STS CONSULTANTS, LTD.

Preliminary Subsurface Exploration and Geotechnical Engineering Analysis
Proposed Commercial Development
Lennox Township, Macomb County, Michigan

Mr. Paul Aragona, Member
Bay River Development Group, LLC
45000 River ridge Drive, Suite 200
Clinton Township, MI 48038

STS Project No. 7-74618

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April 5, 2005

Mr. Paul Aragona, Member
Bay River Development Group, LLC
45000 River Ridge Drive, Suite 200
Clinton Township, MI 48038

Re: Preliminary Subsurface Exploration and Geotechnical Engineering Analysis for Proposed Commercial Development in Lennox Township, Macomb County, Michigan
STS Project No. 7-74618

Dear Mr. Aragona:

The preliminary subsurface exploration and geotechnical engineering analysis for the above referenced project has been completed. The attached report contains the logs of ten (10) soil borings, an evaluation of the conditions encountered by the borings, and our recommendations regarding suitable foundation types, support of floor slabs, pavements and other geotechnical-related design and construction considerations.

We appreciate the opportunity to have provided exploration, testing and geotechnical engineering services for you. If you have any questions regarding the attached report, or if we can be of further assistance, please call us at (616) 464-5260.

Respectfully,

STS CONSULTANTS, LTD.

Donald N. Hopper, P.E.
Senior Project Engineer

James J. Botz, P.E.
Principal Engineer

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1.0 PROJECT OVERVIEW

1.1 Project Description

The project site is located north of 26 Mile Road at the intersection with Interstate I-94 in Lennox Township, Macomb County, Michigan. The preliminary exploration was performed for a Proposed Commercial Development which will have a number of structures of various sizes. We assume that construction will be structural steel framing and concrete masonry unit walls with a brick facade. Structural loads are not known at this time, but it is assumed that column, wall and floor loads will be 100 kips, 6 kips per lineal foot and 100 pounds per square foot or less, respectively. The floor elevations for the various structures will probably vary only slightly since the site is relatively level.

1.2 Scope of Work

The scope of the preliminary geotechnical exploration of the site consisted of performing 10 soil borings to a depth of 25 feet. The borings were staked in the field by STS at locations that were selected by the client based on a proposed site plan prepared by Rogvoy Architects.

The purposes of this report are to describe the site, soil and groundwater conditions, to analyze and evaluate the data obtained, and to provide recommendations regarding the foundations, slabs-on-grade, lateral earth pressures and pavement design and construction for the Proposed Commercial Development.

2.0 EXPLORATION PROCEDURES

2.1 Preliminary Subsurface Exploration

The preliminary subsurface exploration program consisted of drilling 10 soil borings to a depth of 25 feet. The locations of the borings are shown on the Soil Boring Location Plan, Figure 1 in Appendix A.

The borings were performed using an ATV mounted drilling unit. Representative samples were obtained using a split-barrel sampling procedures completed in general accordance with ASTM D-1586, Standard Method of Penetration Test and Split-Barrel Sampling of Soils. A copy of the Standard Boring Log Procedures is included in Appendix D. The surface elevations at the boring locations were approximated by STS using a current topography drawing of the existing site provided by Aragona Properties.

A log of all soils recovered in the borings was maintained by the drill crew. Soil samples obtained from the drilling operations were sealed immediately in the field and returned to our Grand Rapids laboratory for further examination and testing. Observations of water levels encountered in the borings both during and after sampling are noted on the respective boring logs. Upon completion of the borings, the boreholes were backfilled soil cuttings.

2.2 Laboratory Testing Program

The laboratory testing program for this project consisted of visual classification of all samples and water content testing on selected cohesive samples. In addition, either hand penetrometer or unconfined compression tests were performed on cohesive samples. In the hand penetrometer test, the unconfined compressive strength of the soil, to a maximum value of 4.5 tons per square foot (tsf), was estimated by measuring the resistance of the sample to penetration of a small spring calibrated cylinder. The results of the laboratory tests are noted on the boring logs contained in appendix B.

In conjunction with the laboratory testing program, the soil samples were visually examined and classified on the basis of texture and plasticity in accordance with the STS Soil Classification

System. The estimated group symbol included in the parentheses following the soil descriptions on the boring logs is in general conformance with the Unified Soil Classification System which serves as the basis for the STS Soil Classification System. A brief explanation of the classification of soils is included in the Laboratory Procedures section in Appendix D.

The procedures utilized in preparing the final boring logs from the field logs and laboratory test data are described on the sheets entitled “STS Field and Laboratory Procedures” which are included in Appendix D. All soil samples recovered from the borings will be retained in our laboratory for a period of 60 days after which they will be discarded unless specific instructions as to their disposition are received.

3.0 EXPLORATION RESULTS

3.1 Site Conditions

The site is located north of 26 Mile Road at the intersection with Interstate I-94 in Lennox Township, Macomb County, Michigan. The site is gently sloping with grade changes that range from a high of 628 feet at the location of boring B-9 to a low of 617.6 feet at the location of boring B-7. Overall the site elevation is close to 626 feet. A 100 foot wide easement for a natural gas pipeline runs parallel to Interstate I-94 and extends over the entire site. Portions of the site are used for a used car lot with a small office area and a repair garage. There is also a barn complex with silos and other farm out buildings present. The vast majority of the site is vacant with grasses, brush and some scattered small trees for vegetation, although the area is more wooded with larger trees near the eastern boundary.

3.2 Soil Conditions

The following is a brief summary of the subsurface conditions encountered at the site. Detailed information of the soils encountered in each boring are presented on the enclosed soil boring logs located in Appendix B of this report.

Surface Material – Topsoil was encountered at the surface of all of the borings except B-8 where bituminous pavement was found. The topsoil depths varied from 12 to 13 inches over the site. At boring B-8 topsoil was found below the pavement base course to a depth of 1.5 feet.

Fill Soils – Probable fill was found at the location boring B-7 to a depth of 3.0 feet. The fill is classified as silty clay, black and gray in color and was in a stiff condition.

Natural Soils - Natural soils are primarily a granular material consisting of silty fine sand or fine sand. The exception to this is at boring B-7 where the soils are all cohesive and boring B-8 where cohesive soils were found below the pavement to a depth of 5.5 feet. The cohesive soils are classified as silty clay or sandy clay and based on SPT and hand penetrometer values were found to be in a stiff to very stiff condition. The granular soils based on the SPT values were found to be in a loose to medium dense condition.

Additional variations to the above general profile were noted. We refer you to the individual boring logs, attached, for specific information at the boring locations. It should be noted that the stratification lines indicated on the boring logs were selected on the basis of laboratory tests, field logs and visual observations of the recovered soil samples. Therefore, the stratification lines that occur on the boring logs are in some cases estimated: in-situ, the transition between soil types in both the horizontal and vertical directions may be gradual.

3.3 Groundwater Conditions

Groundwater was observed in the majority of the borings. The following table shows the depth to the observed groundwater level and corresponding elevation.

Table 1

Groundwater Data

Boring Number	Surface Elevation	While Drilling		After Boring	
		Depth to Groundwater	Groundwater Elevation	Depth to Groundwater	Groundwater Elevation
1	626.0	3.5	622.5	5.1	617.4
2	625.2	3.5	621.7	4.6	617.1
3	625.9	3.0	622.9	4.9	618.0
4	626.5	3.5	623.0	4.6	618.4
5	625.7	3.5	622.2	4.2	618.0
6	626.5	3.5	623.0	4.2	618.8
7	617.6	Dry		Dry	
8	626.0	6.0	620.0	6.8	613.2
9	628.0	3.5	624.5	5.0	619.5
10	626.0	6.0	620.0	7.3	612.7

Due to the relatively high permeability of the granular soils encountered at this site, these observations should be considered a good indication of the groundwater level at the time of our exploration. Additionally the groundwater table elevations will fluctuate due to seasonal variations in rainfall and surface run-off conditions, and therefore, the readings indicated on the boring logs may not be representative of the long-term hydrostatic groundwater table. Long-term monitoring would be required to make a more accurate estimate of the groundwater table elevation.

4.0 ANALYSIS AND RECOMMENDATIONS

4.1 Earthwork and Mass Grading

The first item to be considered for construction of the project would be tree removal. Several trees are standing on the site. It will be necessary to remove all of the trees, including stumps and roots that will be within any of the building limits. When that has been completed, the topsoil should be removed and stockpiled.

