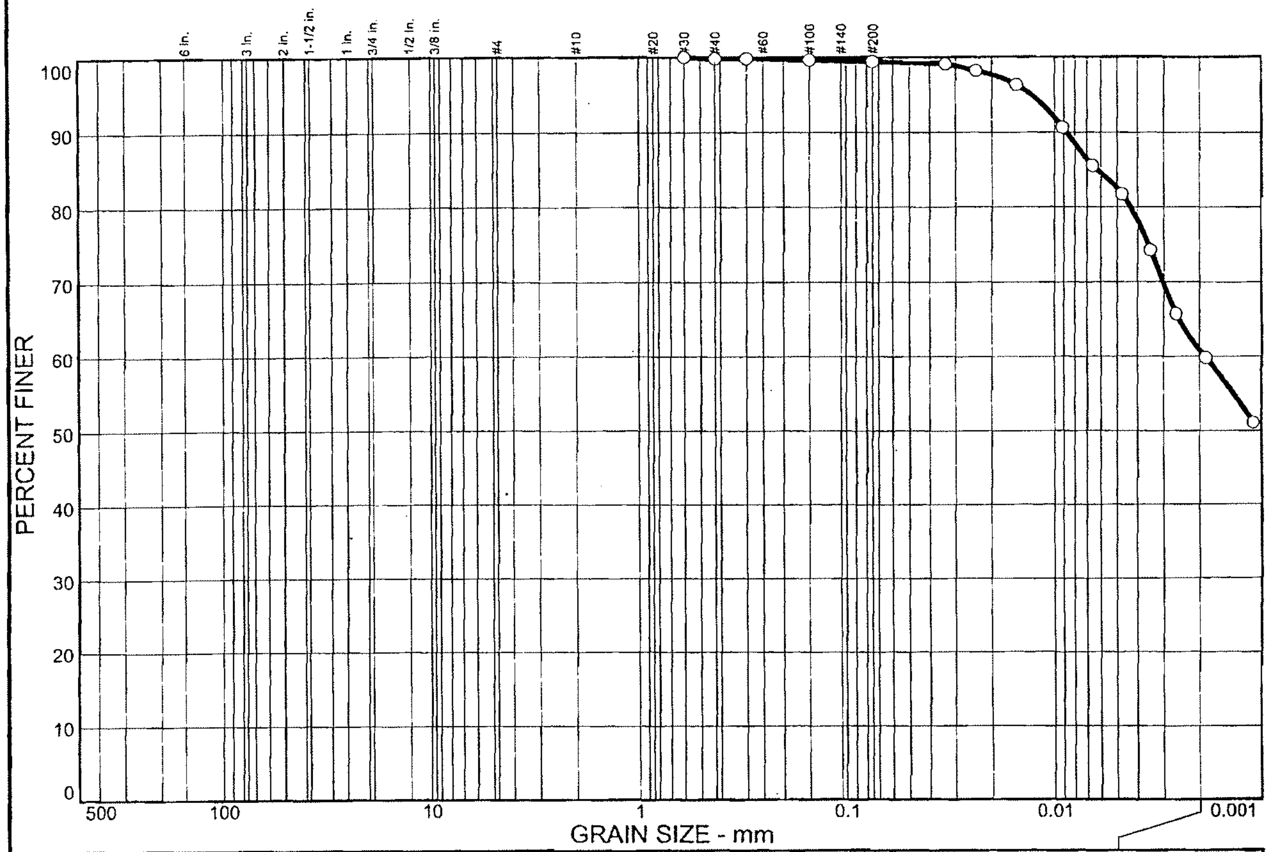
Project: Zone 7 Water Agency - Groundwater Demineralization - 8453.000

Project No.: 109-410

Figure B-2

L:\Project\8000s\8453\Laboratory&gINT\CooperLab-TestResult_fig_B2.ai

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.2	0.4	38.6	60.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#30	100.0		
#40	99.8		
#50	99.8		
#100	99.6		
#200	99.4		
0.0336 mm.	99.1		
0.0239 mm.	98.2		
0.0153 mm.	96.3		
0.0091 mm.	90.6		
0.0066 mm.	85.5		
0.0047 mm.	81.7		
0.0035 mm.	74.2		
0.0026 mm.	65.7		
0.0019 mm.	59.8		
0.0011 mm.	51.1		

* (no specification provided)

Soil Description

Dark Gray Fat CLAY

Atterberg Limits

PL= 27 LL= 70 PI= 43

Coefficients

D_{85}= 0.0063 D_{60}= 0.0019 D_{50}=

D_{30}= D_{15}= D_{10}=

C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

Sample No.: 4-4 **Source of Sample:** B-8 **Date:** 9/28/04

Location: **Elev./Depth:** 15'

COOPER TESTING LABORATORY

Client: Geomatrix Consultants

Project: Zone 7 Water Agency - Groundwater Demineralization - 8453.000

Project No: 109-410

Figure B-3

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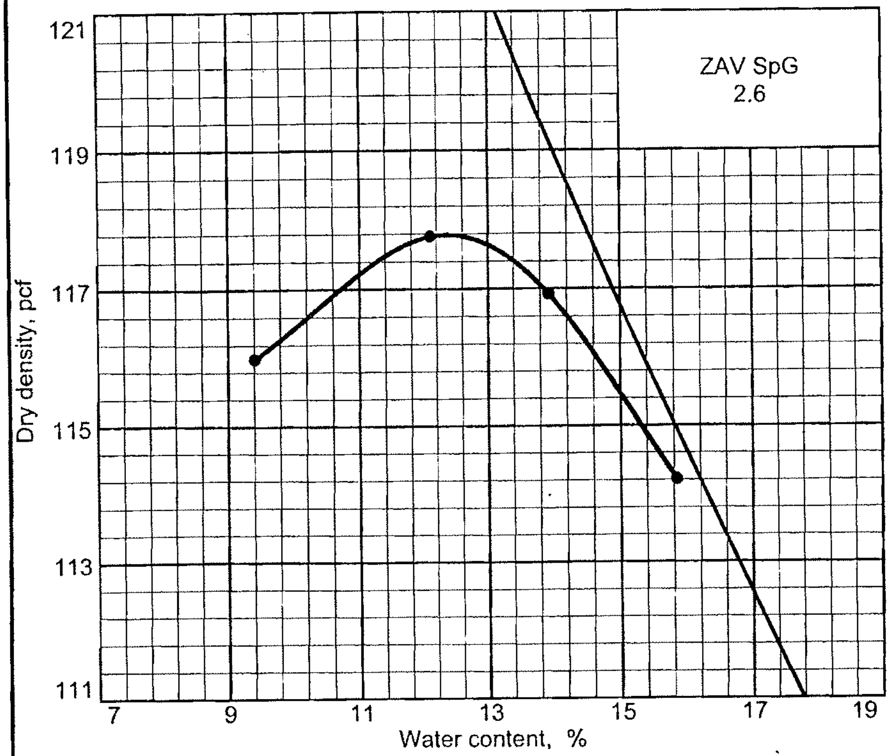
COMPACTION TEST REPORT



Curve No.

Test Specification:
ASTM D 1557-00 Method B Modified

Hammer Wt.: 10 lb.
Hammer Drop: 18 in.
Number of Layers: five
Blows per Layer: 25
Mold Size: .03333 cu.ft.
Test Performed on Material Passing 3/8 in. **Sieve**

Soil Data

NM		**Sp.G.**	2.7
LL	45	**PI**	23
%>3/8 in.		**%<#200**	83.9
USCS	CL	**AASHTO**	

TESTING DATA

	1	2	3	4	5	6
WM + WS	8.86	8.90	8.69	8.87		
WM	4.46	4.46	4.46	4.46		
WW + T #1	475.30	572.40	464.60	669.50		
WD + T #1	434.60	514.20	432.90	598.80		
TARE #1	98.30	96.40	96.10	152.70		
WW + T #2						
WD + T #2						
TARE #2						
MOISTURE	12.1	13.9	9.4	15.8		
DRY DENSITY	117.8	116.9	116.0	114.2		

TEST RESULTS

Maximum dry density = 117.8 pcf

Optimum moisture = 12.4 %

Material Description

Gray Lean CLAY with Sand

Remarks:

Project No. 109-410 **Client:** Geomatrix Consultants
Project: Zone 7 Water Agency - Groundwater Demineralization - 8453.000

● **Source:** B-2 **Sample No.:** Bulk **Elev./Depth:** 0-5'

COMPACTION TEST REPORT

COOPER TESTING LABORATORY

Figure B-4

L:\Project\8000s\8453\Laboratory&gINT\CooperLab-TestResult_fig_B4.ai

R-value Test Report (Caltrans 301)

Job No.: 109-410
Client: Geomatrix Consultants
Project: Zone 7 Water Agency - GW Demineralization
Sample B-5 Bulk @ 0 - 2'
Soil Type: Brown Clayey SAND with Gravel

Date: 09/27/04
Tested MD
Reduced MJ
Checked DC

Initial Moisture, 9.6%
R-value 17
Expansion Pressure 60 psf

Remarks:

Specimen Number	A	B	C	D
Exudation Pressure, psi	224	794	438	
Prepared Weight, grams	1200	1200	1200	
Final Water Added, grams/cc	75	25	50	
Weight of Soil & Mold, grams	3253	3257	3227	
Weight of Mold, grams	2123	2090	2089	
Height After Compaction, in.	2.58	2.51	2.5	
Moisture Content, %	16.4	11.9	14.1	
Dry Density, pcf	113.9	125.9	120.8	
Expansion Pressure, psf	55.9	395.6	103.2	
Stabilometer @ 1000				
Stabilometer @ 2000	132	85	114	
Turns Displacement	3.68	2.89	3.13	
R-value	14	43	24	

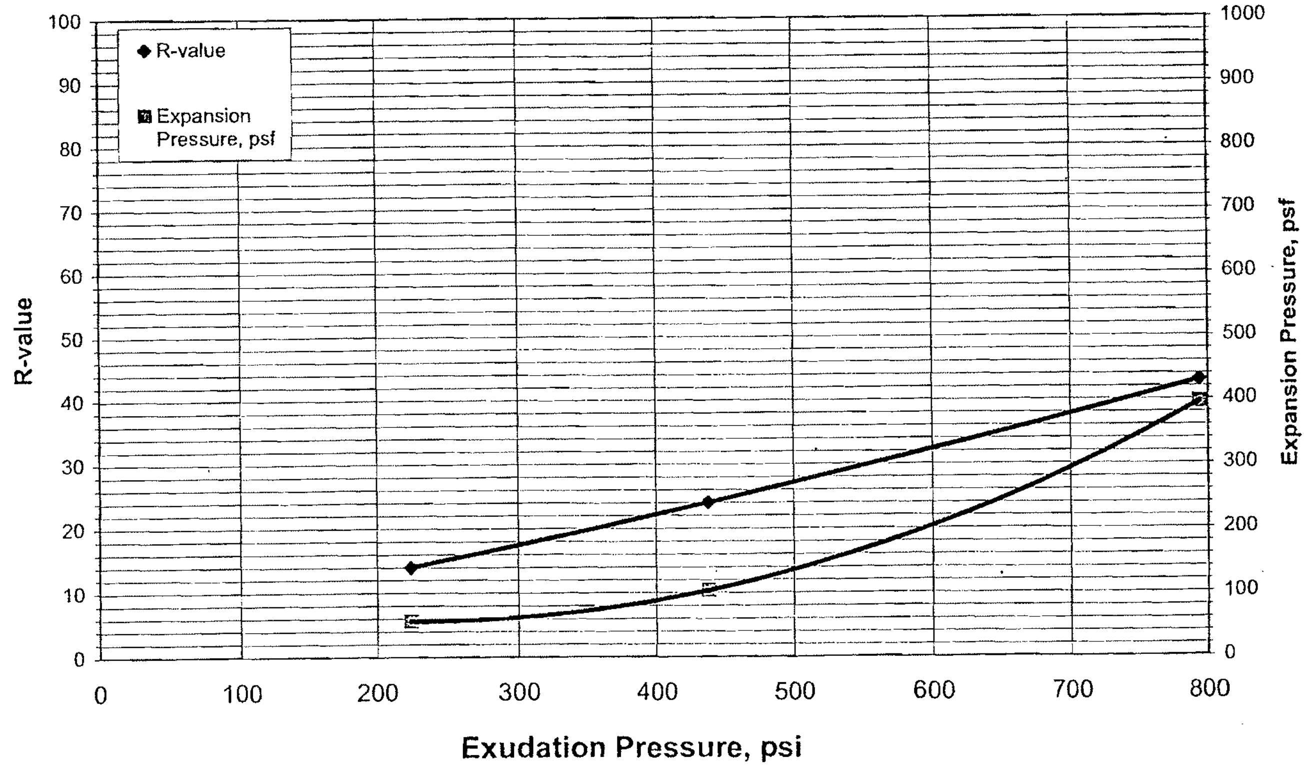
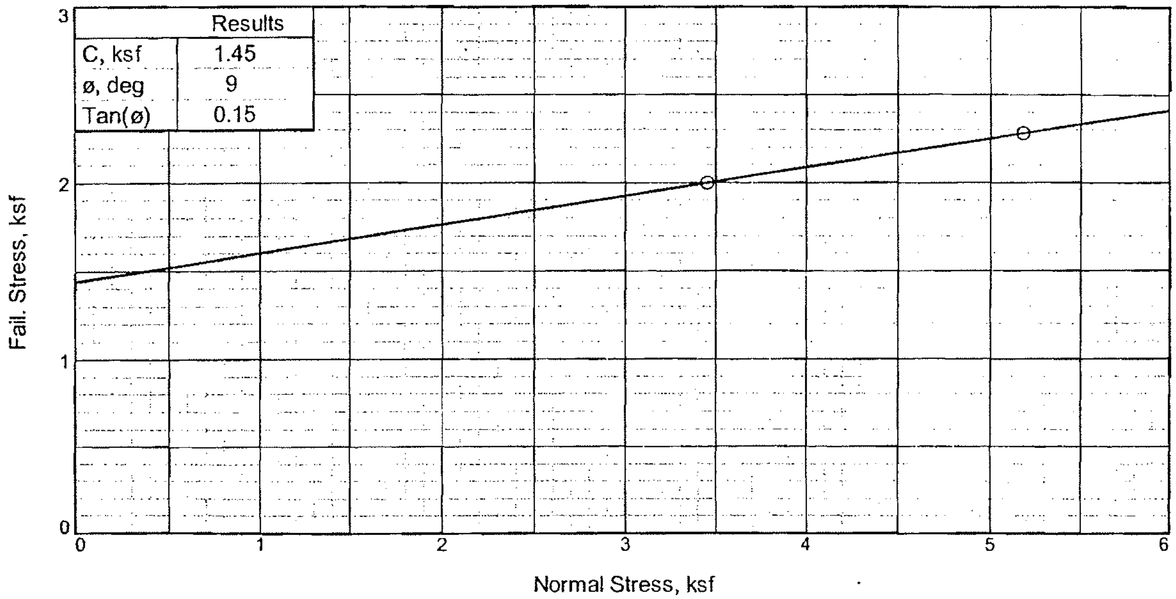
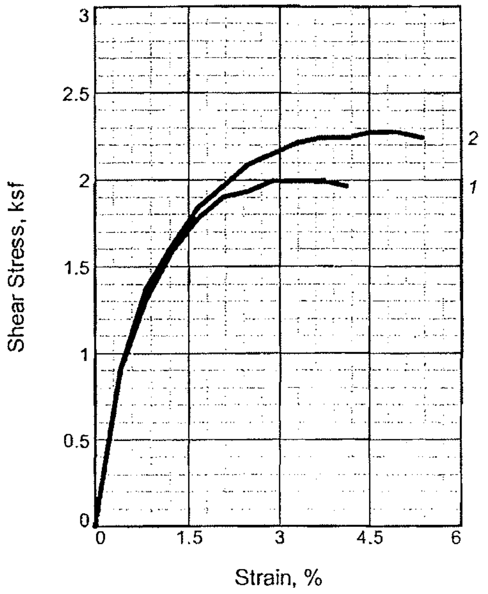


Figure B-5

roject\8000s\8453\Laboratory&gINT\CooperLab-TestResult_fig_B5.ai



Results	
C, ksf	1.45
ø, deg	9
Tan(ø)	0.15



	Sample No.	1	2
Initial	Water Content, %	25.5	24.4
	Dry Density, pcf	99.0	100.1
	Saturation, %	93.2	91.6
	Void Ratio	0.7660	0.7458
	Diameter, in.	2.42	2.42
	Height, in.	1.01	1.01
At Test	Water Content, %	25.0	23.5
	Dry Density, pcf	101.9	105.2
	Saturation, %	97.8	99.3
	Void Ratio	0.7155	0.6623
	Diameter, in.	2.42	2.42
	Height, in.	0.98	0.96
	Normal Stress, ksf	3.46	5.18
	Fail. Stress, ksf	2.00	2.28
	Strain, %	2.9	4.5
	Ult. Stress, ksf		
	Strain, %		
	Strain rate, %/min.	1.00	1.00

Sample Type: Undisturbed
Description: Greeish Gray SILT / Silty CLAY

LL= **PL=** **PI=**
Assumed Specific Gravity= 2.8
Remarks: *DS-CU* A fully undrained condition may not be attained in this test.

Figure _______

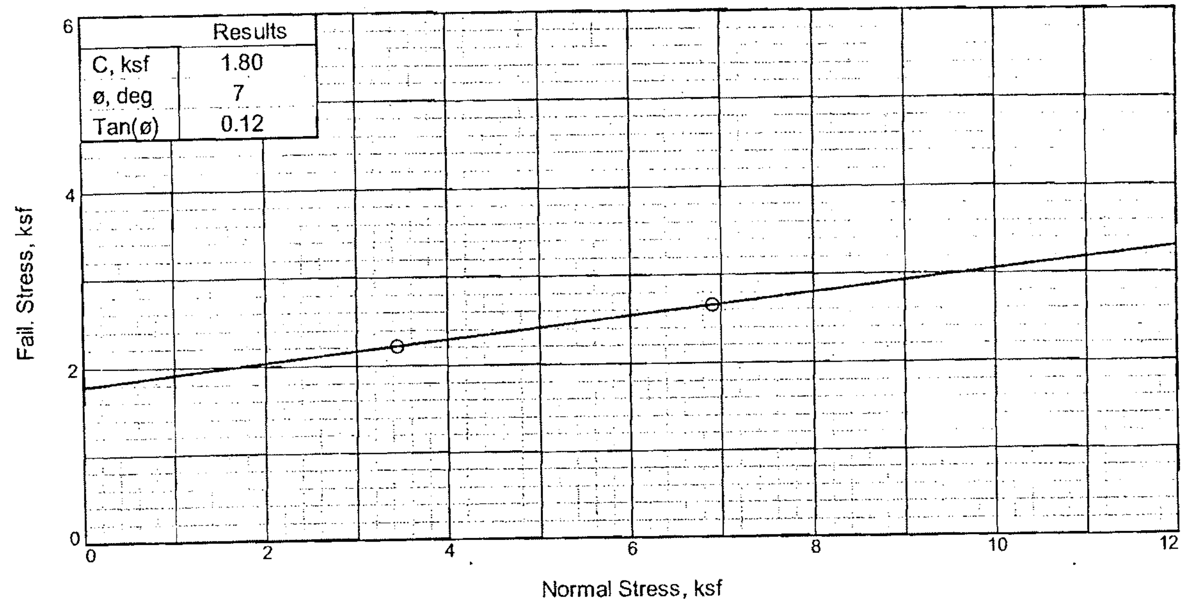
Client: Geomatrix Consultants

Project: Zone 7 Water Agency - Groundwater Demineralization - 8453.000
Source of Sample: B-6 **Depth:** 20'
Sample Number: 5-3
Proj. No.: 109-410 **Date:** 9/28/04

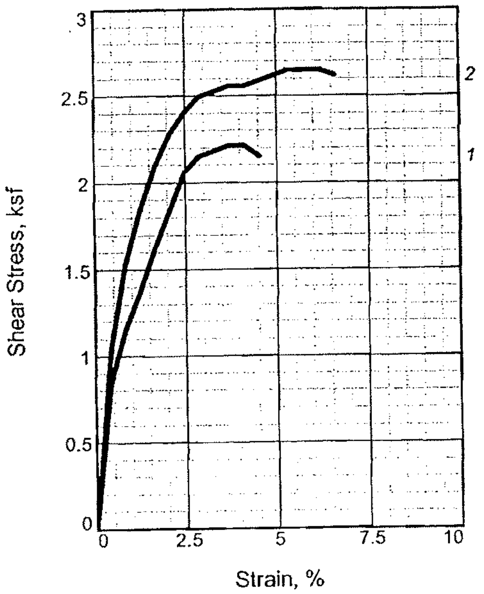
DIRECT SHEAR TEST REPORT

COOPER TESTING LABORATORY

Tested By: MD **Checked By:** PJ **Figure B-6**



Results	
C, ksf	1.80
ø, deg	7
Tan(ø)	0.12



	Sample No.	1	2
Initial	Water Content, %	25.1	24.5
	Dry Density, pcf	98.8	98.0
	Saturation, %	91.5	87.7
	Void Ratio	0.7689	0.7834
	Diameter, in.	2.42	2.42
	Height, in.	1.01	1.02
At Test	Water Content, %	25.0	24.2
	Dry Density, pcf	102.1	103.8
	Saturation, %	98.4	99.1
	Void Ratio	0.7124	0.6842
	Diameter, in.	2.42	2.42
	Height, in.	0.98	0.97
	Normal Stress, ksf	3.46	6.91
	Fail. Stress, ksf	2.21	2.65
	Strain, %	3.7	5.4
	Ult. Stress, ksf		
	Strain, %		
	Strain rate, %/min.	1.00	1.00

Sample Type: Undisturbed
Description: Gray SILT / Silty CLAY

LL= **PL=** **PI=**
Assumed Specific Gravity= 2.8
Remarks: *DS-CU* A fully undrained condition may not be attained in this test.

