Raba Kistner

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Project No. ASR08-043-01
September 30, 2008

Mr. Edward Pape
San Antonio Housing Authority
459 Precious Drive
San Antonio, Texas 78237

RE: Consulting Engineering Services
Subsurface Investigation
432 Precious Drive
San Antonio, Texas

Dear Mr. Pape:

Raba-Kistner Consultants, Inc. (R-K) is pleased to submit this summary report of services for the above referenced project. The purpose of this study was to provide consulting engineering services for the purpose of helping identify subsurface conditions that may be contributing to the cracking conditions observed along the foundation of the home.

LIMITATIONS

The information provided in this document is directed to the CLIENT, San Antonio Housing Authority, and may not contain information for others and/or for other uses. Some of our observations were limited due to vegetation, finishes, etc. Additional conditions may exist or may have existed at the time of our observation. This document includes observation and testing information regarding the home's foundation and wood frame as obtained by **R-K** and from various other sources. Our comments and opinions contained herein are based partially upon that data. If the information described in this document, some of which was provided by others, is incorrect or if additional information becomes available, **R-K** may need to revise the comments and opinions presented in this document.

BACKGROUND INFORMATION

The findings of our initial Residential Distress Study have been provided in our report dated June 12, 2008, **R-K** Project No. ASR08-043-00. In accordance with the approved scope of work outlined in Amended Agreement PSR08-079-00A (dated June 6, 2008), **R-K** has provided additional consulting engineering services to include a subsurface investigation to assess the underlying soil conditions beneath the reinforced beam and slab foundation.

FIELD BORINGS AND LABORATORY TESTS

Subsurface conditions beneath the home were evaluated by three (3) exploratory borings (designated as B-1, B-2, and B-3 on the General Site Layout, Figure 1 of Attachment A). Borings B-1 and B-2 were drilled on July 30, 2008, while Boring B-3 was drilled August 6, 2008 at the locations shown on Figure 1 in Attachment A. The boring locations are approximate and were located in the field based on our observations performed during our initial site visit held on May 29, 2008. Exploratory Boring B-1 was drilled within the living room of the home down to a depth of about 15 ft below the floor slab surface elevation at the time of our study using a Geoprobe sampler. Exploratory Borings B-2 and B-3 were drilled to depths of about 13 ft and 12-1/2 ft, respectively, below the ground surface elevation at the time of our study using a track-mounted, Geoprobe sampler. The exploratory borings were advanced with direct push methods in combination with an 80-pound pneumatic hammer to their respective termination depths until refusal. Upon completion of the soil sampling operations, the 5-inch diameter Boring B-1 was backfilled with bentonite clay chips up to the bottom of the floor slab and the core hole through the floor slab was patched with ready-mix concrete up to the top of the floor slab and trowel finished. Borings B-1 and B-2 were also backfilled with bentonite clay chips up to the adjacent ground surface elevation following completion of the soil sampling operations.

During the exploration activities, the following samples were collected:

Type of Sample	Number Collected
Shelby Tube	41

Representative portions of the samples were sealed in containers to reduce moisture loss, labeled, packaged, and transported to our nationally accredited laboratory for subsequent testing and classification. In addition, two bulk samples were obtained from soils excavated at each test pit location and placed in 5-gallon buckets. These samples were also transported to our laboratory.

In the laboratory, each sample was evaluated and visually classified by a member of our engineering staff in general accordance with the Unified Soil Classification System (USCS). The geotechnical engineering properties of the strata were evaluated by the laboratory tests tabulated in the following table:

Type of Test	Number Conducted
Natural Moisture Content	41
Atterberg Limits	6
Pocket Penetrometer	30
Dry Unit Weight	11
Unconfined Compressive Strength	9
Swell Test	2
Percent Passing a No. 200 Sieve	1

With the exception of the swell test results, the laboratory tests are presented in graphical or numerical form on the boring logs illustrated on Figures 2 through 4. A key to the classification of terms and symbols used on the logs is presented on Figure 5. The results of the laboratory and field testing are also tabulated on Figure 6 for ease of reference. The results of the swell tests are provide on Figures 7 and 8.

Samples will be retained in our laboratory for 30 days after submittal of this report. Other arrangements may be provided at the written request of the CLIENT or its representatives.

SUBSURFACE STRATIGRAPHY

On the basis of the exploratory borings, the subsurface stratigraphy at this site can be described by four generalized strata, each with similar physical and engineering characteristics. For purposes of this document, we have designated the subsurface strata as Stratum I through Stratum IV. The lines designating the interfaces between strata on the exploratory borings logs represent approximate boundaries. Transitions between strata may be gradual. The soils information that is a part of this document may not reflect the actual variations of the subsurface conditions across the site.

Stratum I consists of fill materials comprised of tan and brown, clayey sand with gravel and dark brown clay nodules. This layer was noted only in Boring B-1 from beneath the bottom of the floor slab extending down to depths of about 12 inches. A single percent passing a No. 200 sieve test demonstrates percent fines of about 35 percent. This stratum is visually classified as marginally-plastic. These soils may be classified as SC soils in general accordance with the USCS.

Stratum II consists of top soil materials comprised of tan, lean clay soils with roots and traces of gravel. This stratum was encountered in Borings B-2 and B-3 from the ground surface elevation existing at the time of our study down to depths of about 3-inches. This stratum is visually classified as moderately plastic. These soils may be classified as CL soils in general accordance with the USCS.

Stratum III consists of possible fill materials comprised of dark brown and gray to dark brown to tan to brown, firm to very stiff, fat clay soils with red ferrous stains, calcareous nodules, and traces of roots, and gravel. Traces of asphalt were also encountered in samples recovered from this stratum in Boring B-2. This layer was noted in the exploratory borings from beneath the Stratum I and II soils down to depths of about 4 ft in Boring B-1, and 3 ft in Borings B-2 and B-3. Moisture contents were measured to range from about 22 to 33 percent for this layer. This stratum is classified as highly plastic, with two measured plasticity indices of 44 and 46 percent. On the basis of three unconfined compression tests performed within this layer, the undrained cohesion was measured to range from about 0.7 tsf to 0.8 tsf. Dry unit weights ranging from 88 pcf to 105 pcf were measured for this layer. These soils are classified as CH soils in general accordance with the USCS.