Based on the surface contours it appears as though little earthwork will be required to bring the site to finished grade. However, because of the high water table encountered in the area of some of the proposed building locations it may be desirable to raise the floor elevations of the buildings to keep the footings out of the groundwater.

If the site is to be filled, the fill, including backfill around footings and basement walls should be constructed as a structural fill, placed as follows:

- Remove all topsoil and other unsuitable materials as specified by a representative from STS;
- Proofroll the area where fill is to be placed with a vehicle weighing at least 25 tons, such as a loaded dump truck. The proofrolling should be performed in two perpendicular directions to provide complete coverage and should be continued until the surface is satisfactory. Unsuitable soils should be removed and replaced as directed by the Geotechnical Engineer;
- Clean well-graded granular soils or approved on-site soils can be used for structural fill, unless otherwise specified;
- The structural fill should be placed in lifts of nine (9) inches or less, each lift should be compacted and tested before placing subsequent lifts;
- All soils used for the structural fill or supporting the structural fill must be compacted to 95% of the maximum dry density determined by the modified Proctor method (ASTM D1557);
- Granular soils should be compacted with a vibratory roller. Cohesive soils should be compacted with a sheepsfoot roller with tines equal in length to the thickness of the lift of loose material;
- Fill material should extend a minimum of 10 feet beyond the edges of the foundations and then one (1) foot horizontally for each foot of fill required below the foundations;
- STS should continuously monitor all operations during the excavation and filling phases.

4.2 Foundations

The results of this exploration program indicate the Proposed Commercial Development may be supported on a shallow footing foundation system. The bottom of the footings should be placed at a minimum depth of 3.5 feet below finished exterior grade in heated areas and 4.5 feet in non-heated areas to provide adequate frost protection, however, excavations for all of the footings should extend below any existing fill material and the footings supported by the natural soils. Footings may be designed for placement on natural soils consisting of silty sand or fine sand with a net allowable bearing capacity of 4,000 pounds per square foot (psf). The net allowable soil bearing pressure refers to that pressure that may be transmitted to the foundation soil in excess of the final minimum surrounding overburden pressure.

A minimum footing size of 1.5 feet for continuous and 2.5 feet for spread footings should be utilized to prevent disproportionately small footing sizes.

Before setting forms or placing concrete for the footings the supporting soils should be tested by STS personnel to be certain that the design bearing capacity is available. Any unsuitable subgrade soils should be removed until adequate bearing soils are reached.

Total settlement of the footings as described above is estimated to be 1 inch or less with typical differential settlements ½ of the total settlements.

4.3 Below-Grade Walls and Drainage Considerations

Because of the high water table, constructing basements or lower levels below any of the building proposed for this site is not recommended. However, if below grade walls, such as retaining walls, are constructed they should be designed to resist lateral earth pressures. The active earth pressure coefficient assumes that the wall can deflect at least one (1) percent of wall height. These structures should be designed using the earth pressure coefficients and moist unit weight values presented in Table 1.

TABLE 1

Recommended Below-Grade Wall Design Parameters	
Total Unit Weight, γ_t	115 pcf
Angle of Internal Friction	30°
Active Earth Pressure Coefficient, K_a	0.33
Passive Pressure Coefficient, K_p	3.00
Friction Coefficient between Concrete and Soil	0.30

Backfill consisting of free-draining granular drainage aggregate such as MDOT Class II sand, having less than seven (7) percent by weight passing the No. 200 sieve, should be placed behind the below-grade walls and extend at least five (5) feet from the face. The backfill should be compacted to a minimum of 95% of the maximum dry density as determined by the modified Proctor method (ASTM D-1557) in structural areas and to 90% in green areas.

Surcharge loads extending from a zone of one (1) horizontal to one (1) vertical from the base of the wall should also be included in the design. This includes surcharge loads induced from the floor slab of the structure. The top of the wall should be braced prior to placement of backfill material, and the size of compactor limited to that of less than 500 pounds total weight to minimize stresses on the wall.

4.4 Slabs-On-Grade

We anticipate that the floor slabs within the structure will bear on natural soils. These soils should be suitable for floor slab support, provided the subgrade appears firm while proofrolling immediately prior to construction. The area should be proofrolled with a vehicle weighing at least 25 tons, such as a loaded dump truck. The proofrolling should be performed in two perpendicular directions to provide complete coverage and should be continued until the surface is satisfactory. Unsuitable soils should be removed and replaced as directed by the Geotechnical Engineer. Floor slabs in this area overlying a suitable subgrade may be designed as conventional slabs-on-grade.

We recommend that the floor slab be underlain by at least 6 inches of compacted, well-graded granular material containing less than 5 percent (by weight) of material passing the No. 200 sieve. This granular layer will act both as a base for slab support and as a capillary break to vertical moisture migration between the base of the floor slab and the underlying subgrade. The American Concrete Institute also recommends that a vapor barrier be placed below slabs where moisture sensitive floor coverings will be used. If needed, the depth of the vapor barrier beneath the slab should be based on the slab and concrete mix design in slab-on-grade areas.

Floor slabs should be independently supported from the building foundations to permit slight differential movements to occur between the slabs and foundation elements. Floor slabs should be at least nominally reinforced with steel wire mesh to help reduce cracking and maintain the structural integrity of the slab. Adequate slab joints should also be provided. Slab reinforcement and concrete design should be performed by a qualified professional taking into consideration the expected loading and environment, drainage, and subgrade conditions. We recommend use of a vertical modulus of subgrade reaction of 200 pounds per cubic inch (pci) for design of floor slabs-on-grade. Lightly loaded floor slabs that are constructed in accordance with the preceding recommendations should have a total settlement of less than ¼ inch.

4.5 Pavements

After excavating to the pavement subgrade level or prior to placement of structural fill to raise the site to subgrade elevations, the subgrade should be proofrolled as outlined in Section 4.1 Earthwork and Mass Grading to delineate near surface soft or otherwise unsuitable materials.

The pavement should be designed for the types and volumes of traffic anticipated using a design California Bearing Ratio (CBR) of ten (10) for a granular subgrade. A modulus of subgrade reaction of 200 pci can be used for the design of any Portland cement concrete pavements. Adequate joint spacing dowels and reinforcing should be provided for rigid pavements.

Pavement subgrades should be sloped to drain. Sub-drainage should be provided at any low areas and along the edges of pavements and parking lots to prevent the accumulation of free water within the base course and subgrade, which can result in softening of the subgrade and premature deterioration of the pavement under exposure and repeated traffic conditions.

Inclusion of adequate surface drainage systems is considered imperative in order to maintain the compacted subgrades as close to optimum moisture conditions as possible. Overall, surface grades should be such that no pavement sectors are allowed to impound water. Surface water should be directed to a system of catch basins.

An STS representative should verify the subgrade soils prior to the placement of the granular subbase course. It is also recommended that all waste roll-offs, emergency generator and transformers pads be placed on concrete slabs.

All materials to be employed and field operations required in connection with the contemplated pavement structures should follow recommendations and procedural details as per the Michigan Department of Transportation (MDOT), Asphalt Institute and/or American Concrete Institute.

4.6 Seismic Site Class

According to the 2000 Michigan Building Code (MBC) seismic loading will have to be considered for this site. The structure considered for this site falls into a Category or Seismic Use Group II structure with a Seismic Factor (I_E) of 1.25 based on the 2000 MBC Table 1604.1. For this site, only the standard penetration resistance is known. This information is taken from the borings, which were carried to a maximum depth of 25 feet. Therefore this site should be placed in the Site Class E category based on the 2000 MBC Table 1615.1.1.

4.7 Further Investigations

Since this report was prepared for a preliminary geotechnical investigation, we recommend that when the final locations of the structures planned for the site have been finalized, additional soil borings be completed at locations selected jointly by STS and the owner or his representative. At that time a more complete geotechnical report will be prepared for each of structures.

4.8 Construction Considerations

We anticipate that some excavations, such as for utilities, for this project will be performed below the groundwater table. These excavations will likely require extensive dewatering operations such as deep wells or well points. In addition, all soils which become softened or loosened at the base of the foundation excavations, or excavations which are to receive compacted structural fill or base course materials, should be carefully removed down to an approved, undisturbed soil surface prior to the placement of these fills or foundation concrete. No structural fill or foundation concrete should be placed into excavations which contain water, ice, frozen soil, etc. We strongly recommend that a representative of STS Consultants, Ltd. be present on site to observe the soils exposed at the base of the foundation excavations and in the floor slab and pavement subgrades to check that the conditions at the time of construction are as anticipated in the design.

