KLEINFELDER

#21003

GEOTECHNICAL INVESTIGATION
PETER MOYES RESIDENCE
3608 SOUTH 3610 EAST
SALT LAKE CITY, UTAH

For: Mr. Peter Moyes

File No.: 31287.001

July 1, 2003

KLEINFELDER
An employee owned company

July 1, 2003
File No.: 31287.001

Mr. Peter Moyes
420 East South Temple
Salt Lake City, Utah 84111

Subject: **Geotechnical Investigation**
Peter Moyes Residence
3608 South 3610 East
Salt Lake City, Utah

Dear Mr. Moyes:

Kleinfelder is pleased to present the attached geotechnical investigation report for the referenced project. The purpose of our investigation was to evaluate the subsurface soil conditions at the subject site in order to develop geotechnical engineering recommendations to aid in project design and construction.

Based on the results of our field investigation and laboratory testing program, it is our professional opinion that the site is suitable to support the proposed residence provided that the recommendations presented in this report are incorporated. Specific recommendations regarding the geotechnical aspects of project design and construction are presented in the following report.

We appreciate the opportunity of providing our services for this project. If you have questions regarding this report or if we may be of further assistance, please contact the undersigned.

Sincerely,

KLEINFELDER, INC.

Corbett M. Hansen

Corbett M. Hansen, P.E.
Project Geotechnical Engineer

KLEINFELDER 2677 East Parley's Way, Salt Lake City, UT 84109-1617 (801) 466-6769 (801) 466-6788 fax

Prepared for:

Mr. Peter Moyes
420 East South Temple
Salt Lake City, Utah 84111

File No.: 31287.001

GEOTECHNICAL INVESTIGATION
PETER MOYES RESIDENCE
3608 SOUTH 3610 EAST
SALT LAKE CITY, UTAH

Prepared by:

REGISTERED PROFESSIONAL ENGINEER
No. 343700
Corbett M. Hansen
7/1/03
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Corbett M. Hansen, P.E.
Project Geotechnical Engineer

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Salt Lake City, UT 84109
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July 1, 2003

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APPENDICES

1. INTRODUCTION

1.1 PURPOSE AND SCOPE OF WORK

This report presents the results of our geotechnical investigation performed for the proposed residence at 3608 South 3610 East in Salt Lake City, Utah. The general location of the project is indicated on the Site Vicinity Map, Figure A-1. In general, the purposes of this investigation were to evaluate the general subsurface soil conditions, the nature and engineering properties of the subsurface soils, and to provide recommendations for general site grading and for design and construction of foundations. The investigation included subsurface exploration, representative soil sampling, field and laboratory testing, engineering analyses, and preparation of this report.

The work performed for this report was authorized by Mr. Peter Moyes and was conducted in accordance with our proposal dated June 3, 2003.

1.2 PROJECT DESCRIPTION

was report based on a review of the grading plan?

We understand that the proposed residence will be a three story, single family structure. The southwest corner of the structure is expected to be at site grade with cuts planned into the hillside to accommodate the remainder of the basement. Retaining walls are also planned along the southwest corner of the residence and along the east property boundary. We anticipate that the proposed building will have column loads on the order of 50 kips and wall loads on the order of 4 kips per linear foot. If the building loads are different than described above, we should be notified to reevaluate our recommendations.

2. METHODS OF STUDY

2.1 FIELD INVESTIGATION

The site subsurface soil conditions at the site were explored by drilling two borings to depths ranging from approximately 10 to 33.5 feet below the existing ground surface. The approximate locations of the borings are shown on Figure A-2, entitled "Boring Location Map". Logs of the subsurface conditions, as encountered in the borings, were recorded at the time of drilling and are presented on the logs, Figures A-3 and A-4. A key to soil symbols and terms is found on Figure A-5. All figures are presented in Appendix A.

The borings were advanced using a truck-mounted hollow-stem auger drill rig equipped for soil sampling. Soil samples were obtained using a standard split-spoon (SPT) soil sampler driven by an automatic-trip, 140-pound hammer free-falling through a distance of 30 inches. Sampler driving resistance expressed as "blows per foot of penetration," is presented on the boring logs at the respective sampling depths. The samples were classified by an engineer, and representative portions of each sample were packaged and transported to our laboratory for testing.

2.2 LABORATORY INVESTIGATION

Representative samples were tested in the laboratory to evaluate general index characteristics and pertinent engineering properties of the soils. Moisture content determinations were performed to evaluate the various soil deposits. Grain size distribution analyses and Atterberg Limits determinations were performed on selected samples to aid in classification of the soils. Laboratory tests are presented on the Boring Logs, Figures A-3 and A-4, and in Appendix B.

3. GENERAL SITE CONDITIONS

3.1 SURFACE CONDITIONS

At the time of our investigation the site of the proposed residence consisted of vacant, undeveloped land. The site is covered with concrete debris, weeds, and natural grasses. The site slopes down to the north in excess of 30 percent. Although no distinction between fill and native soil could be assessed through samples obtained during drilling, Mr. Greg Baptist of the Salt Lake County Building Department indicated that fill may be present. The site is bounded to the northwest by 3610 East Street, to the east by an adjacent residence, and to the north, west, and south by vacant, undeveloped land.

3.2 SUBSURFACE CONDITIONS

3.2.1 Soils

Based on the subsurface conditions observed in the two borings explored for this investigation, the soils generally consist of Silty GRAVEL with sand encountered to 33.5 feet below ground surface, the maximum depth explored. However, in Boring B-2, approximately 7 feet of Sandy SILT was observed to overlie the gravelly soils and may extend across other portions of the site. A description of the soils encountered follows:

> <u>Silty GRAVEL with sand</u> -The gravel is very dense, slightly moist to moist, brown in color, and contains frequent cobbles.
>
> Laboratory tests conducted on samples of the granular soils indicate is has natural moisture contents ranging between 3 and 9 percent.

Sandy SILT - The Sandy SILT is hard, slightly moist and brown in color.

Laboratory tests conducted on samples of the silt indicate is has a natural moisture content of 10 percent and low plasticity.

Laboratory test results are presented on the boring logs, Figures A-3 and A-4 and in Appendix B.

3.2.2 Groundwater

At the time of our investigation, groundwater was not encountered in the borings. It should be noted however, that groundwater and soil moisture levels may fluctuate at the site in response to seasonal changes, precipitation, snowmelt and runoff. Perched groundwater and/or high soil moisture conditions may occur periodically during periods of high precipitation, runoff, or snow melt.

4. GEOLOGIC CONDITIONS

4.1 GEOLOGIC SETTING

The site is located at an elevation of approximately 5,040 feet on the eastern margin of the Salt Lake Valley. This valley is a deep, sediment-filled structural basin that has formed since the beginning of the Cenozoic age, since approximately 65 million years ago. The site is located near the transition between the Basin and Range Physiographic Province to the west and the Middle Rocky Mountain Physiographic Province to the east. The Basin and Range Province is characterized by generally north-trending valleys and mountain ranges which have formed by displacement along normal faults. The Wasatch fault forms the boundary between the two provinces and has been active for approximately 10 million years. The Middle Rocky Mountains were formed during a period of regional compression that occurred in Cretaceous time, about 75 to 70 million years ago (Hunt, 1967). The Salt Lake Valley is flanked by two fault-bounded uplifted blocks, the Wasatch Range on the east and the Oquirrh Mountains to the west. The northern portion of the Salt Lake Valley extends beyond the northern limits of the Oquirrh mountain range and is bordered on the west by the southeast shore of the Great Salt Lake, which is a remnant of ancient Lake Bonneville. The Wasatch Range is the easternmost expression of pronounced Basin and Range extension in north-central Utah.