Stratum IV consists of what appear to be native soils comprised of dark brown to dark brown and gray to dark gray to tan and gray, firm to very stiff, fat clay soils with traces of roots, red ferrous stains, calcareous nodules, and rounded river gravel. This stratum was encountered in the exploratory borings beneath the Stratum III soils extending down to at least the termination depths of each boring. Moisture contents ranging from about 19 to 36 percent were measured for this layer. This stratum is classified as highly plastic, with plasticity indices of 51 to 57 percent. Undrained cohesion ranges from about 0.3 tsf to 1.0 tsf based on unconfined compression test data. Dry unit weights ranging from 88 pcf to 107 pcf were measured for this layer. These soils are classified as CH soils in general accordance with the USCS.

GROUNDWATER

Groundwater was not observed in the borings either during or immediately upon completion of the sampling operations. It is possible for groundwater to exist beneath this site at shallower depths on a transient basis. Fluctuations in groundwater levels occur due to variation in rainfall and surface water runoff.

TEST PIT EXCAVATIONS AND LABORATORY TESTS

As part of the field investigation, three test pit excavations, (designated as TP-1, TP-2, and TP-3 on Figure 1 of Attachment A), were performed adjacent the exterior grade beam of the home in order to measure the depth and width of the grade beams at these locations, the in-place moisture content, and soil density. TP-1 was excavated along the right side grade beam near the left-rear corner of the home. TP-2 was excavated along the right side grade beam middle of the exterior living room wall, while TP-3 was performed along the right side grade beam near the middle of the garage wall. The beam measurements are provided in the following table.

Test Pit No.	Approximate Beam Depth measured from the top of Slab Elevation (in)	Approximate Beam Depth Below the Existing Ground Surface Elevation (in)	Approximate Beam Width (in)
TP-1	33	28	10
TP-2	33	27	10
TP-3	31	26	10

At TP-1 and TP-2, the in-place soil moisture content and soil density were measured at approximately 4-inches, 14-inches, and 20 inches beneath the existing ground surface elevation using a nuclear density gage. Similarly at TP-3, the moisture content and soil density were measured at approximately 4-inches, 14-inches, and 24 inches beneath the existing ground surface elevation. Bulk soil samples were obtained from the test pit excavations were visually classified by a member of our engineering staff and samples were selected for physical characteristic testing. Because of the consistency of the bulk samples obtained form TP-2 and TP-3, these samples were mixed together prior to performing the laboratory testing. The laboratory tests performed and their respective results are provided in the following table.

Laboratory Test	TP-1	TP-2 and TP-3
Liquid Limit	57	61
Plastic Limit	17	15
Plasticity Index	40	46
Maximum Dry Density (ASTM D698)	110.6	106.8
Optimum Moisture Content	15.0%	17.6
Clay Particles Passing a No. 200 Sieve	*	72.8%

* Indicates a test was not performed on this sample.

The soils encountered within the test pit excavations are classified as dark brown, clay soils with sand and gravel. These soils are considered to be highly expansive soils. Expansive soils are clay soils that can experience volume changes with changes in soil water content. Expansive soils shrink or reduce their volume when they lose water (damp to dry) and swell or increase their volume when they gain water (damp to wet). The results of the swell tests indicate that these soils have the potential to experience further swell. The foundation design Plasticity Index on the foundation drawing sheet marked S-1 dated July 10, 2000 is 59. The average plasticity Index determined by our soils testing performed on the samples recovered from the exploratory borings and the test pit excavations within the upper 4-ft was about 45. The design Plasticity Index is about 14.5 points greater than the site specific soils encountered within the test pits. It should be noted that traces of asphalt were encountered within the fill materials excavated from the test pit excavations.

Once the maximum dry density and optimum moisture content tests were completed, the results were compared to the moisture content and soil density test results obtained in the field in order to assess the in-place moisture and soil density. On the basis of the information provided in the geotechnical report prepared by Nova Consulting Group, Inc., it is our understanding that on-site soils placed as part of the building pad should be placed in 8-inch thick loose lifts and compacted to a minimum of 95% of the maximum dry density performed in the laboratory in accordance with ASTM D698. Furthermore, the Nova report recommends that the building pad extend about a minimum 5-ft beyond the perimeter of the footprint of the monolithic concrete beam and slab-on-ground foundation.

The results of the maximum dry density tests determined in our laboratory were compared to the in-place dry density tests values measured in each test pit excavation. The in-place dry density measured at each depth interval tested within each excavation was less than 95% of the maximum dry density In addition, the moisture contents recorded in TP-1 range between 21.5 to 26.5 percent higher than the 15.0% optimum moisture content determined in the laboratory demonstrating that the tested soils have taken on more water after placement of the foundation pad construction. In TP-2 and TP-3, the in-place moisture contents range between 3.7 to 16.5 percent higher than 17.6% optimum moisture content determined in the laboratory. Following sampling, testing and measurements, the test pits were backfilled with the excavated soils and compacted in thin lifts. Refer to the table on the following page for the test results.

Test Pit No.	Depth Below the Existing Ground Surface (in)	In-Place Moisture Content (%)	In-Place Wet Density (pcf)	In-Place Dry Density (pcf)	Percent Dry Density (%)
TP-1	4	36.5	103.8	76.1	68.8
	12	37.2	112.7	82.1	74.2
	20	41.5	111.7	79.0	71.4
TP-2	4	21.3	118.6	97.8	91.6
	12	26.6	110.3	87.1	81.6
	20	34.1	118.0	88.0	82.4
TP-3	4	21.5	119.8	98.6	92.3
	12	29.4	116.4	90.0	84.3
	24	30.3	118.2	90.7	84.9
Average		30.9			81.3

GENERAL FOUNDATION INFORMATION

During our initial site visit, we noted a transverse crack in the concrete floor slab, located in the living room. This crack, extends from left-to-right across the floor slab, and was measured to be approximately 9-1/2 ft long (where visible) and approximately 1/8-inch wide in some locations. We also observed cracks in the concrete floor slab within bedrooms 2 and 3, as well as along the hallway. In general, these cracks varied in thickness from hairline to about 1/16-inch wide. At the time of our site visit on June 30, 2007, we measured the transverse crack in the living room to be slightly wider than 1/8-inch.

Using a Schmidt rebound hammer, **R-K** measured the in-place relative compressive strength of the surface concrete within the living room floor slab to be in excess of 3,000 psi. Additionally, **R-K** determined the location and spacing of the slab reinforcing steel using a reinforcing steel detector at two locations within the living room. The spacing of the reinforcing bars in the living room floor slab of the foundation varies from about 12 to 16 inches on center each way in front to back and left to right directions. The location of the steel is estimated to be about 3 inches below the finished floor surface.