The sides of excavations should be made in accordance with OSHA regulations with regard to side slope. Side slopes on the order of 2 horizontal to 1 vertical may be required for temporary foundation excavations extending to the groundwater table. Sideslopes of excavations extending below the groundwater table will assume flatter slopes depending on the dewatering effort. Stockpiled construction materials should not be placed within the zone of influence of the excavation side slopes. Earth retention systems for excavations with insufficient room for adequate sloping should be designed by a licensed Professional Engineer.

Construction safety is the responsibility of the contractor.

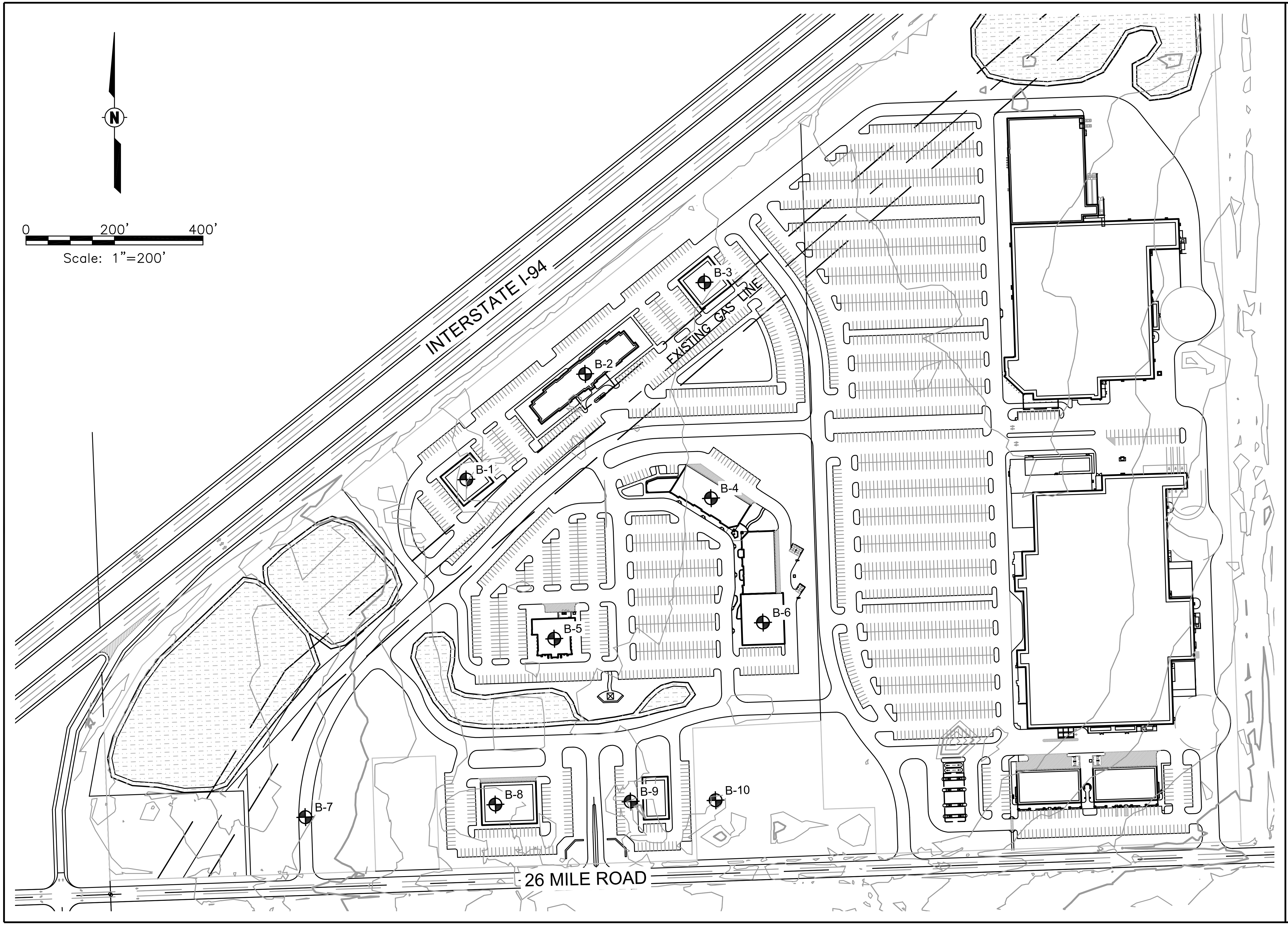
5.0 GENERAL QUALIFICATIONS

This report has been prepared in general accordance with normally accepted geotechnical engineering practices to aid in the evaluation of this site and to assist our Client in the design of this project. We have prepared this report for the purpose intended by our Client, and reliance on its contents by anyone other than our Client is done at the sole risk of the user. No other warranty, either expressed or implied, is made. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects relevant to the geotechnical characteristics. In the event that any changes in the design or location of the facilities as outlined in this report are planned, we should be informed so that the changes can be reviewed and the conclusions of this report modified as necessary in writing by the geotechnical engineer. As a check, we recommend that we be authorized to review the project plans and specifications to confirm that the recommendations contained in this report have been interpreted in accordance with our intent. Without this review, we will not be responsible for the misinterpretation of our data, our analysis, and/or our recommendations, nor how these are incorporated into the final design.

The analysis and recommendations submitted in this report are based on the data obtained from the soil borings performed at the locations indicated on the location diagram and from the information discussed in this report. This report does not reflect any variations which may occur between the borings. In the performance of Preliminary Subsurface explorations, specific information is obtained at specific locations at specific times. However, it is a well-known fact that variations in soil and rock conditions exist on most sites between boring locations and that seasonal and annual fluctuations in groundwater levels will likely occur. The nature and extent of variations may not become evident until the course of construction. If variations then appear evident, it will be necessary for a re-evaluation of the recommendations contained in this report after performing on-site observations during the construction period and noting the characteristics of the variations.

The geotechnical engineer of record is the professional engineer who authored the geotechnical report. It is recommended that all construction operations dealing with earthwork and foundations be observed by the geotechnical engineer of record or the geotechnical engineer's appointed representative to confirm that the design requirements are fulfilled in the actual construction. For some projects, this may be required by the governing building code.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria, viruses, and the byproducts of such organisms) assessment of the site, or identification of or prevention of pollutants, hazardous materials or conditions. Other studies beyond the scope of this project would be required to evaluate the potential of such contamination or pollution.



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LENNOX TOWNSHIP
SOIL BORING LOCATION PLAN
PROPOSED COMMERCIAL DEVELOPMENT
LENNOX TOWNSHIP, MICHIGAN

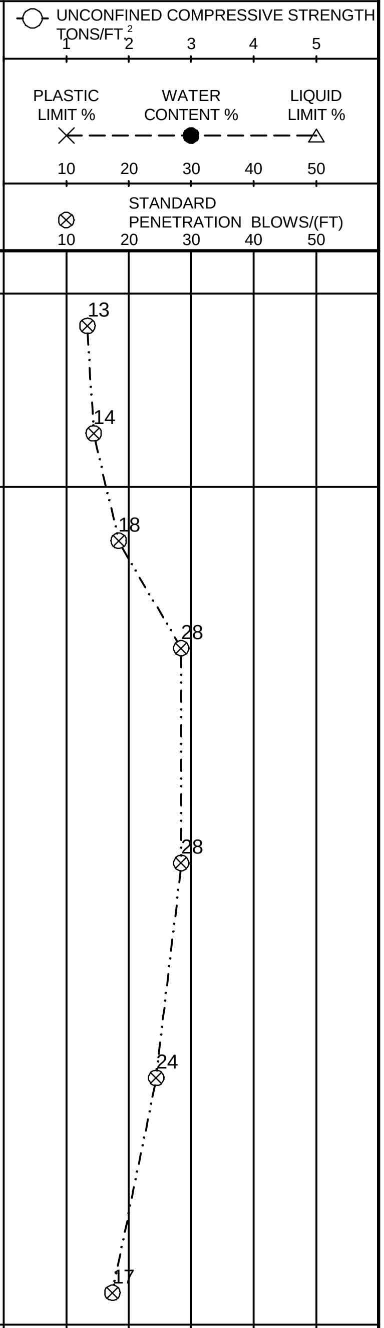
Drawn :	MAM	04/04/2005
Checked:	DNH	04/04/2005
Approved:	DNH	04/04/2005
PROJECT NUMBER	774618	
FIGURE NUMBER	1	

STS Consultants Ltd.

