GEOTECHNICAL ENGINEERING STUDY
for
AUBURN LAKE TRAILS
WATER TREATMENT PLANT
Greenwood, California

Project No. E10208.000
January 2011

YOUNGDAHL
CONSULTING GROUP, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING

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Project No. E10208.000
19 January 2011

Psomas
1075 Creekside Ridge Drive, Suite #200
Roseville, California 95678

Attention: Mr. Roger Kohne

Subject: **AUBURN LAKE TRAILS WATER TREATMENT PLANT**
Sweetwater Trail, Greenwood, El Dorado County, California
GEOTECHNICAL ENGINEERING STUDY

Reference:
1. Draft Auburn Lake Trails WTP Proposed Site Plan, prepared by Psomas.
2. Agreement between Psomas and Subconsultant, prepared by Psomas, executed, 8 November 2010.
3. Proposal for Auburn Lake Trails Water Treatment Plan GES, prepared by Youngdahl Consulting Group, Inc.

Dear Mr. Kohne:

In accordance with your authorization, Youngdahl Consulting Group, Inc. has performed a geotechnical engineering study for the project site located on the west side of Sweetwater Trail in Greenwood, El Dorado County, California. The purpose of this study was to explore and evaluate the surface and subsurface soil conditions at the site and to develop geotechnical information and design criteria for the proposed project. Our scope was limited to a subsurface investigation, laboratory testing, and preparation of this report per our proposal dated 7 December 2011.

Based upon our field study, subsurface exploration program, laboratory testing and engineering analysis, we believe the primary geotechnical issues to be addressed consist of shallow bedrock, processing of loose surface soils, and drainage/groundwater conditions associated with shallow bedrock. Other geotechnical issues may become more apparent during grading operations which are not listed above. The descriptions, findings, conclusions and recommendations provided in this report are formulated as a whole, and specific conclusions or recommendations should not be derived or used out of context. Please review the limitations and uniformity of conditions section of this report.

This report has been prepared for the exclusive use of Psomas Engineering and their consultants, for specific application to this project, in accordance with generally accepted geotechnical engineering practice. Should you have any questions or require additional information, please contact our office at your convenience.

Very truly yours,
Youngdahl Consulting Group, Inc.

Matthew J. Gross, P.E.
Staff Engineer

Reviewed by:

Martha A. McDonnell, P.E.
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1.0 INTRODUCTION

This report presents the results of our Geotechnical Engineering Study performed for the proposed replacement of the Auburn Lake Trails Water Treatment Plant planned to be constructed on the open hill side between the existing treatment plant and Sweetwater Trail. The water treatment facility is location west of Sweetwater Trail, immediately south of the Gate 3 entrance to the Auburn Lake Trails residential district in Greenwood, El Dorado County, California. Refer to Figure A-1 for a vicinity map for the project site.

Purpose and Scope

The purpose of this study was to explore and evaluate the surface and subsurface conditions at the site and to develop geotechnical information and design criteria for the proposed project. The scope of this study includes the following:

- A review of geotechnical and geologic data available to us at the time of our study;
- A field study consisting of a visual site reconnaissance and an exploratory test pit program to characterize the subsurface conditions;
- A laboratory testing program performed on representative samples collected during our field study;
- Engineering analysis of the data and information obtained from our field study, laboratory testing, and literature review.
- Development of recommendations for site preparation and grading, and geotechnical design criteria for foundations, slabs on grade, retaining structures, and underground facilities.
- Preparation of this report summarizing our findings, conclusions, and recommendations regarding the geotechnical aspects for the project.

2.0 PROJECT UNDERSTANDING

Based on the proposed layout plans (Reference 1), we understand that the proposed improvements are expected to include an upgrade to the existing water treatment plant. New will include new filter building and raw water pumps station, a 300,000 gallon storage tank, a dewatering basin, and appurtenant construction for facility operations. The new buildings are anticipated to be one-story and of masonry block construction with concrete slab-on-grade floors. All of the proposed buildings and structures are anticipated to be construction on conventional shallow foundations.

Background

The Auburn Lake Trails subdivision began development in the early 1970s and included the construction of the existing water treatment plant and adjacent storage reservoir. Since that time, minor upgrades have been performed at the plant, including construction of new tanks and filters. With the exception of the minor upgrades, the facility has remained generally unchanged. We understand that the proposed changes included construction of a new facility and closing of the existing facility to construct water treatment operations in accordance with the current standards.

If studies or plans exist that pertain to the site which are not cited as a reference in this report, we should be afforded the opportunity to review and modify our conclusions and recommendations as necessary.

3.0 FINDINGS

Surface Observations

The project site is roughly triangular in shape and is bordered on the northwest by an existing storage reservoir and dam, to the northeast by Sweetwater Trail, and to the south by rural residential construction. The residential area is above the water treatment plant and is separated by steep, tree covered hillsides. The existing facility is located on the west half of the site and consists of four general parts; one general facility building with three filter tanks at the southeast, two clarifying tanks at the northeast, one small lab building to the northwest, and two unlined detention ponds at the southwest. The area of the existing facility is generally graded to slope toward the detention ponds with flat pads constructed for the existing facility structures. The general facility building is raised above the other structures by approximately 4 to 6 feet with short fill-slopes and a two-foot wall completing the grade differential.

The proposed construction areas located on the each half of the project site are generally undeveloped. The terrain slopes downward from the southeast to the northwest at a gradient of about 5H:1V or 6H:1V (Horizontal:Vertical). Riser/ventilation pipes for an existing septic system were located on the south side of the site (near test pit TP-1) which is immediately adjacent to the proposed construction.

Subsurface Conditions

Our subsurface study consisted of an exploratory test pit excavation program on 7 December 2010 under the direction of a Psomas Engineering representative. Our field representative observed and documented the subsurface conditions at the test pit locations and collected bulk samples of the subsurface soils for laboratory review. The approximate locations of the test pits are shown on Figure A-2, Appendix A. A description of the field exploration is also provided in Appendix A.

Test pits TP-1, TP-2, and TP-5 were excavated on the hillside area to observe the subsurface conditions at the proposed new filter building and tank areas. The soil conditions in these test pits generally consisted of silty SAND or SAND (FILL) in a loose and moist to very moist condition to a depth of about 3 to 5 feet. The loose soil materials in test pit TP-1 and TP-5 graded to a medium dense condition at 4 and 3 feet, respectively with a 1 foot thick clay layer in a stiff and slightly moist condition below the sand at test pit TP-1. Below the soils in test pits TP-1, TP-2, and TP-5, our representative observed approximately 2 to 3 feet of completely to highly weathered metasedimentary bedrock which transitioned to moderately weathered bedrock to the maximum depth of exploration.

Explorations performed at test pits TP-3 and TP-4 encountered near surface soil conditions differing from the hillside exploration. The excavation at test pit TP-3 (ponds) exposed approximately 3 feet of loose and wet fill materials consisting of silty SAND and SAND with gravel and rock fragments. Bedrock was encountered below the fill soils and consisted of metasedimentary bedrock in a moderately weathered, closely fractured, and moderately friable condition to the maximum depth of exploration of 6 feet. Seepage was observed during the excavation starting at a depth of 1 foot below grade and caving of the test pit sidewall (including the bedrock) occurred following the excavation.

At test pit TP-4, our representative observed approximately 1 foot of gravel roadbase in a loose and slightly moist condition overlying silty SAND in a loose to moderately dense and very moist condition. It appeared that the upper 1 foot of the soils underlying the gravel roadbase were generally more dense than the rest of the sand layer. Underlying the sands, our representative observed metasedimentary BEDROCK in a moderately weathered, closely fractures, and moderate to slightly friable condition to the maximum depth of exploration.

Effective refusal was encountered at depth of 6 to 10 feet with the equipment used for our study. If desired, a detailed seismic refraction study can provide more information regarding subsurface rock conditions and rippability.

A more detailed description of the subsurface conditions encountered is presented graphically on the "Exploratory Test Pit Logs", Figures A-3 through A-7, presented in Appendix A. These logs show a graphic interpretation of the subsurface profile, the location and depths at which samples were collected.

Groundwater Conditions
With the exception of test pit TP-3, groundwater was generally not encountered during our explorations. Subsurface water conditions typically vary in the foothill region. Our experience in the area shows that water may be perched on less weathered rock and present in the fractures, and seams of the weathered rock found beneath the site at varying times of the year. Since test pit TP-3 was excavated adjacent to the existing ponds, it is likely that the seepage observed during our exploration was a result of the hydrologic effects associated with the ponds.

Soil Expansion Potential
The materials encountered in our explorations were generally non-plastic materials which are considered to be relatively non-expansive. A thin clay layer, generally considered highly expansive, was encountered at the soil/bedrock contact in test pit TP-1. We do not anticipate that special design considerations for expansive soils will need to be addressed for the design or construction of the proposed improvements provided that the clay rined is removed from the site or adequately blended with the non-expansive silts, sands and rock materials. Recommendations can be made during construction operations or at your request if additional expansive soils are encountered or reported which were not disclosed during our study.

Geologic Conditions
The geologic portion of this report included a review of geologic data pertinent to the site, and an interpretation of our observations and the exploratory test pits excavated during the field study. The site is located within the western foothills region of the Sierra Nevada Mountain Range. According to the General Geologic Map of the Georgetown 15-Minute Quadrangle (Wagner, et. al., 1983 – DMG Open File 83-35) this portion of the foothills and the project area are underlain by undifferentiated metasedimentary and metavolcanic rocks of the Mesozoic age.

Naturally Occurring Asbestos
Naturally occurring asbestos (NOA) has been identified as a potential health hazard. In 2000 the California Geological Survey published a map (Open File Report 2000-02) that qualitatively indicates the likelihood for NOA in western El Dorado County.

El Dorado County has adapted the map from Open File Report 2000-02 into an asbestos review map. All projects with zones identified in the map, plus ¼-mile buffers around the asbestos management areas, or are in proximity to the new discoveries periodically added to the map, are subject to special dust control and asbestos mitigation requirements. This project is in an asbestos review area. Care should be taken during excavation to mitigate for the potential of asbestos exposure such as adherence to the Asbestos Dust Mitigation Plan of El Dorado County.

Seismicity

According to the Fault Activity Map of California and Adjacent Areas (Jennings, 1994) and the Peak Acceleration from Maximum Credible Earthquakes in California (CDMG, 1992), no active faults or Earthquake Fault Zones (Special Studies Zones) are located on the project site. No evidence of recent or active faulting was observed at the project site during our field study. The nearest mapped potentially active and active faults related to the site are listed in the following table.

