GEOTECHNICAL INVESTIGATION REPORT

SNF POLYCHEMIE
PLANT EXPANSION – RAW MATERIAL TANKS
PEARLINGTON FACILITY
BAY ST. LOUIS, MISSISSIPPI

FOR

SNF POLYCHEMIE
BAY ST. LOUIS, MS

GULF SOUTH ENGINEERING AND TESTING FILE NO. 17-014C

April 17, 2017

GULF SOUTH
ENGINEERING AND TESTING, INC.
Geotechnical & Materials Consultants

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April 17, 2017

SNF Polychemie
3080 Port and Harbor Drive
Bay. St. Louis, MS 38520

Attention: Wes Christopher
PN: (228) 533-5555
E-mail: wchristopher@snfhc.com

Re:
Geotechnical Investigation Report
SNF Polychemie
Plant Expansion – Raw Material Tanks
Pearlington Facility
Bay St. Louis, MS
Gulf South Engineering & Testing File No. 17-014C

Dear Wes,

Please find attached our geotechnical investigation report that was completed for the referenced project. We appreciate the opportunity to serve your geotechnical needs. Please contact us should you have any questions.

Sincerely,
GULF SOUTH ENGINEERING AND TESTING, INC.

CHAD M. POCHE, P.E.
Principal/Vice President

BLAKE E. VUTERA, P.E.
Geotechnical Engineer

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SNF POLYCHEMIE
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PEARLINGTON FACILITY
BAY ST. LOUIS, MISSISSIPPI

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1.0 INTRODUCTION & LIMITATIONS

This report contains the results of a geotechnical investigation made at the subject site. Instructions to proceed with the investigation were received from SNF Polychemie (Client) via approval of our proposal dated February 14, 2017.

The study included drilling a soil test boring and the performance of soil mechanics laboratory tests to evaluate the soil's physical characteristics. Engineering analyses were made and based on the field and laboratory test data to develop recommendations for the project.

The analyses and recommendations presented in this report are based on the provided project information and the results of the investigation. While it is not likely that conditions will differ significantly from those observed during the field investigation it is always possible that variations can occur away from the borehole location(s).

If it becomes apparent during construction that subsurface conditions differing significantly from those observed in our boring(s) are encountered, Gulf South should be notified. Also, should the nature of the project change or should any of the stated assumptions be inaccurate, the recommendations provided in this report should be re-evaluated.

This report has been prepared for the exclusive use of our Client. The recommendations provided in this report are site specific and are not intended for use at any other site or for any other project. This report provides recommendations for design and construction and should not be used as construction specifications.

Gulf South considers the materials testing and onsite inspection during construction an extension of our geotechnical investigation and a key component to ensuring the recommendations provided in this report are followed. For this type of project, these services may consist of earthwork testing and monitoring, pile inspection and monitoring, vibration monitoring, concrete testing and inspection, and steel inspection. Gulf South should be retained to provide the construction inspection services for this project.

2.0 SOIL BORING

One (1) undisturbed soil boring (Boring B-3) was drilled to a depth of 70 feet below the ground surface on March 7, 2017. The boring was drilled with a truck mounted drill rig at the designated location as approximately shown on Figure 1.

Undisturbed sampling was performed continuously or on approximate 5 foot centers in all cohesive or semi-cohesive materials with a three inch diameter thin wall tube sampler. The samples were extruded in the field, representative portions of each sample were trimmed and placed in moisture proof containers, the samples were properly labeled, and secured for transport to the laboratory.

When cohesionless material was encountered or when soils could not be adequately sampled by undisturbed methods, the Standard Penetration Test was performed. This test consists of driving a two-inch diameter split spoon sampler a total of approximately 18 inches with a 140 lb. hammer falling 30 inches. The number of blows required to drive the sampler per 6 inch increment is recorded and gives an indication of the density of the material.

The blows per foot shown on the boring log are the total of the blow counts for the final 12 inches of penetration.