CLIENT **Aragona Properties**	LOG OF BORING NUMBER **B-1**
PROJECT NAME **Proposed Commercial Development**	ARCHITECT-ENGINEER
SITE LOCATION **Lennox Township, Macomb County, MI**	

SURFACE ELEVATION +626.0

DEPTH(FT)	SAMPLE NO.	SAMPLE TYPE	STRATUM DEPTH	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}	STANDARD PENETRATION BLOWS/(FT)
		HS	1.0	Sandy topsoil - dark brown (12").		
	1	SS		Silty fine sand, trace gravel - brown - medium dense - moist to wet (SM)		13
		HS				
	2	SS				14
5.0		HS	5.5			
	3	SS		Fine sand, trace silt, trace gravel - brown - medium dense - wet (SP)		18
		HS				
	4	SS				28
10.0		HS				
	5	SS				28
15.0		HS				
	6	SS				24
20.0		HS				
	7	SS	25.0			17
25.0				End of Boring 25.0' Boring backfilled with soil cuttings to surface.		



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL 3.5' WD	BORING STARTED 3/15/05	STS OFFICE Detroit	
WL 5.1' AB	BORING COMPLETED 3/15/05	ENTERED BY DNH	SHEET NO. 1 OF 1
WL	RIG/FOREMAN ATV D-50/R. Rumpf	APP'D BY KCK	STS JOB NO. 7-74618

STS Consultants Ltd.

CLIENT: **Aragona Properties**

LOG OF BORING NUMBER **B-2**

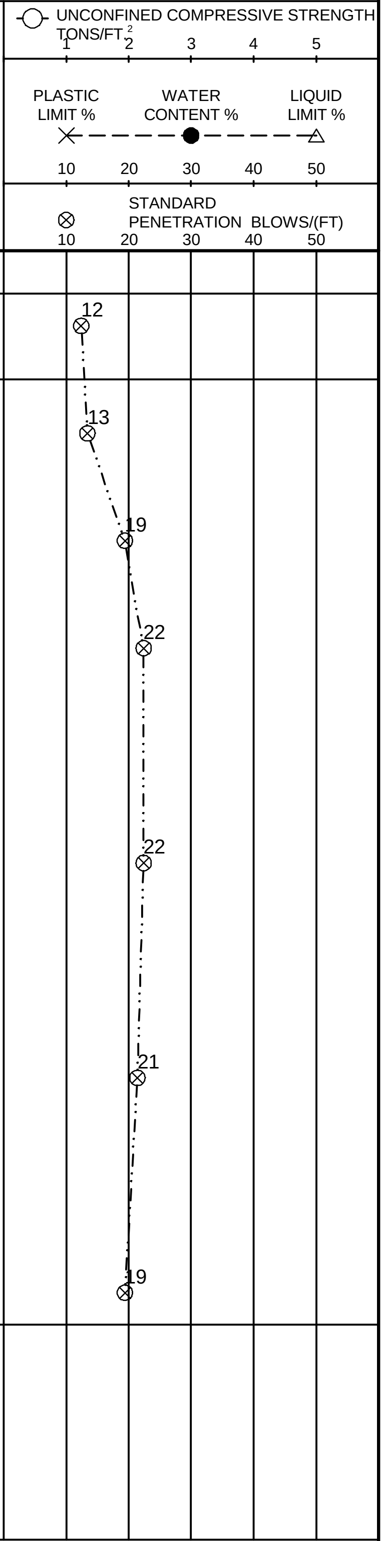
PROJECT NAME: **Proposed Commercial Development**

ARCHITECT-ENGINEER

SITE LOCATION: **Lennox Township, Macomb County, MI**

SURFACE ELEVATION +625.2

DEPTH(FT)	SAMPLE NO.	SAMPLE TYPE	DESCRIPTION OF MATERIAL	STANDARD PENETRATION BLOWS/(FT)
		HS	Sandy topsoil - dark brown (12").	
1.0	1	SS	Silty fine sand, trace gravel - brown - medium dense - moist (SM)	12
3.0		HS	Fine sand, trace silt, trace gravel - brown - medium dense - wet (SP)	
	2	SS		13
5.0		HS		
	3	SS		19
		HS		
	4	SS		22
10.0		HS		
	5	SS		22
15.0		HS		
	6	SS		21
20.0		HS		
	7	SS		19
25.0			End of Boring 25.0' Boring backfilled with soil cuttings to surface.	



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL 3.5' WD	BORING STARTED 3/15/05	STS OFFICE Detroit	
WL 4.6' AB	BORING COMPLETED 3/15/05	ENTERED BY DNH	SHEET NO. 1 OF 1
WL	RIG/FOREMAN ATV D-50/R. Rumpf	APP'D BY KCK	STS JOB NO. 7-74618

STS Consultants Ltd.

CLIENT
Aragona Properties

LOG OF BORING NUMBER **B-3**

PROJECT NAME
Proposed Commercial Development

ARCHITECT-ENGINEER

SITE LOCATION
Lennox Township, Macomb County, MI

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50

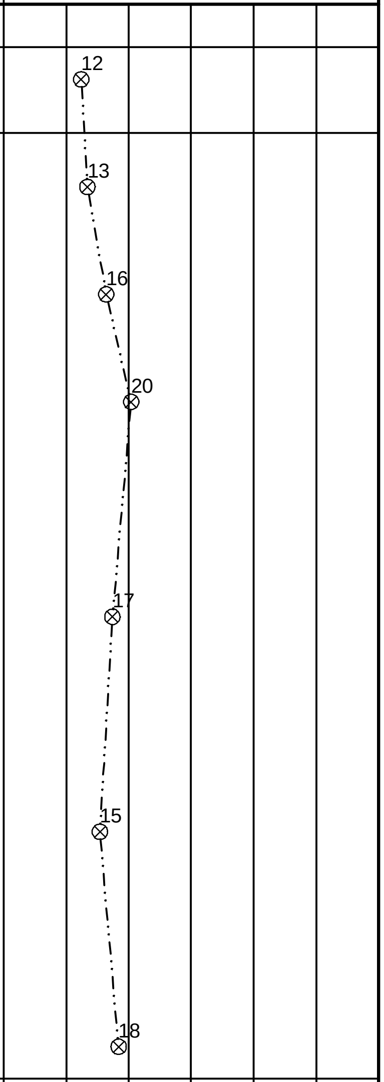
⊗ STANDARD PENETRATION BLOWS/(FT) 10 20 30 40 50

SURFACE ELEVATION +625.9

DEPTH(FT)	SAMPLE NO.	SAMPLE TYPE	DESCRIPTION OF MATERIAL	STANDARD PENETRATION BLOWS/(FT)
0.0–1.0		HS	Sandy topsoil - dark brown (12").	
1.0–3.0	1	SS	Silty fine sand, trace gravel - brown - medium dense - moist (SM)	12
		HS		
3.0–25.0	2	SS	Fine sand, trace silt, trace gravel - brown - medium dense - wet (SP)	13
5.0		HS		
	3	SS		16
		HS		
	4	SS		20
10.0		HS		
	5	SS		17
15.0		HS		
	6	SS		15
20.0		HS		
25.0	7	SS		18

End of Boring 25.0'

Boring backfilled with soil cuttings to surface.



