The thickened sludge/recycle pump station will approximately measure 52-ft by 24-ft. OMI anticipates the structure will be a single story slab on grade structure. OMI anticipates wall loads will range from 2 to 4 kips per linear foot and floor loads will be less than 300 psf.

7.6 Elevated Washwater Storage Tank

Approximate Elevations (ft MSL)

Existing Ground Surface	Planned Ground Surface	FFE Structure
595 to 597	608 to 610	609 Adjacent Pipe Slab=608.5

The proposed elevated washwater tank will have an approximate diameter of 70-ft and a working volume of 1.1 million gallons. The proposed finished floor elevation will be 609-ft MSL with a height of 90-ft above finished grade to the high water level. The tank will be supported by eight to nine columns. Based on conversations with Mr. Jonathan Dixon of Phoenix Fabricators, maximum column loads with be about 920 kips for the outer columns and 2480 kips for the center riser. Further, shallow foundations typically consist of rectangular footings and piers. No wind loads were provided. Based on previous conversations with Caldwell Tanks, a maximum vertical wind load of 31.5 kips and a maximum horizontal wind load of 20 kips would be reasonable for this size water tank.

7.7 Washwater Recovery Basin

Approximate Elevations (ft MSL)

Existing Ground Surface	Planned Ground Surface	Top of Wall	FFE Bottom of Walls	FFE Center of Structure
600 to 605	606 to 607	609.5	592.5	584.58

The washwater recovery basin will be approximately 125-ft in diameter and is expected to be constructed of cast in place concrete. OMI anticipates wall loads will range from 3 to 4 kips per linear foot and soil pressure beneath the slab will be less than 1800 psf. Water will be about 20-ft deep.

7.8 Finished Water Storage Basin and Pump Station

Approximate Elevations (ft MSL)

Structure	Existing Ground Surface	Planned Ground Surface	Top of Wall	FFE Bottom of Structure
Basin	594 to 606	606	608	589.5
Pump Station	594 to 606	606	608	583.5

The finished storage basin and pump station approximately measure 220-ft by 89-ft and the pump station will be located at the northwestern corner of the structure, which is expected to be cast in place concrete. OMI understands preliminary wall thicknesses will be 1.6-ft to 2-ft. The structure will be supported by 2-ft to 2.5-ft thick monolithic footings beneath the walls and 0.67-ft to 1-ft thick mat slab. Several feet of fill will be required on the eastern side of the proposed structure location to reach final grade. OMI anticipates wall loads will range from 5 to 7 kips per linear foot and soil pressures beneath the slab will be less than 1800 psf. Water will be about 15-ft deep.

7.9 Electrical Substation and Generator Building

Approximate Elevations (ft MSL)

Structure	Existing Ground Surface	Planned Ground Surface	FFE of Structure
Generator Building	605 to 608	607	607
Electrical Substation	586 to 604	602 to 606	602 to 606

The electrical substation and generator building will be located on the eastern portion of the site. OMI understands the generator building will be a single story structure constructed similar to the operations and chemical buildings; however, the structure will include an underground chase below the electrical room for the installation of large power cables. OMI anticipates wall loads will range from 3 to 4 kips per linear foot and floor loads will be less than 200 psf.

7.10 Sludge Drying Bed and Sludge Filtrate Pump Station

Approximate Elevations (ft MSL)

Structure	Existing Ground Surface	Planned Ground Surface	FFE of Structure
Drying Bed	603 to 612	610	610
Pump Station	605 t to 610	610	Top of Wet Well=610.5 Base Slab of Wet Well=595

The sludge drying bed will roughly measure 650-ft by 300-ft and will be of CMU construction. The bed will be uncovered with compacted clay bottoms. Walls are expected to be 4-ft or less. Existing ground elevations range from 603-ft MSL to 612-ft MSL. The proposed sludge filtrate pump station will be located at the northeastern corner of the sludge drying bed with a FFE of 595-ft MSL. OMI anticipates wall loads will be less than 1 kip per linear foot.

The sludge filtrate pump station will be approximately 12-ft wide and constructed of cast in place concrete. OMI anticipates wall loads will range from 5 to 7 kips per linear foot. Soil pressures beneath the slab are expected to be less than 1800 psf.

8.0 BASIS FOR RECOMMENDATIONS

The following recommendations are based in part on the preceding project information. This study has utilized the subsurface data, historical information regarding the structural performance of similar structures, and past experience with similar geologic environments to develop professional opinions on which the recommendations are based. Because the structural elements of the design greatly influence the design recommendations, OMI must be provided the opportunity to review the following comments and recommendations in light of changes in building location, elevation, or structural loading.

Standard practice in geotechnical engineering is that all but a few special structures will tolerate 1-in of settlement. Therefore, 1-in is assumed acceptable. Unless otherwise stated, the recommendations in this report are intended to keep post-construction settlement to less than 1-in. Settlement analysis of the elevated water tank indicates approximately 2-in to 2.5-in of settlement can be expected if the structure is supported by shallow foundations.

9.0 DESIGN RECOMMENDATIONS

9.1 Overview

The shallow bearing structures, those bearing within a few feet of the design grade should be relatively straightforward; however, soft, unsuitable soils were encountered at the proposed sludge thickener, sludge pump station, the carbon contactors, and the elevated water tank locations. These soils will require undercutting prior to placement of structural fill. OMI recommends that the site be mass graded with soft to firm soils being undercut and used as structural fill.

Excavation of the deeper bearing structures will encounter groundwater that will make the construction somewhat more complicated. OMI recommends mat foundations or turned down slabs for these structures as they will be most economical and quickest to construct. Groundwater should be kept from the excavations as described within this report. Further, underdrains will be required beneath the storage basins and the sludge thickener to mitigate uplift forces for future maintenance of these structures. Should underdrains not be feasible, OMI also provided recommendations for rock anchors or the use of soil overburden to mitigate buoyant forces.

OMI has provided a modulus of subgrade reaction (k) for design of slab thickness and reinforcement for several structures. The provided modulus of subgrade reaction is based on a 1-ft by 1-ft test plate. Therefore, the following equation may be used to adjust the k value for rectangular foundations:

$k=[k_{(1 \times 1)}(1+0.5(B/L)]/1.5$
k=coefficient of subgrade modulus of the rectangular foundation
$k_{(1 \times 1)}$=coefficient of subgrade modulus of square foundation

9.1.1 Footing Dimensions and Bearing Elevations

Provided the site is prepared in accordance with the recommendations contained in this text, the proposed structures may be supported by a conventional shallow foundation system bearing on residual soil or engineered fill. To allow for minor inconsistencies in the soil subgrade, individual and continuous footings should have minimum widths of 24-in and 18-in, respectively, regardless of loading. Perimeter footings, and those within unheated areas, should bear at least 2-ft below finished exterior grade to provide adequate confinement and protection against frost and movement due to moisture fluctuations. Interior footings should bear at least 1-ft below the soil subgrade. The ground surface around the structure should be graded to provide positive drainage away from the structures.

The slab thickness, reinforcing, and stone base thickness are all a function of the traffic weight, loading frequency, and the soil subgrade strength. Design of the system is primarily a mat design, and the use of dense graded base or open graded stone depends on design concerns.

9.1.2 Buoyancy Resistance

Underdrains

OMI recommends the flocculation and sedimentation basin, finished water storage basin and pump station, and the sludge thickener be equipped with underdrains. The structures should bear on a minimum of 1-ft of stone bedding. Combined with 4-in perforated pipe the stone layer will stabilize the underlying soil and provide an underdrain system to prevent uplift. The underdrain systems should be designed as follows. Perforated pipes should be placed 10-ft on center and oriented in a north/south direction. The pipes should slope down from the center to the north and to the south. A collection pipe should be located along the north side and a second collection pipe located along the south side. Each collection of pipe should extend to a vertical stand pipe where the water is collected and a pump can be installed for future dewatering when the structures are to be emptied for maintenance. OMI recommends using a 24-in diameter corrugated pipe positioned vertically over the collection structure that is connected to the underdrain system. A layer of nonwoven filter fabric such as Contec C100NW or equivalent must be placed on the soil beneath the stone. The grading of the perforated pipes should be constructed to promote flow from the underdrains toward the collection box. The structures may share groundwater collection boxes and vertical access, but OMI recommends multiple draw-down pipes.

Rock Anchors

Rock anchors can be used to resist buoyant forces should underdrains be determined unfeasible. Uplift resistance can be mitigated by grouting a No. 8 rebar into bedrock. The socket should extend at least 10-ft into the bedrock and be a minimum of 3.5-in in diameter. Provided these dimensions are used, an uplift resistance of 20 kips will be provided by each bar. OMI recommends rock anchors only be considered when the FFE of the structure is within a few feet of bedrock.

Soil Overburden

Soil overburden over the footing overhangs may be used to resist uplift forces. Uplift resistance should be designed based on a soil unit weight of 100 pcf for unsaturated conditions and 37.6 pcf for saturated conditions. Further, only the column of soil above the footing overhangs should be considered when designing for uplift resistance.

9.2 Flocculation/Sedimentation Basin and Filters Recommendations

The area of the structures is suitable for the proposed construction. Excavation should be straightforward down to the bearing elevation. The bottom of the flocculation and sedimentation basin and filters may be supported by typical turned-down slab. The foundations should bear on residual soils near elevation 619-ft MSL for the basin and 621-ft MSL for the filters. The turned down portion of the slab may be designed based on a bearing capacity of 3000 psf and the mat foundation may be designed based on a design bearing capacity of 2000 psf. Also, slab thickness and reinforcement may be designed based on a modulus of subgrade reaction (k) of 125 pci. The structure should be equipped with an underdrain system as previously described due to potential fluctuations in the groundwater table elevation resulting from seasonal influence and the proposed mass site grading. Lateral earth pressures are discussed in Section 9.12.

9.3 Control/Chemical Building, Blower Room, and Generator Building Recommendations

Footings should be designed based on a maximum allowable bearing pressure of 3000 psf for individual column and continuous footings; these pressures include a factor of safety of at least three against general shear failure. The ground surface around the building area should be graded to provide positive drainage away from the building. Slab thickness and reinforcement may be designed based on a modulus of subgrade reaction (k) of 125 pci.

Based on drawings provided by Tetra Tech, the control/chemical building will be adjacent to the flocculation and sedimentation basin. Therefore, OMI expects the footing may be structurally tied to the flocculation and sedimentation basin wall.

9.4 Sludge Thickener and Pump Station Recommendations

The proposed FFE elevation of the sludge thickener is approximately 609.5-ft MSL at the walls and about 601-ft MSL at the center. Soft, unsuitable soils were encountered within the upper 3-ft at this location. Fill soils will be required to reach the bearing elevation of the slab of the walls. Based on the soil boring drilled at this location, OMI anticipates up to 3-ft of soil will likely need undercutting before fill is placed to reach the bearing elevation of the structure walls. Assuming the mat foundation will bear in engineered fill near the walls and natural soils at the center of the structure, the mat thickness and reinforcement may be designed based on a design bearing capacity of 1500 psf with a modulus of subgrade of 100 pci. Lateral earth pressures on the walls are discussed in section 9.12.

The proposed FFE of the thickened sludge/recycle pump station is 608-ft MSL. Up to 12-ft of fill will be required to reach the FFE. Soft, unsuitable soils were encountered in the upper 3-ft. These soils will require undercutting prior to the placement of fill. After fill placement, the structure may be supported by a conventional shallow foundation system bearing on the engineered fill. Footings should be designed based on a maximum allowable bearing pressure of 2500 psf for individual column footings and 2000 psf for continuous footings; these pressures include a factor of safety of at least three against general shear failure.

9.5 Carbon Contactors Building Recommendations

Soft soils were encountered in the upper 1.5 to 3-ft at the proposed location of the carbon contactors building. These soils will require undercutting, prior to placement of up to 11-ft of fill to reach the proposed FFE. After fill placement, the structure may be supported by a conventional shallow foundation system bearing on the engineered fill. Footings should be designed based on a maximum allowable bearing pressure of 2500 psf for individual column footings and 2000 psf for continuous footings; these pressures include a factor of safety of at least three against general shear failure.

9.6 Elevated Washwater Tank Recommendations

Shallow Foundations

The findings of this study indicate the proposed elevated washwater tank may be supported by shallow foundations. Soft soils were encountered in the upper 3-ft at this location. These soils will require undercutting and replacement with compacted fill as detailed in later sections of this report. After fill placement, the structure may be supported by a conventional shallow foundation system bearing on engineered fill. Footings should be designed based on a based on a maximum allowable bearing pressure of 2000 psf for individual column and continuous footings. These allowable pressures may be increased to 3500 psf when designing for wind loads. OMI anticipates about 2 to 2.5-in of settlement may occur provided the recommendations within this report are followed. Settlement was calculated based on an overall weight of the structure including water equal to about 11,000 kips and the proposed fill soil at this location. Up lift forces may be resisted by compacted soil fill above the footings. A unit weight of 100 pcf should be used for designing uplift resistance. OMI recommends the footings bear 6 to 9-ft below final grade.

Drilled Shafts

Tetra Tech requested OMI provide recommendations for drilled shaft foundations for the elevated washwater tank. OMI recommends drilled shafts bearing on competent shale or argillaceous limestone at or near elevation 575-ft MSL be designed using a net allowable rock bearing pressure of 40 ksf. A minimum diameter of 30-in should be used, regardless of loading, to allow access by personnel for hand cleaning, drilling a 2-in diameter probe hole, and to check the bottoms for adequacy for bearing. A 2-in diameter, percussion drilled test hole should be required at each pier location to explore the bedrock at the bottom of the caisson. The test hole must extend to a depth of 6-ft or a depth equivalent to twice the shaft diameter below the bearing level, whichever is greater.

Uplift resistance and additional compressive load capacity can be developed by drilling a socket into competent rock. The socket must be drilled into competent rock and be observed. OMI recommends that a value of 30 psi be used to design for the adhesion of the caisson shaft to the rock socket. Additional requirements can be given if sockets are desired.

All caissons should be constructed in a continuous manner from excavation to concrete placement. Delays that require a caisson to remain open for extended periods must be avoided. Proper concrete placement techniques will be required to achieve a continuous uniform column of concrete. Prior to concrete placement, the bearing level must be accepted by the Geotechnical Engineer. This approval will be given based on the Engineer's observation of the bearing surface, the hardness of the rock, exposed joints or slots, the applied loads and the continuity and competency of the underlying rock as judged by probing the test hole. Additional probe holes or rock excavation may be required before approval is given. Water should be pumped from the caisson immediately prior to concrete placement. Concrete may be placed using the free fall method. However, in no instance should the concrete be allowed to free-fall into even a few inches of water. The concrete should be placed with a slump of from 5-in to 7-in to allow for proper filling of the excavation.

Placing concrete in the caisson below the groundwater table is a very critical element of the construction procedure. The Geotechnical Engineer of Record or his representative must be present during placement to observe the conditions of the installation. Sufficient concrete pressure “head” must be attained inside the casing before the casing/bedrock seal is broken to prevent the water/mud slurry outside the casing from intruding into the concrete and jeopardizing the continuity of the concrete column.

Because the piers will penetrate the groundwater table, dewatering of the excavation will be necessary. Appropriate pumping and casing methods must be employed. Discharge water from the pumps my affect other activities within the general site excavation. Coordination of discharges with other construction activities will be necessary.

Pile Foundations

Rock bearing steel H piles are suitable to support the water tank. The following capacities can be used for design purposes:

Pile Size	**Design Capacity**	**Uplift Capacity**
HP 10 x 42	55 Tons	14 tons
HP 12 x 53	70 Tons	32 tons

These loadings take into account possible poor seating and slightly crippled piles, which can be expected on this site.

One of the reasons H piles were chosen is that they can be driven through chert beds and thin lenses of rock. Due to the anticipated hard driving, cast tips should be used on each pile. Points such as APF 77750-B or equivalent should be used. The piles should be driven to a final criterion of 5 to 7 blows per ¼ inch. The driving hammer should have a measured capacity of 25,000 to 30,000 foot-pounds per blow and a ram weight of at least 2,800 pounds.

The International Building Code requires that 3 piles be placed beneath each column and that the piles be spaced at least 24-in apart.

OMI anticipates that a small percentage (1 to 4 percent) of the piles will be damaged during driving or demonstrate a characteristic that indicates a diminished capacity. The engineer responsible for pile installation and observation must decide if the pile is to be pulled or if a replacement pile should be driven. Generally, a replacement pile will be driven and the damaged pile will be left in place. The structural engineer should develop details for replacement piles. These details include a modified pile cap.

Production piles should be driven with equipment approved by OMI. Swinging leads are acceptable. Each pile should be driven within 3-in of the plan location and with a plumbness of 2-in per 10-ft. Proper helmet and cushion blocks must be used to minimize damage to the pile during driving.

During construction, piles are expected to refuse at about elevation 575-ft MSL. However, some piles may be refuse near 580-ft MSL and some may extended to 560-ft MSL. Splices will be required. OMI recommends that full penetration welds or equivalent moment and tension type splices be used.

9.7 Washwater Recovery Basin Recommendations

The proposed washwater recovery basin will measure 125-ft in diameter and will vary in depth. The FFE of the structure walls will be about 592.5-ft MSL while the FFE at the center of the structure will be near 584.58-ft MSL. Excavation of the structure should be relatively straight forward; however, the proposed FFE at the center of the structure is near auger refusal elevation of about 579-ft MSL. Based on coring performed at the proposed finished water storage pump station, boring B-8A, argillaceous limestone or shale was the result of auger refusal at this location.

OMI understands a turned-down slab is proposed for support of this structure based on profile sections provided by Tetra Tech. The turned down portion of the slab may be designed based on a bearing capacity of 2500 psf and the mat foundation may be designed based on a design bearing capacity of 2000 psf. Also, slab thickness and reinforcement may be designed based on a modulus of subgrade reaction (k) of 100 pci. The structure should be equipped with an underdrain system as previously described. Lateral earth pressures are discussed in section 9.12.

9.8 Finished Water Storage Basin Pump Station Recommendations

The proposed finished water storage basin will approximately measure 220-ft by 89-ft. The finished water pump station will be located at the northwestern corner of the structure. The proposed FFE of the basin is about 589.5-ft MSL and the proposed FFE of the pump chamber is about 583.5-ft MSL. Elevations at the northwestern corner of the structure are currently near the proposed finished grade of 606-ft; however, 10-ft to 12-ft of fill will be required at the southeastern corner of structure to reach the proposed finished grade. Due to varying soil conditions, depth to rock, and the proposed construction, OMI recommends fill soil be placed and compacted as outlined in later sections of this report to reach final grade before construction of the structure walls.

OMI understands the present plans are for the structure to be supported by a mat foundation based on profiles provided by Tetra Tech. The mat foundation may be designed based on maximum soil bearing capacity of 2000-psf with a modulus of subgrade reaction of 100 pci. The structure should be equipped with an underdrain system as previously described. Lateral earth pressures are discussed in section 9.12.

9.9 Sludge Drying Bed and Sludge Filtrate Pump Station Recommendations

OMI recommends a minimum of 1-ft of fill soil with a liquid limit of at least 45 be placed and compacted to at least 100 percent of the soil standard Proctor maximum dry density beneath the sludge drying beds. The fill soil should have at least 70 percent fines. Based on the soil borings, the deeper onsite soils appear to meet these requirements. The soil should be protected against drying after placement. If the soils are allowed to dry, cracks will develop and allow water to leak through the soils. These recommendations will provide a relatively low permeability and reduce the infiltration of leachate water into the subgrade soils. The wall footings may be designed based on a maximum allowable bearing pressure of 1500 psf.

The proposed sludge filtrate pump station will be constructed of cast in place concrete with a proposed FFE of near 595-ft MSL. The water table should be kept below the bottom of the excavation during construction. The mat foundation may be designed based on a maximum allowable bearing pressure of 2000 psf. A modulus of subgrade reaction value of 100 pci can be used for design of the mat foundation for the filtrate pump station. Lateral earth pressures are discussed in Section 9.12.

9.10 Electrical Substation

The proposed electrical substation is planned to be supported by a mat foundation. Slab thickness and reinforcement may be designed based on a modulus of subgrade reaction (k) of 100 pci and a design bearing capacity of 2000 psf.

9.11 Seismic Classification

OMI has reviewed the soils at the site with respect to the criteria for seismic classification. In accordance with Section 1613.1, Table 1613.5.2 of the 2009 International Building Code, OMI judges the soil to be Site Class D. Seismic shear wave velocity measurements or a deep boring may allow the site class to be changed.

9.12 Below-Grade/Retaining Walls

All below-grade and retaining walls must be designed to withstand lateral earth pressures induced on them. OMI recommends the use of cast-in-place, reinforced concrete for these walls. The following recommendations for design may only be used if the backfill conditions are also followed.

Walls that are fixed and not allowed to deflect under lateral loads should be designed using at-rest lateral earth pressures (K_o of 0.5) or may be approximated by using an equivalent fluid weight of 55 pcf. Any loads that will be placed near the top of the wall should also be considered. Surcharge loads must also be considered. Appropriate factors of safety must be applied.

The above recommendations apply only when the following backfill requirements are incorporated into the design and construction. All below-grade/retaining walls should be backfilled with uniformly-sized, free-draining crushed stone such as size No. 57, 67, or 78 as per ASTM D448. This stone interval should extend from the base of the wall up to about 2-ft below final grade and extend back from the wall at least ½ the height of the wall as measured at the top of the wall. The stone should be placed in lifts not exceeding 24-in and densified. Heavy compaction equipment should not be operated near the wall. All unsupported walls should be adequately braced during backfilling operations to prevent damage to the wall. A water collection system must be designed and installed to mitigate the build-up of hydrostatic pressures. Also, any basement walls should be adequately waterproofed. When the backfill is exposed to rain or other elements, a cap of compacted clay should be placed over the stone to limit migration of surface water into the backfill.

At the request of Tetra Tech, OMI is providing alternative backfill recommendations using onsite soils. The backfill soils should be low plastic, silty sandy clays with a liquid limit less than 50, a plasticity index of less than 30, and a maximum dry density of at least 101 pcf. The clay fill should be placed and compacted as discussed in Section 10.5 of this report. Walls that are fixed and not allowed to deflect under lateral loads should be designed using at-rest lateral earth pressures (K_o of 0.58) or may be approximated by using an equivalent fluid weight of 74 pcf for moist soil and 100 pcf for saturated soil. Any loads that will be placed near the top of the wall should also be considered. Walls that are free to deflect at the top should be designed using active lateral-earth pressures (K_a of 0.41) or may be approximated by using an equivalent fluid weight of 52 pcf for moist soil and 88 pcf for saturated soil. Surcharge loads must also be considered. Appropriate factors of safety must be applied. It is noted that large lateral pressures will be generated during compaction of the clay backfill.

A minimum 2-ft wide drainage zone and water collection system should be constructed using free draining crushed stone that was previously discussed. The drainage zone should extend from the base of the wall to 2-ft below grade. A 2-ft thick cap of compacted clay should be placed over the stone to limit migration of surface water into the backfill. A water collection system must be designed and installed to mitigate the build-up of hydrostatic pressures. The drainage layer will also assist in reducing lateral loads generated during compaction efforts.

