SUBSURFACE EXPLORATION
AND
GEOTECHNICAL ENGINEERING EVALUATION
PROPOSED METAL BUILDING
USFWS UPPER OUACHITA NWR
MOREHOUSE PARISH, LOUISIANA

PREPARED FOR:

CASEY CIVIL, LLC
1080 OLD SPANISH TRAIL, SUITE 8
SLIDELL, LOUISIANA 70458

PREPARED BY:

ARDAMAN & ASSOCIATES, INC.
7222 GREENWOOD ROAD
SHREVEPORT, LOUISIANA 71119

AAI PROJECT NO.: 113-12-94-8721
SHREVEPORT FILE NO.: 12.94.122

OCTOBER 4, 2012

TABLE OF CONTENTS

LIST OF APPENDICES

Ardaman & Associates, Inc.

Geotechnical, Environmental and
Materials Consultants

October 4, 2012

Casey Civil, L.L.C.
1080 Old Spanish Trail, Suite 8
Slidell, Louisiana 70458

Attention: Mr. Hunter Charbonnet
Vice President

Reference: Subsurface Exploration and Geotechnical Engineering Evaluation
Proposed Metal Building
USFWS Upper Ouachita NWR
Morehouse Parish, Louisiana
AAI Project No.: 113-11-94-8721
Shreveport File No.: 12.94.122

Gentlemen:

Attached is our Subsurface Investigation Report for the above referenced project. Ardaman & Associates, Inc. (AAI) will be happy to assist you further on this project by furnishing any Construction Materials Testing (CMT) Services you or your contractor may require. AAI's local West Monroe office is can provide all of your CMT needs during the construction phase of the project.

It has been a pleasure to perform this work for you. If we can be of any further assistance, please do not hesitate to call on us.

Very truly yours,

ARDAMAN & ASSOCIATES, INC.

Prepared By:

STATE OF LOUISIANA
JAMES M. BELT
REG. No. 27126
REGISTERED
PROFESSIONAL ENGINEER
IN
CIVIL ENGINEERING
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Principal Engineer

cc: (2) client

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MOREHOUSE PARISH, LOUISIANA

GENERAL

This study was authorized by Mr. Hunter Charbonnet, Vice President of Casey Civil, L.L.C. on September 20, 2012. The purposes of the study were to (1) explore the subsurface conditions present at this site, (2) determine the pertinent engineering properties of the materials encountered, and (3) develop recommendations pertinent to design of a foundation and floor slab system compatible with the soils encountered at this site.

PROJECT DESCRIPTION

The site of the proposed building is located on the east side of Long Lonesome Road about 2,100 feet south of its intersection with Company Pond Road in rural northern Morehouse Parish, Louisiana. The approximate geophysical coordinates of the site are Latitude 32° 55.527' North, Longitude 91° 58.539' West. At the time of this investigation, the boring site was occupied by an existing building pad. The pad appeared to have been previously occupied by a structure. Topography of the site appears relatively flat. AAI estimates total elevation differential across the property is on the order of two (2) feet, or less. *Google™earth* puts the ground surface elevation at 90 feet above mean sea level.

AAI understands the proposed project includes the construction of a slab-on-grade pre-engineered metal building. The new building will have a footprint of about 1,800 SF. Loading for this type structure is typically light. The new structure will occupy the western end of the existing pad.

FIELD OPERATIONS

The subsurface exploration at this site consisted of performing a single test boring in the location proposed for the new building. The test boring was advanced to a depth of twenty (20) feet below the existing ground surface. The test boring was performed on September 26th 2012.

The test boring was located in the field by AAI using the site map provided, estimating angles, and taping distances from the existing site features. The location is accurate only to the degree implied by the methods used. A copy of the site map with approximate test boring location is included in Appendix "A" of this report.

The test boring was advanced utilizing continuous-flight augers in general accordance with provisions outlined in *ASTM D1452*, *Standard Practice for Soil Investigation and Sampling by Auger Borings*. Samples were obtained for laboratory evaluation in general accordance with provisions of *ASTM D1586*, *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils* and/or *ASTM D1587*, *Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes*.

