

SUBSURFACE EXPLORATION PROGRAM  
UNIVERSITY HOSPITALS RENEWAL PROJECT  
UNIVERSITY OF MINNESOTA  
MINNEAPOLIS, MINNESOTA

#120-6850



**SOIL EXPLORATION**  
company

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January 21, 1981

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Attn: Ron Cannamore  
Project Director

Gentlemen

Subj: Subsurface Exploration Program  
University Hospitals Renewal Project  
University of Minnesota  
Minneapolis, Minnesota  
#120-6850

We have conducted a subsurface exploration program and prepared a geotechnical review for the referenced project. We are transmitting 15 copies of our report. This work was done in accordance with authorization received on November 18, 1980.

Representative samples of the soil and the entire core recovery will be held at this office until construction starts. About 50% of the remaining soil samples will be held at this office for one month and will then be discarded unless we are notified to do otherwise.

The opinions expressed in this report are based on the conditions observed at our test boring locations and on our present conception of the proposed structure. If different conditions are encountered between borings, or if there would be significant changes in the proposed structure, we request that we be notified so that these new conditions can be reviewed.

Very truly yours

Gordon J Smith, P.E.

Donovan K Stormoe, P.E.

GJS/DKS/mc

Encs

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REPORT OF SUBSURFACE EXPLORATION PROGRAM  
UNIVERSITY HOSPITALS RENEWAL PROJECT  
UNIVERSITY OF MINNESOTA  
MINNEAPOLIS, MINNESOTA  
#120-6850

INTRODUCTION

This report presents our findings and recommendations pertaining to the subsurface exploration program and geotechnical review we have conducted for the proposed University Hospitals renewal project located at the University of Minnesota campus in Minneapolis, Minnesota. The purpose of this report is to describe and review the soil, bedrock and ground water conditions encountered at this site. The results of previous subsurface exploration programs conducted in this general area were also available for our use in our review. Based on a review of the subsurface exploration programs and on the results of laboratory tests and field tests, we are presenting our recommendations as requested in your "Proposal Request for Subsurface Investigation and Foundation Study". Requests for additional information were also made at our meeting on January 7, 1981.

PROJECT INFORMATION

We understand the proposed building will have a partial basement with ten

levels above the basement. We further understand that the building will be of either steel or concrete construction and that column loads for steel will range from about 800 kips to 1900 kips and for concrete from about 1300 kips to 2500 kips. The proposed basement level will be at about 795', the first level at about elevation 817'-4" and the second level at about elevation 830'-8".

The above information constitutes an important part of our review. If there are any substantial changes, we suggest that you contact us for an additional review.

#### SURFACE OBSERVATIONS

The proposed building site is bounded by Essex Street on the north, Harvard Street on the east, the East River Road on the south and the existing K-E unit on the west. The existing Powell Hall covers a portion of the site and there is also an existing apartment building on the east end of Powell Hall. Portions of the site are used for parking. There are existing drives, sidewalks, utilities, etc., that are associated with a previously developed area, such as this site. There are two utility tunnels at the southwest corner of the proposed building site and one of the tunnels also runs along the south side of the proposed building. From the information furnished to us, these tunnels are in the St. Peter sandstone. There are other pedestrian or service tunnels at higher elevations in the overburden. Existing Diehl Hall and the Masonic Hospital are located along the north side of the proposed building. The majority of the site is either covered by buildings, streets, drives or parking lots, except at the southeast portion of the

site, where it is primarily lawn area with a few scattered trees. The south portion of the site generally slopes down to the west.

#### SUBSURFACE EXPLORATION

Twenty-seven soil test borings were put down during a period from December 3, 1980 through January 5, 1981. The borings were put down at the locations shown on the attached sketch. The original boring locations were staked and the elevations were provided by the University of Minnesota. For access, four of the soil test borings were moved a little from the original staked location. These moves are indicated on the attached sketch and the surface elevations at the new locations were determined by us.

#### SUBSURFACE CONDITIONS

##### General

The logs of the borings indicate a generalized profile consisting of fill and/or topsoil overlying coarse alluvial sandy soils and glacial till, which in turn overlie bedrock. The bedrock consists generally of a relatively thin layer of Decorah shale overlying the Platteville limestone. The Platteville limestone is then underlain with Glenwood shale and the shale is underlain with the St. Peter sandstone. Drilling mud was used in maintaining our drill holes and accurate water level measurements were not determined in our borings. Our review of the ground water at this site will be based on the results of previous subsurface exploration programs conducted adjacent to the proposed facility.

Overburden Soils

Fill, soil classified as "may be fill" and/or topsoil was encountered at the surface of the majority of the borings. The thicknesses of these layers ranged from about 2' to 9'. However, it should be anticipated that the fill depths could be extremely variable and extend much deeper, especially adjacent to existing structures or utilities.

The natural soils encountered underlying the fill or topsoil layers consist primarily of coarse alluvial sandy soils and glacial till. The coarse alluvial sandy soils consist of sand and silty sand and the glacial till consists of silty sand, clayey sand and sandy clay. The silty sand till appears to be predominant, although substantial amounts of clayey sand and sandy clay till were encountered especially through the central and southern part of the proposed building area. Several of the borings do indicate relatively thin layers of fine alluvial silt, clayey silt or silty clay in the upper portions of the borings. The penetration resistance (N value) indicates the density of the cohesionless soil ranges from very loose to very dense. The consistency of the cohesive soil ranges from soft to very stiff. In general, the softest and loosest soils were encountered in the upper portions of the borings.

The coarse alluvial sandy soils and glacial till do contain varying amounts of gravel and in some borings, there appeared to be an appreciable amount of gravel, cobbles and boulders.

Bedrock

Bedrock was encountered at a relatively uniform elevation on the site. The first bedrock encountered at the majority of the borings consisted of remnants of the Decorah shale formation. In general, this layer was only relatively thin.

The Decorah shale was then underlain with Platteville limestone. Based on the results of the exploration programs, it appears that this entire formation is present at this site. The elevation of the Platteville limestone ranged from about 791' to 796½' and was generally in the range of 792' to 794'. Except for the two borings that were cored, these elevations were determined only from the action of the drilling equipment and the material returned in the drilling fluid. Possibly, some of the higher elevations indicated for the Platteville limestone may represent limestone layers in the Decorah formation. It appears that the upper portion of the Platteville limestone is not highly weathered, however, it is possible there could be areas where at least the upper 1' or so of the limestone may be weathered. This should be primarily in areas where remnants of the Decorah formation were not encountered.

Based on borings B-4 and B-14, the Platteville limestone is on the order of 28' in thickness. The Platteville limestone is then underlain with the Glenwood shale and the contact elevation between the Platteville limestone and the Glenwood shale appears to be at about elevation 762½'. The Glenwood shale is on the order of about 3½' thick and is underlain with the St. Peter sandstone. The contact elevation between the Glenwood shale and the St. Peter sandstone is at about elevation 759'.



Core recoveries in the limestone ranged from about 79% to 100% and was generally 100% except for the upper portion. The core recovery in the upper portion may have been influenced by the possibility of shale seams being washed out during the coring operation. Typically, the upper 1' to 2' of the Platteville limestone can contain seams or thin layers of shale or bentonite. The log of boring B-4 indicates a possible 0.2' void at about elevation 783'. However, there is sometimes a thin layer of shale in the Platteville formation at about this depth. Visual observations of the cores indicated that there probably was a thin layer of shale at this elevation rather than an actual void.

The Glenwood shale and St. Peter sandstone were also cored. The recovery in these formations was much lower and in some cases no recovery was obtained from the sandstone. This would be due to washing out of shale or sandstone during the coring operations. While the coring was being done, there was no evidence of voids within these formations.

#### Ground Water

As indicated earlier in the report, drilling mud was used in maintaining the drill holes and this drilling mud obscured water level measurements. However, previous borings put down for Diehl Hall on the north side of the proposed building and for the K-E unit on the west side indicated the possibility of at least some water being perched above the bedrock or clay layers. The previous borings indicated water levels ranging from about elevation 792' to about 796½'. The levels of this possibly perched water can be expected to vary seasonally and yearly. Since the site is located relatively close to

the river bluff, it would be our judgment that the actual water table would be near river elevation.

### FIELD TESTS

In addition to the soil and bedrock sampling, pressuremeter tests were conducted in the overburden soils along Diehl Hall and the Masonic Hospital. The borings and depths at which these pressuremeter tests were conducted are given in the table below.

<u>TEST NUMBER</u>	<u>BORING NUMBER</u>	<u>DEPTH TO CENTER OF PROBE (ft)</u>	<u>TONS PER SQUARE FOOT</u>		
			<u>P<sub>f</sub></u>	<u>P<sub>1</sub></u>	<u>E</u>
1	3	30.2	H o l e C a v e d		
2	3	33.3	19.8	Approx. 42	477
3	3	40.0	>23	--	792
4	5	30.0	8.8	17.8	171
5	5	35.0	7.6	15.9	144
6	1	22.5	>19	--	368

A description of the pressuremeter test method is attached to this report.

### LABORATORY TESTS

To aid in review of the soil conditions, a mechanical analysis was conducted on samples of the sand, silty sand and clayey sand. The primary purpose of these tests was to determine their suitability for reuse as controlled fill under floors and for backfill behind the building walls. The results of these tests are shown on attached data sheets.

The moisture content, dry density and/or Atterberg limits were determined on samples of the clayey sand, sandy clay and shale. The purpose of these tests

was primarily to aid in reviewing the suitability of these soils to support floor loads and/or miscellaneous foundations. The results of these tests are shown on the attached logs opposite the samples upon which they were performed.

A CBR test was conducted on the fill material encountered at boring C-3. The results of the CBR tests are given on attached data sheets and curves.

### ENGINEERING REVIEW

#### Foundation Recommendations

The majority of the proposed building will have a basement floor at about elevation 795'. Based on the bedrock elevation at the site, this would put the foundations for the building on the bedrock through the basement area. A portion of the building will have a slab-on-grade at the first level and another small portion of the building will have a slab-on-grade at the second level. The strength of the overburden soils appear to be somewhat variable and clayey till was encountered through the central and southern portion of the proposed building area. Only a relatively light loading would be indicated for foundations placed on or above the clay till. The loading that could be used on the clayey till would probably not result in an economical spread footing design. Also, if a portion of the structure were supported on bedrock and a portion on the overburden soils, then there would be a potential for differential settlement. In view of this, we suggest that all main structural columns and wall loads be carried to the bedrock.

The foundations for all main structural columns and walls should be taken through any remaining overburden soils and the Decorah shale. The foundations should be placed on sound Platteville limestone. It appears that the sound limestone should be encountered immediately underlying the Decorah shale, however, it should be anticipated that there may be areas where the upper portion of the limestone could be weathered. Also, our previous experience in this general area has indicated that there could be a thin layer of bentonite within the upper 1' to 2' of the limestone deposit. If the thickness of this layer would be sufficient to cause detrimental settlement, then the foundations should extend through this layer.

Spread footings could be used directly on the limestone for the portion of the structure with a basement. For the portions of the building where the lower floor level would be at a higher elevation, the foundations should be extended to the bedrock, and it is our judgement that drilled piers would be the most feasible method of doing this. The piers should be drilled full diameter and cased. It is our judgment that it would not be feasible to bell in the limestone. The casing can be removed as the concrete is being placed. The lower level foundation areas could also be prepared using the same type of construction technique as used where overburden soils will remain in place.