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL 3.0' WD	BORING STARTED 3/15/05	STS OFFICE Detroit	
WL 4.9' AB	BORING COMPLETED 3/15/05	ENTERED BY DNH	SHEET NO. 1 OF 1
WL	RIG/FOREMAN ATV D-50/R. Rumpf	APP'D BY KCK	STS JOB NO. 7-74618

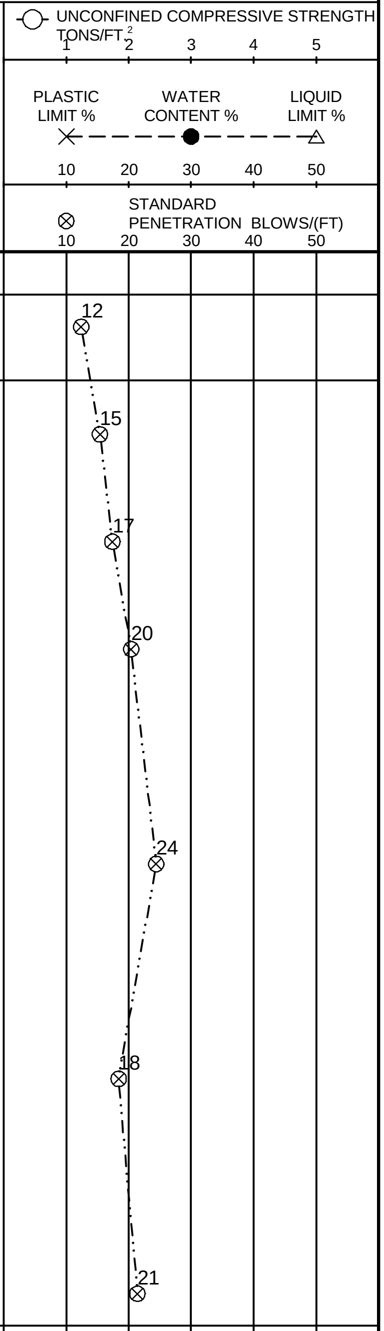
STS Consultants Ltd.

CLIENT **Aragona Properties**	LOG OF BORING NUMBER **B-4**
PROJECT NAME **Proposed Commercial Development**	ARCHITECT-ENGINEER

SITE LOCATION
Lennox Township, Macomb County, MI

SURFACE ELEVATION +626.5

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}	STANDARD PENETRATION BLOWS/(FT)
1.0			HS			Sandy topsoil - dark brown (12").		
3.0		1	SS			Silty fine sand, trace gravel - brown - medium dense - moist (SM)		12
			HS			Fine sand, trace silt, trace gravel - brown - medium dense - wet (SP)		
5.0		2	SS					15
			HS					
		3	SS					17
			HS					
10.0		4	SS					20
			HS					
15.0		5	SS					24
			HS					
20.0		6	SS					18
			HS					
25.0		7	SS					21
						End of Boring 25.0' Boring backfilled with soil cuttings to surface.		



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL **3.5' WD**	BORING STARTED **3/15/05**	STS OFFICE **Detroit**	
WL **4.6' AB**	BORING COMPLETED **3/15/05**	ENTERED BY **DNH**	SHEET NO. **1** OF **1**
WL	RIG/FOREMAN **ATV D-50/R. Rumpf**	APP'D BY **KCK**	STS JOB NO. **7-74618**

STS Consultants Ltd.

CLIENT **Aragona Properties**

LOG OF BORING NUMBER **B-5**

PROJECT NAME **Proposed Commercial Development**

ARCHITECT-ENGINEER

SITE LOCATION **Lennox Township, Macomb County, MI**

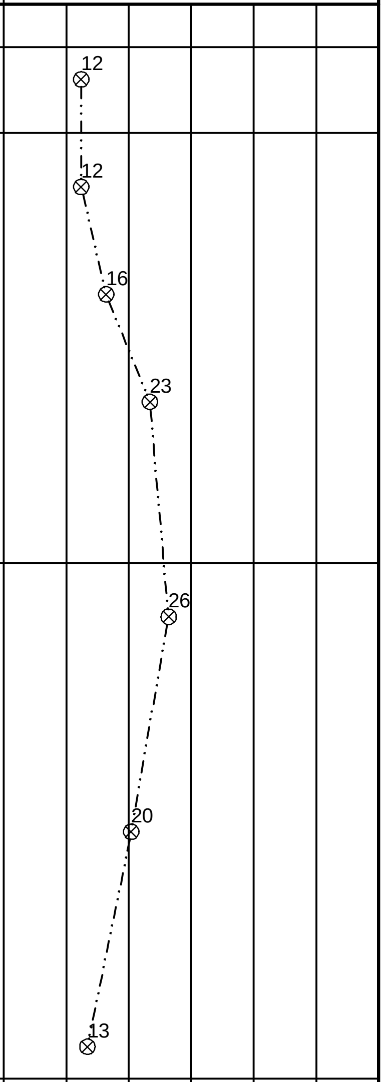
○ UNCONFINED COMPRESSIVE STRENGTH TONS/FT² 1 2 3 4 5

PLASTIC LIMIT % × — WATER CONTENT % ● — LIQUID LIMIT % △ 10 20 30 40 50

⊗ STANDARD PENETRATION BLOWS/(FT) 10 20 30 40 50

SURFACE ELEVATION +625.7

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.³	STANDARD PENETRATION BLOWS/(FT)
			HS			Sandy topsoil - dark brown (12"). 1.0		
		1	SS			Silty fine sand, trace gravel - brown - medium dense - moist (SM) 3.0		12
			HS			Fine sand, trace silt, trace gravel - brown - medium dense - wet (SP)		
		2	SS					12
5.0			HS					
		3	SS					16
			HS					
		4	SS					23
10.0			HS			13.0		
		5	SS			Fine sand, trace silt, trace gravel - gray -medium dense - wet (SP)		26
15.0			HS					
		6	SS					20
20.0			HS					
		7	SS					13
25.0						25.0 End of Boring 25.0' Boring backfilled with soil cuttings to surface.		



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL 3.5' WD	BORING STARTED 3/14/05	STS OFFICE Detroit	
WL 4.2' AB	BORING COMPLETED 3/14/05	ENTERED BY DNH	SHEET NO. 1 OF 1
WL	RIG/FOREMAN ATV D-50/R. Rumpf	APP'D BY KCK	STS JOB NO. 7-74618

STS Consultants Ltd.

CLIENT
Aragona Properties

LOG OF BORING NUMBER **B-6**

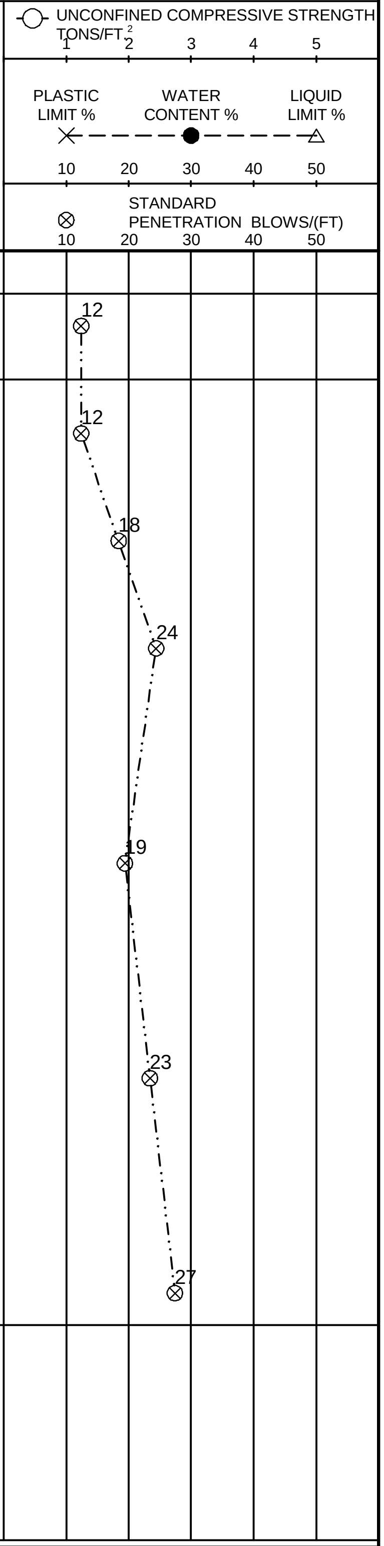
PROJECT NAME
Proposed Commercial Development

ARCHITECT-ENGINEER

SITE LOCATION
Lennox Township, Macomb County, MI

SURFACE ELEVATION +626.5

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
			HS			Sandy topsoil - dark brown (12"). 1.0	
		1	SS			Silty fine sand, trace gravel - brown - medium dense - moist (SM) 3.0	
			HS			Fine sand, trace silt, trace gravel - brown - medium dense - wet (SP)	
5.0		2	SS				
			HS				
		3	SS				
			HS				
10.0		4	SS				
			HS				
15.0		5	SS				
			HS				
20.0		6	SS				
			HS				
25.0		7	SS			25.0	
						End of Boring 25.0' Boring backfilled with soil cuttings to surface.	