Figure ________

Client: Geomatrix Consultants

Project: Zone 7 Water Agency - Groundwater Demineralization - 8453.000
Source of Sample: B-8 **Depth:** 20'
Sample Number: 5-3
Proj. No.: 109-410 **Date:** 9/28/04

DIRECT SHEAR TEST REPORT

COOPER TESTING LABORATORY

Tested By: MD **Checked By:** PJ

Figure B-7

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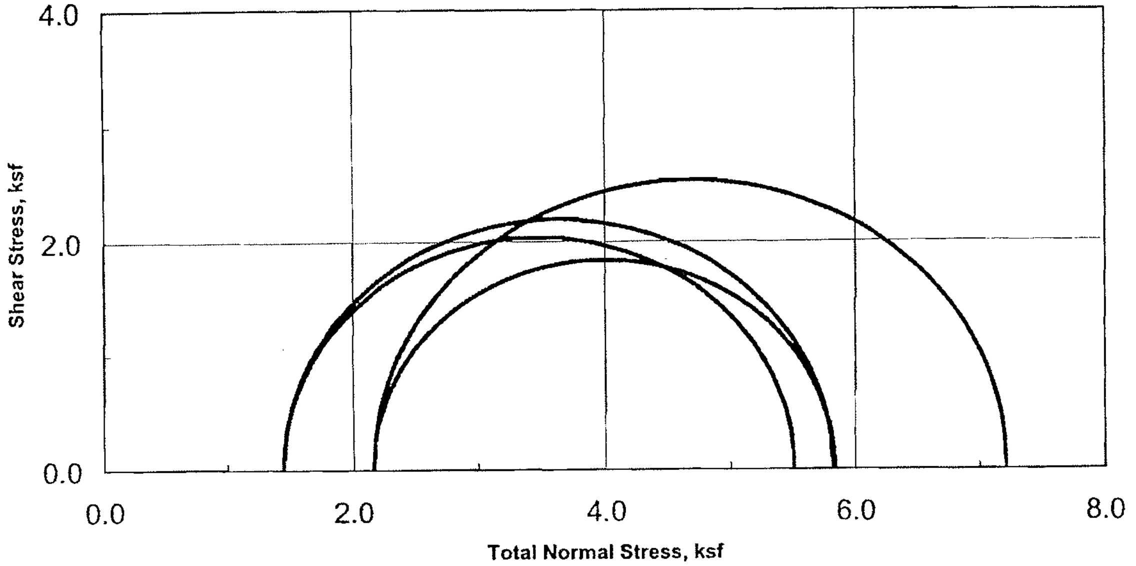
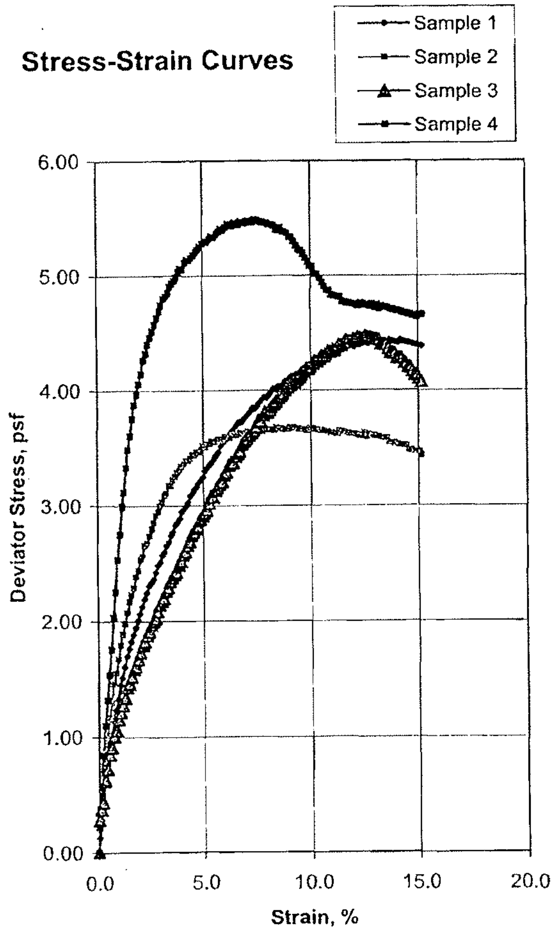
COOPER

Unconsolidated-Undrained Triaxial Test

ASTM D-2850





Sample Data	1	2	3	4
Moisture %	26.9	34.0	26.4	33.2
Density pcf	96.3	85.3	93.4	88.7
Void Ratio	0.751	0.975	0.805	0.899
Saturation %	96.9	94.3	88.7	99.6
Height in	5.00	5.00	5.00	5.00
Diameter in	2.40	2.40	2.41	2.41
Cell psi	10.0	15.0	10.0	15.0
Strain %	13.60	9.10	12.50	7.50
Deviator, ksf	4.437	3.676	4.473	5.492
Rate %/min	1.00	1.00	1.00	1.00
in/min	0.050	0.050	0.050	0.050

Job No.: **109-410a**

Client: **Geomatrix Consultants**

Project: **Zone 7 Water Agency - Groundwater Demineralization - 8453.000**

Boring:	B-1	B-1	B-2	B-6
Sample:	3-4	4-3	3-4	4-4
Depth ft:	10	15	10	15

Visual Soil Description

Sample #	
1	Light Brownish-Gray CLAY
2	Dark Gray CLAY
3	Brownish Gray CLAY
4	Dark Gray CLAY

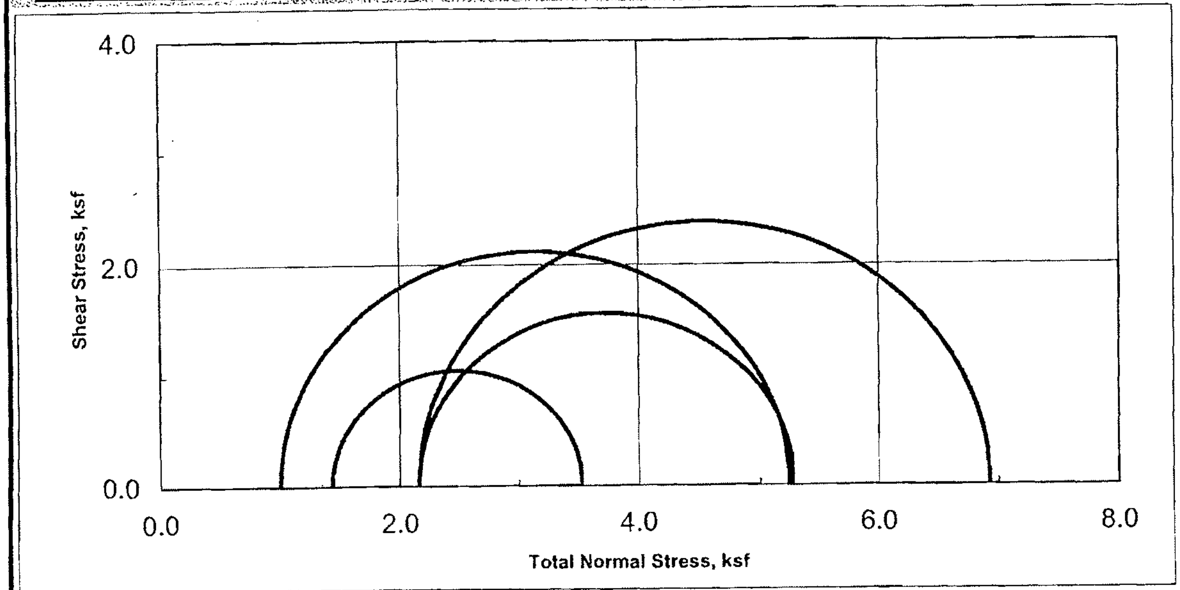
Remarks:

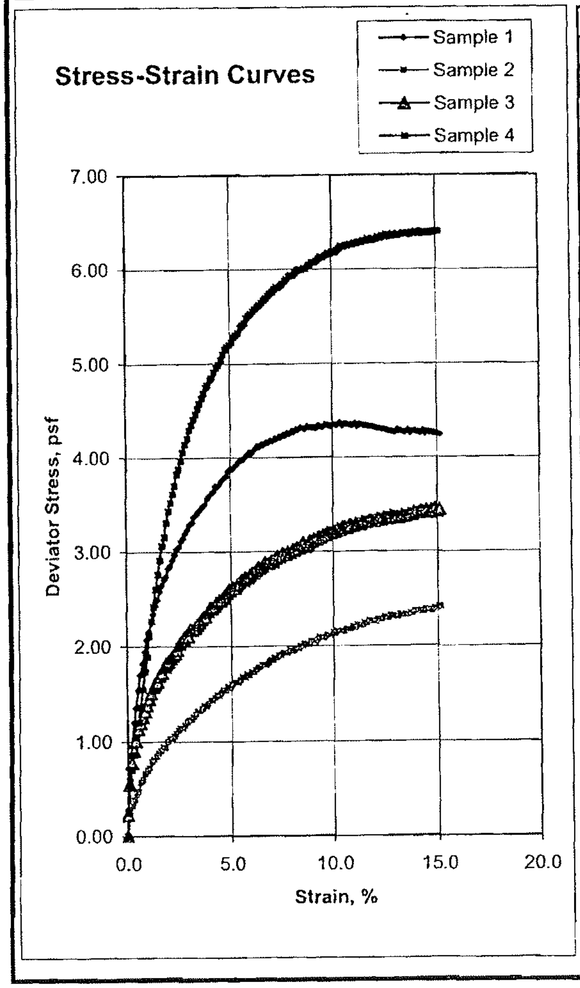
Figure B-8

COOPER

Unconsolidated-Undrained Triaxial Test

ASTM D-2850





Sample Data

	1	2	3	4
Moisture %	26.3	29.5	32.5	27.3
Density pcf	91.7	92.1	91.3	93.8
Void Ratio	0.839	0.831	0.915	0.796
Saturation %	84.8	96.0	99.4	92.5
Height in	5.00	5.00	5.00	5.00
Diameter in	2.41	2.41	2.38	2.40
Cell psi	7.0	10.0	15.0	15.0
Strain %	10.40	15.10	14.90	15.00
Deviator, ksf	4.367	2.416	3.453	6.409
Rate %/min	1.00	1.00	1.00	1.00
in/min	0.050	0.050	0.050	0.050

Job No.: **109-410b**

Client: **Geomatrix Consultants**

Project: **Zone 7 Water Agency - Groundwater Demineralization - 8453.000**

Boring:	B-7	B-7	B-7	B-9
Sample:	2-4	3-4	4	4-4
Depth ft:	5	10	15	15

Visual Soil Description

Sample #	
1	Dark Gray CLAY with Sand
2	Greenish Gray SILT / Silty CLAY
3	Gray grading to Reddish Brown CLAY (Silty)
4	Grayish Brown CLAY (Silty)

Remarks:

Figure B-9

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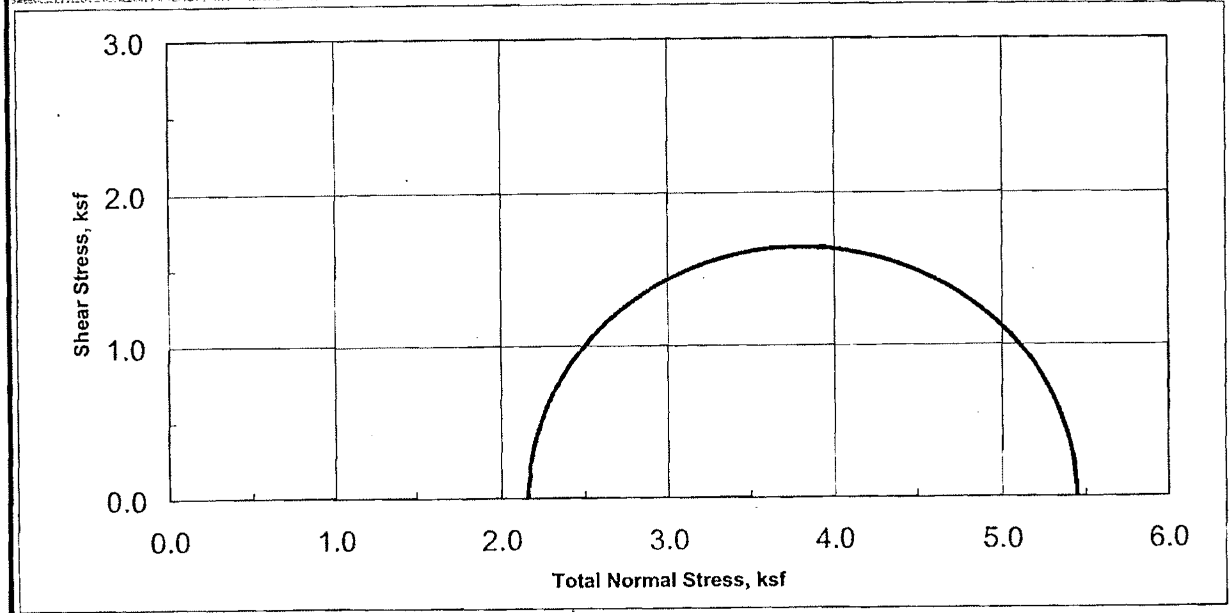
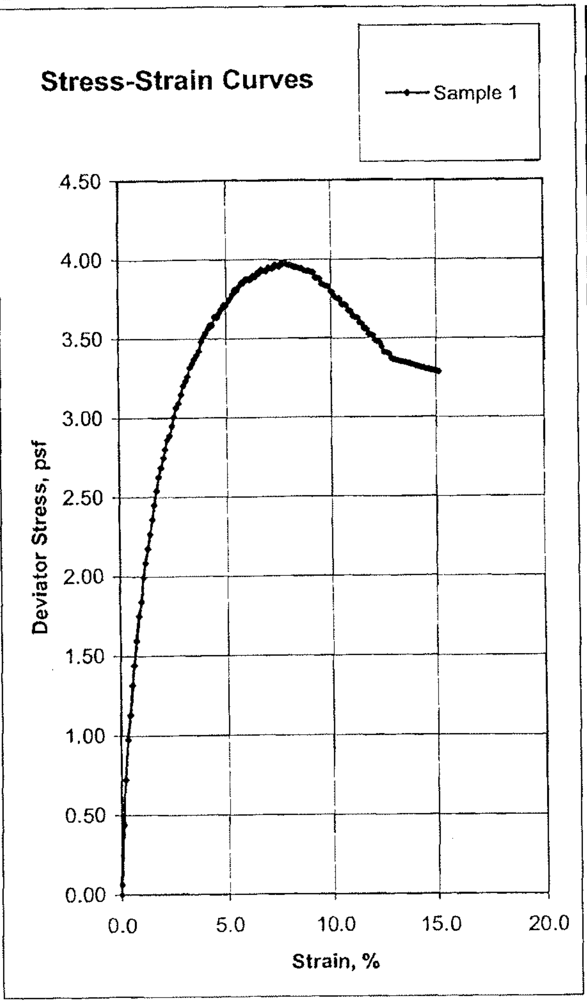
Unconsolidated-Undrained Triaxial Test

ASTM D-2850





Sample Data	1	2	3	4
Moisture %	30.2			
Density pcf	91.9			
Void Ratio	0.835			
Saturation %	97.6			
Height in	5.00			
Diameter in	2.41			
Cell psi	15.0			
Strain %	7.70			
Deviator, ksf	3.979			
Rate %/min	1.00			
in/min	0.050			

Job No.: 109-410d

Client: Geomatrix Consultants

Project: Zone 7 Water Agency - Groundwater Demineralization - 8453.000

Boring:	B-8			
Sample:	4-4			
Depth ft:	15			

Visual Soil Description

Sample #	
1	Dark Gray Fat CLAY
2	
3	
4	

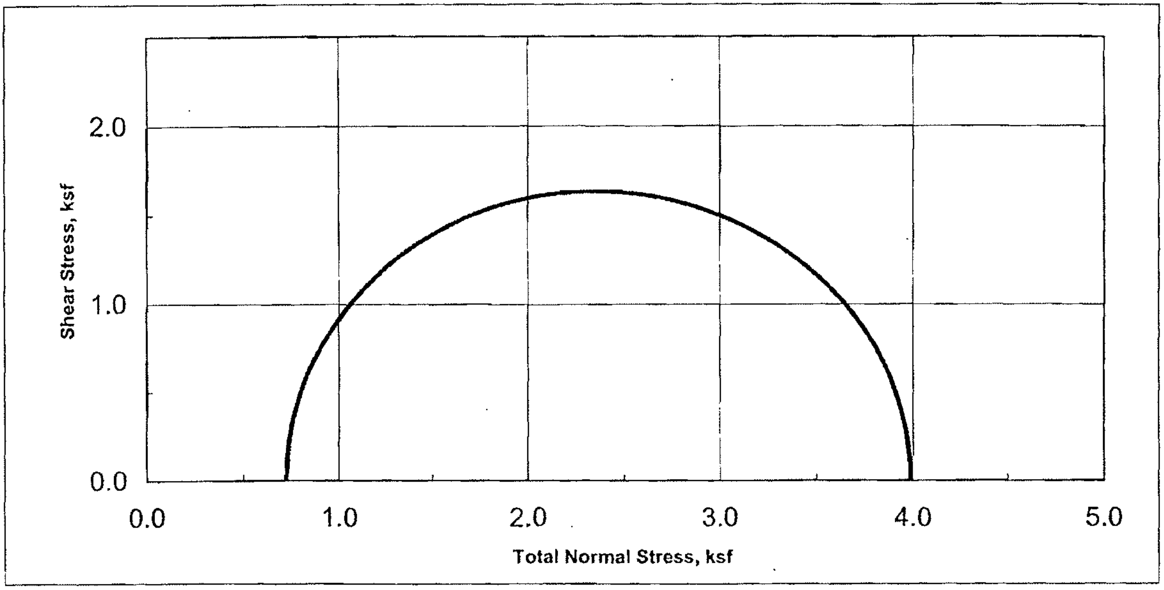
Remarks:

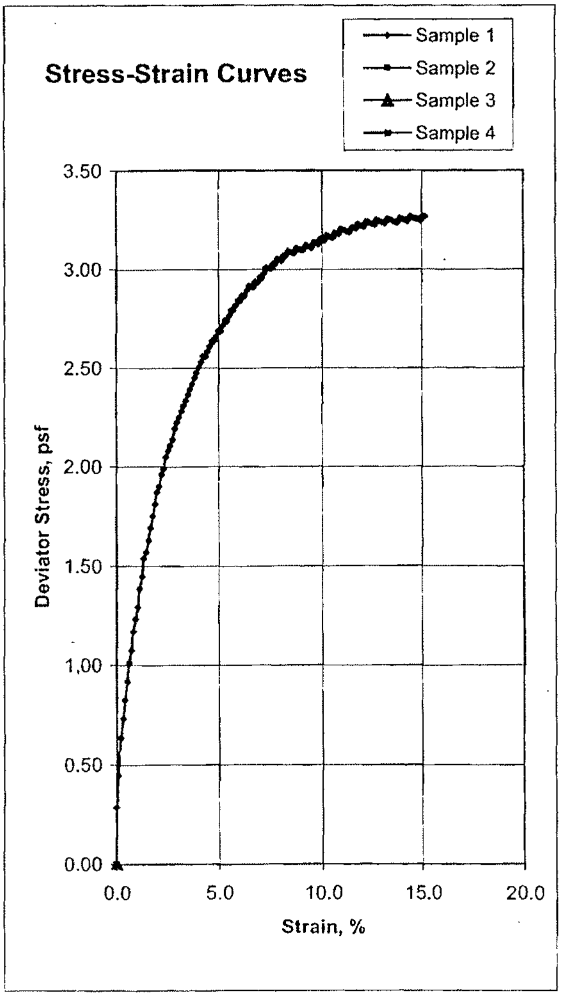
Figure B-10

L:\Project\8000s\8453\Laboratory&gINT\CooperLab-TestResult_fig_B10.ai

Unconsolidated-Undrained Triaxial Test

ASTM D-2850





Sample Data				
	1	2	3	4
Moisture %	16.4			
Density pcf	111.1			
Void Ratio	0.518			
Saturation %	85.8			
Height in	5.00			
Diameter in	2.40			
Cell psi	5.0			
Strain %	14.40			
Deviator, ksf	3.271			
Rate %/min	1.00			
in/min	0.050			

Job No.:	**109-410c**
Client:	**Geomatrix Consultants**
Project:	**Zone 7 Water Agency - Groundwater Demineralization - 8453.000**

Boring:	B-10			
Sample:	2-4			
Depth ft:	5			

Visual Soil Description	
Sample #	
1	Greenish Gray Silty CLAY grading to Silty SAND
2	
3	
4	

Remarks:

Figure B-11

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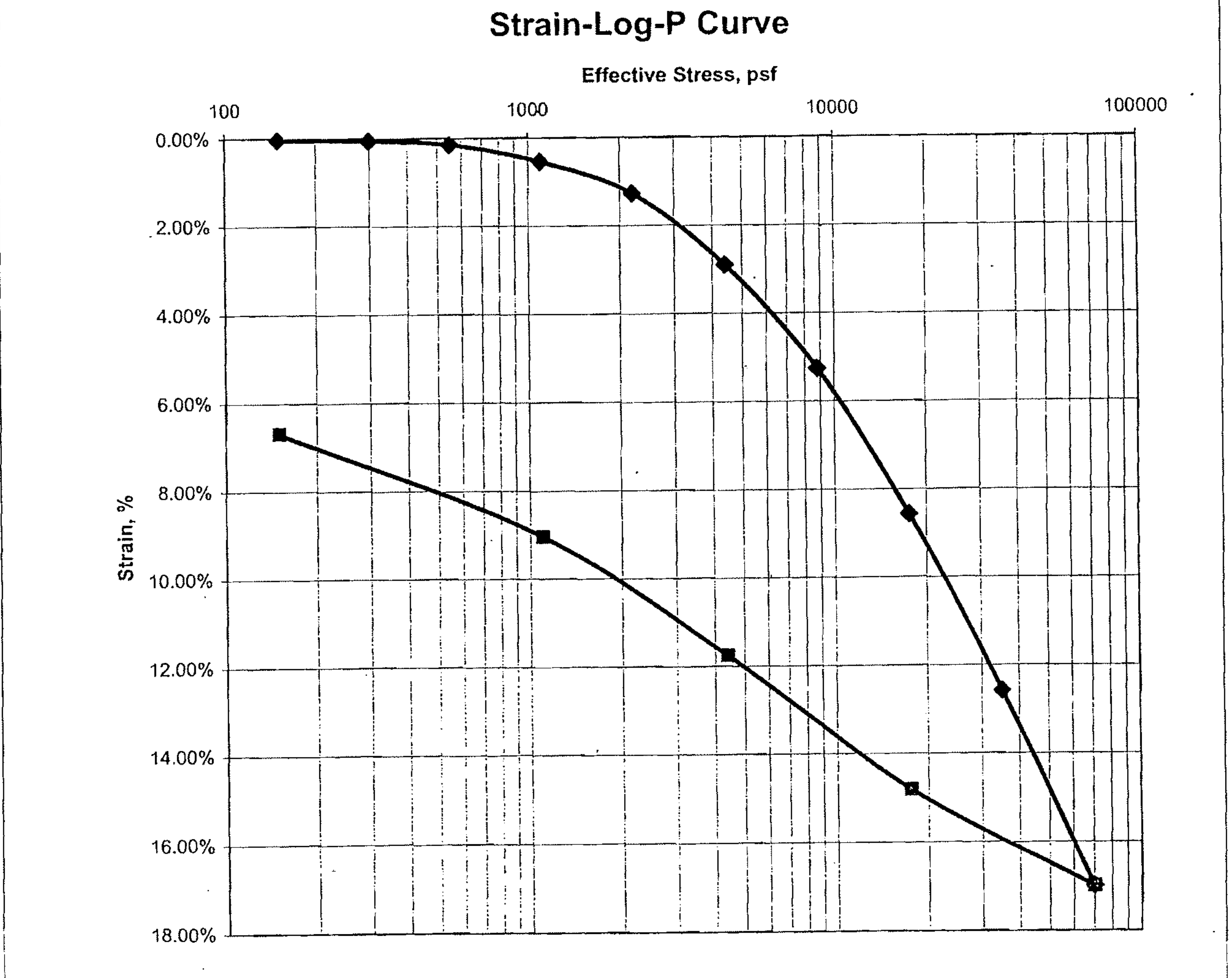
Consolidation Test