We suggest foundations placed on sound Platteville limestone be designed for a maximum allowable bearing pressure of 50 tsf (tons per square foot). Unless loading conditions require it, we would not consider it necessary to socket the piers into sound rock. However, we do recommend that the maximum slope of the rock on which the piers are placed be no more than 2" vertical in 12" horizontal.

For the purpose of observing bedrock conditions at the bottom of the piers, and to aid in removing possible boulders, we would suggest a minimum pier diameter of 42" be used.

We understand it is planned to support a small portion of the structure adjacent to the Masonic Hospital on a mat foundation. This will be at the first level elevation. We understand the loadings on this mat will be very light, and in our judgment, the mat foundation could be used in this area and if the loading on the mat would not exceed 3000 psf (pounds per square foot), it is our judgment that settlement should be less than  $\frac{1}{4}$ ".

We understand there will be some miscellaneous foundations, such as for canopies or stairs. These foundations would not be part of the structural framing. It is our judgment these foundations could be placed on the overburden soil and would not have to be extended to bedrock, however, in the basement area, these foundations should extend to the limestone. Other than adjacent to basement areas, these foundations should be taken through any existing fill, topsoil or other very soft or loose soils. It is our judgment these foundations could be designed for a maximum soil bearing pressure of 3000 psf and settlement should not exceed about  $\frac{1}{4}$ ".

It is our judgment that the recommended loadings given for foundation design should provide a theoretical factor of safety of well over 3 against a general shear failure and we would not anticipate any settlement for the foundations placed on bedrock. Our estimates of possible settlement for foundations placed on the overburden soils were given above.

There will be areas where adjacent foundations, either for the new construction or between the new construction and existing construction, will be at different elevations. To place foundations at different elevations without shoring or bracing and so the loadings on the adjacent foundations would not influence each other, a line drawn from the bottom edge of the lower footing to a point 3' outside of the adjacent edge of the upper footing should not exceed  $30^{\circ}$  as measured from the horizontal. For bedrock, this angle could be increased to a maximum of  $45^{\circ}$ .

We understand that there will be a channel excavated into the bedrock generally at the southwest portion of the building area. We understand this excavation will be about 8' deep. In this area, the foundations should be placed so that they will meet the above criteria. Also, there is an existing retaining wall along the west end of Powell Hall, and if this retaining wall is socketed into the bedrock, new foundations in this area may have to extend through any old foundations and to the bedrock.

#### Floor Support

For the portion of the building that will have a basement, any remaining overburden soils and the Decorah shale should be excavated. The shale is potentially expansive. The area should then be brought to bottom of floor elevation with a compacted granular fill material. We suggest this fill material consist of a relatively clean, free-draining granular soil containing a maximum of 5% passing the #200 sieve. This fill material should be compacted to a minimum of 95% of the maximum density determined by the standard proctor (ASTM: D 698).

Where the slab-on-grade portions of the structure will be at higher elevations, any existing fill or topsoil should be removed. If fill is required to bring these areas to bottom of floor elevation, this fill should consist of a granular soil compacted to a minimum of 95% of the standard proctor density. Sand or silty sand could be used for this fill material, however, we suggest that a minimum of 6" of a clean, free-draining granular material be provided immediately below the floor.

For fill placed and compacted as recommended above, we estimate that a k-value (modulus of subgrade reaction) of 200 pci (pounds per cubic inch) be used in evaluating the actual floor loads that could be supported. The plans indicate a 6" concrete floor, and this thickness of floor over a granular subgrade should generally support fairly heavy floor loads and even occasional vehicle loads in the 9-ton axle load range.

#### Lateral Earth Pressures

The approximate lateral earth pressures against below-grade portions of the structure will depend on the type of material used for backfill and also on the degree of compaction and how the backfill is placed. Two types of material that would be available at this site and would be suitable for backfill are the silty sand and sand. As indicated earlier, several of the borings, especially through the central and southern portion of the site, did indicate clayey sand and sandy clay till. We would not suggest using this type of material for backfill within a certain zone behind the walls. This zone should include an area extending 1' out from the drain tile and then upward and outward at an angle of 30° to the proposed ground surface from the vertical wall. All

natural clayey soils should also be removed from this zone. Also, it should be anticipated that some difficulty may be encountered in separating the cleaner sand that contains less than 10% passing the #200 sieve from the silty sands that contain 20% to over 30% fines.

In the table below are given recommended lateral pressure coefficients for the soils and rock encountered in the borings and expected to be used as backfill. These coefficients do not consider sloping ground surfaces or surface loads which could effect the lateral pressure. Also, the active and passive coefficients for the soil assume soil movement of about  $\frac{1}{4}$ " to  $\frac{3}{8}$ " to mobilize the active and passive soil pressures. Practically no movement is needed to mobilize the passive pressure in the sound limestone bedrock. Without soil (or wall) movement, the at-rest pressure should be used.

<u>SOIL TYPE</u>	<u>COHESION</u>	<u>INTERNAL FRICTION ANGLE</u>	<u>EFFECTIVE DENSITY</u>	<u>ACTIVE PRESSURE COEFFICIENT (wall movement allowed)</u>	<u>AT-REST PRESSURE COEFFICIENT (no wall movement allowed)</u>	<u>PASSIVE PRESSURE COEFFICIENT</u>
Native Sand-Silty Sand mixture (maximum 25% -#200)	0	33 <sup>0</sup>	135 pcf	0.30	0.45	3.35
Clean Sand (maximum 10% -#200)	0	35 <sup>0</sup>	125 pcf	0.27	0.43	3.65
Sound Lime-stone bedrock	25 tsf	0	165 pcf	0	0	50 tsf*

\*Indicates uniform lateral passive resistance.



For calculating resistance against sliding between the bottom of the concrete foundations and the bearing material, we suggest using the following friction factors:

<u>TYPE OF BEARING MATERIAL</u>	<u>FRICTION FACTOR</u>
Clean Sound Limestone	0.70
Sand and Silty Sand	0.45
Clayey Sand and Sandy Clay	0.35

#### Excavation Procedures and Earth Retention Systems

Where excavation is done below the level of existing foundations, streets, utilities or other structures to remain in service, consideration must be given to protect those structures from subsidence. It is our opinion that the maximum slope steepness without protection should be 1-3/4 horizontal to 1 vertical (30° angle as measured from the horizontal). If steeper slopes are needed, excavations extending beyond these slope limits should be done in segments of no more than about 20' long sections or earth retention systems should be used.

Considering possible ground vibrations which could be dangerous or undesirable to the functioning of the existing nearby buildings, we recommend earth retention systems which cause a minimum of disturbance when installed. Drilled piers and lagging (or soldier piles installed in drilled holes) or just drilled piers should be considered. Where necessary, earth or rock anchors can be used. Pressure-injected anchors with capacities of 35-40 tons for permanent anchors and 70-75 tons for temporary anchors (construction) should be possible.

We have considered the use of slurry wall construction, however, this type of construction may not be cost-effective for this project.

#### Ground Water Control

Temporary and permanent methods for controlling ground water should be considered. Some ground water seepage can be expected during construction. The information available at this time does not show sufficient evidence to indicate dewatering wells will be necessary. However, localized pumping in the excavations should be considered a possibility.

For permanent ground water control, we recommend a minimum design consisting of damp-proofing on exterior below-grade walls, a free-draining exterior and underfloor granular fill and an exterior perimeter drain tile system. A minimum 6" diameter tile should be used and should be surrounded by a suitable filter aggregate. Pea gravel of #4 to 3/4" concrete aggregate should be suitable for this filter aggregate. At least a sump should be provided for the area that will be excavated into the limestone.

We recommend that allowance be made for a more elaborate ground water control system if construction observation indicates appreciable water is present. This is a possibility, especially in gravel seams or fissures in the rock. A more extensive system may include waterproofing on the exterior walls and an interior underfloor drain system. If such systems are needed, we are available for further discussion.

#### Uplift Loads

If uplift resistance by anchoring is necessary, several possible methods can

be considered. For dowel anchors or concrete piers drilled into rock, we recommend a maximum allowable friction of 75 psi at the contact between sound limestone and either the anchor grout or pier concrete. For friction between the concrete piers and the natural soil, we suggest using an allowable value of 750 psf. If there are groups of anchors or piers where the spacing between anchors is less than 8' or for piers is less than three diameters, the efficiency of each group member should be taken as 70% of an individual anchor or pier. The values given above would be subject to change depending on the actual spacing and depth of embedment and should be reviewed after this information is known.

#### Deflection of Piers from Lateral Loads

Based on an article by Mr. B.L. McKorkle ("Side-Bearing Pier Foundations" - May, 1969 Civil Engineering-ASCE, Pages 55 and 56), it is our judgment the following formula could be used to estimate deflection of piers installed through the soils encountered at this site.

$$\Delta = \left( \frac{216 F}{KDL^2} \right) \left( \frac{1.33H}{L} + 1 \right)$$

Where:

D = diameter or width of pier, feet

L = length of pier, feet

F = resultant of all horizontal external loads, kips

H = distance from ground line to resultant of horizontal loads, feet

$\Delta$  = lateral movement of pier at ground line, inches

K = coefficient of passive subgrade reaction, kips per cubic foot. Use 100 for clayey sand or sandy clay and 60 for sand or silty sand.

Site Grading and Earthwork

Backfill behind the retaining walls should be placed in relatively thin lifts and compacted with light compaction equipment, at least adjacent to the walls. The compaction should be done parallel to the walls. Also, we suggest no boulders larger than 6" in their greatest dimension be used in the backfill. The fill behind the walls should be compacted to a minimum of 95% of the maximum density determined by the standard proctor (ASTM: D 698-70). It is our judgment this degree of compaction would be suitable to support miscellaneous foundations and sidewalks. For street and drive areas, we suggest the upper 3' of the fill be compacted to a minimum of 98% of the standard proctor density.

A CBR test was conducted on a sample of the fill material obtained at boring C-3. The description of this material given on the boring logs indicated the soil is primarily silty sand. However, the larger samples taken for the CBR test did contain sufficient clay so that when the soils were mixed together the resulting material was a clayey sand. Based on this type of material, we suggest pavement sections be designed for a CBR value of 8. If cleaner sands are used in the upper 3' of the subgrade, it is our judgment the CBR value used for design could be increased to 20.

We understand it is planned to keep Essex Street open during the demolition of Powell Hall. We would again suggest that the maximum slope of the excavation be no steeper than 1-3/4 horizontal to 1 vertical unless shoring is provided. The slope of the excavation should also be protected from erosion.

Construction Difficulties

It should be anticipated that there will be areas where relatively large amounts of gravel, cobbles and possibly boulders will be encountered. Based on our borings, it is our judgment that these boulders should not exceed about 24" in largest dimension, although it is possible there could be an occasional larger boulder. It is also possible that subsurface water may be encountered and this was discussed previously under "Ground Water Control".

Observation and Testing During Construction

Observations and testing by a soils engineer should be done during construction to further evaluate possible ground water problems and to determine that foundations are placed on suitable bearing material. Backfill behind walls or fill required under floors and paved areas should be checked by field density tests as the fill is being placed, and preferably, the backfill behind the walls should be observed by a person competent in the field of soil compaction.