The near-surface geology of the Salt Lake Valley is dominated by sediments deposited within the last 30,000 years by Lake Bonneville (Currey and Oviatt, 1985; Personius and Scott, 1992). As the lake receded, streams began to regrade through large deltas formed at the mouths of major Wasatch Range canyons and the eroded material was deposited in shallow lakes and marshes in the basin, and in a series of recessional deltas and alluvial fans and terraces. Toward the center of the valley, deep-water deposits of clay, silt and fine sand predominate (Personius and Scott, 1992). However, these deep-water deposits are in places locally covered by a post-Lake Bonneville alluvium and or thin eolian covers.

The surface sediments at the site are mapped as Pleistocene lacustrine sand and gravel related to the transgression of Lake Bonneville (Personius and Scott, 1992). These sediments were deposited during the transgression of Lake Bonneville, between approximately 17,000 to 15,000 years ago.

4.2 Seismicity and Faulting

The "Surface Fault Rupture and Liquefaction Potential Special Study Areas" map dated March 31, 1989 and published by Salt Lake County Public Works - Planning Division, indicates there are no known active faults that pass under or immediately adjacent to the site. The site is located approximately 3.7 miles east of the Wasatch fault zone (Personius and Scott, 1992; Hecker, 1993). The Wasatch fault zone is considered active and capable of generating earthquakes as large as magnitude 7.11, and is likely to be the greatest contributor to the seismic hazard in the vicinity of the site, however the other seismogenic sources should also be considered as potential sources for strong ground motion at the site (Arabasz et al., 1992). Surface faulting commonly occurs in conjunction with events of magnitude 6.9 or larger. Other potentially active seismogenic sources in the vicinity of the site include the West Valley fault zone approximately 10 miles to the west of the site, (Personius and Scott, 1992; Hecker, 1993). The West Valley fault zone is considered active and capable of generating earthquakes as large as magnitude 7.0.

The soils at the proposed site correspond with Site Class C of the International Building Code 2000 (IBC). The design spectral response acceleration parameters are S_{DS} = 1.17g and S_{D1} = 0.76g for short period and one second period, respectively. The intermediate values from IBC used to obtain the design parameters are contained in Tables 1 and 2.

Table 1
Design acceleration for short periods

S_S	F_a	S_{MS}	S_{DS}
		$S_{MS} = F_aS_s$	$S_{DS} = 2/3\ S_{MS}$
1.75	1.0	1.75	1.17

S_S = The mapped spectral accelerations for short periods (U.S. Geological Survey Web Page, 1999)
F_a = Site coefficient from Table 1615.1.2(1)
S_{MS} = The maximum considered earthquake spectral response accelerations for short periods
S_{DS} = Five-percent damped design spectral response acceleration at short periods

Table 2
Design acceleration for 1 second period

S_1	F_v	S_{M1}	S_{D1}
		$S_{M1} = F_vS_1$	$S_{D1} = 2/3\ S_{M1}$
0.78	1.3	1.01	0.76

S_1 = The mapped spectral accelerations for 1-second period (U.S. Geological Survey Web Page, 1999)
F_v = Site coefficient from Table 1615.1.2(2)
S_{M1} = The maximum considered earthquake spectral response accelerations for 1 second period
S_{D1} = Five-percent damped design spectral response acceleration at 1 second period

4.3 LIQUEFACTION POTENTIAL HAZARDS

In conjunction with the ground shaking potential of large magnitude seismic events as discussed previously, certain areas within the Salt Lake Valley also possess a potential for liquefaction during such events. Liquefaction is a phenomenon whereby loose, saturated, granular soil deposits lose a significant portion of their shear strength due to excess pore water pressure buildup resulting from dynamic loading, such as that caused by an earthquake. Among other effects, liquefaction can result in densification of such deposits causing settlements of overlying layers after an earthquake as excess pore water pressures are dissipated. The primary factors affecting liquefaction potential of a soil deposit are: (1) level and duration of seismic ground motions; (2) soil type and consistency; and (3) depth to groundwater.

Referring to the "Surface Fault Rupture and Liquefaction Potential Special Study Areas" map dated March 31, 1989 and published by Salt Lake County Public Works - Planning Division, the subject site is located within an area designated as "Very Low" for liquefaction potential

Based upon the soils encountered in our boring, the blow counts and lack of groundwater recorded during the drilling, we do not believe that surface deformation from liquefaction induced settlements at depth could impact the proposed construction during a strong earthquake.

4.4 SLOPE STABILITY CONDITIONS

Slope gradients on the site are on the order of 30 percent or greater, thus a slope stability analysis was conducted for the proposed construction. The results of our analysis are summarized in section 5.2.5 of this report. No landslides were observed on the site.

5. ENGINEERING ANALYSIS AND RECOMMENDATIONS

5.1 GENERAL CONCLUSIONS

Based on the results of our field and laboratory investigations, it is our opinion that the site is suitable for the proposed construction provided that the recommendations contained in this report are complied with. In general, the structure may be supported by conventional, continuous, spread type foundations established on native granular soils or properly placed and compacted structural fill. The Sandy SILT beneath the foundation for the residence should be overexcavated and replaced with properly compacted structural fill.

Specific recommendations regarding site grading, structural fill placement, and foundation design are presented in Sections 5.2 and 5.3 of this report. Additional sections present our recommendations for floor slab, concrete flatwork, moisture protection, and surface drainage.

5.2 EARTHWORK

5.2.1 General Site Preparation and Grading

Prior to commencing site-grading operations, the planned building pad should be stripped of all vegetation, topsoil, fill material, Sandy SILT, and debris. We estimate the depth of required stripping to remove organic-laden topsoil to be approximately 6 inches.

According to comments made by Mr. Greg Baptist of the Salt Lake County Building Department and our site observations, fill may be present beneath the building location. Excavated soils from construction of surrounding residences and roadways may have been placed on the slope at the building site. Because the fill material is similar to the native gravelly soils, the depth of the fill could not be clearly identified at the time of drilling. From our observations, we estimate that approximately 10 feet of fill may be present at the site. Any fill encountered within the building area should be removed to expose competent, native soils. Due to the possible difficulty identifying the fill soils, we recommend that excavation work be observed by the Geotechnical Engineer to assist the Contractor in identifying and handling these soils. We estimate that approximately 10 feet of fill may be present at the site.

Because fine grained soil are sensitive to changes in the moisture content, the Sandy SILT layer should be excavated and replaced with granular structural fill within the building area to prevent damage from shrinkage or swelling. We estimate the depth of excavation to be approximately 7 feet.

The excavated topsoil and Sandy SILT encountered in portions of the site are not suitable for use as structural fill below the structure, however, these soils may be stockpiled for use in general fill or landscaped areas. The Geotechnical Engineer should observe excavation operations to assist the Contractor in identifying proper stripping depths across the site.

5.2.2 Excavation Stability

Stability of construction excavations is the contractor's responsibility. All excavations should be protected in accordance with all applicable OSHA[1] Health and Safety Standards. Based on the limited subsurface exploration, the site soils can be classified as Type C according to the OSHA document titled "Occupational Safety and Health Standards-Excavations; Final rule, 29 CFR part 1926".

Temporary excavations extending less than four feet into undisturbed native soils may be excavated with near-vertical sideslopes. Excavations deeper than four feet must be sloped at 1½:1 (H:V) or flatter. If loose, caving, or otherwise unstable conditions are encountered, flatter sideslopes or bracing and/or shoring may be required.