3.0 LABORATORY TESTING

Soil mechanics laboratory tests were performed on samples obtained from the boring. The testing consisted of natural moisture content, unit weight, Atterberg limits, grain size analyses, and unconfined compression strength testing. The results of the laboratory tests are shown on the soil boring log provided in the appendix of this report.

4.0 SUBSOIL CONDITIONS

4.1 Subsoil Description

Reference to the boring shows there is medium stiff sandy clay from the ground surface to the approximate 4 foot depth. Below these layers, medium stiff clay with sand pockets follows to the approximate 6 foot depth. A layer of very soft organic clay follows to the approximate 13 foot depth. Below this layer, medium stiff clay with sand pockets is present to the approximate 18 foot depth. A medium dense to dense sand layer follows to the approximate 25 foot depth. Interbedded layers of soft to medium stiff sandy clay, silty clay and clay follow to the approximate 44 foot depth. Below these layers, very dense clayey sand and gravelly sand layers are present to the approximate 60 foot depth. Stiff clay follows to the boring's termination depth of 70 feet.

4.2 Groundwater

At the time of making the boring, no groundwater was encountered to a depth to the approximately 20 feet below the ground surface (b.g.s.). Below this depth, drilling mud was introduced into the borehole and groundwater was unable to be detected afterward. These observations were made during a short period of time and groundwater may not have become fully realized at the time of observation. Groundwater can fluctuate with seasonal precipitation, drainage, and prolonged drought. If the depth to groundwater is important to construction, it should be measured at that time.

5.0 FURNISHED INFORMATION AND FOUNDATION RECOMMENDATIONS

Furnished information indicates a raw material tank area will be constructed at the SNF Polychemie Pearlington facility in Bay St. Louis, LA. The proposed structure will consist of a new tank pad and concrete dike area for future storage tanks and will be approximately 2,400 square feet in plan dimensions. Structural loads were not furnished but are expected to be typical for this type of structure. We understand that no more than 2 feet of fill will be placed on site.

Due to the soft near surface soils, the use of shallow foundations should be considered "borderline" with respect to the support of the proposed structure. Alternatively, we recommend the structure be supported on deep foundations consist of driven, open-ended, steel, pipe (OSP), piles; or augered, cast-in-place (ACIP), concrete piles. Deep foundations should support all structural loads including floor slabs.

Shallow foundations for the proposed structure may be used if the values for bearing and settlement given in this report are tolerable. If used, the footings should be placed to bear at a minimum depth of 2 feet within firm bearing soil and below the finished ground surface. If the proposed footing dimensions are larger than what has been stated in our report, Gulf South should be notified.

Prior to construction and if deep foundations are used, we recommend that a probe pile program be performed to verify pile tip depth and load capacities. Deep foundations should be used if heavy loads or large areas loads are anticipated.

Structural analyses and the structural adequacy of the foundations are outside our scope of work for the project. Utilities to and from the structure should be attached to the slab using suitable hangers and flexible connections.

Preliminary laboratory test results indicate the near surface soils may have slight shrink/swell potential. Care should be taken during and after construction to limit activities that could affect moisture within the soils below and around the foundations. By precluding surface waters from saturating the soils, the resulting volumetric movements will be minimized. In this regard, good roof and surface drainage should be assured with positive collection and runoff of these waters.

6.0 SHALLOW FOUNDATIONS

6.1 Allowable Soil Bearing Capacities

We estimate net allowable soil bearing capacities of 1,000 pounds per square foot (psf) and 1,300 psf are available for design of shallow strip and square footings, respectively. These allowable soil bearing capacities assume the footings are seated at least 2 feet below grade and in firm natural soils as described and encountered in our borings.

Foundation excavations should be thoroughly inspected to assure that the footings are seated in firm and well drained soil. The allowable soil bearing capacities contain a factor of safety of at least 3.0 against failure but do not preclude settlements, as will be discussed.