We suggest the bedrock below all major foundations be further evaluated by drilling probe holes. These probe holes should extend at least one footing width or a minimum of 5' below the bottom of foundation elevation, whichever is greater. The actual drilling of the probe holes should be observed by a soils engineer or geologist to aid in detecting possible voids or seams of weaker material.

For permanent tieback anchors, every anchor should be proofed to 115% of the working load and the proof load should be held for 15 minutes. At least 10% of the anchors should be tested to 150% of the working load.

Additional Discussion and Recommendations

We understand it is possible that there may be some stress increase on existing footings or Diehl Hall and the Masonic Hospital. It is our judgment that the soils encountered underlying these foundations would be suitable to support a maximum loading of 10,000 psf and settlement should not exceed about  $\frac{1}{2}$ ".

We recommended the free-draining granular material for underfloor fill contain a maximum of 5% passing the #200 sieve. In addition, this material should contain a maximum of 45% passing the #40 sieve.

As indicated earlier in the report, we understand there are two utility tunnels in the St. Peter sandstone. However, the information furnished to us indicated that these tunnels are relatively small, and based on the amount of Platteville limestone that will be in place over these tunnels, it is our judgment that no special precautions would have to be taken in this area, such as shoring the roofs of the tunnels.

We would suggest that the existing buildings surrounding the construction site be observed and any existing cracking be documented before construction of the new facility begins.

We would suggest that we be given an opportunity to review the final foundation plans. We also suggest that a pre-construction meeting be held and that we be given an opportunity to participate in this meeting.

FIELD EXPLORATION PROCEDURES

Soil Sampling

Soil sampling was done according to the procedure described by ASTM: D 1586-67. Using this procedure, a 2" O.D. split barrel sampler is driven into the soil by repeated blows of a 140 lb weight falling 30". After an initial set of 6", the number of blows required to drive the sampler an additional 12" is known as the penetration resistance or N value. The N value is an index of the relative density of cohesionless soils and the consistency of cohesive soils. Rock core samples were obtained by rotary core drilling in accordance with ASTM: D 2113-70.

Soil Classification

As the samples were obtained in the field, they were visually and manually classified by the crew chief in accordance with ASTM: D 2488-69. Representative portions of all samples were then sealed and returned to the laboratory for further examination and for verification of the field classification. In addition, selected samples were submitted to a program of laboratory tests. Logs of the borings indicating the depth and identification of the various strata, the N value, the laboratory test data, water level information and pertinent information regarding the method of maintaining and advancing the drill holes are attached. Charts illustrating the soil classification procedure, the descriptive terminology and symbols used on the boring logs are also attached. Three profiles have been prepared in a west-east direction across the site. These profiles are also attached.

EXPLORATION LIMITATIONS

The recommendations and/or suggestions contained in this report are our opinions based on data which are assumed to be representative of the site explored; but because the area of the borings in relation to the entire area is very small, and for other reasons, we do not warrant conditions below the depths of our borings, or that the strata logged from our borings are necessarily typical of the entire site.

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the Laws of the State of Minnesota

Gordon J. Smith  
GORDON J. SMITH

Date 1-21-81 Reg. No. 9242

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the Laws of the State of Minnesota.

Donovan K. Stormoe  
DONOVAN K. STORMOE

Date January 21, 1981 Reg. No. 10493



# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-1  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>839.8'</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL PL	Qu
2	SANDY CLAY, black, frozen to 1/2' (CL)	TOPSOIL			1	HSA				
5	SAND, medium grained, a little gravel, a few cobbles, brown, moist, very dense (SP)	COARSE ALLUVIUM	50		2	SS				
12	SILTY SAND, a little gravel, a few cobbles, brown, moist, dense (SM)	TILL	21		3	SS				
			26		4	SS				
			27		5	SS				
14	SAND, medium grained, a little gravel, brown, moist, very dense (SP)	COARSE ALLUVIUM	57		6	SS				
	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense (SM)	TILL	50		7	SS				
			0.5							
34	SAND, fine grained, light brown, moist, very dense (SP)	COARSE ALLUVIUM	50		8	SS				
			0.5							
			40		9	SS				
			0.3							
38	SAND, fine grained, light brown, moist, very dense (SP)	COARSE ALLUVIUM	73		10	SS				
40	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense (SM)	TILL								
	Continued on next page									

Pressuremeter Test  
 $P_f > 19$  TSF

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-1 Cont.  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL/PL	Qu
40	SILTY SAND, (Cont.) (SM)	TILL (Cont.)	50 0.4		11	SS				
43½	SHALE, gray	DECORAH FORMATION								
45.8 46.3	<del>NO SAMPLES RECOVERED. Appears (See #1)</del>	<del>SEE NOTE:</del>	92 0.8		12	SS				
	End of Boring	NOTE: PLATTEVILLE FORMATION								
	#1 - to be LIMESTONE, based on action of drilling equipment and on evidence of material returned in drilling fluid.									
	*No measurement recorded due to presence of drilling fluid.									

WATER LEVEL MEASUREMENTS							START	COMPLETE
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	12-18-80	12-29-80
12-18	12:00	8½'	None	8'	to	None	METHOD 6 FA 0-7'	@ 1:45
12-29	1:45	46.3'	8½'		to	*	4C 0-8½', DM 8½-46.3'	
12-29	1:50	46.3'	None		to	*		
					to		CREW CHIEF Francis	

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-2  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	W	D	LL PL	QU	
	↙ SURFACE ELEVATION <u>839.6'</u>										
	FILL, mixture of SILTY SAND and SILTY CLAY, a trace of gravel, brick and concrete, dark brown and black	FILL	50		1	HSA					
			0.5		2	SS					
6			8		3	SS					
	SILT, dark grayish brown, moist, loose (ML)	TOPSOIL	5		4	SS					
8½											
10	SILT, brown, moist, loose (ML)	FINE ALLUVIUM			5	SS					
	SAND, medium grained, a little gravel, brown, moist, dense (SP-SM)		21		6	SS					
12											
	SAND, medium grained, a little gravel, a few cobbles, brown, rather dry, very dense (SP)	COARSE ALLUVIUM	60		7	SS					
			50		8	SS					
18											
	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense to dense to very dense, a few lenses of sand and clayey sand (SM)	TILL	50		9	SS					
			30		-	--					
			22		10	SS					
35	Continued on next page										

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-2 Cont.  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL P.L.	Qu
35	SILTY SAND, (Cont.) (SM)	TILL (Cont.)	63		11	SS				
			50 0.2		12	SS				
44			100 0.4		13	SS				
45.7	SHALE, gray	DECORAH FORMATION								
46.2	(See #1)	SEE NOTE:								
	End of Boring	NOTE:								
	#1 - NO SAMPLES RECOVERED. Appears to be LIMESTONE, based on action of drilling equipment and on evidence of material returned in drilling fluid.	PLATTEVILLE FORMATION								
	*No measurement recorded due to presence of drilling fluid.									

WATER LEVEL MEASUREMENTS							START	COMPLETE
							12-29-80	12-30-80
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD	
12-29	2:55	16'	14½'	16'	to	None	3¼ HSA 0-14½'	@ 11:25
12-30	11:25	46.2'	14½'		to	*	DM 16-46.2'	
12-30	11:35	46.2'	None		to	*		
					to			
							CREW CHIEF	Francis

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-3  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL PL	Qu
	SURFACE ELEVATION <u>840.0'</u> FILL, mixture of SILTY SAND and SILTY CLAY, a trace of gravel, dark brown and black, frozen to $\frac{1}{2}$ '	FILL			1	HSA				
4			12		2	SS				
7	SANDY SILT, dark grayish brown, moist, dense (ML)	TOPSOIL	21		3	SS				
9	SILTY SAND, medium to fine grained, a little gravel, brown, (See#1)(SM)	COARSE ALLUVIUM	48		4	SS				
	SAND, medium grained, some gravel, a few cobbles, brown, moist, very dense (SP-SM)		100		-	--				
			0.1		44	5	SS			
			37		6	SS				
18	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense (SM)	TILL	37		7	SS				
			47		8	SS				
			$\frac{60}{0.5}$		9	SS				Pressuremeter Test (no test-hole caved)
35										Pressuremeter Test P <sub>f</sub> = 19.8 TSF
	Continued on next page									

# LOG OF TEST BORING

120-6850

VERTICAL SCALE 1" = 6'

B-3 Cont.

JOB NO  
PROJECT

UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

BORING NO

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	W	D	LL P.L.	Qu	
35	SILTY SAND, (Cont.) (SM)	TILL (Cont.)	50 0.3		10	SS					
			50 0.5		11	SS					
			100 0.2		-	--					
48.7 49.2	See #2)	SEE NOTE:									
	End of Boring	NOTE: PLATTEVILLE FORMATION									
	#1 - rather dry, very dense (SM)										
	#2 - NO SAMPLE RECOVERED. Appears to be LIMESTONE, based on action of drilling equipment and on evidence of material returned in drilling fluid										
	*No measurement recorded due to presence of drilling fluid.										

Pressuremeter Test  
P<sub>f</sub> > 28 TSF

**WATER LEVEL MEASUREMENTS**

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL
12-18	2:00	8½'	None	8'	to	None
12-19	3:50	49.2'	9½'		to	*
12-22	8:45	49.2'	None		to	*

START	12-18-80	COMPLETE	12-19-80
METHOD	¾ HSA 0-8½' @ 3:50		
	4C 0-9½', DM 8½'-49.2'		
CREW CHIEF	Francis		

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-4  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL PL	Qu
	SURFACE ELEVATION <u>839.9'</u> FILL, mostly SILTY SAND, some gravel, brown, dark brown and a little black	FILL			1	HSA				
			8		2	SS				
			6		3	SS				
			13		4	SS				
9	SAND, medium to coarse grained, some gravel, brown, moist, very dense (SP-SM)	COARSE ALLUVIUM	33		5	SS				
			34		6	SS				
			48		7	SS				
17	SILTY SAND, a little gravel, a few cobbles and boulders, brown, moist, very dense (SM)	TILL	35		8	SS				
			66		-	--				
			0.6							
			50		9	SS				
			0.1							
35	Continued on next page									

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-4 Cont.  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	or <sup>N</sup> R	WL	SAMPLE		LABORATORY TESTS				
					NO	TYPE	W	D	LL PL	RQD	
35	SILTY SAND, (Cont.) (SM)	TILL (Cont.)	54 0.5		10	SS					
40	SAND, fine grained, light brown, moist, very dense (SP)	COARSE ALLUVIUM	67		11	SS					
43½					12	SS					
45.9	SHALE, gray	DECORAH FORMATION	78 0.7		13	SS					
	LIMESTONE, gray and light gray to about 49.8', then light brownish gray to about 54½', then light gray to about 58½', then gray to about 63.2', then light gray and gray mottled, a few shale seams above about 48', may be a void (about 0.2') at 57'	PLATTEVILLE FORMATION CARIMONA**	86%			NQ				40%	
		MAGNOLIA MEMBER	100%			NQ				100%	
		---	---	100%			NQ				92%
		HIDDEN FALLS MEMBER	---	100%			NQ				100%
		---	---	100%			NQ				100%
		MIFFLIN MEMBER	---	100%			NQ				92%
70	Continued on next page	**MEMBER									



# LOG OF TEST BORING

JOB NO 120-6850 VERTICAL SCALE 1" = 6' BORING NO B-4 Cont.  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	OR	R	WL	SAMPLE		LABORATORY TESTS				
						NO	TYPE	W	D	LL PL	RQD	
70	LIMESTONE, (Cont.)	MIFFLIN MEMBER (Cont.)	100%	(cont.)			NQ					100%
77.5	SHALE, gray to about 79.7' then light bluish gray and white mottled	GLENWOOD FORMATION	98%				NQ					70%
81.2	SANDSTONE, brown and tan to about 85' then white and light tan, cemented above about 85'	ST. PETER FORMATION	66%				NQ					34%
			0%				NQ					0%
			76%				NQ					0%
94.7	End of Boring	NOTE: PECATONICA MEMBER										

R = Percent of Core Recovery  
 RQD= Rock Quality Designation (%)  
 \*No measurement recorded due to pressure of drilling/coring fluid.

### WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL
12-3	10:50	8½'	None	8'	to	None
12-6	10:45	94.7'	46.2'		to	*
12-6	11:30	94.7'	None		to	*
					to	

START 12-3-80 COMPLETE 12-6-80  
 METHOD 6 FA 0-7' @ 10:45  
4 C 0-8.8', DM 8½-46.2',  
NC 0-46.2', NQ Wireline-cored  
 CREW CHIEF 46.2'-94.7' Francis

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-5  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	W	D	LL PL	Qu	
	SURFACE ELEVATION <u>839.8</u> ↓										
9	FILL, mostly SILTY SAND, a little silty clay and gravel, dark brown, brown and a little black, frozen to 1/2'	FILL	13		1	HSA					
			9		2	SS					
			17		3	SS					
			16		4	SS					
14	SAND, medium grained, a little gravel, a few cobbles, brown, moist, dense to very dense (SP-SM)	COARSE ALLUVIUM	41		5	SS					M.A.
	SAND, fine to medium grained, light brown, moist, very dense (SP)		34		6	SS					
19	SAND, fine grained, light brown, moist, very dense (SP-SM)		56		7	SS					
22	SAND, fine grained, light brown, moist, very dense (SP-SM)		93		8	SS					
28	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense (SM-SC)	TILL			9	SS					
30	SAND, medium grained, a little gravel, brown, moist, very dense (SP-SM)	COARSE ALLUVIUM									
	Continued on next page										Pressuremeter Test P <sub>f</sub> = 8.8 TSF

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-5 Cont.  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS													
					NO.	TYPE	W	D	L.L. P.L.	Qu										
30	SAND, (Cont.) (SP-SM)	COARSE ALLUVIUM (Cont.)	38		10	SS														
34	CLAYEY SAND, a little gravel, gray, rather stiff (SC-SM)											TILL	13	11	SS					Pressuremeter Test P <sub>f</sub> = 7.6 TSF
38	SILTY SAND, medium grained, a little gravel, a few cobbles, brown, moist, very dense (SM-SP)																			
44	SHALE, gray	DECORAH FORMATION	76		13	SS														
45.8	<del>NO SAMPLES RECOVERED, Appears (See #1)</del>		<del>SEE NOTE:</del>																	
46.3	End of Boring																			
			NOTE:																	
			PLATTEVILLE FORMATION																	
			#1 - to be LIMESTONE, based on action of drilling equipment and on evidence of material returned in drilling fluid.																	
			*No measurement recorded due to presence of drilling fluid.																	

WATER LEVEL MEASUREMENTS							START	COMPLETE
							12-22-80	12-22-80
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD 6 FA 0-4½' CS @ 2:50	
12-22	9:40	8½'	None	8'	to	None	4½' - 8½', 4C 0-9', DM 8½' - 46.3'	
12-22	2:50	46.3'	9'		to	*		
12-22	3:00	46.3'	None		to	*		
							CREW CHIEF Francis	

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-6  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>838.6'</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO	TYPE	W	D	LL PL	Qu
2	SILTY SAND, a trace of gravel, dark brown, moist, frozen to 1/2' (SM)	TOPSOIL			1	HSA				
4	SAND, fine grained, a trace of gravel, light brown, moist, medium dense (SP)	COARSE ALLUVIUM	9		2	SS				
	SAND, medium grained, some to a little gravel, a few cobbles, light brown, moist, medium dense to very dense (SP)		12		3	SS				
			31		4	SS				
			32		5	SS				
			28		6	SS				M.A.
			33		7	SS				
			40 0.5		8	SS				
22	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense, a few lenses of sand (SM)	TILL	35		9	SS				
	Continued on next page		36		10	SS				
33			SAND, medium grained, some gravel, a few cobbles, brown, moist, (Cont.) (SP-SM)	COARSE ALLUVIUM						
35										

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-6 Cont.  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	L.L. P.L.	Qu
35	SAND, (Cont.), very dense (SP-SM)	COARSE ALLUVIUM (Cont.)	60		11	SS				
38	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense (SM)		TILL	50		12	SS			
43½	NO SAMPLE RECOVERED. Appears to be	DECORAH FORMATION								
45½	SHALE based on material (See#1)	SEE NOTE:	29		--	--				
46	NO SAMPLES RECOVERED. Appears (See#2)		0.5							
End of Boring		NOTE:  PLATTEVILLE FORMATION								
#1 - returned in drilling fluid. DECORAH FORMATION										
#2 - to be LIMESTONE, based on action of drilling equipment and on evidence of material returned in drilling fluid.										
* No measurement recorded due to presence of drilling fluid.										

WATER LEVEL MEASUREMENTS							START	COMPLETE
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	12-23-80	12-23-80
12-23	9:45	16'	14½'	16'	to	None	METHOD ¾ HSA 0-14½'	@ 12:00
12-23	12:00	46'	14½'		to	*	DM 16-46'	
12-23	1:10	46'	None		to	*		
							CREW CHIEF	Francis

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-7  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>839.7'</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL PL	QU
4	FILL, mixture of SILTY SAND and SILTY CLAY, dark brown and black, frozen to 1½'	FILL	40		1	HSA				
					2	SS				
9	SAND, medium grained, a little to some gravel, a few cobbles, light brown, moist, very dense (SP)	COARSE ALLUVIUM	31		3	SS				
			50		4	SS				
			0.2							
35	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense, a few lenses of sand (SM)	TILL	46		5	SS				
			50		-	--				
			0.3							
			90		6	SS				
			0.5							
			41		7	SS				M.A.
			60		8	SS				
			0.5							
			41		9	SS				
			0.5							
Continued on next page										

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-7 (Cont.)  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL P.L.	Qu
35	SILTY SAND, (Cont.) (SM)	TILL (Cont.)	50 0.5		10	SS				
44					71	11	SS			
45½	SHALE, gray	DECORAH*	60		12	SS				
47	NO SAMPLES RECOVERED. Appears See #1) PLATTEVILL*		0.2							
	End of Boring  #1 - to be LIMESTONE based on action of drilling equipment and on evidence of material returned in drilling fluid.  **No measurement recorded due to presence of drilling fluid.									
		*FORMATION								

### WATER LEVEL MEASUREMENTS

START 1-5-81 COMPLETE 1-5-81  
 METHOD ¾ HSA 0-14½' @ 2:35  
DM 16-47'  
 CREW CHIEF Saugestad

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL
1-5		15'	14½'		to	None
1-5	2:35	47'	14½'		to	**
1-5	3:10		None	10'	to	None

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-8  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>838.1'</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL PL	Qu
4	FILL, mostly SILTY SAND, a little gravel, dark brown and brown	FILL	6		1	SS				
			17		2	SS				
6	SILTY SAND, a little gravel, brown, moist, very dense (SM)	TILL	36		3	SS				
12	SAND, medium grained, a little gravel, light brown, moist, very dense (SP)	COARSE ALLUVIUM	40		4	SS				
			57		5	SS				
23	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense (SM)	TILL	99		6	SS				
			93		7	SS				
			104		8	SS				
33	SAND, medium grained, a trace of gravel, brown, moist, very dense, lenses of silty sand (SP-SM)	COARSE ALLUVIUM	102		9	SS				
			110		10	SS				
40	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense (SM)	TILL	40 0.1		11	SS				
Continued on next page										



# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-8 Cont.  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	W	D	LL P.L.	Qu	
40	SILTY SAND, (Cont.) (SM)	TILL (Cont.)	30 0.2		12	SS					
44	SHALE, gray	DECORAH FORMATION	100 0.3		13	SS					
46	<del>No SAMPLE RECOVERED. Appears (See#1)</del>										
46.7	End of Boring										
	#1 - to be LIMESTONE based on action of drilling equipment and on evidence of material returned in drilling fluid.										
	*No measurement recorded due to presence of drilling fluid.										
		NOTE: PLATTEVILLE FORMATION									

WATER LEVEL MEASUREMENTS							START	COMPLETE
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	12-6-80	12-8-80
12-8	10:00	16'	14½'	16'	to	None	3¼ HSA 0-14½' @ 2:00 DM 16-46.7'	
12-8	2:00	46.7'	14½'		to	*		
12-8	2:20	46.7'	None		to	*		
							CREW CHIEF	Francis

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-9  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS					
					NO.	TYPE	W	D	LL P.L.	Qu		
	↙ SURFACE ELEVATION <u>823.5'</u>											
6	FILL, mixture of SAND and SILTY SAND, a little gravel, brown, black and dark brown, frozen to 1'	FILL	6		1	SS						
			5		2	SS						
	SAND, medium grained, a trace to a little gravel, light brown, moist, loose to very dense, a few lenses of silty sand below 15' (SP)	COARSE ALLUVIUM	11		3	SS						
			9		4	SS						
			60		5	SS						
			70		6	SS						
17½	CLAYEY SAND, a little gravel, a few cobbles, brown, stiff to very stiff (SC-SM)	TILL	21		7	SS						
			35		8	SS						
28	CLAYEY SAND, a little gravel, gray, rather stiff (SC)				9	SS						
30½	SILTY SAND, a little (See #1) (SM)		8		10	SS						
31.7	NO SAMPLES RECOVERED. Appears (See #2)	See Note										
33.0	END OF BORING  #1 - gravel, gray, loose (SM)  #2 - to be LIMESTONE based on action of drilling equipment and on evidence of material returned in drilling fluid.  *Drilling fluid	Note: PLATTEVILLE FORMATION										

WATER LEVEL MEASUREMENTS							START <u>1-5-81</u>	COMPLETE <u>1-5-81</u>
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD	
1-5		14'	12½'		to	None	¾ HSA 0-13'	@ 1:45
1-5	1:45	33.0'	13'		to	6' *	DM 14-33.0'	
1-5	2:10	33.0'	None		to	8' *		
					to			
							CREW CHIEF	LeMay