Two concrete cores were performed within the living room floor slab. One of the cores samples was obtained from the location for Boring B-1 and was measured to be about 6-inches thick. The second core sample (designated as C-1 on Figure 1 of Attachment A) was performed along the main living room crack. This core sample was measured to be about 5-3/4 inches thick. From our observations of this core sample, we noted that the crack extends downward through the width of the floor slab. A vapor barrier was present beneath both core locations.

COMMENTS

The concrete foundation is judged to be performing within the boundaries for floor slab elevation differentials in the San Antonio locale. Although the soil density measured in the test pit excavations averaged 81.3 percent of the laboratory compacted density, it is our judgment that the soils adjacent to the foundation have not affected the performance of the foundation.

From our review of the foundation plan document, prepared by Unitech Consulting Engineers, Inc., we understand that design called for the perimeter grade beams to extend a minimum of 12-inches into "undisturbed soil", which is also referred to as "natural" soil in the construction industry. As such, it is our judgment that these particular beams do not extend to the depth specified on the foundation plan.

There are several factors that can cause and/or influence cracking of beam and slab-on-ground foundations including: soil-related movements; plumbing leaks; initial drying and shrinkage related cracking during the curing of the concrete following placement, thermal expansion and contraction, internal or external restraint to shortening; settlement of the supporting soils; and the applied loading to the floor slab to identify a few.

OPINIONS

On the basis of our observations / measurements, the field and laboratory test results, the information provided by others, and our knowledge of beam and slab-on-ground "floating" foundations founded on expansive clay soils, it is our opinion that:

- The movements are not associated with plumbing leaks; however, this should be confirmed by performing plumbing leak testing on both domestic water supply lines and the sanitary sewer lines within and beneath the foundation.
- The concrete cracks noted in the foundation are a result of expansive soil related movements in conjunction with thermal expansion and contraction of the foundation.
- Cracks that are in excess of 0.02 inches in width should be repaired with an epoxy material, such as Metabond, in accordance with the manufacturer's recommendations to prevent insect infestation and maintain the good performance of the foundation.
- The expansive clay soils beneath the foundation have the potential to experience additional swell if the moisture conditions beneath and along the perimeter of the foundation are not maintained at or near 31 percent.
- The beam depths measured at TP-1, TP-2, and TP-3 did not achieve the specified beam depth. It is our judgment that this has not adversely affected the performance of the foundation.
- The foundation supporting the home and the wood frame is considered structurally adequate.
- Underpinning the foundation will not improve the performance of the concrete foundation and wood frame.

RECOMMENDATIONS

To the extent possible, all sources of water around and beneath the foundation should be and regulated based on weather conditions year in and year out; therefore:

- We recommend that plumbing leak testing be performed on the domestic water lines and the sanitary sewer lines within and beneath the foundation to assess if leaks are occurring beneath the floor slab.
- The cracks within the living areas should be repaired with a self-leveling epoxy sealant such as MetaBond HM, Manufactured by American Metaseal Company, or an approved equivalent, such as Versafill or Sidkadur. This work should be performed by a reputable sealant contractor with experience in foundation crack repair such as Western Waterproofing of San Antonio, Texas, or Jean's Waterproofing of New Braunfels, Texas.
- Irrigation should be controlled within a 10-foot zone around the perimeter of the home's foundation. The moisture content of the surface clay soils should be maintained at a uniform condition year round. The ground within this area should not be allowed to become dry to the point where the ground cracks and pulls away from the foundation. This is particularly true of this residence where these conditions were noted along the left and right sides of the foundation. Water should also not be allowed to pond in these areas or near the foundation.
- The soils in the yard need to be maintained adjacent to the foundation year round. This can be managed by watering along the perimeter of the foundation with soaker hoses connected to a short 12-foot long garden hose that is attached to the hose bibbs along the exterior of the home. The soaker hoses can be laid out in an "S" pattern extending preferably about five feet, if property lines allow, away from the foundation as shown on Figure 9 of Attachment A of this document. Generally, slow soaking watering for a maximum of about 4 hours per week will provide a uniform water content in the yards surface soils during dry weather conditions. The flow rate of the water through the soaker hoses should be maintained at a 3/4 valve turn at the hose bibbs. Watering should be controlled so that there is no trapped or ponded water near the foundation. Refer to Figure 9 of Attachment A for a proposed plan for the placement of the soaker hoses along the perimeter of the foundation.
- In order to help control the effects of surface water around the home, all water draining off the roof eaves should be collected in gutters and downspouts and redirected to drain to the street located along the front of the residence.

We appreciate the opportunity to be of service to you on this project. Should you have any questions about the information presented in this document, or if we may be of additional service, please call.

Very truly yours,

RABA-KISTNER CONSULTANTS, INC.