[1] Occupational Safety and Health Administration

All excavations should be observed by qualified geotechnical engineering personnel. If any signs of instability are noted, immediate remedial action must be initiated. Furthermore, prior to placing any fill, the excavations should be observed by the Geotechnical Engineer to observe that all unsuitable materials have been removed and that the exposed soils are in a firm, non-yielding condition.

5.2.3 Excavatability

Based on observations made during our field investigation, excavation with conventional excavation equipment in the gravelly soils may be difficult and may require the use of heavy duty excavation equipment. The earthwork contractor should review the subsurface soil conditions at the site to properly evaluate the excavatability of the subsurface soils and the type of excavation equipment needed.

5.2.4 Structural Fill and Compaction

All fill placed within the proposed building area should be structural fill. Structural fill for the building pad may consist of on-site granular soils, excluding rocks in excess of 4 inches in diameter, or approved granular import soils. We recommend that all imported material consist of well graded granular soils with a maximum of 50 percent passing the No. 4 mesh sieve, a maximum of 30 percent passing the No.200 sieve with no material greater than 4 inches in effective diameter. Structural fill, including all utility trench backfill, should be placed in maximum ten-inch loose lifts and compacted to at least 95 percent of the maximum dry density as determined by ASTM D-1557. All structural fill should be placed at near optimum (± 2%) moisture content to facilitate compaction. All imported fill materials should be approved by the Geotechnical Engineer prior to importing.

Prior to placing any fill, the excavations should be observed by the Geotechnical Engineer to verify that all unsuitable materials have been removed and that the exposed soils are in a firm, unyielding condition.

5.2.5 Slope Stability

A slope stability analysis was performed to evaluate the stability of the cut slopes for the residence. Our analysis indicated that the factor of safety for the slope with building loads applied is 1.64 under static conditions. Using a horizontal ground acceleration of 0.34g (half the value of the peak ground acceleration for two percent probability of exceedance in 50 years), the factor of safety for the psuedo-static analysis was 1.03. Although this factor of safety is greater than 1.0, movement of the slope may occur during or after earthquake events.

5.3 FOUNDATIONS

The proposed structure may be supported by conventional spread footings established on native granular soils or approved imported structural fill. The footings may be proportioned for a maximum net allowable bearing pressure of 3,000 psf. A one-third increase may be used for transient wind or seismic loads.

Total and differential settlement for foundations established on properly prepared native granular soils or structural fill should be less than 1-inch with differential settlements less than ½-inch.

For frost protection, the structure should be established on footings at least 30 inches below the lowest adjacent finish grade. Interior footings located beneath heated space should be established at a minimum depth of 18 inches below finish floor elevation.

Prior to placement of structural fill and constructing the foundations, the footing excavations should be observed by the Geotechnical Engineer to evaluate whether suitable bearing soils have been exposed and whether the excavation bottoms are free of loose or disturbed soils.

Horizontal loads acting on foundations formed in open excavations will be resisted by friction acting at the base of foundations and by passive earth pressures. If design makes use of passive earth pressures, it is important that the Geotechnical Engineer be present during any footing backfill placement.

The friction acting along the base of footings founded on the native granular soils or structural fill may be computed by using a coefficient of friction of 0.73 with the normal dead load. An ultimate lateral passive earth pressure may be computed by using an equivalent fluid weighing 500 pcf for the sides of footings placed against natural soils or properly placed and compacted backfill. An appropriate factor of safety should be applied to the coefficient of friction and passive earth pressure value. The values given above may be increased by one-third for transient wind or seismic loads.

5.4 LATERAL EARTH PRESSURES

Retaining walls and below-grade structures should be designed to resist lateral pressures imposed by the backfill and surcharge loads applied to the top of the backfill. The "active" condition may be used for walls that are allowed to deflect away from the backfill. For walls that are not allowed to deflect, the "at-rest" condition should be used. The "passive" condition applies to walls or structures that move into the backfill.

TABLE 3
Lateral Pressure Equivalent Fluid Densities (pounds per cubic foot, pcf)
Static Case

Material	Active	At-rest	Passive
Native Granular Soil/ Structural Fill	34	54	500

TABLE 4
Lateral Pressure Equivalent Fluid Densities (pounds per cubic foot, pcf)
Earthquake Case

Material	Active	At-rest	Passive
Native Granular Soil/ Structural Fill	100	120	435

Lateral earth pressures for the earthquake case correspond to a horizontal ground acceleration of 0.68g and assume a unit weight of 130 pcf for the native granular soils and structural fill.

The above values assume a horizontal backfill extending at least 10 feet away from the wall. Surcharge loads applied to the backfill within a distance from the wall equal to the wall height must be considered for lateral pressures. For surcharge loads applied to the backfill, a lateral pressure equal to the lateral pressure coefficient times the uniform surcharge load should be used.

Backfills within three to five feet of the walls must be placed in uniform eight-inch loose lifts and compacted with light, manually-propelled compaction equipment. Backfill beyond three to five feet of the walls may be compacted with conventional self-propelled compaction equipment. If the backfill within three to five feet of the walls is compacted with heavy equipment, the design values presented above should be increased by 50 percent. For inclined backfill, or surcharges within a horizontal distance equal to twice the wall height, higher lateral pressures may be imposed on the walls. For these cases, Kleinfelder should be contacted for additional consultation.

We recommend installing a drainage system behind walls to limit the build-up of hydrostatic pressures. This may be accomplished by placing free-draining gravel against the wall with a geotextile filter fabric placed against the gravel to reduce infiltration of fines into the gravel. As an alternative, a prefabricated geotextile drainage mat, such as Miradrain 6000 or equivalent, may be placed against the wall. In either case, the drainage materials must be extended to the base of the wall. Water collected by the drainage system must be removed from behind the wall by means of weep holes or collection pipes which discharge to a suitable location.

5.5 CONCRETE SLAB-ON-GRADE CONSTRUCTION

Direct support for concrete floor slabs may be provided by a minimum six-inch blanket of pea gravel or clean gravel (less than 10 percent passing No. 4 sieve and less than 2 percent passing No. 200 sieve). Prior to placement of the gravel, the natural soils or structural fill should have been prepared as recommended in Sections 5.2.1 and 5.2.5 of this report. As a basis for designing concrete slab thickness, the conditioned native soils and structural fill may be considered to possess a subgrade modulus of 300 psi/in. The actual floor slab thickness and reinforcement design should be provided by the Structural Engineer.

Special precautions must be taken during the placement and curing of all concrete slabs. Excessive slump (high water-cement ratio) of the concrete and/or improper curing procedures used during either hot or cold weather conditions could lead to excessive shrinkage, cracking or curling in the slabs. We recommend that all concrete placement and curing operations be performed in accordance with the American Concrete Institute (ACI) Manual.

5.6 EXTERIOR CONCRETE FLATWORK

All exterior concrete flatwork not exposed to traffic loads should have a minimum thickness of four inches and be supported on a minimum of six inches of gravel as described above. Prior to constructing the concrete slabs or placement of structural fill, all unsuitable soils should have been removed and the subgrade prepared as recommended in Section 5.2.1.

5.7 MOISTURE PROTECTION AND SURFACE DRAINAGE

Care should be taken during and after construction to avoid over wetting or drying of soils beneath foundations, flatwork, pavements, or other structures. Over-wetting of the fine-grained soils prior to or during construction may result in softening and pumping, causing equipment mobility problems and difficulty in achieving compaction. Positive drainage should be established away from structures in all directions. Concrete flatwork or asphalt pavement is recommended as an apron around the building to allow for surface drainage away from the building. All roof drain downspouts should be extended well away from the building and discharged into suitable collection features.