ASTM D2435

Job No.: 109-410a
Client: Geomatrix Consultants
Boring: B-1
Sample: 5-4
Run By: MD
Reduced: MJ

Project: Zone 7 Water Agency - Groundwater Demineralization - 8453.000
Depth, ft.: 20
Checked: PJ
Soil Type: Dark Gray CLAY, (Silty)
Date: 10/5/2004



Ass. Gs = 2.7	Initial	Final
Moisture %:	26.8	25.5
Density, pcf:	97.6	99.9
Void Ratio:	0.727	0.687
% Saturation:	99.5	100

Remarks:

Figure B-12

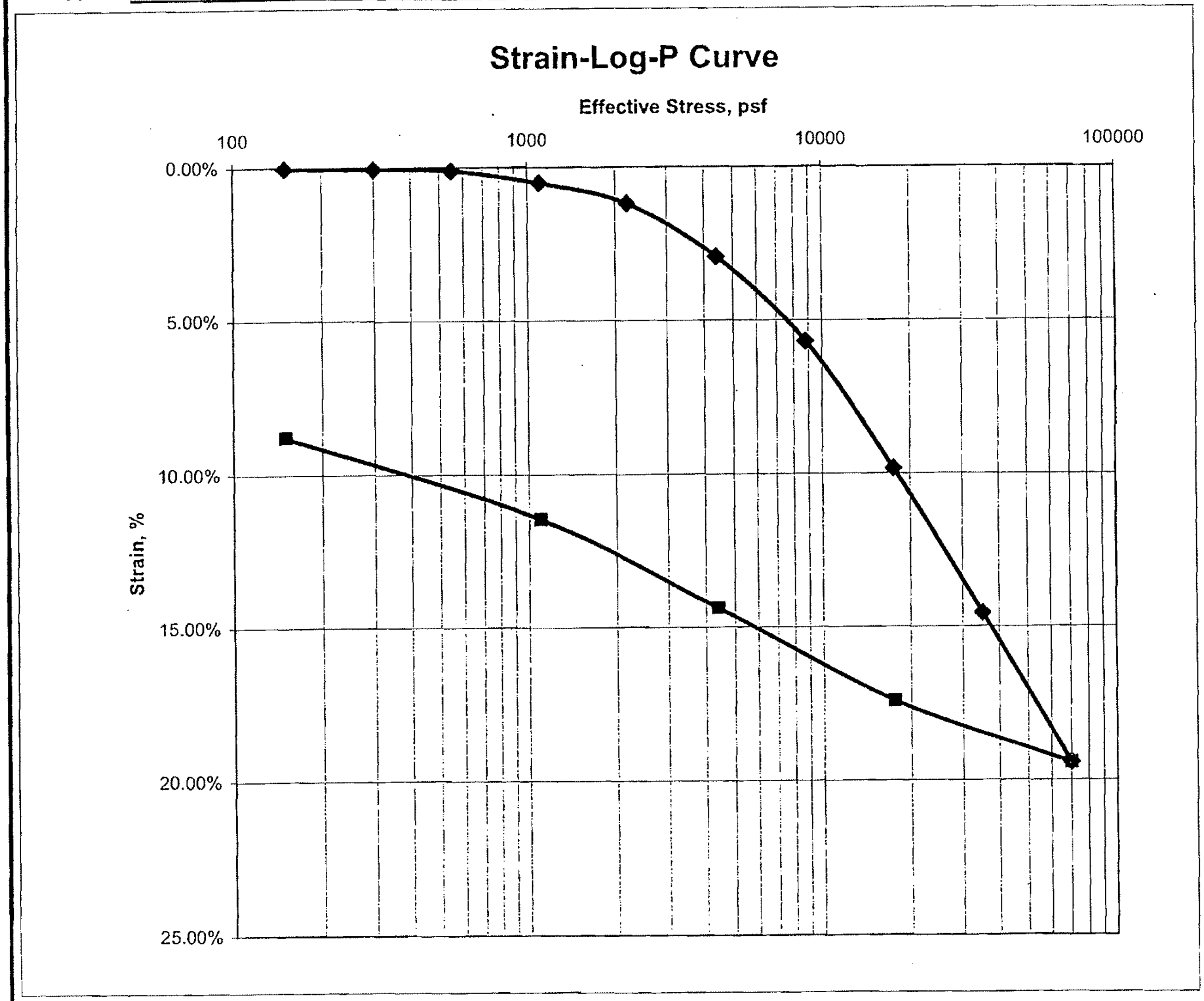
L:\Project\8000s\8453\Laboratory&gINT\CooperLab-TestResult_fig_B12.ai

Consolidation Test

ASTM D2435

Job No.: 109-410b
Client: Geomatrix Consultants
Boring: B-2
Sample: 2-4
Run By: MD
Reduced: MJ

Project: Zone 7 Water Agency - Groundwater Demineralization - 8453.000
Depth, ft.: 5
Checked: PJ
Soil Type: Gray CLAY
Date: 10/5/2004


Strain-Log-P Curve

Ass. Gs = 2.7	Initial	Final
Moisture %:	32.7	29.7
Density, pcf:	89.2	93.7
Void Ratio:	0.891	0.800
% Saturation:	99.3	100

Remarks:

Figure B-13

App. C

APPENDIX C

APPENDIX C

CORROSION TESTING AND ANALYSIS

Zone 7 Water Agency – Groundwater Demineralization Project
Pleasanton, California

An evaluation of corrosion potential for cast-in-place concrete foundations and buried pipes was performed by JDH Corrosion Consultants (JDH) of Walnut Creek, California. The study by JDH included an inspection of the project site, field measurements of in-situ soil resistivity, analytical tests on samples of near-surface soil, developing recommendations, and preparation of a letter report.

The following soil samples (collected during the geotechnical exploration by Geomatrix) were analyzed by CERCO Analytical, Inc., of Pleasanton, California:

Boring No.	Sample No.	Depth Interval of Sample (feet, below ground surface)
B-1	3	10.5 to 11
B-2	1	2.5 to 3
B-3	2	5.5 to 6
B-4	2	5.5 to 6
B-5	2A	6.5 to 7
B-6	4	15.5 to 16
B-7	4	15.5 to 16
B-8	4	15.5 to 16
B-9	4	15.5 to 16
B-10	4	15.5 to 16

Laboratory tests performed include electrical resistivity, pH, redox potential, and sulfate and chloride content. The letter report by JDH (presented in this appendix) describes field and laboratory test results and provides recommendations for mitigating corrosion potential.

JDH Corrosion Consultants
Incorporated

October 7, 2004

Geomatrix Consultants, Inc.
2101 Webster Street, 12th Floor
Oakland, CA 94612

Attention: **Mr. Joe de Larios**
Project Manager

Subject: **Soil Corrosivity Evaluation & Recommendations for Corrosion Control**
Zone 7 Demineralization Project
Pleasanton, CA

Dear Mr. de Larios,

Pursuant to your request, ***JDH Corrosion Consultants, Inc***. has completed the soil corrosivity evaluation for the *Zone 7 Demineralization Project* referenced above. We have provided herein recommendations for long-term corrosion control for materials of construction for the project.

PROJECT BACKGROUND

The project involves the construction of a new demineralization facility to be built adjacent to the existing pumping station located in the northwest corner of the intersection of Santa Rita Road and Stoneridge Drive in Pleasanton, CA. The supply pipeline for the facility will extend about 1,100 feet to the southeast, crossing under both Stoneridge Drive and Santa Rita Road connecting the new Demineralization Facility to Zone 7's Mocho Wells 1, 3 and 4. Steel casings will be utilized for crossing Santa Rita Road and Stoneridge Drive. There will be various process pipelines and treatment structures and buildings constructed as a part of this overall project.

PURPOSE

The purpose for this evaluation is to determine the corrosion potential, resulting from the soils at the subject site and to provide recommendations for long-term corrosion control for the concrete foundations and the buried metallic water pipelines, steel casings and other utilities.

SOIL TESTING AND ANALYSIS

Ten (10) soil samples were collected from the site by ***Geomatrix Consultants, Inc.*** field personnel and transported to a state certified testing laboratory, ***CERCO Analytical, Inc.*** (certificate no. 2153) located in Pleasanton, CA for chemical analysis. The samples were analyzed for pH, chlorides, resistivity (@ 100% saturation), sulfates and Redox potential using ASTM test methods as detailed in the table below. The preparation of the soil samples for chemical analysis was in accordance with the applicable specifications.

SOIL TESTING AND ANALYSIS
Soil Analysis Test Methods

Chemical Analysis	ASTM Method
Chlorides	D4327
pH	D4972
Resistivity (100% Saturation)	G57
Sulfate	D4327
Sulfide	D4658M
Redox Potential	D1498

The results of the chemical analysis are provided in CERCO Analytical, Inc. report dated Sept. 22, 2004.

The results are summarized as follows:

.CERCO Analytical, Inc.
Soil Laboratory Analysis

Chemical Analysis	Range of Results	Corrosion Classification
Chlorides	N.D. - 36 mg/kg	Non-corrosive *
pH	7.7 – 8.1	Non-corrosive*
100% Saturated Resistivity	710 – 1,900 ohms-cm	Corrosive*
Sulfate	30 - 100 mg/kg	Non-corrosive **
Sulfide	N/A	N/A
Redox Potential	450 - 470 mV	Non -corrosive*

* With respect to bare steel or ductile iron.
** With respect to mortar coated steel

Brief Explanation of Chemical Parameters

Chlorides: Chloride ions are cathode depolarizers which enhance the rate of corrosion. The higher the concentration, the greater the rate of corrosion.

pH: Acidic soils are more conducive to galvanic corrosion of ferrous materials than alkaline soils. The more acidic the soil the greater the rate of anticipated corrosion.

Resistivity: Measures the overall resistance of the soil to electric current flow. Since corrosion is an electrochemical process requiring the flow of electric current through the soil, this parameter relates directly to the degree to which specific soils allow corrosion currents to flow.

Sulfates: Sulfates in the soil can be extremely detrimental to concrete structures due to combined chemical and physical attack. They can react with the binding compounds such as calcium aluminate hydrates to effectively soften the concrete and they can also react physically through crystallization and resultant expansion and contraction processes to crack and weaken concrete structures. Under anaerobic soil conditions sulfates can be reduced to sulfides which can cause corrosion to buried steel structures.

Sulfides: Sulfides are present in the soil if anaerobic soil conditions exist at the site. If anaerobic soils are encountered, anaerobic bacteria can be present which can be extremely detrimental to steel pipe.

Redox Potential: The redox potential indicates the degree of aeration of the soil. This is an important factor because low redox levels indicate anaerobic soil conditions which can support corrosive sulfate-reducing bacteria.

Chemical Testing Analysis

The chemical analysis provided by ***CERCO Analytical, Inc.*** indicates that the soils are, in general, classified as "corrosive" to steel and ductile iron based upon the resistivity measurements. The chloride levels indicate "non-corrosive" conditions to steel and ductile iron and the sulfate levels indicate "non-corrosive" conditions for concrete structures placed into these soils with regard to sulfate attack. The pH of the soils is neutral to slightly alkaline which classifies them as "non-corrosive" to buried steel and concrete structures. The Redox potential indicates that the subject soils are aerobic which classifies them as "non-corrosive" to buried steel structures.

In-Situ Soil Resistivity Testing

The in-situ resistivity of the soil was measured at four (4) locations at the project site as shown in Figs. 1 and 2 attached, by ***JDH Corrosion Consultants, Inc.*** field personnel. Resistance measurements were conducted with probe spacing of 2.5, 5, 7.5, 10 and 15-feet at each location. For analysis purposes we have calculated the resistivity of soil layers 0-2.5, 2.5-5, 5-10 and 10-15' using the Barnes Method as follows:

$$\rho_{b-a} = KR_{(b-a)}$$

Where;

ρ_{b-a} = soil resistivity of layer depth b-a (ohm-cm)
a = soil depth to top layer (ft)
b = soil depth to bottom layer (ft)
R_a = soil resistance read at depth a (ohms)
R_b = soil resistance read at depth b (ohms)
R_{b-a} = resistance of soil layer from a to b (ft)
K = layer constant = $60.96\pi(b-a)$ (cm)

and $$\frac{1}{R_{b-a}} = \frac{1}{R_a} - \frac{1}{R_b}$$

In-Situ Soil Resistivity Analysis

Corrosion of a metal is an electro-chemical process and is accompanied by the flow of electric current. Resistivity is a measure of the ability of a soil to conduct an electric current and is, therefore, an important parameter in consideration of corrosion data. Soil resistivity is primarily dependent upon the chemical content and moisture content of the soil mass. The greater the amount of chemical constituents present in the soil, the lower the resistivity will be. As moisture content increases, resistivity decreases until maximum solubility of dissolved chemicals is attained. Beyond this point, an increase in moisture content results in dilution of the chemical concentration and resistivity increases.

The corrosion rate of steel in soil normally increases as resistivity decreases. Therefore, in any particular group of soils, maximum corrosion will generally occur in the lowest resistivity areas. The following classification of soil corrosivity, developed by William J. Ellis[1], is used for the analysis of the soil data for the project site.

Resistivity (Ohm-cm)	Corrosivity Classification
0 – 500	Very Corrosive
501 – 2,000	Corrosive
2,001 – 8,000	Moderately Corrosive
8,001 – 32,000	Mildly Corrosive
> 32,000	Progressively Less Corrosive

The above classifications are appropriate for the project site and the results are presented in the tables attached to the end of this report. In general, the soils are classified as "corrosive" with respect to corrosion of buried cast/ductile iron and steel structures throughout the top 15 feet of the site. The attached graph of the in-situ soil resistivity data for the soil layers 0' to 15' indicates that 67% of the soils are classified as "corrosive", 27% as "moderately corrosive" and 7% as "mildly corrosive".

DISCUSSION

Reinforced Concrete Foundations

Due to the low levels of water-soluble sulfates and chlorides found in these soils, there is no special requirement for sulfate resistant concrete or concrete impervious to chloride intrusion, to be used at this site. The type of cement used should be in accordance with UBC for soils which have less than 0.10 percentage by weight of water soluble sulfate (SO_4) in soil and the minimum depth of cover for the reinforcing steel should be as specified in UBC as well.

Underground Metallic Pipelines

The soils at the project site are considered to be "corrosive" to ductile/cast iron, steel and dielectric coated steel. Therefore, we recommend the use of coatings, or polyethylene encasement, supplemented with cathodic protection for direct buried metallic pressure piping such as domestic and fire water pipelines and process water pipelines. All underground pipelines should also be electrically isolated from above grade structures, reinforced concrete structures and copper lines in order to minimize potential galvanic corrosion problems.

Steel Casings

The soils at the project site are considered to be "corrosive" to steel casings. Therefore, we recommend the use of coatings supplemented with cathodic protection for buried steel casings whether installed using trenching methods or bore & jack methods.

Underground Mortar-Coated Steel Pipelines

The soils at the project site are considered to be "moderately-corrosive" with respect to mortar-coated steel pipelines and concrete cylinder pipe. Therefore, we recommend the use of test stations and bonding for implementation of a corrosion monitoring system. All underground pipelines should also be electrically isolated from above grade structures and copper pipelines in order to minimize potential galvanic corrosion problems.

RECOMMENDATIONS

Reinforced Concrete Foundations

We recommend using a Type I or II concrete mix with a maximum water-to-cement ratio as specified in UBC for soils which have less than 0.10 percentage by weight of water soluble sulfate (SO_4). Also, adhering to the minimum depth of cover for the reinforcing steel in the foundations as specified in the Uniform Building Code is recommended to ensure a long useful life for the subject structures.

Ductile Iron Pipe (Pressure Piping such as Domestic, Fire and Process Water)

1. Direct buried ductile iron pipe should be encased in 8-mil polyethylene as specified in AWWA specification C-105. Epoxy coatings are also an acceptable alternative type of coating system for the pipe and/or fittings such as valves.

2. All rubber gasket joints, fusion-bonded epoxy coated flanges and flexible couplings on ductile iron pipelines should be bonded with insulated copper cable to insure electrical continuity of the pipeline and fittings.

3. Insulating flanges and/or couplings should be installed to electrically isolate the buried portion of pipeline from other metallic pipelines, reinforced concrete structures and above grade buildings or structures.

4. Test stations shall be installed on all ductile iron pipelines at a spacing of 800 to 1,000 feet. Bonding and test stations shall comply with all applicable Zone 7 Water Agency Standards.

5. A sacrificial type of cathodic protection utilizing high potential ***magnesium*** anodes should be installed to protect the entire length of buried metallic pipeline. Cathodic protection should be designed in accordance with NACE Standard RP1069-02 and applicable Zone 7 Water Agency standards and included with the contract documents to permit installation along with the pipeline.

6. As an alternate, non-metallic piping may be used in lieu of ductile iron piping as allowed by State and local codes. Non-metallic piping does not require the implementation of any special type of corrosion prevention measures. However, all metallic valves, fittings and appurtenances on non-metallic piping will require protection as specified below.

Ductile Iron Fittings & Metallic Valves (On Plastic Piping)

1. All direct buried ductile iron fittings installed on non-metallic piping shall be provided with a bituminous coating from the factory and encased in an 8-mil polyethylene bag in the field in accordance with AWWA Specification C-105. All bolts, restraining rods, etc. shall be coated with bitumastic prior to encasement in the polyethylene bag.

2. All metallic valves shall be coated from the factory (i.e. using powdered epoxy or equivalent type of coating system) and all bolts shall be either made out of stainless steel or mild carbon steel and coated with bitumastic in the field and the entire valve shall be encased in an 8-mil polyethylene bag in accordance with AWWA Specification C-105.

3. A sacrificial type of cathodic protection utilizing high potential ***magnesium*** anodes should be installed to protect the valves and fittings. Cathodic protection should be designed in accordance with NACE Standard RP1069-02 and applicable Zone 7 Water Agency standards and included with the contract documents to permit installation along with the pipeline.

Cast Iron Drain Lines

1. No special corrosion considerations are required for the cast iron sewer lines and storm drains.

Steel Pipelines (Process Pipelines, Natural Gas Pipelines & Risers)

1. A fusion-bonded epoxy coating system or a suitable tape coating should be applied to all buried steel pipelines in accordance with ANSI/AWWA C214-95, "AWWA Standard for Tape Coating Systems for the Exterior of Steel Water Pipelines." Also, a tape coating per AWWA Standard C209-95 is recommended for special sections, connections and fittings.

2. Insulating flanges and/or couplings should be installed to electrically isolate the buried portions of steel pipelines from other metallic pipelines, reinforced concrete structures and above grade structures.

3. All rubber gasket joints, fusion epoxy coated flanges and flexible couplings should be bonded with insulated copper cable to insure electrical continuity of the pipeline and fittings.

4. A sacrificial type of cathodic protection using high potential ***magnesium*** anodes should be installed to protect the buried portions of steel pipelines used for the natural gas piping systems. Cathodic protection should be designed in accordance with NACE Standard RP0169-02 and applicable Zone 7 Water Agency standards and included with the contract documents to permit installation along with the subject pipeline.

Copper Process Pipelines

1. Direct buried copper water service and process pipelines should be encased in 8-mil minimum polyethylene as specified in AWWA specification C-105.

Mortar-Coated Steel Pipelines

1. All rubber gasket joints, fusion-bonded epoxy coated flanges and flexible couplings on mortar-coated steel pipelines should be bonded with insulated copper cable to insure electrical continuity of the pipeline and fittings.

2. Insulating flanges and/or couplings should be installed to electrically isolate the buried portion of the subject pipelines from other metallic pipelines, above grade structures and copper process pipelines.

3. Test stations shall be installed on all mortar-coated steel pipelines at insulating joints and at an interval not to exceed 1,000 feet on long runs of piping.

4. Valves, blow-offs, air release valves, etc. and other appurtenances on mortar-coated steel pipelines shall be either electrically isolated from the pipelines using insulating joints or encased in mortar like the pipeline.

Steel Casings

1. Cathodic protection utilizing sacrificial anodes or solar/AC powered impressed current should be installed to protect the exterior surfaces of steel casings. Cathodic protection should be designed in accordance with NACE Standard RP0169-02 and applicable Zone 7 Water Agency standards and included with the contract documents to permit installation along with the casings. All casings shall also be provided with a coating system consisting of a 10 mil minimum DFT of abrasion resistant epoxy.

SYSTEM DESIGN

The design of the corrosion monitoring and cathodic protection systems will comply with two major objectives:

- Provide an adequate level of protection to the subject pipelines and casings in accordance with NACE Standards
- Provide adequate test points for the corrosion monitoring systems for the mortar coated steel pipelines and for regularly checking the performance of the cathodic protection systems and to allow for future system adjustment.

The minimum design life of the cathodic protection systems should be 20 years. The cathodic protection systems will require an annual survey and adjustment in order to ensure the long-term satisfactory operating performance of the systems. In addition the corrosion monitoring systems will require surveys every three to four years.

Pipeline Isolation

Cathodically protected pipelines must not be directly connected to grounded structures. Protection against electrical shock of electrical operating equipment (e.g. electrical operated valves, transducers and other facilities for operating the pipeline) must be adjusted to the requirements of the cathodic protection system. Insulating flanges shall be used to electrically isolate the pipeline from above grade structures, valve vaults, etc. Electrical isolation shall also be maintained between the pipeline and casings.