It is noted that OMI recommends the use free draining crushed stone compared to onsite soil for backfill due to the difficulty in compacting clay backfill adjacent to the below grade walls.

Please be aware that the use of "drainboards" and impervious backfill may significantly increase the actual load on the wall.

9.13 Fill Soils

Fill soils should be clayey soils free of organics, deleterious debris, or rocks larger than 3-in in diameter. The soil should have a plasticity index (PI) of less than 30 and a maximum dry density of at least 95 pcf as determined by the standard Proctor (ASTM D698). The fill should be compacted to at least 100 percent of the soil's standard Proctor maximum dry density, SPMDD. The top 1-ft beneath the building and pavement areas should be compacted to 100 percent SPMDD. The on-site soil in the upper layers meets the guideline set forth above. Deeper soils encountered at the site were highly plastic. These soils should only be used for fill in the sludge drying beds as previously discussed.

9.14 Pavement Areas

The access road should be prepared in accordance with general recommendations for stripping and fill placement stated elsewhere in this text, except the upper 1-ft must be compacted to at least 100 percent of the standard Proctor maximum dry density. Specific traffic frequency and loading information has not been provided; however, based on previous experience, the following pavement sections may be used based on the assumption that normal traffic will be 1 to 10 pickup trucks a day and an occasional heavy truck.

FLEXIBLE PAVEMENT DESIGN

PAVEMENT MATERIAL	AUTOMOBILE
ASPHALT SURFACE COURSE (Hot Mix) ALDOT No. 424A, 1/2-in ESAL Range A/B	1.0 inches
ASPHALT BINDER COURSE ALDOT No. 424B, ¾-in, ESAL Range A/B	2.0 inches
STONE BASE COURSE ALDOT No. 825 B (Compacted to 100% Standard Proctor as per AASHTO T-99)	5.0 inches
TOTAL THICKNESS	8.0 inches

All pavement materials and construction methods should conform to the guidelines and requirements of the Alabama Department of Transportation. During placement of the aggregate base and asphalt courses, density tests and thickness measurements should be performed to compare the design section to the constructed section. The soil subgrade should be graded to provide a smooth transition from one pavement section to another. It is imperative that truck traffic be limited to areas specifically designed to carry those vehicles.

Immediately prior to placement of the aggregate base, the subgrade must be proofrolled to judge the stability of the soil. The soil may require recompaction. The stone base course should only be applied to a stable, compact soil subgrade. Asphalt paving should proceed closely after stone placement. If lengthy delays between stone and asphalt paving occur, the stability of the stone and soil subgrade should be checked prior to paving.

Rigid pavement should be specified for areas that will be used for the storage of refuse bins and the operation of waste removal vehicles.

RIGID PAVEMENT DESIGN

Design of the pavements assumes the site is prepared as recommended in this report. Also, the top 2-ft must be compacted to at least 98 percent of the soil's standard Proctor maximum dry density (SPMDD).

RIGID PAVEMENT DESIGN

PAVEMENT MATERIAL	AUTOMOBILE
CONCRETE WITH A FLEXURAL STRENGTH OF 650 PSI	5.0 inches

This design is based on a flexural strength of 650 psi and a soil subgrade modulus of 150 pci. Proper design of the joints and joint spacings is important for the service life of the pavement. OMI recommends flexural beams be molded during concrete placement. Flexural strength and compressive strength should be tested and used as acceptance criteria.

Uniformity of support is critical to the performance of rigid pavements. Construction activity often disturbs and compacts areas of the site during the building construction. This creates hard and soft spots that can result in cracked pavements or early failure. OMI recommends the parking and pavement areas be recompacted and shaped just prior to pouring.

10.0 CONSTRUCTION CONSIDERATIONS

10.1 Site Preparation General Site

OMI anticipates the site will be mass graded prior to excavation of any of the proposed structures. To prepare the proposed locations for construction, the construction area should be stripped of trees, topsoil, large root zones, and other organic or soft soil. Stripping should extend at least 10-ft beyond the limits of construction cut and fill. Subsequently, the areas approximately at grade or to receive fill should be proofrolled in the presence of a geotechnical engineer. Proofrolling is performed by repeated passes of a heavy rubber-tired vehicle, such as a loaded dump truck. Any areas judged to deflect excessively during proofrolling should be undercut to a stable soil horizon. Such over-excavation must be backfilled with structural fill placed as described below. Upon reaching subgrade elevation in cut areas, the exposed soil subgrade should be similarly proofrolled and repaired. The distance between borings is large and variations (soft areas) should be expected that are not identified by the borings. However, OMI anticipates the following areas will require undercutting below the present ground surface depending on the final grade.

Boring	Depth
B-1A	1-ft
B-1B	1-ft
B-2	2-ft
B-3A	4-ft
B-3B	2-ft
B-4	4-ft
B-5	4-ft
B-6A	4-ft
B-6B	4-ft
B-7	2-ft
B-7A	2-ft
B-8	2-ft
B-9A	1-ft
B-9B	1.5-ft
B-10A	2-ft

Boring	Depth
B-10B	2-ft
B-10C	2-ft
B-10D	4-ft
B-10E	4-ft
B-10F	1-ft
B-11	1-ft
B-12	1-ft
B-13	4-ft
B-14	4-ft
B-15	2-ft
B-16	2-ft
B-17A	1-ft
B-17B	3-ft
B-18	4-ft
B-19	2-ft

10.2 Estimated Topsoil Removal

The depth of topsoil varies across the site. OMI believes that the stripping depth to remove the topsoil will average about 8-in. Stripping depths in wooded areas may be up to 2-ft to remove roots. Close observation by OMI personnel during construction can allow the disturbed but only slightly organic soils to be compacted in-place or to be used as engineered fill.

10.3 Underdrains

Once the excavation of the finished water storage basin, sludge thickener, and flocculation and sedimentation basin have been completed, OMI recommends a 12-in layer of No. 2 stone be placed and used as working pad for laying out the underdrain systems at these locations. After the drainage system is laid out, the 4-in, schedule 40 perforated pipe should be observed by the geotechnical engineer and then covered with additional stone. Equipment traffic should not be allowed on the gravel and a vibratory plate compactor should be used to densify the gravel. The use of the vibratory plate will prevent crushing the 4-in perforated piping.

10.4 Rock Anchors

The following construction sequence should be followed for the installation of rock anchors if underdrains are determined unfeasible:

1. A 3.5-in diameter hole should be drilled 10-ft deep into bedrock.
2. Mix grout per manufacturers specifications to a thick but flowable consistency.
3. Fill the hole with high strength non shrink grout such as Sikagrout 300 PT or approved equivalent.
4. Insert clean No 8 rebar to bottom of hole and rod up and down six times to improve contact between rod grout and hole sides. Add grout if required.
5. Allow grout and rod to set at least eight hours without disturbing.

10.5 Excavation Stability, OSHA Compliance

OMI recommends all OSHA guidelines be followed during the construction. The onsite soils appear to be type C soils. Appropriate excavation slopes and trench boxes should be used. All excavations over 20-ft deep or that encounter water must be designed for stability by an engineer.

10.6 Fill Placement

After proofrolling is complete, placement of structural fill may begin, as necessary. Specific requirements of the soil properties are discussed previously. The soil should be placed in loose lifts, not exceeding 8-in in thickness, and systematically compacted to at least 95 percent of the soil's standard Proctor maximum dry density (ASTM D698) except the top 1-ft should be compacted to 100 percent SPMDD.

10.7 Density Testing

Field density testing should be performed on each lift prior to placement of additional lifts. Test locations should be evenly distributed throughout the fill area and should be performed at the frequencies shown on the following table.

AREA	METHOD OF PLACEMENT AND COMPACTION	INITIAL TEST FREQUENCY	RETEST FREQUENCY
General Site	Large self-propelled equipment	1 test per 5000-ft^2, minimum 3 tests per lift	1 test per failed test
Isolated Areas	Hand-guided equipment	1 test per lift	1 test per failed test
Trench backfill and behind retaining walls	Hand-guided equipment	1 test per 50 linear feet per 6-in of fill	1 test per failed test

Test frequencies may be changed during the early stages of earthwork construction. Compaction requirements should apply to all excavation/backfill operations conducted on the proposed development property.

10.8 Footing Observations

The footing excavation process generates a disturbed layer of soft soil in the excavation bottoms. This soft compressible layer should be removed prior to placement of concrete. Each foundation excavation should be observed by a member of OMI's professional staff to check for local variations in the soil strength as well as the removal of the disturbed layer.

10.9 Pile Installation

Several procedures should be followed during pile installation. First, the geotechnical engineer should review the bid documents to confirm that the proper equipment and installation procedures are specified.

The pile contractor should submit a list of equipment and procedures that he plans to use. This list should be approved prior to mobilization. After the equipment has been assembled on site, it should be reviewed by the geotechnical engineer. The contractor must have a proper helmet for the hammer and piles and an adequate supply of approved cushion blocks.

The contractor should receive the piling on-site, properly attach the points, and mark the piles on 1-ft intervals. The geotechnical engineer should observe each pile as it is driven. The engineer should keep a pile driving record for each pile. The record should include the pile number, size, length below ground, the number of blows per foot, the hammer make and model, and other information such as cut-off elevation and if they pile was spliced, damaged, or retapped. The engineer must monitor the pile during driving. If the pile refuses at an unusual depth or if it is damaged, the engineer should recommend that an alternate pile be driven or that the pile be pulled and a replacement pile be driven in the original location.

10.10 Foundation Construction

The deeper soils at this site are moderately to highly plastic. Exposing the soils to excessive wetting or drying during construction can cause problems such as heaving or settlement due to shrinking and swelling of the clay. The foundations should be excavated, hand cleaned, checked, and concrete placed as expeditiously as possible. Footing excavations that will be left open for more than 8 hours should be covered for protection.

10.11 Construction Monitoring

The foundation and site preparation recommendations contained in this report are based on the conditions encountered during the subsurface exploration and past experience in this geologic setting. Because subsurface conditions may vary from the anticipated, it is important to have a well-rounded quality control program. Construction monitoring on a project of this nature can serve as an economical means to achieve the best possible foundation system and reduce the potential for future problems. The involvement in the subsurface exploration portion of this project uniquely qualifies OMI, Inc., to provide these services as a party responsible to the Owner. OMI, Inc., strongly recommends that all construction monitoring be performed under contract with the Owner or the Owner's representative.

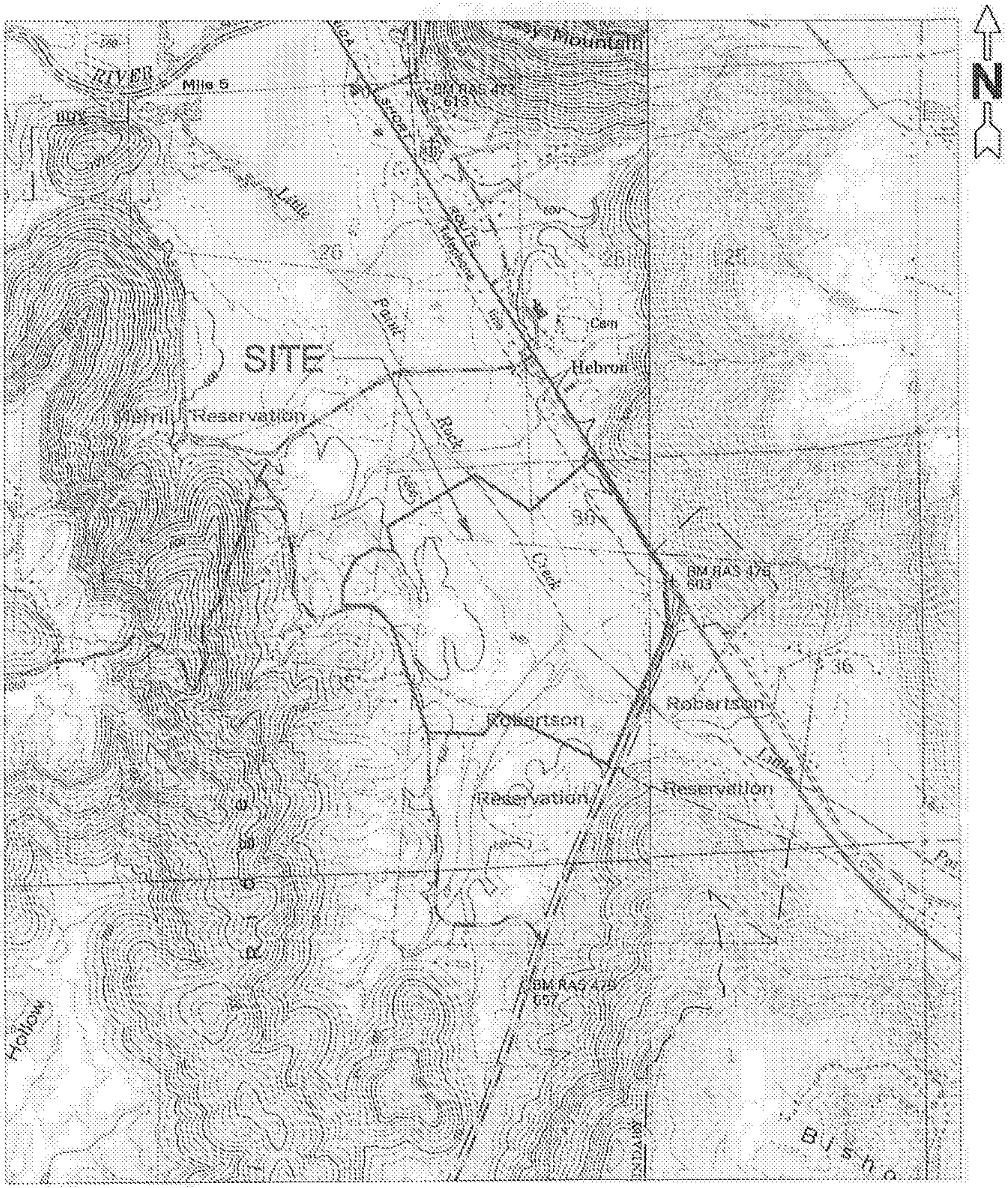
APPENDICES

OMI, Inc.

5151 Research Dr. NW
Huntsville, AL 35805

PH: (256) 837 - 7664

www.omi-eng.com



GUNTERSVILLE DAM QUADRANGLE
ALABAMA
7.5 MINUTE SERIES (TOPOGRAPHIC) 83-NE
1948 REVISED 1980

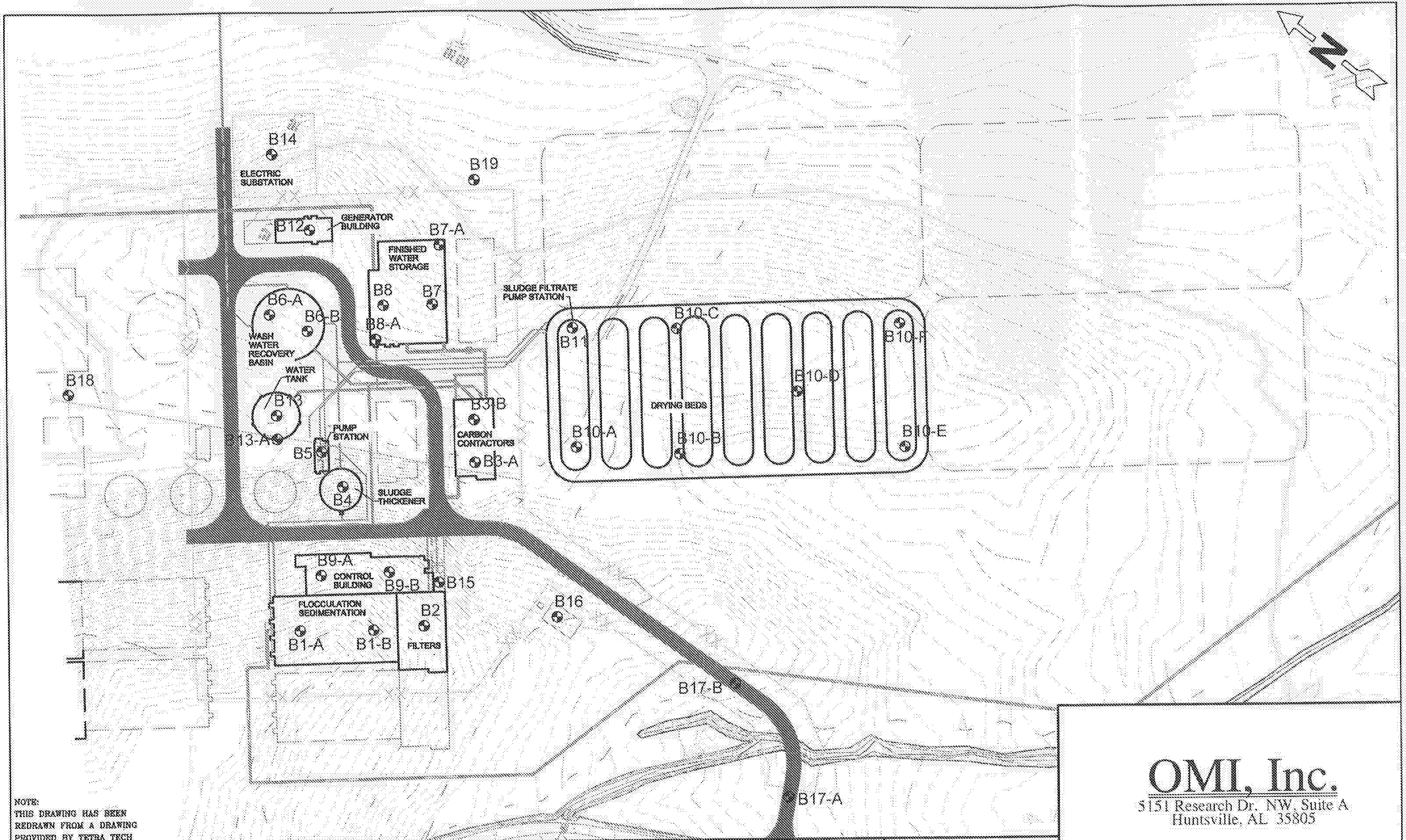
MT. CARMEL QUADRANGLE
ALABAMA MARSHALL CO
7.5 MINUTE SERIES (TOPOGRAPHIC) 83-NE
1949 PHOTOREVISED 1983

JOB NAME:
SOUTHEAST WATER TREATMENT PLANT
HIGHWAY 431
MARSHALL COUNTY, ALABAMA

SITE PLAN

DRAWING NO: 6644-1

JOB NO: 6644
DATE: 09-18-2013
SCALE: 1" =2000'
DRAWN BY: CCT



NOTE:
THIS DRAWING HAS BEEN
REDRAWN FROM A DRAWING
PROVIDED BY TETRA TECH

JOB NAME: SOUTHEAST WATER TREATMENT PLANT
HWY 431
MARSHALL COUNTY, ALABAMA

BORING PLAN

DRAWING NO: 6644-2

JOB NO: 6644
DATE: 09-18-2013
SCALE: 1" = 150'
DRAWN BY: CCT

OMI, Inc.
5151 Research Dr. NW, Suite A
Huntsville, AL 35805

PH: (256) 837 - 7664 FAX: (256) 837 - 7677

OMI, Inc.

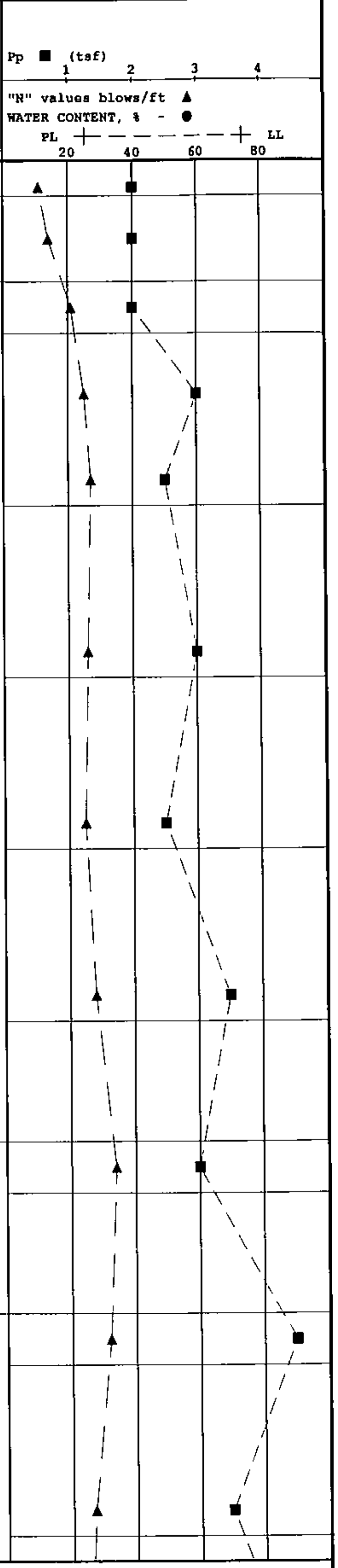
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 **JOB:** Southeast WTP **LOG OF BORING:** B-1 A

JOB LOCATION: Highway 431 **BORING LOCATION:**

Elevation=641-FT

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0	TOPSOIL	11		2.0
	SANDY SILTY CLAY, 25% fine sand, 75% fines, low plasticity, reddish brown, stiff, moist, residuum, CL	14		2.0
5	SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	21		2.0
		25		3.0
10		27		2.5
15		26		3.0
20		25		2.5
25		28		3.5
30	SANDY SILTY CLAY with chert, 15% gravel sized chert, 30% medium sand, 55% fines, low plasticity, reddish brown, hard, moist, residuum, CL	34		3.0
35	SANDY SILTY CLAY with trace amount chert, 30% medium sand, 70% fines, high plasticity, reddish tan, very stiff to hard, moist, residuum, CH	32		4.5
40		27		3.5



COMPLETION DEPTH: 53 **DEPTH TO WATERINITIAL:** 50-FT OMI,Inc.