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-10  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	W	D	LL P.L.	Qu	
	↙ SURFACE ELEVATION <u>823.5'</u>										
5	FILL, mixture of SILTY SAND and SAND, a little gravel, black, brown, and light brown, frozen to 1'	FILL	3		1	SS					
			18		2	SS					
	SAND, medium grained, some gravel, brown, moist, dense to very dense (SP-SM)	COARSE ALLUVIUM	41		3	SS					M.A.
			41		4	SS					
			41		5	SS					
			41		6	SS					
15	SILTY CLAY, gray, rather stiff (CL)	FINE*	15		7	SS					
16	SANDY CLAY, a little gravel, a few cobbles, gray, rather stiff, a few lenses of sand and silty sand, a limestone slab between 19½'-20.7' (SC)	TILL									
			50		-	--					
			0.0								
28	No SAMPLE RECOVERED. Appears to be COBBLES and GRAVEL based (See #1)		10		8	SS	20	109	29	15	
30	No SAMPLE RECOVERED. Appears to be LIMESTONE based on action of drilling equipment and on (See #2)	PLATTEVILLE FORMATION	50		-	--					
			0.0								
33.5	END OF BORING #1- on action of drilling equipment. #2- evidence of material returned in drilling fluid. Appears to be weathered above about 32½' and a possible void at 30.4'-30.5'. **Drilling fluid	*ALLUVIUM									

### WATER LEVEL MEASUREMENTS

START 1-2-81 COMPLETE 1-5-81

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD
1-5	8:50	30.5	13'		to	29½' **	3¼ HSA 0-14½' @ 9:45 DM 16-33.5'
1-5	9:45	33.5'	13'		to	27' **	
1-5	10:00	33.5'	None	25'	to	None	

CREW CHIEF LeMay

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-11  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS							
					NO.	TYPE	W	D	LL P.L.	Qu				
	SURFACE ELEVATION <u>832.6'</u>													
2	SILTY CLAY, black and brown, frozen to 1' (CL)	TOPSOIL			1	HSA								
4	CLAYEY SILT, brown, soft (ML-CL)	FINE ALLUVIUM	4		2	SS								
6	SAND, fine grained, light brown, moist, loose to medium dense, a few lenses of silty sand and silty clay (SP-SM)	COARSE ALLUVIUM	6		3	SS								
14			4	SS										
67			5	SS										
57			6	SS										
26					7	SS								
18	SILTY SAND, medium grained, with gravel, a few cobbles, brown, moist, very dense (SM-SP)				98	8	SS							
23	SILTY SAND, a little gravel, brown, moist, dense (SM-SC)	TILL			25	9	SS							
28	CLAYEY SAND, a little gravel, brown, stiff (SC)				17	10	SS							
33	SILTY SAND, a little gravel, brown, wet, loose, a lense (See #1) (SM)				9	11	SS							
35½	SHALE, gray	DECORAH FORMATION			12	SS	25	100	45	25				
39.4	<del>NO SAMPLES RECOVERED. Appears (See #2)</del>													
40	END OF BORING #1 - of sandy clay (SM) #2 - to be LIMESTONE based on action of drilling equipment and on evidence of material returned in drilling fluid. **No measurement recorded due to presence of drilling fluid.	*FORMATION												

WATER LEVEL MEASUREMENTS							START <u>12-30-80</u>	COMPLETE <u>12-31-80</u>
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD	
					to		<u>3¼ HSA 0-14½'</u>	<u>@ 10:30</u>
					to		<u>DM 16-40'</u>	
<u>12-30</u>	<u>3:30</u>	<u>16'</u>	<u>14½'</u>	<u>15½'</u>		<u>None</u>		
<u>12-31</u>	<u>10:30</u>	<u>40'</u>	<u>14½'</u>			<u>**</u>		
<u>12-31</u>	<u>10:35</u>	<u>40'</u>	<u>None</u>			<u>**</u>		
							CREW CHIEF	<u>Francis</u>

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-12  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	W	D	LL PL	Qu	
	↙ SURFACE ELEVATION <u>832.7'</u>										
2	FILL, mixture of SILTY CLAY and SILTY SAND, a little (See #1)	FILL			1	HSA					
	FILL, mixture of SAND and SILTY SAND, a little gravel, brown some black		9		2	SS					
			6		3	SS					
			9		4	SS					
8½	SAND, medium grained, a little gravel, a few cobbles, light brown, moist, dense (SP)	COARSE ALLUVIUM			5	SS					
			16		6	SS					
			27		7	SS					
				16	7	SS					
18	SILTY SAND, a little gravel, brown, moist, very dense to dense (SM)	TILL			40	8	SS	9	132		M.A.
					24	9	SS				
					40	10	SS				
28	SANDY CLAY, a little gravel, a few cobbles, gray, brown, rather stiff, a few lenses of sand (CL)										
34½	SHALE, gray	DECORAH FORMATION			100 0.2	11	SS				
38	NO SAMPLES RECOVERED. Appears to be Limestone based on action (See #2)	PLATTEVILLE FORMATION									
40	End of Boring										
	#1 - gravel, black, frozen to ½'										
	#2 - of drilling equipment and on evidence of material returned in drilling fluid.										
	*No measurement recorded due to presence of drilling fluid.										

WATER LEVEL MEASUREMENTS							START	COMPLETE
							12-31-80	12-31-80
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD	
							3½ HSA 0-14½' @ 1:55	
					to		DM 16-40'	
12-31	11:30	16'	14½'	16'		None		
12-31	1:55	40'	14½'			*		
12-31	2:00	40'	None			*		
							CREW CHIEF Francis	

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-13  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>839.6'</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	W	D	LL PL	Qu	
2	FILL, mostly SILTY SAND, a little gravel, some crushed limestone (See #1)	FILL			1	HSA					
4	SILTY SAND, fine grained, dark brown, moist, medium dense (SP)	COARSE ALLUVIUM	13		2	SS					
	SAND, medium grained, a little gravel, light brown, moist, dense to very dense (SP)		24		3	SS					
			33		4	SS					
			41		5	SS					
			34		6	SS					
			33		7	SS					
18	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense (SM)		TILL	34		8	SS				
			44		9	SS					
			100 0.2		-	--					
35	Continued on next page										

# LOG OF TEST BORING

JOB NO 120-6850 VERTICAL SCALE 1" = 6' BORING NO B-13 Cont.  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL PL	Qu
35	SILTY SAND, (Cont.) (SM)	TILL (Cont.)	40 0.1		10	SS				
44			62		11	SS				
45½	SHALE, gray	DECORAH *	100		12	SS				
46	<del>NO SAMPLE RECOVERED. Appears (See #2)</del>	<del>PLATTEVILLE*</del>	0.6							
End of Boring		*FORMATION								
	#1 - brown, a 0.2' layer of blacktop at the surface, frozen to ½' #2 = to be LIMESTONE based on action of drilling equipment and on evidence of material returned in drilling fluid.									
	***No measurement recorded due to presence of drilling fluid.									

WATER LEVEL MEASUREMENTS							START	12-11-80		COMPLETE	12-11-80	
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD	3¼ HSA 0-14½'		@	1:50	
12-11	10:15	16'	14½'		to	None	DM 16-46'					
12-11	1:50	46'	14½'		to	***						
12-11	2:10	46'	None		to	***						
					to		CREW CHIEF		Francis			

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-14  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>839.1'</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO	TYPE	W	D	LL PL	Qu
4	FILL, mostly SILTY SAND, a little gravel, brown and dark brown, a layer of blacktop at the surface	FILL	5		1	FA				
					2	SS				
6½	FILL, mostly SILTY SAND, a little gravel and concrete, brown		56 0.8		3	SS				
12	SAND, medium grained, a little gravel, light brown, rather dry, very loose to very dense (SP)	COARSE ALLUVIUM	3		4	SS				
					5	SS				
14	SANDY CLAY, a little gravel, brown, stiff (CL-SC)	TILL	19		6	SS				
23	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense (SM)	TILL	50 0.3		-	--				
					40	7	SS			
29	NO SAMPLE RECOVERED. Appears to be SAND, medium grained, a little gravel, a few cobbles, brown, very dense based on action of drilling equipment and on evidence of material returned in (See #1)	COARSE ALLUVIUM	50 0.2							
40	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense (SM)	TILL	50 0.4		8	SS				
					100 0.4	9	SS			
Continued on next page										



# LOG OF TEST BORING

 JOB NO 120-6850

 VERTICAL SCALE 1" = 6'

 BORING NO B-14 Cont.

PROJECT \_\_\_\_\_

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	OR NR	WL	SAMPLE		LABORATORY TESTS			
					NO	TYPE	W	D	LL PL	RQD
40	SILTY SAND, (Cont.) (SM)	TILL (Cont.)	80		10	SS				
43½ 44.5	No SAMPLE RECOVERED. Appears (See#2)	DECORAH*								
	LIMESTONE, gray and a little light gray to about 48.7' then light brownish gray to about 56½' then light gray to gray to about 62.8' then light gray and gray mottled, contains a few thin lenses of shale at about 46.0' and about 47.4'	PLATTEVILLE FORMATION CARIMONA MEMBER	79%			NQ				30%
			100%			NQ				81%
		MAGNOLIA MEMBER	100%			NQ				100%
				100%		NQ				100%
		HIDDEN FALLS MEMBER		100%		NQ				98%
				100%		NQ				86%
				100%		NQ				88%
				100%		NQ				84%
76.6±	SEE NOTE:									
	SHALE, gray to about 79' then light bluish and greenish gray with a little white, sandy shale (See #3)	GLENWOOD FORMATION	100%			NQ				84%
80	SANDSTONE, yellow with a little light grayish brown to about 84½' then tan to white, cemented above about 84½'	ST. PETER FORMATION	74%			NQ				8%
85										
	Continued on next page	*FORMATION								
		NOTE: PECATONICA FORMATION								

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-14 Cont.  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	OR <sup>N</sup> R	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL P.L.	RQD
85	SANDSTONE, (Cont.)	ST. PETER FORMATION (Cont.)	0% (Cont.)			NQ				0%
			0%		NQ		0%			
94.5	<p style="text-align: center;">End of Boring</p> <p>#1-based on action of drilling equipment and on evidence of material returned in drilling fluid.</p> <p>#2 - to be SHALE, gray , based on action of drilling equipment and on evidence of material returned in drilling fluid.</p> <p>#3 - below about 78½'</p> <p>R ≠ Percent of Core Recovery</p> <p>RQD = Rock Quality Designation (%)</p> <p>*No measurement recorded due to presence of drilling/coring fluid.</p>									

WATER LEVEL MEASUREMENTS							START	COMPLETE
							12-9-80	12-10-80
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD <u>6 FA 0-7' CS 7'-11'</u> @ <u>2:30</u>	
12-9	10:15	11'	None	11'	to	None	4C 0-10', DM 11-44½', NC 0-44½', NQ Wireline-cored 44.5'-94.5'	
12-10	2:30	94.5'	44½'		to	*		
12-10	3:30	94.5'	None		to	*		
							CREW CHIEF <u>Francis</u>	

## LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-15  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS						
					NO.	TYPE	W	D	LL P.L.	Qu			
	↙ SURFACE ELEVATION <u>838.3'</u>												
2	SANDY SILT, dark grayish brown, moist, loose (ML)	TOPSOIL	5		1	SS							
4	SANDY CLAY, a trace gravel, brown, rather stiff (CL)	WEATHERED TILL	9		2	SS							
6	CLAYEY SAND, a little gravel, brown, rather stiff, a few lenses of sand (SC)	TILL	14		3	SS							
	SAND, medium grained, a trace of gravel, light brown, moist, dense to very dense (SP)	COARSE ALLUVIUM	16		4	SS							
			38		5	SS							
12			79		6	SS							
	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense (SM)	TILL	0.5										
			50										
			0.1										
			70		7	SS							
			0.5										
			67		8	SS							
			0.5										
28													
	SAND, medium grained, a little gravel, brown, moist, very dense (SP)	COARSE ALLUVIUM	65		9	SS							
			0.5										
33													
	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense (SM)	TILL	75		10	SS							
	***No measurement recorded due to presence of drilling fluid.												
			48		11	SS							
43													
44.3	SEE NOTE: NO SAMPLES RECOVERED.	DECORAH*											
44.7	End of Boring	**											
	Appears to be SHALE to about 44.3' then LIMESTONE based on action of drilling equipment and on evidence of	*FORMATION **PLATTEVILLE FORMATION											

\*\*\*\* material returned in drilling fluid.