Mortar coated steel pipelines must be electrically isolated from dielectric coated steel pipelines, ductile iron pipelines, copper pipelines and above grade structures. Valves, blow-offs, air release valves, etc. and other appurtenances on mortar-coated steel pipelines shall be either electrically isolated from the mortar-coated steel pipelines using insulating joints or encased in mortar like the pipeline.

Test Stations

Test stations shall be installed to allow for the accurate monitoring and adjustment of the cathodic protection systems and for corrosion monitoring systems for the mortar coated steel pipelines. Test stations shall be utilized at the following locations:

- Galvanic anode installations
- Foreign pipeline crossings with metallic pipelines and other cathodically protected pipelines
- Casings
- Buried insulating joints
- Maximum spacing of 1,000 ft.

Test stations at the demineralization facility shall be wall-mounted above grade to allow for ease of maintenance and adjustment in the future where feasible.

LIMITATIONS

The conclusions and recommendations contained in this report are based on the information and assumptions referenced herein. All services provided herein were performed by persons who are experienced and skilled in providing these types of services and in accordance with the standards of workmanship in this profession. No other warrantees expressed or implied are provided.

We appreciate the opportunity to be of service to ***Geomatrix Consultants, Inc.*** on this project and trust that you find the analysis and recommendations contained herein satisfactory.

If you have any questions concerning the contents of this report or if we can be of any additional assistance, please do not hesitate to contact us at (925) 927-6630.

Respectfully submitted,

J. Darby Howard, Jr., P.E.
JDH CORROSION CONSULTANTS, INC.
Principal

REGISTERED PROFESSIONAL ENGINEER
J. DARBY HOWARD, JR.
No. CR001055
Exp. 6/30/05
CORROSION
STATE OF CALIFORNIA

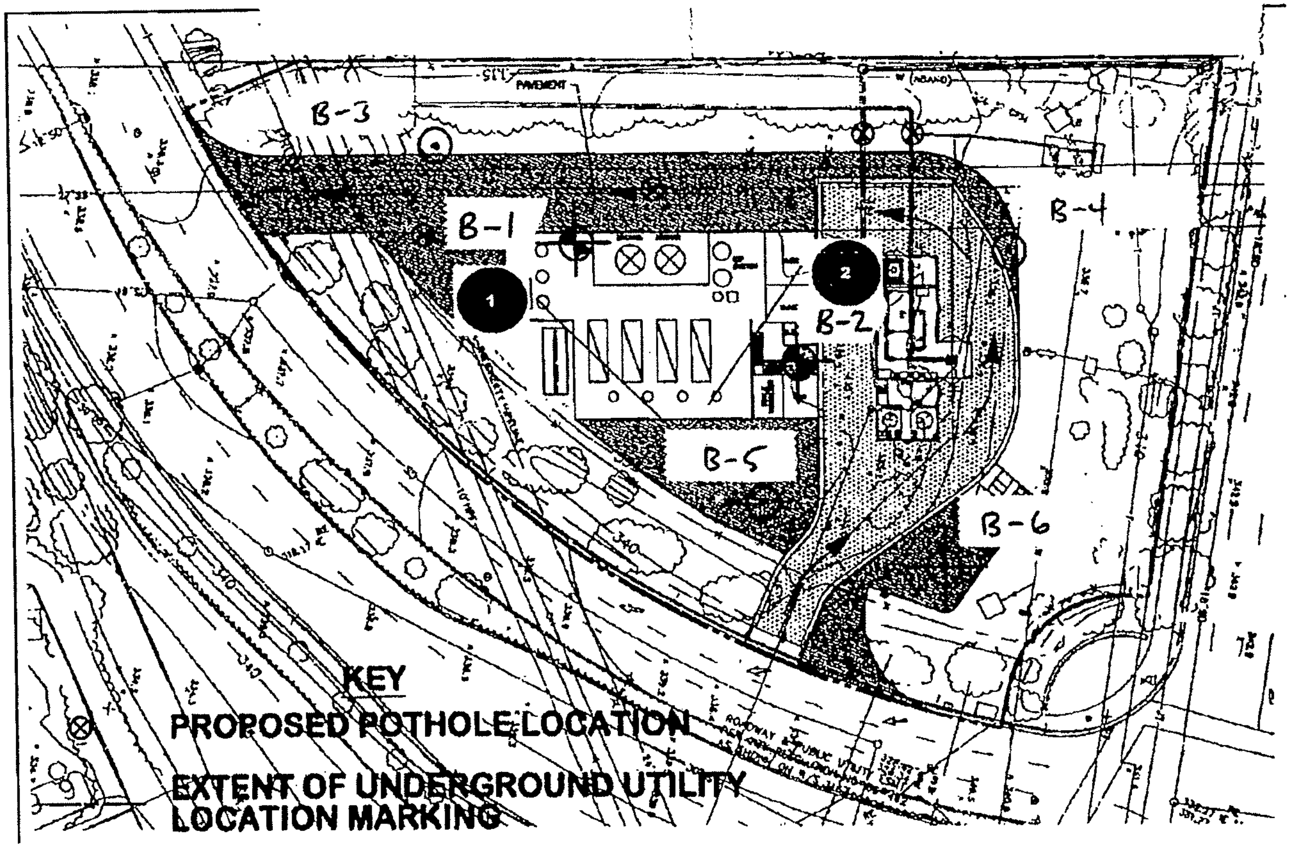
cc: File 24129

REFERENCES

1. *Ellis, William J., Corrosion of Concrete Pipelines, Western States Corrosion Seminar, 1978*

2. *AWWA Manual of Water Supply Practices - M27, First Edition, External Corrosion - Introduction to Chemistry and Control (Denver, CO: 1987)*

3. *National association of Corrosion Engineers, Standard Recommended Practice, RP 01-69-96, Control of External Corrosion on Underground or Submerged Pipeline*



NOTES:

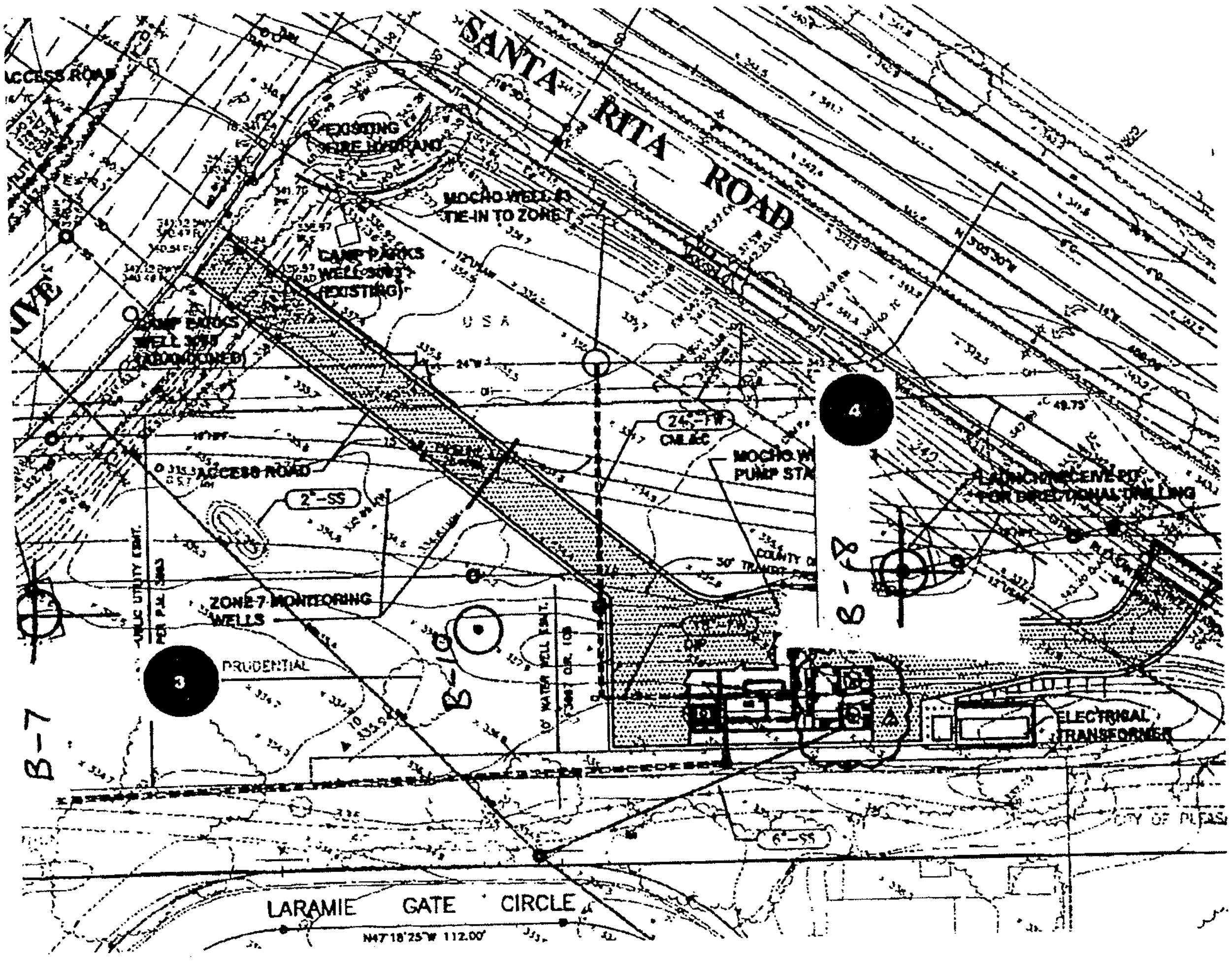
1. WENNER 4-PIN TEST METHOD USED FOR ALL IN-SITU SOIL RESISTIVITY MEASUREMENTS.
2. AEMC MODEL 4500 SOIL RESISTIVITY METER WAS USED FOR IN-SITU TESTING.

JDH Corrosion Consultants
Incorporated

Geomatrix Consultants, Inc
Zone 7 Demineralization Project

IN-SITU SOIL RESISTIVITY LOCATIONS

ENG: DH	CAD: CGL	JOB:	FILE: 24129	SCALE: N.T.S.	DATE: 9/16/04	DWG: FIGURE 1



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JDH Corrosion Consultants
Incorporated

Geomatrix Consultants, Inc
Zone 7 Demineralization Project

IN-SITU SOIL RESISTIVITY LOCATIONS

ENG:	CAD:	JOB:	FILE:	SCALE:	DATE:	DWG:
DH	CGL		24129	N.T.S.	9/16/04	FIGURE 2

Client: *Geomatrix Consultants, Inc.*
Project: *Zone 7 Water Agency*
Location: *Pleasanton, CA*
Date: *9/24/2004*
Subject: *In-Situ Soil Resistivity Data*

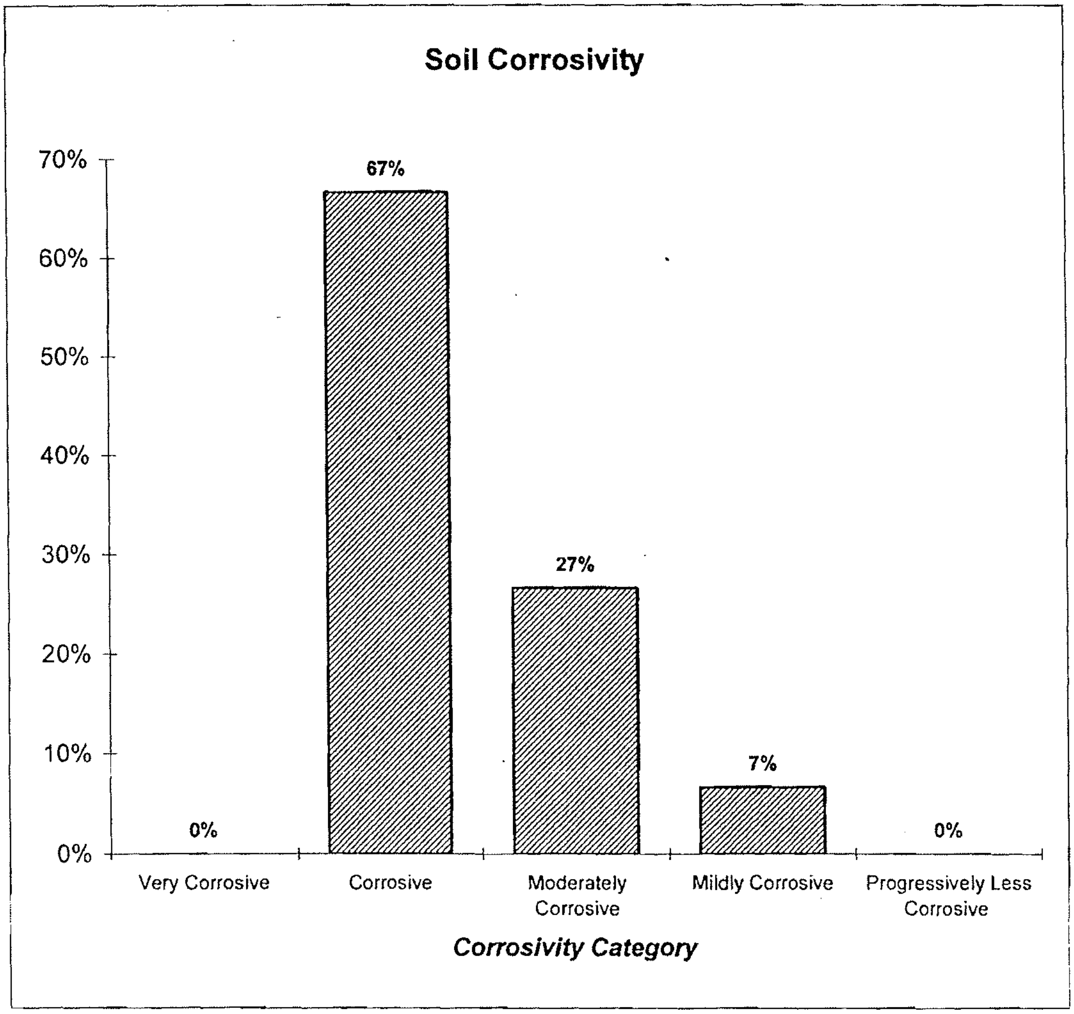
*Test	Resistance Data From AEMC Meter				Soil Resistivities (ohm-cm)				Barnes Layer Analysis (ohm-cm)			
#	2.5	5	10	15	2.5	5	10	15	0-2.5'	2.5-5'	5-10'	10-15'
1	3.17	1.232	1.015	1.275	1518	1180	1944	3662	1518	965	5518	NEG
2	8.56	1.706	0.589	0.397	4098	1633	1128	1140	4098	1020	861	1166
3	5.63	1.929	0.875	0.6	2695	1847	1676	1724	2695	1405	1533	1828
4	6.31	1.827	0.641	0.628	3021	1749	1228	1804	3021	1231	945	29649

Zone 7 Water Agency
Demineraliztion Facility
Pleasanton, CA

In-situ Soil Resistivities for Soil Depths 2.5-ft. thru 15-feet

Corrosivity Category	Resistivity (Ohm-Cm)			No. In Category	Total %	Cumulative %
Very Corrosive	0	to	500	0	0%	0%
Corrosive	501	to	2000	10	67%	67%
Moderately Corrosive	2001	to	8000	4	27%	93%
Mildly Corrosive	8001	to	32000	1	7%	100%
Progressively Less Corrosive	Above	32000			0%	100%

Total Number of Tests = 15



CERCO A ytical, Inc.
3942-A Valley Avenue, Pleasanton, CA 94566-4715 (925) 462-2771 Fax (925) 462-2775

FINAL RESULTS

Client: JDH Corrosion Consultants, Inc.
Client's Project No.: #24129 (Geomatrix No.8453.000)
Client's Project Name: Not Indicated
Authorization: Signed Chain of Custody

Date Sampled: 09/08 & 09/04
Date Received: 9-Sep-2004
Date of Report: 22-Sep-2004
Matrix: Soil

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Conductivity (umhos/cm)*	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
0409062-001	B2-1-3	450	7.9	-	1,500	-	N.D.	42
0409062-002	B6-4-3	460	7.8	-	770	-	N.D.	96
0409062-003	B7-4-3	460	7.9	-	1,300	-	21	78
0409062-004	B8-4-3	460	7.9	-	1,500	-	N.D.	63
0409062-005	B9-4-3	460	7.8	-	1,900	-	36	30
0409062-006	B10-4-3	460	7.7	-	1,400	-	N.D.	52
0409062-007	B1-3-3	460	8.0	-	1,400	-	N.D.	48
0409062-008	B3-2-3	470	8.1	-	850	-	18	46
0409062-009	B4-2-3	470	7.7	-	710	-	22	100
0409062-010	B5-2A-4	460	8.1	-	1,600	-	N.D.	35

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Detection Limit:	-	-	10	-	50	15	15
Date Analyzed:	14-Sep-2004	16-Sep-2004	-	20-Sep-2004 & 21-Sep-2004	-	16-Sep-2004	16-Sep-2004

Cheryl McMillen
Laboratory Director

* Results Reported on "As Received" Basis
N.D. - None Detected
(1) Detection limit is elevated to 75 mg/kg due to dilution

Quality Control Summary - All laboratory quality control parameters were found to be within established limits

App. D

APPENDIX D

APPENDIX D

LOGS OF BORINGS FROM PREVIOUS INVESTIGATIONS AND WELL LOGS

Zone 7 Water Agency – Groundwater Demineralization Project
Pleasanton, California

As part of the evaluation of subsurface conditions at the R/O Building site and along the proposed supply pipeline alignment, Geomatrix reviewed reports and well logs prepared by previous investigators to obtain subsurface data that could be used to supplement information developed during this study. The information presented in this appendix was collected from the Zone 7 Water Agency and Geomatrix project files. The City of Pleasanton was also contacted and no information was readily available in their files for our review.

It should be noted that the files we reviewed may not include all the geologic/geotechnical investigation reports prepared for projects in the vicinity of the proposed project. In addition, this report may not include all the information for the study area that is available in the Zone 7 Water Agency archives. Only the information we judged to be most pertinent to the geologic/geotechnical study for the Zone 7 Water Agency – Groundwater Demineralization Project is included in this appendix.

Included in this appendix is selected text and figures from the available documents, including a site plan, boring logs, and/or water level monitoring data. Because the information presented in this appendix does not completely describe the evaluation and exploration techniques used or the subsurface and groundwater conditions encountered, the reader may want to review the original reports from which the information was excerpted. The logs included in this appendix should be considered to depict subsurface conditions only at the specific locations and at particular times the exploration work was performed and/or water levels were measured. Soil and groundwater conditions at other locations may differ from the conditions occurring at these locations. Also, the passage of time may result in changes in the soil and groundwater conditions at these locations.

GEOTECHNICAL ENGINEERING STUDY

Mocho Wells/Pump Stations 3 and 4

Pleasanton, California

Prepared for:

Luhdorff and Scalmanini
Consulting Engineers
500 First Street
Woodland, California 95695

Prepared by:

CONSOLIDATED ENGINEERING LABORATORIES
7060 Koll Center Parkway, Suite 300
Pleasanton, California 94566-3108
CEL Project No. G14412

CONSOLIDATED ENGINEERING
LABORATORIES

December 17, 1998

Luhdorff and Scalmanini
Consulting Engineers
500 First Street
Woodland, California 95695

Attention: Mr. John Fawcett

Subject: **Geotechnical Engineering Study**
Mocho Wells/Pump Stations 3 and 4
Santa Rita Road and Stoneridge Drive
Pleasanton, California
CEL Project No. G14412

Gentlemen:

In accordance with your authorization, Consolidated Engineering Laboratories (CEL) has completed a geotechnical engineering study for the proposed Mocho Wells/Pump Stations 3 and 4 in Pleasanton, California. Transmitted herewith are the results of the findings, conclusions, and recommendations for foundation and pavement design, retaining walls, site grading and drainage, utility trench backfill, and guide specifications for grading operations.

In general, the proposed development at each of the well sites is considered to be geotechnically feasible provided the recommendations of this report are implemented in the design and construction of the project.

Should you or members of the design team have questions or need additional information, please contact the undersigned The opportunity to be of service to Luhdorff and Scalmanini, Consulting Engineers and to be involved in the design of this project is appreciated.

