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Project No. E04198.5
18 August 2005

El Dorado County
Department of Transportation (DOT)
2850 Fairlane Court
Placerville, California 95667

Attention: Mr. Adam Bane

Subject: **HEADINGTON ROAD MAINTENANCE YARD IMPROVEMENTS**
Headington Road
Placerville, California
FOUNDATION DESIGN CRITERIA

References: 1) Proposal and Contract for Headington Maintenance Yard, executed 2 August 2005 by Youngdahl Consulting Group, Inc.

Dear Mr. Bane:

This letter presents the findings and recommendations resulting from our site visit on 17 August 2005. The purpose of our visit was to observe and evaluate existing conditions relevant to the support of the proposed wash rack and sewer line improvements. We understand that the proposed improvements will include the construction of a wash rack (which may include a sump pit) and two additional sewer line installations for the existing facilities in Placerville, California. Our scope of work included our subsurface exploration, laboratory testing, and preparation of this letter report per the referenced contract.

Site Description
The maintenance yard is located at 2441 Headington Road in Placerville, California. The maintenance yard is mostly covered by asphaltic concrete pavement for driveways and parking and has numerous corrugated steel and wood framed buildings throughout the site. The subject site is located north of Headington Road, and is bounded by residential and commercial properties on the north, east and west (which runs parallel to Missouri Flat Road). The proposed wash rack is centrally located on the site where an existing corrugated steel building is currently located. The proposed sewer lines are to be located along the eastern side of the site and the southern third of the site traversing north to south for the eastern line (Sewer Line 1) and west to east for the southern line (Sewer Line 2).

Subsurface Observations
During our subsurface exploration, we observed the soil conditions near the existing footings on the proposed wash rack. The native soil exposed near the footings appeared to be a moderately weathered bedrock in a dry state. A representative of Youngdahl Consulting Group, Inc. continuously observed three test pits excavated at the site. Test Pits TP-1 and TP-2 encountered approximately 2 to 12 inches (variable) asphalt concrete (AC) pavement with no aggregate baserock beneath the AC. Below the AC, a moderately weathered metavolcanic BEDROCK was encountered to the maximum 6 feet depth explored. An electrical line was encountered in Test Pit TP-1 approximately 3 feet below the surface before the excavation was halted and relocated adjacent to the line. The line was covered by a medium course sand shading and backfilled with bedrock fill to the bottom of the AC pavement.

The eastern sewer line will likely encounter similar condition as the building except for existing fills which were encountered within Test Pit TP-3. The fills above the bedrock were composed of processed weathered bedrock materials and likely associated with the previous ramp buildup and surrounding grading. Beneath the sandy FILL, a layer of native red brown sandy SILT/silty SAND with trace to few clay in a moist and medium stiff/medium dense state was encountered from 4 feet to 6 feet depth. Beneath the native silty SANDS/sandy SILTS, a weathered metavolcanic BEDROCK was encountered (similar to bedrock encountered in Test Pits TP-1 and TP-2) to the maximum depth of 8 feet explored. No caving or groundwater was encountered in any of the test pits excavated. The southern sewer line exploration was not conducted at your request; however, we anticipate similar conditions

The laboratory testing of the collected bulk samples was precluded due to the existence of shallow weathered bedrock observed beneath the existing asphaltic concrete pavement in the proposed wash rack building location. Fill materials were composed of like materials previously graded for the ramp. The strength parameters of the foundation soils were based on exposed bedrock encountered during our exploration.

RECOMMENDATIONS

Foundations

We offer the following comments and recommendations for purposes of footing design and construction. **Our firm should be afforded the opportunity to review the project foundation plans to confirm the applicability of the recommendations provided below. Modifications to these recommendations may be made at the time of our review.**

Bearing Capacity: Based on a footing depth of 12 inches, and a minimum width of 12 inches, an allowable dead plus live load bearing pressure of 4,000 p.s.f. may be used for footings based on weathered bedrock. Engineered fills composed of like materials from excavations may use an allowable dead plus live load bearing pressure of 2,500 p.s.f. for design of footings.

Footing Configuration: Continuous spread footing foundations should be reinforced with a minimum of two No. 4 reinforcing bars, one located near the bottom of the footing and one near the top of the stem wall. Final design is the purview of the structural engineer.

Settlement: A total settlement of less than ½ inch is anticipated where foundations are bearing on like materials. This settlement is based upon the assumption that foundation loads will be typical of residential wood framed construction with foundations sized in accordance with the provided allowable bearing capacities.