6.2 Estimated Settlement

Fill. We have calculated the estimated long-term settlement of the ground surface due to the placement of 2 feet of fill over an approximate 60 ft. by 40 ft. area to be on the order of 2 ¾ to 3 ½ inches. Our analyses are based on a unit weight of 110 pounds per cubic foot (pcf) for the fill material. Settlement due to fill placement should be quick (within 3 to 6 months of placement). Fill should be placed as far in advance of construction as possible.

Footings. Settlement analyses were made using applied pressures equal to 100% of the allowable soil bearing values. Long-term settlement of square footings no larger than 6 feet in width and strip footings no wider than 3 feet in width is estimated to be on the order of ¾ to 1 inch. Settlement will increase

with the size of the footing and/or loading and if larger footings are needed for support, revised settlement analyses should be made.

Slab. For comparison purposes, we have performed a long term consolidation settlement analysis at the center of an approximate 20 ft. by 20 ft. flexible slab. We estimate the magnitude of settlement to be on the order of 7 to 8 inches using a uniform loading of up to 1,000 psf. The estimated settlement should occur over most of the loaded area while the edge settlements should be approximately one–half (1/2) of the center settlement and may only occur over a limited range near the perimeter. Slab settlement should be added to the estimates calculated for footings if footings are used in conjunction with the slab.

In view of the magnitude of the estimated settlement and to bridge any undetected soft or loose areas, good rigidity should be assured in the foundations to minimize the effects of differential settlements. This may be accomplished by using a post tensioned slab, a ribbed or waffle type slab, etc. Additional, preloading or surcharging the building area may be used to accelerate the consolidation settlement process prior to construction.

The provided settlement estimates for a flexible slab can be reduced by 15% if a rigid slab is used. Adequate steel reinforcement should be designed and included within the foundations. If the estimated settlements for shallow footings are considered prohibitive, deep foundations should be used for support of the structure.

6.3 Site Preparation and Fill Materials

Prior to construction, the foundation areas should be stripped of all vegetation, debris, soft or loose surface soils, deleterious materials, etc., and should be well drained. Subsequent to stripping, the foundation areas should be proof rolled using a heavy wheeled vehicle.

Any "soft" soils noted during the proof rolling or observed within excavations should be removed to a depth where stiffer soils are encountered or to a minimum depth of 2 feet. Excavated soils should be replaced with controlled-compacted structural fill. If fill is needed, the area should be brought to grade using a clean, select, fill material free from debris or organic matter.

A cohesionless soil described as clean sand with less than 10% passing the U.S. No. 200 Sieve may be used for fill. Alternatively, a lean, silty or sandy clay (CL - USCS Classification) may be used for fill. The clay fill should have a Liquid Limit of less than 40 and a Plasticity Index (PI) of less than 20.

6.4 Fill Placement and Compaction

Fill should be placed in 10 to 12 inch loose lifts. Minimum compaction criteria of a dry density at least equal to 95% of its maximum, as determined by the Standard Proctor compaction test (ASTM D698), should be used for fill that will support foundations.

7.0 DEEP FOUNDATIONS

As an alternative to shallow foundations, a deep foundation system consisting of driven piles (OSP) or augered piles (ACIP) may be used for support of the structure. Consideration should be given to supporting all loads (columns, walls, and floors) on piles if deep foundations are used.

7.1 Allowable Pile Load Capacities

Analyses have been made to determine the estimated allowable pile load capacities for several types/sizes of piles. Allowable pile load capacities are provided on Figures 2 and 3.

The allowable pile load capacities provide for a 2-foot cutoff below the existing ground surface, assume the piles are vertical, and do not include the weight of the pile. The provided compression capacities contain an estimated factor of safety of 2 against failure of a single pile through the soil. The

provided tension capacities contain an estimated factor of safety of 3 against failure. The capacities also include a limiting adhesion value based on load tests in geologically similar soils.

The analyses for pile capacities are based on a soil-pile relationship only. The structural capacity of the piles and their connections to transmit these loads should be determined by a structural engineer.

7.2 Drag Load

When fill is placed on the site, the underlying compressible soils consolidate, resulting in surface settlement. As the compressible soils consolidate, "negative skin friction" or downdrag can be imparted on piles/shafts. This can result in a load that is additive to structural loads on the piles/shafts and will increase settlement of the piles/shafts and structure.