DATE: 5/15/13 **DEPTH TO WATERFINAL:** 33-FT

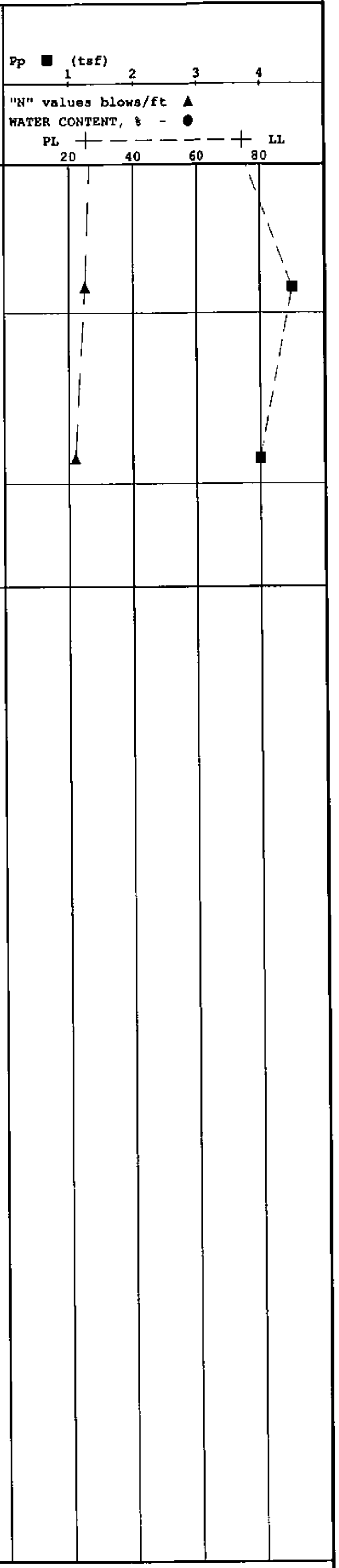
OMI, Inc.

5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-1 A

JOB LOCATION: Highway 431 BORING LOCATION:

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
			Elevation=641-FT			
				25		4.5
45						
				22		4.0
50						
			AUGER REFUSAL AT 53-FT			
55						
60						
65						
70						
75						
80						



COMPLETION DEPTH: 53 DEPTH TO WATERINITIAL: 50-FT OMI,Inc.

DATE: 5/15/13 DEPTH TO WATERFINAL: 33-FT

OMI, Inc.

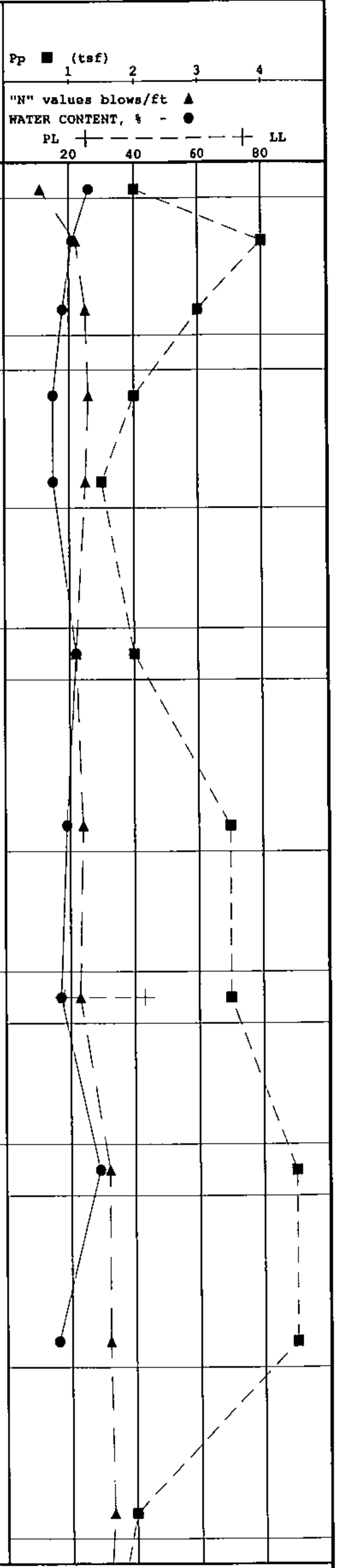
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-1 B

JOB LOCATION: Highway 431 BORING LOCATION:

Elevation=638-FT

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0			TOPSOIL	11	26	2.0
			SANDY SILTY CLAY, 30% fine sand, 70% fines, low plasticity, reddish brown, stiff to very stiff, moist, residuum, CL	22	21	4.0
				25	18	3.0
5						
			SANDY SILTY CLAY, 40% medium sand, 60% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	26	15	2.0
				25	15	1.5
10						
			SANDY SILTY CLAY with trace amount chert, 35% medium sand, 65% fines, low plasticity, reddish tan, very stiff, moist, residuum, CL	22	22	2.0
15						
				24	19	3.5
20						
			SANDY SILTY CLAY with trace amount chert, 40% medium sand, 60% fines, low plasticity, reddish tan, very stiff, moist, residuum, CL	23	17	3.5
25						
			SANDY SILTY CLAY, 25% medium sand, 75% fines, high plasticity, tan, hard, moist, residuum, CH	32	29	4.5
30						
				32	16	4.5
35						
				33		2.0
40						



COMPLETION DEPTH: 57

DATE: 5/13/13

DEPTH TO WATERINITIAL: 50-ft

DEPTH TO WATERFINAL: 30-ft

OMI,Inc.

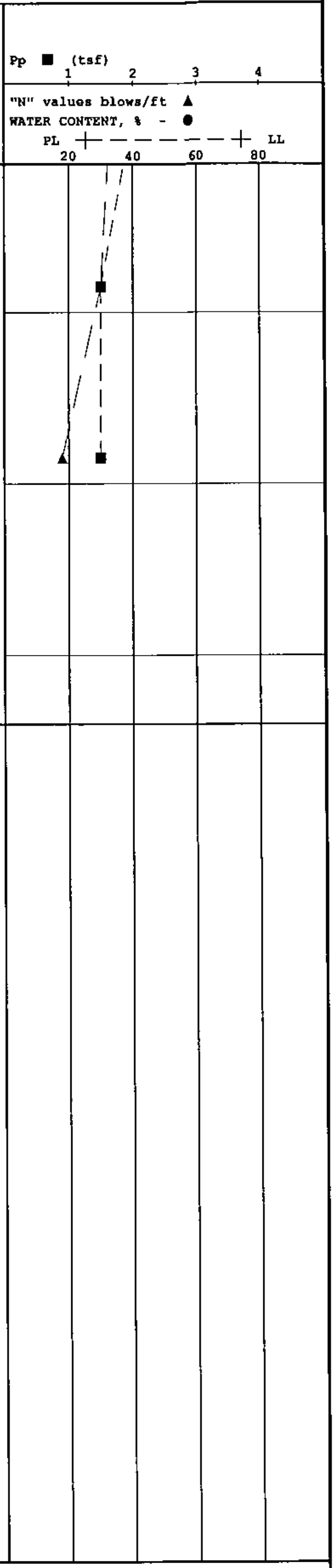
OMI, Inc.

5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-1 B

JOB LOCATION: Highway 431 BORING LOCATION:

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL Elevation=638-FT	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
45	▨	▼		30		1.5
50	▨	▼		18		1.5
55	▨					
57			AUGER REFUSAL AT 57-FT			
60						
65						
70						
75						
80						



COMPLETION DEPTH: 57 DEPTH TO WATERINITIAL: 50-ft OMI,Inc.

DATE: 5/13/13 DEPTH TO WATERFINAL: 30-ft

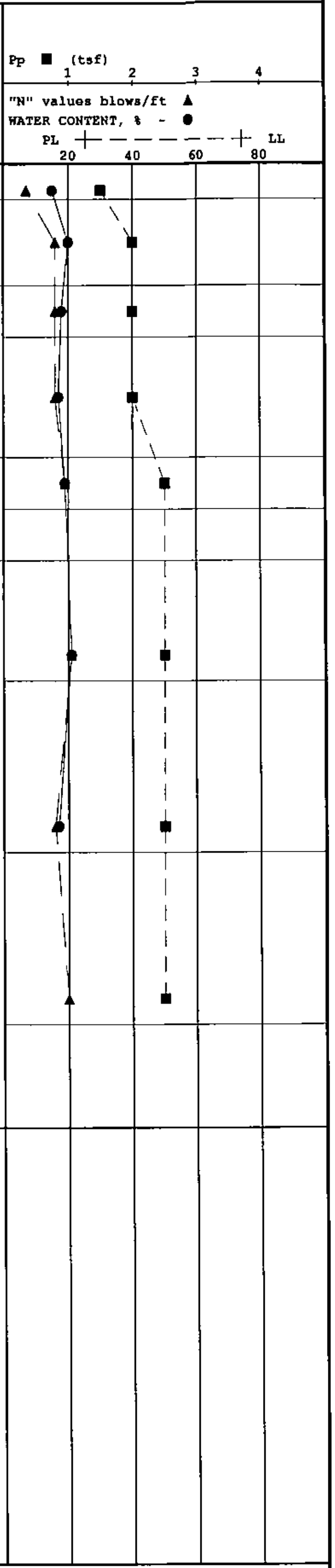
OMI, Inc.

5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-2

JOB LOCATION: Highway 431 BORING LOCATION:

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL Elevation=632-FT	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0			TOPSOIL	7	15	1.5
			SANDY SILTY CLAY, 30% medium sand, 70% fines, low plasticity, red, firm to very stiff, moist, residuum, CL	16	20	2.0
			SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, red, very stiff, moist, residuum, CL	16	18	2.0
5						
				16	17	2.0
			SANDY SILTY CLAY with chert, 10% gravel sized chert, 30% medium sand, 60% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	19	19	2.5
10						
			SANDY SILTY CLAY, 30% medium sand, 65% fines, low plasticity, reddish tan, very stiff, moist, residuum, CL			
				21	21	2.5
15						
				16	17	2.5
20						
				20		2.5
25						
30						
35						
40						



COMPLETION DEPTH: 28 DEPTH TO WATERINITIAL: DRY OMI,Inc.
DATE: 5/9/13 DEPTH TO WATERFINAL: 27-FT Page 1 of 1

OMI, Inc.

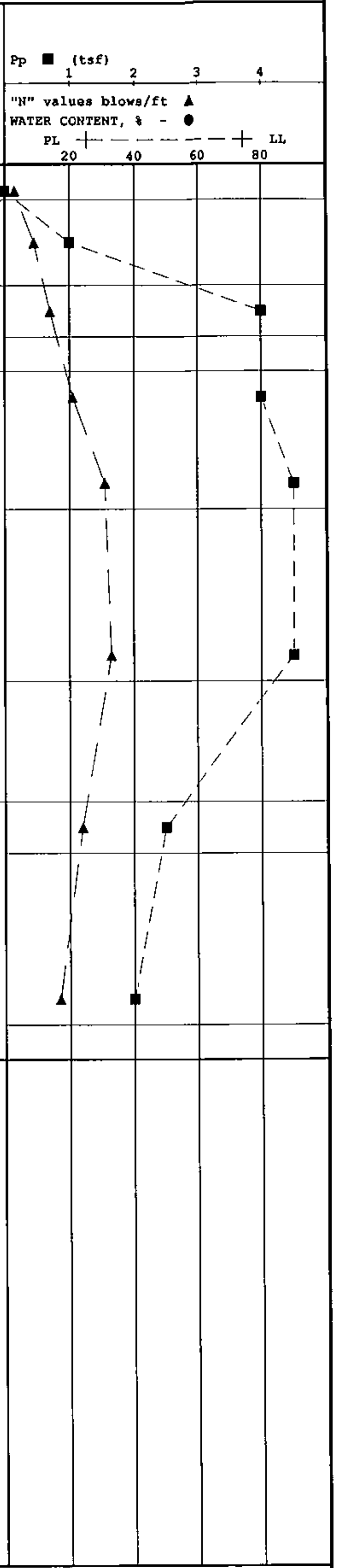
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-3 A

JOB LOCATION: Highway 431 BORING LOCATION:

Elevation=600-FT

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0	TOPSOIL	3		0.0
	SANDY SILTY CLAY, 25% medium sand, 75% fines, low plasticity, brown, soft to stiff, moist, residuum, CL	9		1.0
	SANDY SILTY CLAY, 40% medium sand, 60% fines, low plasticity, tan and gray, stiff, moist, residuum, CL	14		4.0
5				
	SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	21		4.0
		31		4.5
10				
		33		4.5
15				
	SANDY SILTY CLAY, 30% medium sand, 70% fines, high plasticity, orangish tan, very stiff, moist to wet, residuum, CH	24		2.5
20				
		17		2.0
25				
	AUGER REFUSAL AT 26-FT			
30				
35				
40				



COMPLETION DEPTH: 26 DEPTH TO WATERINITIAL: 2-FT OMI,Inc.

DATE: 5/14/13 DEPTH TO WATERFINAL: 3-FT Page 1 of 1

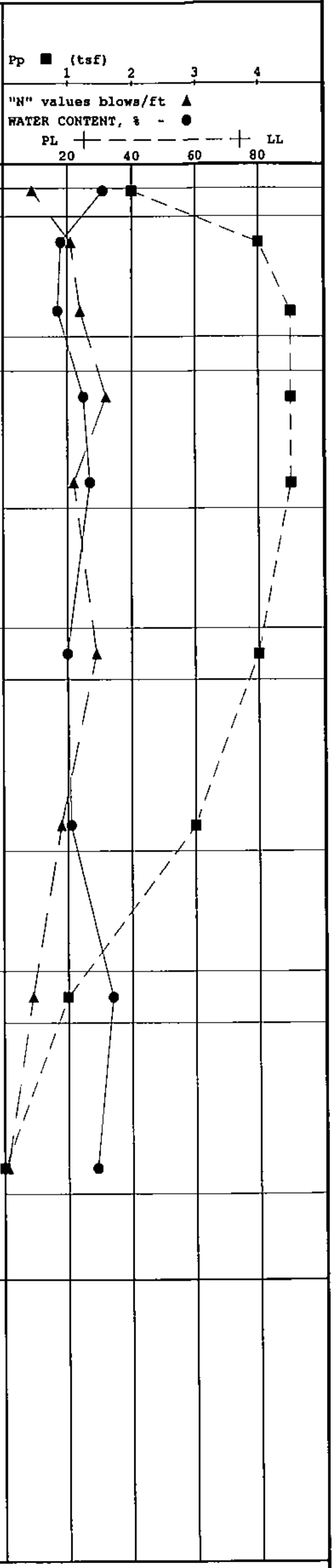
OMI, Inc.

5151 Research Drive, N.W.   Huntsville, AL 35805

JOB NO.: 6644 **JOB:** Southeast WTP **LOG OF BORING:** B-3 B

JOB LOCATION: Highway 431 **BORING LOCATION:**

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL Elevation=600-FT	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0			TOPSOIL	9	31	2.0
			SANDY SILTY CLAY, 25% medium sand, 75% fines, low plasticity, tan, stiff, moist, residuum, CL	21	18	4.0
5			SANDY SILTY CLAY with trace amount chert, 30% medium sand, 70% fines, low plasticity, tan, very stiff, moist, residuum, CL	24	17	4.5
				32	25	4.5
10			SANDY SILTY CLAY, 25% medium sand, 75% fines, low plasticity, tan, very stiff to hard, moist, residuum, CL	22	27	4.5
15			SANDY SILTY CLAY with trace amount chert, 30% medium sand, 70% fines, low plasticity, tan, very stiff, moist, residuum, CL	29	20	4.0
20				18	21	3.0
25			SANDY SILTY CLAY, 30% fine sand, 70% fines, high plasticity, brown, stiff, moist, residuum, CH	9	34	1.0
30				1	29	0.0
35			AUGER REFUSAL AT 32.5-FT			
40						



COMPLETION DEPTH: 32.5 **DEPTH TO WATERINITIAL:** 8-FT OMI,Inc.
DATE: 5/3/13 **DEPTH TO WATERFINAL:** 3-FT Page 1 of 1

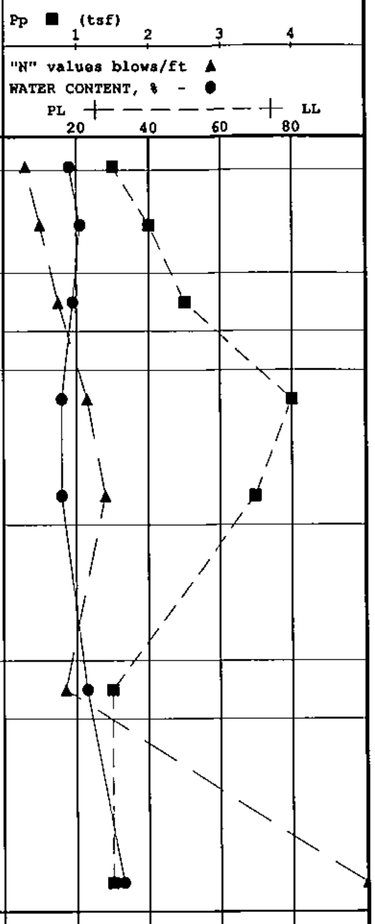
OMI, Inc.

5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 **JOB:** Southeast WTP **LOG OF BORING:** B-4

JOB LOCATION: Highway 431 **BORING LOCATION:**

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL Elevation=600-FT	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0			TOPSOIL	6	18	1.5
			SANDY SILTY CLAY, 25% medium sand, 75% fines, low plasticity, brown and tan, firm to stiff, moist, colluvium, CL	10	21	2.0
5			SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, tan, very stiff, moist, residuum, CL	15	19	2.5
			SANDY SILTY CLAY with trace amount of chert, 30% medium sand, 70% fines, low plasticity, gray, very stiff, moist, residuum, CL	23	16	4.0
10				28	16	3.5
15			SANDY SILTY CLAY, 30% medium sand, 70% fines, high plasticity, yellowish tan, very stiff, moist to wet, residuum, CH	17	23	1.5
				100+	33	1.5
20			AUGER REFUSAL AT 20-FT			
25						
30						
35						
40						



COMPLETION DEPTH: 20 **DEPTH TO WATERINITIAL:** 8-FT OMI,Inc.

DATE: 5/14/13 **DEPTH TO WATERFINAL:** 4-FT Page 1 of 1

OMI, Inc.

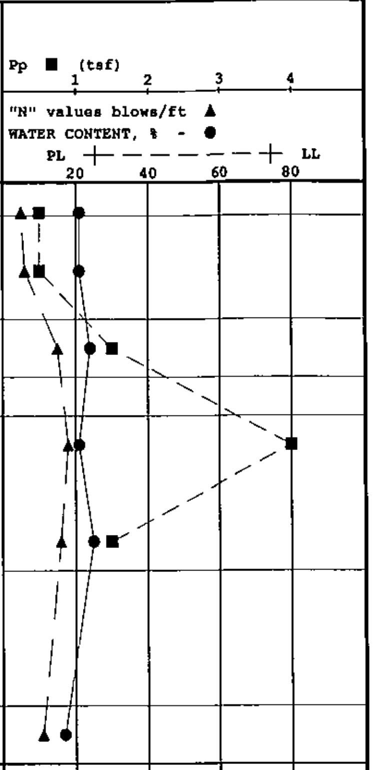
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-5

JOB LOCATION: Highway 431 BORING LOCATION:

Elevation=597-FT

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0	TOPSOIL	5	21	0.5
	SANDY SILTY CLAY, 30% medium sand, 70% fines, low plasticity, brown, firm, moist to wet, residuum, CL	6	21	0.5
5	SANDY SILTY CLAY, 30% medium sand, 70% fines, low plasticity, tan, very stiff, moist, residuum, CL	15	24	1.5
10	SANDY SILTY CLAY, 30% medium sand, 70% fines, high plasticity, gray, very stiff, moist, residuum, CH	18 16	21 25	4.0 1.5
15	SANDY SILTY CLAY, 35% medium sand, 65% fines, high plasticity, tan, stiff, moist, residuum, CH	11	17	---
	BORING TERMINATED AT 15-FT			
20				
25				
30				
35				
40				



COMPLETION DEPTH: 15 DEPTH TO WATERINITIAL: 6-FT OMI,Inc.

DATE: 5/14/13 DEPTH TO WATERFINAL: 4-FT Page 1 of 1

OMI, Inc.

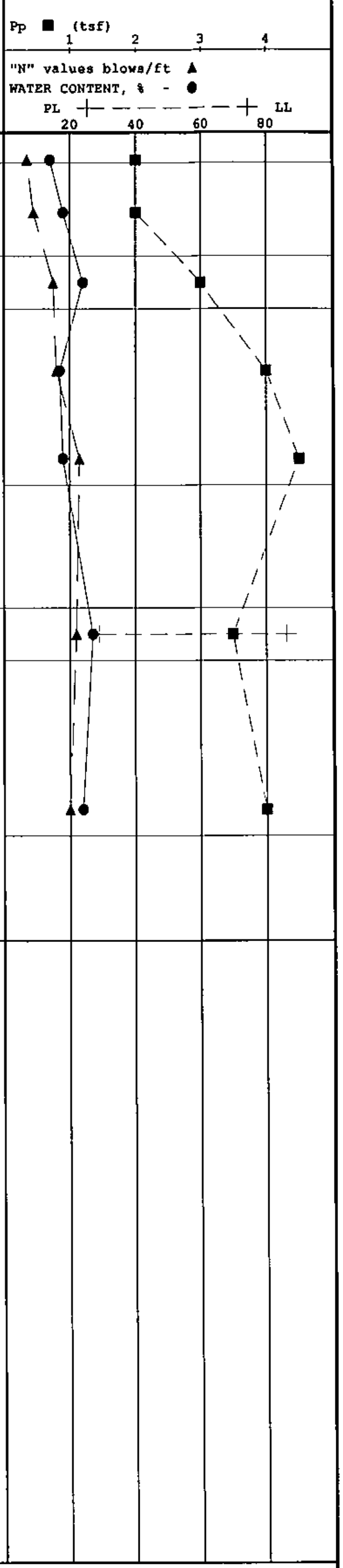
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 **JOB:** Southeast WTP **LOG OF BORING:** B-6 A

JOB LOCATION: Highway 431 **BORING LOCATION:**

Elevation=602-FT

DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
TOPSOIL	7	14	2.0
SANDY SILTY CLAY, 30% fine sand, 70% fines, low plasticity, brown, stiff, moist, residuum, CL	9	18	2.0
SANDY SILTY CLAY with trace amount chert, 35% coarse sand, 65% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	15	24	3.0
	16	17	4.0
	23	18	4.5
SANDY SILTY CLAY, 35% coarse sand, 65% fines, high plasticity, reddish tan, very stiff, moist, residuum, CH	22	27	3.5
	20	24	4.0
AUGER REFUSAL AT 23-FT			



COMPLETION DEPTH: 23 **DEPTH TO WATERINITIAL:** 12-FT

DATE: 5/8/13 **DEPTH TO WATERFINAL:** 6-FT

OMI, Inc.