Sincerely,
CONSOLIDATED ENGINEERING LABORATORIES

REGISTERED PROFESSIONAL ENGINEER
WILLIAM E. PRATT
NO. 52704
EXP.: 12/31/02
CIVIL
STATE OF CALIFORNIA

William E. Pratt, C.E. 52704
Principal Engineer, Geotechnical Division

Copies: 6 to Addressee

WRS/WEP:tsp

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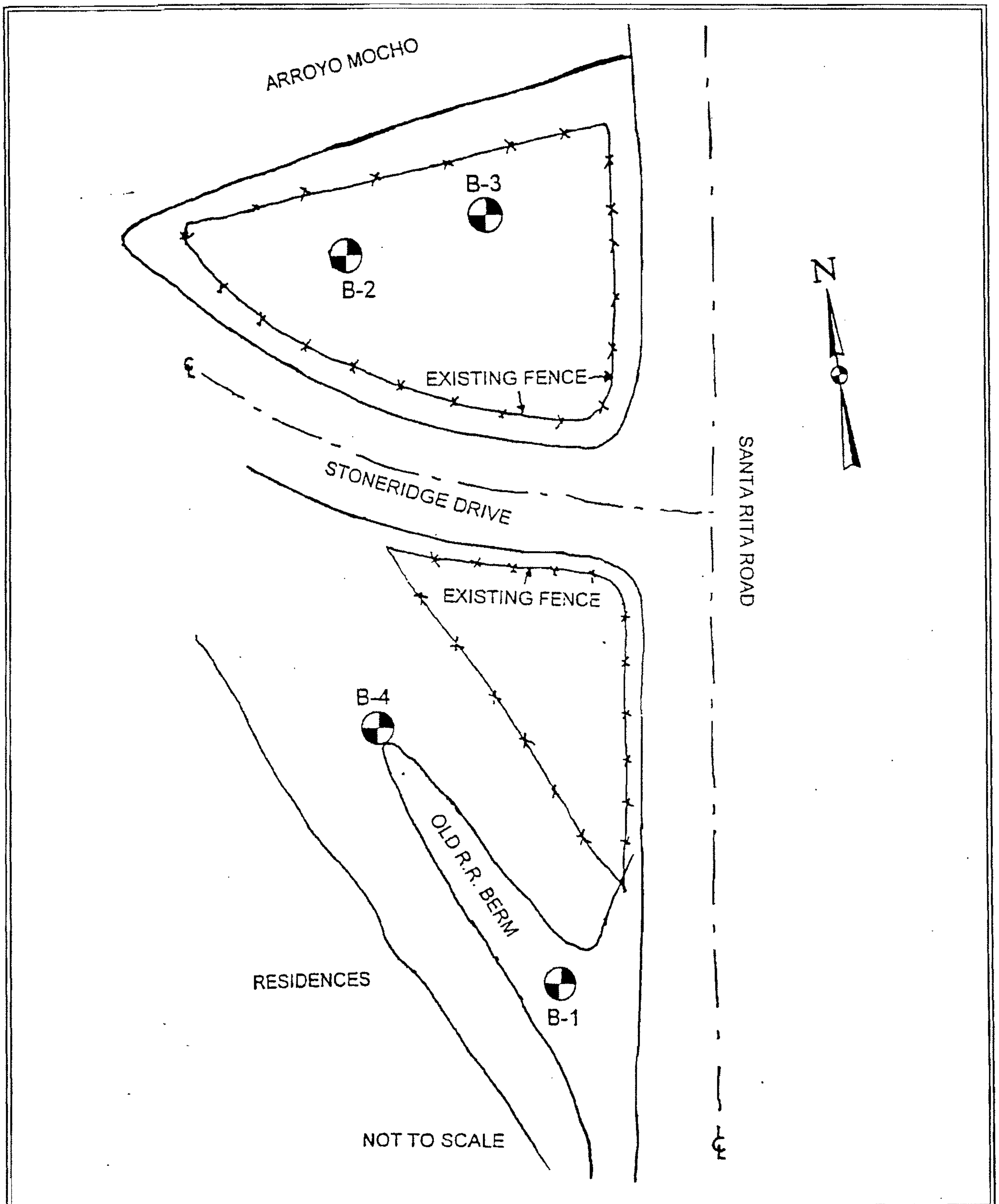
7060 Koll Center Parkway, Suite 300 • Pleasanton, CA 94566-3108 • Tel. 925 485-5000 • FAX 925 485-5018



Mocho Wells/Pump Stations 3 and 4	CEL #G14412	December, 1999
CONSOLIDATED ENGINEERING LABORATORIES	Pleasanton, CA	Figure #2 Site Plan

APPENDIX A

Key to Boring Logs

Logs of Borings

Key to Boring Logs

]	3-inch O.D. Hand Sampler with 2.5-Inch O.D. by 6-inch long Brass Liner installed.
◣	2-inch O.D. Standard Penetration Test (SPT)
⧗	Bulk Sample
█	3-inch O.D. Shelby Tube (hydraulically advanced)
▽	Groundwater Level Encountered During Drilling
▼	Groundwater Level Measured After Drilling
25	Blow Count To Drive Sampler One Foot

1. The boring locations were determined by pacing, sighting and/or measuring from site features. Elevations of borings (if included) are determined by interpolation between plan contours. The location and elevation of borings should be considered accurate only to the degree implied by the method used.
2. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.
3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. This data has been reviewed and interpretations made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, tides, temperature and other factors at the time measurements were made.

Mocho Wells/Pump Stations 3 and 4	CEL # G14412	December, 1999
CONSOLIDATED ENGINEERING LABORATORIES	Pleasanton, CA	Key to Boring Logs

Project Name: Mocho 3 and 4 | **Project No.** G14412 | **Logged By:** WRS | **Boring No.:** B-1

Location: Mocho 3 site | **Drilling Method:** 8-inch Hollow Stem | **Date Drilled:** 11/30/99

Depth (ft)	Sample Symbol	Penet. Resist (Blows/ft)	Sample Number	Pocket Pen (TSF)	Dry Density (PCF)	Moisture Content (%)	DESCRIPTION AND REMARKS	Moisture Condition	Consistency	USCS Soil Classification	Water Level
0							Elevation 336; on mounded area, old RR ROW Gravel fill at surface Brown gravelly sand with clay (fill)	moist	med. dense	SP	0
	■	18	1-1	3.2	118.8	18.3	Brown mottled orange brown, lean clay with sand	moist	med. stiff	CL	
5							Very dark gray to light gray lean clay with gray and orange brown mottling	moist	med. stiff	CL	5
	■	13	1-2	1.5	93.1	30.3	Veins of fine sand with clay Unconfined Compressive Strength = 1817 psf @ 11.4 % strain	moist	med. stiff	CL	
10											10
	■	34	1-3	2.0	97.6	26.6	Minor small subrounded gravel	moist	stiff	CL	
15											15
	■	27	1-4	2.0	101.3	26.4					
20											20
	■	40	1-5	2.5	96.8	27.3					
25							Boring terminated at a depth of 24.5 feet No groundwater encountered				25

CONSOLIDATED ENGINEERING LABORATORIES

Project Name: Mocho 3 and 4

Project No. G14412

Logged By: WRS

Boring No.: B-2

Location: Mocho 4 site by desal. plant

Drilling Method: 8-inch Hollow Stem

Date Drilled: 11/30/99

Depth (ft)	Sample Symbol	Penet. Resist (Blows/ft)	Sample Number	Pocket Pen (TSF)	Dry Density (PCF)	Moisture Content (%)	DESCRIPTION AND REMARKS	Moisture Condition	Consistency	USCS Soil Classification	Water Level
0							Elevation 335 Brown lean clay with rootlets	moist	soft	CL	0
		4					Grayish brown clayey fine sand	moist	loose	SC	
5		18	2-1	3.3	101.0	23.3	Black lean clay with orange mottling	moist	med. stiff	CL	5
							Grayish brown to dark gray lean clay with orange brown mottling Unconfined Compressive Strength = 2684 psf @ 4.8% strain	moist	very stiff	CL	
10		15	2-2	1.2 3.3	95.7	27.5		moist	stiff to very stiff	CL	10
15		34	2-3	2.2	97.5	27.2		moist	very stiff	CL	15
20		37	2-4	3.1	101.9	23.7		moist	hard	CL	20
							Boring terminated at a depth of 21.5 feet No groundwater encountered				
25											25

CONSOLIDATED ENGINEERING LABORATORIES

Project Name: Mocho 3 and 4
Project No. G14412
Logged By: WRS
Boring No.: B-3
Location: Mocho 4 site by pump station
Drilling Method: 8-inch Hollow Stem
Date Drilled: 11/30/99

Depth (ft)	Sample Symbol	Penet. Resist (Blows/ft)	Sample Number	Pocket Pen (TSF)	Dry Density (PCF)	Moisture Content (%)	DESCRIPTION AND REMARKS	Moisture Condition	Consistency	USCS Soil Classification	Water Level
							Elevation 334				
0							Grayish brown silty lean clay	moist	soft	CL	0
5		6					Brown clayey fine sand	moist	loose	SC	5
0		12		1.0			Mottled gray, grayish brown with black and reddish brown mottling lean clay with silt. Silt content diminishes with depth.	moist	stiff	CL	10
15		22		2.5				moist	very stiff	CL	15
20		18		2.8			Mottled with orange brown				20
25		20		3.3			White nodules				25

CONSOLIDATED ENGINEERING LABORATORIES

Project Name: Mocho 3 and 4

Project No. G14412

Logged By:WRS

Boring No.:3 (cont.)

Location: Mocho 4 site by pump station

Drilling Method: 8 inch hollow stem

Date Drilled: 11/30/99

Depth (ft)	Sample Symbol	Penet. Resist (Blows/ft)	Sample Number	Pocket Pen (TSF)	Dry Density (PCF)	Moisture Content (%)	DESCRIPTION AND REMARKS	Moisture Condition	Consistency	USCS Soil Classification	Water Level
25											25
-											-
-											-
-											-
-	◣	21		4.2			Light grayish brown with dark gray brown, white and orange brown mottling lean clay	moist	very stiff	CL	-
30							Bottom of Hole at 30 feet No groundwater encountered				30
-											-
-											-
-											-
-											-
35											35
-											-
-											-
-											-
-											-
40											40
-											-
-											-
-											-
-											-
45											45
-											-
-											-
-											-
-											-
50											50

Project Name: Mocho 3 and 4	**Project No**. G14412	**Logged By**: WRS	**Boring No.**: B-4
Location: Mocho 3	**Drilling Method**: 8-inch Hollow Stem		**Date Drilled**: 11/30/99

Depth (ft)	Sample Symbol	Penet. Resist (Blows/ft)	Sample Number	Pocket Pen (TSF)	Dry Density (PCF)	Moisture Content (%)	DESCRIPTION AND REMARKS	Moisture Condition	Consistency	USCS Soil Classification	Water Level
							Elevation 338 on old RR ROW				
0							Brown sandy gravel with silt	moist	med. dense	GM	0
5	■	17	4-1	1.3	92.2	30.0	Dark gray brown with orange brown mottling lean clay with some 1/4" sub-rounded gravel	moist	stiff	CL	5
10	■	14	4-2	2.8	111.2	18.3					10
							Boring terminated at a depth of 11.5 feet No groundwater encountered				
15											15
20											20
25											25

APPENDIX B

Unconfined Compression

Plasticity Index

R-Value Test

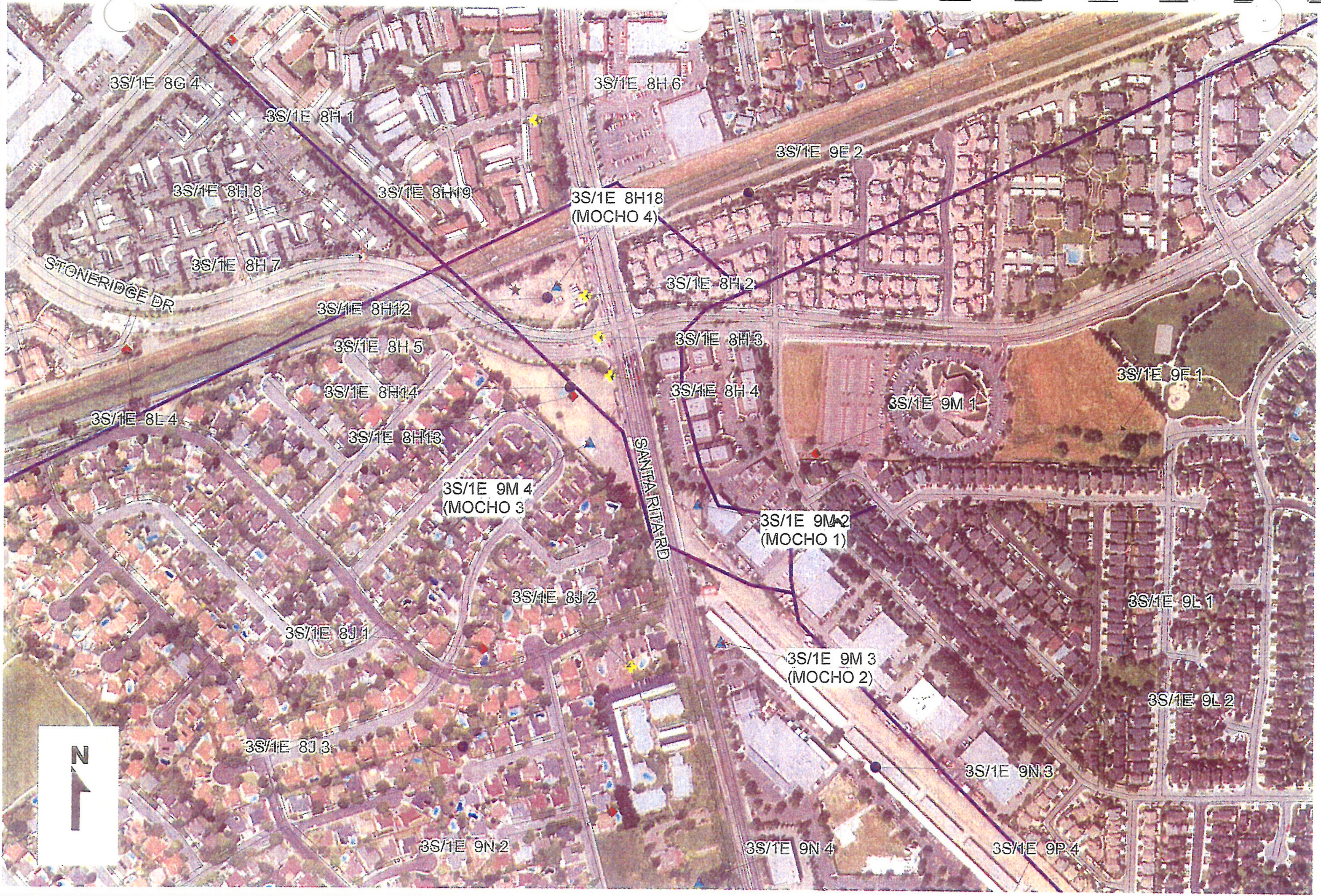
Water Soluble Sulfate

Subject
Project No.
Task No.
By
Checked By
File No.
Date
Date
Sheet of

LOGS OF

ZONE 7

WELLS



ZONE 7 WATER AGENCY
5997 PARKSIDE DRIVE
PLEASANTON, CA 94588

WELL LOCATION MAP

SCALE: 1"= 450 ft

DATE: 9/1/04

MOCHO WELLS - A
\zone7-file\MapInfo\FLOOD\REFERALLS\REFERALLS.WOR

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

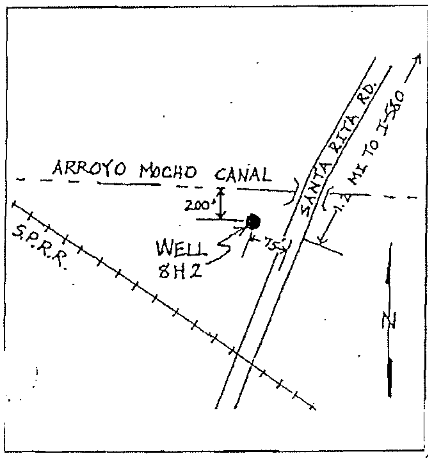
No. 253974

State Well No. 3S/1E 8H2
Other Well No. Navy Well #1

ice of Intent No. ____
Local Permit No. or Date ____

(1) OWNER: Name Department of the Army, Parks
Address Reserve Forces Training Area, P.O. Box DD
City Dublin ZIP 94568

(2) LOCATION OF WELL (See instructions):
County Alameda Owner's Well Number ____
Well address if different from above ____
Township 3S Range 1E Section 8
Distance from cities, roads, railroads, fences, etc. Near Santa Rita Road south of the Arroyo Mocho Canal in Pleasanton.



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☒
Other ☐
(Describe)

(5) EQUIPMENT:
Rotary ☐ Reverse ☐
Cable ☒ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☐ No ☑ Size ____
Diameter of bore ____
Packed from ____ to ____ ft.

(7) CASING INSTALLED:
Steel ☐ Plastic ☐ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
		14		124	139	
				148	165	
				6 cuts per 10 inches		

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☐ No ☐ If yes, to depth ____ ft.
Were strata sealed against pollution? Yes ☐ No ☐ Interval ____ ft.
Method of sealing ____

(10) WATER LEVELS:
Depth of first water, if known ____ ft.
Standing level after well completion 5 ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? ____
Type of test Pump ☒ Bailer ☐ Air lift ☐
Depth to water at start of test 5 ft. At end of test 54 ft.
Discharge 705 gal/min after 2 hours Water temperature ____
Chemical analysis made? Yes ☐ No ☐ If yes, by whom? ____
Was electric log made Yes ☐ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth 205 ft. Completed depth ____ ft.

from ft.	to	ft. Formation (Describe by color, character, size or material)
0	2	Soil.
2	46	Clay, various colors.
46	77	Gravel and hard rock.
77	86	Yellow clay.
86	120	Blue clay.
120	124	Yellow clay.
124	139	Gravel and hard rock.
139	148	Yellow clay.
148	165	Gravel and hard rock.
165	171	Yellow clay.
171	185	Blue clay.
185	205	Yellow clay.

Report prepared using Zone 7 file information for this well.
WH 10 Jul 90

Work started ____ 19 ____ Completed 24 Dec 1942

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed ____
(Well Driller)
NAME ____
(Person, firm, or corporation) (Typed or printed)
Address ____
City ____ ZIP ____
License No. ____ Date of this report ____

DWR 188 (REV. 12-86)

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

86 96355

INVESTIGATION

LIVERMORE VALLEY

DIVISION OF WATER RESOUF
DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORNIA

WELL LOG

SHEET

NUMBER 31E-62

LOCAL DESIGNATION #2

3S/1E 8H3

LOCATION In well field on W/s Santa Rita Rd. between Arroyo Mocho and S.P.R.R. (see sketch)

OWNER U. S. Navy

DATE COMPLETED Jan. 7, 1943

DIAMETER OF CASING

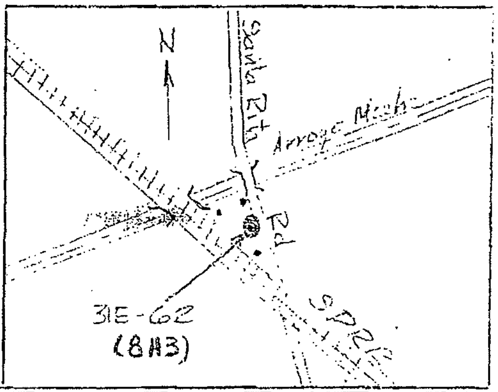
DRILLED BY

SOURCE OF INFORMATION C. Marliave

INSPECTED WHILE DRILLING SEE FILE NO.

SURFACE ELEVATION

SKETCH



DEPTH	ELEVATION OF BOTTOM OF STRATUM	MATERIAL	THICKNESS FEET	% VOIDS	ABSOLUTE VOIDS FEET	TOTAL VOIDS FEET
0-3		Soil	3			
3-47		Clay	44			
47-80		Gravel	33			
80-88		Yellow clay	8			
88-99		Blue clay	11			
99-103		Blue shale	4			
103-119		Blue clay	16			
119-124		Yellow clay	5			
124-138		Gravel (perforated)	14			
138-151		Yellow clay	13			
151-171		Gravel (perforated)	20			
171-198		Yellow clay	27			
198-201		Gravely clay	3			
201-203		Yellow clay	2			

FOR FIELD COPIES USE ALTERNATE LINES

LOG OBTAINED BY R. A. Basye DATE August 10, 1949

07588 9-32 15M CALIFORNIA STATE PRINTING OFFICE

3S/1E-8H3

SHEET 1

LIVERMORE VALLEY

DIVISION OF WATER RESOU

DEPARTMENT OF PUBLIC WORKS

STATE OF CALIFORNIA

WELL LOG

NUMBER 31E-61

LOCAL DESIGNATION #3

3S/1E-8H4

LOCATION In well field on W/s Santa Rita Rd. between Arroyo Mocho and S.P.R.R. (see sketch)

OWNER U. S. Navy

DATE COMPLETED Feb. 15, 1943

DIAMETER OF CASING

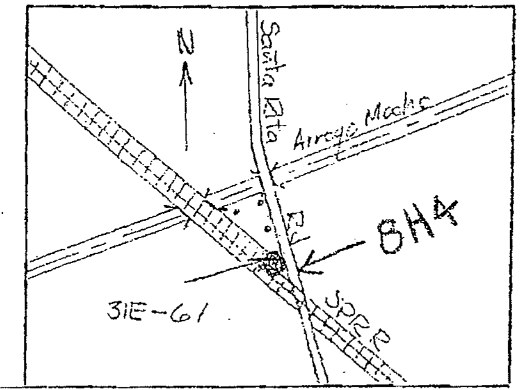
DRILLED BY

SOURCE OF INFORMATION C. Marliave

INSPECTED WHILE DRILLING SEE FILE NO.

SURFACE ELEVATION

SKETCH



DEPTH	ELEVATION OF BOTTOM OF STRATUM	MATERIAL	THICKNESS FEET	% VOIDS	ABSOLUTE VOIDS FEET	TOTAL VOIDS FEET
0-3		Soil	3			
3-46		Clay	43			
46-85		Gravel	39			
85-90		Yellow clay	5			
90-104		Blue clay	14			
104-108		Blue shale	4			
108-127		Blue clay	19			
127-130		Yellow clay	3			
130-146		Gravel (perforated)	16			
146-152		Yellow clay	6			
152-156		Gravely clay	4			
156-181		Gravel (perforated)	25			
181-200		Yellow clay	11			

FOR FIELD COPIES USE ALTERNATE LINES

LOG OBTAINED BY R. A. Basye DATE August 10, 1949

97388 9-32 15M CALIFORNIA STATE PRINTING OFFICE

3S/1E-8H4

WELL LOG

WELL #3

Well for - McNeil Construction Co.
Location - Pleasanton, California
Date - Feb. 15, 1943
Driller - Art Daly
Size - 14" x 10 gauge

0-3	Soil
3-46	Clay
46-85	Gravel
85-90	Yellow clay
90-104	Blue clay
104-108	Blue sandy clay
108-127	Blue clay
127-130	Yellow clay
130-146	Gravel
146-152	Yellow clay
152-156	Gravel and clay
156-181	Gravel
181-200	Yellow clay

Perforated

6 cuts to 10"

130-146 -- 16'
156-181 -- 25'

All measurments from existing ground level. Correction for permanent pump setting plus 4 from base of pump.

Bottom of well filled with cement to 190'.

3S/1E-8H4

INVESTIGATION LIVERMORE VALLEY

DIVISION OF WATER RESOU
DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORN

WELL LOG

SHEET 1

NUMBER 31E-64 ✓

LOCAL DESIGNATION #4

3S/1E 8H5

LOCATION In well field on W/s Santa Rita Rd. between Arroyo Mocho and S.P.R.R. (see sketch)

OWNER U. S. Navy

DATE COMPLETED Spring 1943

DIAMETER OF CASING

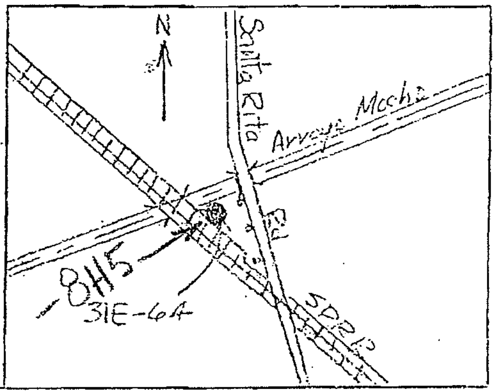
DRILLED BY

SOURCE OF INFORMATION C. Marliave

INSPECTED WHILE DRILLING SEE FILE NO.