Transient Bearing Capacities: 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.

Shallow Footing / Stemwall Backfill: We recommend that all footing or stemwall excavations be backfilled after the concrete has been poured. Either imported engineered fill or non-organic on-site soils can be used for this purpose. All footing backfill soil should be compacted to at least 90 percent of the maximum dry density (based on ASTM D1557).

Finish Grading Following Foundation Construction: All soils placed against foundations during finish grading should be compacted to at least 90 percent of the maximum dry density (based on ASTM D1557).

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 0.40 may be utilized for sliding resistance at the base of spread footings in undisturbed native materials or engineered fill. A passive resistance of 400 pcf equivalent fluid weight may be used against the side of shallow footings. If friction and passive pressures are combined, the lesser value should be reduced by 50%.

Retaining Walls

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

Retaining Wall Foundations: 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. For footings founded in engineered fill or native soil, an allowable dead plus live load bearing capacity of 2,500 p.s.f. should be used. 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 400 pcf may be used against the sides of shallow footings founded in native soil or engineered fill. A friction factor of 0.40 may be used at the base of footings founded on soil or engineered fill. If friction and passive pressures are combined, the lesser value should be reduced by 50%. All backfill placed behind retaining walls or against retaining wall footings should be compacted to at least 90 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 12 inches in uncompacted thickness. The fill should be moisture conditioned as necessary and compacted to a relative compaction of not less than 90 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.

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.

Wall Type	Wall Slope Configuration	Equivalent Fluid Weight (pcf)	Surcharge Load (psf)*	Lateral Pressure Coefficient
Free Cantilever	Flat	30	per structural	0.22
	2H:1V	NA	NA	NA
Restrained**	Flat	50	per structural	0.35

* 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.

Wall Drainage: The above criteria is 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 typical 1"x #4 concrete coarse aggregate mix approximates this specification. A clean pea gravel or 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.

Pavement Design

We understand that asphaltic pavements may be used for the associated parking and driveways. The following comments and recommendations are given for pavement design and construction purposes. All pavement construction and materials used should conform to applicable sections of the latest edition of the California Department of Transportation Standard Specifications.

Subgrade Compaction: After installation of any underground facilities, the upper 8 inches of subgrade soils under pavements sections should be compacted to a minimum relative compaction of 95 percent based on the ASTM D1557 test method at a moisture content above optimum. Aggregate bases should also be compacted to a minimum relative compaction of 95 percent based on the aforementioned test method. All subgrades should be proof-rolled with a full water truck or equivalent immediately before paving, in order to verify their condition.

Design Criteria: Critical features that govern the durability of a pavement section include the stability of the subgrade; the presence or absence of moisture, free water, and organics; the fines content of the subgrade soils; the traffic volume; and the frequency of use by heavy vehicles. Soil conditions can be defined by a soil resistance value, or "R"-Value, and traffic conditions can be defined by a Traffic Index (TI).

Design Values: Table 1 provides recommended pavement sections based on materials expected to be exposed at subgrade as well as our experience with similar materials in the area. An R-value of 35 was utilized for the native and fill BEDROCK encountered. Review of test pit logs indicate that in some locations clay soils were encountered at depths of 5.5 to 6½ feet below grade. *If clay soils are encountered, we should review pavement subgrades to determine the appropriateness of the provided sections, and provide additional pavement design recommendations as field conditions dictate. Even minor clay constituents will greatly reduce the R-Value design value.* The recommended design thicknesses presented in Table 1 were calculated in accordance with the methods presented in the latest update of the Fifth Edition of the California Department of Transportation Highway Design Manual.

Table 1. Recommended Pavement Design Thickness

DESIGN TRAFFIC INDICES	ALTERNATIVE PAVEMENT SECTIONS (INCHES)	
	ASPHALT CONCRETE *	AGGREGATE BASE **
4.5	2.5 3.0	5.0 4.0
5.0	2.5 3.0	6.0 5.0
5.5	3.0 3.5	6.5 5.5
6.0	3.0 3.5	7.5 6.5
6.5	3.5 4.0	8.0 7.0

NOTES:
* Asphaltic Concrete: must meet specifications for CAL TRANS Type B Asphaltic Concrete
** Aggregate Base: must meet specifications for CAL TRANS Class II Aggregate Base ("R"-Value = minimum 78)

Portland Cement Concrete (PCC) Pavements

The following recommendations are to address the proposed portland cement concrete pavement construction at the above project site. An in-depth traffic study is beyond the scope of our work for this project. However, we anticipate that the traffic at the project site would consist primarily of construction type trucks and garbage trucks with axle loads varying from 20,000 to 30,000 pounds.