Drag load is dependent on the thickness of fill, compressibility of the soils, time-rate of consolidation, and pile size and length. Gulf South should be notified if more than 2 feet of fill is expected to be placed on site.

7.3 Group Effect

The effects of pile/shaft grouping on single pile/shaft load capacities is dependent on pile/shaft spacing, pile/shaft lengths, and soil characteristics throughout the pile/shaft length and below the pile/shaft tip. Assuming a minimum center to center spacing of 3 ft., group effect should be unimportant for pile clusters of up to 6 piles/shafts. Group effect may become important for larger clusters and should be evaluated when actual pile/shaft layouts are known using the criteria provided on Figure 4.

7.4 Estimated Settlement for Deep Foundations

Settlement of pile supported footings and slabs constructed in single, widely, spaced rows, or in clusters of up to 4 to 6 piles is estimated to be 1 inch or less for the provided capacities and tip depths. These values assume piles are driven/augered to the specified tip depths and not loaded greater than the stated allowable carrying capacities.

7.5 Pile Driving

In general, driving of open-ended, steel, pipe piles (OSP) should be performed using a hammer with a minimum driving energy of 19,500 foot-pounds per blow using a Vulcan No. 6 hammer, or equivalent.

Predrilling for pile installation does not appear necessary. However, predrilling may be used to reduce vibrations. If necessary, predrilling should be made with a bit that is no larger than 85% of the pile's tip diameter and should not penetrate to within 10 feet of the pile's design tip depth.

7.6 Augered Cast-In-Place Pile Installation

In general, augered cast-in-place piles consist of grout injected pilings that are installed from the pile toe to pile head. An experienced augered cast-in-place pile contractor should be contacted to determine the proper installation techniques in this area.

The concrete or grout mix (water to cement ratio) should be proportioned to achieve the necessary design strength while allowing "workability" during pile installation. A program of on-site quality control by a qualified geotechnical technician is strongly recommended during pile installation.

7.7 Probe Piles and Pile Load Tests

We recommended that probe type piles be installed at the site to establish installation characteristics and pile lengths. The probe piles should be of the same type and size as the job piles and should be installed with the same equipment and techniques that will be used to install the job piles.

We recommend the probe piles be allowed to set for a period of 14 days and at least one of the probe piles be tested to failure in accordance with ASTM D 1143. Gulf South should be retained to evaluate and verify the estimated pile load capacities.

7.8 Vibrations

Vibrations due to construction activities should be expected and they should be monitored during all construction activities. In general, vibrations should be limited to about 0.25 inch/sec. (average peak particle velocity) at all existing nearby sensitive structures. Construction should be stopped if peak values exceed about 0.5 in./sec.

8.0 CLOSING

Gulf South is available to answer any questions you may have concerning this report. Should additional analyses be required or requested, additional fees may be necessary.

As previously discussed, Gulf South considers the materials testing and onsite inspection during construction an extension of our geotechnical investigation. Gulf South should be retained to provide the construction inspection services.

We appreciate the opportunity to provide this report and look forward to working with you again in the future.