STATE OF TEXAS
JESSE H. AGUILAR
100290
LICENSED
PROFESSIONAL ENGINEER
9/30/08

Jesse H. Aguilar, P.E.
Project Engineer

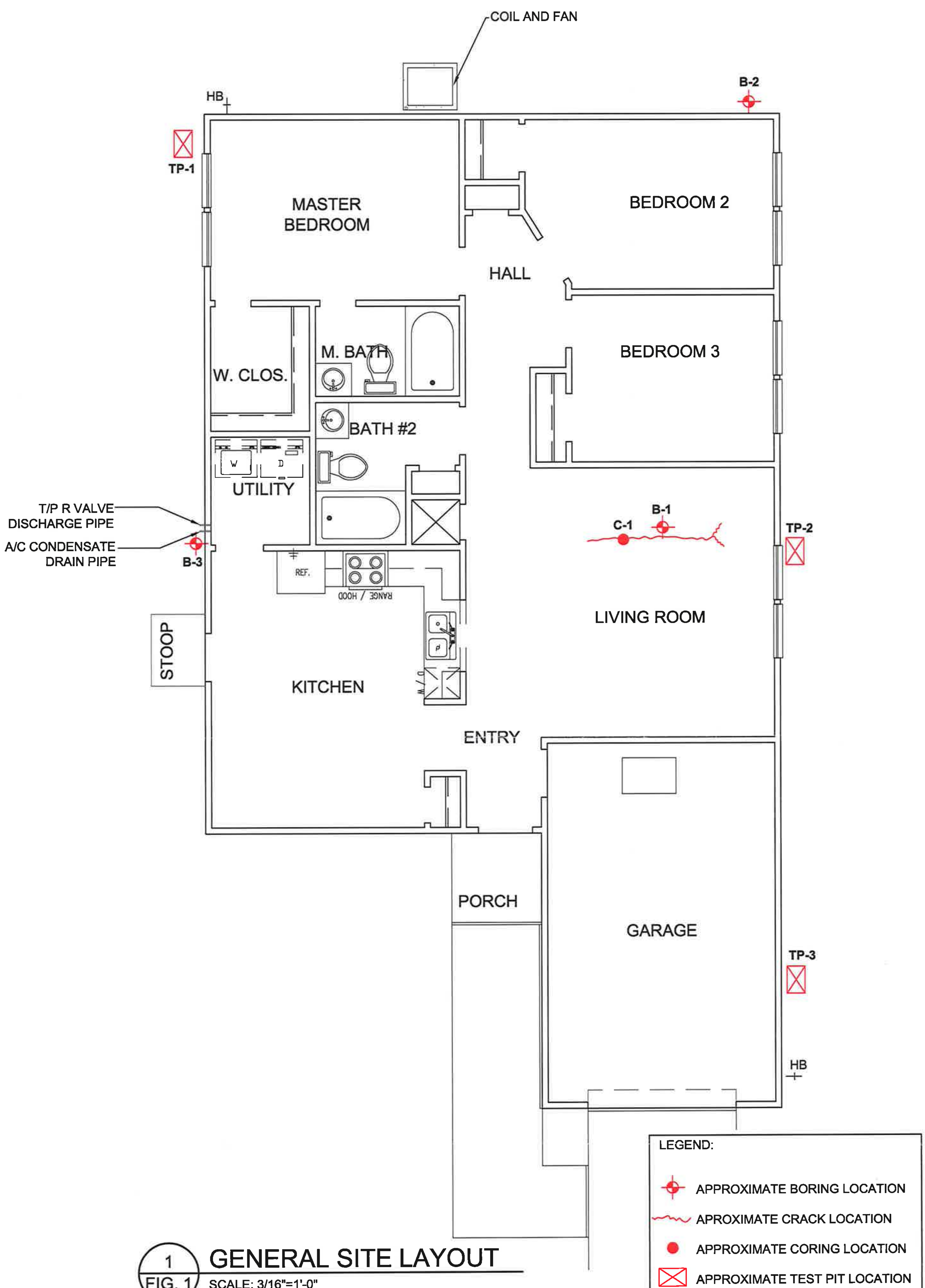
Richard W. Kistner, P.E.
Vice Chairman

JHA/RWK/jg

Attachments: A – Figures 1 through 9

Copies Submitted: Above (3 Originals and 1 Electronic Copy)

ATTACHMENT A



1 FIG. 1 GENERAL SITE LAYOUT
SCALE: 3/16"=1'-0"

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GENERAL SITE LAYOUT

RESIDENTIAL SUBSURFACE INVESTIGATION STUDY
432 PRECIOUS DRIVE
SAN ANTONIO, TEXAS

REVISIONS: No.	DATE	DESCRIPTION

PROJECT No.: ASR08–043–01
DRAWN BY: JR
CHECKED BY: JAA
REVIEWED BY: JAA

FIGURE 1

LOG OF BORING NO. B-1

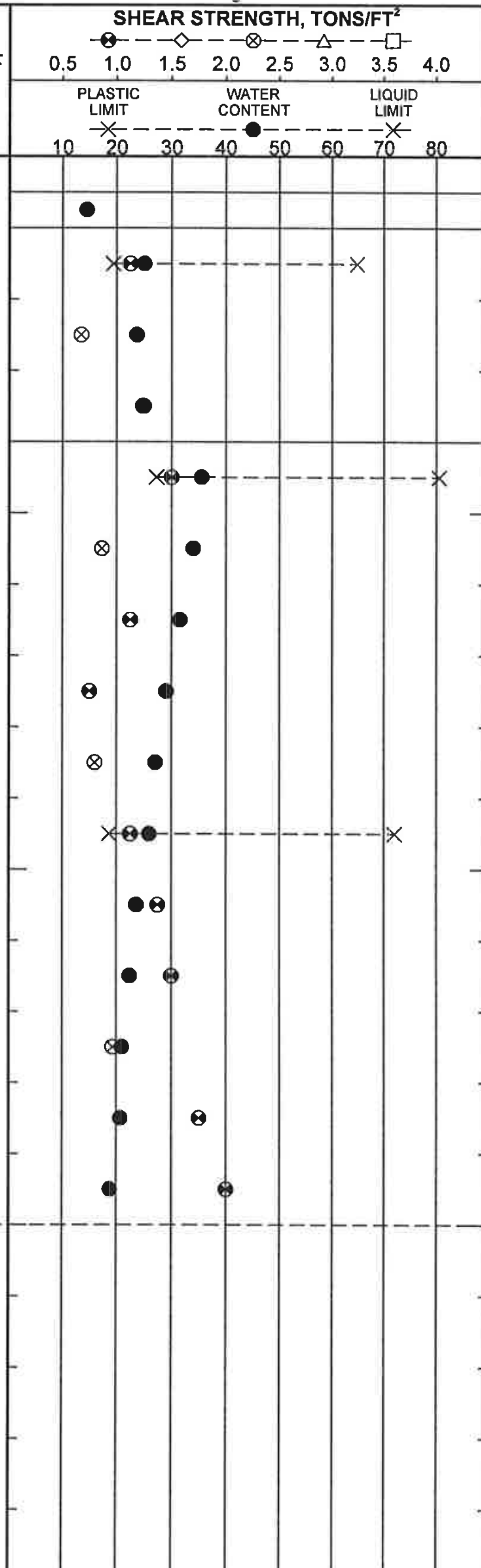
Residential Study - Subsurface Investigation
432 Precious Drive
San Antonio, Texas

Raba Kistner

DRILLING METHOD: Geoprobe

LOCATION: See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WIEGHT, pcf	SHEAR STRENGTH, TONS/FT²	PLASTICITY INDEX	% -200
			PORTLAND CEMENT CONCRETE (PCC) - 6 inches					
			FILL: Sand, clayey, tan and brown, with gravel and dark brown clay					35
			POSSIBLE FILL: Clay, fat, very stiff to stiff, dark brown and gray, with red ferrous stains, calcarious nodules, and traces of roots				46	
					100			
					88			
			CLAY, fat, very stiff to stiff to very stiff, dark brown, with traces of roots				54	
5					88			
			- becomes dark brown and gray to dark gray at a depth of about 7 ft					
			- becomes tan and gray to light tan and gray below a depth of about 8 ft		98			
							53	
10								
			- becomes tan and mottled below a depth of about 11 ft					
					107			
			- becomes tan to tan and gray in color, with rounded gravel and calcareous nodules below a depth of about 14 ft					
15			Boring completed at a depth of about 15 ft. Upon completion of the drilling operations, the boring was observed dry.					