Standard, thin-walled, seamless Shelby tube samplers (ASTM D1587) were used to obtain specimens of cohesive materials. Soils which contained enough cohesionless material or were sufficiently dense to prevent recovery of undisturbed specimens with Shelby Tube samplers were evaluated by means of the Standard Penetration test (ASTM D1586). This test consists of determining the number of blows required by a 140 pound hammer dropped 30 inches to achieve one foot penetration of the soil. This number is then related to "in situ" relative density of the material.

These soil samples were taken continuously to a depth of ten (10) feet below the existing ground surface. Below this depth, samples were obtained at intervals of five (5) feet as the borings were advanced. All samples obtained were logged, packaged, and sealed in the field to protect them from disturbance and maintain their in situ moisture content during transportation to our laboratory. The results of the boring program (Logs of Boring) are included as Appendix "A" of this report.

LABORATORY TESTING

Upon return to our laboratory selected samples were subjected to standard laboratory tests under the supervision of a geotechnical engineer. These soil properties were used to evaluate shear strength, to classify the soils and to evaluate their potential for volumetric change. Our laboratory testing program included the ASTM standard methods outlined below. The results of our laboratory testing program are included on the Logs of Boring in Appendix "A".

ASTM D 1140 – Amount of Material in Soils Finer than the No. 200 (75-μm) Sieve.

ASTM D 2166 – Unconfined Compressive Strength of Cohesive Soil.

ASTM D 2216 – Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

ASTM D 4318 – Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

SOIL CONDITIONS

Soil conditions described in this section are of a generalized nature and are intended to emphasize key features and characteristics. For a more detailed description of the subsurface materials encountered refer to the soil profiles on each Log of Boring in Appendix "A" of this report. Strata contacts indicated on our Logs are approximate. Actual transitions may be gradual in nature.

The upper two (2) feet (the existing building pad) appears to be loose clayey sand fill material. This surficial layer classifies (SC) or *clayey sand* per *ASTM D2487*, *Standard Practice for Classification of Soils for Engineering Purposes (Unified Soils Classification system)*. Below the fill material, Stiff to very soft sandy lean clay (CL) was encountered to a depth of ten (10) feet. At thirteen (13) feet, medium dense silty sand (SM) was encountered. Our test boring was terminated in this (SM) stratum at a depth of twenty (20) feet below the existing ground surface.

The soil types generally encountered within the upper ten (10) feet at our test borings have very low potential for shrink and swell with changes in moisture content and they are not considered expansive.

GROUNDWATER

Although a soft zone was encountered at a depth of about five (5) feet, groundwater was not encountered until a depth of about fifteen (15) feet. The test boring was backfilled upon completion of sampling and not left open for a twenty-four hour period, therefore water at this depth should not be construed as the static watertable for the site.

We do not anticipate that groundwater will adversely impact construction activities on this site. However surface moisture could be problematic. The underlying sandy lean clay soils will often retain a "perched" watertable. Perched water is temporary but can significantly impact earthwork activities. Levels will vary significantly with the climatic seasons of the year and recent rainfall events, disappearing entirely during the dry season. If construction activities are to be initiated during the wetter seasons of the year, we recommend water levels at the site be verified prior to any construction activity.

SUBGRADE PREPARATION

Prior to subsequent construction activity, surficial vegetation, existing foundations, and any abandoned utilities should be removed and wasted. Provide drainage of the exposed subgrade by sloping grades and ditching away from the construction site.

After stripping and rough site grading is complete the exposed surface of areas where the structures, paving or fill are to be placed should be proof rolled to identify any isolated weak soils. Isolated weak spots should be investigated, removed, or repaired under the supervision of the geotechnical engineer prior to subsequent construction activity. After establishment of a stable subgrade layer, the exposed subgrade layer should be scarified to a minimum of twelve (12) inches, the moisture content adjusted to within one (1) percent below to three (3) percent above optimum and recompacted to ninety-five (95) percent of the laboratory maximum as determined by *ASTM D698, Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3)* prior to placement of any fill or base materials.