SURFACE ELEVATION

SKETCH



DEPTH	ELEVATION OF BOTTOM OF STRATUM	MATERIAL	THICKNESS FEET	% VOIDS	ABSOLUTE VOIDS FEET	TOTAL VOIDS FEET
0-3		Soil	3			
3-53		Clay	50			
53-71		Gravel	18			
71-82		Yellow clay	11			
82-118		Blue clay	36			
118-120		Yellow clay	2			
120-133		Gravel (perforated)	13			
133-148		Yellow clay	15			
148-156		Gravel (perforated)	8			
156-159		Yellow clay	3			
159-165		Gravel (perforated)	6			
165-178		Yellow clay	13			
178-186		Fine gravel and sand	8			
186-197		Yellow clay	11			
197-205		Gravel (perforated)	8			
205-215		Yellow clay	10			

FOR FIELD COPIES USE ALTERNATE LINES

LOG OBTAINED BY R. A. Basye DATE August 10, 1949

57698 9-32 1EM CALIFORNIA STATE PRINTING OFFICE

3S/1E-8H5

WELL LOG

WELL #4

Well for - McNeil Construction Co.
Location - Pleasanton, California
Date - May 6, 1943
Driller - Art Daly
Size - 14" x 10 gauge

0-3	Soil
3-53	Clay
53-71	Gravel
71-82	Yellow clay
82-118	Blue clay
118-120	Yellow clay
120-133	Gravel
133-148	Yellow clay
148-156	Gravel
156-159	Yellow clay
159-165	Gravel
165-178	Yellow clay
178-186	Fine gravel and packed sand
186-197	Yellow clay
197-205	Gravel
205-215	Yellow sandy clay

Perforated

6 cuts to 10"

120-133 -- 13'
148-156 -- 8'
159-165 -- 7'
197-205 -- 8'

All measurements from existing ground level. Correction for permanent pump setting plus 4 from base of pump.

Bottom of well filled with cement to 210'.

3S/1E-8H5

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

30314

Do not fill in

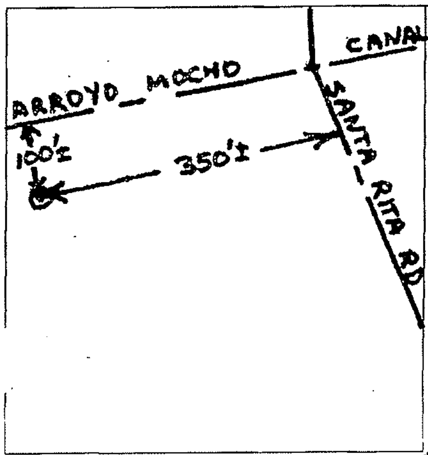
No. 299155

State Well No. 3S/1E-08H05
Other Well No.

otice of Intent No. 208434
Local Permit No. or Date 88372

(1) OWNER: Name U.S. Army
Address
City ZIP

(2) LOCATION OF WELL (See instructions):
County Alameda Owner's Well Number
Well address if different from above Pleasanton
Township 3 south Range 1 east Section 8
Distance from cities, roads, railroads, fences, etc.
100'± from Arroyo Mocho Canal,
350'± from Santa Rita Road.



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☐ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☒ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☑
Irrigation ☑
Industrial ☐
Test Well ☐
Municipal ☐
Other ☑
(Describe)

(5) EQUIPMENT:
Rotary ☐ Reverse ☐
Cable ☐ Air ☐
Other ☒ Bucket ☐

(6) GRAVEL PACK:
Yes ☐ No ☑ Size
Diameter of bore
Packed from to ft.

(7) CASING INSTALLED:
Steel ☐ Plastic ☐ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
				7	17	mills

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 22 ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval ft.
Method of sealing neat cement

(10) WATER LEVELS:
Depth of first water, if known ft.
Standing level after well completion ft.

(11) WELL TESTS:
well test made? Yes ☐ No ☒ If yes, by whom?
of test Pump ☐ Bailer ☐ Air lift ☐
th to water at st~~XXXXX~~ 60 ft. At end of test ft.
ischarge gal/min after hours Water temperature
Chemical analysis made? Yes ☐ No ☒ If yes, by whom?
Was electric log made Yes ☐ No ☒ If yes, attach copy to this report

(12) WELL LOG: Total depth ft. Completed depth ft
from ft to ft. Formation (Describe by color, character, size or material)

1. Removed lineshaft turbine pump.
2. Cut casing 2' below grade.
3. Removed slab.
4. Perforated from 7' to 17' with a Mills knife perforator.
5. Filled well:
215 - 22 pea gravel
22 - 2 neat cement
2 - 0 native material.

Work started 15 Aug. 1988 Completed 19 Aug. 1988

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed J. H. DeLucchi
(Well Driller)
NAME DELUCCHI WELL & PUMP, INC.
(Person, firm, or corporation) (Typed or printed)
Address 35137 Missen Blvd.
City Fremont, CA. ZIP 94536-1598
License No. C57-394454 Date of this report 19 Oct. 1988

CONFIDENTIAL
NOT FOR PUBLIC USE
WATER CODE SEC. 13752

DWR 188 (REV. 12-86)

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

86 96355

QUADRUPLICATE
For Local Requirements

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 509803

Page 1 of 1
Owner's Well No. 1
Date Work Began 12-6-96 . Ended 12-12-96
ocal Permit Agency Alameda County Env. Health
Permit No. 96863 Permit Date

DWR USE ONLY — DO NOT FILL IN
3S 1E 8H 2
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DEPTH TO FIRST WATER k/n (Ft.) BELOW SURFACE

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	21	topsoil/sandy clays
21	47	clays
47	78	gravel/rock
78	81	clays
81	111	clays w/chasing gravels
111	171	sand & ~~grauds~~ w/some clay
171	195	clay & gravel
195	205	gravel
205	215	gravel & small rock
215	225	gravel & rock/sands some clays
225	246	gravel & clays few sand streaks
246	276	clay w/some sand & gravel
276	305	sand & gravel
305	315	mostly clay
315	330	sand & gravel
330	351	sandy gravel & rock
351	396	sandy gravel & rock
396	426	med to very coarse sand
426	456	fine to very coarse sands almost
		gravel
56	505	sandy gravel w/some clays
505	561	" " " " "
561	591	sand/gravel/rock/clay
591	636	sandy gravel/w.some clays
636	726	fine to very coarse sands w/cemented
		streaks/some clays
726	741	fine to coarse sands w/clay strks
741	786	fine to very coarse sands w/clays
786	831	clays w/few sand stringers
831	846	sands

TOTAL DEPTH OF BORING 846 (Feet)
TOTAL DEPTH OF COMPLETED WELL ______ (Feet)

WELL OWNER

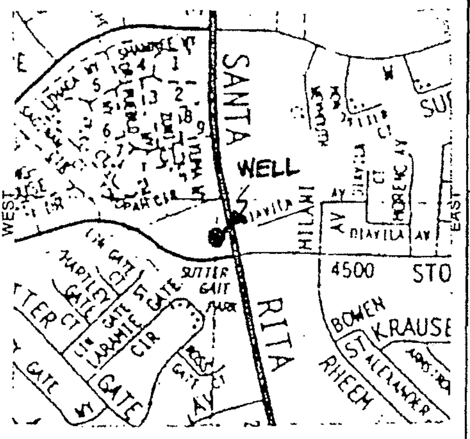
Name Luhdorff & Scalmanini
Mailing Address 500 First St.
Woodland Ca. 95695
CITY STATE ZIP

WELL LOCATION

Address Dublin/San Ramon Svc. Dist/Camp Parks
City Pleasanton
County Alameda
APN Book ______ Page ______ Parcel ______
or
Township 3S Range 1E Section 8H
or
Latitude ___ NORTH Longitude ___ WEST
DEG. MIN. SEC. DEG. MIN. SEC.

LOCATION SKETCH

NORTH



SOUTH

Illustrate or Describe Distance of Well from Landmarks such as Roads, Buildings, Fences, Rivers, etc.
PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

X NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USE(S) (✓)

X MONITORING
WATER SUPPLY
___ Domestic
___ Public
___ Irrigation
___ Industrial
___ "TEST WELL"
___ CATHODIC PROTECTION
___ OTHER (Specify)

DRILLING METHOD ______ FLUID ______

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL ______ (Ft.) & DATE MEASURED ______
ESTIMATED YIELD* ______ (GPM) & TEST TYPE ______
TEST LENGTH ______ (Hrs.) TOTAL DRAWDOWN ______ (Ft.)
** May not be representative of a well's long-term yield.*

CASING(S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL/GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
		12 3/4								
***SEE ATTACHED SHEET										

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
✓ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ______
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

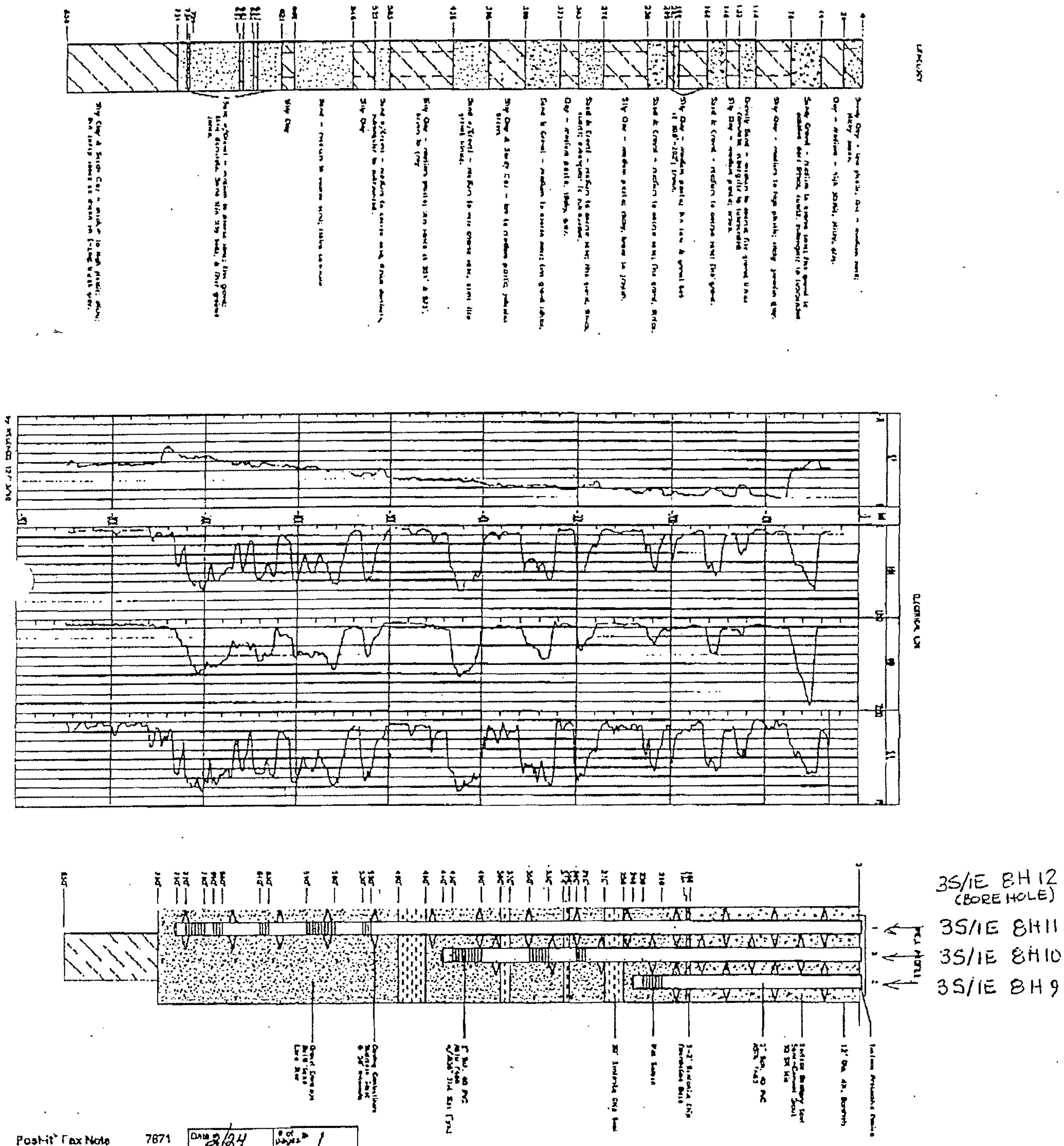
NAME Bradley & Sons
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

17702 Baldwin Madera Ca. 93638
ADDRESS CITY STATE ZIP

Signed ______ 2-24-97 414178
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 7-90

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM



Post-it® Fax Note 7871

Date 2/24	# of pages ▶ 1
To Doug Bradley	From Tom Elson
Co./Dept. Bradley + Sons	Co. LSCE
Phone # 309-674-1603	Phone # 916-661-0109
Fax # 309-674-1608	Fax # 916-661-6806

SHEET: 1/1

DATE: JANUARY 1993
JOB NO.: [illegible]
DRAWN BY: [illegible]
CHECKED BY: [illegible]
FILE: CAMPTH1.DWG

REVISIONS		
NO	DATE	REVISION

LUHDORFF & SCALMANINI
CONSULTING ENGINEERS

Monitoring Well Profile

Dublin San Ramon Service District
Camp Parks Testhole #1

ORIGINAL
File with DWR
Page 1 of 2
Owner's Well No. 7
Date Work Began 12/7/98, Ended 12/11/98
Local Permit Agency ALAMEDA COUNTY ZONE 7 WATER AGENCY
Permit No. 98167 Permit Date 10/9/98

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 817346

DWR USE ONLY — DO NOT FILL IN
3S1E 8H13
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD ______ FLUID ______

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION Describe material, grain size, color, etc.
0	25	GRAVEL, CLAY
25	40	CLAY
40	55	CLAY W/GRAVEL
55	70	GRAVELY W/VERY LITTLE CLAY
70	85	GRAVEL
85	100	GRAVELY CLAY SOME FINE-MED SAND
100	115	GRAVLEY CLAY SOME FINE-MED SAND
115	130	GRAVELY CLAY ; CLAY
130	145	GRAVELY CLAY
145	160	GRAVEL
160	175	GRAVEL
175	190	GRAVEL, FINE TO COURSE SANDS
190	205	GRAVLEY CLAY W/FINE TO MED SANDS
205	220	GRAVEL SOME SANDS
220	235	GRAVEL W/GRAVELY CLAY
235	250	GRAVEL SOME SANDS
250	265	GRAVEL AND CLAY
265	280	CLAY W/SOME GRAVEL
80	295	CLAY
5	310	CLAY, GRAVEL CLAY
310	325	GRAVELY CLAY
325	340	GRAVLEY CLAY
340	355	GRAVELY CLAY
355	370	GRAVELY CLAY
370	385	GRAVLEY CLAY
385	400	GRAVELY CLAY, FINE TO MED SANDS
400	415	FINE TO MEDIUM SAND W/CLAY
415	430	FINE TO MED SANDS, CLAY, GRAVEL
430	445	GRAVEL AND CLAY
445	460	GRAVEL, CLAY, FINE TO MED SANDS

TOTAL DEPTH OF BORING ______ (Feet)
TOTAL DEPTH OF COMPLETED WELL ______ (Feet)

WELL OWNER

Name ZONE 7 WATER AGENCY
Mailing Address 5997 PARKSIDE DR.
PLEASANTON CA 94588
CITY STATE ZIP

WELL LOCATION

Address STONERIDGE DR. & SANTA RITA RD.
City PLEASANTON
County ALAMEDA
APN Book 946 Page 3325 Parcel 095 03
Township ______ Range ______ Section ______
Latitude ___ ___ ___ NORTH DEG. MIN. SEC.
Longitude ___ ___ ___ WEST DEG. MIN. SEC.

LOCATION SKETCH

NORTH
WEST
EAST
SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

___ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
___ Irrigation ___ Industrial
MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ______ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL ______ (Ft.) & DATE MEASURED ______
ESTIMATED YIELD * ______ (GPM) & TEST TYPE ______
TEST LENGTH ______ (Hrs.) TOTAL DRAWDOWN ______ (Ft.)
** May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
570	580	8 3/4"		X			2" SCH 40	2		
580	600	"	X				" "	"		
600	630	"		X			" "	"		
630	660	"	X				" "	"		
660	670	"		X			" "	"		
670	690	"	X				" "	"		

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	280	X			

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ______
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME BRADLEY & SONS
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

17702 BALDWIN MADERA CA 93638
ADDRESS CITY STATE ZIP

Signed Becky Dunn 1-28-99 414178
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR
Page 2 of 2
Owner's Well No.
Date Work Began , Ended
Local Permit Agency
Permit No. Permit Date

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 817347

DWR USE ONLY — DO NOT FILL IN

3	S	1	E		8	H	1	3

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ___ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD ___ FLUID ___

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
460	475	GRAVEL,CLAY,SAND
475	490	GRAVEL,CLAY,SAND
490	505	SANDS W/CLAY STRINGERS
505	520	CLAY STRINGERS
520	535	CLAY W/FEW SAND STREAKS
535	550	CLAY W/FEW SAND STREAKS
550	565	SAND STREAKS
565	585	SANDS W/SOME CLAYS
585	595	CLAY W/SOME SANDS
595	636	FINE TO COURSE SAND,FEW CLAY STREAKS
636	670	" "
670	683	CLAYS W/SOME SANDS
683	715	FINE TO COURSE SAND,GRAVEL,CLAYS
715	730	FINE TO COURSE SAND AND CLAYS
730	745	CLAYS W/SOME SANDS
745	760	FINE TO COURSE SAND W/CLAYS
760	785	FINE TO CURSE SANDS W/CLAYS
785	805	CLAYS W/SOME SANDS

TOTAL DEPTH OF BORING 805 (Feet)
TOTAL DEPTH OF COMPLETED WELL 800 (Feet)

WELL OWNER

Name
Mailing Address
CITY STATE ZIP

WELL LOCATION

Address
City
County
APN Book Page Parcel
Township Range Section
Latitude DEG. MIN. SEC. NORTH Longitude DEG. MIN. SEC. WEST

LOCATION SKETCH

NORTH

WEST EAST

SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

___ NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
___ Irrigation ___ Industrial
MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL ___ (Ft.) & DATE MEASURED ___
ESTIMATED YIELD * ___ (GPM) & TEST TYPE ___
TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)
** May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
690	730	8 3/4		X			SCH 40	2		
730	740	" "	X				" "	"		
740	790	" "		X			" "	"		

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME BRADLEY & SONS
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

17702 BALDWIN MADERA CA 93638
ADDRESS CITY STATE ZIP

Signed Becky Dunn 1-28-99 414178
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

Page 1 of 2

Owner's Well No. ______

Date Work Began 1-19-99, Ended 2-13-99

Local Permit Agency Alameda County Zone & Water Resc.

Permit No. 98181 Permit Date October 30, 1998

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 510070

DWR USE ONLY — DO NOT FILL IN

3S 1E 8H 14
STATE WELL NO./STATION NO.

LATITUDE ______ LONGITUDE ______

APN/TRS/OTHER ______

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DEPTH TO FIRST WATER 60 (Ft.) BELOW SURFACE

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	3	top soil
3	12	Dark Borwn Clay
12	40	Hard Brown Clay
40	45	Brown Sandy Clay
45	52	Med. Gravel & Brown Clay
52	68	Hard Cemented Sand & Med.Gr
68	72	Brown Sandy Clay
72	94	Large Med. Gravel
94	96	Brown Clay & Med. Gravel
96	119	Hard Brown Clay
119	132	Grey Clay
132	140	Brown Sandy Clay
140	152	Med. Gravel
152	182	Gravel & Brown Clay
182	184	Brown Clay
184	194	Med. Gravel & Brown Clay
194	195	Hard Brn. Sandy Clay Fine Gr
195	207	Brown Clay & Fine Sand
07	213	Med. Fine Gravel Fine Sand
13	220	Large Med. Gravel
220	223	Large Med.Gravel Brn Clay
223	253	Large Med. Gravel
253	255	Brn. Clay Fine Gravel/Sand
255	278	Grey Sandy Clay & Med. Grav
278	301	Hard Brn. Clay Fine Gravel
301	320	Large.Med.Fine Grav. Sand
320	325	Brown Clay & Med. Gravel
325	340	Brown Clay
340	375	Fine Med. Gravel Coarse Snd
375	390	Brown Clay sand & Gravel

TOTAL DEPTH OF BORING 760 (Feet)

TOTAL DEPTH OF COMPLETED WELL 760 (Feet)

WELL OWNER

Name Alameda County Zone 7 Water Resc.

Mailing Address 5997 Parkside Dr.

Pleasanton, Calif. 94588-5127
CITY STATE ZIP

WELL LOCATION

Address S. W. Corner Stone Ridge & Santa rita

City Pleasanton

County Alameda

APN Book 946 Page 3325 Parcel 095-03

or

Township 035 Range 01E Section 08H14

or

Latitude ___ DEG. ___ MIN. ___ SEC. NORTH Longitude ___ DEG. ___ MIN. ___ SEC. WEST

LOCATION SKETCH

NORTH

WEST

EAST

SOUTH

Illustrate or Describe Distance of Well from Landmarks such as Roads, Buildings, Fences, Rivers, etc.
PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR

___ Deepen

___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

PLANNED USE(S) (✓)

___ MONITORING

WATER SUPPLY

___ Domestic

___ Public

___ Irrigation

___ Industrial

X "TEST WELL"

___ CATHODIC PROTECTION

___ OTHER (Specify)

DRILLING METHOD Dual Rotary FLUID Air

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL 60 (Ft.) & DATE MEASURED 2-13-99

ESTIMATED YIELD* ______ (GPM) & TEST TYPE ______

TEST LENGTH ______ (Hrs.) TOTAL DRAWDOWN ______ (Ft.)