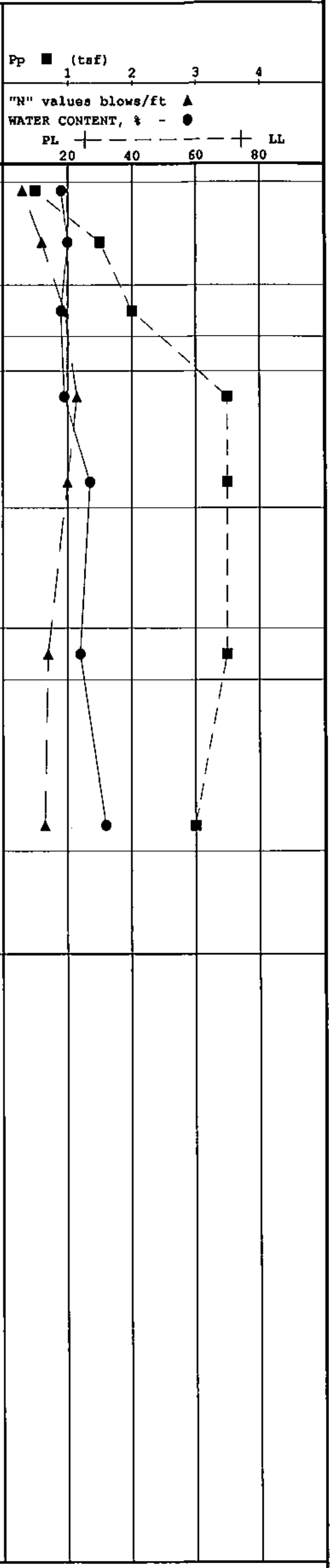
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-6 B

JOB LOCATION: Highway 431 BORING LOCATION:

Elevation=603-FT

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0	TOPSOIL	6	18	0.5
	SANDY SILTY CLAY, 35% fine sand, 65% fines, low plasticity, reddish brown, firm to stiff, moist, residuum, CL	12	20	1.5
5	SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish brown, firm to stiff, moist, residuum, CL	19	18	2.0
	SANDY SILTY CLAY with chert, 15% gravel sized chert, 35% medium sand, 50% fines, low plasticity, reddish tan, very stiff, moist, residuum, CL	23	19	3.5
10		20	27	3.5
15	SANDY SILTY CLAY, 25% fine sand, 75% fines, high plasticity, tan with blue inclusions, stiff, moist, residuum, CH	14	24	3.5
20		13	32	3.0
25	AUGER REFUSAL AT 23-FT			
30				
35				
40				



COMPLETION DEPTH: 23 DEPTH TO WATERINITIAL: 15-FT OMI,Inc.

DATE: 5/8/13 DEPTH TO WATERFINAL: 5-FT Page 1 of 1

OMI, Inc.

5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-7

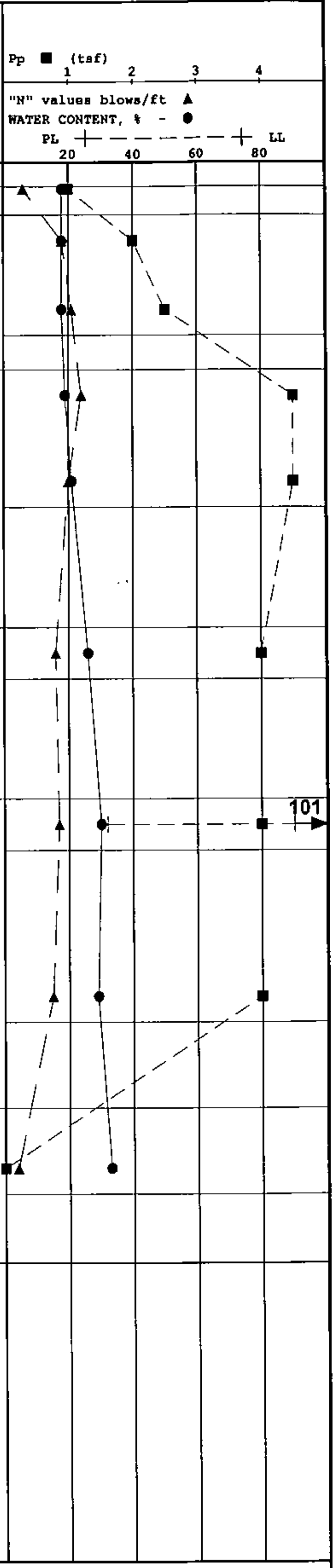
JOB LOCATION: Highway 431 BORING LOCATION:

DEPTH, FT | SYMBOL | SAMPLES

Elevation=602-FT

DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
TOPSOIL	6	18	1.0
SANDY SILTY CLAY, 30% fine sand, 70% fines, low plasticity, reddish brown, firm, moist, residuum, CL	18	18	2.0
SANDY SILTY CLAY, 30% medium sand, 70% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	21	18	2.5
SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish tan, very stiff, moist, residuum, CL	24	19	4.5
	20	21	4.5
SANDY SILTY CLAY with trace amount chert, 35% medium sand, 65% fines, high plasticity, tan, very stiff, moist, residuum, CH	16	26	4.0
SANDY SILTY CLAY with trace amount chert, 35% medium sand, 65% fines, high plasticity, tan, very stiff, moist, residuum, CH	17	30	4.0
	15	29	4.0
SANDY SILTY CLAY, 35% coarse sand, 65% fines, high plasticity, tannish brown, soft, moist, residuum, CH	4	33	0.0
AUGER REFUSAL AT 32-FT			

DEPTH, FT: 0, 5, 10, 15, 20, 25, 30, 35, 40



COMPLETION DEPTH: 32 DEPTH TO WATERINITIAL: 23-FT OMI,Inc.

DATE: 5/9/13 DEPTH TO WATERFINAL: 13-FT Page 1 of 1

OMI, Inc.

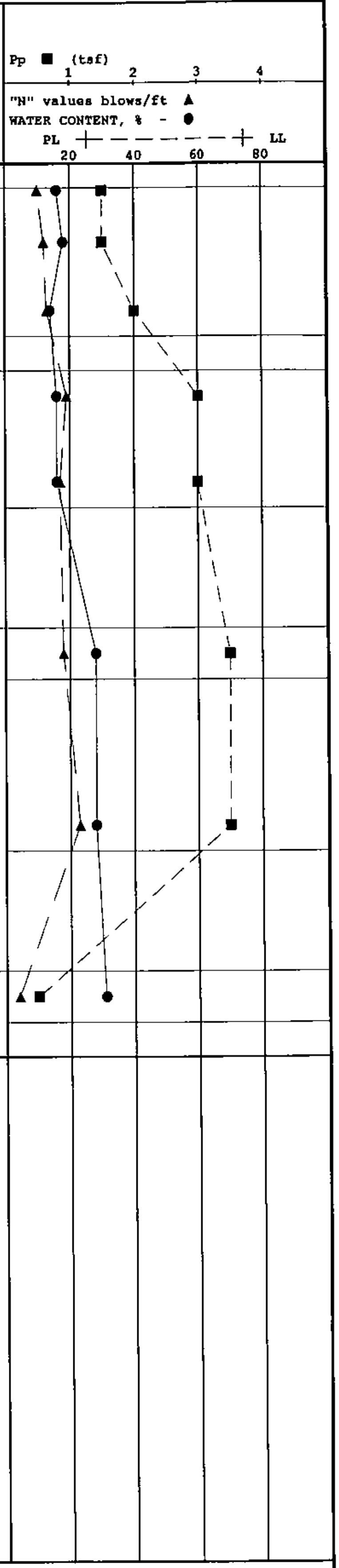
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 **JOB:** Southeast WTP **LOG OF BORING:** B-7 A

JOB LOCATION: Highway 431 **BORING LOCATION:**

Elevation=594-FT

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0	TOPSOIL			
	SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish brown, stiff, moist, residuum, CL	10 12 13	16 18 14	1.5 1.5 2.0
5				
	SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish tan, very stiff, moist, residuum, CL	19 17	16 16	3.0 3.0
10				
15	SANDY SILTY CLAY with trace amount chert, 30% medium sand, 70% fines, high plasticity, tan, very stiff, moist, residuum, CH	18	28	3.5
20		23	28	3.5
25	SANDY SILTY CLAY, 30% medium sand, 70% fines, high plasticity, tan, soft, wet, residuum, CH	4	31	0.5
	AUGER REFUSAL AT 26-FT			
30				
35				
40				



COMPLETION DEPTH: 26 **DEPTH TO WATERINITIAL:** 23-FT OMI,Inc.

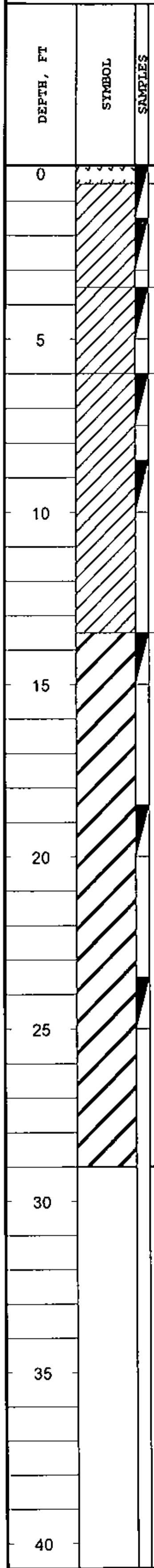
DATE: 6/6/13 **DEPTH TO WATERFINAL:** 10-FT Page 1 of 1

OMI, Inc.

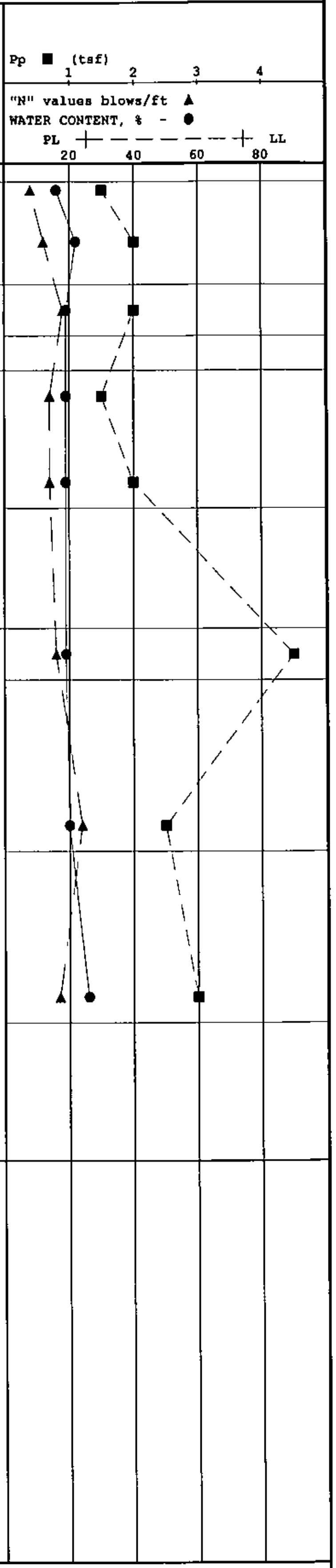
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-8

JOB LOCATION: Highway 431 BORING LOCATION:



DESCRIPTION OF MATERIAL Elevation=604-FT	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
TOPSOIL	8	16	1.5
SANDY SILTY CLAY, 30% fine sand, 70% fines, low plasticity, reddish brown, stiff, moist, residuum, CL	12	22	2.0
SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	18	19	2.0
SANDY SILTY CLAY, 40% medium sand, 60% fines, low plasticity, reddish tan, stiff, moist, residuum, CL	14	19	1.5
	14	19	2.0
SANDY SILTY CLAY with trace amount chert, 35% medium sand, 65% fines, high plasticity, tan, very stiff, moist, residuum, CH	16	19	4.5
	24	20	2.5
	17	26	3.0
AUGER REFUSAL AT 29-FT			



COMPLETION DEPTH: 29 DEPTH TO WATERINITIAL: 20-FT OMI,Inc.

DATE: 5/9/13 DEPTH TO WATERFINAL: 12-FT Page 1 of 1

OMI, Inc.

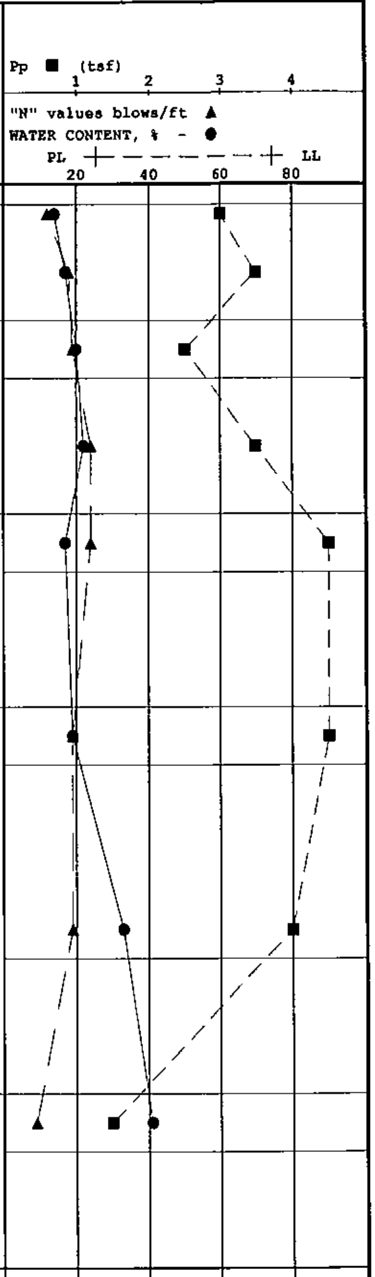
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-8 A

JOB LOCATION: Highway 431 BORING LOCATION:

Elevation=607-FT

DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
TOPSOIL	12	14	3.0
SANDY SILTY CLAY, 35% coarse to fine sand, 65% fines, low plasticity, reddish brown, stiff to very stiff, moist, residuum, CL	18 19	17 20	3.5 2.5
SANDY SILTY CLAY with decomposed chert, 35% coarse to fine sand, 65% fines, low plasticity, reddish tan, very stiff, moist, residuum, CL	24	22	3.5
SANDY SILTY CLAY with trace amount chert and oxides, 30% coarse to fine sand, 70% fines, low plasticity, tan, very stiff, moist, residuum, CL	24	17	4.5
SANDY SILTY CLAY, 30% coarse to fine sand, 70% fines, high plasticity, tan, very stiff, moist, residuum, CH	19 19	19 33	4.5 4.0
SILTY CLAY, 30% coarse to fine sand, 70% fines, high plasticity, brownish tan, stiff, moist, residuum, CH	9	41	1.5
AUGER REFUSAL AT 28-FT			



COMPLETION DEPTH: 28 DEPTH TO WATERINITIAL: 15-FT OMI,Inc.

DATE: 6/6/13 DEPTH TO WATERFINAL: 9-FT Page 1 of 1

OMI, Inc.

DRILL LOG

PROJECT SE WTP		PROJECT NO. 6644	BORING NO. B-8 A
SITE Highway 431	BEGUN 6-6-13	COMPLETED 6-6-13	HOLE SIZE
			PAGE NO. 1 of 1
COORDINATES	DEPTH GROUND WATER	AT FIRST CHECK	GROUND ELEVATION 607
DRILLER South Drilling	CORE RECOVERY (%)	# SAMPLES	# CORE BOXES
			DEPTH TOP OF ROCK 28-ft
DRILL MAKE AND MODEL	LOGGED BY: CJ		DEPTH BOTTOM OF HOLE 38

SAMPLE DATA					REMARKS: NOTES ON WATER LOSSES AND LEVELS, CAVING, AND DRILLING CONDITIONS CASING DEPTH	FRACTURES PER FOOT	STRATA ELEVATION/ DEPTH	DEPTH	GRAPHIC LOG	DESCRIPTION
SAMPLE TYPE AND DIAMETER	SAMPLE NO.	SAMPLE LENGTH	SAMPLE RECOVERY	N-VALUE/ RQD (%)						
NQ Core at 28'						0				Top of Rock 28-ft 579-ft
						2	-29-			ARGILLACEOUS LIMESTONE, weathered, hard, fine grained
	Run 1	54"	42" 78%	71%		2		30		
						---	-31- -31.3-			4" Clay Seam
										CALCAREOUS SHALE, highly weathered, dargray, moderately hard, fine grained.
NQ Core at 32.5'						6		32.5		CALCAREOUS SHALE, highly weathered, dark gray, soft, fine grained
						8	-33.5-			
							-34-			4" Clay seam
						10				CALCAREOUS SHALE, highly weathered, dark gray, soft, fine grained.
	Run 2	60"	46" 77%	0%			-35-	35		CALCAREOUS SHALE, decomposed, dary gray, soft, fine grained, with several clay seams
NQ Core at 37.5'	Run 3	6"	3" 50%	0%				37.5		
					CORING TERMINATED AT 38-FT					
								40		
								42.5		
								45		

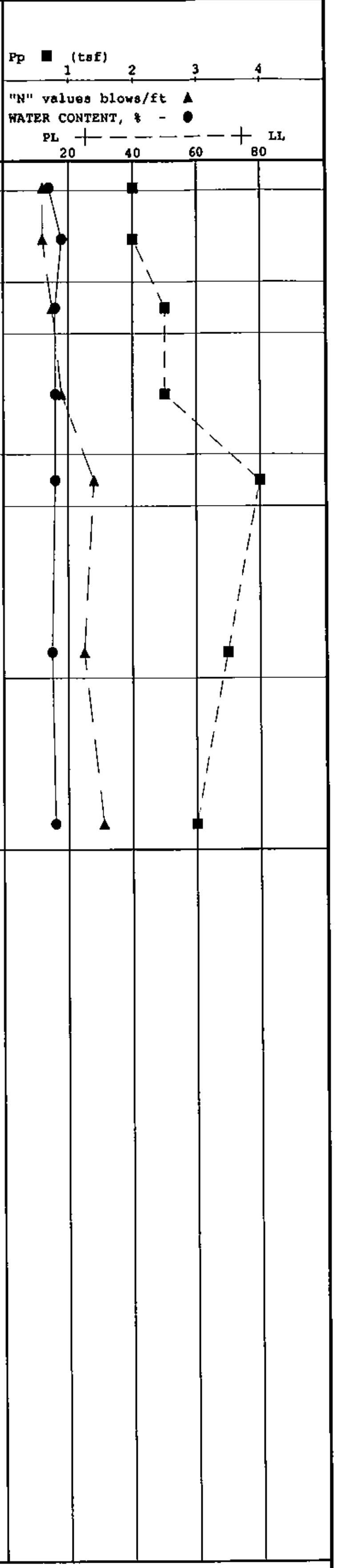
OMI, Inc.

5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 **JOB:** Southeast WTP **LOG OF BORING:** B-9 A

JOB LOCATION: Highway 431 **BORING LOCATION:**

DEPTH, FT	DESCRIPTION OF MATERIAL Elevation=636-FT	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0	TOPSOIL	12	14	2.0
	SANDY SILTY CLAY, 25% medium sand, 75% fines, low plasticity, brown, stiff, moist, residuum, CL	12	18	2.0
5	SANDY SILTY CLAY, 30% medium sand, 70% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	15	16	2.5
		18	16	2.5
10	SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	28	16	4.0
15		25	15	3.5
		31	16	3.0
20	BORING TERMINATED AT 20-FT			
25				
30				
35				
40				



COMPLETION DEPTH: 20 **DEPTH TO WATERINITIAL:** DRY OMI,Inc.

DATE: 5/15/13 **DEPTH TO WATERFINAL:** DRY TO 13-FT ON 5/16/13 Page 1 of 1

OMI, Inc.

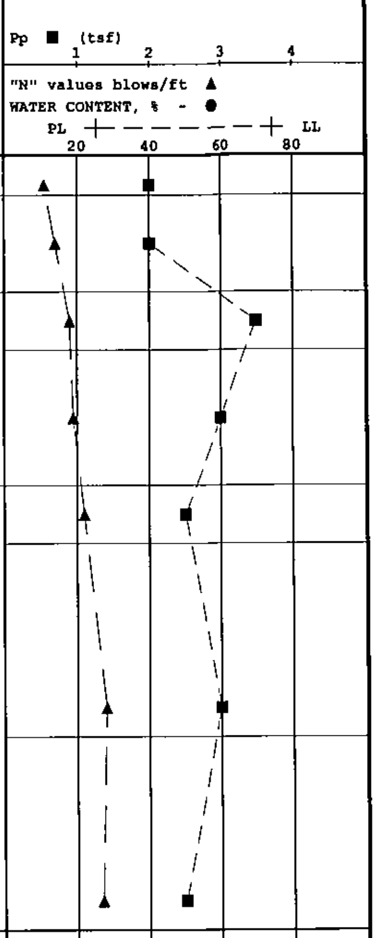
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-9 B

JOB LOCATION: Highway 431 BORING LOCATION:

Elevation=632-FT

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0	TOPSOIL	11		2.0
	SANDY SILTY CLAY, 30% medium sand, 70% fines, low plasticity, brown, stiff, moist, residuum, CL	14		2.0
	SANDY SILTY CLAY, 30% medium sand, 70% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	18		3.5
5		19		3.0
10	SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	22		2.5
15		28		3.0
		27		2.5
20	BORING TERMINATED AT 20-FT			
25				
30				
35				
40				



COMPLETION DEPTH: 20 DEPTH TO WATERINITIAL: DRY OMI,Inc.

DATE: 5/15/13 DEPTH TO WATERFINAL: DRY TO 14-FT ON 5/16/13 Page 1 of 1

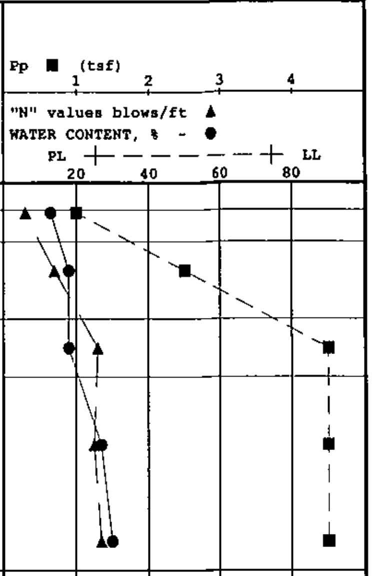
OMI, Inc.

5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-10 A

JOB LOCATION: Highway 431 BORING LOCATION:

DEPTH, FT	DESCRIPTION OF MATERIAL Elevation=606-FT	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0	TOPSOIL	6	13	1.0
	SANDY SILTY CLAY with 25% fine sand, 75% fines, low plasticity, grayish tan, firm, moist, residuum, CL	14	18	2.5
5	SANDY SILTY CLAY, 30% medium sand, 70% fines, low plasticity, tan, stiff, moist, residuum, CL	26	18	4.5
	SANDY SILTY CLAY with trace amount chert, 35% medium sand, 65% fines, high plasticity, tan, very stiff, moist, residuum, CH	25	27	4.5
		27	30	4.5
10	BORING TERMINATED AT 10-FT			
15				
20				
25				
30				
35				
40				



COMPLETION DEPTH: 10 DEPTH TO WATERINITIAL: 3-FT OMI,Inc.

DATE: 5/3/13 DEPTH TO WATERFINAL: 3-FT Page 1 of 1

OMI, Inc.