FILL RECOMMENDATIONS

Where fill materials may be required to achieve the desired finished grade elevations, the material should be placed in controlled lifts. Lifts should be placed in thin horizontal layers not exceeding eight (8) inches compacted thickness. Each lift of select fill should be moisture conditioned to within two (2) percentage points of optimum moisture and compacted to a minimum of ninety-five (95) percent of the laboratory maximum as determined by ASTM D698.

All imported fill material should be *"select"*. Select materials classify SC or CL (clayey sand or sandy lean clay) in accordance with ASTM D2487 and should have liquid limits no greater than thirty-eight (38), plasticity indices (PI) between eight (8) and eighteen (18), and no more than sixty (60) percent passing the U.S. Standard No. 200 Sieve.

Onsite soils encountered within the upper ten (10) feet at this site are suitable for use as fill with adequate processing and moisture conditioning. Typical specifications for compaction of sandy clay and clayey sand type soils are included in Appendix "B" or this report.

FOUNDATION RECOMMENDATIONS

Soil conditions encountered at this site appear to be such a conventionally reinforced, shallow foundation system with ground supported slab can be utilized to support lightly loaded structure at this site. Bearing capacity is controlled by settlement potential in the soft soils encountered below a depth of four (4) feet. An allowable bearing pressure of 1,250 PSF can be utilized to proportion continuous (strip) footings placed at a depth of not more than two (2) feet below the existing ground surface on the stiff sandy lean clay stratum or at a depth of approximately two (2) feet below the finished floor slab elevation in density controlled fill. A minimum footing width of eighteen (18) inches should be maintained for all continuous footings.

Areas of concentrated load can be supported by isolated spread (spot) footings. The base of the footings should be placed in the previously described manner. An allowable bearing pressure of 1,500 PSF can be used to proportion all spread footings. A minimum footing width of twenty-four (24) inches should be maintained for all spread footings. The bearing pressures provided above contain a minimum factor of safety on the order of two (2) against shear failure of the bearing stratum and was selected to limit settlement to less than one less than one (1) inch.

The slab for the proposed structure can be placed directly on the density controlled fill or prepared subgrade. A Modulus of Subgrade Reaction (k) of 200 PCI can be used for the prepared sandy lean clay subgrade or density controlled select fill. Use of a polyethylene moisture (vapor) barrier is recommended under all climate controlled areas. It is recommended the slab be structurally tied to the foundation.

CONSTRUCTION CONCERNS

The upper soils at the site are fine-grained materials composed of a significant silt and/or clay fraction. Silty and clayey soils are subject to extreme changes in shear strength with varying moisture conditions and, if construction is initiated during wetter seasons of the year, it may be very difficult to move equipment about the site. Once the silt or clay becomes saturated, compaction operations can be seriously hampered by a tendency of the silt to "pump" or the clay to shear. Consequently, it is imperative adequate site drainage be established and maintained prior to and during construction operations to prevent water ponding on or adjacent to the site resulting in subsequent saturation of the soil. Compaction operations may be expedited by using light compaction equipment and thin lifts of soil. Rolling only as necessary to obtain compaction is advisable because further repetitive loading may cause the subgrade to "pump" or fail.

Compaction operations and installation of the foundations should be supervised by an AAI inspector. All foundation excavations should be inspected to verify cleanliness and bearing stratum suitability. Concrete should be placed in foundation excavations as soon as practical after forming and imbed placements have been approved, to avoid prolonged exposure of the bearing stratum and possible disturbance due to standing water, desiccation or construction operations.

Earthwork performed during wet periods of the climatic cycle may warrant special considerations. The use of hydrated lime, fly ash or Portland cement stabilization should be considered to provide a working platform. The need for such techniques is dependent upon earthwork scheduling with respect to weather patterns and good site management of drainage during the construction phase.