* *May not be representative of a well's long-term yield.*

CASING(S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	28	16								
0	320	12.75	x				steel	12	.375	
320	560	12.75	x				steel	12.25	.250	
530	560	12.75	x				steel	6	.250	
560	580	12.75		x			steel	6		.040
580	600	12.75	x				steel	6	.250	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	28	x			

ATTACHMENTS (✓)

___ Geologic Log

___ Well Construction Diagram

___ Geophysical Log(s)

___ Soil/Water Chemical Analyses

___ Other ______

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME De La Grange & Sons, Incorporated
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2711 Fairview Road Hollister, California 95023
ADDRESS CITY STATE ZIP

Signed ______ 3-23-99 532085
(WELL DRILLER/AUTHORIZED REPRESENTATIVE) DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 7-90 IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

Page 2 of 2   Log 510070 pg. 1

No. 510069

Owner's Well No.
Date Work Began 1-19-99, Ended 2-13-99
Local Permit Agency
Permit No. 98181   Permit Date October 30, 1998

DWR USE ONLY — DO NOT FILL IN
35 | E 8H 14
STATE WELL NO./STATION NO.
LATITUDE   LONGITUDE
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DEPTH TO FIRST WATER ______ (Ft.) BELOW SURFACE

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
390	400	Red Clay
400	514	Coarse Sand Fine Med. Gravel
514	520	Hard Brown Clay Med. Gravel
520	542	Large Med. Gravel Coarse Snd
542	560	Brown Clay Sandy
560	573	Large Med. Gravel Coarse Snd.
573	585	Brown Hard Silty Sand
585	645	Large Med. Gravel Coarse Snd.
645	649	Hard Brown Clay
649	672	Large Med. Gravel Coarse Snd.
672	683	Hard Brown Sandy Clay
683	688	Cemented Gravel Fine Silt Snd
688	721	Large Med. Gravel Hard Fine
		Sand and Silt
721	727	Silty Brn. Clay Med. Gravel
727	740	Brown Silty clay
740	753	Hard Med. Fine Gravel Sand
		Additional Blank 6" steel
		730' - 740'
		Additional Screen 6" steel
		740' - 760'
753	760	Large Gravel Cobble Stone

TOTAL DEPTH OF BORING 760 (Feet)
TOTAL DEPTH OF COMPLETED WELL 760 (Feet)

WELL OWNER

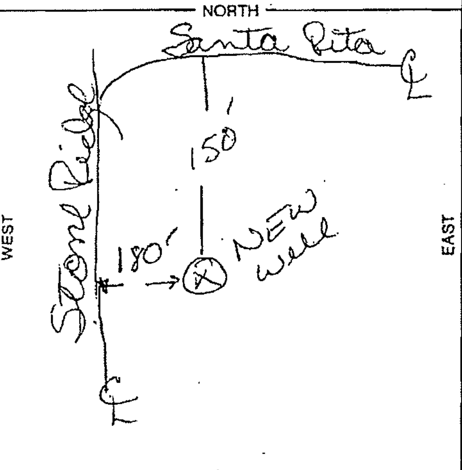
Name
Mailing Address
CITY   STATE   ZIP

WELL LOCATION

Address
City
County
APN Book 946 Page 3325 Parcel 095-03
Township 035 Range 01E Section 08H14
Latitude ___ NORTH   DEG. MIN. SEC.   Longitude ___ WEST   DEG. MIN. SEC.

LOCATION SKETCH

NORTH



SOUTH

Illustrate or Describe Distance of Well from Landmarks such as Roads, Buildings, Fences, Rivers, etc.
PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

___ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USE(S) (✓)

___ MONITORING
WATER SUPPLY
___ Domestic
___ Public
___ Irrigation
___ Industrial
___ "TEST WELL"
___ CATHODIC PROTECTION
___ OTHER (Specify)

DRILLING METHOD Dual Rotary   FLUID air

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL ______ (Ft.) & DATE MEASURED ______
ESTIMATED YIELD* ______ (GPM) & TEST TYPE ______
TEST LENGTH ______ (Hrs.) TOTAL DRAWDOWN ______ (Ft.)
** May not be representative of a well's long-term yield.*

CASING(S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL/ GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
600	630	12.75		x			steel	6		.040
630	650	12.75	x				steel	6		
650	670	12.75		x			steel	6		.040
670	680	12.75	x				steel	6		
680	690	12.75		x			steel	6		.020
690	730	12.75		x			steel	6		.040

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ______

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME De La Grange & Sons, Inc.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2711 Fairview Road Hollister, Californai 95023
ADDRESS   CITY   STATE   ZIP

Signed President, Joseph T   3-23-99   532085
WELL DRILLER/AUTHORIZED REPRESENTATIVE   DATE SIGNED   C-57 LICENSE NUMBER

DWR 188 REV. 7-90   IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

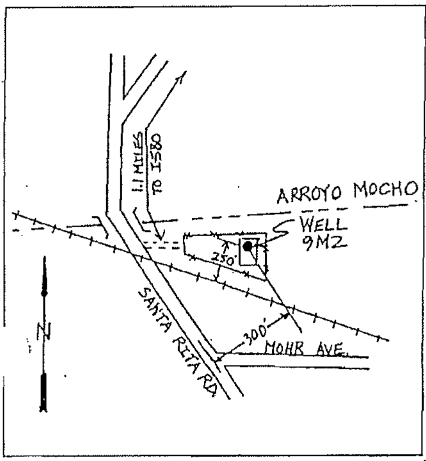
No. 271972

Notice of Intent No.
Local Permit No. or Date

State Well No. 3S/1E 9M2
Other Well No. Mocho Well #1

(1) OWNER:
Name Zone 7 Water Agency
Address 5997 Parkside Drive
City Pleasanton ZIP 94588

(2) LOCATION OF WELL (See instructions):
County Alameda Owner's Well Number
Well address if different from above 2722 SANTA RITA RD.
Township 3S Range 1E Section 9
Distance from cities, roads, railroads, fences, etc. Near Santa Rita Road north of Mohr Avenue in Pleasanton.



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☒
Other ☐
(Describe)

(5) EQUIPMENT:
Rotary ☒ Reverse ☐
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size 4 x 16
Diameter of bore 30 inch
Packed from 0 to 530 ft.

(7) CASING INSTALLED:
Steel ☒ Plastic ☐ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	45	30	5/16	150	270	3x1/8
0	530	16	1/4	330	510	3x1/8
Factory	milled	8	perf.	per row	4 rows	per ft.

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 0 - 45 ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval ft.
Method of sealing cement

(10) WATER LEVELS:
Depth of first water, if known not available ft.
Standing level after well completion not available ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? Driller
Type of test Pump ☐ Bailer ☐ Air lift ☐
XXXXXXXXXXXXXXt 21 ft. drawdown At end of test ft.
Discharge 3000 gal/min after 71 hours Water temperature
Chemical analysis made? Yes ☐ No ☒ If yes, by whom?
Was electric log made Yes ☒ No ☐ If yes, attach copy to this report

(12) WELL LOG:
Total depth 558 ft. Completed depth 530 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	8	Top soil.
8	43	Yellow clay.
43	55	Yellow sandy clay.
55	83	Coarse sand.
83	95	Heavy gravel.
95	103	Gravel.
103	120	Gray sandy clay.
120	140	Blue clay.
140	145	Sandy blue clay and gravel.
145	148	Sand and gravel packed in clay.
148	155	Gray sandy clay and gravel.
155	166	Heavy gravel.
166	169	Hard sand.
169	185	Gravel (tight).
185	192	Coarse sand (free).
192	203	Cemented gravel.
203	219	Yellow sandy clay.
219	262	Gravel, clay streaks, few
		boulders.
262	272	Gravel (tight).
272	285	Brown sandy clay, some gravel.
285	331	Blue sandy clay.
331	344	Gravel (free).
344	365	Brown sandy clay and gravel.
365	380	Gray clay.
380	386	Coarse sand and gravel.
386	410	Gravel, clay streaks.
410	416	Yellow clay.
416	433	Gravel (tight).
433	438	Yellow clay.
438	443	Blue clay.
443	453	Yellow clay.
453	475	Gravel (clay streaks).
475	487	Gravel (yellow clay streaks).
487	510	Hard yellow sandy clay and
		gravel.
510	515	Brown sandy clay and gravel.

-Well log continued and E log on
-reverse.

Work started 11 Feb 1964 Completed 24 Apr 1964

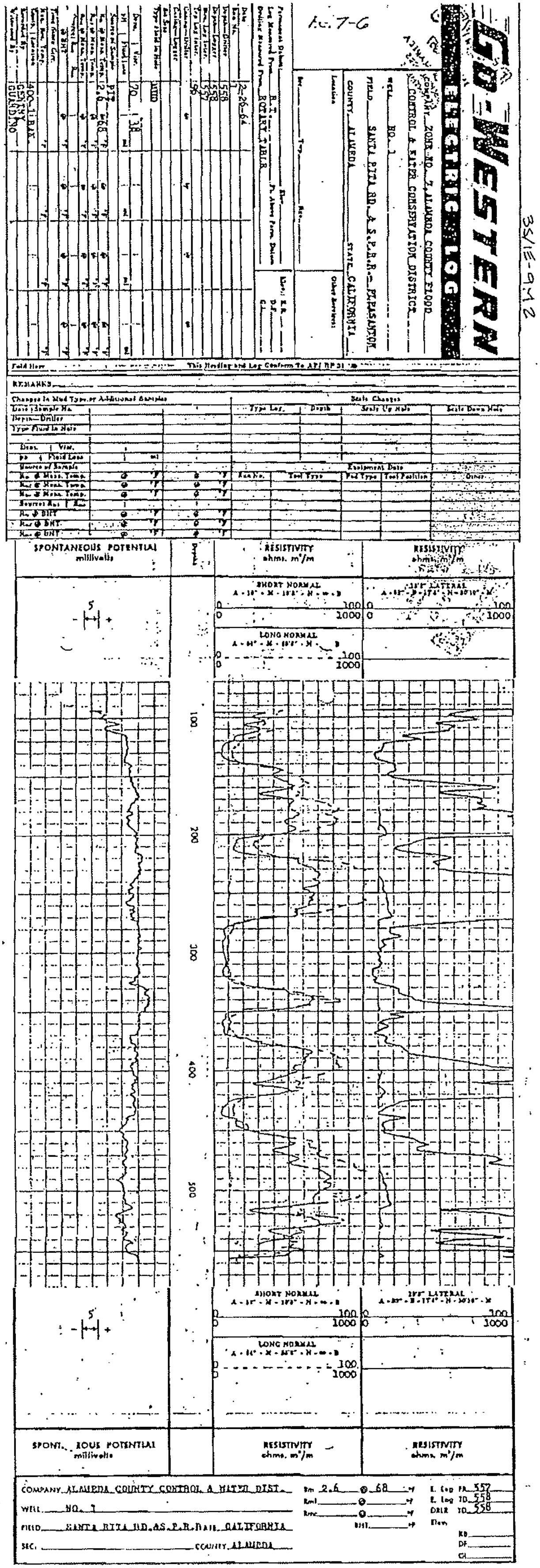
WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed Original report signed S. A. indicisi?
(Well Driller)
NAME Western Well Drilling Company, Ltd.
(Person, firm, or corporation) (Typed or printed)
Address P. O. Box 47
City San Jose ZIP 95103
License No. 25182 Date of this report 14 Jul 64

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

3S/1E 9M2



COMPANY ALAMEDA COUNTY CONTROL A WATER DIST.
WELL NO. 1
FIELD SANTA RITA RD. AS. P.R. Rail CALIFORNIA
SEC. COUNTY ALAMEDA
Rm 2.6 @ 68 °F
E. Log FR 557
E. Log TD 558
DRLR TD 558

Well log continued...

from ft.	to ft.	Formation
515	- 524	Gravel (tight).
524	- 545	Gravel, cemented.
545	- 554	Coarse sand and gravel, little gray clay.
554	- 555	Cemented gravel.
555	- 558	Yellow sandy clay.

Information from original Western Well Drilling Company Water Well Drillers Report.

WH 11 Jul 90

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in:

No. [illegible]

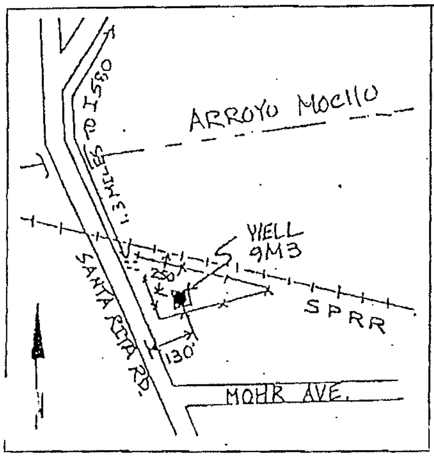
Information mainly from original Drillers
Report supplemented with other Zone 7 file
information for this well. TNW 13 Aug 90

Notice of Intent No. ________
el Permit No. or Date ________

State Well No. 3S/1E 9M3
Other Well No. Mocho #2

(1) OWNER: Name Zone 7 Water Agency
Address 5997 Parkside Drive
City Pleasanton ZIP 94588

(2) LOCATION OF WELL (See instructions):
County Alameda Owner's Well Number ________
Well address if different from above 2552 Santa Rita Road
Township 3S Range 1E Section 9
Distance from cities, roads, railroads, fences, etc. East side of Santa Rita Road north of Mohr Avenue in Pleasanton.



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☒
Other ☐
(Describe)

(5) EQUIPMENT:
Rotary ☒ Reverse ☐
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size ________
Diameter of bore 28 inch
Packed from 0 to 575 ft.

(7) CASING INSTALLED:
Steel ☒ Plastic ☐ Concrete ☐

(8) PERFORATIONS: Roscoe-Moss
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	150	32	5/16	250	330	3 x 3/8
0	575	18	5/16	450	570	3 x 3/8

Factory milled 14 perforations per row.

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 0 - 147 ft.
Were strata sealed against pollution? Yes ☐ No ☐ Interval ________ ft.
Method of sealing cement grout 32" ID . 38" OD

(10) WATER LEVELS:
Depth of first water, if known ________ ft.
Standing level after well completion ________ ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? Driller
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test ________ ft. At end of test ________ ft.
arge 3000 gal/min after ________ hours Water temperature ________
emical analysis made? Yes ☐ No ☐ If yes, by whom? ________
as electric log made Yes ☒ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth 615 ft. Completed depth 575 ft.

from ft.	to	ft.	Formation (Describe by color, character, size or material)
0	-	4	Top soil.
4	-	6	Sand.
6	-	18	Loam.
18	-	30	Gray clay.
30	-	42	Blue clay.
42	-	51	Yellow sandy clay.
51	-	133	Gravel, sand and boulders
	-		(loose).
133	-	142	Yellow sandy clay.
142	-	160	Blue sticky clay.
160	-	164	Gravel and sand.
164	-	169	Yellow sandy clay.
169	-	188	Blue clay.
188	-	207	Gray clay.
207	-	232	Gravel, sand and boulders
	-		(loose).
232	-	235	Yellow clay.
235	-	251	Gray sandy clay.
251	-	318	Gravel, sand and boulders.
318	-	327	Gravel, sand and gravelly
	-		yellow clay layers.
327	-	332	Yellow clay.
332	-	341	Gray and yellow clay.
341	-	389	Blue clay.
389	-	410	Yellow clay.
410	-	446	Gray and yellow clay.
446	-	471	Gravel, sand and boulders.
471	-	482	Yellow gritty clay.
482	-	511	Gravel, sand and boulders.
511	-	525	Yellow sandy clay.
525	-	565	Gravel, sand and boulders
	-		showing some yellow clay.
565	-	574	Yellow sandy clay.
574	-	595	Gravel, sand showing some
	-		yellow clay.
595	-	610	Gravel, sand, boulders showing
	-		some yellow clay.
610	-	615	Gravel, sand and boulders.

See E log on reverse.

Work started ________ 19__ Completed February 1967

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed Original report signed P.L. unreadable
(Well Driller)
NAME C & N Pump and Well Company
(Person, firm, or corporation) (Typed or printed)
Address 1745 Walsh Avenue
City Santa Clara ZIP 95050
License No. 68648 Date of this report 21 Feb 68

DWR 188 (REV. 12-86)

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

86 96355

Changes in Mud Type or Additional Samples				
Date	Sample No.			
Depth—Driller				
Type Fluid in Hole				
Dens.	Visc.			
ph	Fluid Loss	ml		
Source of Sample				
R_m @ Meas. Temp.	@ °F		@ °F	
R_{mf} @ Meas. Temp.	@ °F		@ °F	
R_{mc} @ Meas. Temp.	@ °F		@ °F	
Source: R_{mf}	R_{mc}			
R_m @ BHT	@ °F		@ °F	
R_{mf} @ BHT	@ °F		@ °F	
R_{mc} @ BHT	@ °F		@ °F	

Scale Changes			
Type Log	Depth	Scale Up Hole	Scale Down Hole

Equipment Data				
Run No.	Tool Type	Pad Type	Tool Pos.	Other
1	S-54		FREE	

SCHLUMBERGER ELECTRICAL LOG

COMPANY C & N PUMP AND WELL

WELL ALAMEDA COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT WELL – MOCHO #2

FIELD 3S/1E-9M3

COUNTY ALAMEDA STATE CALIFORNIA

LOCATION

Sec. 9 Twp. 3 Rge. 1

Other Services:

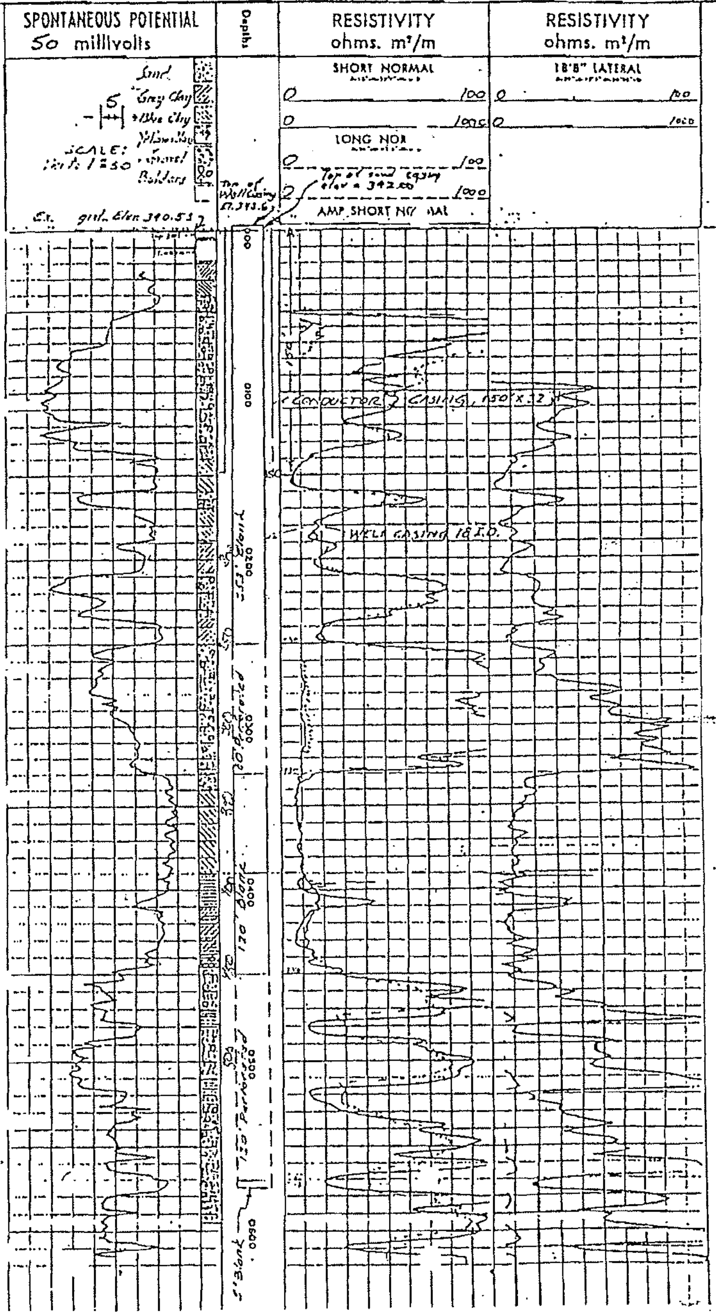
COUNTY
FIELD
LOCATION
WELL
COMPANY

Permanent Datum: ______, Elev. ______
Log Measured From ______ Ft. Above Perm. Datum
Drilling Measured From ______

Elev.: K.B. ______
D.F. ______
G.L. ______

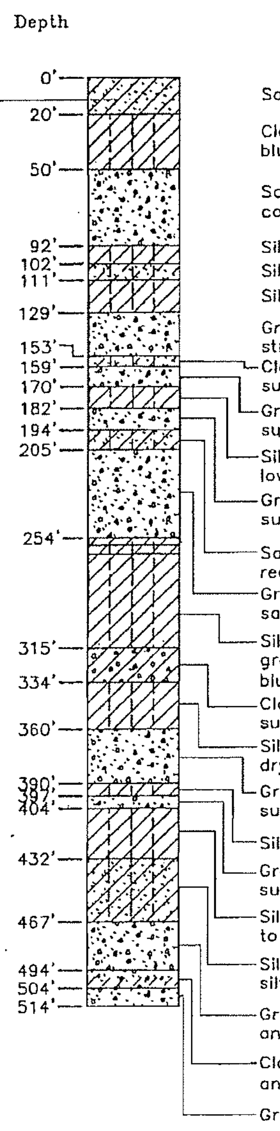
Date	2-24-67							
Run No.	-1-							
[illegible]—Driller	615							
[illegible]gger	615							
[illegible]erval	614							
[illegible]terval	70							
[illegible]—Driller	– @ –		@		@		@	
Casing—Logger	–							
Bit Size	12¼							
Type Fluid in Hole	FRESH NAT							
Dens. | Visc.	NA	NA						
pH | Fluid Loss	8	NA ml		ml		ml		ml
Source of Sample	CIRCULATED							
R_m @ Meas. Temp.	17.9 @ 57 °F		@ °F		@ °F		@ °F	
R_{mf} @ Meas. Temp.	– @ – °F		@ °F		@ °F		@ °F	
R_{mc} @ Meas. Temp.	– @ – °F		@ °F		@ °F		@ °F	
Source: R_{mf} | R_{mc}	–	–						
R_m @ BHT	– @ – °F		@ °F		@ °F		@ °F	
Time Since Circ.	1 HR							
Max. Rec. Temp.	– °F		°F		°F		°F	
Equip. | Location	3768	JRC						
Recorded By	CREEL							
Witnessed By								

3S/1E-9M3



3S/1E 9M4

MOCHO WELL #3 (AS-BUILT)
LITHOLOGY



Description

Sandy Clay – low plastic, bluish brown

Clay/Silty Clay – high plastic, sticky, stiff, bluish gray to reddish brown

Sand & Gravel – coarse sand to coarse gravel w/pebbles and cobbles, subangular to subrounded

Silty Clay – medium to high plastic, stiff, blue

Silty Sandy Clay – medium plastic, brown

Silty Clay – medium to high plastic, bluish gray to reddish brown

Gravel – fine to coarse w/pebbles and cobbles, angular to subrounded, stringers of silty clay, low plastic, dry, brittle, poorly lithified, blue

Clayey Gravel – medium to coarse w/pebbles and cobbles, subangular to subrounded

Gravel – fine to medium, up to coarse w/pebbles and cobbles, subangular to subrounded