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	15.0 ft	**DEPTH TO WATER:**	Dry	**PROJ. No.:**	ASR08-043-01
DATE DRILLED:	7/30/2008	**DATE MEASURED:**	7/30/2008	**FIGURE:**	2

LOG OF BORING NO. B-2

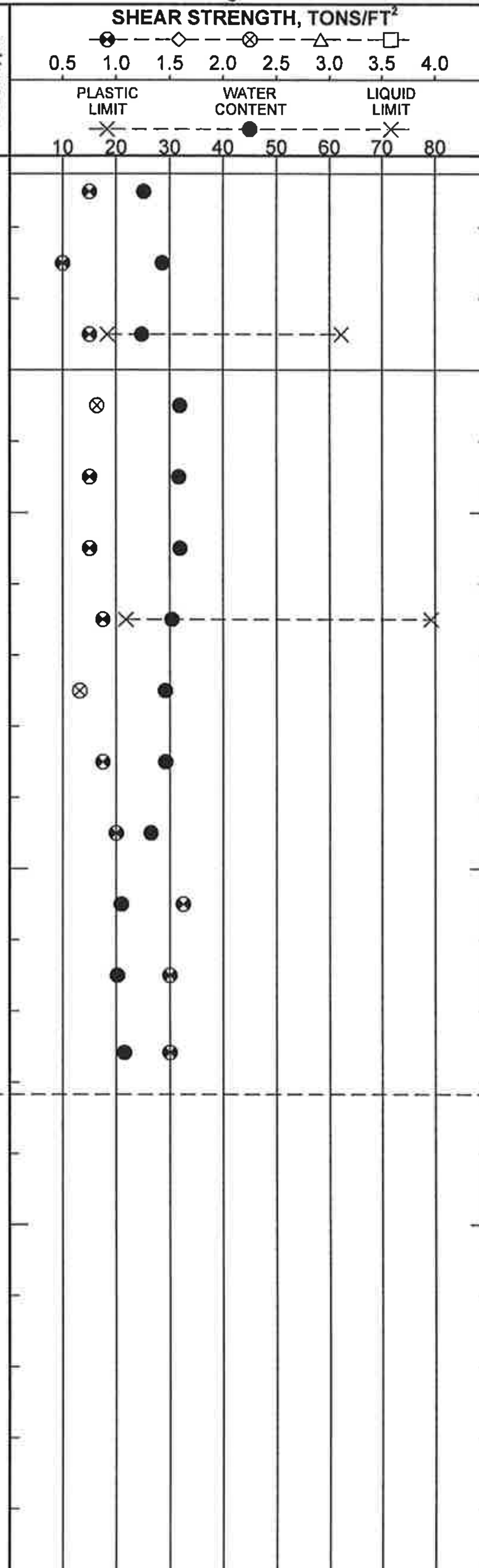
Residential Study - Subsurface Investigation
432 Precious Drive
San Antonio, Texas

Raba Kistner

DRILLING METHOD: Geoprobe

LOCATION: See Figure 1

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WIEGHT, pcf	PLASTICITY INDEX	% -200
0	TOPSOIL: CLAY, lean, tan, with roots and traces of gravel				
	FILL: Clay, fat, stiff, dark brown to tan and brown, with traces of asphalt, gravel, and roots				
	- with calcareous nodules below a depth of about 2.5 ft			44	
	CLAY, fat, stiff to very stiff, dark brown, with traces of roots		89		
5			89		
				57	
	- becomes dark brown and gray to brown and gray in color below a depth of about 7 ft		94		
	- becomes tan and gray in color below a depth of about 9 ft				
10					
	- with rounded gravel and calcareous nodules below a depth of about 11 ft				
	- with red ferrous stains below a depth of about 12 ft				
	Boring terminated at a depth of about 13.2 ft due to auger refusal. Upon completion of the drilling operations, the boring was observed dry.				
15					



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 13.2 ft	**DEPTH TO WATER:** Dry	**PROJ. No.:** ASR08-043-01	
DATE DRILLED: 7/30/2008	**DATE MEASURED:** 7/30/2008	**FIGURE:** 3	

LOG OF BORING NO. B-3

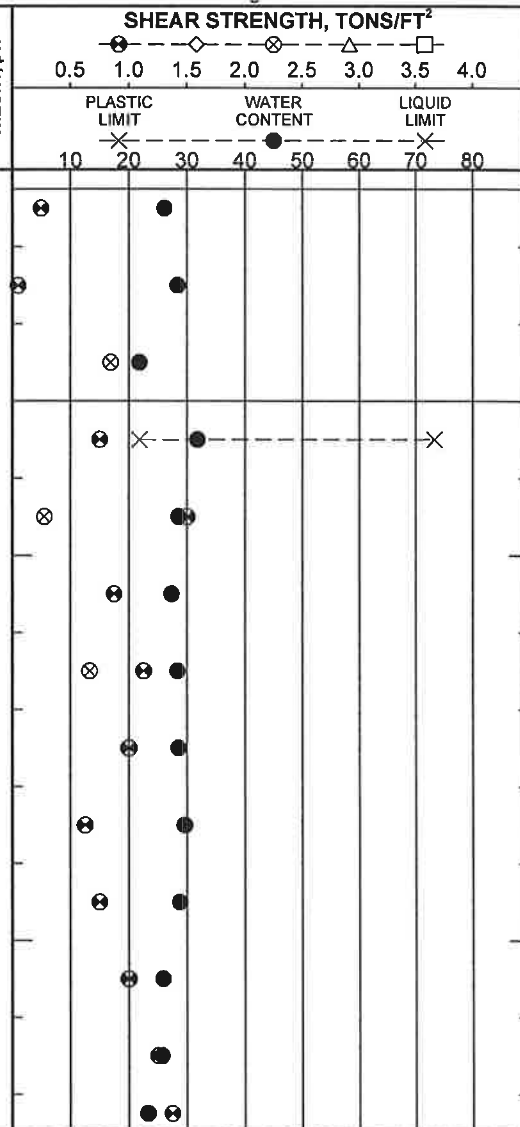
Residential Study - Subsurface Investigation
432 Precious Drive
San Antonio, Texas

Raba Kistner

DRILLING METHOD: Geoprobe

LOCATION: See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WIEGHT, pcf	SHEAR STRENGTH, TONS/FT² / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	PLASTICITY INDEX	% -200
			TOPSOIL: CLAY, lean, tan, with roots					
			POSSIBLE FILL: Clay, fat, firm to stiff, dark brown and gray, with roots and traces of gravel		105			
5			CLAY, fat, stiff to firm to very stiff, dark brown and gray to dark gray, with calcareous nodules - with traces of tan clay and gray below a depth of about 4 ft		92 94		51	
10			- becomes tan and gray in color below a depth of about 9 ft - with rounded gravel below a depth of about 12 ft					
15			Boring terminated at a depth of about 12.5 ft due to auger refusal. Upon completion of the drilling operations, the boring was observed dry.					