Proximity to Faults and Fault Zones

Status	Fault Name	Distance, Direction
Active	North Tahoe Fault	75 km E
	Dunnigan Hills Fault	85 km E
Potentially Active	Melones Fault Zone – W Splay	< 1km E
	Melones Fault Zone – E Splay	2 km E
	Bear Mountains Fault	15 km W

Based on our literature review of shear-wave velocity characteristics of geologic units in California (Wills and Silva; August 1998: Earthquake Spectra, Volume 14, No. 3) and subsurface interpretations, we recommend that the project be designed in accordance with the 2010 California Building Code (CBC), Chapter 16. This site is classified as Site Class C in accordance with Table 1613.5.2.

Liquefaction, Slope Instability and Surface Rupture Potential

Liquefaction is the sudden loss of soil shear strength and sudden increase in porewater pressure caused by shear strains, as could result from an earthquake. Research has shown that saturated, loose to medium-dense sands with a silt content less than about 25 percent located within the top 40 feet are most susceptible to liquefaction and surface rupture/lateral spreading. Slope instability can occur as a result of seismic ground motions and/or in combination with weak soils and saturated conditions.

Due to the absence of a permanent elevated groundwater table, the relatively low seismicity of the area, and the relatively shallow depth to bedrock, the potential damage due to site liquefaction, slope instability and surface rupture are considered negligible. The existing slopes on the project site were observed to have adequate vegetation on the slope face, appropriate drainage away from the slope face, and no apparent tension cracks or slump blocks in the slope face or at the head of the slope. No other indications of slope instability such as seeps or springs were observed. For the above-mentioned reasons, mitigation for these potential hazards is not considered necessary.

4.0 RECOMMENDATIONS

General

Based upon the results of our field explorations and analysis, it is our opinion that construction of the proposed improvements is feasible from a geotechnical standpoint, provided the recommendations contained in this report are incorporated into the design plans and implemented during construction. The native soils, rock, and/or engineered fills composed of like materials and processed and compacted as recommended below are considered suitable for support of the planned improvements. The existing surface soils and fills are relatively loose and are not considered suitable for support of the proposed improvements in their current condition. Based on the proposed grading plans, we anticipate that a significant amount of the loose soils will be removed during grading and construction operations. Recommendations are presented below for the overexcavation and recompaction of the loose soil materials on the site remaining after the initial cut operations area performed.

4.1 SITE GRADING AND IMPROVEMENTS

Site Preparation

Preparation of the project site should involve considerations for demolition, site drainage controls, dust control, clearing, stripping, removal of existing fills, and exposed grade compaction. The following paragraphs state our geotechnical comments and recommendations concerning site preparation.

Demolition: As part of the demolition operation, any unwanted foundation or structural improvement elements should be exhumed and removed from the site. In addition, any underground storage tanks, abandoned wells or other utilities not intended for reuse should be removed or backfilled in accordance with the appropriate regulations.

Concrete and asphalt separated from the other debris, and adequately broken down in particle size, may be mixed thoroughly with native soils and placed as engineered fill as described below. If this option is exercised, a representative from our firm should be contacted to observe the adequacy of grading operations associated with the breaking and mixing of these elements.

Site Drainage Controls: We recommend that initial site preparation involve intercepting and diverting any potential sources of surface or near-surface water within the construction zones. Because the selection of an appropriate drainage system will depend on the water quantity, season, weather conditions, construction sequence, and contractor's methods, final decisions regarding drainage systems are best made in the field at the time of construction. All drainage and/or water diversion performed for the site should be in accordance with the Clean Water Act and applicable Storm Water Pollution Prevention Plan.

Dust Control: Dust control provisions should be provided for as required by the local jurisdiction's grading ordinance (i.e. water truck or other adequate water supply during grading). Special attention to dust control may be necessary due to the anticipated cuts into naturally occurring asbestos materials. Refer to the fugitive dust mitigation plan or asbestos dust mitigation plan for details on grading within potential naturally occurring asbestos areas.

Clearing and Stripping: Clearing and stripping operations should remove all organic laden materials including trees, bushes, root balls, root systems, and any soft or loose material generated from removal operations. Surface grass stripping operations are necessary based upon our observations during our site visit. Short or mowed dry grasses may be pulverized and lost within fill materials provided no concentrated pockets of organics result. It is the responsibility of the grading contractor to remove excess organics from the fill materials. No more than 2 percent of organic material, by weight, should be allowed within the fill materials at any given location.

General site clearing should also include removal of any loose or saturated materials from the proposed structural improvement and pavement areas. A representative of our firm should be present during site clearing operations to identify the location and depth of potential fills not disclosed by this report, to observe removal of deleterious materials, and to identify any existing site conditions which may require mitigation prior to site development.

Addressing Existing Fills: Following general site clearing, all existing fills and loose soils should be over-excavated down to firm native materials. Reference should be made to the site description and exploratory test pit logs for anticipated fill locations. Any depressions extending below final grade resulting from the removal of fill materials or other deleterious materials should be properly prepared as discussed below and backfilled with engineered fill. Prior to placement of engineered fill, the exposed soil surfaces receiving fills should be scarified to a minimum depth of 8 inches, moisture conditioned as necessary, and compacted to at least 95 percent of the maximum dry density based on the ASTM D1557 test method. Additionally, test pits should be re-excavated and backfilled with engineered fill.

Exposed Grade Compaction: Exposed soil grades following initial site preparation activities should be scarified to a minimum depth of 8 inches and compacted to the requirements for engineered fill. Prior to placing fill, the exposed subgrades should be in a firm, unyielding state. Any localized zones of soft or pumping soils observed within a subgrade should either be scarified and recompacted or be overexcavated and replaced with engineered fill as detailed in the engineered fill section below.

Soil Moisture Considerations

The near-surface fine grained soils may become partially or completely saturated during the rainy season. Grading operations during this time period may be difficult since compaction efforts may be hampered by saturated materials. It is, therefore, suggested that consideration be given to the seasonal limitations and costs of winter grading operations on the site. Special attention should be given regarding the drainage of the project site. If the project is expected to work through the wet season, the contractor should install appropriate temporary drainage systems at the construction site and should minimize traffic over exposed subgrades due to the moisture-sensitive nature of the on-site soils. During wet weather operations, the soil should be graded to drain and should be sealed by rubber tire rolling to minimize water infiltration.

Excavation Characteristics

The test pits were excavated using a CAT 430D backhoe equipped with an 18-inch wide bucket. The degree of difficulty encountered in excavating our test pits is an indication of the effort that will be required for excavation during construction. Based on our test pits, we expect that the site soils can be excavated using conventional earthmoving equipment such as a Caterpillar D6 to D8 for grading and rubber tired backhoe for trench excavations.

The underlying rock materials can likely be excavated to depths of several feet using dozers equipped with rippers. We expect that the upper, weathered portion of the rock, indicated to extend 3 to 4 feet below the rock surface at most locations, will require use of a Caterpillar D8 equipped with a single or multiple shank rippers, or similar equipment. We anticipate that a ripper equipped D8 can penetrate at least as deep as our test pits at most locations with moderate effort. Deeper excavation into the less weathered rock may require heavier equipment, such as a D9, or a D10. Blasting cannot be ruled out in areas of resistant rock.

Where hard rock cuts in fractured rock are proposed, the orientation and direction of ripping will likely play a large role in the rippability of the material. When hard rock is encountered, we should be contacted to provide additional recommendations prior to performing an alternative such as blasting.

Utility trenches will likely encounter hard rock excavation conditions especially in deeper cut areas. Utility contractors should be prepared to use special rock trenching equipment such as large excavators (Komatsu PC400 or CAT 345 or equivalent). Blasting to achieve utility line grades, especially in planned cut areas, cannot be precluded. Water inflow into any excavation approaching hard rock surface is likely to be experienced in all but the driest summer and fall months.

Engineered Fills

All materials placed as fills on the site should be placed as "Engineered fill" observed and compacted as described in the following paragraphs.

Suitability of Onsite Materials: We anticipate that a large amount of onsite soils will be generated during grading operations. We expect that soil generated from excavations on the site, excluding deleterious material, may be used as engineered fill provided the material does not exceed the maximum size specifications listed below. Soil anticipated to be off-hauled from the site should be reviewed for NOA prior to export.

Rock fragments or boulders exceeding 24 inches in maximum dimension should not be placed within the upper five feet of site grade. The upper two feet of grades should consist of predominantly rocks and rock fragments less than 8 inches in maximum dimension. The rock fragments should be thoroughly mixed with soil so that a uniform mixture of rocks and compacted soil is obtained without voids. Boulders over 24 inches in maximum dimension should be disposed of to an offsite location or mechanically reduce the rocks to less than 8 inches in maximum dimension. The contractor should avoid placing rocks or rock fragments larger than 8 inches in maximum dimension within zones of proposed underground facilities.

Fill Placement and Compaction: All areas proposed to receive fill should be scarified to a minimum depth of 8 inches, moisture conditioned as necessary, and compacted to at least 95 percent of the maximum dry density based on the ASTM D1557 test method. The fill should be placed in thin horizontal lifts not to exceed 8 inches in uncompacted thickness. The fill should be moisture conditioned as necessary and compacted to a relative compaction of not less than 95 percent based on the ASTM D1557 test method. The upper 8 inches of fills placed under proposed pavement areas should be compacted to a relative compaction of not less than 95 percent based on the ASTM D1557 test method. Clays, if remaining after initial grading operations, should be blended with non-expansive site soils to generate a soil with no or low expansive potential. Proper disposition of clays on site should be verified by a representative of Youngdahl Consulting Group, Inc.

Fill soil compaction should be verified by means of in-place density tests performed during fill placement so that adequacy of soil compaction efforts may be evaluated as earthwork progresses, or by method specification if the quantity of rock fragments in the fills preclude traditional compaction testing. This will likely include the excavation of test pits within the fill materials to observe and document that a uniform over-optimum moisture condition, and absence of large and/or concentrated voids has been achieved prior to additional fill placement.

Compaction Equipment: In areas to receive structural fill, a Caterpillar 825 steel-wheel compactor, large vibratory padded drum compactor, or approved equivalent should be employed as a minimum to facilitate breakdown of oversize bedrock materials and generation of soil fines during the fill placement process. If the quantity of rock fragments in the fills preclude traditional compaction testing, then the proposed fills should be compacted using method specifications as indicated below.

Import Materials: If imported fill material is needed for this project, import material should be approved by the Geotechnical Engineer prior to transporting it to the project. It is preferable that import material meet the following requirements:

1. Plasticity index not to exceed 12.
2. Should not contain rocks larger than 6 inches in diameter.
3. Not more than 15% passing through the No. 200 sieve.

If these requirements are not met, additional testing and evaluation may be necessary to determine the appropriate design parameters for foundations, pavement and other improvements.

Slope Configuration and Grading

The existing slopes on the project site were observed to have adequate vegetation on the slope face, appropriate drainage away from the slope face, and no apparent tension cracks or slump blocks in the slope face or at the head of the slope.