Silty Clay – medium to high plastic, sticky, reddish brown, stringers of low plastic, dry, brittle, blue

Gravel – mostly fine up to coarse w/pebbles and cobbles, subangular to subrounded

Sandy Silty Clay – medium to high plastic, moderately sticky, reddish brown

Gravel – fine to coarse w/pebbles and cobbles, few very coarse sands, subangular to subrounded

Silty Clay – medium to high plastic, moderately to highly sticky, bluish gray to brown, 258–263 from e–log, silty clay, low plastic, dry, brittle, blue w/ fine gravel & pebbles

Clayey Gravel – very coarse sand to coarse gravel w/pebbles and cobbles, subangular to subrounded

Silty Clay – low to medium plastic, reddish brown & low plastic, dry, brittle, blue

Gravel – very coarse sand to coarse gravel w/pebbles and cobbles, subangular to subrounded

Silty Clay – low to medium plastic, bluish brown, w/mudstone, brittle, blue

Gravel – very coarse sand to coarse gravel w/pebbles and cobbles, subangular to subrounded

Silty Clay – low to medium plastic, soft, reddish brown to bluish gray

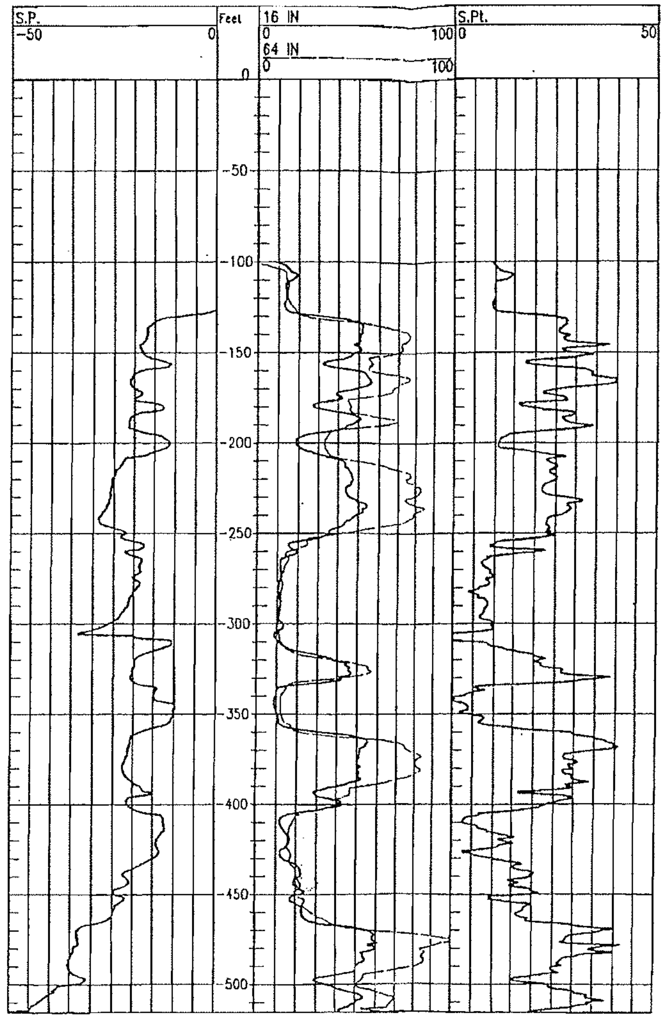
Silty Sandy Clay – low plastic, soft, reddish brown, stringers of silty clay, medium to high plastic, stiff, bluish gray to reddish brown

Gravel – fine to coarse w/pebbles and cobbles, angular to subrounded

Clayey Sand & Gravel – very coarse sand to fine gravel, few pebbles, angular to subrounded w/silty clay, low plastic, red

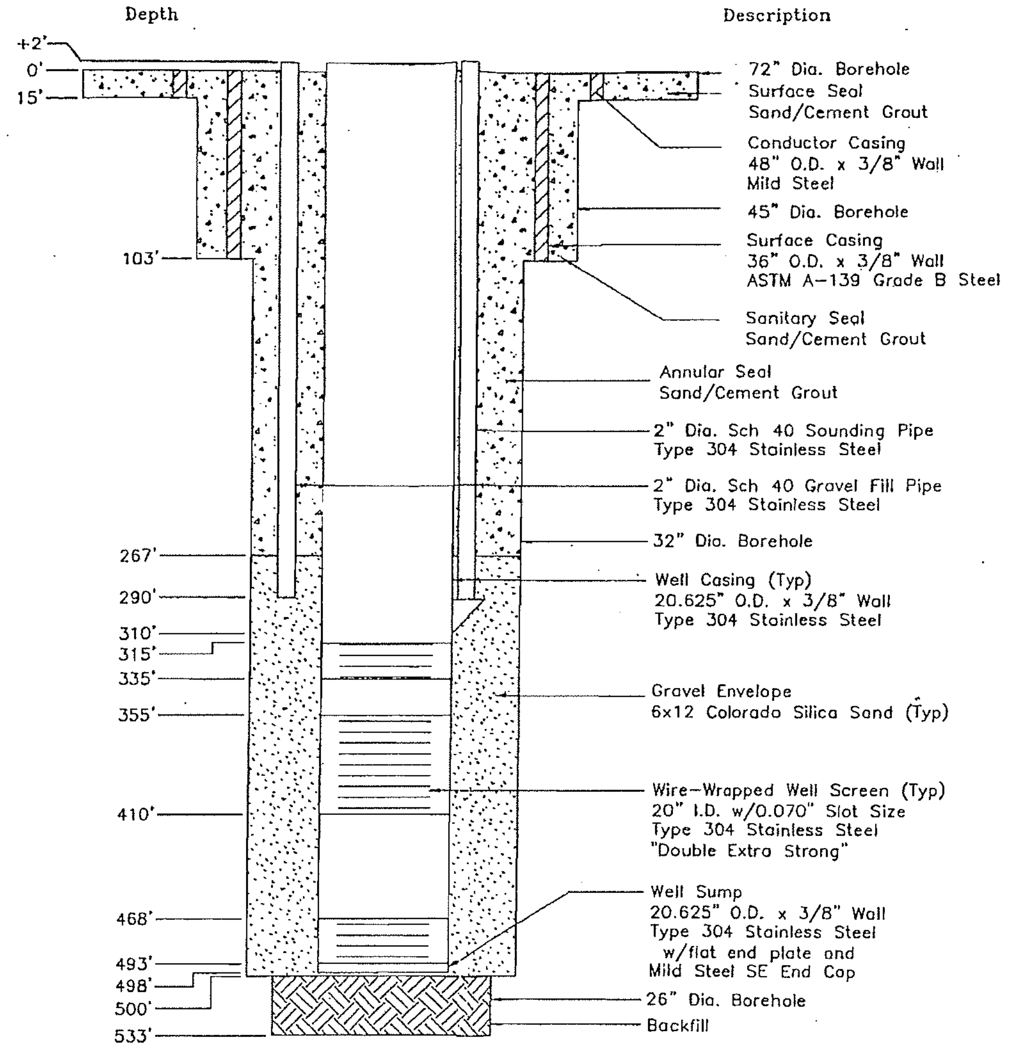
Gravel – fine to coarse, angular to subrounded

MOCHO WELL #3 (AS-BUILT)
ELECTRIC LOG



E–Log by WELENCO, 6/18/00

MOCHO WELL #3 (AS-BUILT)
WELL PROFILE



NOTE:

Centralizers of Type 304 Stainless Steel to be Installed Above and Below Screen Sections and at 80' Intervals to Surface.

BID SET

AS-BUILT

ZONE 7

ALAMEDA COUNTY
FLOOD CONTROL &
WATER CONSERVATION
DISTRICT

LINE IS 2 INCHES
AT FULL SIZE
(IF NOT 2"–SCALE ACCORDINGLY)

FILE G–3.DWG
DRAWN DWT
DESIGNED TDE
CHECKED LHE
CHECKED

JOHN D. FAWCETT
C 048255
Exp 6/30/04
CIVIL

LUHDORFF & SCALMANINI
CONSULTING ENGINEERS

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

ALAMEDA, COUNTY
MOCHO WELLS 3&4
PUMP STATIONS

SUBMITTED: DATE:
SUBMITTAL APPROVED: DATE:

WELL PROFILE

MOCHO WELL NO. 3

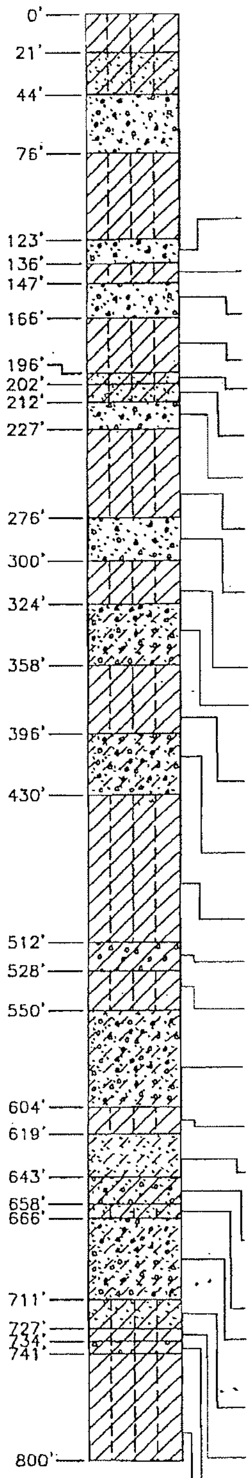
SCALE
AS SHOWN

DRAWING NUMBER
G-3

SHEET NUMBER
3 OF 36

3S/1E 8H18

MOCHO WELL #4 (AS-BUILT)
LITHOLOGY



Description

Silty Clay – high plastic, moderately stiff & sticky, bluish gray

Silty Sandy Clay – low to medium plastic, bluish gray, silty, moderately dry and brittle, reddish brown, dry and crumbly

Sand & Gravel – coarse sand to medium gravel, w/pebbles and cobbles, angular to subraunded

Silty Clay – medium to high plastic, moderately to very stiff, w/chunks of dry, poorly lithified, bluish gray, few stringers, soft, reddish brown

Sand & Gravel – coarse sand to fine gravel w/pebbles & cobbles, angular to subrounded, mostly moasic

Silty Cloy – low to medium plastic, stiff, gray and red molted, chunky or brittle, dry, clay, moderately lithified

Sand & Gravel – coarse sand to medium gravel w/pebbles and cobbles, subangular to subrounded, 75% mosaic

Silty Clay – low to medium plastic, stiff & sticky, grayish brown

Silty Sandy Clay – medium plastic, brown, coarse sand to medium gravel w/pebbles

Silty Sandy Clay – medium to high plastic, very stiff, brown, few pebbles and cobbles

Sand & Gravel – caarse sand to medium gravel, w/pebbles & cobbles, angular to subrounded, clean

Silty Cloy – low to medium plastic, moderately to very stiff, moderately to very sticky, bluish gray to brown, chunky or poorly to well lithified, dry, brittle, possible silt stone

Sand & Gravel – fine sand to medium gravel, few pebbles and cobbles, angular to subrounded, mostly clear w/few chunks silty clay, low to medium plastic, blue and brown

Silty Clay – high plastic, sticky, brown

Clayey Sand & Gravel – medium sand to coarse gravel w/ pebbles and possible cobbles, angular to subrounded, mostly fine to medium gravel, w/ silty clay, soft to stiff, low plastic, grayish brown

Silty Clay – low to high plastic, moderately stiff & sticky, brownish gray to reddish brown w/ chunks of silty clay, stiff, dry, brittle, brownish red & blue

Clayey Sand & Gravel – coarse sand to medium gravel w/ pebbles and cobbles, angular to subrounded, clay matrix, soft, low plastic, light brown w/ chunky dry brittle silty clay near bottom

Silty Cloy – low plastic, brittle, dry, poorly to moderately lithified, brown to blue

Clayey Gravel – fine to medium w/pebbles, angular to subrounded w/silty clay, low to medium plastic, soft to moderately stiff, reddish brown

Silty Clay – low to medium plastic, soft to moderately stiff, brown w/ lots of small chunky silty clay, dry, brittle, poorly to moderately lithified, blue

Sandy Gravely Cloy & Clayey Sand & Gravel – coarse sand to medium gravel, angular to subrounded and silty clay, low plastic. chunky, dry, brittle, poorly to moderately lithified, brown to blue

Silty Clay – medium plastic, moderately stiff slightly sandy, reddish brown w/chunks of dry brittle poorly lithified, blue

Clayey Sand & Gravel – very coarse sand to medium gravel w/pebbles & cobbles, angular to subrounded and silty clay, dry, brittle, poorly lithified, reddish brown to blue

Sandy Gravely Clay – low plastic, soft, brownish blue & dry, brittle very poorly lithified silty clay, blue w/fine sand to fine gravel, angular to subrounded

Sandy Silty Clay – low plastic soft w/few chunks very stiff, brown

Clayey Sand & Gravel – very fine sand to coarse gravel w/pebbles and cobbles, angular to subrounded w/silty clay, low plastic, soft, brown & brittle, poorly lithified, blue

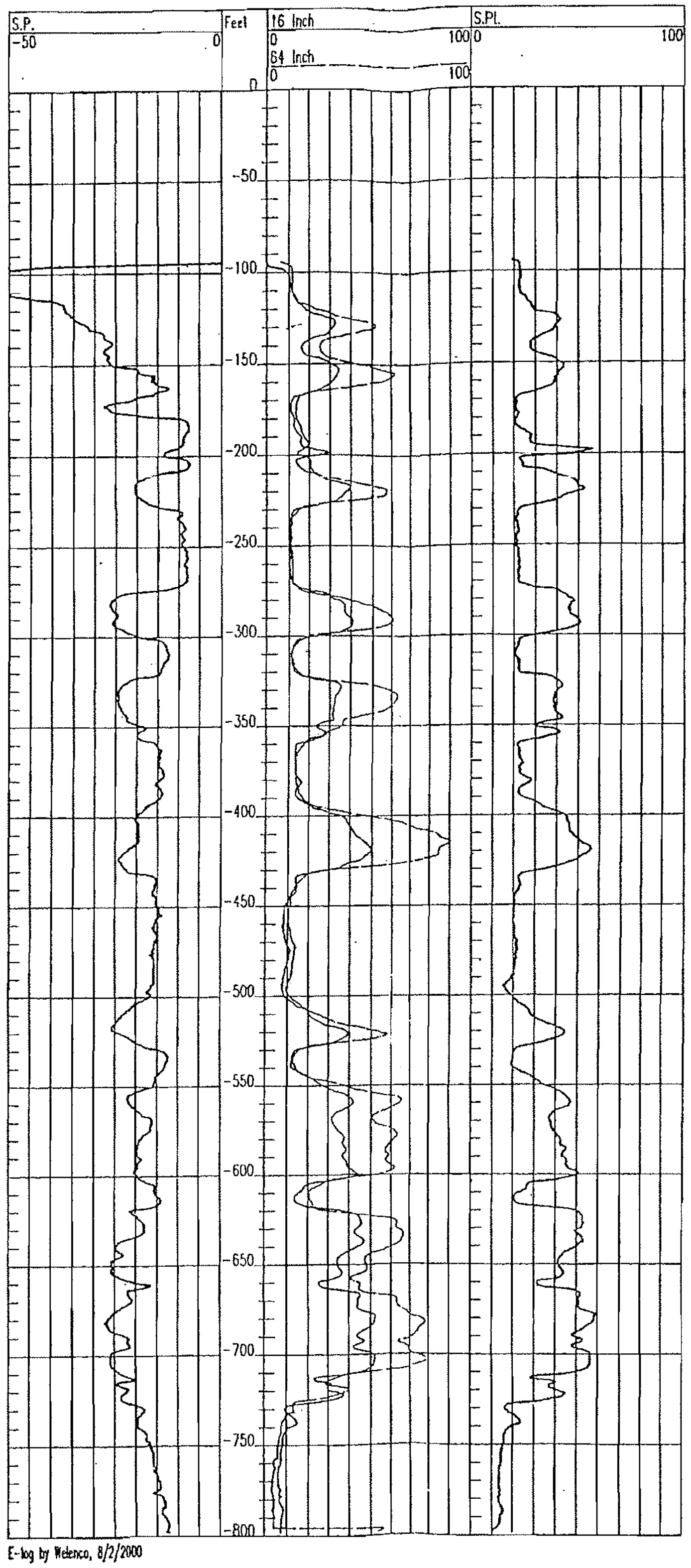
Sandy Gravelly Silty Cloy – low plastic, soft, brown w/fine sand to medium gravel, angular to subrounded

Silty Clay – low plastic, soft w/ chunks of dry brittle poorly lithified, bluish gray

Gravely Silty Clay – low plastic, soft, bluish gray

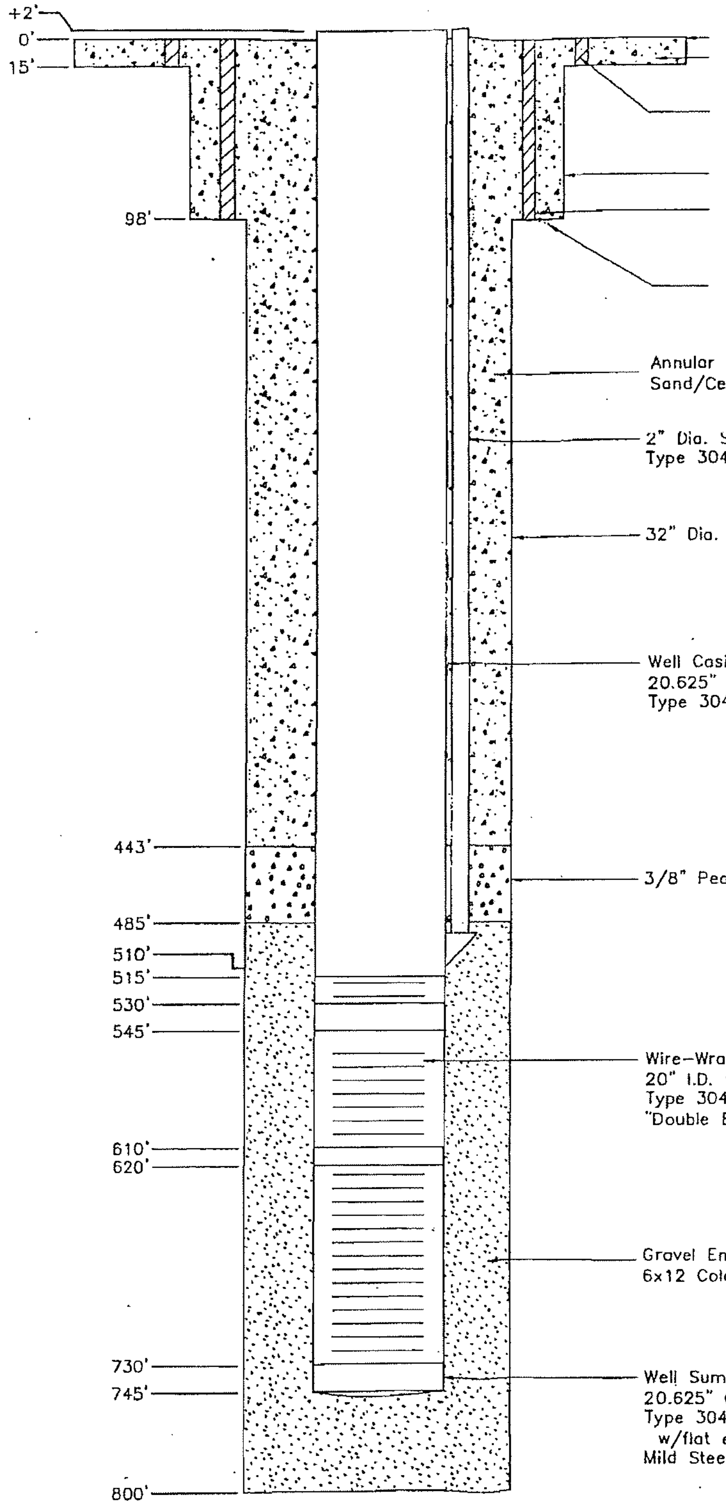
Silty Cloy – low plastic, very stiff, blue to brown

MOCHO WELL #4 (AS-BUILT)
ELECTRIC LOG



E-log by Welenco, 8/2/2000

MOCHO WELL #4 (AS-BUILT)
WELL PROFILE



Description

72" Dia. Borehole

Surface Seal
Sand/Cement Grout

Conductor Casing
48" O.D. x 3/8" Wall
Mild Steel

45" Dia. Borehole

Surface Casing
36" O.D. x 3/8" Wall
ASTM A-139 Grade B Steel

Sanitary Seal
Sand/Cement Grout

Annular Seal
Sand/Cement Grout

2" Dia. Sch 40 Sounding Pipe
Type 304 Stainless Steel

32" Dia. Borehole

Well Casing (Typ)
20.625" O.D. x 3/8" Wall
Type 304 Stainless Steel

3/8" Pea Gravel

Wire-Wrapped Well Screen (Typ)
20" I.D. w/0.070" Slot Size
Type 304 Stainless Steel
"Double Extra Strong"

Gravel Envelope
6x12 Colorado Silica Sand (Typ)

Well Sump
20.625" O.D. x 3/8" Wall
Type 304 Stainless Steel
w/flat end plate and
Mild Steel SE End Cap

BID SET

AS-BUILT

NOTE:
Centralizers of Type 304 Stainless Steel to be Installed Above and Below Screen Sections and at 80' Intervals to Surface.

ZONE 7

ALAMEDA COUNTY
FLOOD CONTROL &
WATER CONSERVATION
DISTRICT

LINE IS 2 INCHES
AT FULL SIZE
(IF NOT 2"-SCALE ACCORDINGLY)

FILE G-4.DWG
DRAWN DWT
DESIGNED TDE
CHECKED LHE
CHECKED

JOHN D. FAWCETT
C 048255
Exp 6/30/04

LUHDORFF & SCALMANINI
CONSULTING ENGINEERS

REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

ALAMEDA, COUNTY
MOCHO WELLS 3&4
PUMP STATIONS

SUBMITTED: ______ DATE: ______
SUBMITTAL APPROVED: ______ DATE: ______

WELL PROFILE
MOCHO WELL NO.4

SCALE
AS SHOWN

DRAWING NUMBER
G-4

SHEET NUMBER
4 OF 36

CAD FILE: G:\...\Zone 7/99-2-024/G-4.dwg CFG FILE: LSCE2500.PCP_MRG DATE: 11-03-00 9:04am