When the structures are complete, the ground surface should slope away from the structure and downspouts should carry runoff water several feet away from the structure, preferably into paved areas or sewers, before discharging.

Although significant differential movement is not anticipated, minor movements could occur between the additions and the existing structure(s). AAI recommends the liberal use of expansion joints between the all new construction and the pre-existing structures.

LIMITATIONS

This study has been prepared in accordance with generally accepted geotechnical engineering principles and practices in this area at this time. We make no other warranty either express or implied.

The conclusions and recommendations submitted in this report are based upon the data obtained from the exploratory borings drilled at the locations indicated in Appendix "A", the proposed type of construction and our experience in the area. Our findings include interpolation and extrapolation of the subsurface conditions identified at the exploratory borings and variations in the subsurface conditions may not become evident until excavations are performed. If conditions encountered during construction appear to be different from those described in this report, we should be notified at once so that supplemental recommendations if required can be made.

This study has been prepared for the exclusive use by our client for design purposes. We are not responsible for technical interpretations by others of our exploratory information, which has not been described or documented in this report. As the project evolves, we should provide continued consultation and field services during design and construction to review and monitor the implementation of our recommendations, and to verify that the recommendations have been appropriately interpreted. Design changes may require additional analysis or modifications of the recommendations presented herein.

We recommend the geotechnical engineer of record (AAI) be retained to provide, construction materials testing, on-site observation of excavations, and verification of foundation bearing strata during the construction phase of this project.

APPENDIX A

LOCATION DIAGRAMS
AND
LOG OF BORING

<u>SITE LOCATION</u>

PROPOSED MEATAL BUILDING
USFWS UPPER OUACHITA NWR
MOREHOUSE PARISH, LOUISIANA

BORING SITE

PROPOSED METAL BUILDING
USFWS UPPER OUACHITA NWR
MOREHOUSE PARISH, LOUISIANA

LOG OF BORING NO B-1

PROJECT: USFWS Upper Ouachita NWR

SHEET 1 of 1

CLIENT: Casey Civil LLC

LOCATION: Morehouse Parish, Louisiana

DATE: 9/26/12

SURFACE ELEV: 90' +/-

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water encountered at fifteen (15) feet depth

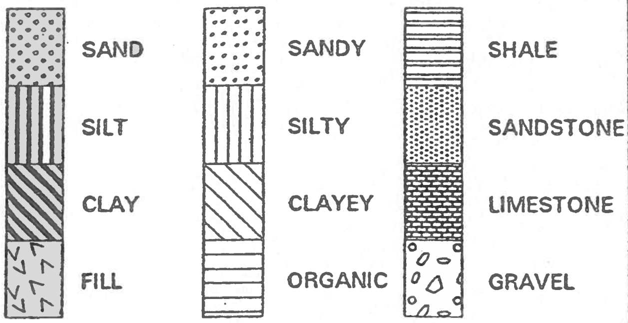
FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
	0–2	Split-spoon	N=5	13		28	14	14	37				Loose red clayey sand (fill) 2.0
	2–4	Split-spoon	N=22	17		27	16	11					Stiff tan sandy clay
	4–6	Split-spoon	N=0	22					70				--Very soft, wet very silty clay with sand
	6–8	Split-spoon	N=6	28									--Medium, wet
	8–10	Tube		15	112	27	15	12	62	2.94	2.2		--Stiff tan sandy clay 11.5
	11.5												Medium dense light gray silty sand
	13–15	Split-spoon	N=13	25					14				
	15		▼ (water level)										
	18–20	Split-spoon	N=15	24									20.0
	20												Bottom of boring at 20 feet

Sample type legend: TUBE SAMPLE; AUGER SAMPLE; SPLIT-SPOON; ROCK CORE; THD CONE PEN.; NO RECOVERY