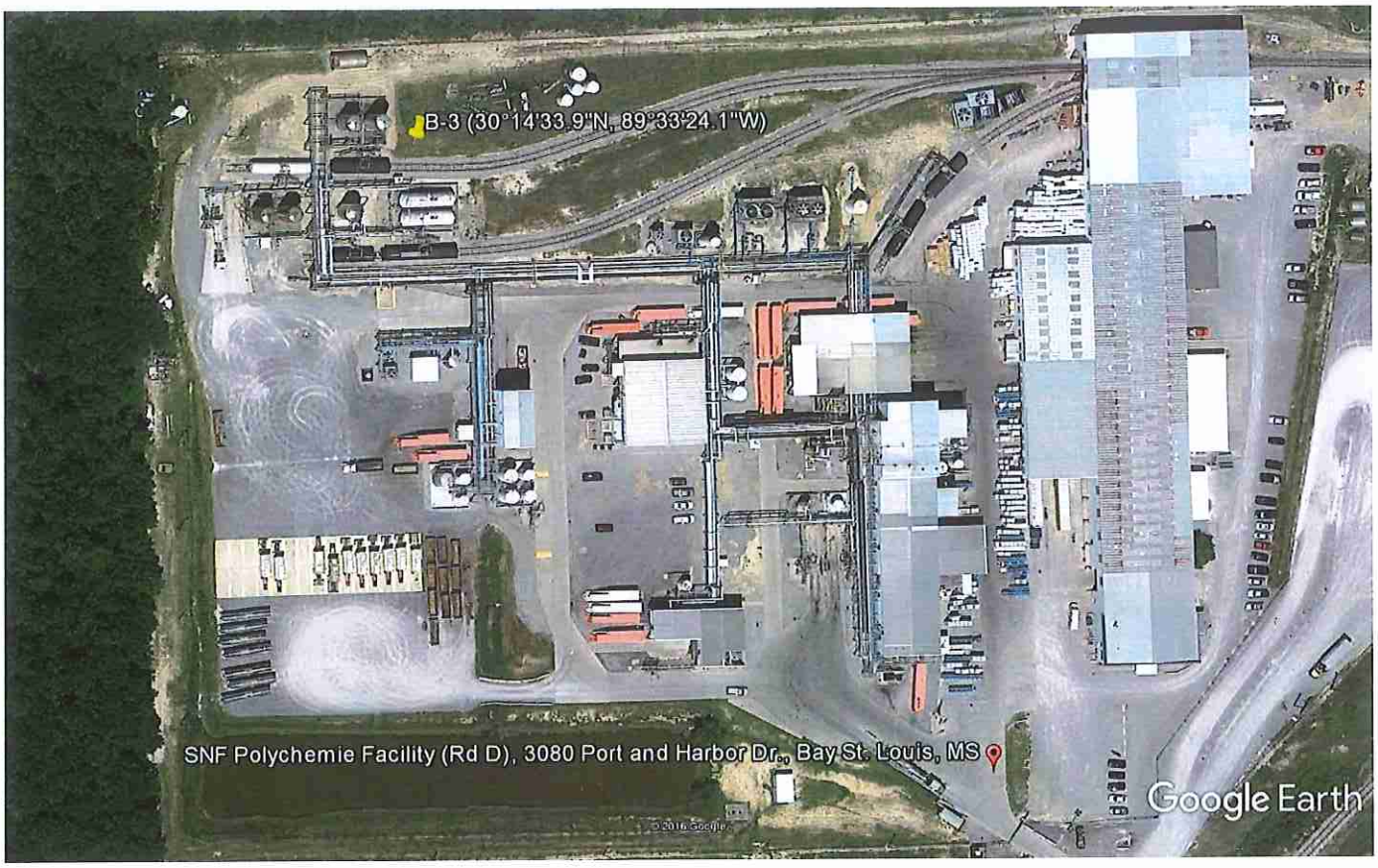
Sincerely,

GULF SOUTH ENGINEERING AND TESTING, INC.

CHAD M. POCHE, P.E.
Principal/Vice President

BLAKE E. VUTERA, P.E.
Geotechnical Engineer

FIGURES



feet 600
meters 100

Gulf South File 17-014C	GULF SOUTH ENGINEERING AND TESTING, INC. Geotechnical & Materials Consultants	
SNF Polychemie Plant Expansion Pearlington Facility Bay St. Louis, MS	**For SNF Polychemie Bay St. Louis, MS**	**BORING PLAN**
		Figure No. 1