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL **3.5' WD**
WL **4.2' AB**
WL

BORING STARTED **3/14/05**
BORING COMPLETED **3/14/05**
RIG/FOREMAN **ATV D-50/R. Rumpf**

STS OFFICE **Detroit**
ENTERED BY **DNH**
APP'D BY **KCK**

SHEET NO. **1** OF **1**
STS JOB NO. **7-74618**

BORING_LOG 74618 ARAGONA PROPERTIES.GPJ STS.GDT 4/14/05

STS Consultants Ltd.

CLIENT
Aragona Properties

LOG OF BORING NUMBER **B-7**

PROJECT NAME
Proposed Commercial Development

ARCHITECT-ENGINEER

SITE LOCATION
Lennox Township, Macomb County, MI

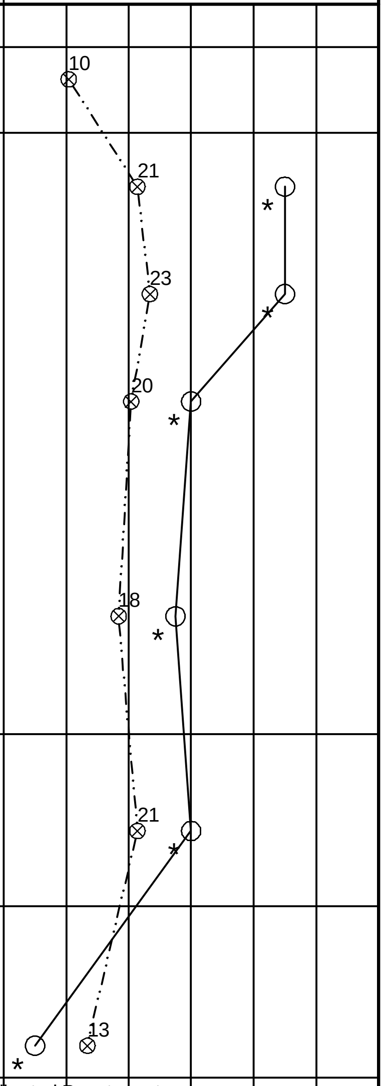
SURFACE ELEVATION +617.6

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.³
			HS			Sandy topsoil - dark brown (12"). 1.0	
		1	SS			Fill: Silty clay, trace sand - gray and black - stiff (CL) 3.0	
			HS			Silty clay, trace gravel - brown - hard to very stiff (CL)	
5.0		2	SS				
			HS				
		3	SS				
			HS				
10.0		4	SS				
			HS				
15.0		5	SS				
			HS			17.0	
						Silty clay, little sand, trace gravel - gray - very stiff (CL)	
20.0		6	SS			21.0	
			HS			Silty clay, some sand - gray - medium (CL)	
25.0		7	SS			25.0	
						End of Boring 25.0' Boring backfilled with soil cuttings to surface.	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50

STANDARD PENETRATION BLOWS/(FT) 10 20 30 40 50



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL Dry WD	BORING STARTED 3/15/05	STS OFFICE Detroit	
WL Dry AB	BORING COMPLETED 3/15/05	ENTERED BY DNH	SHEET NO. 1 OF 1
WL	RIG/FOREMAN ATV D-50/R. Rumpf	APP'D BY KCK	STS JOB NO. 7-74618

BORING_LOG 74618 ARAGONA PROPERTIES.GPJ STS.GDT 4/14/05

STS Consultants Ltd.

CLIENT
Aragona Properties

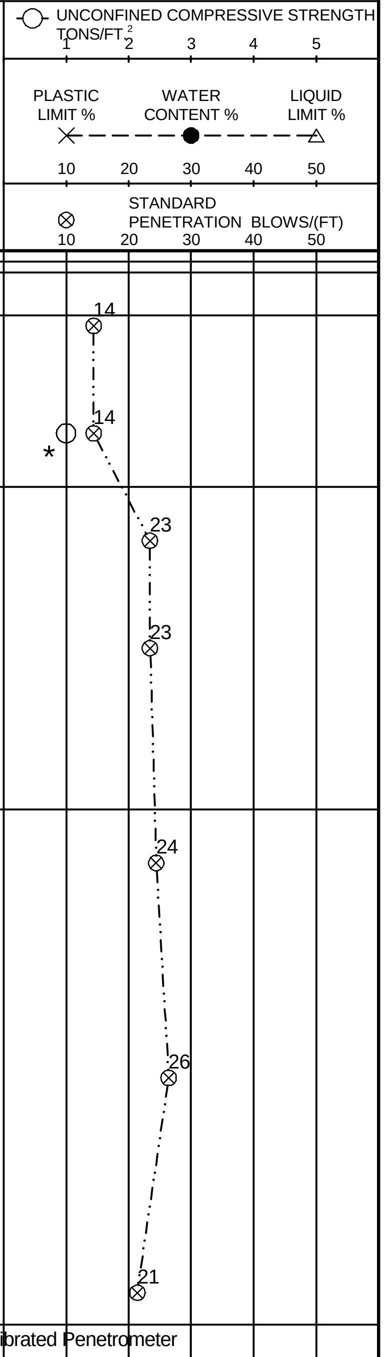
LOG OF BORING NUMBER **B-8**

PROJECT NAME
Proposed Commercial Development

ARCHITECT-ENGINEER

SITE LOCATION
Lennox Township, Macomb County, MI

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
						SURFACE ELEVATION +626.0	
			HS			0.3 Bituminous pavement (3")	
						0.5 Road gravel (3")	
						1.5 Clayey topsoil	
		1	SS			Sandy clay, trace gravel - brown - stiff (CL)	
			HS				
		2	SS				
5.0			HS			5.5	
						Silty fine sand, trace gravel - brown - medium dense - wet (SM)	
		3	SS				
			HS				
		4	SS				
10.0			HS			13.0	
						Fine sand, trace silt, trace gravel - gray - medium dense - wet (SP)	
		5	SS				
15.0			HS				
		6	SS				
20.0			HS				
		7	SS				
25.0						25.0	
						End of Boring 25.0' Boring backfilled with soil cuttings to surface.	



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL **6.0' WD**	BORING STARTED **3/15/05**	STS OFFICE **Detroit**	
WL **6.8' AB**	BORING COMPLETED **3/15/05**	ENTERED BY **DNH**	SHEET NO. **1** OF **1**
WL	RIG/FOREMAN **ATV D-50/R. Rumpf**	APP'D BY **KCK**	STS JOB NO. **7-74618**

STS Consultants Ltd.

CLIENT
Aragona Properties

LOG OF BORING NUMBER **B-9**

PROJECT NAME
Proposed Commercial Development

ARCHITECT-ENGINEER

SITE LOCATION
Lennox Township, Macomb County, MI

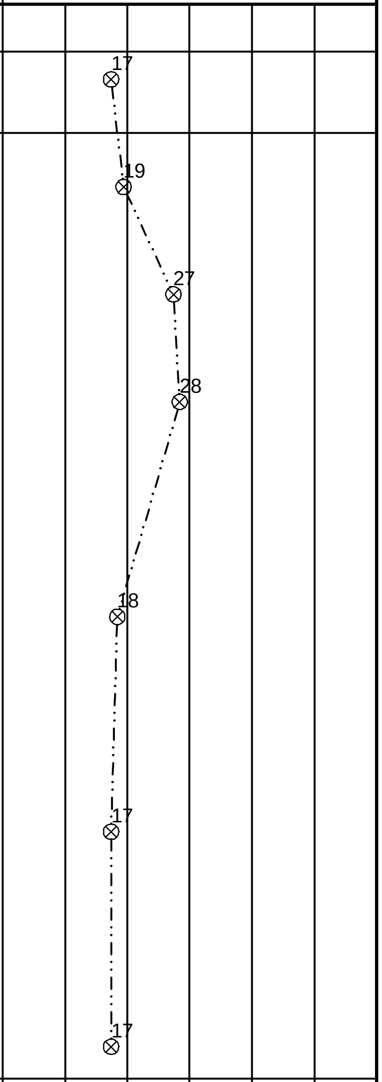
UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2: 1 2 3 4 5

PLASTIC LIMIT % × — WATER CONTENT % ● — LIQUID LIMIT % △: 10 20 30 40 50

⊗ STANDARD PENETRATION BLOWS/(FT): 10 20 30 40 50

SURFACE ELEVATION +628.0

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}	STANDARD PENETRATION BLOWS/(FT)
			HS			Sandy topsoil - dark brown (13"). 1.1		
		1	SS			Silty fine sand, trace gravel - brown - medium dense - moist (SM) 3.0		17
			HS			Fine sand, trace silt, trace gravel - brown - medium dense - wet (SP)		
5.0		2	SS					19
			HS					
		3	SS					27
			HS					
10.0		4	SS					28
			HS					
15.0		5	SS					18
			HS					
20.0		6	SS					17
			HS					
25.0		7	SS			25.0		17
						End of Boring 25.0' Boring backfilled with soil cuttings to surface.		