The project site is proposed to have cuts and fill with a maximum slope orientation of 2H:1V. Generally a cut slope orientation of 2H:1V is considered stable with the material types encountered on the site. A fill slope constructed at the same orientation is considered stable if compacted to the engineered fill recommendations as stated in the recommendations section of this report. All slopes should have appropriate drainage and vegetation measures to minimize erosion of slope soils.

Steeper fill slope gradients may be achievable through the use of geotextile materials to strengthen and/or provide erosion protection. Surficial stability of steeper cut slopes may be achievable due to the geology of the cut materials. Steepening of slopes greater than 2H:1V will require design and observation during the proposed cut and/or fill. Any slope excavations proposed to be greater than 10 feet in maximum height should be evaluated during and prior to completion of site grading.

Placement of Fills on Slopes: Placement of fill material on natural slopes should be stabilized by means of keyways and benches. Where the slope of the original ground equals or exceeds 5H:1V, a keyway should be constructed at the base of the fill. The keyway should consist of a trench excavated to a depth of at least two feet into firm, competent materials. The keyway trench should be at least eight feet wide or as designated by the Geotechnical Engineer. Benches should be cut into the original slope as the filling operation proceeds. Each bench should consist of a level surface excavated at least six feet horizontally into firm soils or four feet horizontally into rock. The rise between successive benches should not exceed 36 inches. The need for subdrainage should be evaluated at the time of construction.

Slope Face Compaction: All slope fills should be laterally overbuilt and cut back such that the required compaction is achieved at the proposed finish slope face. As a less preferable alternative, the slope face could be track walked or compacted with a wheel. If this second alternative is used, additional slope maintenance may be necessary.

Slope Drainage: Surface drainage should not be allowed to flow uncontrolled over any slope face. Adequate surface drainage control should be designed by the project civil engineer in accordance with the latest applicable edition of the CBC. All slopes should have appropriate drainage and vegetation measures to minimize erosion of slope soils.

Differential Support Conditions

Differential support conditions may be a concern where fills are placed and compacted for construction of a structural pad and the proposed structure will span from a native to deep fill or soil to bedrock condition. In order to mitigate the potential for differential settlement, overexcavation of the cut portion of the building pad, deepening of the foundations or adjustment of compaction requirements may be recommended. We should be afforded the opportunity to review the construction plans in order to develop site specific recommendations regarding differential conditions.

Based on an interpolation of the soil/bedrock contact at the exploratory test pits, we anticipate that the proposed storage tank location will span a soil/bedrock contact and may be susceptible to differential settlement. To mitigate for this condition, we recommend that the storage tank be supported entirely within bedrock by either lowering the grade or deepening the footings.

Underground Improvements

Trench Excavation: Trenches or excavations in soil should be shored or sloped back in accordance with current OSHA regulations prior to persons entering them. Where clay rind in combination with moist conditions is encountered in fractured bedrock, the project engineering geologist should be consulted for appropriate mitigation measures. The potential use of a shield to protect workers cannot be precluded. Refer to the Excavation Characteristics section of Site Grading and Improvements of this report for anticipated excavation conditions.

Backfill Materials: Backfill materials for utilities should conform to the local jurisdiction's requirements. It should be realized that permeable backfill materials will likely carry water at some time in the future.

When backfilling within structural footprints, compacted low permeability materials are recommended to be used a minimum of 5 feet beyond the structural footprint to minimize moisture intrusion. If the materials are too rocky, they may need to be screened prior to backfill in order to limit pipe damage. If a permeable material is used as backfill within this zone, subdrainage mitigation may be required. In addition, if structures are oriented downhill of the roadway or utilities, grout cutoffs or plug and drains around all utility penetrations at the foundation are useful to keep moisture out from underneath the structure.

Backfill Compaction: All backfill, placed after the underground facilities have been installed, including lot wet/dry utilities and lateral connections, should be compacted a minimum of 95 percent relative compaction. Compaction should be accomplished using lifts which do not exceed 8 inches. However, thickness of the lifts should be determined by the contractor. If the contractor can achieve the required compaction using thicker lifts, the method may be judged acceptable based on field verification by a representative of our firm using standard density testing procedures. Light weight compaction equipment may require thinner lifts to achieve the required densities.

Drainage Considerations: In areas with the potential for a perched groundwater condition (i.e. shallow bedrock), underground utilities can become collections points for subsurface water. When these conditions are present, we recommend permanent subdrainage mitigation measures be installed. Such measures may include plug and drains within the utility trenches to collect and convey water to the storm drain system or other approved outlet. Temporary dewatering measures may be necessary and could include the installation of submersible pumps and/or point wells.

4.2 DESIGN RECOMMENDATIONS

Foundations

In our opinion, continuous footings will provide adequate support for the proposed buildings and structures if the subgrades are properly prepared as described in the Site Grading and Improvement Section of this report. We offer the following comments and recommendations for purposes of footing design and construction. The provided minimums do not constitute a structural design of foundations which should be performed by the structural engineer. Our firm should be afforded the opportunity to review the project grading and foundation plans to confirm the applicability of the recommendations provided below. Modifications to these recommendations may be made at the time of our review. In addition to the provided recommendations, foundation design and construction should conform to applicable sections of the 2010 California Building Code.

Bearing Capacities: An allowable dead plus live load bearing pressure of 2,500 psf may be used for design of footings based on firm native soils or engineered fills. An allowable dead plus live load bearing pressure of 4,000 psf may be used for design of footings based on weathered bedrock. These capacities are based upon minimum foundations depths of 12 inches below lowest adjacent grade. The above allowable pressures are for support of dead plus live loads and may be increased by 1/3 for short term wind and seismic loads.

A total settlement of less than 1 inch is anticipated; a differential settlement of ½ of the total is anticipated where foundations are bearing on like materials. Greater differential settlements should be anticipated where cut to fill or soil to bedrock contacts occur.

Lateral Pressures: Lateral forces on structures may be resisted by passive pressure acting against the sides of shallow footings and/or friction between the soil and the bottom of the footing. For resistance to lateral loads, a friction factor of 0.30 may be utilized for sliding resistance at the base of footings in firm native materials or engineered fill and 0.45 for foundations on bedrock. A passive resistance of 300 pcf equivalent fluid weight may be used against the side of shallow footings in firm native soil or engineered fill and 450 for footing founded in bedrock. If friction and passive pressures are combined, the lesser value should be reduced by 50 percent.

Footing Configuration: Foundation reinforcement should be provided by the structural engineer. The reinforcement schedule should account for typical construction issues such as load consideration, concrete cracking, and the presence of isolated irregularities. At a minimum, we recommend that continuous spread footing foundations be reinforced with two No. 4 reinforcing bars, one located near the bottom of the footing and one near the top of the stem wall.

Where foundations are constructed within a cut-fill transition, soil-bedrock interface, or over minor surface irregularities (i.e. point load conditions within resistant bedrock), as a consideration to span these localized differential irregularities. For general construction we suggest that structural footing reinforcing steel be doubled top and bottom (minimum, four #4 reinforcing bars, two each top and bottom) extending a minimum of 10 feet continuous length on both sides of the transition/irregularity. Heavy construction such as the proposed storage tank should be founded on uniform soil conditions for mitigate for these conditions.

All footings should be founded below an imaginary 2H:1V plane projected up from the bottoms of adjacent footings and/or parallel utility trenches, or to a depth that achieves a minimum horizontal clearance of 6 feet from the outside toe of the footings to the slope face, whichever requires a deeper excavation.

Foundations for one and two-story concrete slab-on-grade structures should be a minimum of 12 inches in width, and be founded a minimum of 12 inches below the lowest adjacent grade. Isolated pad footings should be a minimum of 24 inches wide.

Subgrade Conditions: Footings should never be cast atop soft, loose, organic, slough, debris, nor atop subgrades covered by ice or standing water. A representative of our firm should be retained to observe all subgrades during footing excavations and prior to concrete placement so that a determination as to the adequacy of subgrade preparation can be made.

Shallow Footing / Stemwall Backfill: All footing/stemwall backfill soil should be compacted to at least 90 percent of the maximum dry density (based on ASTM D1557).

Seismic Criteria

Based on the 2010 California Building Code, Chapter 16, and our previous site investigation findings, the following seismic parameters are recommended from a geotechnical perspective for structural design. The final choice of design parameters, however, remains the purview of the project structural engineer.

Seismic Design Criteria

2010 CBC Chapter 16	Seismic Parameter	Recommended Value
Table No. 1613.5.2	Site Class	C
Figure No. 1613.5(3)*	Short-Period MCE at 0.2s, S_S	0.46g
Figure No. 1613.5(4)*	1.0s Period MCE, S_1	0.19g
Table No. 1613.5.3(1)**	Site Coefficient, F_a	1.2
Table No. 1613.5.3(2)**	Site Coefficient, F_v	1.6
Equation 16-36	Adjusted MCE Spectral Response Parameters, $S_{MS} = F_a S_s$	0.55
Equation 16-37	Adjusted MCE Spectral Response Parameters, $S_{M1} = F_v S_1$	0.31
Equation 16-38	Design Spectral Acceleration Parameters, $S_{DS} = ⅔S_{MS}$	0.36
Equation 16-39	Design Spectral Acceleration Parameters, $S_{D1} = ⅔S_{M1}$	0.21
Table 1613.5.6(1)	Seismic Design Category (Short Period), Occupancy I to III	C
Table 1613.5.6(1)	Seismic Design Category (Short Period), Occupancy IV	D
Table 1613.5.6(2)	Seismic Design Category (1-Second Period), Occupancy I to III	D
Table 1613.5.6(2)	Seismic Design Category (1-Second Period), Occupancy IV	D

* Values from Figures 1613.5(3)/(4) are derived from the National Earthquake Hazards Reduction Program (NEHRP) for Site Class B soil profiles.

** Values from Tables 1613.3(1)/(2) are adjustments to account for the Site Class (Project Specific) provided in Table 1613.5.2.

Slab-on-Grade Construction

It is our opinion that soil-supported slab-on-grade floors could be used for the main floor, contingent on proper subgrade preparation. Often the geotechnical issues regarding the use of slab-on-grade floors include proper soil support and subgrade preparation, proper transfer of loads through the slab underlayment materials to the subgrade soils, and the anticipated presence or absence of moisture at or above the subgrade level. We offer the following comments and recommendations concerning support of slab-on-grade floors. *The slab design (concrete mix, reinforcement, joint spacing, moisture protection and underlayment materials) is the purview of the project Structural Engineer.*

<u>Slab Subgrade Preparation</u>: All subgrades proposed to support slab-on-grade floors should be prepared and compacted to the requirements of engineered fill as discussed in the Site Grading and Improvements section of this report.