The following table provides recommended pavement section thicknesses based on concrete compressive strengths and varying loading conditions:

Concrete Compressive Strength (psi)	Pavement Thickness (inches)		
	Axle Load (pounds)		
	≤ 20,000	25,000	30,000
2,500	7.5	8.0	8.5
3,000	7.0	7.5	8.0
3,500	6.5	7.0	7.5
4,000	6.5	6.5	7.0

The above values were determined in accordance with the computer program PCAPAV 2.10 (Portland Cement Association), modified as necessary for use at the project site. A 20 year design life was assumed, as well as an average daily truck traffic of 4; half of the trucks were assumed to be in the largest axle load range, and the other half distributed among the smaller load ranges. If steel reinforcement is utilized, the above structural section thicknesses may be reduced by one (1) inch. The reinforcement should consist of a minimum of #4 deformed reinforcing bars placed at 24 inches on center, both ways in the center of the structural section. A modulus of subgrade reaction of k = 175 psi per inch was utilized in our design

The long term performance of PCC pavement is related to the volume of traffic it is subjected to. Short term performance can be affected by heavy truck traffic when axle loads exceed the values listed in the above table. An increase in the average daily truck traffic would result in a decrease of the design life of the pavement. The final selection of concrete thickness, compressive strength, and traffic volumes should be based on cost and desired level of future maintenance, and is the purview of the project design engineer.

Pavement underlayment should consist of a minimum of 4 inches of Cal Trans Class II aggregate base compacted to a minimum of 95 percent of the maximum dry density as determined by the ASTM D1557-91 test method. The top 8 inches of soil subgrades should also be compacted to a minimum of 95 percent of the maximum dry density. Tooled or saw cut contraction joints grooved to one-fourth the slab thickness should be used to separate the pavement into nearly square sections with a spacing of no more than 30 times the slab thickness, each way. A concrete shrinkage of approximately 1/16 inch per 10 feet of length should be anticipated and contraction joints should be designed accordingly. Expansion (isolation) joints should be substituted for every other joint.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. This report has been prepared for the exclusive use of El Dorado County Department of Transportation for specific application to the Headington Road Maintenance Yard Improvements 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. Section 3317.8 in Appendix Chapter 33 of the latest edition of the California Building Code is applicable to this report.

   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.

3. 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.

If you have any questions about this Foundation Engineering Study letter, do not hesitate to call us at (916) 933-0633.

Very truly yours,
Youngdahl Consulting Group, Inc.

Reviewed by:

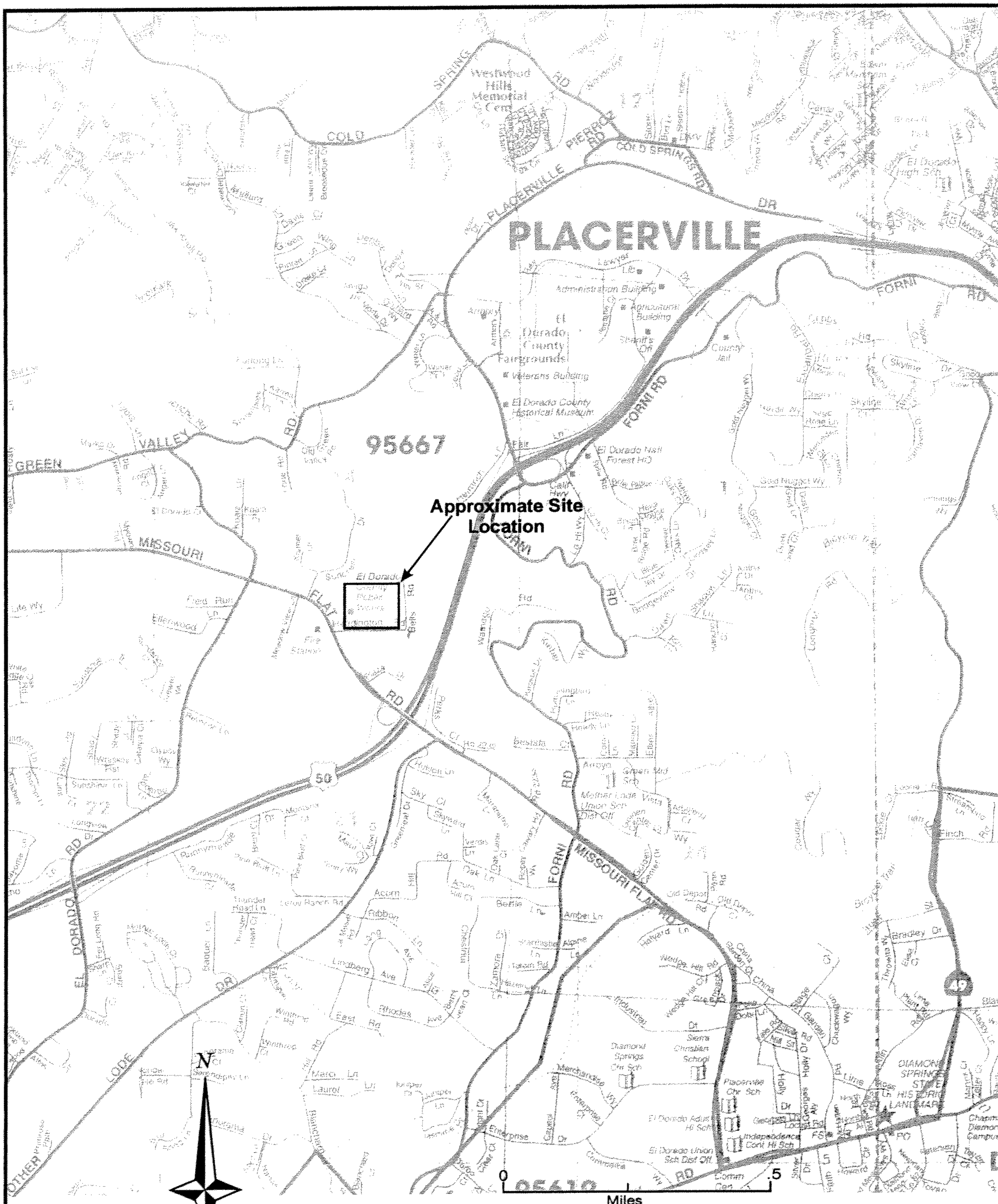
REGISTERED PROFESSIONAL ENGINEER
JOHN C. YOUNGDAHL
NO. C60224
Exp. 06-30-12
CIVIL
STATE OF CALIFORNIA