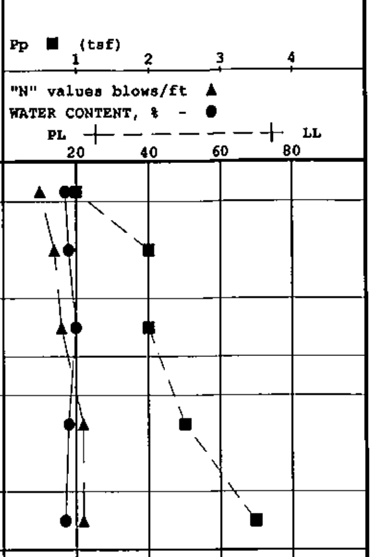
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-10 B

JOB LOCATION: Highway 431 BORING LOCATION:

Elevation=603-FT

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0			TOPSOIL	10	17	1.0
			SANDY SILTY CLAY with oxides, 25% fine sand, 75% fines, low plasticity, grayish tan, stiff, moist, residuum, CL	14	18	2.0
5			SANDY SILTY CLAY, 30% fine sand, 70% fines, low plasticity, reddish tan, very stiff, moist, residuum, CL	16	20	2.0
			SANDY SILTY CLAY, 35% coarse sand, 65% fines, low plasticity, tan, very stiff, moist, residuum, CL	22	18	2.5
10			SANDY SILTY CLAY with oxides, 35% medium sand, 65% fines, low plasticity, grayish tan, very stiff, moist, residuum, CL	22	17	3.5
			BORING TERMINATED AT 10-FT			
15						
20						
25						
30						
35						
40						



COMPLETION DEPTH: 10 DEPTH TO WATERINITIAL: 3-FT OMI,Inc.
DATE: 5/3/13 DEPTH TO WATERFINAL: 3-FT Page 1 of 1

OMI, Inc.

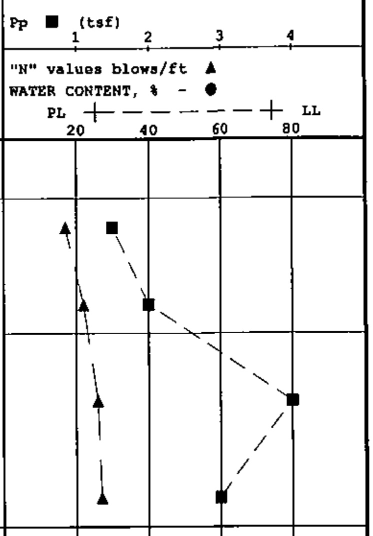
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-10 C

JOB LOCATION: Highway 431 BORING LOCATION:

Elevation=612-FT

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0			TOPSOIL			
			SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	17		1.5
				22		2.0
5						
				26		4.0
				27		3.0
10			BORING TERMINATD AT 10-FT			
15						
20						
25						
30						
35						
40						



COMPLETION DEPTH: 10 DEPTH TO WATERINITIAL: DRY OMI,Inc.

DATE: 5/13/13 DEPTH TO WATERFINAL: DRY to 8.5-FT on 5/14/13 Page 1 of 1

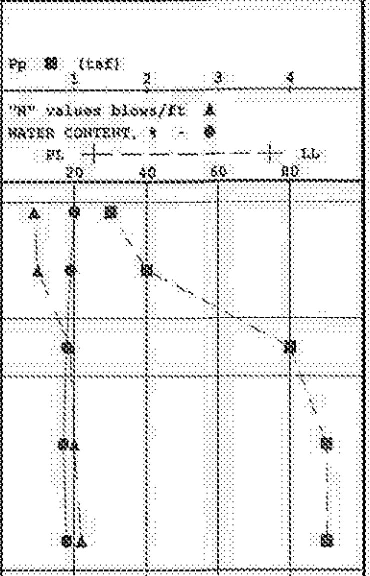
OMI, Inc.

5161 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-10 D

JOB LOCATION: Highway 431 BORING LOCATION:

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL Elevation=610-FT	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0			TOPSOIL	9	20	1.5
			SANDY SILTY CLAY, 30% medium sand, 70% fines, low plasticity, reddish brown, stiff, moist, residuum, CL	10	19	2.0
5			SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	19	18	4.0
				20	17	4.5
10				22	18	4.5
			BORING TERMINATED AT 10-FT			
15						
20						
25						
30						
35						
40						



COMPLETION DEPTH: 10 DEPTH TO WATERINITIAL: DRY OMI,Inc.

DATE: 5/3/13 DEPTH TO WATERFINAL: DRY to 5-FT on 5/9/13 Page 1 of 1

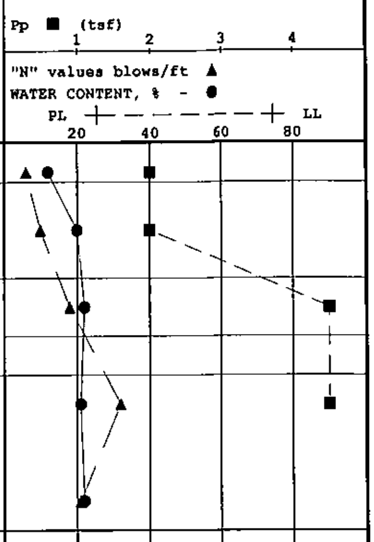
OMI, Inc.

5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-10 E

JOB LOCATION: Highway 431 BORING LOCATION:

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
			Elevation=605-FT			
0			TOPSOIL	6	12	2.0
			SANDY SILTY CLAY, 35% fine sand, 65% fines, low plasticity, yellowish tan, stiff moist, residuum, CL	10	20	2.0
5			SANDY SILTY CLAY, 35% fine sand, 65% fines, low plasticity, reddish tan, very stiff, moist, residuum, CL	18	22	4.5
			SANDY SILTY CLAY, 30% fine sand, 70% fines, low plasticity, reddish tan, hard, moist, residuum, CL	32 21	21 22	4.5
10			BORING TERMINATED AT 10-FT			
15						
20						
25						
30						
35						
40						



COMPLETION DEPTH: 10 DEPTH TO WATERINITIAL: DRY OMI,Inc.

DATE: 5/3/13 DEPTH TO WATERFINAL: DRY to 3-FT on 5/9/13 Page 1 of 1

OMI, Inc.

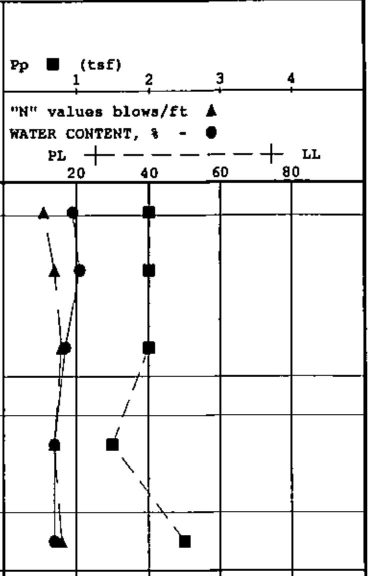
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-10 F

JOB LOCATION: Highway 431 BORING LOCATION:

Elevation=607-FT

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0			TOPSOIL	11	19	2.0
			SANDY SILTY CLAY, 30% fine sand, 70% fines, low plasticity, reddish brown, stiff to very stiff, moist, residuum, CL	14	21	2.0
5				16	17	2.0
			SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish brown, stiff, moist, residuum, CL	14	14	1.5
10			SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, tan, very stiff, moist, residuum, CL	16	14	2.5
			BORING TERMINATED AT 10-FT			
15						
20						
25						
30						
35						
40						



COMPLETION DEPTH: 10 DEPTH TO WATERINITIAL: DRY OMI,Inc.

DATE: 5/3/13 DEPTH TO WATERFINAL: DRY to 7-FT on 5/9/13 Page 1 of 1

OMI, Inc.

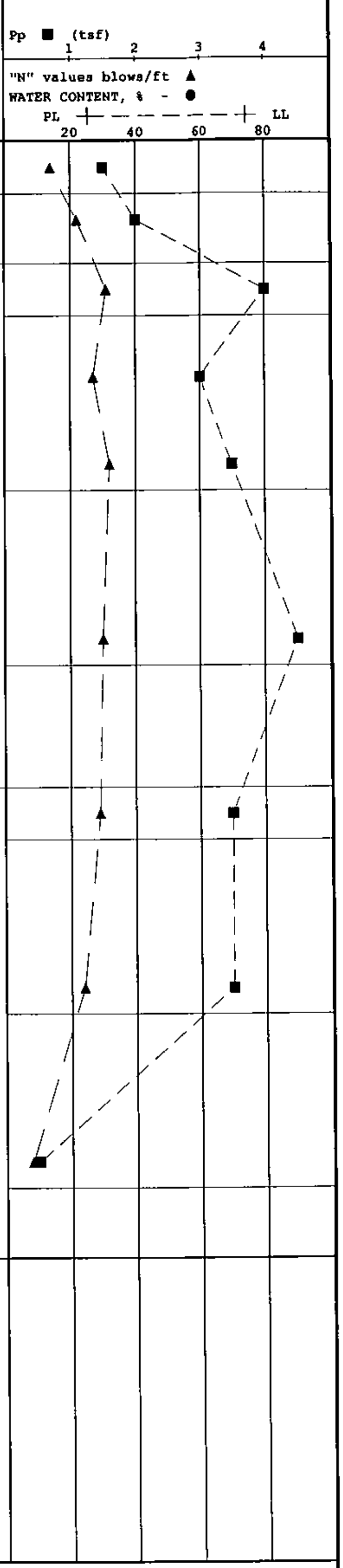
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-11

JOB LOCATION: Highway 431 BORING LOCATION:

Elevation=608-FT

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0	TOPSOIL	14		1.5
	SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish brown, stiff to very stiff, moist, residuum, CL	22		2.0
5	SANDY SILTY CLAY with trace amount chert, 35% medium sand, 65% fines, low plasticity, reddish brown, very stiff to hard, moist, residuum, CL	31		4.0
		27		3.0
10		32		3.5
15		30		4.5
20	SANDY SILTY CLAY with trace amount chert, 30% medium sand, 70% fines, high plasticity, tan, very stiff to hard, moist, residuum, CH	29		3.5
25		24		3.5
30		8		0.5
35	AUGER REFUSAL AT 32-FT			
40				



COMPLETION DEPTH: 32 DEPTH TO WATERINITIAL: DRY OMI,Inc.

DATE: 5/13/13 DEPTH TO WATERFINAL: DRY to 13-FT on 5/14/13 Page 1 of 1

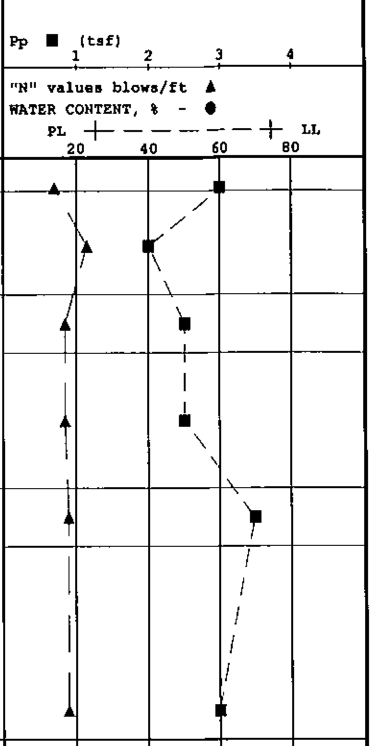
OMI, Inc.

5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-12

JOB LOCATION: Highway 431 BORING LOCATION:

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL Elevation=607-FT	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0			TOPSOIL	14		3.0
			SANDY SILTY CLAY, 30% medium sand, 70% fines, low plasticity, reddish brown, stiff to very stiff, moist, residuum, CL	23		2.0
5			SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	17		2.5
				17		2.5
10			SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish tan, very stiff, moist, residuum, CL	18		3.5
				18		3.0
15			BORING TERMINATED AT 15-FT			
20						
25						
30						
35						
40						



COMPLETION DEPTH: 15 DEPTH TO WATERINITIAL: DRY OMI,Inc.

DATE: 5/8/13 DEPTH TO WATERFINAL: Dry to 9-FT on 5-9-13

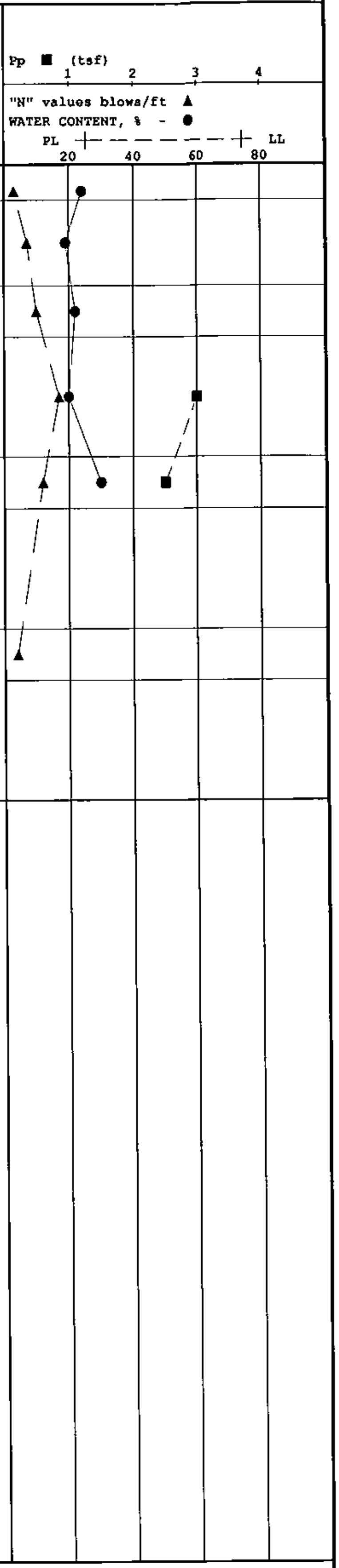
OMI, Inc.

5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-13

JOB LOCATION: Highway 431 BORING LOCATION:

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL Elevation=597-FT	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0			TOPSOIL	3	24	---
			SANDY SILTY CLAY, 30% coarse to fine sand, 70% fines, tan, soft to firm, moist, residuum, CL	7	19	---
5			SANDY SILTY CLAY, 35% coarse to fine sand, 65% fines, low plasticity, stiff, moist, residuum, CL	10 17	22 20	--- 3.0
10			SANDY SILTY CLAY with trace amount chert, 35% coarse sand, 65% fines, high plasticity, tan, very stiff, moist, residuum, CH	12	30	2.5
15			SANDY SILTY CLAY, 30% coarse to fine sand, 70% fines, high plasticity, tan, soft, wet, residuum, CH	4		---
20			AUGER REFUSAL AT 18.5-FT			
25						
30						
35						
40						



COMPLETION DEPTH: 18.5 DEPTH TO WATERINITIAL: 8-FT OMI,Inc.

DATE: 5/8/13 DEPTH TO WATERFINAL: 3.5-FT Page 1 of 1

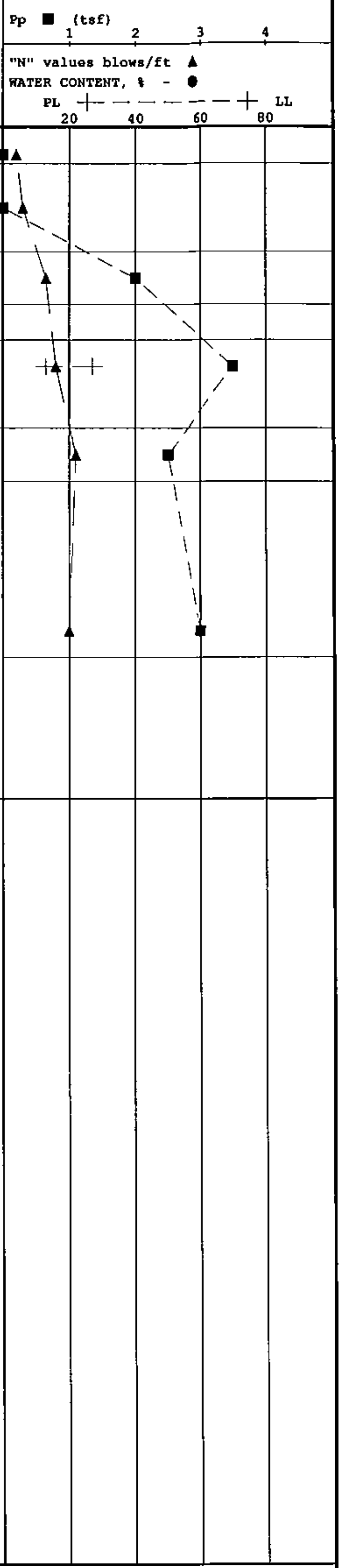
OMI, Inc.

5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-13 A

JOB LOCATION: Highway 431 BORING LOCATION:

DEPTH, FT	DESCRIPTION OF MATERIAL Elevation=595-FT	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0	TOPSOIL	4		0.0
	SANDY SILTY CLAY, 30% coarse to fine sand, 70% fines, low plasticity, brown, soft to firm, moist, residuum, CL	6		0.0
5	SANDY SILTY CLAY, 35% coarse to fine sand, 65% fines, low plasticity, gray and tan, stiff to very stiff, moist, residuum, CL	13		2.0
	SANDY SILTY CLAY, 35% coarse to fine sand, 65% fines, low plasticity, gray and tan, stiff to very stiff, moist, residuum, CL	16		3.5
10	SANDY SILTY CLAY, 30% coarse to fine sand, 70% fines, high plasticity, tan and gray, very stiff, moist, residuum, CH	22		2.5
15		20		3.0
20	AUGER REFUSAL AT 19-FT			
25				
30				
35				
40				



COMPLETION DEPTH: 19 DEPTH TO WATERINITIAL: 7-FT OMI,Inc.

DATE: 6/7/13 DEPTH TO WATERFINAL: 3-FT Page 1 of 1

OMI, Inc.

DRILL LOG

PROJECT SE WTP		PROJECT NO. 6644	BORING NO. **B-13 A**
SITE Highway 431	BEGUN 6-7-13	COMPLETED 6-7-13	HOLE SIZE 29'
PAGE NO. 1 of 1			
COORDINATES	DEPTH GROUND WATER	AT FIRST CHECK	GROUND ELEVATION 596
DRILLER South Drilling	CORE RECOVERY (%)	# SAMPLES	# CORE BOXES
DEPTH TOP OF ROCK 19-ft			
DRILL MAKE AND MODEL	LOGGED BY: CJ		DEPTH BOTTOM OF HOLE 30.5

SAMPLE DATA					REMARKS:					
SAMPLE TYPE AND DIAMETER	SAMPLE NO.	SAMPLE LENGTH	SAMPLE RECOVERY	N-VALUE/ RQD (%)	NOTES ON WATER LOSSES AND LEVELS, CAVING, AND DRILLING CONDITIONS CASING DEPTH	FRACTURES PER FOOT	STRATA ELEVATION/ DEPTH	DEPTH	GRAPHIC LOG	DESCRIPTION
NQ Core 19'	Run 1	42"	33" 79%	33%		1 6 6 3	- 19.25- -20.5- - 20.75-	20		Top of Rock at 19; 577-ft ARGILLACEOUS LIMESTONE, weathered, gray, moderately hard, fine grained 3" Clay seam ARGILLACEOUS LIMESTONE, weathered, gray, moderately hard, fine grained
NQ Core 22.5'	Run 2	60"	43" 72%	30%		4 3 5 0	-23.5- - 23.75- -26.5- -27-	22.5 25		3" Clay seam CALCAREOUS SHALE, highly weathered, dark gray, soft, fine grained 6" Clay Seam
NQ Core 27.5'	Run 3	36"	30" 83%	0%		3 9 8	-28- -28.5-	27.5 30		CALCAREOUS SHALE, highly weathered, dark gray, soft, fine grained 3" Clay Seam CALCAREOUS SHALE, highly weathered, dark gray, soft, fine grained
					CORING TERMINATED AT 30.5-FT			32.5 35 37.5		

OMI, Inc.

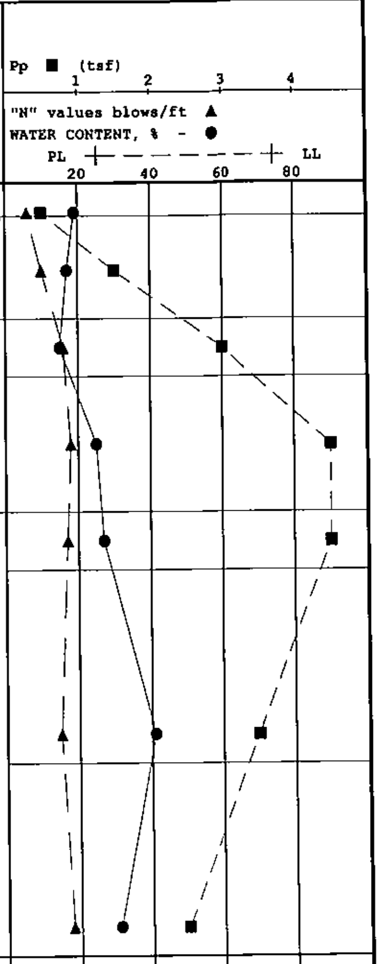
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-14

JOB LOCATION: Highway 431 BORING LOCATION:

Elevation=596-FT

DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
TOPSOIL	6	19	0.5
SANDY SILTY CLAY, 35% medium sand, 65% fines, low plasticity, reddish brown, firm to stiff, moist, residuum, CL	10	17	1.5
SANDY SILTY CLAY with trace amount chert, 40% medium sand, 60% fines, low plasticity, tan, very stiff, moist, residuum, CL	16	15	3.0
	18	25	4.5
SANDY SILTY CLAY, 25% fine sand, 75% fines, high plasticity, reddish tan, very stiff, moist, residuum, CH	17	27	4.5
	15	41	3.5
	18	31	2.5
BORING TERMINATED AT 20-FT			



DEPTH, FT: 0, 5, 10, 15, 20, 25, 30, 35, 40

COMPLETION DEPTH: 20 DEPTH TO WATERINITIAL: DRY OMI,Inc.

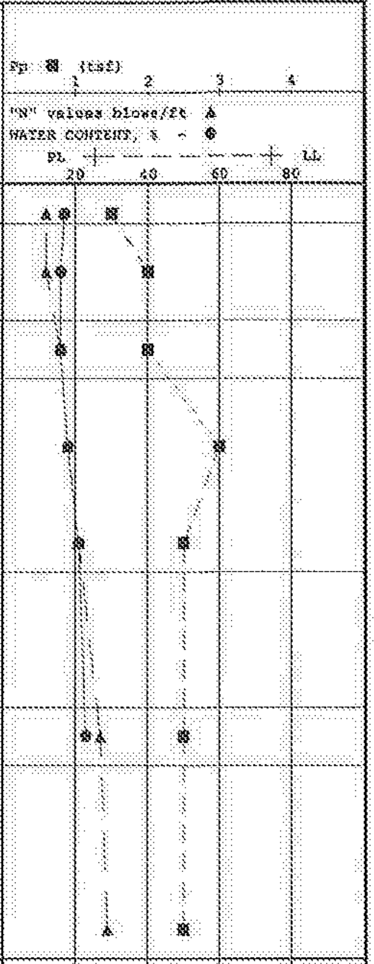
DATE: 5/9/13 DEPTH TO WATERFINAL: 12-FT Page 1 of 1

OMI, Inc.