<u>Slab Underlayment</u>: As a minimum for slab support conditions, the slab should be underlain by a minimum 4 inch crushed rock layer and covered by a moisture retarding plastic membrane. An optional 1 inch blotter sand layer above the plastic membrane is sometimes used to aid in curing of the concrete. If the blotter is omitted, special curing procedures may be necessary. The blotter layer can become a reservoir for excessive moisture if inclement weather occurs

prior to pouring the slab, excessive water collects in it from the concrete pour, or an external source of water enters above or bypasses the membrane. The membrane may only be functional when it is above the vapor sources. The bottom of the crushed rock layer should be above the exterior grade to act as a capillary break and not a reservoir, unless it is provided with an underdrain system. The slab design and underlayment should be in accordance with ASTM E1643 and E1745.

Slab Moisture Protection: Due to the potential for landscape to be present directly adjacent to the slab edge/foundation or for drainage to be altered following our involvement with the project, varying levels of moisture below, at, or above the pad subgrade level should be anticipated. The slab designer should include the potential for moisture vapor transmission when designing the slab. Our experience has shown that vapor transmission through concrete is controlled through slab thickness as well as proper concrete mix design.

It should be noted that placement of the recommended plastic membrane, proper mix design, and proper slab underlayment and detailing per ASTM E1643 and E1745 will not provide a waterproof condition. If a waterproof condition is desired, we recommend that a waterproofing expert be consulted for slab design.

Slab Thickness and Reinforcement: Geotechnical reports have historically provided minimums for slab thickness and reinforcement for general crack control. The concrete mix design and construction practices can additionally have a large impact on concrete crack control. All concrete should be anticipated to crack. As such, these minimums should not be considered to be stand alone items to address crack control, but are suggested to be considered in the slab design methodology.

In order to help control the growth of cracks in interior concrete from becoming significant, we suggest the following minimums. Interior concrete slabs-on-grade not subject to heavy loads should be a minimum of 4 inches thick. A 4 inch thick slab should be reinforced. A minimum of No. 3 deformed reinforcing bars placed at 30 inches on center both ways, at the center of the structural section is suggested. Joint spacing should be provided by the structural engineer. Troweled joints recovered with paste during finishing or "wet sawn" joints should be considered every 10 feet on center. Expansion joint felt should be provided to separate floating slabs from foundations and at least at every third joint. Cracks will tend to occur at recurrent corners, curved or triangular areas and at points of fixity. Trim bars can be utilized at right angle to the predicted crack extending 40 bar diameters past the predicted crack on each side.

Vertical Deflections: Soil-supported slab-on-grade floors can deflect downward when vertical loads are applied, due to elastic compression of the subgrade. For design of concrete floors, a modulus of subgrade reaction of $k = 250$ psi per inch would be applicable for native soils and engineered fills.

Exterior Flatwork: Exterior concrete flatwork need not be underlain by a rock cushion where non-expansive soils are encountered. However, some vertical movement of concrete should be anticipated when arranging outside concrete flatwork joints where rock is omitted. Where expansive soils are encountered, a 4 inch rock cushion under concrete flatwork and pre-saturation is recommended.

If exterior flatwork concrete is against the floor slab edge without a moisture separator it may transfer moisture to the floor slab. Expansion joint felt should be provided to separate exterior flatwork from foundations and at least at every third joint. Contraction / groove joints should be provided to a depth of at least 1/4 of the slab thickness and at a spacing of less than 30 times the slab thickness for unreinforced flatwork, dividing the slab into nearly square sections. Cracks will tend to occur at recurrent corners, curved or triangular areas and at points of fixity. Trim bars can be utilized at right angle to the predicted crack extending 40 bar diameters past the predicted crack on each side.

Retaining Walls
Our design recommendations and comments regarding retaining walls for the project site are discussed below.

Retaining Wall Foundations: For footings founded in firm native soil or engineered fill, an allowable dead plus live load bearing capacity of 2,500 psf should be used. For footings with a minimum depth of 12 inches into weathered bedrock, an allowable dead plus live load bearing capacity of 4,000 pounds per square foot is considered appropriate. The following allowable pressures may be increased by 1/3 for short term wind or seismic loads.

Resisting Forces: Lateral forces on the retaining walls may be resisted by passive pressure acting against the side of the wall footing and/or friction between the soil and the bottom of the footing. A passive equivalent fluid weight of 300 pcf may be used against the sides of shallow footings founded in firm native soil or engineered fill. A friction factor of 0.30 may be used at the base of footings founded on firm native soil or engineered fill. For footings founded into bedrock conditions, a passive equivalent fluid weight of 450 pcf may be used against the sides of shallow footings and a friction factor of 0.45 may be used at the base of footings. If friction and passive pressures are combined, the lesser value should be reduced by 50 percent. All backfill placed behind retaining walls or against retaining wall footings should be compacted in accordance with the "Engineered Fill" section of this report.

Retaining Wall Lateral Pressures: Based on our observations and testing, the retaining wall should be designed to resist lateral pressure exerted from a soil media having an equivalent fluid weight as follows.

Retaining Wall Parameters

Wall Type	Wall Slope Configuration	Equivalent Fluid Weight (pcf)	Surcharge Load (psf)*	Lateral Pressure Coefficient	Earthquake Loading (plf)***
Free Cantilever	Flat	40	per structural	0.33	$18H^2$ Applied 0.6H above the base of the wall
	2H:1V	60	per structural	0.50	
Restrained**	Flat	60	per structural	0.50	

* The surcharge loads should be applied as uniform loads over the full height of the walls as follows: Surcharge Load (psf) = (q) (K), where q = surcharge in psf, and K = coefficient of lateral pressure. Final design is the purview of the project structural engineer.

** Restrained conditions shall be defined as walls which are structurally connected to prevent flexible yielding, or rigid wall configurations (i.e. walls with numerous turning points) which prevent the yielding necessary to reduce the driving pressures from an at-rest state to an active state.

*** Section 1802.2.7 of the 2007 California Building Code states that a determination of lateral pressures on basement and retaining walls due to earthquake loading shall be provided for structures to be designed in Seismic Design Categories D, E or F (Load value derived from Wood (1973) and modified by Whitman (1991)).

Wall Drainage: The above criteria are based on fully drained conditions. For these conditions, we recommend that a blanket of filter material be placed behind all proposed walls. The blanket of filter material should be a minimum of 12 inches thick and should extend from the bottom of the wall to within 12 inches of the ground surface. The filter material should conform to Class One, Type B permeable material as specified in Section 68 of the California Department of Transportation Standard Specifications, current edition. A clean ⅜ inch angular gravel or ¾ inch crushed rock is also acceptable, provided filter fabric is used to separate the open graded gravel/rock from the surrounding soils. The top 12 inches of wall backfill should consist of a compacted native soil cap. A filter fabric should be placed on top of the gravel filter material to separate it from the native soil cap. A 4 inch diameter drain pipe should be installed near the bottom of the filter blanket with perforations facing down. The drain pipe should be underlain by at least 4 inches of filter-type material. As an alternative to drain pipe, where deemed appropriate, weep holes may be provided. Adequate gradients should be provided to discharge water that collects behind the retaining wall to an controlled discharge system. Prior to placement of the drainage blanket, additional consideration should be given to the use of a waterproofing membrane such as bituthene or equivalent membrane system on the outside of the wall.

Drainage Considerations
In order to maintain the engineering strength characteristics of the soil presented for use in this Geotechnical Engineering Study, maintenance of the site will need to be performed. This maintenance generally includes, but is not limited to, proper drainage and control of surface and subsurface water which could affect structural support and fill integrity. A difficulty exists in determining which areas are prone to the negative impacts resulting from high moisture conditions due to the diverse nature of potential sources of water; some of which are outlined in the paragraph below. We suggest that measures be installed to minimize exposure to the adverse effects of moisture, but this will not guarantee that excessive moisture conditions will not affect the structure.

Some of the diverse sources of moisture could include water from annual rainfall, offsite construction activities, runoff from impermeable surfaces, collected and channeled water, and water in fractures or perched on the weathered bedrock. Some of these sources can be controlled through drainage features installed either by the owner or builder. Others may not become evident until they, or the effects of the presence of excessive moisture, are visually observed on the property.

Some measures that can be employed to minimize the build up of moisture include, but are not limited to; proper backfill materials and compaction of utility trenches on the site and within the footprint of the proposed facilities to minimize the transmission of moisture through these areas; grout plugs at foundation penetrations; collection and channeling of drained water from impermeable surfaces (i.e. roofs and paved areas), and installation of subdrain/cut-off drain provisions.

All grades should provide rapid removal of surface water runoff; ponding water should not be allowed on building pads or adjacent to foundations or other structural improvements (during and following construction). All soils placed against foundations during finish grading should be compacted to minimize water infiltration. Finish and landscape grading should include positive drainage away from all foundations. Surface drainage should be designed by the Project Architect/Civil Engineer in general accordance with Section 1804.3 of the 210 California Building Code. Downspouts should be tight piped via an area drain network and discharged to an appropriate non-erosive outlet.

Post Construction: All drainage related issues may not become known until after construction and landscaping are complete. Therefore, some mitigation measures may be necessary following site development. In foothill areas with construction using cut/fill pads on shallow bedrock conditions, seepage may not be apparent until post construction. In order to mitigate these conditions additional subdrainage measures may be necessary.

5.0 DESIGN REVIEW AND CONSTRUCTION MONITORING

The design plans and specifications should be reviewed and accepted by Youngdahl Consulting Group, Inc., hereinafter described as the Geotechnical Engineer, prior to contract bidding. A review should be performed to determine whether the recommendations contained within this report are still applicable and/or are properly reflected and incorporated into the project plans and specifications.

Construction Monitoring

Construction monitoring is a continuation of the findings and recommendations provided in this report. It is essential that our representative be involved with all grading activities in order for us to provide supplemental recommendations as field conditions dictate. Youngdahl Consulting Group, Inc. should be notified at least two working days before site clearing or grading operations commence, and should observe the stripping of deleterious material overexcavation of existing fills and provide consultation to the Grading Contractor in the field.

Low Impact Development Standards

Low Impact Development or LIDs standards have become a consideration for many projects in the region. LID standards are intended to address and mitigate urban storm water quality concerns. These methods include the use of Source Controls, Run-off Reduction and Treatment Controls. For the purpose of this report use of proposed Run-off Reduction measures and some Treatment Controls may impact geotechnical recommendations for the project. Use of any LID measure that would require infiltration of discharge of water to surfaces adjacent to structures/pavement or include infiltration type measures should be reviewed by Youngdahl Consulting Group, Inc. during the design process.

A review of soil survey and the data collected from test pits indicate that soils within the project are Hydrologic Soil Group D (low permeability) with a depth of less than 3 feet. Based on this condition use of infiltration type LID methods (Infiltration trenches, dry wells, infiltration basins, Permeable Pavements, etc.) should not be considered for this property. Youngdahl Consulting Group, Inc. did not perform any percolation of infiltration testing for the site as part of the Geotechnical Investigation.