GEOTECHNICAL INVESTIGATION

SNF POLYCHEMIE
PLANT EXPANSION – RAW MATERIAL TANKS
PEARLINGTON FACILITY
BAY ST. LOUIS, MISSISSIPPI

GULF SOUTH ENGINEERING AND TESTING PROJECT NO. 17-014C

ALLOWABLE PILE LOAD CAPACITIES

OPEN-ENDED, STEEL, PIPE PILE

PILE TYPE AND SIZE	PILE TIP EMBEDMENT BELOW GROUND SURFACE IN FEET	ESTIMATED ALLOWABLE SINGLE PILE LOAD CAPACITIES IN TONS COMPRESSION FACTOR OF SAFETY = 2 TENSION FACTOR OF SAFETY = 3	
		COMPRESSION	TENSION
Steel Pipe (12" O.D.)	20-22*	11	7
	35	15	10
	40	17	11
	45-50*	29	19
Steel Pipe (18" O.D.)	20-22*	20	13
	35	22	14.5
	40	26	17
	45-50*	50	33

* Assumes pile driven to refusal in the sand deposits encountered at these depths

GEOTECHNICAL INVESTIGATION

SNF PLOYCHEMIE
PLANT EXPANSION – FUTURE RAW MATERIAL TANKS
PEARLINGTON FACILITY
BAY ST. LOUIS, MISSISSIPPI

GULF SOUTH ENGINEERING AND TESTING PROJECT NO. 17-014C

ALLOWABLE PILE LOAD CAPACITIES

AUGERED CAST-IN-PLACE PILES (ACIP)
(ASSUMES 15% OVERTAKE)

PILE TYPE AND SIZE	PILE TIP EMBEDMENT BELOW GROUND SURFACE IN FEET	ESTIMATED ALLOWABLE SINGLE PILE LOAD CAPACITIES IN TONS COMPRESSION FACTOR OF SAFETY = 2 TENSION FACTOR OF SAFETY = 3	
		COMPRESSION	TENSION
ACIP (12" Diameter)	20-22*	15	10
	35	17	11
	40	19	12.5
	45-50*	33	22
ACIP (16" Diameter)	20-22*	21	14
	35	27	18
	40	49	33
	45-50*	59	39

* Assumes pile tip firmly embedded in the sand deposits encountered at these depths

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FIGURE 3

Minimum Pile/Shaft Spacing

$SP = 0.05\ L_1 + 0.025\ L_2 + 0.0125\ L_3$

SP (ft.) = Center to center spacing of piles/shafts = (Min. 3.0 ft.)

L_1 = Pile/Shaft penetration in ft. up to 100 ft.

L_2 = Pile/Shaft penetration in ft. from 101 to 200 ft.

L_3 = Pile/Shaft penetration in ft. from 201 to 300 ft.

Allowable Group Capacity*

$$Q_a = \frac{P * L * c}{FSF} + \frac{2.6 * q_u * (1 + 0.2\ {}^{w}/_{b}) * A}{FSB}$$

P = Average perimeter of pile/shaft group (ft.)

L = Length of piles/shafts in group (ft.)

c = Average (weighted) shear strength (½ q_u) of soil throughout pile/shaft length (lbs./sq. ft.)

q_u = Unconfined compressive strength of soils below pile tips (lbs./sq.ft.)

w = Width of pile/shaft group at tip (ft.)

b = Length of pile/shaft group at tip (ft.)

A = Area of pile/shaft group at tip (sq. ft.)

FSF = Factor of safety for friction area = 2

FSB = Factor of safety for tip area = 3

*In no case should the cumulative single pile/shaft load capacity of the group be exceeded.

APPENDIX

BORING LOG

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Boring No. B-3

Project: SNF Polychemie - Plant Expansion
Pearlington Facility
Location: Bay St. Louis, MS

Client: SNF Polychemie
Bay St. Louis, MS

GSE&T File No.: 17-014
Date: 3/7/2017
Technician: J. Glaser
Rig Type: Truck
Driller: TRI
Page: 1 of 2