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL 3.5' WD	BORING STARTED 3/14/05	STS OFFICE Detroit	
WL 5.0' AB	BORING COMPLETED 3/14/05	ENTERED BY DNH	SHEET NO. 1 OF 1
WL	RIG/FOREMAN ATV D-50/R. Rumpf	APP'D BY KCK	STS JOB NO. 7-74618

BORING_LOG 74618 ARAGONA PROPERTIES.GPJ STS.GDT 4/14/05

STS Consultants Ltd.

CLIENT
Aragona Properties

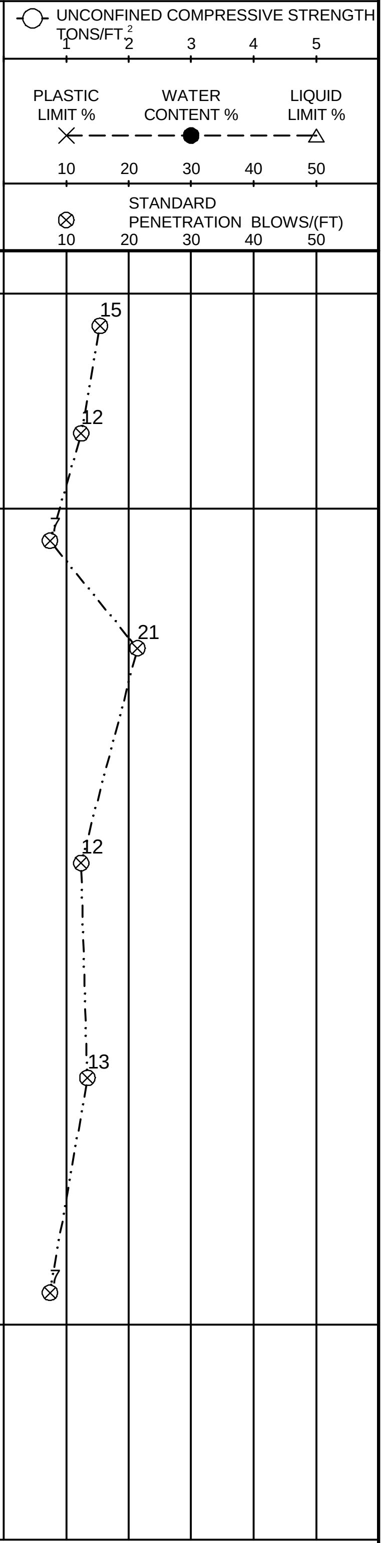
LOG OF BORING NUMBER **B-10**

PROJECT NAME
Proposed Commercial Development

ARCHITECT-ENGINEER

SITE LOCATION
Lennox Township, Macomb County, MI

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}	STANDARD PENETRATION BLOWS/(FT)
						SURFACE ELEVATION +626.0		
			HS			Sandy topsoil - dark brown (12"). 1.0		
		1	SS			Silty fine sand, trace gravel - brown - medium dense - moist (SM)		15
			HS					
		2	SS					12
5.0			HS			6.0		
		3	SS			Fine sand, trace silt, trace gravel - brown to gray - loose to medium dense - wet (SP)		7
			HS					
		4	SS					21
10.0			HS					
		5	SS					12
15.0			HS					
		6	SS					13
20.0			HS					
		7	SS			25.0		7
25.0						End of Boring 25.0' Boring backfilled with soil cuttings to surface.		



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL **6.0' WD**	BORING STARTED **3/14/05**	STS OFFICE **Detroit**	
WL **7.3' AB**	BORING COMPLETED **3/14/05**	ENTERED BY **DNH**	SHEET NO. **1** OF **1**
WL	RIG/FOREMAN **ATV D-50/R. Rumpf**	APP'D BY **KCK**	STS JOB NO. **7-74618**

STS General Notes

STS CONSULTANTS

DRILLING & SAMPLING SYMBOLS:

SS : Split Spoon - 1-3/8" I.D. 2" O.D.
Unless otherwise noted
ST : Shelby Tube-2" O.D.
Unless otherwise noted
PA : Power Auger
DB : Diamond Bit-NX, BX, AX
AS : Auger Sample
JS : Jar Sample
VS : Vane Shear

OS : Osterberg Sampler
HS : Hollow Stem Auger
WS : Wash Sample
FT : Fish Tail
RB : Rock Bit
BS : Bulk Sample
PM : Pressuremeter Test
GS : Giddings Sampler

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon sampler, except where otherwise noted.

WATER LEVEL MEASUREMENT SYMBOLS:

WL : Water Level
WS : While Sampling
WD : While Drilling
AB : After Boring

WCI : Wet Cave In
DCI : Dry Cave In
BCR : Before Casing Removal
ACR : After Casing Removal

Water levels indicated on the boring logs are the levels measured in the boring at the time indicated. In pervious soils, the indicated elevations are considered reliable groundwater levels. In impervious soils, the accurate determination of groundwater elevations may not be possible, even after several days of observations; additional evidence of groundwater elevations must be sought.

GRADATION DESCRIPTION AND TERMINOLOGY:

Coarse grained or granular soils have more than 50% of their dry weight retained on a #200 sieve; they are described as boulders, cobbles, gravel or sand. Fine grained soils have less than 50% of their dry weight retained on a #200 sieve; they are described as clay or clayey silt if they are cohesive and silt if they are non-cohesive. In addition to gradation, granular soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their strength or consistency and their plasticity.

Major Component of Sample	Size Range	Description of Other Components Present in Sample	Percent Dry Weight
Boulders	Over 8 in. (200 mm)	Trace	1-9
Cobbles	8 inches to 3 inches		
	(200 mm to 75 mm)	Little	10-19
Gravel	3 inches to #4 sieve		
	(75 mm to 4.76 mm)	Some	20-34
Sand	#4 to #200 sieve		
	(4.76 mm to 0.074 mm)	And	35-50
Silt	Passing #200 sieve		
	(0.074 mm to 0.005 mm)		
Clay	Smaller than 0.005 mm		

CONSISTENCY OF COHESIVE SOILS:

Unconfined Compressive Strength, Qu, tsf	Consistency
<0.25	Very Soft
0.25 - 0.49	Soft
0.50 - 0.99	Medium (firm)
1.00 - 1.99	Stiff
2.00 - 3.99	Very Stiff
4.00 - 8.00	Hard
>8.00	Very Hard

RELATIVE DENSITY OF GRANULAR SOILS:

N-Blows per foot	Relative Density
0 - 3	Very Loose
4 - 9	Loose
10 - 29	Medium Dense
30 - 49	Dense
50 - 80	Very Dense
>80	Extremely Dense

FIELD SAMPLING PROCEDURES

Auger Sampling (AS)

In this procedure, soil samples are collected from cuttings off of the auger flights as they are removed from the ground. Such samples provide a general indication of subsurface conditions; however, they do not provide undisturbed samples, nor do they provide samples from discrete depths.

Split-Barrel Sampling (SS) - (ASTM Standard D-1586-99)

In the split-barrel sampling procedure, a 2-inch O.D. split barrel sampler is driven into the soil a distance of 18 inches by means of a 140-pound hammer falling 30 inches. The value of the Standard Penetration Resistance is obtained by counting the number of blows of the hammer over the final 12 inches of driving. This value provides a qualitative indication of the in-place relative density of cohesionless soils. The indication is qualitative only, however, since many factors can significantly affect the Standard Penetration Resistance Value, and direct correlation of results obtained by drill crews using different rigs, drilling procedures, and hammer-rod-spoon assemblies should not be made. A portion of the recovered sample is placed in a sample jar and returned to the laboratory for further analysis and testing.