Landscaping should be carefully planned to minimize the need for irrigation adjacent to the structure. Any landscaping located upgradient from the structure should be carefully designed for low water demand and all surface runoff should be directed away from the structure. Furthermore, all snow storage areas should be located down-gradient from structures, preferably in landscaping or other non-paved areas.

All utility trenches leading into the structure should be backfilled with compacted structural fill. Special care should be taken during installation of subfloor sewer and water lines to reduce the possibility of future wetting.

6. CLOSURE

6.1 LIMITATIONS

The recommendations contained in this report are based on our field explorations, laboratory tests, and our understanding of the proposed construction. The subsurface data used in the preparation of this report was obtained from the two borings explored for this investigation. It is possible that variations in the soil and groundwater conditions could exist between the points explored. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site, which are different from those described in this report, our firm should be immediately notified so that we may make any necessary revisions to recommendations contained in this report. In addition, if the scope or location of the proposed construction changes from that described in this report, our firm should also be notified.

This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, express or implied, is made.

It is the Client's responsibility to see that all parties to the project including the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

6.2 ADDITIONAL SERVICES

The recommendations made in this report are based on the assumption that an adequate program of tests and observations will be made during the construction to verify compliance with these recommendations. These tests and observations should include, but not necessarily be limited to, the following:

- Engineering observation and testing during site preparation, earthwork and structural fill placement.

- Observation of footing excavations.

- Consultation as may be required during construction.

We also recommend that project plans and specifications be reviewed by us to verify compatibility with our conclusions and recommendations. Additional information concerning the scope and cost of these services can be obtained from our office.

7. REFERENCES

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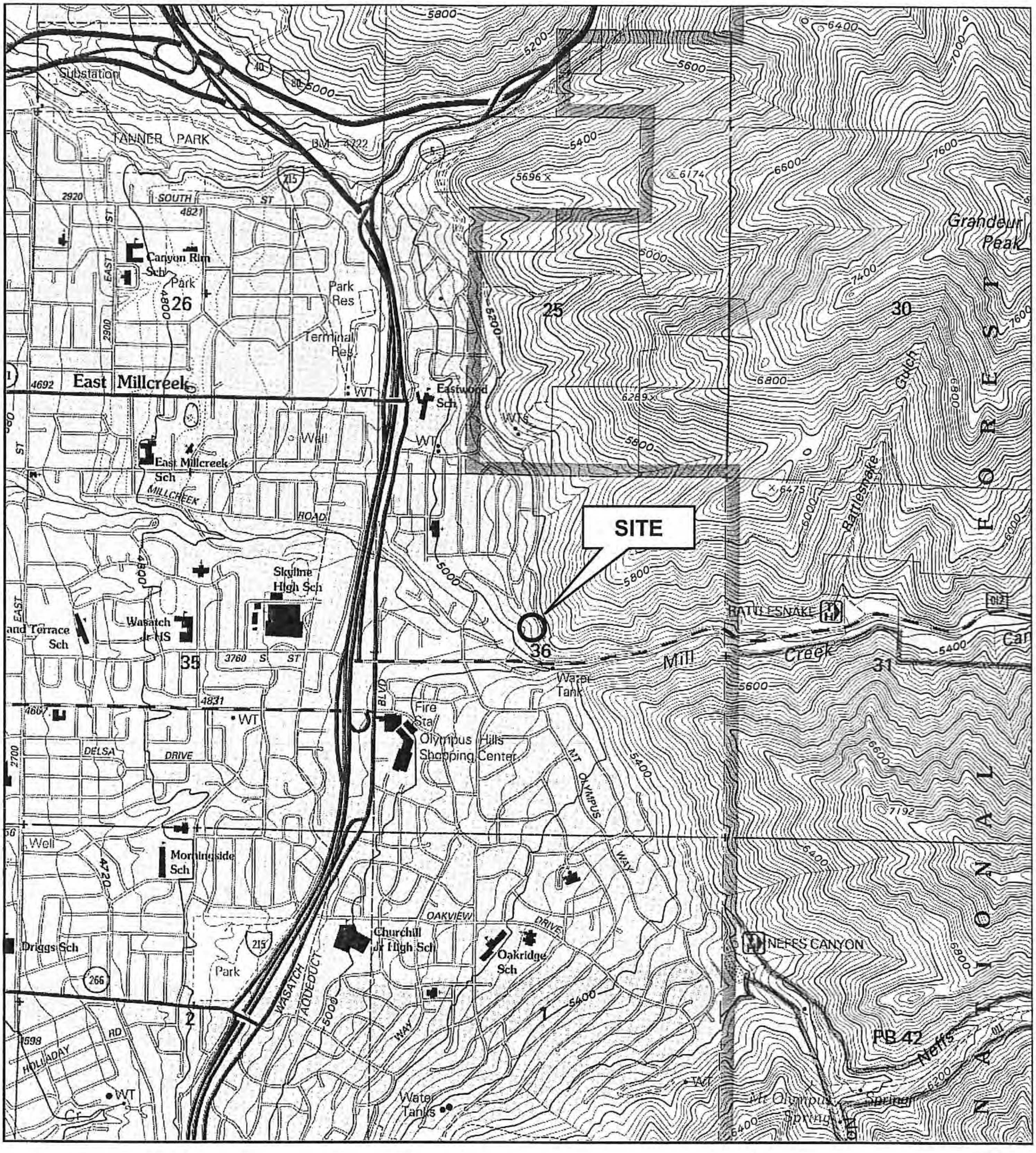

0' 1000' 2000'