Depth (Feet)	Sample	(Field Test) PP/ SPT	Comp. Strength (tsf)	Water Content (%)	Wet Density (pcf)	LL (%)	PI (%)	Passing No. 200 (%)	TYPE	Coord.: 30° 14' 33.9" N, 89° 33' 24.1" W Description of Stratum
0		1.50 (PP)	0.608	17.5	122					Medium Stiff brown SANDY CLAY (CL) with roots
		n/a		3.5		28	9			dry sample
5		0.25 (PP)	0.832*	18.5	127					Medium Stiff gray CLAY (CH) with sand pockets [* - UU confining pressure = 2.0 psi]
		0.50 (PP)		70.3	97					Very Soft black and dark gray ORGANIC CLAY (OH) with sand layers, wood fragments
		0.50 (PP)	0.194*	124.3	87					with trace peat [* - UU confining pressure = 3.1 psi]
10		0.50 (PP)		130.0						
		1.75 (PP)	0.792	25.8	120	59	44			Medium Stiff gray CLAY (CH) with sand pockets
15										
		24 b/f (10-12-12)		26.4						Medium Dense to Dense gray and tan SAND (SP) with silt, clay
20		36 b/f (21-18-18)		29.6				14.7		
25										Soft gray SANDY CLAY (CL) with trace wood
		0.50 (PP)	0.418*	26.4	125					[* - UU confining pressure = 10.0 psi]
30										
		0.50 (PP)	0.588**	75.1	101					Medium Stiff gray CLAY (CH) with sand pockets, trace silt [** - possible slick-in-side failure]
35										
		n/a	0.583	33.8	121	43	21			Medium Stiff gray SILTY CLAY (CH) with sand pockets
40										

Sample Legend:

- Core (Shelby Tube)
- Standard Penetration (SPT)
- No Recovery
- Auger Sample

Comments/Notes:

- Borehole backfilled per LA DOTD & LA DEQ requirements upon completion
- Dry Auger Depths = 0-20 ft.
- Rotary Wash Depths = 20-70 ft.
- Ground water = Not encountered

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ENGINEERING AND TESTING, INC.
Geotechnical & Materials Consultants

Boring No. B-3

Project: SNF Polychemie - Plant Expansion
Pearlington Facility
Location: Bay St. Louis, MS

Client: SNF Polychemie
Bay St. Louis, MS

GSE&T File No.: 17-014
Date: 3/7/2017
Technician: J. Glaser
Rig Type: Truck
Driller: TRI
Page: 2 of 2

Coord.: 30° 14' 33.9" N, 89° 33' 24.1" W

Depth (Feet)	Sample	(Field Test) PP/ SPT	Comp. Strength (tsf)	Water Content (%)	Wet Density (pcf)	LL (%)	PI (%)	Passing No. 200 (%)	TYPE	Description of Stratum
40										Medium Stiff gray SILTY CLAY (CH) with sand pockets
		0.50 (PP)								
				24.6				12.3		Very Dense gray CLAYEY SAND (SC)
45		60 b / 4 inches		26.2				26.4		
		60 b / 5 inches		53.9						clay layers
50										
		60 b / 5 inches		16.8				10.8		Very Dense gray GRAVELLY SAND (SG) with silt, clay %gravel = 27.9 ; %sand = 61.3 ; %fines = 10.8
55		60 b / 5 inches		15.8						
		60 b / 4 inches		14.4				7.3		%gravel = 39.7 ; %sand = 59.7 ; %fines = 7.6
60										Stiff gray CLAY (CH) with silt pockets
		0.75 (PP)	1.080**	52.3	105	80	50			[** - possible slick-in-side failure]
65										
		0.75 (PP)	1.969	52.9	112					
70										Boring completed at 70 feet below ground surface
75										
80										

Sample Legend:

- Core (Shelby Tube)
- Standard Penetration (SPT)
- No Recovery
- Auger Sample

Comments/Notes:

- Borehole backfilled per LA DOTD & LA DEQ requirements upon completion
- Dry Auger Depths = 0-20 ft.
- Rotary Wash Depths = 20-70 ft.
- Ground water = Not encountered