Victor P. Dumlao
Staff Engineer

John C. Youngdahl, P.E.
Principal Engineer

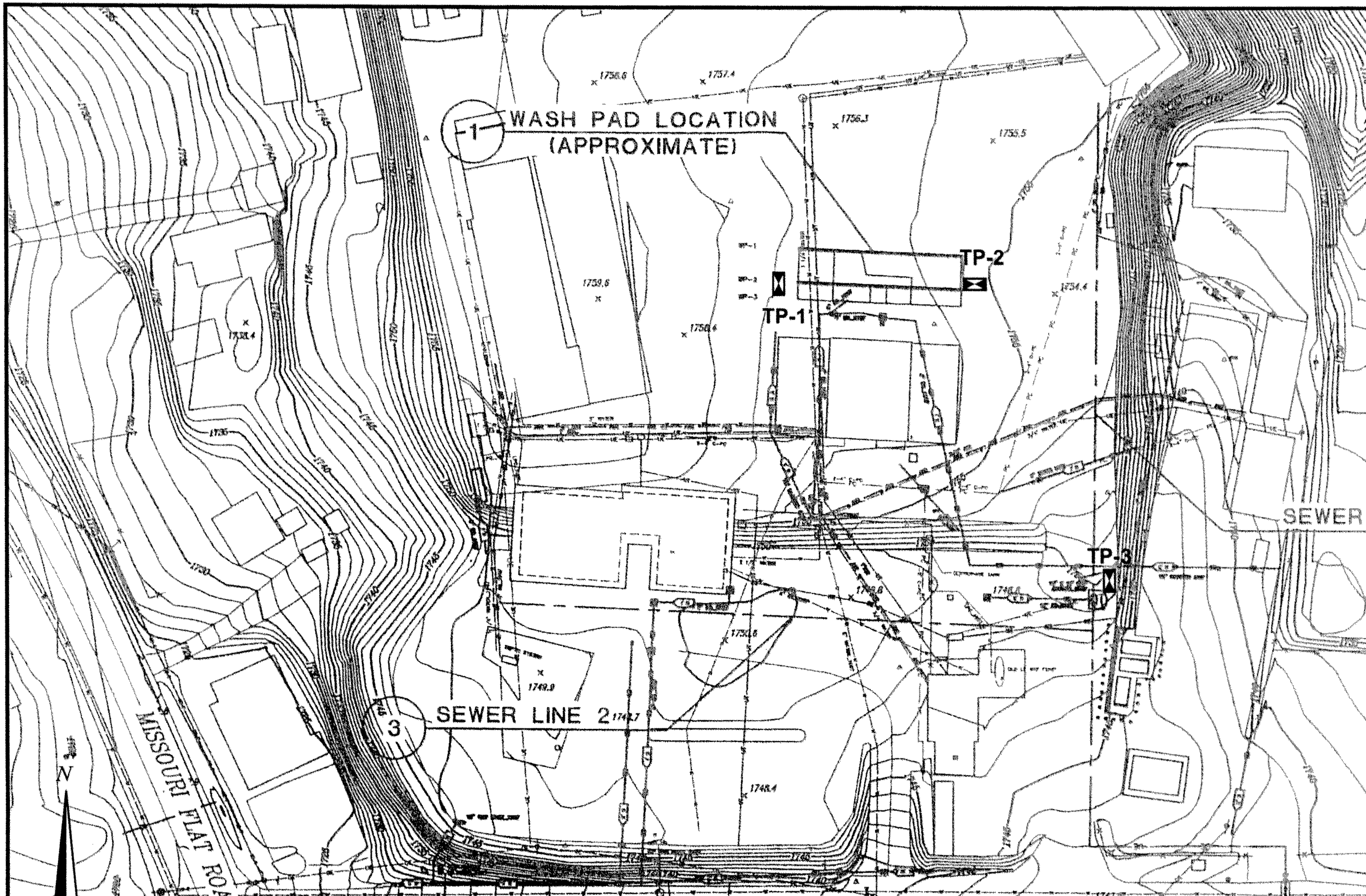
Attachments: Figure 1 (Vicinity Map), Figure 2 (Site Map), Figures 3-6 (Exploratory Test Pit Logs), Figure 4 (Soil Classification Chart and Pit Log Legend)

Copies: (4) to client



REFERENCE: El Dorado County Compass Map 2004 Page 200

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING	Project No.: E04198.5	**VICINITY MAP**	**FIGURE**
	August 2005	**Headington Maintenance Yard** Placerville, California	**1**



= Approximate Test Pit Locations

REFERENCE: El Dorado County DOT, preliminary, dated 8/01/05

0 20 40 80

Approximate Scale: 1" = 40'