SCALE 1:24,000
1" = 2000'
CONTOUR INTERVAL 40 FEET
SUPPLEMENTAL CONTOUR INTERVAL 10 FEET

BASE MAP:
SUGAR HOUSE, UTAH
U.S.G.S. 7.5 MINUTE QUADRANGLE
1998

UTAH
QUADRANGLE LOCATION

N

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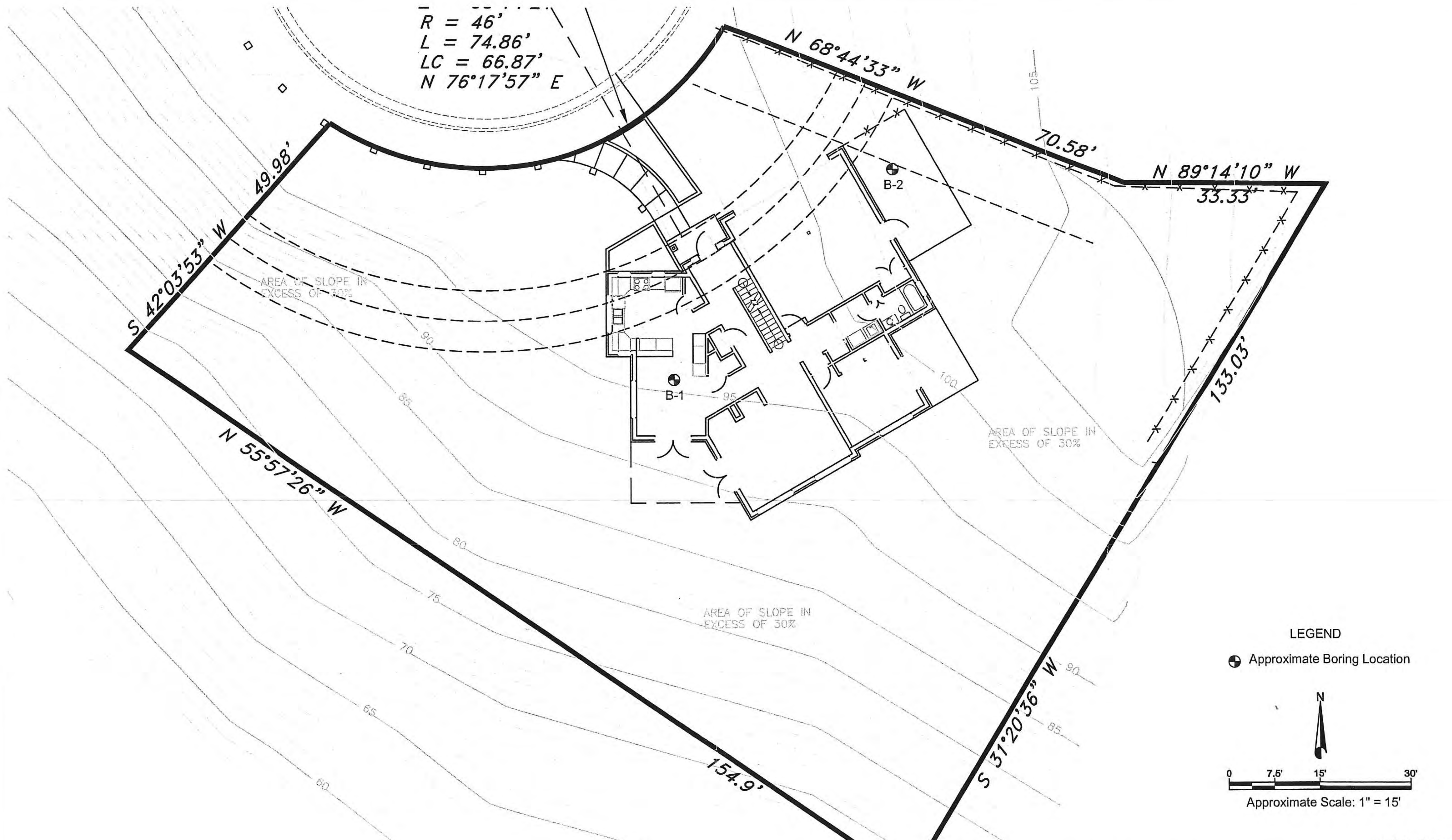
KLEINFELDER

Date: 06/30/03
Project Number 31287.001

Peter Moyes Residence
3608 South 3610 East
Salt Lake City, Utah

SITE VICINITY MAP

FIGURE
A-1



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KLEINFELDER

Date: 07/01/03
Project Number 31287.001

Peter Moyes Residence
3608 South 3610 East
Salt Lake City, Utah

BORING LOCATION MAP

FIGURE
A-2

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

LOG KEY SYMBOLS

- BULK / BAG SAMPLE
- MODIFIED CALIFORNIA SAMPLER (2-1/2 inch outside diameter)
- CALIFORNIA SAMPLER (3 inch outside diameter)
- WATER LEVEL (level after completion)
- STANDARD PENETRATION SPLIT SPOON SAMPLER (2 inch outside diameter)
- SHELBY TUBE (3 inch outside diameter)
- DIAMOND BIT CORE BARREL (47.6mm Cores)
- WATER LEVEL (level where first encountered)

CEMENTATION

DESCRIPTION	DESCRIPTION
WEAKELY	CRUMBLES OR BREAKS WITH HANDLING OR SLIGHT FINGER PRESSURE
MODERATELY	CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE
STRONGLY	WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE

OTHER TESTS KEY

C	CONSOLIDATION	SV	PARTICLE SIZE ANALYSIS
PI	PLASTICITY INDEX	DS	DIRECT SHEAR
UC	UNCONFINED COMPRESSION	T	TRIAXIAL
S	SOLUBILITY	R	RESISTIVITY
O	ORGANIC CONTENT	RV	R-VALUE
CBR	CALIFORNIA BEARING RATIO	SS	SOLUBLE SULFATES
P	MOISTURE/DENSITY RELATIONSHIP	PM	PERMEABILITY
SF	SOIL FERTILITY		

MODIFIERS

DESCRIPTION	%
TRACE	<5
SOME	5 - 12
WITH	>12

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST	DAMP BUT NO VISIBLE WATER
WET	VISIBLE FREE WATER, USUALLY SOIL BELOW WATER TABLE

STRATIFICATION

DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2"
LAYER	1/2 - 12"

DESCRIPTION	THICKNESS
OCCASIONAL	ONE OR LESS PER FOOT OF THICKNESS
FREQUENT	MORE THAN ONE PER FOOT OF THICKNESS

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil conditions between individual sample locations.
3. Logs represent general soil conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT (blows/ft)	MODIFIED CA. SAMPLER (blows/ft)	CALIFORNIA SAMPLER (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
VERY LOOSE	<4	<4	<5	0 - 15	EASILY PENETRATED WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
LOOSE	4 - 10	5 - 12	5 - 15	15 - 35	DIFFICULT TO PENETRATE WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
MEDIUM DENSE	10 - 30	12 - 35	15 - 40	35 - 65	EASILY PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
DENSE	30 - 50	35 - 60	40 - 70	65 - 85	DIFFICULT TO PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
VERY DENSE	>50	>60	>70	85 - 100	PENETRATED ONLY A FEW INCHES WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT (blows/ft)	TORVANE UNDRAINED SHEAR STRENGTH (tsf)	POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH (tsf)	FIELD TEST
VERY SOFT	<2	<0.125	<0.25	EASILY PENETRATED SEVERAL INCHES BY THUMB. EXUDES BETWEEN THUMB AND FINGERS WHEN SQUEEZED BY HAND.
SOFT	2 - 4	0.125 - 0.25	0.25 - 0.5	EASILY PENETRATED ONE INCH BY THUMB. MOLDED BY LIGHT FINGER PRESSURE.
MEDIUM STIFF	4 - 8	0.25 - 0.5	0.5 - 1.0	PENETRATED OVER 1/2 INCH BY THUMB WITH MODERATE EFFORT. MOLDED BY STRONG FINGER PRESSURE.
STIFF	8 - 15	0.5 - 1.0	1.0 - 2.0	INDENTED ABOUT 1/2 INCH BY THUMB BUT PENETRATED ONLY WITH GREAT EFFORT.
VERY STIFF	15 - 30	1.0 - 2.0	2.0 - 4.0	READILY INDENTED BY THUMBNAIL.
HARD	>30	>2.0	>4.0	INDENTED WITH DIFFICULTY BY THUMBNAIL.