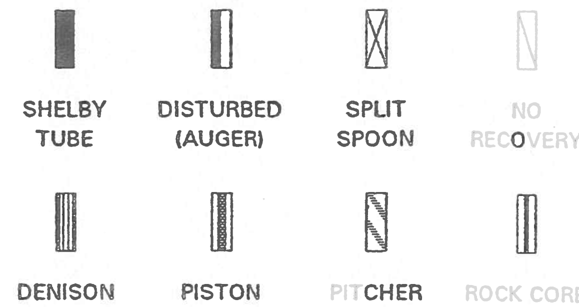
REMARKS:

KEY TO SOIL CLASSIFICATION TERMS AND SYMBOLS

SOIL OR ROCK TYPES



SAMPLER TYPES



CONSISTENCY OF COHESIVE SOILS (MAJOR PORTION PASSING NO. 200 SIEVE)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH,TONS/SQ FT
VERY SOFT	LESS THAN 0.25
SOFT	0.25 TO 0.5
FIRM	0.5 TO 1.0
STIFF	1.0 TO 2.0
VERY STIFF	2.0 TO 4.0
HARD	GREATER THAN 4.0

RELATIVE DENSITY OF GRANULAR SOILS (MAJOR PORTION RETAINED ON NO. 200 SIEVE)

DESCRIPTIVE TERM	RELATIVE DENSITY,%
VERY LOOSE	LESS THAN 15
LOOSE	15 TO 35
MEDIUM DENSE	35 TO 65
DENSE	65 TO 85
VERY DENSE	GREATER THAN 85

WATER LEVELS

▼ - DEPTH GROUNDWATER FIRST ENCOUNTERED DURING DRILLING

▽ - GROUNDWATER LEVEL AFTER 24 HOURS (UNLESS OTHERWISE NOTED)

TERMS DESCRIBING SOIL STRUCTURE

Parting: paper thin in thickness

Seam: 1/8" - 3" in thickness

Layer: greater than 3" in thickness

Calcareous: containing appreciable quanties of calcium carbonate

Ferrous: containing appreciable quantities of iron

Well-graded: having wide range in grain size & similar proportions of all intermediate sizes

Poorly graded: predominately one grain size or having a range of sizes with few or no particles of some intermediate sizes

Fissured: containing shrinkage cracks, frequently filled with fine sand or silt, usually more or less vertical

Interbedded: composed of alternate layers of different soil types

Laminated: composed of thin layers of varying color and texture

Slickensided: having inclined planes of weakness that are slick & glossy in appearance

<u>NOTE:</u> Clays possessing slickensided or fissured structure may exhibit lower measured shear strength than indicated by the described consistency. The consistency of such soil is interpreted using the measured shear strength along with pocket penetrometer results.

APPENDIX B

PROCEDURES
AND
SPECIFICATIONS

B.1. SPECIFICATIONS FOR COMPACTION

Sandy Clay and Clayey Sand Soils

The thickness of lifts used should be no more than the height of the teeth on sheepsfoot rollers. Generally, for a forty-eight (48) inch diameter or smaller drum roller, the maximum compacted lift thickness acceptable is six (6) inches. For rollers with drums of sixty (60) inches in diameter and larger with teeth about nine (9) inches long, a nine (9) inch final compacted lift thickness will be acceptable. The sole determination of the thickness of a lift will be the capability of the contractor's equipment to obtain the required compaction.

When obtaining the average density of a lift to determine its conformance to specifications, the lift should be immediately rejected if any density is more than 2% below the required average.

Generally, sheepsfoot rollers are most suitable for compaction of sandy clay and clayey sand soils, the contractor may use spiketooth rollers, rubber tired rollers, or any fill compaction equipment that has sufficient mass to compact the soil. Generally, the drums of sheepsfoot rollers should be filled with water or for additional weight with both water and sand. Tractors or other vehicles used primarily for hauling should not be allowed as fill compaction equipment. The contractor should also have smooth wheel rollers to seal the working area at the end of the day's operations so overnight rains will not saturate the soil and delay his work. These rollers should also be used to seal the surface whenever rainfall is imminent.

The geotechnical engineer or his representative will perform density tests and will accept or reject a lift within two (2) hours after being tested. No material will be placed on any lift that has not been accepted by the engineer.