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

Project No.: E04198.5

August 2005

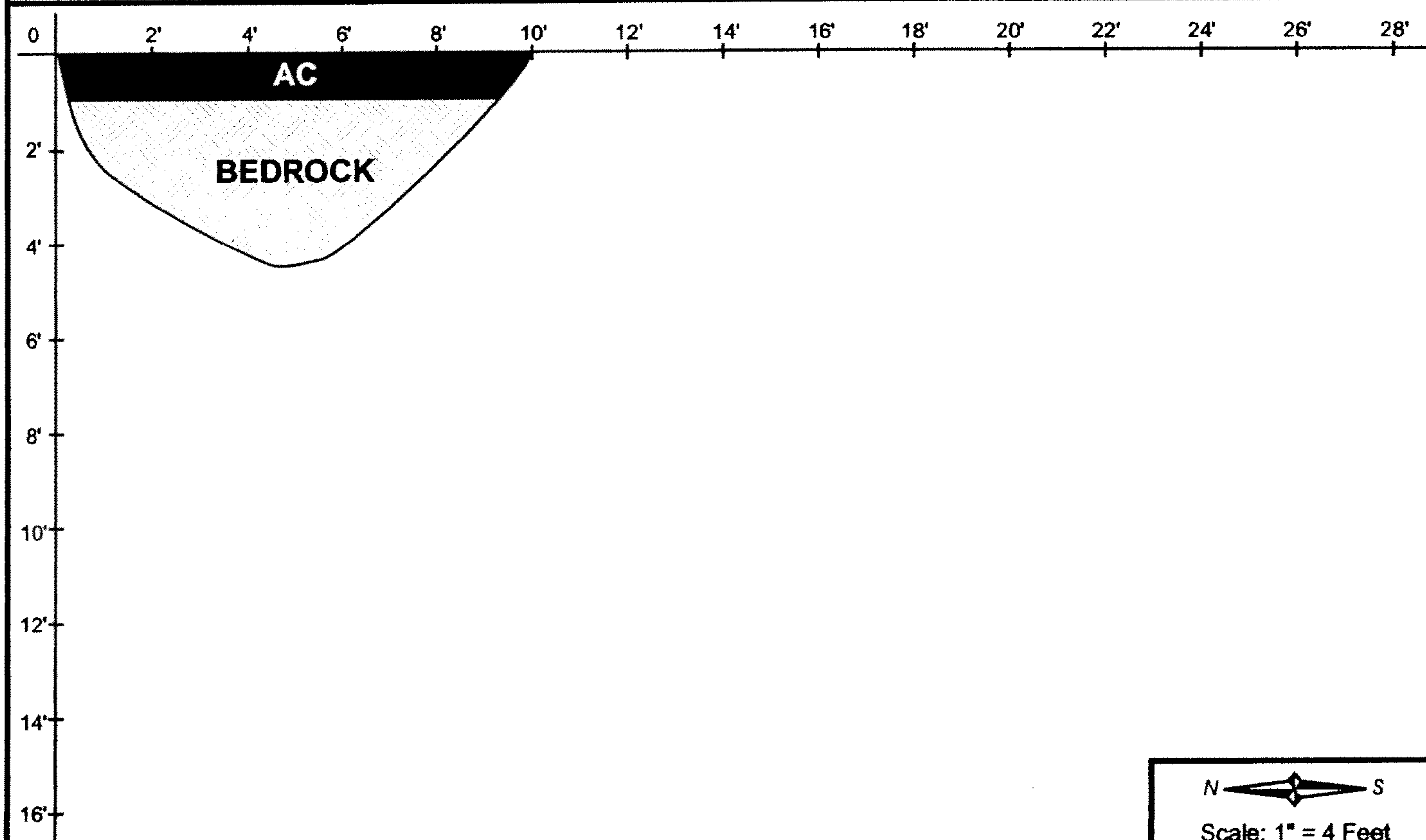
SITE PLAN

Headington Maintenance Yard
Placerville, California

FIGURE
2

Logged By: **VPD**	Date: **17 August 2005**	Elevation:	Pit No. **TP-1**
Equipment: **John Deere 310 SG with 24" Bucket**		Pit Orientation: **N - S**	

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 1'	AC		
@ 1' - 4.5'	Yellow brown metavolcanic **BEDROCK**, moderately weathered, moderately indurated to indurated	**Rock 1** @ 1.5'-4.5'	
	Test pit terminated at 4.5' (practical refusal) No free groundwater encountered No caving noted		