Post Construction Monitoring

As described in Post Construction section of this report, all drainage related issues may not become known until after construction and landscaping are complete. Youngdahl Consulting Group, Inc. can provide consultation services upon request that relate to proper design and installation of drainage features during and following site development.

6.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. This report has been prepared for the exclusive use of Psomas Engineering for specific application to the Auburn Lake Trails Water Treatment Plant project. Youngdahl Consulting Group, Inc. has endeavored to comply with generally accepted geotechnical engineering practice common to the local area. Youngdahl Consulting Group, Inc. makes no other warranty, express or implied.

2. As of the present date, the findings of this report are valid for the property studied. With the passage of time, changes in the conditions of a property can occur whether they be due to natural processes or to the works of man on this or adjacent properties. Legislation or the broadening of knowledge may result in changes in applicable standards. Changes outside of our control may cause this report to be invalid, wholly or partially. Therefore, this report should not be relied upon after a period of three years without our review nor should it be used or is it applicable for any properties other than those studied.

3. Section 106.3.4.1 of the International Building Code and Appendix Chapter 1 of the 2010 California Building Code states that, in regard to the design professional in responsible charge, the building official shall be notified in writing by the owner if the registered design professional in responsible charge is changed or is unable to continue to perform the duties.

   WARNING: Do not apply any of this report's conclusions or recommendations if the nature, design, or location of the facilities is changed. If changes are contemplated, Youngdahl Consulting Group, Inc. must review them to assess their impact on this report's applicability. Also note that Youngdahl Consulting Group, Inc. is not responsible for any claims, damages, or liability associated with any other party's interpretation of this report's subsurface data or reuse of this report's subsurface data or engineering analyses without the express written authorization of Youngdahl Consulting Group, Inc.

4. The analyses and recommendations contained in this report are based on limited windows into the subsurface conditions and data obtained from subsurface exploration. The methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. Should any variations or undesirable conditions be encountered during the development of the site, Youngdahl Consulting Group, Inc., will provide supplemental recommendations as dictated by the field conditions.

5. The recommendations included in this report have been based in part on assumptions about strata variations that may be tested only during earthwork. Accordingly, these recommendations should not be applied in the field unless Youngdahl Consulting Group, Inc. is retained to perform construction observation and thereby provide a complete professional geotechnical engineering service through the observational method. Youngdahl Consulting Group, Inc. cannot assume responsibility or liability for the adequacy of its recommendations when they are used in the field without Youngdahl Consulting Group, Inc. being retained to observe construction. Unforeseen subsurface conditions containing soft native soils, loose or previously placed non-engineered fills should be a consideration while preparing for the grading of the property. It should be noted that it is the responsibility of the owner or his/her representative to notify Youngdahl Consulting Group, Inc., in writing, a minimum of 48 hours before any excavations commence at the site.

6. Our experience has shown that vapor transmission through concrete is controlled through proper concrete mix design. As such, proper control of moisture vapor transmission should be considered in the design of the slab as provided by the project

architect, structural or civil engineer. It should be noted that placement of the recommended plastic membrane, proper mix design, and proper slab underlayment and detailing per ASTM E1643 and E1745 will not provide a waterproof condition. If a waterproof condition is desired, we recommend that a waterproofing expert be consulted for slab design.

7. Following site development, additional water sources (ie. landscape watering, downspouts) are generally present. The presence of low permeability materials can prohibit rapid dispersion of surface and subsurface water drainage. Utility trenches typically provide a conduit for water distribution. Provisions may be necessary to mitigate adverse effects of perched water conditions. Mitigation measures may include the construction of cut-off systems and/or plug and drain systems. Close coordination between the design professionals regarding drainage and subdrainage conditions may be warranted.

   Seepage may be observed emanating from the cut slopes following their excavation during the following rainy season or following development of the areas above the cut. Generally this seepage is not enough flow to be a stability issue to the cut slope, but may be an issue for the owner of the lot at the base of the cut from a surface drainage and standing water (damp spot) standpoint. This amount of water is generally collected easily with landscaping drainage, surface drainage at the toe of the slope, or subsurface toe drains. Recommendations may be provided at the time of observed seepage; however, we recommend that the developer of the property disclose this possibility to future owners.

CHECKLIST OF RECOMMENDED SERVICES

	Item Description	Recommended	Not Anticipated
1	Provide foundation design parameters	Included	
2	Review grading plans and specifications	✓	
3	Review foundation plans and specifications	✓	
4	Observe and provide recommendations regarding demolition	✓	
5	Observe and provide recommendations regarding site stripping	✓	
6	Observe and provide recommendations on moisture conditioning removal, and/or precompaction of unsuitable existing soils	✓	
7	Observe and provide recommendations on the installation of subdrain facilities	✓	
8	Observe and provide testing services on fill areas and/or imported fill materials	✓	
9	Review as-graded plans and provide additional foundation recommendations, if necessary	✓	
10	Observe and provide compaction tests on storm drains, water lines and utility trenches	✓	
11	Observe foundation excavations and provide supplemental recommendations, if necessary, prior to placing concrete	✓	
12	Observe and provide moisture conditioning recommendations for foundation areas and slab-on-grade areas prior to placing concrete		✓
13	Provide design parameters for retaining walls	Included	
14	Provide finish grading and drainage recommendations	Included	
15	Provide geologic observations and recommendations for keyway excavations and cut slopes during grading	✓	
16	Excavate and recompact all test pits within structural areas	✓	

APPENDIX A

Field Study

Vicinity Map
Site Plan
Logs of Exploratory Test Pits
Soil Classification Chart and Log Exploration

Introduction

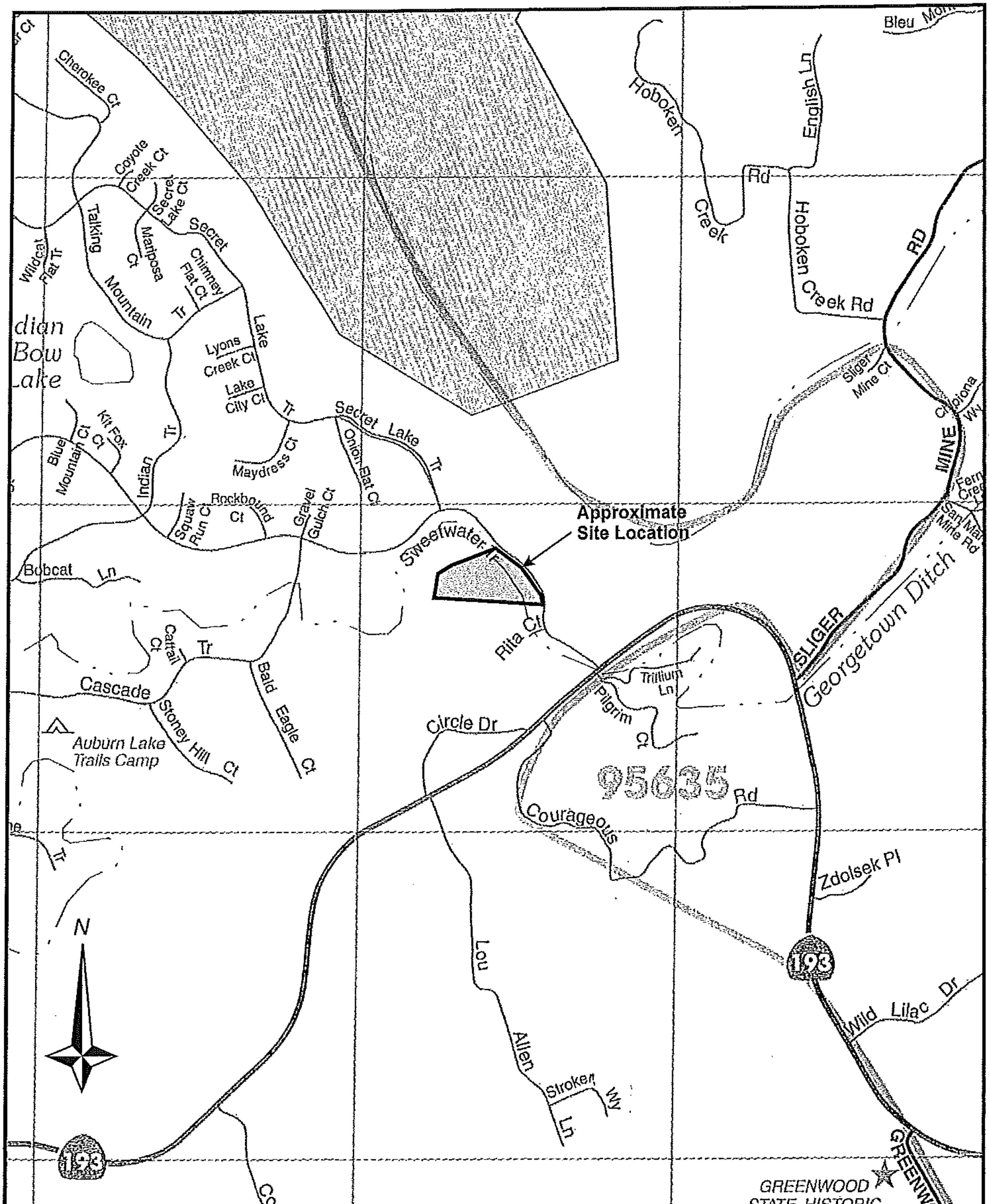
The contents of this appendix shall be integrated with the geotechnical engineering study of which it is a part. They shall not be used in whole or in part as a sole source for information or recommendations regarding the subject site.

Field study

Our field study included a site reconnaissance by a Youngdahl Consulting Group, Inc. representative followed by a subsurface exploration program conducted on 7 December 2011, which included the excavation of 5 test pits at the locations selected by Psomas Engineering. The approximate locations shown on Figure A-2, this Appendix. Excavation of the test pits was accomplished with a CAT 430D rubber tire-mounted backhoe equipped with an 18-inch wide bucket. Bulk and bag samples were also collected from the pits.