5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-15

JOB LOCATION: Highway 431 BORING LOCATION:



DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL Elevation=625-FT	BLOWS PER FT	NATURAL MOISTURE	POCKET PENE TEST
0			TOPSOIL	12	17	1.5
			SANDY SILTY CLAY, 30% medium sand, 70% fines, low plasticity, reddish brown, stiff, moist, residuum, CL	12	16	2.0
			SANDY SILTY CLAY with trace amount chert, 30% medium sand, 70% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	16	16	2.0
5				18	18	3.0
10				21	21	2.5
15			SANDY SILTY CLAY with chert, 10% gravel sized chert, 35% medium sand, 55% fines, low plasticity, reddish brown, very stiff, moist, residuum, CL	27	23	2.5
				29		2.5
20			BORING TERMINATED AT 20-FT			
25						
30						
35						
40						

COMPLETION DEPTH: 20 DEPTH TO WATERINITIAL: DRY OMI,Inc.

DATE: 5/15/13 DEPTH TO WATERFINAL: DRY TO 12-FT ON 5/16/13 Page 1 of 1

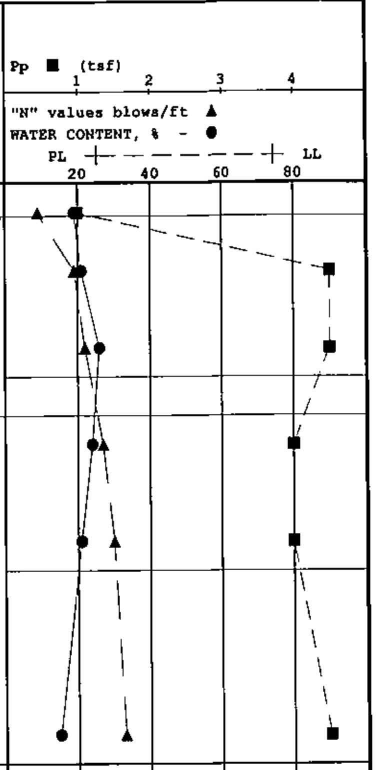
OMI, Inc.

5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-16

JOB LOCATION: Highway 431 BORING LOCATION:

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL Elevation=623-FT	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0			TOPSOIL	9	19	1.0
			SANDY SILTY CLAY, 25% medium sand, 75% fines, low plasticity, reddish tan, stiff to very stiff, moist, residuum, CL	19	21	4.5
				22	26	4.5
5						
			SANDY SILTY CLAY, 30% medium sand, 70% fines, low plasticity, reddish tan, very stiff to hard, moist, residuum, CL	27	24	4.0
				30	21	4.0
10						
				33	15	4.5
15			BORING TERMINATED AT 15-FT			
20						
25						
30						
35						
40						



COMPLETION DEPTH: 15 DEPTH TO WATERINITIAL: DRY OMI,Inc.

DATE: 5/15/13 DEPTH TO WATERFINAL: DRY TO 13-FT ON 5/16/13 Page 1 of 1

OMI, Inc.

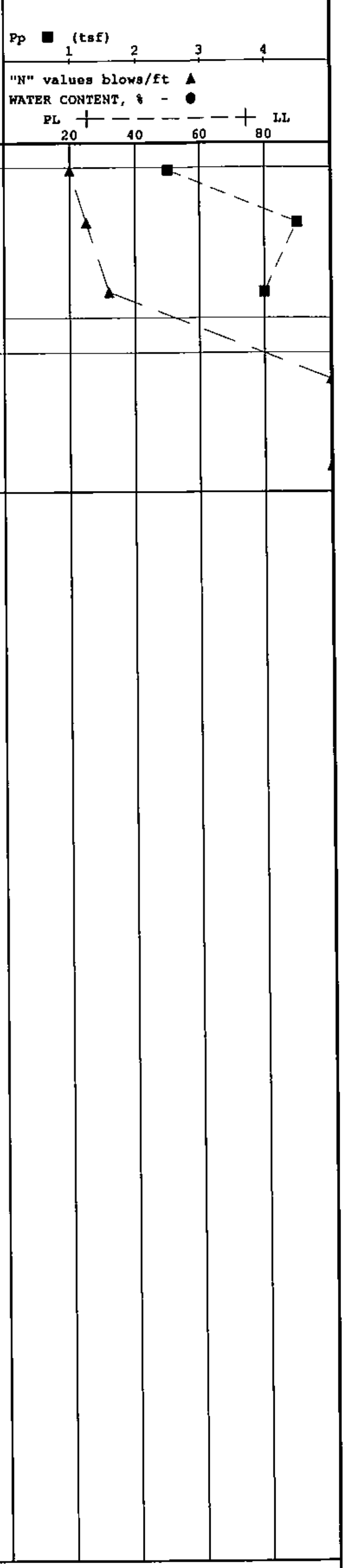
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-17 A

JOB LOCATION: Highway 431 BORING LOCATION:

Elevation=612-FT

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0			TOPSOIL			
			SANDY SILTY CLAY with chert, 10% gravel sized chert, 30% medium sand, 60% fines, low plasticity, yellowish tan, very stiff, moist, residuum, CL	20 25 32		2.5 4.5 4.0
5			SANDY SILTY CLAY with chert, 10% gravel sized chert, 30% medium sand, 60% fines, low plasticity, brown, hard, moist, residuum, CL	100+ 100+		--- ---
10			BORING TERMINATED AT 10-FT			
15						
20						
25						
30						
35						
40						



COMPLETION DEPTH: 10 DEPTH TO WATERINITIAL: DRY OMI,Inc.

DATE: 5/15/13 DEPTH TO WATERFINAL: DRY TO 6-FT ON 5/16/13 Page 1 of 1

OMI, Inc.

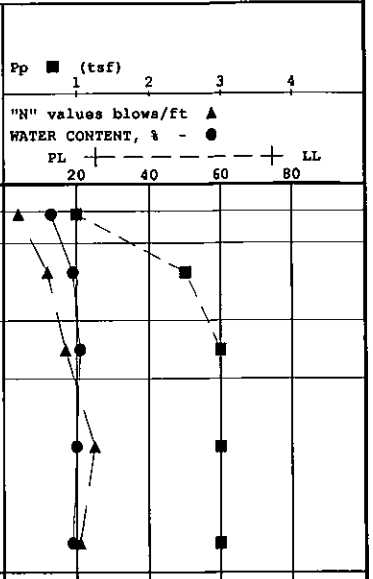
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-17 B

JOB LOCATION: Highway 431 BORING LOCATION:

Elevation=614-FT

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0			TOPSOIL	4	13	1.0
			SANDY SILTY CLAY, 35% fine sand, 65% fines, low plasticity, tan, soft, moist, residuum, CL	12	19	2.5
5			SANDY SILTY CLAY with trace amount chert, 35% fine sand, 65% fines, low plasticity, tan, stiff, moist, residuum, CL	17	21	3.0
				25	20	3.0
			SANDY SILTY CLAY with oxides, 35% fine sand, 65% fines, low plasticity, reddish tan, very stiff, moist, residuum, CL	21	19	3.0
10			BORING TERMINATED AT 10-FT			
15						
20						
25						
30						
35						
40						



COMPLETION DEPTH: 10 DEPTH TO WATERINITIAL: DRY OMI,Inc.

DATE: 5/3/13 DEPTH TO WATERFINAL: DRY TO 5-FT ON 5/8/13 Page 1 of 1

OMI, Inc.

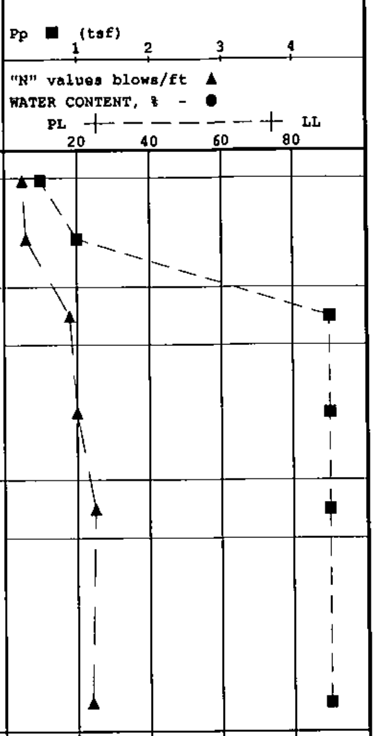
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-18

JOB LOCATION: Highway 431 BORING LOCATION:

Elevation=588-FT

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
0			TOPSOIL	5		0.5
			SANDY SILTY CLAY, 30% medium sand, 70% fines, low plasticity, tan, firm, moist to wet, residuum, CL	6		1.0
5			SANDY SILTY CLAY, 30% medium sand, 70% fines, low plasticity, yellowish tan, very stiff, moist, residuum, CL	18 20		4.5 4.5
10			SANDY SILTY CLAY, 30% medium sand, 70% fines, high plasticity, tan, very stiff, moist, residuum, CL	25 24		4.5 4.5
15			BORING TERMINATED AT 15-FT			
20						
25						
30						
35						
40						



COMPLETION DEPTH: 15 DEPTH TO WATERINITIAL: 2-FT OMI,Inc.

DATE: 5/15/13 DEPTH TO WATERFINAL: 3-FT

OMI, Inc.

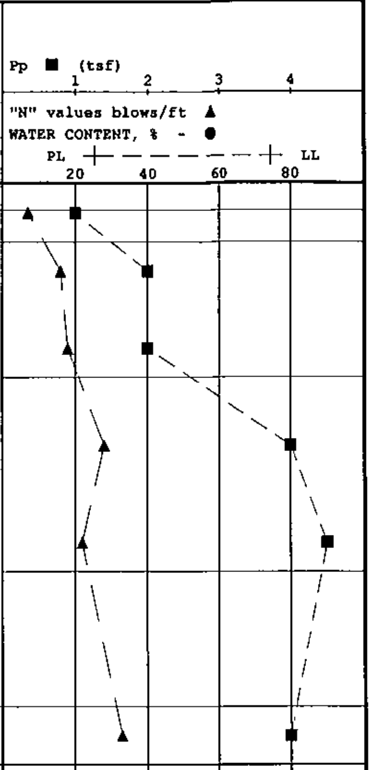
5151 Research Drive, N.W. Huntsville, AL 35805

JOB NO.: 6644 JOB: Southeast WTP LOG OF BORING: B-19

JOB LOCATION: Highway 431 BORING LOCATION:

Elevation=593-FT

DESCRIPTION OF MATERIAL	BLOWS PER FT	NATURAL MOISTURE	POCKET PENT TSF
TOPSOIL			
SANDY SILTY CLAY, 30% fine sand, 70% fines, low plasticity, reddish brown, stiff, moist, residuum, CL	7		1.0
	16		2.0
SANDY SILTY CLAY, 40% medium sand, 60% fines, low plasticity, tan, very stiff, moist, residuum, CL	18		2.0
	28		4.0
	22		4.5
SANDY SILTY CLAY with trace amount chert, 35% medium sand, 65% fines, high plasticity, tan, hard, moist, residuum, CH	33		4.0
BORING TERMINATED AT 15-FT			



COMPLETION DEPTH: 15 DEPTH TO WATERINITIAL: DRY OMI,Inc.

DATE: DEPTH TO WATERFINAL: DRY TO 8-FT ON 5/13/13

BORING LEGEND

SOIL SYMBOLS

MAJOR DIVISIONS			GROUP SYMBOLS		TYPICAL NAMES
COARSE GRAIN SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVELS 50% OR MORE OF COARSE FRACTION RETAINED ON #4 SIEVE	CLEAN GRAVELS	⁘	GW	WELL-GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			▦	GP	POORLY GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES	⁘	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			▦	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN 50% OF COARSE FRACTION PASSES #4 SIEVE	CLEAN SANDS	□	SW	WELL-GRADED SANDS AND GRAVELLY SANDS, LITTLE OR NO FINES
			▒	SP	POORLY GRADED SANDS AND GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES	▦	SM	SILTY SANDS, SAND-SILT MIXTURES
			▧	SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAIN SOILS 50% OR MORE PASSES NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT 50% OR LESS	▥	ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS
			▨	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			▤	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50%	▥	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS
			▨	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			▧	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS			≋	PT	PEAT, MUCK AND OTHER HIGHLY ORGANIC SOILS

ABBREVIATIONS:

SS- SPLIT SPOON SAMPLE

UD- UNDISTURBED SAMPLE

REC-SAMPLE RECOVERY

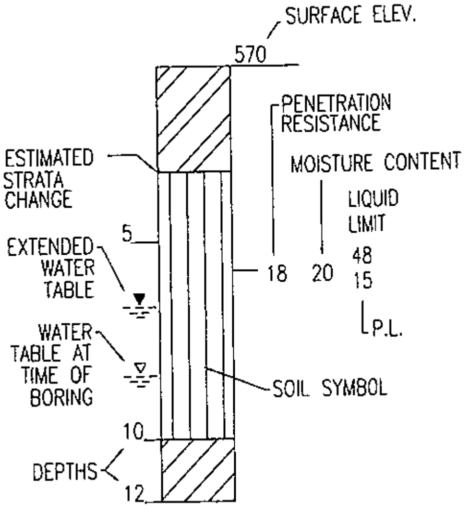
USC-VISUAL UNIFIED SOIL CLASSIFICATION

POCKET PENET- POCKET PENETROMETER READING, TSF

RQD-ROCK QUALITY DESIGNATION

FF- FRACTURE FREQUENCY PER FOOT OF CORE

KEY TO BORING RECORDS OR PROFILES



ROCK SYMBOLS

▒ SANDSTONE

▤ SHALE

▨ GNEISS OR SCHIST

○ CONGLOMERATE

▦ LIMESTONE OR DOLOMITE

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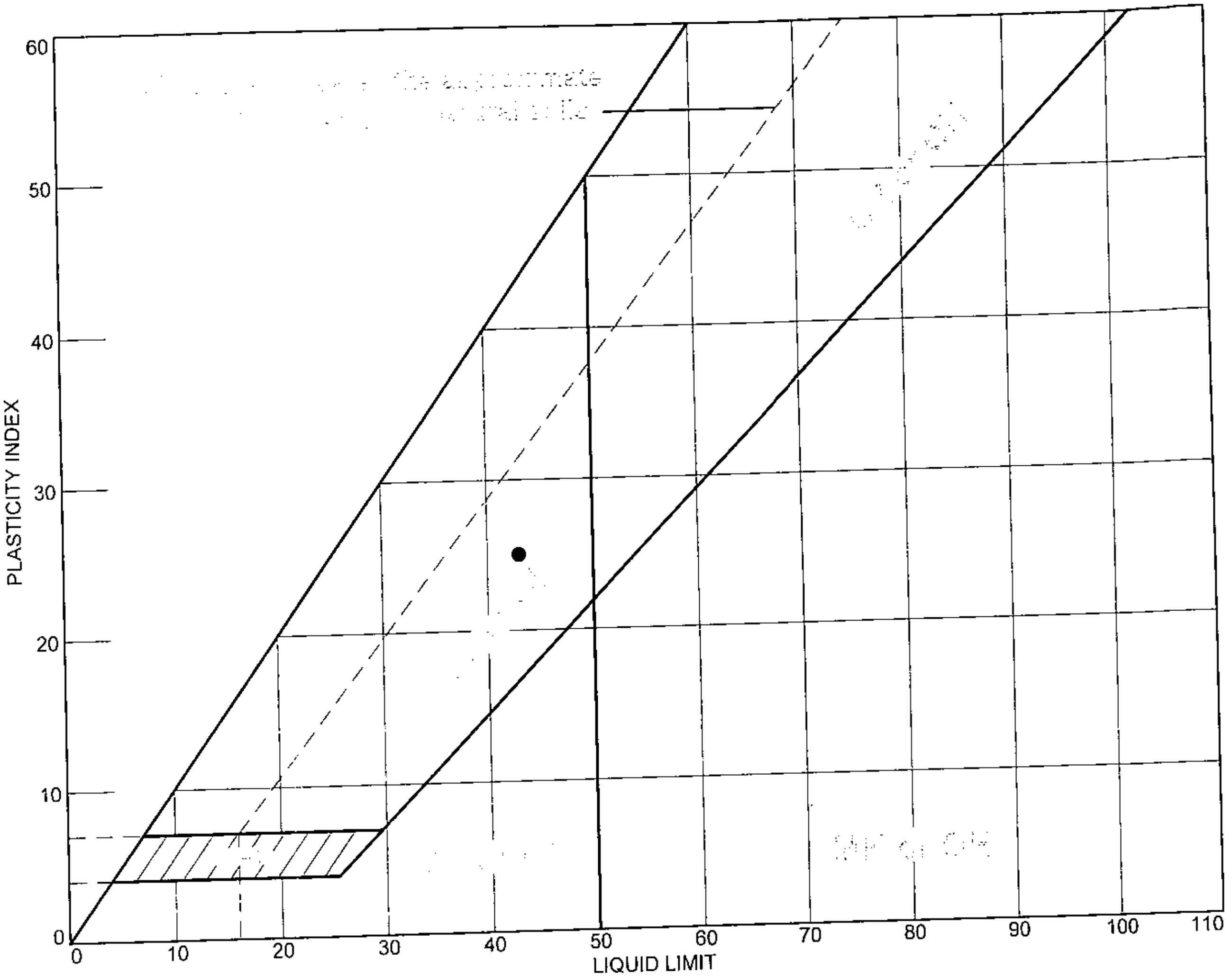
LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SANDY SILTY CLAY with trace amount chert, 40% medium sand, 60% fines, low plasticity, reddish tan, very	43	18	25			CL

Project No. 6644 **Client:**

Project: WTP

● **Source of Sample:** B-1 B **Depth:** 23.5

OMI, Inc.

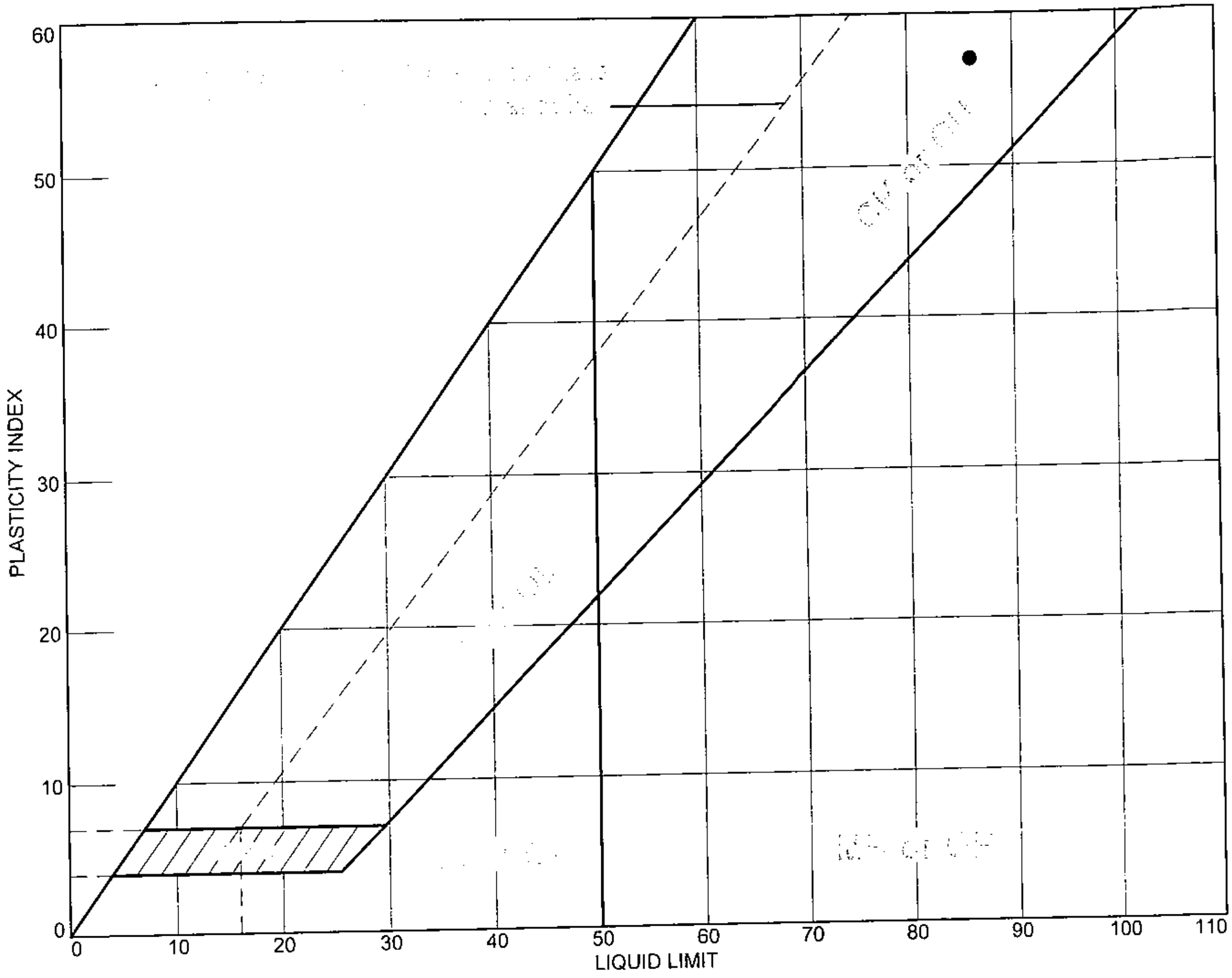
Huntsville, AL

Remarks:
● Tested 6/20/13

Figure

Tested By: SS **Checked By:** CJ

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SANDY SILTY CLAY, 35% coarse sand, 65% fines, high plasticity, reddish tan, very stiff, moist, residuum,	86	29	57			CH

Project No. 6644 **Client:**

Project: WTP

● **Source of Sample:** B-6 A **Depth:** 13.5

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Huntsville, AL

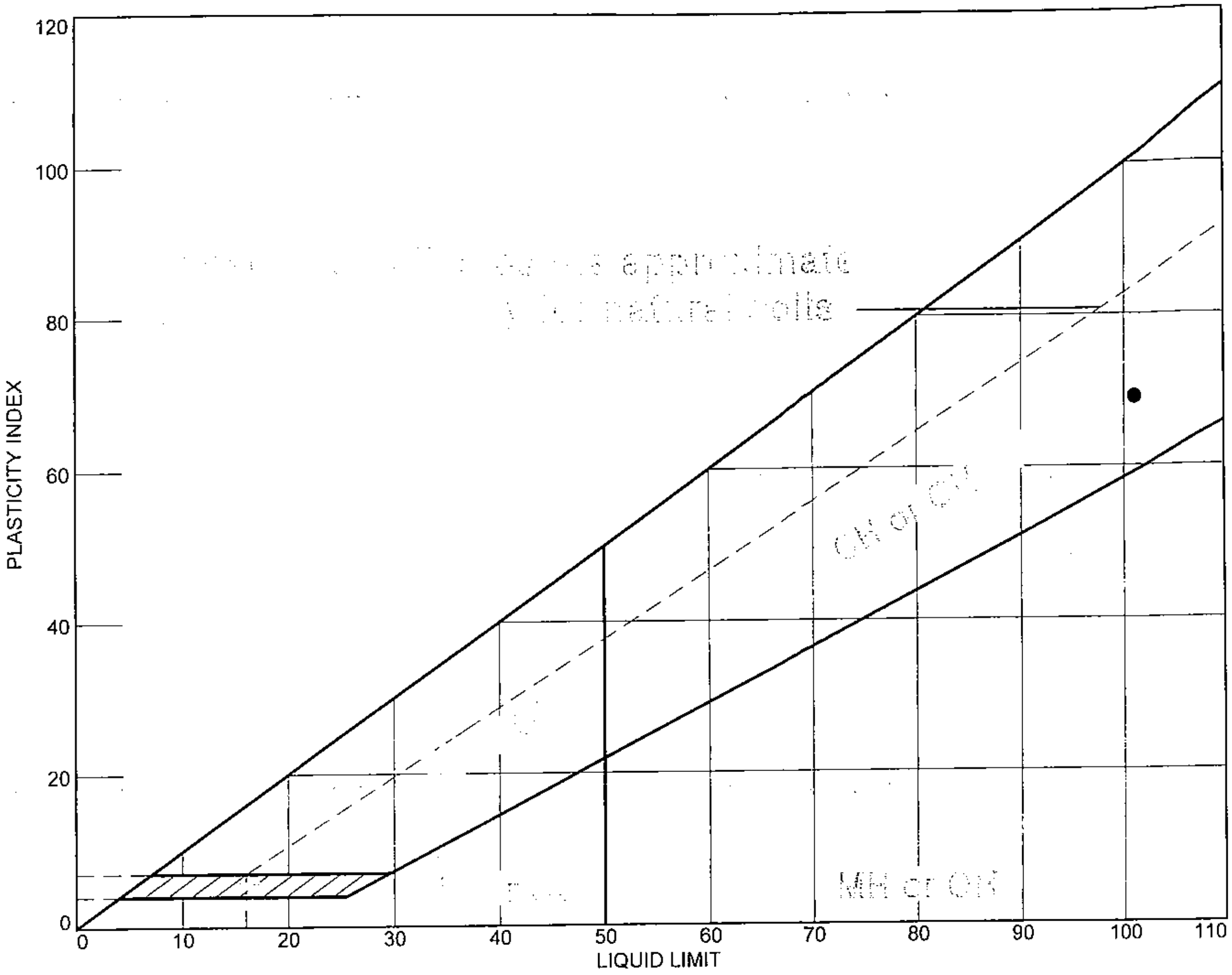
Remarks:

● Tested 6/20/13

Figure

Tested By: SS **Checked By:** CJ

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SANDY SILTY CLAY with trace amount chert, 35% medium sand, 65% fines, high plasticity, tan, very stiff,	101	32	69			

Project No. 6644 **Client:**

Project: Southeast WTP

● **Source of Sample:** B-7 **Depth:** 18.5

OMI, Inc.