WATER LEVEL MEASUREMENTS							START	COMPLETE
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	12-16-80	12-16-80
12-16	9:55	16'	14½'	16'	to	None	METHOD 3¼ HSA 0-14½'	@ 11:45
12-16	11:45	44.7'	14½'		to	***	DM 16-44.7'	
12-16	12:00	44.7'	None		to	***		
					to			
							CREW CHIEF	Francis

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-16  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS							
					NO.	TYPE	W	D	LL P.L.	Qu				
	↙ SURFACE ELEVATION <u>822.9'</u>													
	FILL, mixture of SILTY SAND and SILTY CLAY, black, dark brown and brown, frozen to 1½'	FILL				1	HSA							
5														
6	SILT, black, moist, loose (ML)	TOPSOIL	6			2	SS							
7½	SILTY CLAY, dark brown to brown medium (CL)	FINE ALLOUVIUM				3	SS							
			18			4	SS							
9½	SILTY SAND, fine grained, a trace of gravel, brown, moist, dense (SM)	COARSE ALLOUVIUM												
11	SAND, medium grained, (See #1) (SP-SM)		8			5	SS							
				20			6	SS						
	SAND, medium grained, a trace to some gravel, a few cobbles, light brown and brown, moist, dense to very dense (SP)			74			7	SS						
18½														
	CLAYEY SAND, some gravel, a few cobbles and boulders, gray to brown, very stiff to stiff (SC)	TILL	37			9	SS							
28			27			10	SS							
	SILTY SAND, a little gravel, gray, wet, medium dense (SM)													
31.9			18			11	SS							
33.4	NO SAMPLE RECOVERED. Appears (See#2)	PLATTEVILLE*												
	End of Boring	*FORMATION												
	#1 - a little gravel, brown, moist loose (SP-SM)													
	#2 - to be LIMESTONE based on action of drilling equipment and on evidence of material returned in drilling fluid.													
	**No measurement recorded due to presence of drilling fluid.													

### WATER LEVEL MEASUREMENTS

START 1-5-81 COMPLETE 1-5-81

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD	TIME
1-5		14'	12'		to	None	3¼ HSA 0-13'	@ 4:10
1-5	4:10	34.4'	13'		to	**	DM 14-33.4'	
1-5	4:20	34.4'	None	None	to	**		
					to			

CREW CHIEF LeMay

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-17  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS						
					NO.	TYPE	W	D	LL P.L.	Qu			
	↙ SURFACE ELEVATION <u>822.3'</u>												
2	CLAYEY SILT, dark grayish brown, frozen to 1/2'	(ML-CL) TOPSOIL			1	HSA							
4	SANDY SILT, dark brown, moist, dense	(ML) FINE ALLUVIUM	17		2	SS							
7	SILTY SAND, fine grained, brown, moist, medium dense	(SM) COARSE ALLUVIUM	10		3	SS							
	SAND, medium grained, a little gravel, light brown, moist, medium dense to very dense	(SP)	14		4	SS							
			17		5	SS							
14			52		6	SS							
	SAND, medium grained, some gravel, a few cobbles, brown, rather dense	(SP)	100		7	SS							
17 1/2	CLAYEY SAND, a little gravel, a few cobbles, brown and grayish brown	(SC-SM) TILL	18		8	SS	15	116				M.A.	
			18		9	SS							
31			40		10	SS							
34	NO SAMPLE RECOVERED. Appears to be LIMESTONE based on action of drilling equipment and on evidence (See #1)	PLATTEVILLE FORMATION	50		-	--							
	End of Boring		0.0										
	#1 - of material returned in drilling fluid.												
	*No measurement recorded due to presence of drilling fluid.												

### WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD	START	COMPLETE
12-31		16'	14 1/2'		to	None	3 1/4 HSA 0-14 1/2'	12-31-80	1-2-81
1- 2	11:30	34'	14 1/2'		to	*	DM 16-34'		
1- 2	11:45	34'	None		to	*			
					to				

CREW CHIEF Francis & LeMay

# LOG OF TEST BORING

JOB NO. 120-6850

VERTICAL SCALE 1" = 6'

BORING NO. B-18

PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>828.1'</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL PL	Qu
2	SANDY CLAY, black, frozen to 1/2' (CL)	TOPSOIL			1	HSA				
4	SILTY SAND, fine grained, dark brown, moist, loose (SM)	COARSE ALLUVIUM	5		2	SS				
7 1/2	SILTY SAND, fine grained, brown, moist, very loose, a lense of silt at about 7' (SM-SP)		4		3	SS				
9	SAND, fine grained, light(See#1)(SP)		20		4	SS				
					5	SS				
					6	SS				
	SAND, medium grained, a little gravel, a few cobbles, brown, moist, dense to very dense, a few lenses of fine sand (SP)			23		6	SS			
				32		7	SS			
				31		8	SS			
18	CLAYEY SAND, a little gravel, a few cobbles, brown, very stiff to stiff (SC)	TILL	43		9	SS				
25	Continued on next page									

# LOG OF TEST BORING

JOB NO. 120-6850

VERTICAL SCALE 1" = 6'

BORING NO. B-18 Cont

PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	W	D	LL PL	Qu	
25	CLAYEY SAND, (Cont.) (SC)	TILL (Cont.)	19		10	SS					
			13		11	SS	11	129	16 13		
			16		-	--					
37.3 37.8	<del>NO SAMPLES RECOVERED. Appears (See #2)</del>		<del>SEE NOTE:</del>								
	End of Boring										
	#1 - brown, moist, dense (SP)										
	#2 - to be LIMESTONE, based on action of drilling equipment and on evidence of material returned in drilling fluid.										
	*No measurement recorded due to presence of drilling fluid.										
		NOTE: PLATTEVILLE FORMATION									

**WATER LEVEL MEASUREMENTS**

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	START	COMPLETE
12-17	2:30	16'	14½'	16'	to	None	12-17-80	12-18-80
12-18	9:55	37.8'	14½'		to	*	METHOD 3¼ HSA 0-14½'	@ 9:55
12-18	10:10	37.8'	None		to	*	DM 16-37.8'	
					to		CREW CHIEF Francis	

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-19  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>829.5'</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO	TYPE	W	D	LL PL	Qu
9	FILL, mixture of SAND, SILTY SAND and CLAYEY SAND, a little gravel, brown, dark brown and black, a layer of crushed limestone at the surface	FILL			1	HSA				
			16		2	SS				
			13		3	SS				
			11		4	SS				
18	SAND, medium grained, a little gravel, a few cobbles, brown, moist, dense to very dense, a few lenses of fine grained sand (SP)	COARSE ALLUVIUM	26		5	SS				
			19		6	SS				
			36		7	SS				
27	SILTY SAND, a little gravel, a few cobbles, brown to grayish brown, moist, very dense (SM)	TILL	45		8	SS				
			89 0.9		9	SS				
30	CLAYEY SAND, a little gravel, gray, stiff to rather stiff, a few lenses of silty sand (SC-SM)									
	Continued on next page									



# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-19 Cont.  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO	TYPE	W	D	LL P.L.	Qu
30	CLAYEY SAND, (Cont.) (SC-SM)	TILL (Cont.)	17		10	SS				
			14		11	SS				
37.7 38.7	NO SAMPLES RECOVERED. Appears (See #1)		SEE NOTE:							
	End of Boring									
	#1 - to be LIMESTONE based on action of drilling equipment and on evidence of material returned in drilling fluid.									
	*No measurement recorded due to presence of drilling fluid.									
		NOTE: PLATTEVILLE FORMATION								

### WATER LEVEL MEASUREMENTS

START 12-17-80 COMPLETE 12-17-80  
 METHOD 3 1/4 HSA 0-14 1/2' @ 11:30  
DM 16-38.7'  
 CREW CHIEF Francis

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL
12-17	9:50	16'	14 1/2'	14 1/2'	to	None
12-17	11:30	38.7'	14 1/2'		to	*
12-17	11:45	38.7'	None		to	*

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-20  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	W	D	LL P.L.	Qu	
	SURFACE ELEVATION <u>835.0'</u>										
2	SANDY SILT, dark grayish brown, moist, very loose (ML)	TOPSOIL	4		1	SS					
4	SILT, brown, moist, loose (ML)	FINE ALLUVIUM	5		2	SS					
9	SILTY SAND, fine grained, light brown, moist, loose to medium dense, a few lenses of sand and silty clay (SM)	COARSE ALLUVIUM	7		3	SS					
			10		4	SS					
			47		5	SS					
			0.5		40	6	SS				
			40		47	7	SS				
27	SAND, medium grained, a little to some gravel, a few cobbles, light brown, moist, very dense (SP-SM)		49		8	SS					
			37		9	SS					
			44		--						
38	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense (SM)	TILL	32		10	SS					
			14		11	SS					
43.2	CLAYEY SAND, a little gravel, grayish brown, rather stiff, a few laminations of sand (SC)										
44.0			No SAMPLE RECOVERED. Appears to (See #1) *PLATTEVILLE *FORMATION								
End of Boring											
#1 - be LIMESTONE based on action of drilling equipment and on evidence of material returned in drilling fluid.											

M.A.

**\*\*No measurement recorded due to presence of drilling fluid.**

WATER LEVEL MEASUREMENTS						START <u>12-15-80</u> COMPLETE <u>12-15-80</u>
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL
12-15	10:20	16'	14½'	15½'	to	None
12-15	12:05	44.0'	14½'		to	**
12-15	1:10	44.0'	None		to	**
						METHOD <u>¾ HSA 0-14½'</u> @ <u>12:05</u>
						<u>DM 16-44.0'</u>
						CREW CHIEF <u>Francis</u>

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-21  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	W	D	LL PL	Qu	
	↙ SURFACE ELEVATION <u>838.2'</u>										
2	SANDY SILT, dark brown, moist, frozen to 1' then medium dense (ML)	TOPSOIL			1	SS					
7	SILTY SAND, fine grained, brown, moist, medium dense (SM)	COARSE ALLUVIUM	15		2	SS					
			13		3	SS					
			19		4	SS					
			5		5	SS					
			14		6	SS					
			23		7	SS					
			36		-	--					
28	SAND, medium grained, a little to some gravel, a few cobbles, brown, moist, dense to very loose to very dense (SP)	COARSE ALLUVIUM	94		8	SS					
			47		9	SS					
			22		-	--					
43½	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense to dense to very dense (SM)	TILL	38		10	SS					
			100		11	SS					
44.9	SHALE, gray	DECORAH*	0.4								
	End of Boring	*FORMATION									
	**No measurement recorded due to presence of drilling fluid.										