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 12.5 ft	**DEPTH TO WATER:** Dry	**PROJ. No.:**	ASR08-043-01
DATE DRILLED: 8/6/2008	**DATE MEASURED:** 8/6/2008	**FIGURE:**	4

KEY TO TERMS AND SYMBOLS

MATERIAL TYPES

SOIL TERMS

- CALCAREOUS
- CALICHE
- CLAY
- CLAYEY
- GRAVEL
- GRAVELLY
- PEAT
- SAND
- SANDY
- SILT
- SILTY
- FILL

ROCK TERMS

- CHALK
- CLAYSTONE
- CLAY-SHALE
- CONGLOMERATE
- DOLOMITE
- IGNEOUS
- LIMESTONE
- MARL
- METAMORPHIC
- SANDSTONE
- SHALE
- SILTSTONE

OTHER

- ASPHALT
- BASE
- CONCRETE/CEMENT
- BRICKS / PAVERS
- WASTE
- NO INFORMATION

WELL CONSTRUCTION AND PLUGGING MATERIALS

- BLANK PIPE
- SCREEN
- BENTONITE
- CEMENT GROUT
- BENTONITE & CUTTINGS
- CONCRETE/CEMENT
- CUTTINGS
- GRAVEL
- SAND
- VOLCLAY

SAMPLE TYPES

- AIR ROTARY
- GRAB SAMPLE
- CORE
- GEOPROBE SAMPLER
- MUD ROTARY
- NO RECOVERY
- NX CORE
- TEXAS CONE PENETROMETER
- SHELBY TUBE
- SPLIT BARREL
- SPLIT SPOON

STRENGTH TEST TYPES

- POCKET PENETROMETER
- TORVANE
- UNCONFINED COMPRESSION
- TRIAXIAL COMPRESSION UNCONSOLIDATED-UNDRAINED
- TRIAXIAL COMPRESSION CONSOLIDATED-UNDRAINED

NOTE: VALUES SYMBOLIZED ON BORING LOGS REPRESENT SHEAR STRENGTHS UNLESS OTHERWISE NOTED

PROJECT NO. ASR08-043-01

KEY TO TERMS AND SYMBOLS (CONT'D)

TERMINOLOGY

Terms used in this report to describe soils with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOILS MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc., 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in American Society for Testing and Materials D2487-06 and D2488-00, Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics; 2005.

The depths shown on the boring logs are not exact, and have been estimated to the nearest half-foot. Depth measurements may be presented in a manner that implies greater precision in depth measurement, i.e 6.71 meters. The reader should understand and interpret this information only within the stated half-foot tolerance on depth measurements.

RELATIVE DENSITY

Penetration Resistance Blows per ft	Relative Density
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
> 50	Very Dense

COHESIVE STRENGTH

Resistance Blows per ft	Consistency	Cohesion TSF
0 - 2	Very Soft	0 - 0.125
2 - 4	Soft	0.125 - 0.25
4 - 8	Firm	0.25 - 0.5
8 - 15	Stiff	0.5 - 1.0
15 - 30	Very Stiff	1.0 - 2.0
> 30	Hard	> 2.0

PLASTICITY

Plasticity Index	Degree of Plasticity
0 - 5	None
5 - 10	Low
10 - 20	Moderate
20 - 40	Plastic
> 40	Highly Plastic

ABBREVIATIONS

B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes
BTEX = Total BTEX
TPH = Total Petroleum Hydrocarbons
ND = Not Detected
NA = Not Analyzed
NR = Not Recorded/No Recovery
OVA = Organic Vapor Analyzer
ppm = Parts Per Million

Qam, Qas, Qal = Quaternary Alluvium
Qat = Low Terrace Deposits
Qbc = Beaumont Formation
Qt = Fluviatile Terrace Deposits
Qao = Seymour Formation
Qle = Leona Formation
Q-Tu = Uvalde Gravel
Ewi = Wilcox Formation
Emi = Midway Group
Mc = Catahoula Formation
El = Laredo Formation
Kknm = Navarro Group and Marlbrook Marl
Kpg = Pecan Gap Chalk
Kau = Austin Chalk

Kef = Eagle Ford Shale
Kbu = Buda Limestone
Kdr = Del Rio Clay
Kft = Fort Terrett Member
Kgt = Georgetown Formation
Kep = Person Formation
Kek = Kainer Formation
Kes = Escondido Formation
Kew = Walnut Formation
Kgr = Glen Rose Formation
Kgru = Upper Glen Rose Formation
Kgrl = Lower Glen Rose Formation
Kh = Hensell Sand

RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Residential Study - Subsurface Investigation
432 Precious Drive
San Antonio, Texas

FILE NAME: ASR08-043-01.GPJ 9/17/2008

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
B-1	0.0 to 0.5										
	0.5 to 1.0		14.5						35		
	1.0 to 2.0		25.1	65	19	46				1.13	PP
	2.0 to 3.0		23.7					100		0.67	UC
	3.0 to 4.0		24.7					88		1.25	PP
	4.0 to 5.0		35.5	81	27	54				1.50	PP
	5.0 to 6.0		33.9					88		0.86	UC
	6.0 to 7.0		31.5							1.13	PP
	7.0 to 8.0		29.1							0.75	PP
	8.0 to 9.0		27.1					98		0.80	UC
	9.0 to 10.0		26.0	72	19	53				1.13	PP
	10.0 to 11.0		23.6							1.38	PP
	11.0 to 12.0		22.4							1.50	PP
	12.0 to 13.0		21.0					107		0.97	UC
	13.0 to 14.0		20.7							1.75	PP
	14.0 to 15.0		18.8							2.00	PP
B-2	0.0 to 1.0		25.1							0.75	PP
	1.0 to 2.0		28.6							0.50	PP
	2.0 to 3.0		24.8	62	18	44				0.75	PP
	3.0 to 4.0		31.9					89		0.82	UC
	4.0 to 5.0		31.7							0.75	PP
	5.0 to 6.0		31.9					89		0.75	PP
	6.0 to 7.0		30.4	79	22	57				0.88	PP
	7.0 to 8.0		29.2					94		0.66	UC
	8.0 to 9.0		29.2							0.88	PP
	9.0 to 10.0		26.5							1.00	PP
	10.0 to 11.0		20.9							1.63	PP
	11.0 to 12.0		20.2							1.50	PP
	12.0 to 13.2		21.5							1.50	PP
B-3	0.0 to 1.0		26.1							0.25	PP
	1.0 to 2.0		28.4							0.05	PP
	2.0 to 3.0		21.8					105		0.84	UC
	3.0 to 4.0		31.8	73	22	51				0.75	PP
	4.0 to 5.0		28.5					92		0.28	UC
	5.0 to 6.0		27.3							0.88	PP
	6.0 to 7.0		28.4					94		0.66	UC
	7.0 to 8.0		28.5							1.00	PP
	8.0 to 9.0		29.6							0.63	PP
	9.0 to 10.0		28.8							0.75	PP