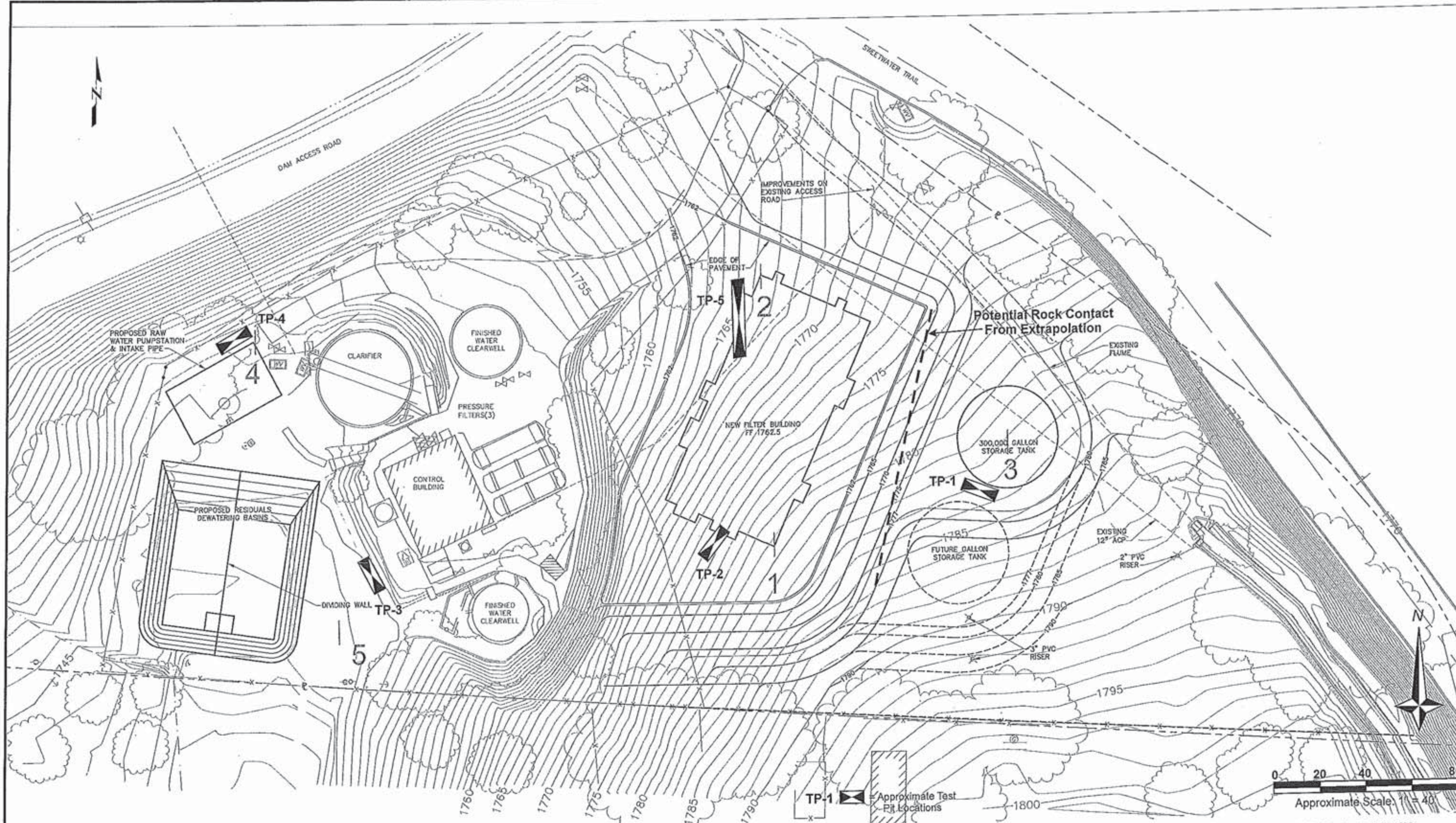
The Exploratory Test Pit Logs describe the vertical sequence of soils and materials encountered in each test pit, based primarily on our field classifications and supported by our subsequent laboratory examination and testing. Where a soil contact was observed to be gradual, our logs indicate the average contact depth. Our logs also graphically indicate the sample type, sample number and approximate depth of each soil sample obtained from the test pits.

The soils encountered were logged during excavation and provide the basis for the "Logs of Test Pits", Figures A-3 through A-7, this Appendix. These logs show a graphic representation of the soil profile, the location and depths at which samples were collected.



BASE MAP REFERENCE: *Placer County Street And Road Atlas, Compass Maps, 2004 Edition, Page 223*

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING	Project No.: E10208.000 January 2011	**VICINITY MAP** **Auburn Lake Trails Water Treatment Plant** Greenwood, California	**FIGURE** **A-1**

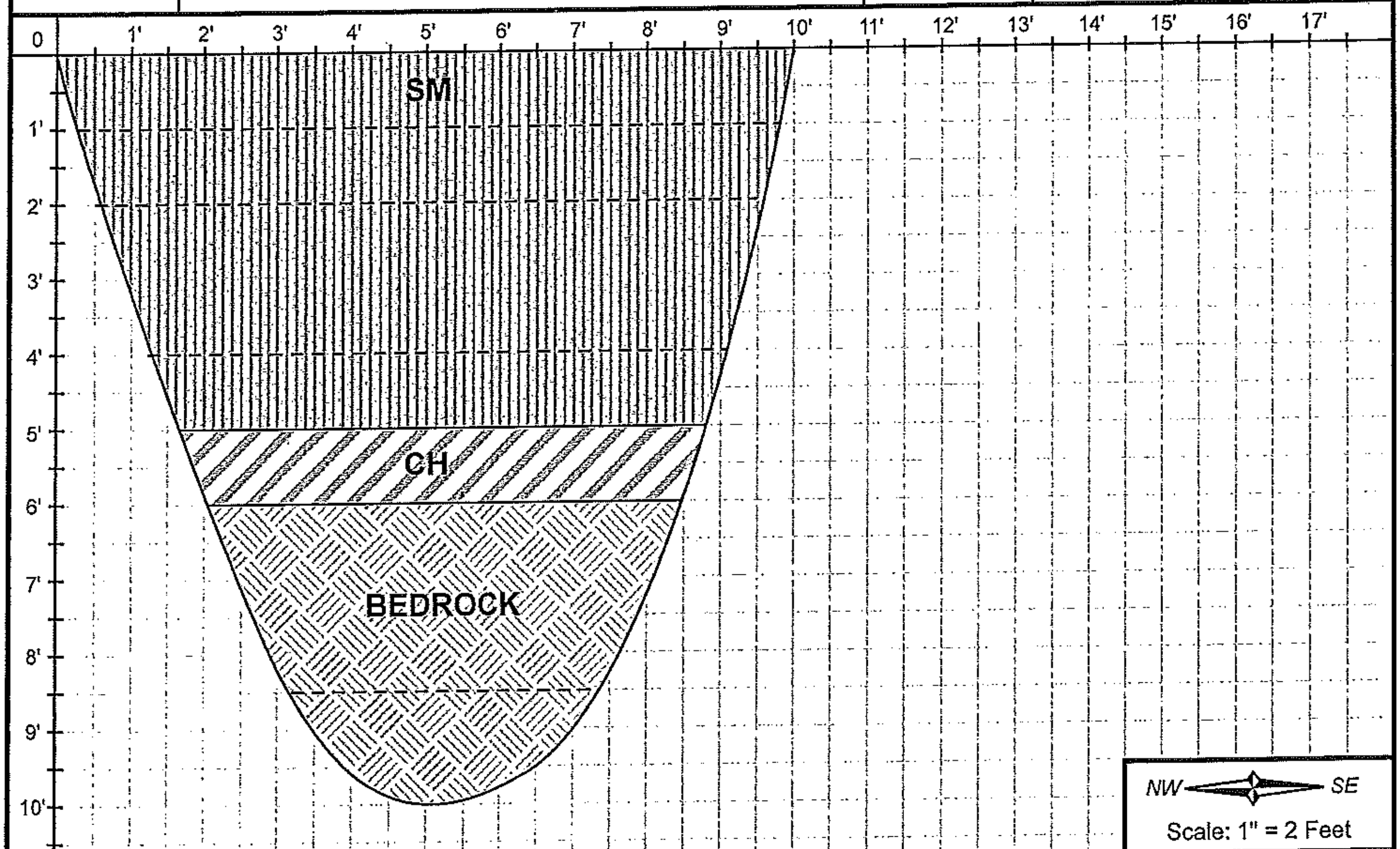


BASE MAP REFERENCE: *Georgetown Divide PUD Auburn Lake Trails WTP Project, PSOMAS, Draft 12/01/10*

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING	Project No.: E10208.000	**SITE PLAN** Auburn Lake Trails Water Treatment Plant Greenwood, California	FIGURE A-2
	January 2011		

Logged By: **MJG**	Date: **7 December 2010**	Elevation: **~ 1783'**	Pit No. **TP-1**
Equipment: **CAT 430D With 18" Bucket**		Pit Orientation: **NW - SE**	

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 1'	Dark red brown silty **SAND (SM)**, very loose to loose, moist		
@ 1' - 2'	*Grades loose*		
@ 2' - 4'	*Grades red brown, loose to medium dense*		
@ 4' - 5'	*Grades medium dense*		
@ 5' - 6'	Yellow brown **CLAY (CH)** rind		
@ 6' - 8.5'	Yellow brown to red brown completely weathered metasedimentary **BEDROCK**		
@ 8.5' - 10'	*Grades moderately weathered*		
	Test pit terminated at 10' No free groundwater encountered No caving noted		