WATER LEVEL MEASUREMENTS							START	12-12-80	COMPLETE	12-12-80
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD			
12-12	1:15	16'	14½'	16'	to	None	3¼ HSA 0-14½'		@ 3:50	
12-12	3:50	44.9'	14½'		to	**	DM 16-44½'			
12-15	9:00	44.9'	None		to	**				
					to				CREW CHIEF Francis	

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-22  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>838.6'</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL PL	Qu
3	SILTY SAND, fine grained, dark grayish brown, frozen to 0.2' then moist, very loose (may be fill)(SM)	COARSE ALLUVIUM OR FILL	4		1	SS				
			4		2	SS				
5½	SILTY SAND, fine grained, brown, moist, loose (SM)	COARSE ALLUVIUM	4		3	SS				
			11		4	SS				
6½	SILTY SAND, medium grained, (See #1)(SM)				5	SS				
9	SAND, medium grained, a little gravel, light brown, (See #2) (SP)		31		6	SS				
			10		7	SS				
10	SAND, medium to coarse(See#3) (SP-SM)		21		8	SS				
11½	SILTY SAND, a little gravel(See#4)(SM)	TILL								
14	SAND, fine grained, some gravel, brown, moist, very dense (SP-SM)	COARSE ALLUVIUM	42		9	SS				
			48		10	SS				
	SILTY SAND, a little gravel, brown, moist, very dense, a few lenses of sand (SM)	TILL	36		11	SS				M.A.
			73		12	SS				
			97		13	SS				
33	SAND, medium grained, a little gravel, brown, moist, very dense (SP-SM)	COARSE ALLUVIUM								
35	Continued on next page									

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-22 Cont.  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL PL	Qu
35	SAND, (Cont.) (SP-SM)	COARSE ALLUVIUM (Cont.)	100 0.8		14	SS				
38	SILTY SAND, a little gravel, brownish gray, moist, very dense (SM)	TILL	63		15	SS				
44	SHALE, gray	DECORAH*	100		16	SS				
45	NO SAMPLE RECOVERED. Appears (See #5)	MAYBE**	0.2							
45.7	End of Boring	*FORMATION **PLATTEVILLE FORMATION								
	#1 - some gravel, brown, moist, dense (SM)									
	#2 - moist, very dense (SP)									
	#3 - grained, a little gravel, brown, moist dense (SP-SM)									
	#4 - brown, moist, dense (SM)									
	#5 - to be LIMESTONE based on action of drilling equipment and on evidence of material on sampler bit.									
	***No measurement recorded due to presence of drilling fluid.									

WATER LEVEL MEASUREMENTS							START	COMPLETE
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	12-8-80	12-8-80
12-8		16'	14½'		to	None	3¼ HSA 0-14½'	@ 12:00
12-8	12:00	45.7'	14½'		to	***	DM 14½-44½'	
12-8	12:55	45.7'	None		to	***		
					to			
							CREW CHIEF	White

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-23  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	W	D	LL P.L.	Qu	
	☐ SURFACE ELEVATION <u>836.9'</u>										
2	FILL, mostly SILTY SAND, a little gravel, dark brown, frozen to 1/2'	FILL	15		1	SS					
4	SILT, dark brown, rather dry, loose (ML)	TOPSOIL	8		2	SS					
7	SILT, brown, moist, medium dense (ML)	FINE ALLUVIUM	9		3	SS					
8 1/2	SILTY SAND, fine grained, (See#1) (SM)	COARSE ALLUVIUM	8		4	SS					
	SAND, medium grained, a little gravel, a few cobbles, brown, moist, very dense to dense (SP)		57		5	SS					
			46		6	SS					
			30		7	SS					
18	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense, lenses and laminations of sand (SM)	TILL	46		8	SS					
			85		9	SS					
			77 0.9		10	SS					
33	CLAYEY SAND, a little gravel, gray, very stiff, a few lenses of sand (SC)		35		11	SS					
38 1/2											
40.2	SHALE, gray	DECORAH FORMATION	50		12	SS					
41	NO SAMPLE RECOVERED. Appears (See#2) *FORMATION	*PLATTEVILLE	0.2								
	End of Boring #1-light brown, moist, loose (SM) #2 to be LIMESTONE based on action of drilling equipment and on evidence of material on sampler bit. **No measurement recorded due to presence of drilling fluid.	*FORMATION									

WATER LEVEL MEASUREMENTS							START	12-15-80	COMPLETE	12-15-80
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD			
12-15	2:00	16'	14 1/2'	15 1/2'	to	None	3 1/4 HSA 0-14 1/2' @ 3:35			
12-15	3:35	41'	14 1/2'		to	**	DM 16-41'			
12-16	8:45	41'	None		to	**				
					to		CREW CHIEF Francis			

## LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-24  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>838.5'</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL PL	Qu
3½	SILTY SAND, fine grained, a trace of gravel, dark brown, frozen to 0.2', then moist, loose to very (See#1)(SM)	COARSE ALLUVIUM OR FILL	6		1	SS				
			4		2	SS				
6½	SILTY SAND, fine to medium grained, a little gravel, brown, moist, medium dense, a few lenses of sand (SM)	COARSE ALLUVIUM	11		3	SS				
			33	TILL	4	SS				
46	5	SS								
31	6	SS								
15½	SAND, fine grained, light brown, moist, very dense (SP)	COARSE ALLUVIUM	33		7	SS				
18				8	SS					
33	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense (SM)	TILL	53		9	SS				
					100 0.8	10	SS			
			39		11	SS				
40	CLAYEY SAND, a little gravel, brown, very stiff (SC-SM)		31		12	SS				
Continued on next page										

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. B-24 Cont.  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL / P.L.	Qu
40	CLAYEY SAND, (Cont.) (SC-SM)	TILL (Cont.)	44		13	SS				
44	NO SAMPLE RECOVERED. Appears (See#2)	PLATTEVILLE FORMATION								
45.7										
	End of Boring									
	#1 - loose (may be fill) (SM)									
	#2- to be LIMESTONE based on action of drilling equipment and on evidence of material returned in drilling fluid.									
	*No measurement recorded due to presence of drilling fluid.									

WATER LEVEL MEASUREMENTS							START	COMPLETE
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD	
12-8		11'	9½'		to	None	¾ HSA 0-9½'	@ 3:20
12-8	3:20	45.7'	9½'		to	*	DM 9½-45.7'	
12-8	3:40	45.7'	None		to	*		
					to			
							CREW CHIEF	White



# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. C-1  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>817.1'</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL P.L.	Qu
3½	FILL, mixture of SILTY SAND and SILT, a little gravel, dark brown, brown and black	FILL	6		1	HSA				
					2	SS				
5	CLAYEY SILT, dark grayish(See#1)(ML-CL)	TOPSOIL			3	SS				
9	SAND, fine to medium grained, a little gravel, a few cobbles and boulders, brown, moist, medium dense (SP)	COARSE ALLUVIUM	11		4	SS				
			100		-	--				
14.7	SANDY CLAY, a little gravel, a boulder at about 14½', grayish brown, stiff (CL-SC)	TILL	19		5	SS				
			20		6	SS				
			50		-	--				
			0.0							
	Obstruction (boulder)									
	#1 - brown, medium (ML-CL)									

WATER LEVEL MEASUREMENTS							START	12-11-80	COMPLETE	12-12-80
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD <u>¾ HSA 0-14.7'</u> @ <u>9:25</u>			
					to					
12-12	9:25	14.7'	14.7'	14.7'	to	None				
12-12	9:30	14.7'	None	10'	to	None				
					to		CREW CHIEF <u>Francis</u>			

# LOG OF TEST BORING

JOB NO. 120-6850 VERTICAL SCALE 1" = 6' BORING NO. C-2  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	W	D	LL P.L.	Qu	
	☐ SURFACE ELEVATION <u>838.7'</u>										
2	FILL, mostly SILTY SAND, a little gravel, brown, dark brown (See #1)	FILL				1	SS				
4	SANDY CLAY, a little gravel, brown, stiff (CL)	MIXED ALLUVIUM	16			2	SS				
7	SAND, medium grained, a little gravel, brown, moist, dense (SP-SM)	COARSE ALLUVIUM	29			3	SS				
	SILTY SAND, a little gravel, a few cobbles, brown, moist, dense to very dense, a few lenses of sand (SM)	TILL	21			4	SS				
			100			5	SS				
			$\frac{65}{0.5}$			6	SS				
			105			7	SS				
20½			$\frac{63}{0.5}$			8	SS				
	End of Boring										
	#1 - black, frozen to 0.7'										

### WATER LEVEL MEASUREMENTS

START <u>12-12-80</u> COMPLETE <u>12-12-80</u>						
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL
						METHOD <u>¾ HSA 0-19½'</u> @ <u>11:10</u>
					to	
12-12	11:10	20½'	19½'	20½'	to	None
12-12	11:20	20½'	None	11½'	to	None
					to	
CREW CHIEF <u>Francis</u>						