Huntsville, AL

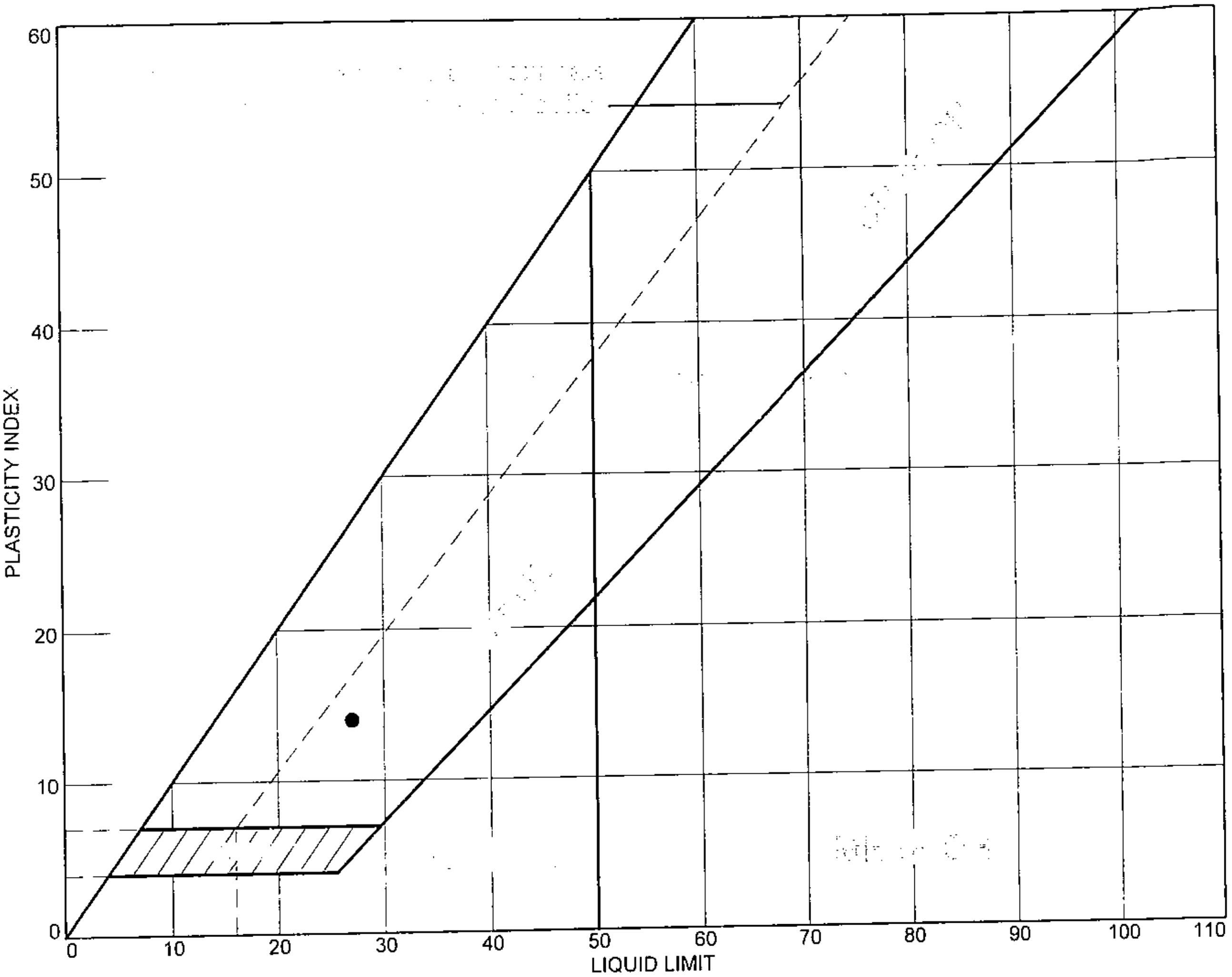
Remarks:

● Tested 6/18/13

Figure

Tested By: SS **Checked By:** CJ

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SANDY SILTY CLAY, 35% coarse to fine sand, 65% fines, low plasticity, gray and tan, stiff to very stiff.	27	13	14			

Project No. 6644 **Client:**

Project: Southeast WTP

● **Location:** B-13 **Depth:** 5' to 7'

Remarks:

● Tested 6/25/13

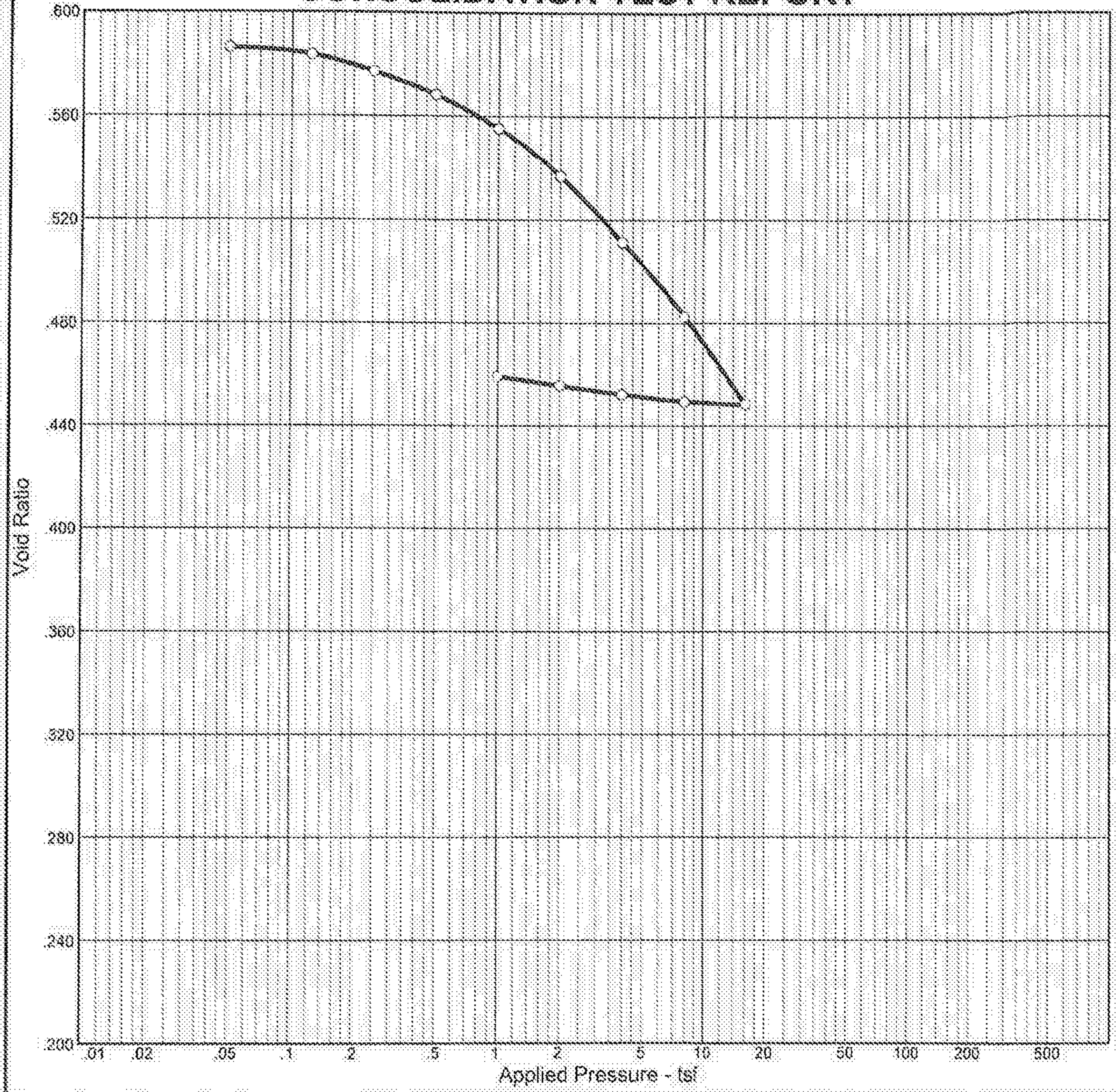
OMI, Inc.

Huntsville, AL

Figure

Tested By: SS **Checked By:** CJ

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Swell %	e_o
Sat.	Moist.											
74.6 %	16.3 %	113.5	27	14	2.691	0.25	3.19	0.12	0.01			0.588

MATERIAL DESCRIPTION	USCS	AASHTO
SANDY SILTY CLAY, 35% coarse to fine sand, 65% fines, low plasticity, gray and tan, stiff to very stiff, moist, residuum, CL		

Project No. 6644 **Client:**

Project: Southeast WTP

Source: B-13 A **Elev./Depth:** 6.0

OMI, Inc.

Huntsville, AL

Remarks:

Figure

FIELD TEST PROCEDURES

OMI, Inc., generally follows field and laboratory testing procedures as outlined by the American Society for Testing and Materials (ASTM) and the U. S. Army Corps of Engineers. Field procedures are outlined and an overview description is provided in ASTM Standard D-420, "Standard Guide to Site Characterization for Engineering, Design, and Construction Purposes." This document is a guide to the selection of various standards for investigating soil, rock, and ground water for earth related construction. Applicable procedures include geophysical, in-situ, and boring methods. A summary of each procedure used during this study is presented below.

SOIL DRILLING PROCEDURES

Several techniques are used to advance borings for collection of soil, rock, or ground water samples. Different techniques are used, depending on the samples desired and the soil and water conditions. Depths for sample intervals, strata changes, and boring termination or refusal are recorded to the nearest 1/10 of a foot. The project utilized the following.

Soil Borings

A) Solid stem continuous flight augers (ASTM D-1452)

B) Hollow stem continuous flight augers (ASTM D-1452)

C) Rotary drilling techniques using roller cone bits or drag bits and water with or without drilling mud or other additives to flush the hole

D) Hand augers

E) Backhoes or other excavating equipment.

Rock Borings

A) Core borings with diamond bits with double or triple core barrels (ASTM D-2113)

B) Rock borings with roller cone bit

C) Rotary hammer drilling.

Hollow and Solid Stem Auger: An auger is a center post with a continuous spiral flange wrapped around it. The post is called the stem. Augers are usually constructed in 5-foot long sections that can be coupled together. As the auger is turned and advanced into the ground; the soil "cuttings" are brought to the surface. Solid stem augers have a solid core and have to be removed from the boring to allow access for sampling tools. Hollow stem augers have the spiral flange connected to a hollow tube (stem). Sampling tools can access the bottom of the boring without removing the augers from the hole.

Rotary Borings: Rotary drilling involves the use of roller cone or drag type drill bits attached to the end of hollow drill rods. A flushing medium, normally water or bentonite slurry, is pumped through the rods to clear the cuttings from the bit face and flush them to the surface. Casing is sometimes set behind the advancing bit to prevent the hole from collapsing and to restrict the penetration of the drilling fluid into the surrounding soils. Cuttings returned to the surface by the drilling fluid are usually collected in a settling tank to allow the fluid to be re-circulated.

Hand Auger Borings: Hand auger borings are advanced by manually twisting a 4-inch diameter steel bucket auger into the ground and withdrawing it when filled to observe the sample collected. Other equipment such as post-hole diggers is sometimes used in lieu of augers to obtain shallow soil samples. Occasionally, these hand auger borings are used for driving 3-inch diameter steel tubes to obtain intact soil samples.

Test Pits: A backhoe or other construction equipment is sometimes used to excavate into soils to observe the soil and collect samples.

Core Drilling: Soil drilling methods are not normally capable of penetrating through hard cemented soil, weathered rock, coarse gravel or boulders, thin rock seams, or sound continuous rock. Material which cannot be penetrated by auger or rotary soil drilling methods at a reasonable rate is designated as "refusal material." Core drilling procedures are required to penetrate and sample refusal materials.

Prior to coring, casing may be set in the drilled hole through the overburden soils to keep the hole from caving and to prevent excessive water loss. The refusal materials are then cored according to ASTM D-2113 using a diamond bit fastened to the end of a hollow, double, or triple tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Core samples of the material penetrated are protected and retained in the swivel-mounted inner tube. Upon completion of each drill run, the core is brought to the surface, recovery is measured, and the core is sequentially placed in boxes and transported to our laboratory for review and storage.

SAMPLING AND TESTING IN BOREHOLES

Several techniques are used to obtain samples and data in soils; however, the following methods were utilized in this project:

A) Standard Penetration Testing
B) Undisturbed Sampling
C) Dynamic Cone Penetration Testing
D) Pocket Penetrometer Testing
E) Hand-Held Static Cone Penetrometer
F) Water Level Readings.

These procedures are presented below. Any additional testing techniques employed during this exploration are contained in other sections of the Appendix.

Standard Penetration Testing: At regular intervals, the drilling tools are removed and soil samples are obtained with a standard 2-inch diameter split tube or "split spoon" sampler connected to a drill rod. The sampler is first seated 6 inches to penetrate any loose cuttings then driven an additional 12 inches with blows of a 140 pound safety hammer falling 30 inches. Generally, the number of hammer blows required to drive the sampler the final 12 inches is designated the "penetration resistance" or "N" value, defined in blows per foot (bpf). The split spoon sampler is designed to retain the soil penetrated so it may be returned to the surface for observation. Representative portions of the soil samples obtained from each split spoon sample are placed in jars, sealed, and transported to the laboratory.

The standard penetration test, when properly evaluated, provides an indication of the soil strength and compressibility. The tests are conducted according to ASTM Standard D-1586. The depths and N-values of standard penetration tests are shown on the Boring Records. Split spoon samples are suitable for visual observation and classification tests, but generally are not sufficiently intact for quantitative laboratory testing.

Undisturbed Sampling: Relatively undisturbed samples are obtained by pushing 3 inch outside diameter (OD), 30 inch long steel tubes with hydraulic pressure supplied by the drill rig into the soil at the desired sampling levels (ASTM Standard D-1587). These tubes are also known as Shelby tubes. Each tube, together with the encased soil, is removed from the ground, sealed, and transported to the laboratory. Locations and depths of undisturbed samples are shown on the Boring Records.

Dynamic Cone Penetrometer: The dynamic cone is a hand-operated penetrometer used in hand auger borings and observation pits. This test is intended to provide data that can be correlated to the standard penetration test. A 1.5-inch OD cone is seated to penetrate any loose cuttings, and then driven for 3 intervals of 1.75 inch with blows from a 15-pound weight falling 20 inches. The average number of blows required to drive the cone over 1 increment is an index to soil strength and compressibility.

Pocket Penetrometer Testing: The pocket penetrometer is a hand operated penetrometer used in test pits and on split spoon and undisturbed samples. This test is intended to provide data that can be correlated to the unconfined compressive strength test. A ¼-in diameter shaft is pressed into the soil ¼-in deep. The shaft pushes against a spring with a constant of 12 pounds per inch to provide a compressive strength value in tons per square foot. The penetrometer is capable of providing readings between 0.25 tons per square foot and 4.5 tons per square foot.

Water Level Readings: Water table readings are normally taken in the borings and are recorded on the Boring Records. In sandy soils, these readings indicate the approximate location of the hydrostatic water table at the time of the field exploration. In clayey soils, the rate of water seepage into the borings is low and it is generally not possible to establish the location of the hydrostatic water table through short-term water level readings. Also, fluctuation in the water table should be expected with variations in precipitation, surface run-off, evaporation, and other factors. For long-term monitoring of water levels, it is necessary to install piezometers.

The water level reported on the Boring Records is determined by field crews immediately after the drilling tools are removed, and again several hours after the borings are completed, if possible. The time lag is intended to permit stabilization of the ground water table which may have been disrupted by the drilling operation.

Occasionally, the borings will cave in, preventing water level readings from being obtained or trapping drilling water above the cave-in zone. The cave-in depth is measured and recorded on the Boring Records.

BORING RECORDS

The subsurface conditions encountered during drilling are reported on a Boring Record. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of coarse gravel, cobbles, etc., and observations of ground water. It also contains the driller's and the geotechnical engineer's interpretation of soil conditions between samples. Therefore, these boring records contain both factual and interpretative information. A geotechnical engineer visually classifies the soil samples and prepares the Boring Records which are the basis for all evaluations and recommendations.

LABORATORY TEST PROCEDURES

OMI, Inc., generally follows laboratory testing procedures as outlined by the American Society for Testing and Materials (ASTM), the U. S. Army Corps of Engineers, and other applicable procedures. All work is initiated and supervised by qualified engineers. Laboratory tests are performed by technicians trained to perform the work according to the appropriate procedures. The equipment is well maintained and inspected and calibrated annually or as specified by ASTM.

A description of the procedures used during this exploration or study are included in this Appendix.

SOIL CLASSIFICATION

Classification of soils provides a record and general guide to the engineering properties of the soils encountered during this study. Samples obtained during the field testing (drilling) operations are visually examined and classified by the geotechnical engineer. OMI, Inc., generally follows ASTM procedure No. D-2488 "Visual-Manual Procedure for Classifying Soils." Soil consistency and relative density is based on the number of blows from the standard penetration test. Representative or special samples are then selected for laboratory testing. Soil Boring Records are developed which present the data from the field testing as well as the soil description, water level information, and other data.

MOISTURE CONTENT

Moisture content values, when used in conjunction with other data, can be a useful and inexpensive tool to the engineer as an indicator of the engineering characteristics and parameters of the soil when compared to other data. Moisture content is performed by weighing a moist sample, drying, then re-weighing the dry sample. The moisture content is expressed as a percent of the dry weight of the soil. ASTM Method D-2216 is used to determine the moisture content of soil.

ATTERBERG LIMITS

Atterberg limits include the liquid limit (LL), plastic limit (PL), and shrinkage limit (SL) tests. These tests are performed to aid in the classification of soils and to determine the plasticity and volume change characteristics of the soil. The liquid limit is the minimum moisture content at which the soil will flow as a heavy viscous fluid. The plastic limit is the minimum moisture content at which the soil behaves as a plastic material. The shrinkage limit is the moisture content below which no further volume change will occur with continued drying. The plasticity index (PI) is the difference between the liquid limit and the plastic limit. The PI is the range of moisture at which the soil remains plastic. Many engineering characteristics have been correlated to the Atterberg limits. These are ASTM procedures D-4318, D-4943, and D-427.

STANDARD PROCTOR COMPACTION TEST

This test is used to establish a curve that predicts the effect of moisture and compactive effort on the dry density of the soil sample. It is useful as a comparative value in monitoring contractors' efforts during fill placement and compaction during construction. Also, correlations of engineering parameters such as strength, compressibility, and permeability are related to the percent compaction and soil type.

A representative sample of the proposed fill material (soil or stone) is collected. The sample is divided into four or more samples. Each sample is then brought to a different moisture content about 2% apart. Each sample is then placed in a standard 4-inch diameter mold in 3 equal layers with each layer being compacted with 25 blows from a 5.5-pound hammer falling 12 inches. The sample is trimmed to a known volume of 1/30 cubic foot then weighed. The moisture content of the sample is determined and the dry density is calculated. A graph of dry density (pcf) versus moisture content is developed. The maximum density and its corresponding moisture content known as the optimum moisture content are derived from the curve. A graph of the moisture-density relationship is given in the Appendix. ASTM D-698 describes the procedure.

UNCONFINED COMPRESSION TESTS - ROCK CORES

The strength of rock is important in many engineering applications. This strength is usually desired and reported as the unconfined or simple shear strength. Selected samples of rock cores are cut using a diamond saw. The cores are usually cut to a length equal to about twice the core diameter. The capped length and diameter of each core is measured and recorded. The cores are then loaded to failure in a compression machine. The unconfined compressive strength is calculated by dividing the cross-sectional area of the core into the maximum load required to crush the sample. If the length to diameter ratio is less than 2.0, then the maximum strength is adjusted mathematically. The results are reported in psi. This procedure is similar to ASTM D-2938.