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression UU = Unconsolidated Undrained Triaxial

CU = Consolidated Undrained Triaxial FV = Field Vane PROJECT NO. ASR08-043-01

Raba-Kistner

FIGURE 6a

RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Residential Study - Subsurface Investigation
432 Precious Drive
San Antonio, Texas

FILE NAME: ASR08-043-01.GPJ 9/17/2008

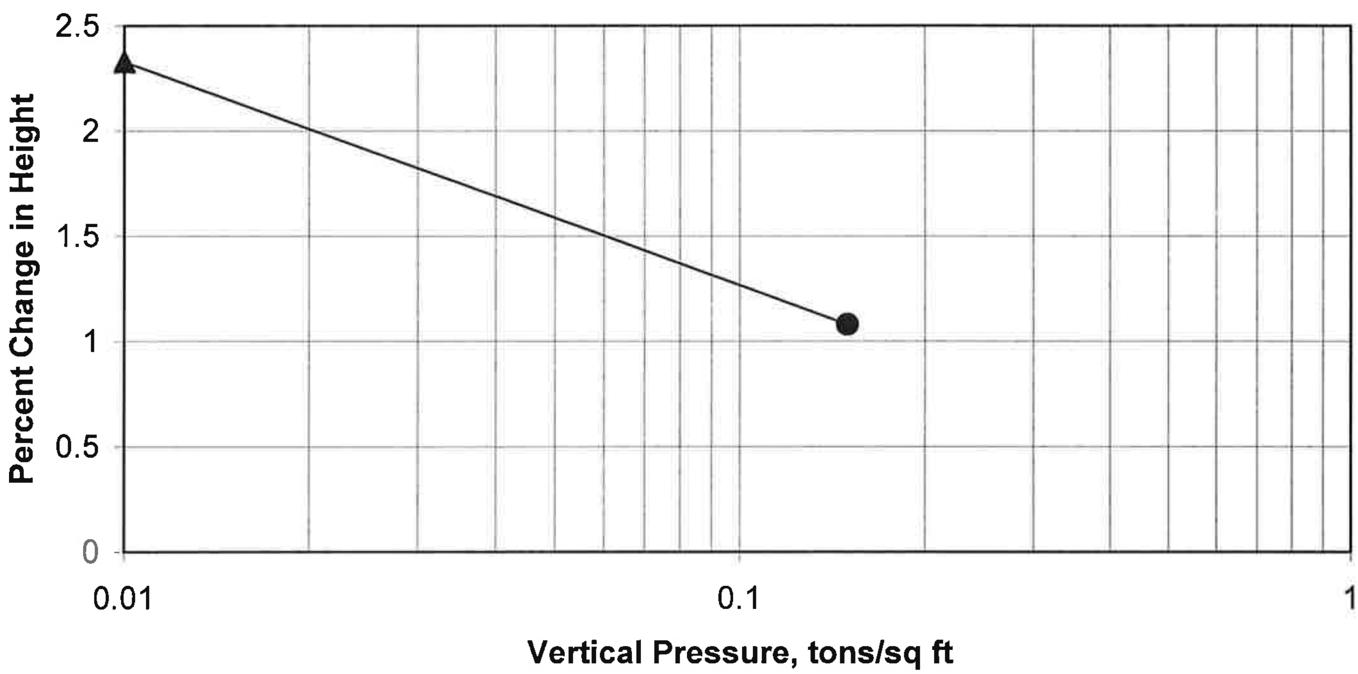
Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
B-3	10.0 to 11.0		25.9							1.00	PP
	11.0 to 12.0		25.7							1.25	PP
	12.0 to 12.5		23.2							1.38	PP

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression UU = Unconsolidated Undrained Triaxial

CU = Consolidated Undrained Triaxial FV = Field Vane

SWELL TEST RESULTS
ASTM D4546-03 (Modified)

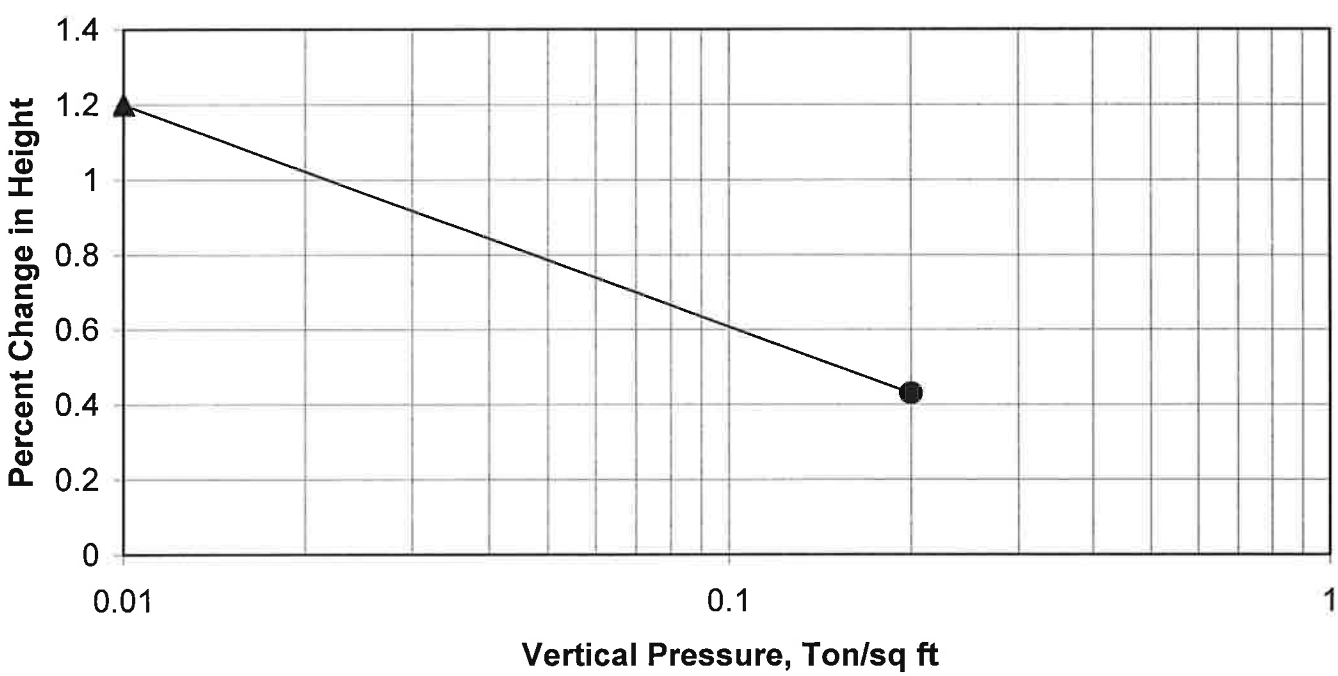
Project No.:	ASR08-043-01	**Unit Dry Weight:**	88.2 lb/cu ft
Boring No.:	1	**Initial Water Content:**	32.5 %
Sample No.:	4	**Final Water Content:**	33.4 %
Depth:	3-4 ft	**Liquid Limit:**	N/A
Material:	Dark brown clay with trace gravel	**Plastic Limit:**	N/A