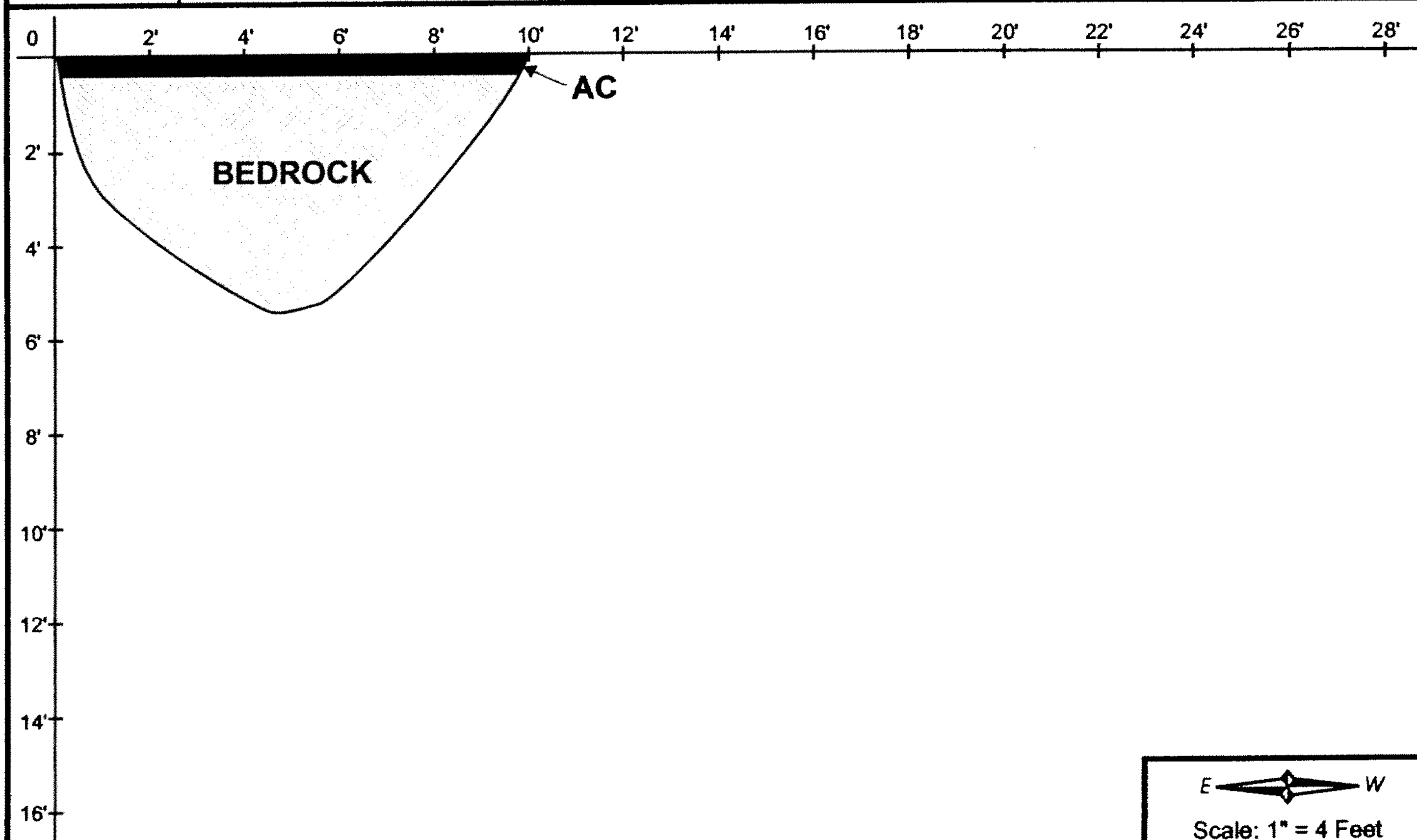


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at 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.: E04198.5	**EXPLORATORY TEST PIT LOG**	**FIGURE**
	August 2005	**Headington Maintenance Yard** Placerville, California	**3**

Logged By: **VPD**	Date: **17 August 2005**	Elevation:	Pit No. **TP-2**
Equipment: **John Deere 310 SG with 24" Bucket**		Pit Orientation: **E - W**	

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ *0 - 3"*	AC		
@ *3" - 5'*	Yellow brown metavolcanic **BEDROCK**, moderately weathered, weakly indurated to moderately indurated		
	Test pit terminated at 5' No free groundwater encountered No caving noted		