CONSOLIDATION TESTING

The consolidation test provides data for estimating the settlement and time rate of settlement of the soil in response to the applied loads. Representative soil samples are collected from undisturbed samples, trimmed into a disk about 2.5 inches in diameter and 1 inch thick, then placed in the consolidometer. The disk is confined in a brass ring and sandwiched by porous stones on the top and bottom. The sample ring and stones are placed in a testing device, inundated, then loaded in increments. The sample height is measured as each load caused it to compress. The resulting loads and deformations are reduced to a graph which is presented in the Appendix. These results may be presented in load versus percent strain or load versus void ration. This procedure is described in ASTM D-2435.

OMI, Inc.

SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING STUDY

Proposed
Southeast Water Treatment Plant
Water Lines
Highway 431
Marshall and Madison Counties, Alabama

OMI Job No. 6759

October 30, 2013

5151 Research Drive, N.W., Suite A Huntsville, AL 35805 Tel: (256) 837-7664 Fax: (256) 837-3677 E-mail: omi@omi-eng.com

OMI, Inc.

October 30, 2013

Tetra Tech, Inc.
2110 Powers Ferry Road, Suite 202
Atlanta, GA 30339

ATTN: Mr. David Lavergne

SUBJECT: Report of Geotechnical Engineering Study
Proposed Southeast Water Treatment Plant Water Lines
Highway 431
Marshall and Madison Counties, Alabama
OMI Job No. 6759

Gentlemen:

OMI, Inc., has completed a subsurface exploration and geotechnical engineering study for the referenced project. Enclosed is the report of the findings as well as recommendations for trench design and construction, site preparation, and other geotechnically related site activities. This work was authorized on September 25, 2013 by Mr. Christian Dunaway of Tetra Tech.

OMI, Inc., appreciates the opportunity to be of service to Tetra Tech and looks forward to continued involvement with the construction monitoring phase of this project. Please direct any questions concerning this report to the undersigned.

Respectfully submitted,
OMI, Inc.

Christopher S. Jones, E.I.
Staff Engineer

John M Ozier
John M. Ozier, P.E.
Senior Engineer

Distribution: 3 Copies to Addressee

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TABLE OF CONTENTS

APPENDICES

1.0 EXECUTIVE SUMMARY

Traditional open cut trench methods are suitable for the installation of the water lines based on the soil borings drilled during this study. Auger refusal was encountered in the two borings near the Paint Rock River; however, the remaining borings did not encounter auger refusal. This implies that rock will not be encountered during the trench excavation for the majority of the project. However, the borings were drilled 1,000-ft apart and rock can be shallow between the borings. Groundwater was not encountered within 5-ft of the surface in any of borings drilled during this study; however, OMI anticipates groundwater control will be required at several locations along the proposed water line, especially if the work is performed during the wet season.

Specific recommendations for foundation design and site earthwork are given in the body of this report.

2.0 INTRODUCTION

OMI, Inc., has completed a geotechnical engineering study for the proposed raw and finished water lines for the proposed Southeast Water Treatment Plant in Marshall County, AL. This report outlines the scope of services provided and presents comments and recommendations based on professional opinions formed during the course of this study. This work was authorized on September 25, 2013, by Mr. Christian Dunaway of Tetra Tech. The work was performed in general accordance with OMI Proposal No. P-4111-A.

Assessment of the environmental aspects of this site, including previous land use or the determination of the presence of any chemical, industrial, or hazardous waste is beyond the scope of this study. However, OMI can provide these services if desired.

3.0 EXPLORATION METHODS

The procedures used by OMI for field and laboratory testing are in general accordance with ASTM procedures and established engineering practice. Brief descriptions of the procedures used in this exploration are contained in the Appendix of this report.

Thirty two soil test borings to 10-ft each, six borings to 15-ft, and two borings to auger refusal were performed during this study. Boring locations and depths were provided by Tetra Tech and are shown on the appended Boring Location Plan. A member of the OMI professional staff directed the drilling and logged the soils in the field during excavation. Subsequently, each sample was sealed and transported to the office. Selected samples were tested to determine the natural moisture content and Atterberg limits of the soil. These tests assist in confirming the visual classifications as well as provide an index of certain engineering properties. The soil classifications, field testing data, and the results of the laboratory tests are provided on the Soil Boring Records in the Appendix of this report.

4.0 SITE CONDITIONS

Raw Water Line

OMI previously performed subsurface studies for the proposed raw water line extending from Guntersville Lake along Guntersville Dam Road to the southern border of the site proposed for the Southeast Water Treatment Plant. As part of this study, OMI drilled four soil borings on the site proposed for the Southeast Water Treatment Plant along the proposed location of the raw water line. This location consists of mowed fields and wooded areas containing wetlands. Surface drainage within this area is controlled by wetlands and tributaries of Little Paint Rock Creek located northeast of the proposed raw water line location.

Finished Water Line

The proposed finished water line generally extends east from the proposed water treatment plant to Highway 431, which forms the eastern border to the site. The finished water line will cross beneath Highway 431 and extend north approximately 34,250-ft to just north of Ed Sprears Road in New Hope, AL. The proposed finished water line will be predominately located in existing right of way along the east side of Highway 431. The proposed location consists predominately of mowed grass with varying topography. The proposed water line appears to cross through wetlands located on the proposed water treatment plant site before intersecting Highway 431.

5.0 SUBSURFACE CONDITIONS

Raw Water Line

Borings RW-1 through RW-4 generally encountered low plastic, firm to very stiff, sandy silty clays below the topsoil layer that extended to depths ranging from 3.5-ft to boring termination at 10-ft. Standard Penetration Tests (SPT's) within this layer ranged from 7 to 19 blows per foot (bpf) and pocket penetrometer values ranged from 0.75 tons per square foot (tsf) to 4.5 tsf with an average of about 3 tsf. A sample was collected from boring RW-1 at a depth of 3.5 to 5-ft for an Atterberg Limits test. The test resulted in a plastic limit of 24 and liquid limit of 40. High plastic, very stiff, sandy silty clays were encountered below this layer to boring termination at 10-ft in borings RW-1 and RW-2. SPT values within this layer ranged from 16 to 18 bpf and pocket penetrometer values within this layer ranged from 3 to 4.5 tsf with an average of about 4 tsf.

Extended groundwater table measurements showed borings RW-B-1 through RW-B-4 were dry to depths ranging from 6-ft to 8-ft. However, OMI anticipates groundwater control will be required, especially within the wooded areas that are believed to contain wetlands.

Finished Water Line

The following table summarizes the subsurface conditions identified by the borings performed during this study:

Borings	Soil Conditions	SPT Values	Pocket Penetrometer Values (tsf)
FW-B-1 through FW-B-3	0-ft to 0.5-ft Topsoil		
	0.5-ft to 10-ft Stiff to very stiff, low plastic, sandy silty clay , CL	8 to 20	0.75 to 4.5
FW-B-4	0-ft to 0.5-ft Topsoil		
	0.5-ft to 13.5-ft Firm to stiff, low plastic, sandy silty clay , CL	5 to 10	0.5 to 2.5
	13.5-ft to 15-ft Very stiff, high plastic, sandy silty clay, CH	22	2.5
FW-B-5 through FW-B-7	0-ft to 0.5-ft Topsoil		
	0.5-ft to 10-ft Firm to very stiff, low plastic, sandy silty clay , CL	9 to 26	1.5 to 4.5
FW-B-8 through FW-B-10	0-ft to 0.5-ft Topsoil		
	0.5-ft to 8.5-ft Stiff to very stiff, low plastic, sandy silty clay , CL	12 to 25	2.5 to 4.5
	8.5-ft to 10-ft Very stiff, high plastic, sandy silty clay, CH	16 to 20	1.25 to 2.5
FW-B-11	0-ft to 0.5-ft Topsoil		
	0.5-ft to 13.5-ft Stiff to very stiff, high plastic, sandy silty clay , CH	14 to 20	2.5 to 4.0
	13.5-ft to AR at 28-ft Soft to firm, low plastic, sandy silty clay, CL	4 to 8	0 to 1.5
FW-B-12	0-ft to 0.5-ft Topsoil		
	0.5-ft to 8.5-ft Stiff , low plastic, sandy silty clay , CL	10 to 12	2.0 to 2.5
	8.5-ft to AR at 38-ft Very stiff, low plastic, sandy silty clay, CL	16 t0 100+	2.5 to 4.0
FW-B-13 through FW-B-18	0-ft to 0.5-ft Topsoil		
	0.5-ft to 10-ft Stiff to very stiff, low plastic, sandy silty clay , CL	9 to 26	1.5 to 4.5
FW-B-19 through FW-B-22	0-ft to 0.5-ft Topsoil		
	0.5-ft to 1.5 -5-ft Soft to stiff, low plastic, sandy silty clay , CL	4 to 16	0.5 to 4.5
	1.5 - 5-ft to 10-ft Very stiff, low plastic sandy silty clay, CL	16 to 21	1.75 to 4.5
FW-B-23 through FW-B-29	0-ft to 0.5-ft Topsoil		
	0.5-ft to 8.5-ft Stiff to very stiff, low plastic, sandy silty clay , CL	8 to 29	0.5 to 4.5
FW-B-30 through FW-B-31	0-ft to 0.5-ft Topsoil		
	0.5-ft to 15-ft Stiff to very stiff, low to high plastic, sandy silty clay , CL	8 to 100+	1.5 to 4.5
FW-B-32 through FW-B-34	0-ft to 0.5-ft Topsoil		
	0.5-ft to 10-ft Firm to very stiff, low to high plastic, sandy silty clay , CL	7 to 100+	1.5 to 3.0
FW-B-35 through FW-B-36	0-ft to 0.5-ft Topsoil		
	0.5-ft to 15-ft Firm to very stiff, low to high plastic, sandy silty clay , CL	6 to 26	1.0 to 4.0

The shallowest groundwater measurement recorded was at 5-ft below the ground surface in borings FW-B-2 and FW-B-22. Recorded groundwater table measurements and review of soil samples collected during this study indicate groundwater will likely infiltrate into the trench at several locations throughout the proposed water line location, especially if the work is performed during the wet season.

Because of the geology of this region, the groundwater levels are generally a function of seasonal precipitation and locally heavy rainfall events. Consequently, the groundwater levels can and do fluctuate with time.

6.0 SITE GEOLOGY

Bangor Limestone (generally south of Paint Rock River)

The Bangor Limestone is composed of about 350-ft to 420-ft of bioclastic and oolitic limestone, dolomite, and shale. Chert contained in the Bangor is generally small black nodules or gray geodes found in the upper portion of the formation. The upper Bangor Limestone grades northeastward toward the Pennington Formation and is generally composed of green to gray, calcareous shales and thin beds of dolomite and limestone. The middle part of the Bangor is generally medium to massive-bedded argillaceous limestone with occasional partings of yellow calcareous shale.

Monteagle Limestone (generally north of Paint Road River)

In Alabama, the name Monteagle replaces the names St. Genevieve and Gasper Limestone. In Madison County the Monteagle Limestone ranges in thickness from 200 to 250-ft and is characterized by light gray oolitic limestone in crossbedded, massive beds. Near the top of the formation, the limestone is thinly bedded and separated by beds of shale ranging from 2-in to 5-ft thick.

Sinkhole Activity

Sinkholes have occurred in this formation within the vicinity of this site. However, surface observations and the subsurface exploration did not disclose evidence of sinkhole activity on this site. This exploration does not, nor was it intended to, address the possibility of future sinkhole development.

7.0 PROJECT INFORMATION

Raw Water Line

The line is currently expected to have an invert elevation approximately 5-ft below the existing ground surface elevations. The line will extend from Guntersville Dam Road on to the site proposed for the southeast water treatment plant.

Finished Water Line

The proposed finished water line will consist of 48-in diameter pipe with approximately 3-ft of cover. Cover will vary when crossing existing utilities. The trench depth will vary from 7.5-ft to 15-ft. The proposed finished water line will generally extend east from the proposed plant toward Highway 431. The majority of the water line will be located within existing right of way along the east side of Highway 431. Jack and bore methods will be utilized at road crossings. The line length for this study included approximately 34,250 feet. The proposed water line will tie into existing mains located on the west side of Highway 431 just north of Ed Spears Road in New Hope, AL.

8.0 BASIS FOR RECOMMENDATIONS

The following recommendations are based in part on the preceding project information. This study has utilized the subsurface data, historical information regarding the structural performance of similar structures, and past experience with similar geologic environments to develop professional opinions on which the recommendations are based. Because the layout elements of the design greatly influence the recommendations, OMI must be provided the opportunity to review the following comments and recommendations in light of changes in line location or elevation.

9.0 CONSTRUCTION CONSIDERATIONS

9.1 Raw Water Line Excavation

Based on the borings drilled during this study, OMI anticipates traditional open cut trenches can be utilized during installation of the water lines. Auger refusal was encountered in the two borings drilled near the Paint Rock River; however, none of the remaining borings encountered auger refusal. Based on the borings, it does not appear rock excavation will be required for the majority of the project; however, it is noted that the borings were generally 1000-ft apart. Due to the geologies within the area, fluctuations in the bedrock elevation can and do occur.

9.2 Estimated Topsoil Removal

The depth of topsoil varies across the proposed water line location. OMI believes that the stripping depth to remove the topsoil will average about 6-in.

9.3 Groundwater Control

Groundwater control will be required at several locations throughout the proposed water line location. Groundwater was not encountered within 5-ft of the ground surface in any of the borings drilled during this study; however, groundwater table measurements and review of soil samples collected from the borings indicate infiltration of groundwater into the trench can be expected at several locations throughout the project corridor. It is noted that a few of the borings appeared to be located adjacent to wetlands that likely hold additional water during the wet season elevating the groundwater table within the general area. OMI anticipates dewatering can be accomplished with typical methods.

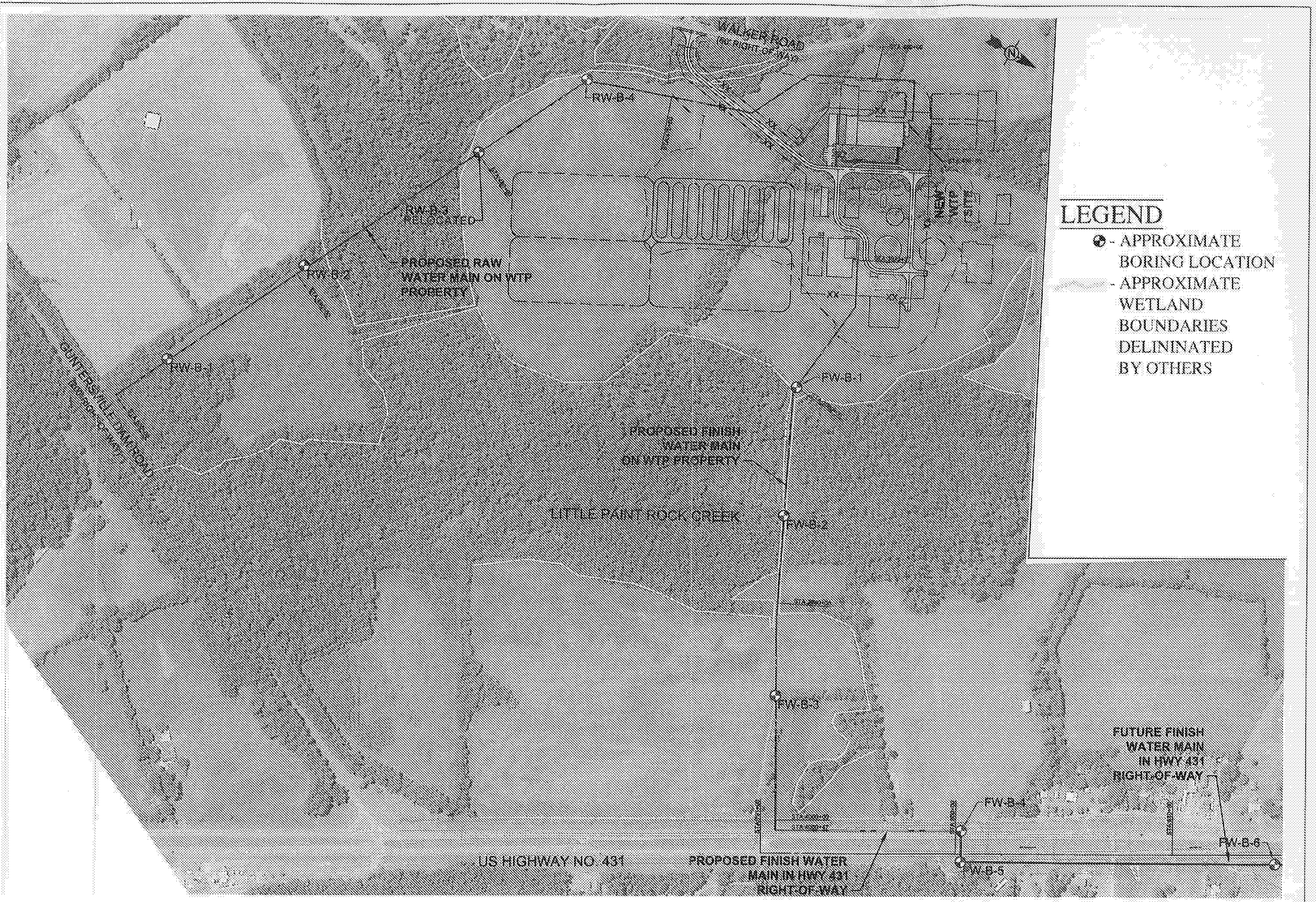
9.4 Excavation Stability, OSHA Compliance

OMI recommends all OSHA guidelines be followed during the construction. The soils encountered during this study appear to range from type B to type C soils.

9.5 Construction Monitoring

The site preparation recommendations contained in this report are based on the conditions encountered during the subsurface exploration and past experience in this geologic setting. Because subsurface conditions may vary from the anticipated, it is important to have a well-rounded quality control program. The involvement in the subsurface exploration portion of this project uniquely qualifies OMI, Inc., to provide these services as a party responsible to the Owner. OMI, Inc., strongly recommends that all construction monitoring be performed under contract with the Owner or the Owner's representative.

APPENDICES



LEGEND

- ● - APPROXIMATE BORING LOCATION
- - APPROXIMATE WETLAND BOUNDARIES DELININATED BY OTHERS

NOTE: THIS DRAWING WAS REDRAWN FROM A DRAWING PROVIDED BY TETRA TECH, HUNTSVILLE, ALABAMA

BORING LOCATION PLAN
SOUTHEAST WATER TREATMENT PLANT
WATERLINES
U.S. HIGHWAY 431
MADISON & MARSHALL CO., ALABAMA

OMI, Inc.
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JOB NO:6759
DATE: 10-30-2013
SCALE: 1" = 400'
DRAWN BY: CCT
SHEET 1 OF 3

BORING LOCATION PLAN
SOUTHEAST WATER TREATMENT PLANT
WATERLINES
U.S. HIGHWAY 431
MADISON & MARSHALL CO., ALABAMA

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JOB NO:6759
DATE: 10-30-2013
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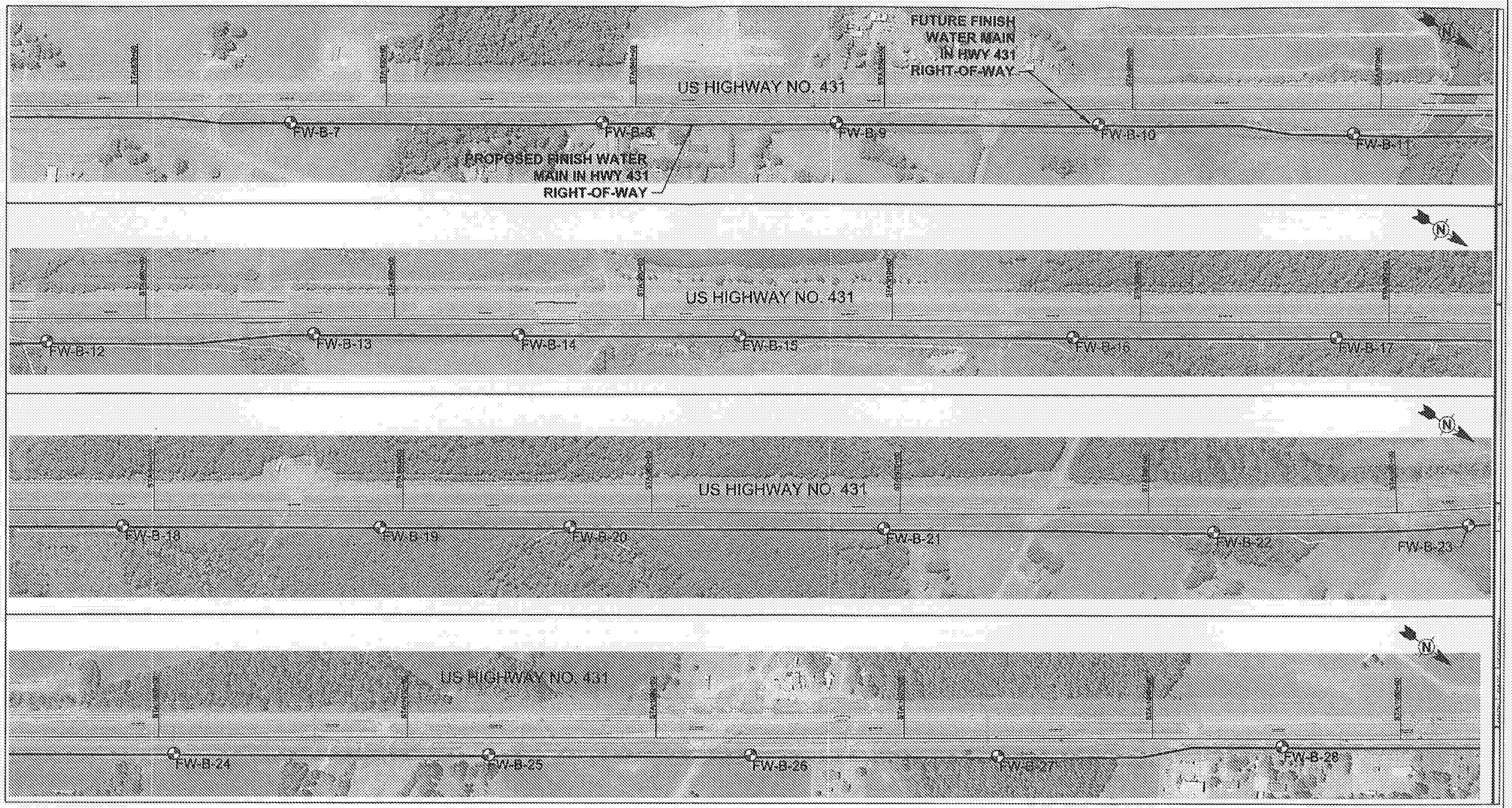
SHEET 2 OF 3



LEGEND

● -BORING LOCATION

NOTE: THIS DRAWING WAS REDRAWN FROM A DRAWING PROVIDED BY TETRA TECH, HUNTSVILLE, ALABAMA