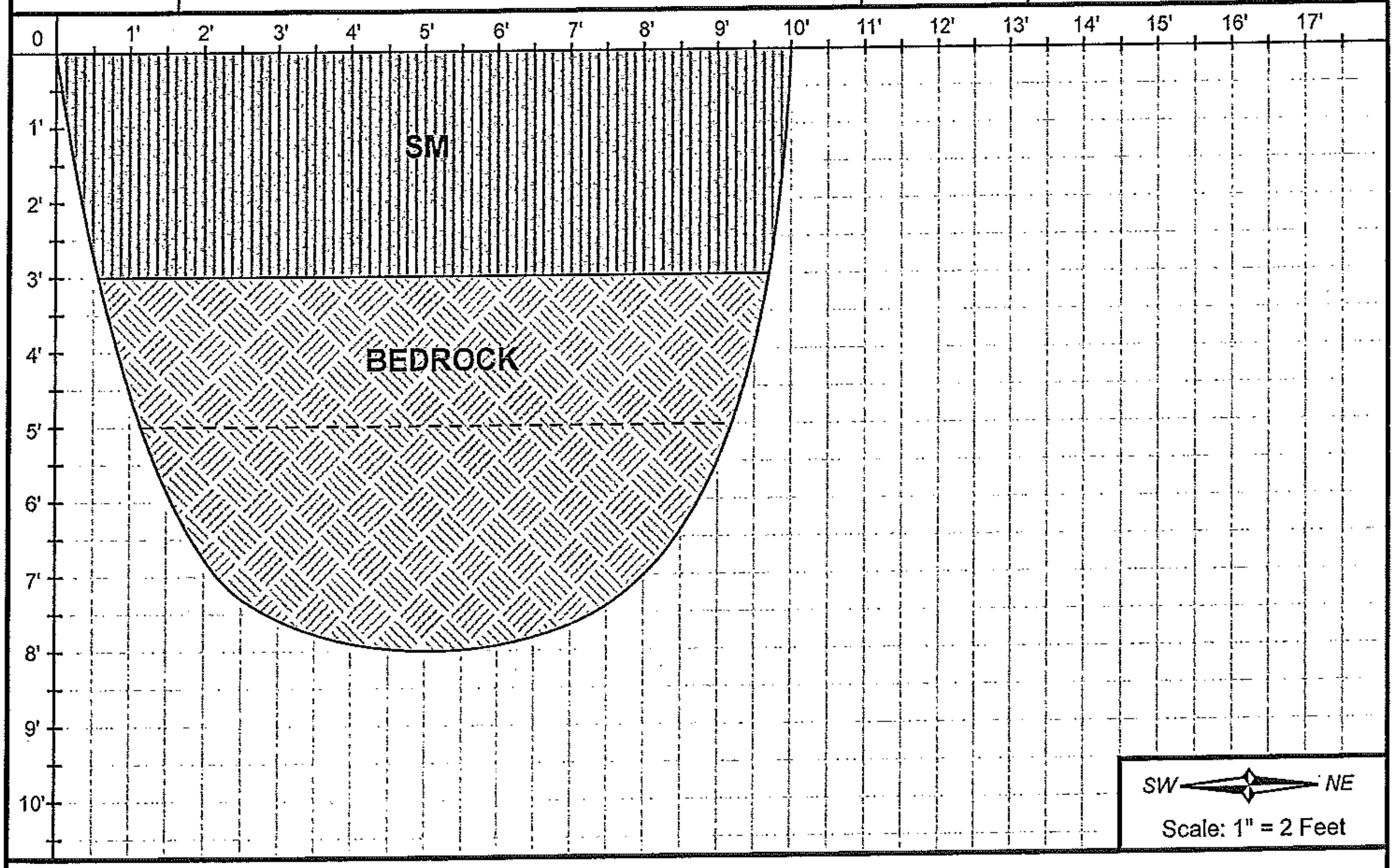


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING	Project No.: E10208.000 **January 2011**	**EXPLORATORY TEST PIT LOG** **Auburn Lake Trails Water Treatment Plant** Greenwood, California	**FIGURE A-3**

Logged By: **MJG**	Date: **7 December 2010**	Elevation: **~ 1774'**	Pit No. **TP-2**
Equipment: **CAT 430D With 18" Bucket**		Pit Orientation: **SW - NE**	

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 3'	Dark red brown silty **SAND (SM)**, loose, moist		
@ 3' - 5'	Red brown to yellow brown highly weathered metasedimentary **BEDROCK**, very closely fractured, fragments <6" Diameter, seams filled with clay and angular sand, select areas with close fracture spacing		
@ 5' - 8'	Yellow brown to blue gray moderately weathered metasedimentary **BEDROCK**, closely fractured, moist, with clay in seams		
	Test pit terminated at 8' (practical refusal) No free groundwater encountered No caving noted		

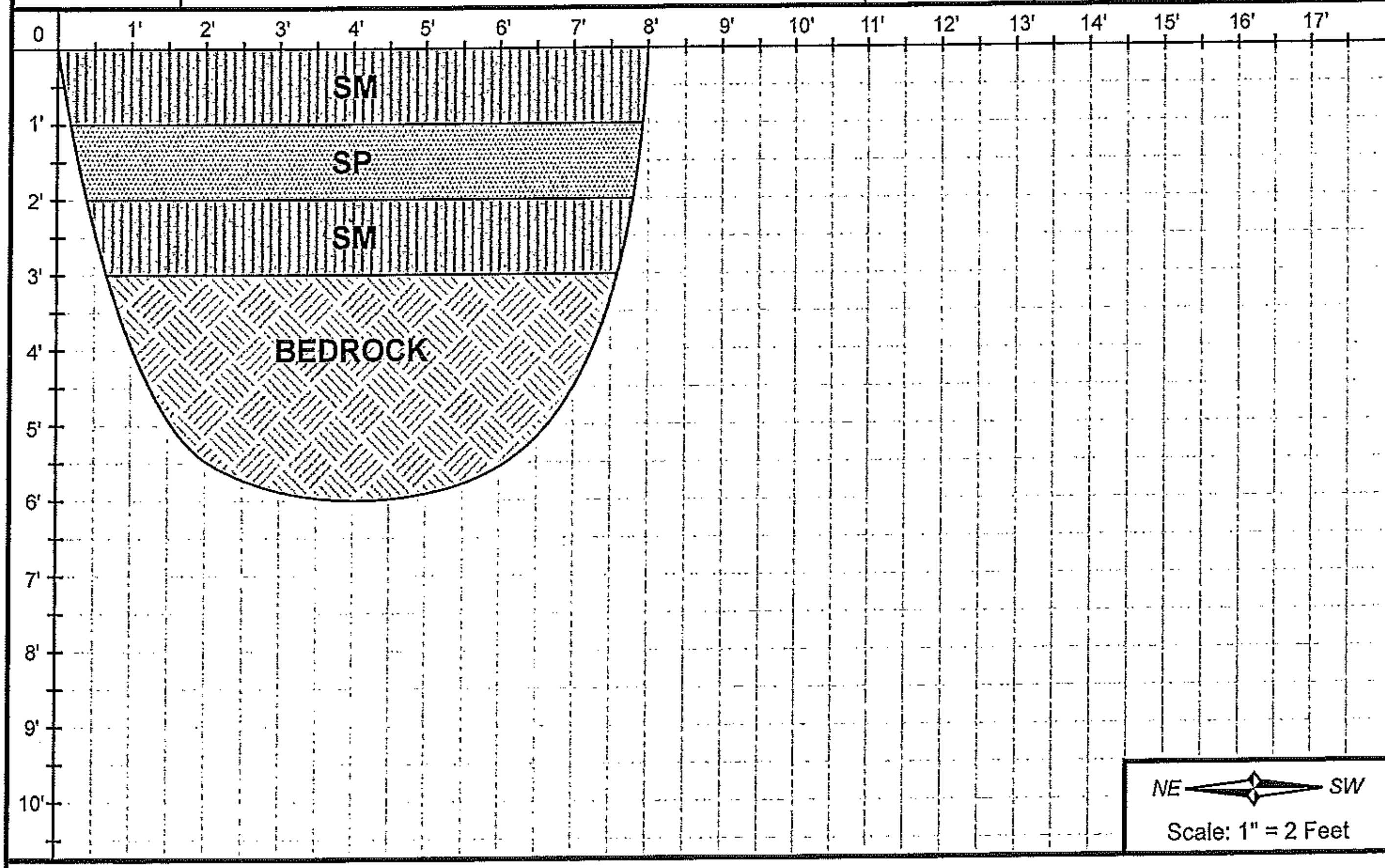


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING	Project No.: E10208.000 **January 2011**	**EXPLORATORY TEST PIT LOG** **Auburn Lake Trails** **Water Treatment Plant** Greenwood, California	**FIGURE** **A-4**

Logged By: **MJG**	Date: **7 December 2010**	Elevation: **~ 1750'**	Pit No. **TP-3**
Equipment: **CAT 430D With 18" Bucket**		Pit Orientation: **NE - SW**	

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 1'	Dark red brown silty **SAND (SM)**, very loose, very moist		
@ 1' - 2'	Yellow gray brown coarse **SAND (SP)** with gravel and rock, loose, wet		
@ 2' - 3'	Red brown silty **SAND (SM)**, loose, wet		
@ 3' - 6'	Gray moderately weathered metasedimentary **BEDROCK**, closely fractured, mildly friable		
	Test pit terminated at 6' (practical refusal) Seepage encountered at 1' Caving noted from 0 - 6'		

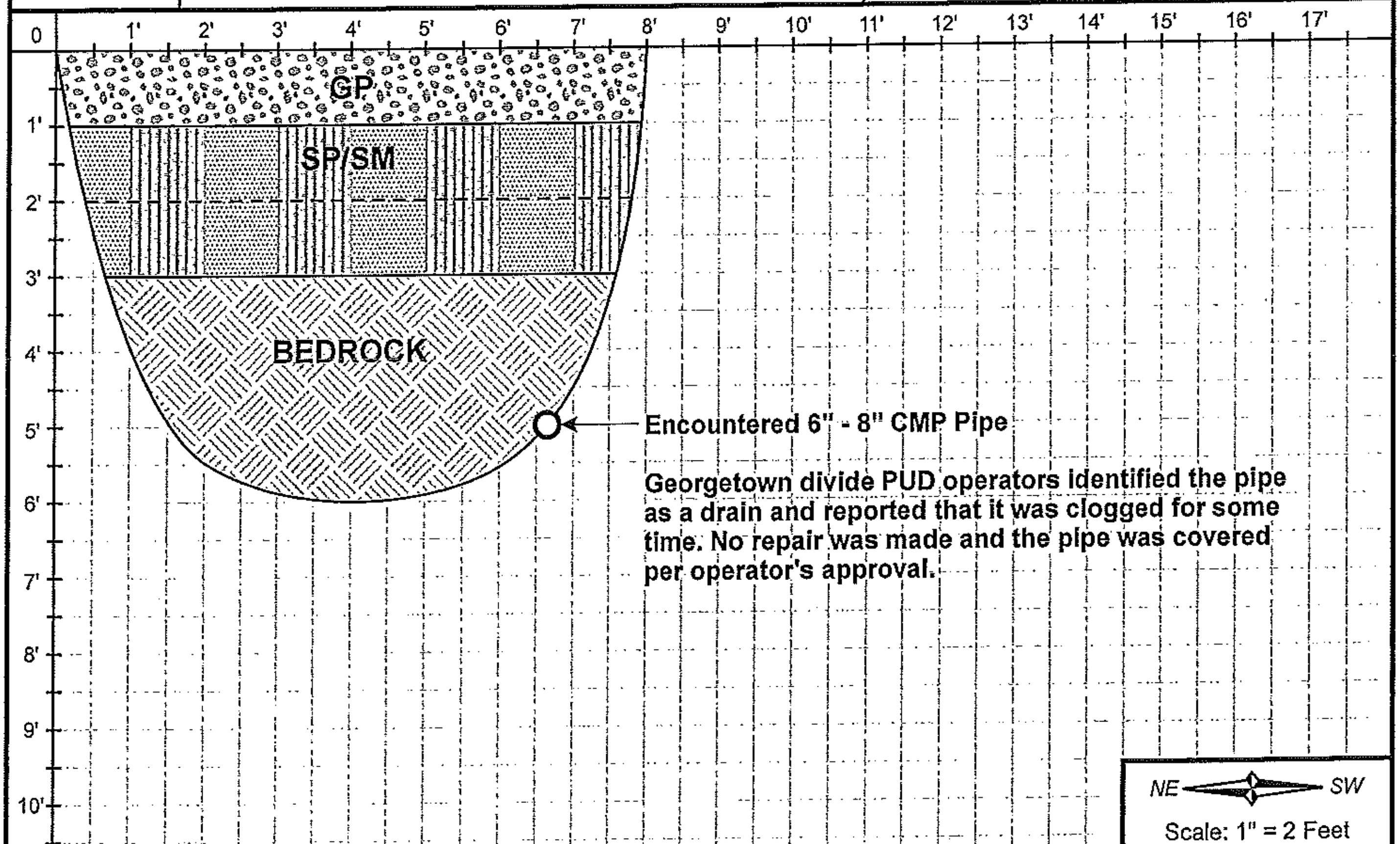


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING	Project No.: E10208.000 January 2011	**EXPLORATORY TEST PIT LOG** **Auburn Lake Trails** **Water Treatment Plant** Greenwood, California	**FIGURE** **A-5**