FIGURE

A-5

KLEINFELDER

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRADATION			ATTERBERG LIMITS		OTHER TESTS*	UNIFIED SOIL CLASSIFICATION
BORING NO.	DEPTH (ft)			GRAVEL (%)	SAND (%)	SILT AND CLAY (%)	LIQUID LIMIT	PLASTICITY INDEX		
B- 1	14	3		52	37	12				Silty GRAVEL with sand (GM)
B- 1	24	3		45	41	14				Silty GRAVEL with sand (GM)
B- 2	5	10				62	23	3		Sandy SILT (ML)
B- 2	9	9		38	30	32				Silty GRAVEL with sand (GM)

*R = Resistivity (ohms-cm); WSS = Water Soluble Sulfates (ppm); UC = Unconfined Compression (psf); TV = Torvane (psf);
C = Consolidation Test, CBR = California Bearing Ratio (%), S = Swell Potential (%), ND = Non Detect

SUMMARY OF LAB TESTS-E-B SLC3Z048.GPJ 6/26/03

KLEINFELDER

PROJECT NO. **31287.001**

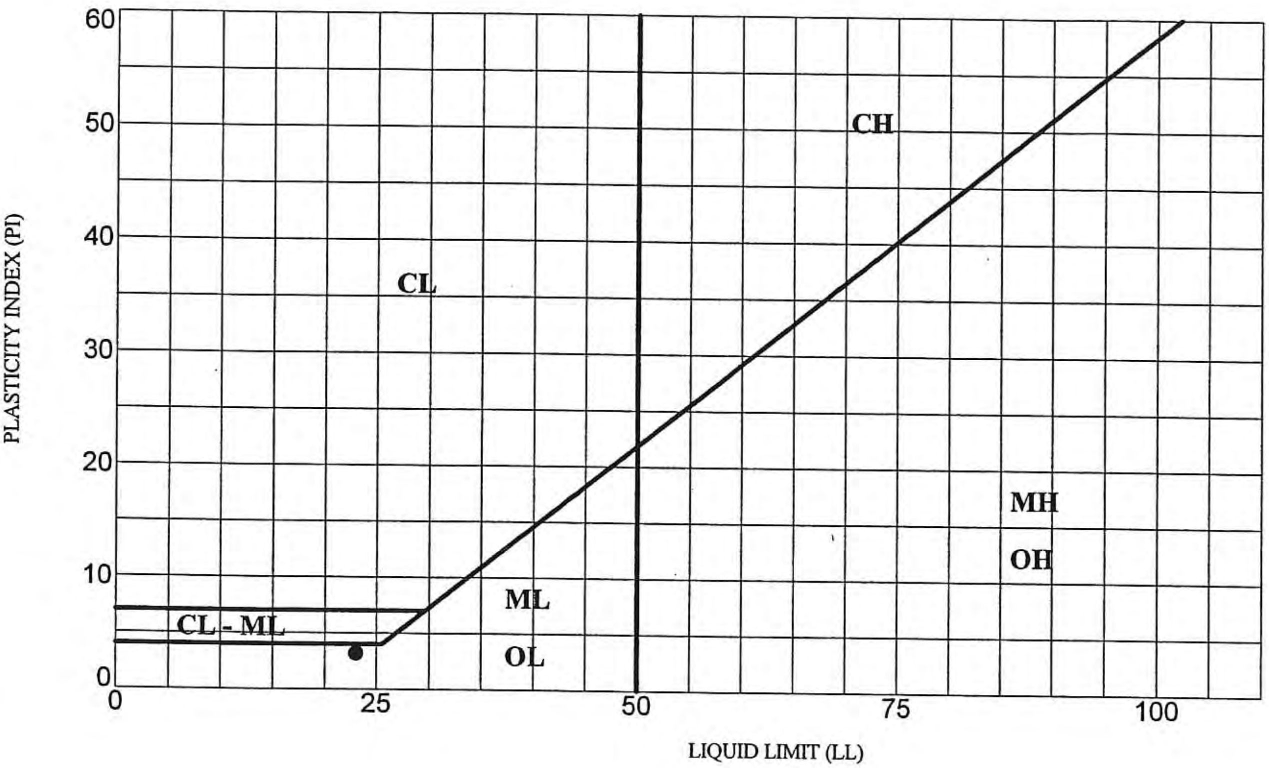
SUMMARY OF LABORATORY TEST RESULTS

Peter Moyes Residence

3608 South 3610 East

FIGURE

B-1



	Specimen Identification	USCS Classification	LL	PL	PI
●	B- 2 at 5.0 feet	Sandy SILT (ML)	23	20	3

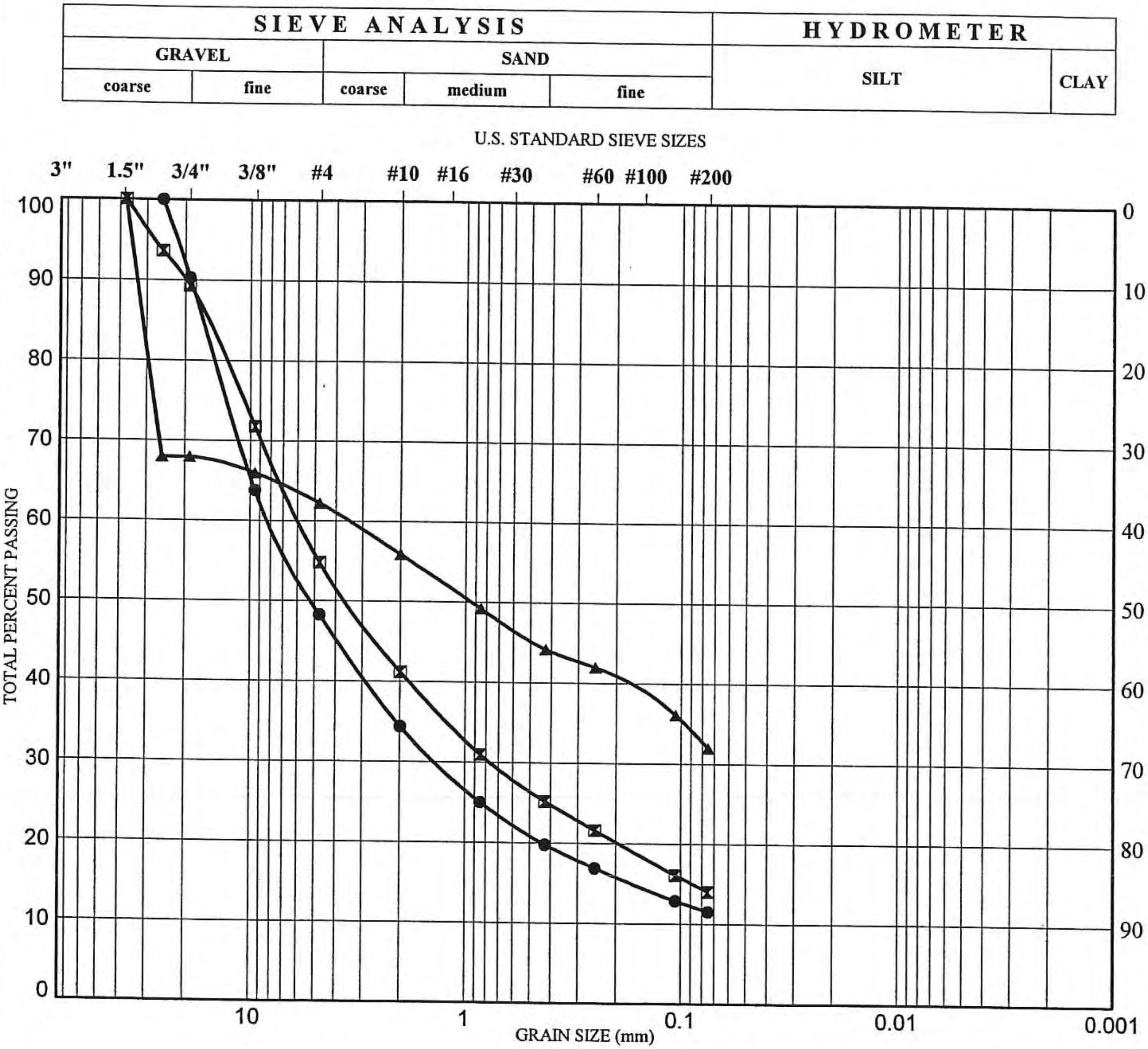
LL - Liquid Limit **PL - Plastic Limit** **PI - Plasticity Index**