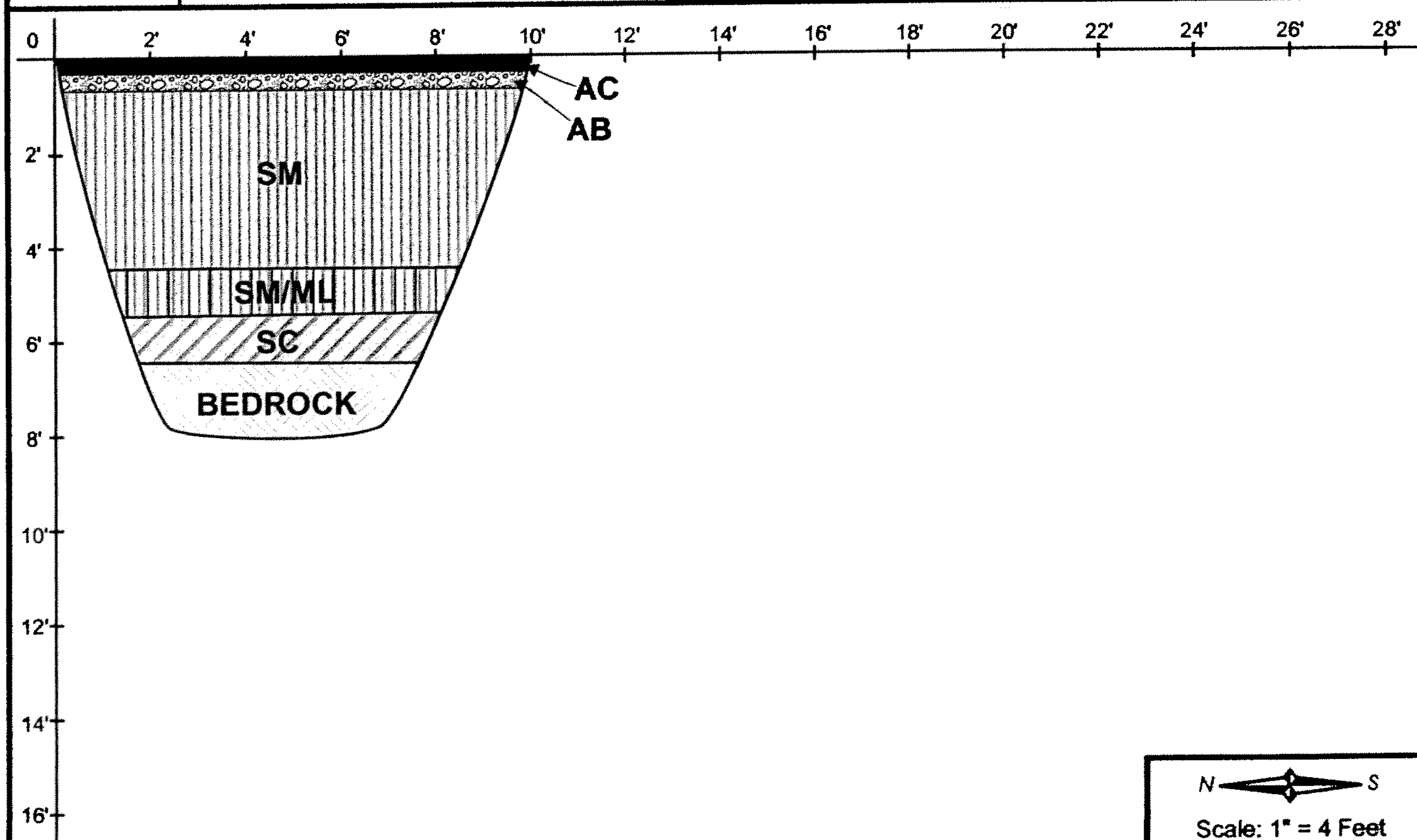


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at 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.: E04198.5 **August 2005**	**EXPLORATORY TEST PIT LOG** **Headington Maintenance Yard** Placerville, California	**FIGURE** **4**

Logged By: **VPD**	Date: **17 August 2005**	Elevation:	Pit No. **TP- 3**
Equipment: **John Deere 310 SG with 24" Bucket**		Pit Orientation: **N - S**	

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 4"	AC		
@ 4" - 1'	AB		
@ 1' - 4.5'	Yellow brown silty **SAND (SM)**, medium dense, moist (FILL)		
@ 4.5' - 5.5'	Red brown silty **SAND** to sandy **SILT(SM/ML)**, with trace clay, medium dense, moist (Native)		
@ 5.5' - 6.5'	Red brown clayey **SAND (SC)**, medium dense, moist		
@ 6.5' - 8'	Yellow brown to red brown metavolcanic **BEDROCK**, moderately weathered, moderately indurated		
	Test pit terminated at 8' 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.

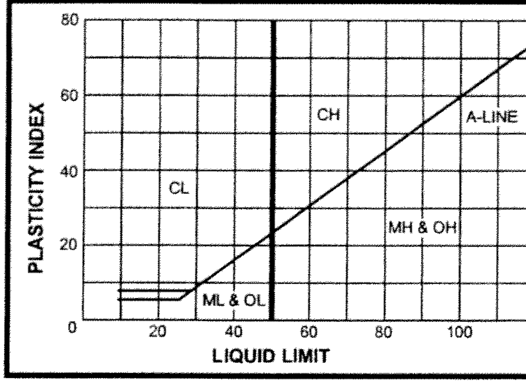
YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING	Project No.: E04198.5 **August 2005**	**EXPLORATORY TEST PIT LOG** **Headington Maintenance Yard** Placerville, California	**FIGURE** **5**

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		
SOIL	BOULDER		COBBLE		GRAVEL COARSE		GRAVEL FINE		SAND COARSE		SAND MEDIUM		SAND FINE		SILT		CLAY
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