Logged By: **MJG**	Date: **7 December 2010**	Elevation: **~ 1746'**	Pit No. **TP-4**
Equipment: **CAT 430D With 18" Bucket**		Pit Orientation: **NE - SW**	

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 1'	Blue gray **GRAVEL (GP)**, loose, slightly moist (road base)		
@ 1' - 2'	Red brown silty coarse **SAND (SP/SM)**, moderately dense, very moist		
@ 2' - 3'	*Grades loose to moderately dense*		
@ 3' - 6'	Red brown to yellow brown moderately weathered metasedimentary **BEDROCK**, closely fractured, mildly to slightly friable fragments		
	Test pit terminated at 6' (practical refusal) Seepage encountered at 3' No caving noted		

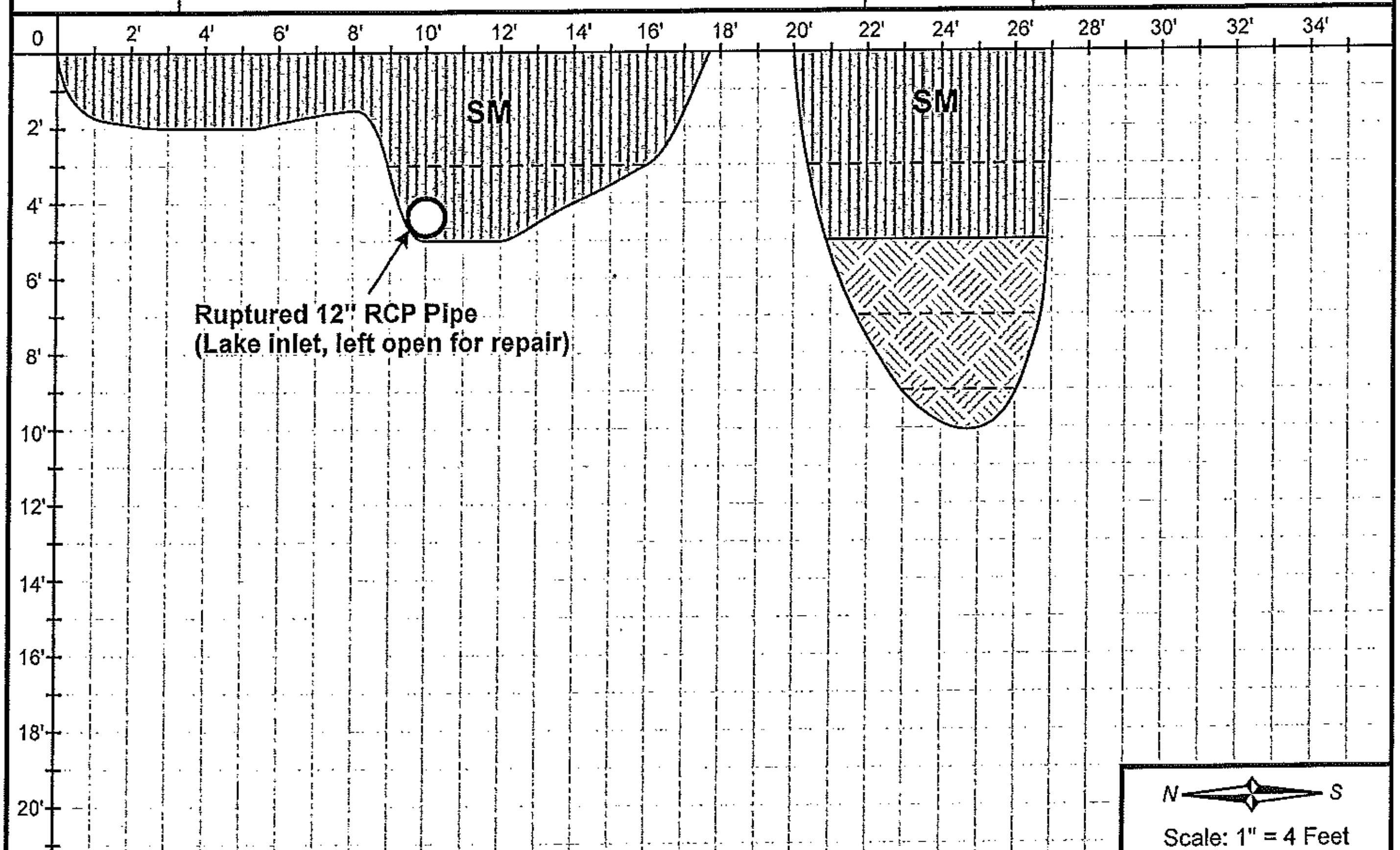


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING	Project No.: E10208.000 January 2011	**EXPLORATORY TEST PIT LOG** **Auburn Lake Trails** **Water Treatment Plant** Greenwood, California	**FIGURE** **A-6**

Logged By: **MJG**	Date: **7 December 2010**	Elevation: **~ 1765'**	Pit No. **TP-5**
Equipment: **CAT 430D With 18" Bucket**		Pit Orientation: **N - S**	

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 3'	Red brown silty **SAND (SP/SM)**, loose, slightly moist		
@ 3' - 5'	*Grades loose to moderately dense*		
@ 5' - 7'	Red to blue gray slightly to moderately weathered metasedimentary **BEDROCK**		
@ 7' - 9'	*Grades moderately weatherd*		
@ 9' - 10'	*Grades less weathered*		
	Test pit terminated at 10' (practical refusal) No free groundwater encountered No caving noted		



Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

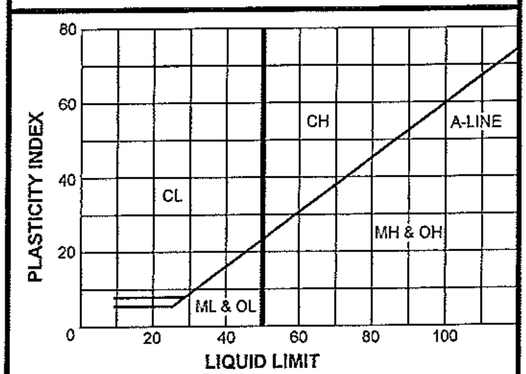
YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING	Project No.: E10208.000 January 2011	**EXPLORATORY TEST PIT LOG** **Auburn Lake Trails** **Water Treatment Plant** Greenwood, California	**FIGURE A-7**

UNIFIED SOIL CLASSIFICATION SYSTEMS

MAJOR DIVISION			SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS Over 50% > #200 sieve	GRAVELS Over 50% > #4 sieve	Clean **GRAVELS** With Little Or No Fines	GW	Well graded **GRAVELS**, **GRAVEL-SAND** mixtures
			GP	Poorly graded **GRAVELS**, **GRAVEL-SAND** mixtures
		GRAVELS With Over 12% Fines	GM	Silty **GRAVELS**, poorly graded **GRAVEL-SAND-SILT** mixtures
			GC	Clayey **GRAVELS**, poorly graded **GRAVEL-SAND-CLAY** mixtures
	SANDS Over 50% < #4 sieve	Clean **SANDS** With Little Or No Fines	SW	Well graded **SANDS**, gravelly **SANDS**
			SP	Poorly graded **SANDS**, gravelly **SANDS**
		SANDS With Over 12% Fines	SM	Silty **SANDS**, poorly graded **SAND-SILT** mixtures
			SC	Clayey **SANDS**, poorly graded **SAND-CLAY** mixtures
FINE GRAINED SOILS Over 50% < #200 sieve	**SILTS & CLAYS** Liquid Limit < 50		ML	Inorganic **SILTS**, silty or clayey fine **SANDS**, or clayey **SILTS** with plasticity
			CL	Inorganic **CLAYS** of low to medium plasticity, gravelly, sandy, or silty **CLAYS**, lean **CLAYS**
			OL	Organic **CLAYS** and organic silty **CLAYS** of low plasticity
	SILTS & CLAYS Liquid Limit > 50		MH	Inorganic **SILTS**, micaceous or diamacious fine sandy or silty soils, elastic **SILTS**
			CH	Inorganic **CLAYS** of high plasticity, fat **CLAYS**
			OH	Organic **CLAYS** of medium to high plasticity, organic **SILTS**
HIGHLY ORGANIC CLAYS			PT	PEAT & other highly organic soils

PLASTICITY CHART

USED FOR CLASSIFICATION OF FINE GRAINED SOILS



SAMPLE DRIVING RECORD

BLOWS PER FOOT	DESCRIPTION
25	25 Blows drove sampler 12 inches, after initial 6 inches of seating
50/7"	50 Blows drove sampler 7 inches, after initial 6 inches of seating
50/3"	50 Blows drove sampler 3 inches during or after initial 6 inches of seating

Note: To avoid damage to sampling tools, driving is limited to 50 blows per 6 inches during or after seating interval.

SOIL GRAIN SIZE

U.S. STANDARD SIEVE	6"		3"	¾"	4	10	40	200		
	BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY	
			COARSE	FINE	COARSE	MEDIUM	FINE			
SOIL GRAIN SIZE IN MILLIMETERS	150		75	19	4.75	2.0	.425	0.075	0.002	

KEY TO PIT & BORING SYMBOLS

- Standard Penetration test
- 2.5" O.D. Modified California Sampler
- 3" O.D. Modified California Sampler
- Shelby Tube Sampler
- 2.5" Hand Driven Liner
- Bulk Sample
- Water Level At Time Of Drilling
- Water Level After Time Of Drilling
- P Perched Water

KEY TO PIT & BORING SYMBOLS

	Joint
	Foliation
	Water Seepage
NFWE	No Free Water Encountered
FWE	Free Water Encountered
REF	Sampling Refusal
DD	Dry Density (pcf)
MC	Moisture Content (%)
LL	Liquid Limit
PI	Plasticity Index
PP	Pocket Penetrometer
UCC	Unconfined Compression (ASTM D2166)
TVS	Pocket Torvane Shear
EI	Expansion Index (ASTM D4829)
Su	Undrained Shear Strength

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING	Project No.: E10208.000 / January 2011	**SOIL CLASSIFICATION CHART AND LOG EXPLANATION** **Auburn Lake Trails WTP** Greenwood, California	**FIGURE A-8**