Shelby Tube Sampling Procedure (ST) - ASTM Standard D-1587-94

In the Shelby tube sampling procedure, a thin-walled steel seamless tube with a sharp cutting edge is pushed hydraulically into the soil and a relatively undisturbed sample is obtained. This procedure is generally employed in cohesive soils. The tubes are identified, sealed and carefully handled in the field to avoid excessive disturbance and are returned to the laboratory for extrusion and further analysis and testing.

Giddings Sampler (GS)

This type of sampling device consists of 5-foot sections of thin-wall tubing which are capable of retrieving continuous columns of soil in 5-foot maximum increments. Because of a continuous slot in the sampling tubes, the sampler allows field determination of stratification boundaries and containerization of soil samples from any sampling depth within the 5-foot interval.

LABORATORY PROCEDURES

Water Content (Wc)

The water content of a soil is the ratio of the weight of water in a given soil mass to the weight of the dry soil. Water content is generally expressed as a percentage.

Hand Penetrometer (Qp)

In the hand penetrometer test, the unconfined compressive strength of a soil is determined, to a maximum value of 4.5 tons per square foot (tsf) or 7.0 tsf depending on the testing device utilized, by measuring the resistance of the soil sample to penetration by a small, spring-calibrated cylinder. The hand penetrometer test has been carefully correlated with unconfined compressive strength tests, and thereby provides a useful and a relatively simple testing procedure in which soil strength can be quickly and easily estimated.

Unconfined Compression Tests (Qu)

In the unconfined compression strength test, an undisturbed prism of soil is loaded axially until failure or until 20% strain has been reached, whichever occurs first.

Dry Density (γd)

The dry density is a measure of the amount of solids in a unit volume of soil. Use of this value is often made when measuring the degree of compaction of a soil.

Classification of Samples

In conjunction with the sample testing program, all soil samples are examined in our laboratory and visually classified on the basis of their texture and plasticity in accordance with the STS Soil Classification System which is described on a separate sheet. The soil descriptions on the boring logs are derived from this system as well as the component gradation terminology, consistency of cohesive soils and relative density of granular soils as described on a separate sheet entitled "STS General Notes". The estimated group symbols included in parentheses following the soil descriptions on the boring logs are in general conformance with the Unified Soil Classification System (USCS) which serves as the basis of the STS Soil Classification System.

STS Standard Boring Log Procedures

STS CONSULTANTS, LTD.

In the process of obtaining and testing samples and preparing this report, standard procedures are followed regarding field logs, laboratory data sheets and samples.

Field logs are prepared during performance of the drilling and sampling operations and are intended to essentially portray field occurrences, sampling locations and procedures.

Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory by more experienced soil engineers, and differences between the field logs and the final logs may exist.

The engineer preparing the report reviews the field and laboratory logs, classifications and test data, and using judgment and experience in interpreting this data, may make further changes.

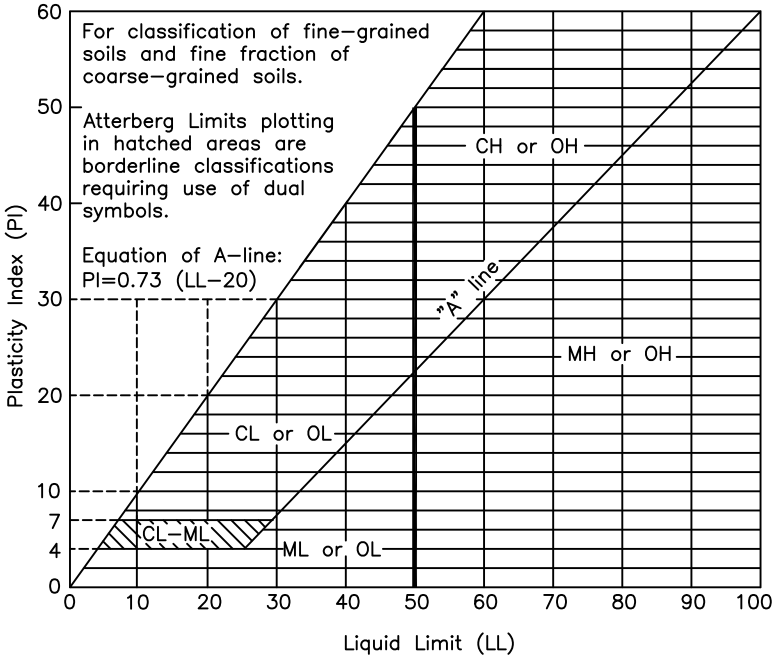
Samples taken in the field, some of which are later subjected to laboratory tests, are retained in our laboratory for sixty days and are then destroyed unless special disposition is requested by our client. Samples retained over a long period of time, even in sealed jars, are subject to moisture loss which changes the apparent strength of cohesive soil, generally increasing the strength from what was originally encountered in the field. Since they are then no longer representative of the moisture conditions initially encountered, observers of these samples should recognize this factor.

It is common practice in the geotechnical engineering profession that field logs and laboratory data sheets are not included in engineering reports, because they do not represent the engineer's final opinions as to appropriate descriptions for conditions encountered in the exploration and testing work. On the other hand, we are aware that perhaps certain contractors and subcontractors submitting bids or proposals on work might have an interest in studying these documents before submitting a bid or proposal. For this reason, the field logs are retained in our office for review by all contractors submitting a bid or proposal. We would welcome the opportunity to explain any changes that have been and typically are made in the preparation of our final reports, to the contractor or subcontractors, before the firm submits its bid or proposal, and to describe how the information was obtained to the extent the contractor or subcontractor wishes. Results of laboratory tests are generally shown on the boring logs or are described in the text of the report, as appropriate.

The descriptive terms and symbols used on the logs are described on the attached sheet, entitled: "General Notes".

STS Soil Classification System (1)

STS Consultants

	Major Divisions		Group Symbols	Typical Names	Laboratory Classification Criteria		
Coarse-grained soils (More than half of material is ***larger*** than No. 200 sieve size)	Gravel (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW	Well-graded gravel, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent . . . . . GW, GP, SW, SP More than 12 percent . . . . GM, GC, SM, SC 5 to 12 percent . . . . Borderline cases ***requiring*** dual symbols (3)	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 & 3	
			GP	Poorly graded gravel, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravel, gravel-sand-silt mixtures		Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are ***borderline*** cases requiring use of dual symbols
			GC	Clayey gravel, gravel-sand-clay mixtures		Atterberg limits above "A" line or PI greater than 7	
	Sand (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sand (Little or no fines)	SW	Well-graded sand, gravelly sand, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 & 3	
			SP	Poorly graded sand, gravelly sand, little or no fines		Not meeting all gradation requirements for SW	
		Sand with fines (Appreciable amount of fines)	SM	Silty sand, sand-silt mixtures		Atterberg limits below "A" line or PI less than 4	Limits plotting in hatched zone with PI between 4 and 7 are ***borderline*** cases requiring use of dual symbols
			SC	Clayey sand, sand-clay mixtures		Atterberg limits above "A" line or PI greater than 7	
Fine-grained soils (More than half of material is ***smaller*** than No. 200 sieve size)	Silt and clay (Liquid limit less than 50)		ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or clayey silt with slight plasticity	Plasticity Chart (2) 		
			CL	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay, silty clay, lean clay			
			OL	Organic silt and organic silty clay of low plasticity			
	Silt and clay (Liquid limit greater than 50)		MH	Inorganic silt, micaceous or diatomaceous fine sandy or silty soils, elastic silt			
			CH	Inorganic clay of high plasticity, fat clay			
			OH	Organic clay of medium to high plasticity, organic silt			
	Highly organic soils		PT	Peat and other highly organic soil			

For classification of fine-grained soils and fine fraction of coarse-grained soils.

Atterberg Limits plotting in hatched areas are borderline classifications requiring use of dual symbols.

Equation of A-line:
PI=0.73 (LL-20)

1) See STS General Notes for component gradation terminology, consistency of cohesive soils and relative density of granular soils.

2) Reference: Unified Soil Classification System

3) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

Y:\UEPL\ STS SOIL CLASSIFICATION SYSTEM.dwg