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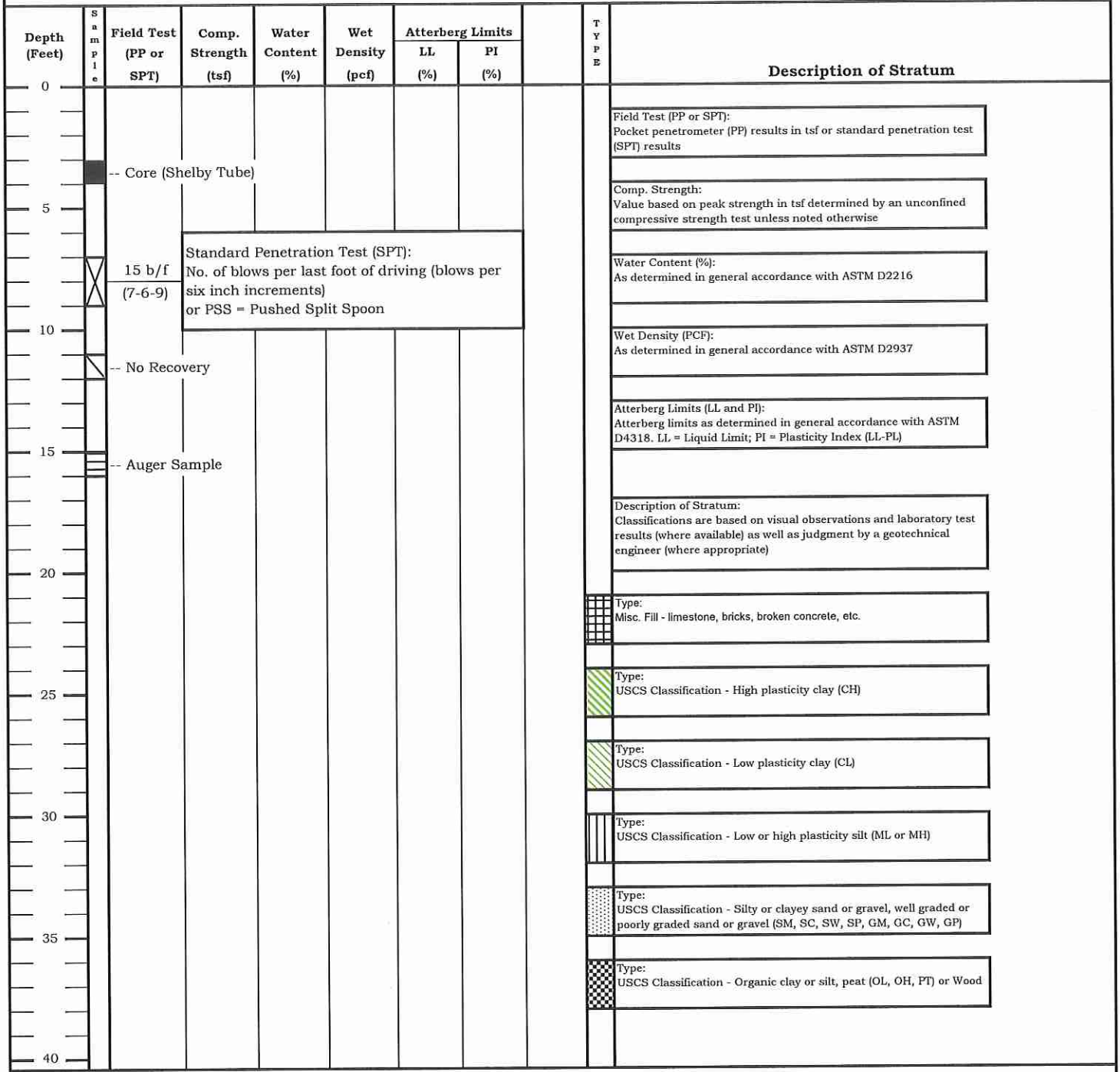
SOIL BORING LOG - DESCRIPTION OF TERMS AND SYMBOLS



Sample Legend:

- Core (Shelby Tube)
- Standard Penetration Test (SPT)
- No Recovery
- Auger Sample

Comments/Notes:

General notes or comments regarding boring and data

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