Unified Soil Classification
Fine Grained Soil Groups

	LL < 50
ML	Inorganic silts and clayey silts to very fine sands of low plasticity
CL	Inorganic clays of low to medium plasticity
OL	Organic silts and organic silty clays of low plasticity

	LL ≥ 50
MH	Inorganic silts and clayey silts of high plasticity
CH	Inorganic clays of high plasticity
OH	Organic clays of high plasticity, organic silts

KLEINFELDER	**Peter Moyes Residence** **3608 South 3610 East**	***FIGURE***
PROJECT NO. **31287.001**	**PLASTICITY CHART**	**B-2**



Symbol	Sample	Depth (ft)	USCS Soil Description	USCS Classification
●	B- 1	14.0	Silty GRAVEL with sand	GM
⊠	B- 1	24.0	Silty GRAVEL with sand	GM
▲	B- 2	9.0	Silty GRAVEL with sand	GM

KLEINFELDER

PROJECT NO. 31287.001

Peter Moyes Residence

Salt Lake City, Utah

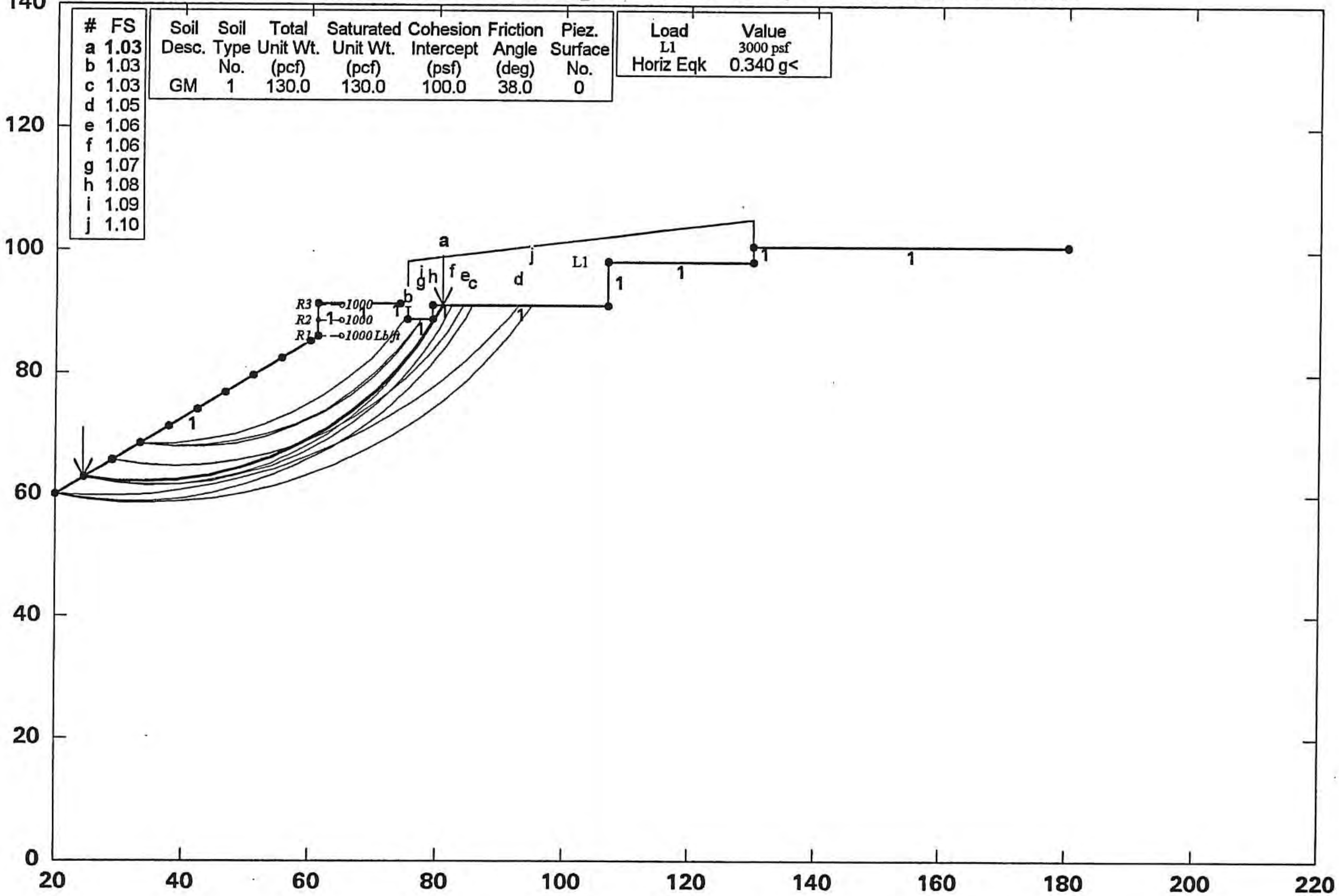
GRAIN SIZE DISTRIBUTION

FIGURE

B-3

Peter Moyes Residence

U:\CHANSEN\PROJECTS\MOYES_~1\MOYES.PL2   Run By: Username   6/26/2003   8:53AM



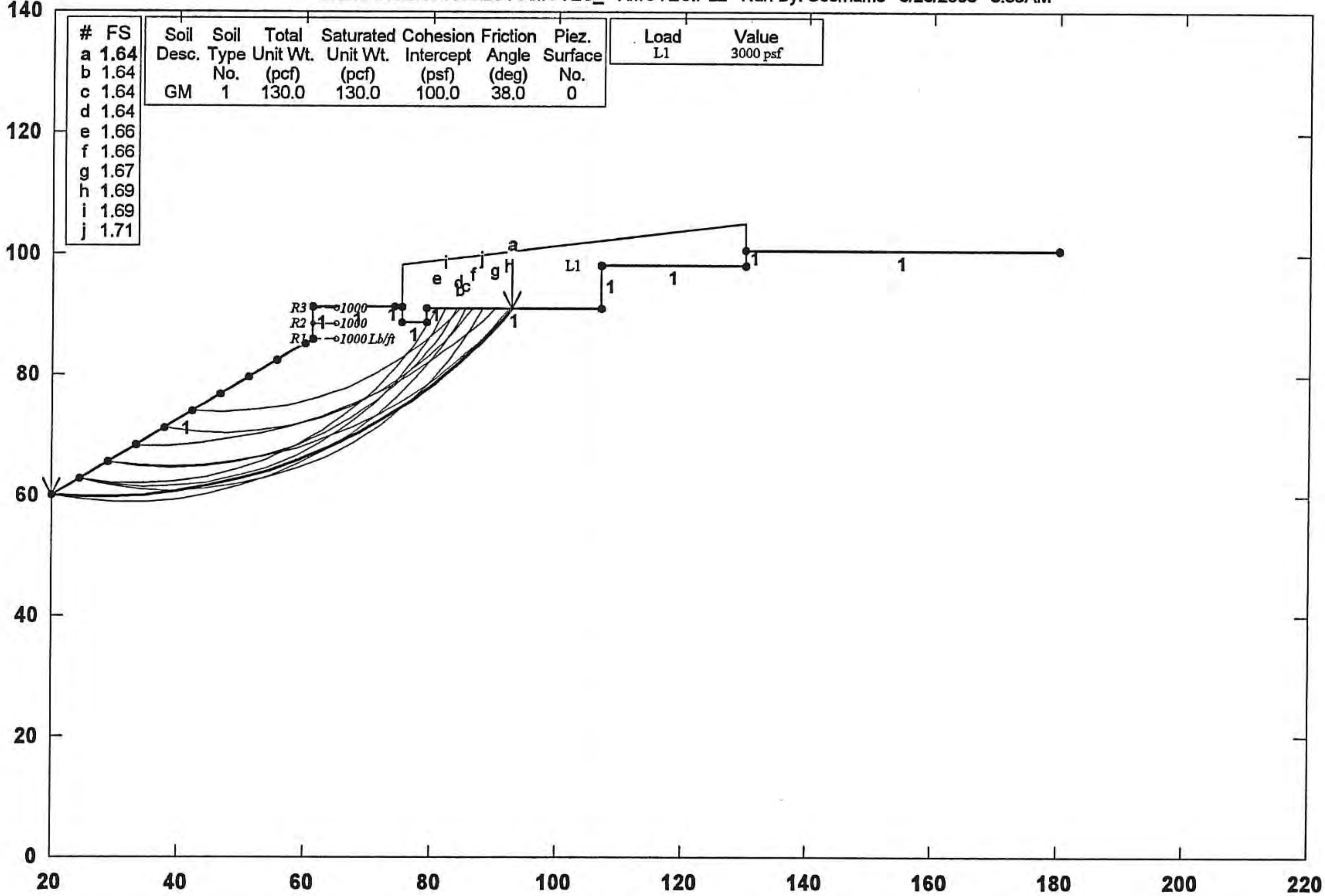
GSTABL7 v.2 FSmin=1.03

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Peter Moyes Residence

U:\CHANSEN\PROJECTS\MOYES_~1\MOYES.PL2 Run By: Username 6/26/2003 8:59AM



GSTABL7 v.2 FSmin=1.64

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Depth (feet)	Percent Passing #200	Unconfined Compression (psf)	Dry Density (pcf)	Moisture Content (%)	Other Tests	Blows per foot	Sample	USCS	SOIL DESCRIPTION
0								GM	Silty GRAVEL with sand - very dense, slightly moist, brown with white, reddish brown and gray gravel, frequent cobbles
9.5						50	◣		
14.5	12			3	SV	81	◣		
19.5						76	◣		
24.5	14			3	SV	85	◣		
33.5						50 for 4"	◣		33.5

DEPTH IN FEET: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40

DATE DRILLED: **6-11-03**
TOTAL DEPTH: **33.5 feet**
DIAMETER OF BORING: **8 inches**

LOGGED BY: **C. Hansen**
EQUIPMENT: **Diedrich D-120 ATV**
ELEVATION: **Not Measured**

KLEINFELDER

PROJECT NO. **31287.001**

LOG OF BORING B- 1

Peter Moyes Residence
3608 South 3610 East
Salt Lake City, Utah

FIGURE
A-3

Depth (ft)	Percent Passing #200	Unconfined Compression (psf)	Dry Density (pcf)	Moisture Content (%)	Other Tests	Blows per foot	Sample	USCS	SOIL DESCRIPTION
0								ML	Sandy SILT - hard, slightly moist, brown
~5.5	62			10	PI	35			
7.0								GM	Silty GRAVEL with sand - very dense, slightly moist, brown with white, reddish brown and gray gravel, frequent cobbles
~9.5	32			9	SV	52			
10.5									

DEPTH IN FEET (0–40)

DATE DRILLED: **6-11-03**
TOTAL DEPTH: **10.5 feet**
DIAMETER OF BORING: **8 inches**

LOGGED BY: **C. Hansen**
EQUIPMENT: **Diedrich D-120 ATV**
ELEVATION: **Not Measured**

KLEINFELDER

PROJECT NO. **31287.001**

LOG OF BORING B- 2

Peter Moyes Residence
3608 South 3610 East
Salt Lake City, Utah

FIGURE
A-4

APPLICATION FOR AUTHORIZATION TO USE

Peter Moyes Residence
3608 South 3610 East
Salt Lake City, Utah

Report originally prepared for ***Peter Moyes***

File Number: 31287.001 Report Date: July 1, 2003

KLEINFELDER, INC.
2677 East Parley's Way
Salt Lake City, Utah 84109
Office (801) 466-6769
Fax (801) 466-6788

To Whom It May Concern:

Applicant understands and agrees that the above-referenced report for the subject site is a copyrighted document, that Kleinfelder, Inc. is the copyright owner and that unauthorized use or copying of the report for the subject site is strictly prohibited without the express written permission of Kleinfelder, Inc. Applicant understands that Kleinfelder, Inc. may withhold such permission at its sole discretion, or grant permission upon such terms and conditions as it deems acceptable.