● Swell at Overburden 0.15 tsf

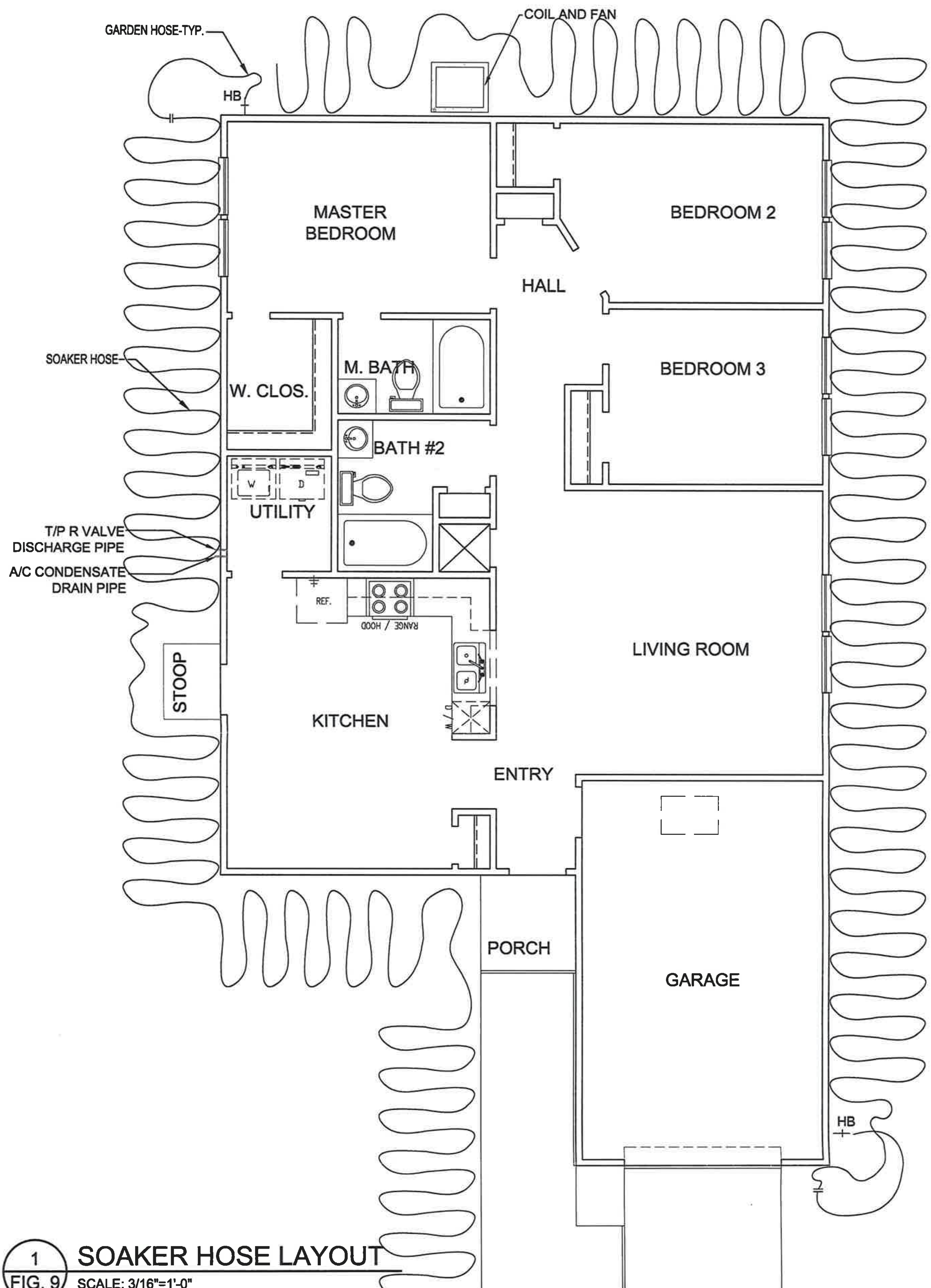
SWELL TEST RESULTS
ASTM D4546-03 (Modified)

Project No.:	ASR08-043-01	**Unit Dry Weight:**	89.3 lb/cu ft
Boring No.:	2	**Initial Water Content:**	31.4 %
Sample No.:	6	**Final Water Content:**	33.1 %
Depth:	5-6 ft	**Liquid Limit:**	N/A
Material:	Dark brown clay with trace gravel	**Plastic Limit:**	N/A



● Swell at Overburden 0.2 tsf

N:\Active Projects\San Antonio\ASR08-043-01 432 Precious Drive - Soil Borings\0804301_dwgs\432 Precious_Fig 9.dwg



1 FIG. 9 SOAKER HOSE LAYOUT
SCALE: 3/16"=1'-0"

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SOAKER HOSE LAYOUT

RESIDENTIAL SUBSURFACE INVESTIGATION STUDY

432 PRECIOUS DRIVE
SAN ANTONIO, TEXAS

REVISIONS: No.	DATE	DESCRIPTION

PROJECT No.: ASR08-043-01
DRAWN BY: JR
CHECKED BY: JHH
REVIEWED BY: JHH

FIGURE 9