By signing below, the Relying Parties agree to the same terms and conditions as Kleinfelder's original client, including any limitations of liability or indemnity obligations. The original services agreement may be obtained from the original client identified above or from Kleinfelder, upon request.

To be Completed by Applicant

______________________ *(company name)*	By: ______________________ *(Print Name)*
______________________ *(address)*	______________________ *(Signature)*
______________________ *(city, state, zip)*	Title: ______________________
__________ *(telephone)* __________ *(FAX)*	Date: ______________________

To be Completed by Kleinfelder, Inc.

______ Approved for reuse with applicant agreeing to above terms and concurrence by original client. Additional fees are estimated at $__________.

______ Disapproved, report needs to be updated.

By: ______________________ *Kleinfelder, Inc.* Date: ______________________

RETURN COMPLETED FORM TO KLEINFELDER

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one—not even you*—should apply the report for any purpose or project except the one originally contemplated.

Read the full report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions *only* at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an *opinion* about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observations.*

A Geotechnical Engineering Report is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also, retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited: encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations", many of these provisions indicate where geotechnical engineers responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geo-technical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Rely on Your Geotechnical Engineer for Additional Assistance

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE

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Telephone: 301-565-2733 Facsimile: 301-589-2017
Email: info@asfe.org www.asfe.org

KLEINFELDER
An employee owned company

MHTN Architects, Inc.

July 9, 2003
File No.: 31287.001

Mr. Peter Moyes
420 East South Temple
Salt Lake City, Utah 84111

Subject: Addendum to the Geotechnical Investigation
Peter Moyes Residence
3608 South 3610 East
Salt Lake City, Utah

Dear Mr. Moyes:

We are submitting this addendum to our geotechnical investigation for your residence to present revised values for lateral earth pressures. Lateral earth pressures for seismic conditions presented in Table 4 in our original geotechnical report dated July 1, 2003, were based on a peak horizontal ground acceleration (PHGA) for two percent probability of exceedance in 50 years of 0.68g.

We have researched the issue of dynamic lateral earth pressures on residential structures and found that no standard of practice exists. However, dynamic lateral earth pressures calculated using the full PHGA may be overly conservative. Recent literature on the subject has suggested that one-third to two-thirds of the PHGA is adequate. We recommend lateral earth pressures based on half of the PHGA value, 0.34g, be used in design. Dynamic lateral earth pressures calculated using half of the PHGA are presented in Table 1.

TABLE 1
REVISED Lateral Pressure Equivalent Fluid Densities
(pounds per cubic foot, pcf)
Earthquake Case

Material	Active	At-rest	Passive
Native Granular Soil/ Structural Fill	67	87	468

KLEINFELDER 2677 East Parley's Way, Salt Lake City, UT 84109-1617 (801) 466-6769 (801) 466-6788 fax

If you have any questions regarding the revisions presented in this addendum, please contact us.

Sincerely,

KLEINFELDER, INC.

Corbett M. Hansen

Corbett M. Hansen, P.E.
Project Geotechnical Engineer

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