# LOG OF TEST BORING

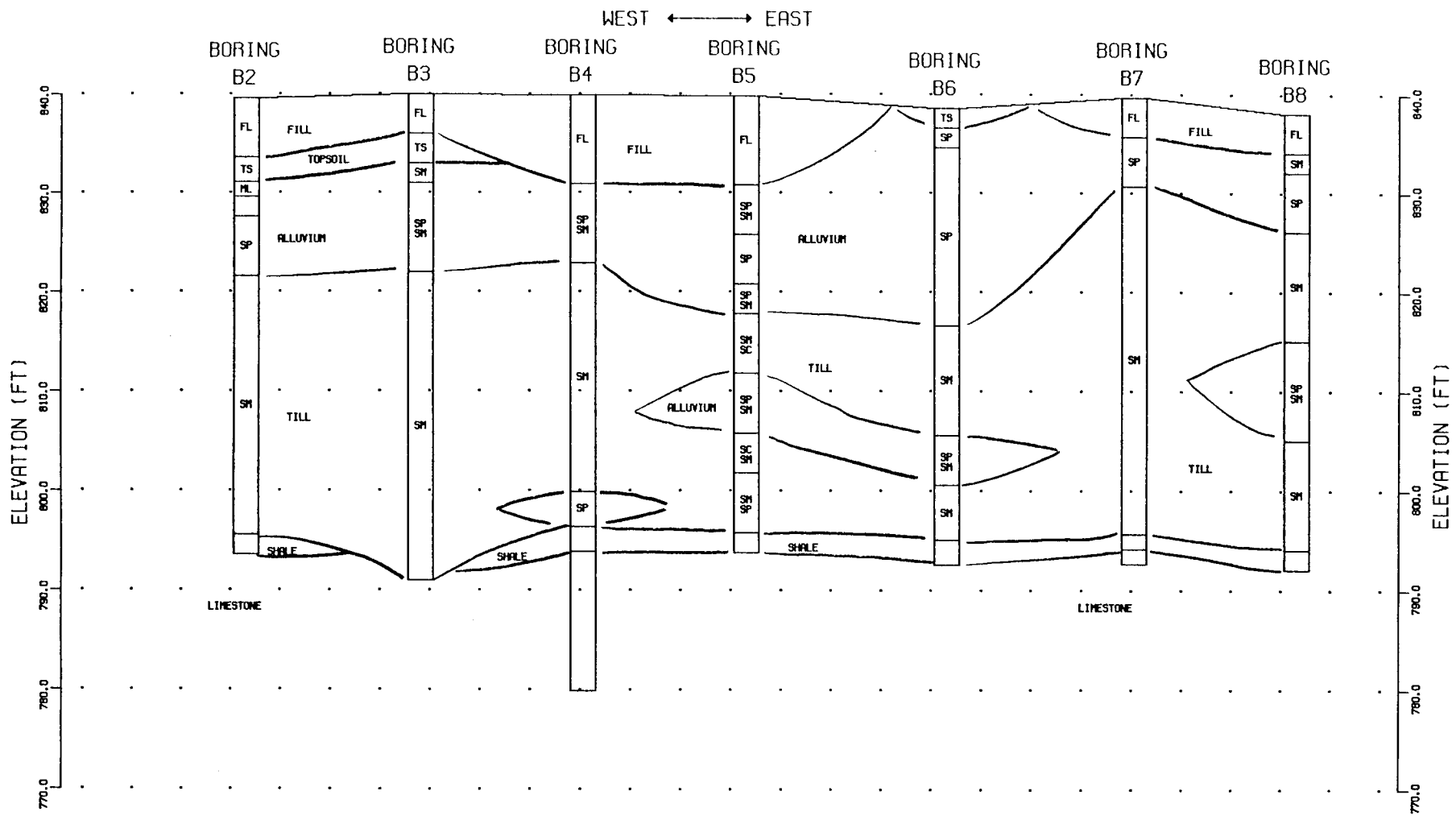
JOB NO 120-6850 VERTICAL SCALE 1" = 6' BORING NO C-3  
 PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT - MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>838.6'</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS			
					NO.	TYPE	W	D	LL PL	Qu
4	FILL, mixture of SAND and SILTY SAND, a little gravel, a few cobbles, brown, some black silty clay at the surface	FILL	20		1	SS				
			12		-	--				
9	SILTY SAND, a little gravel, brown, moist, dense (SM)	TILL	28		2	SS				
			26		3	SS				
14	SAND, medium grained, a trace of gravel, light brown, rather dry, medium dense to very dense (SP)	COARSE ALLUVIUM	14		4	SS				
			42		5	SS				
20½	SILTY SAND, a little gravel, a few cobbles, brown, moist, very dense (SM)	TILL	91		6	SS				
			65		7	SS				
	0.5									
End of Boring										

### WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD	START	COMPLETE
								12-8-80	12-8-80
							¾ HSA 0-19½'		@ 3:50
12-8	3:50	20½'	19½'	20'	to	None			
12-9	9:00	20½'	None	10'	to	None			
					to				

CREW CHIEF Francis

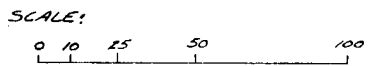


NOTE: EXCEPT AT BORING LOCATIONS THE GROUND SURFACE, WATER LEVEL, AND BOUNDARIES BETWEEN SOIL LAYERS ARE INFERRED.

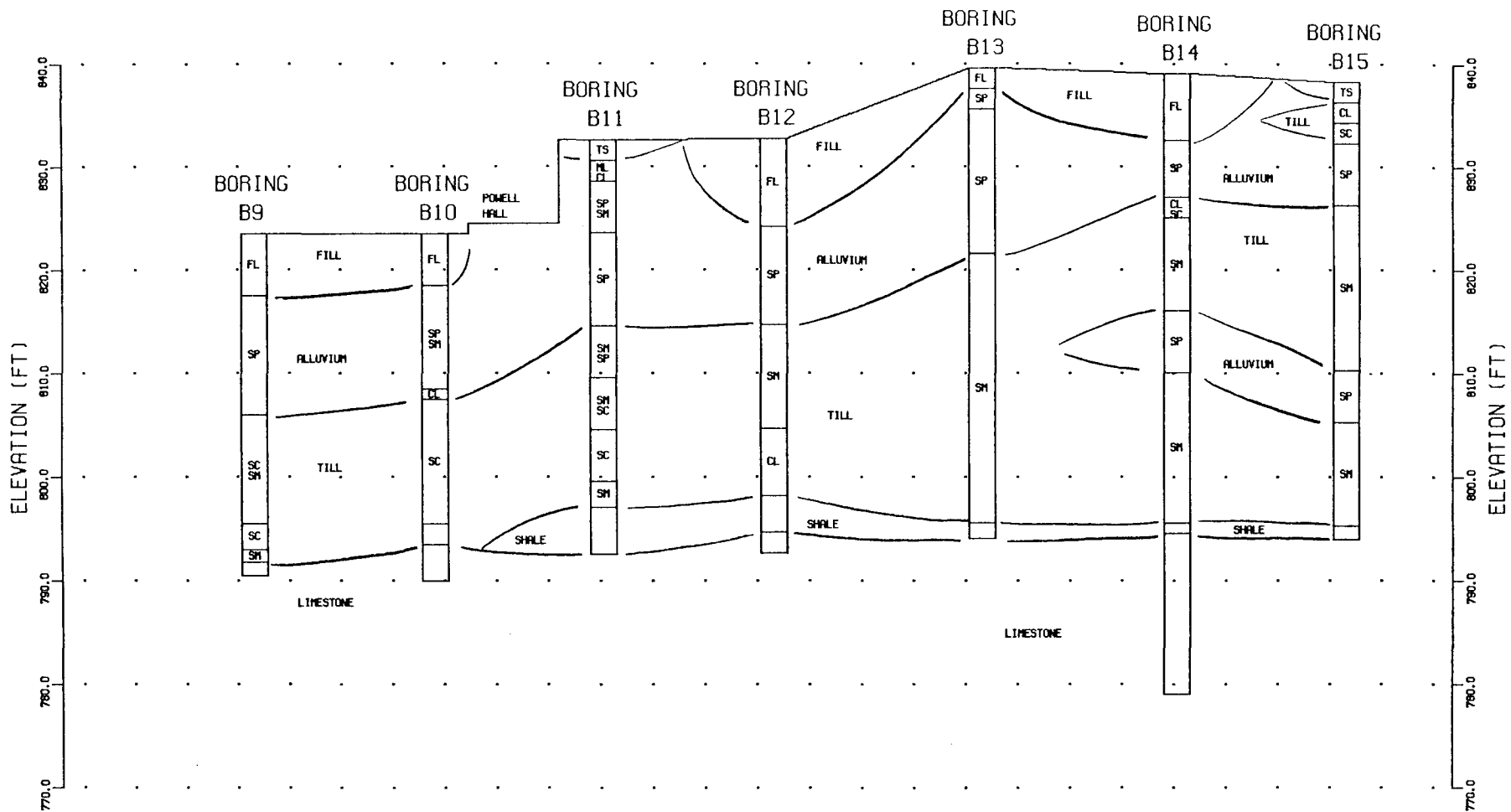
SOIL PROFILE

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CROSS SECTION A  
UNIV. HOSP. RENEWAL PROJ.  
120-6850



WEST ← → EAST



NOTE: EXCEPT AT BORING LOCATIONS THE GROUND SURFACE, WATER LEVEL, AND BOUNDARIES BETWEEN SOIL LAYERS ARE INFERRED.

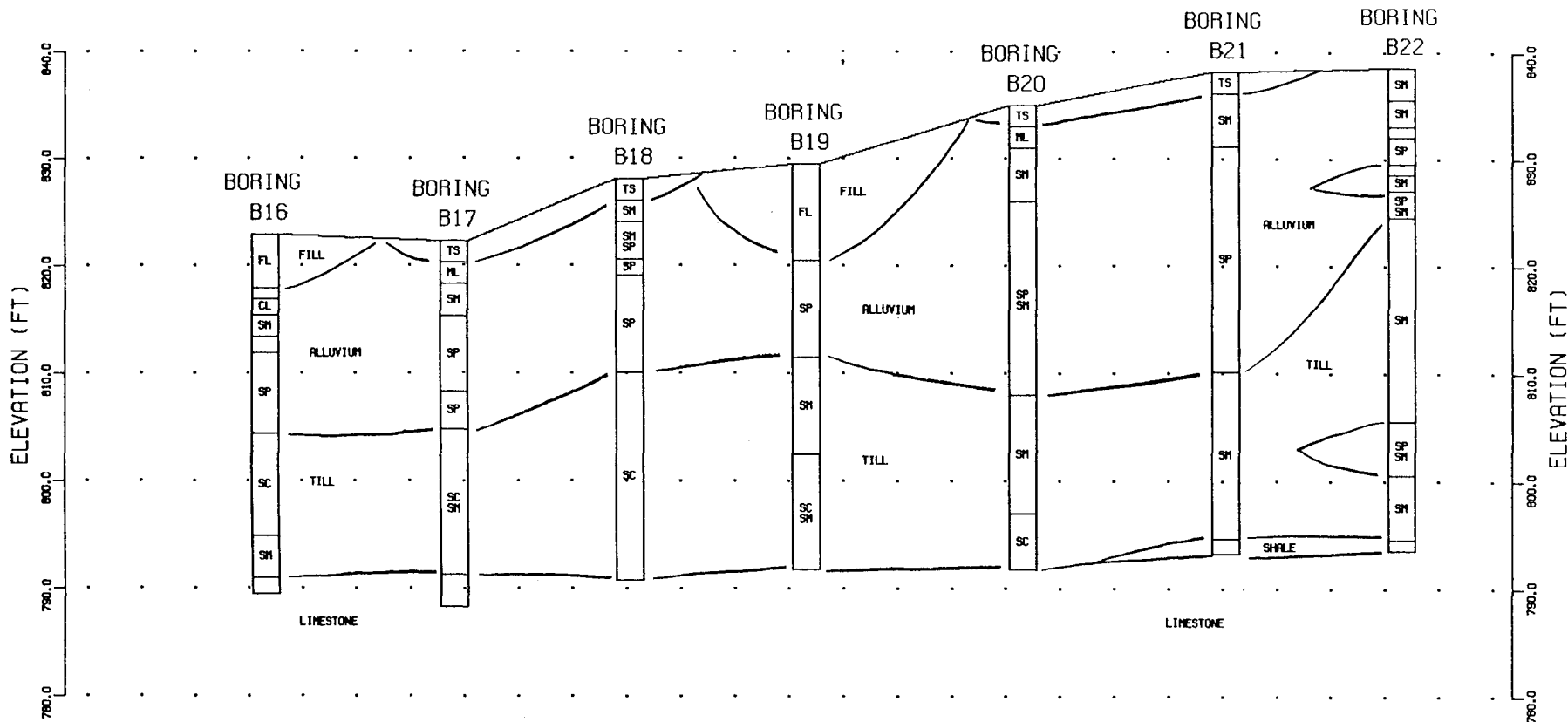
SOIL PROFILE

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CROSS SECTION B  
UNIV. HOSP. RENEWAL PROJ.  
120-6850

SCALE: 0 10 25 50 100

WEST ← → EAST



NOTE: EXCEPT AT BORING LOCATIONS THE GROUND SURFACE, WATER LEVEL, AND BOUNDARIES BETWEEN SOIL LAYERS ARE INFERRED.

SOIL PROFILE  
CROSS SECTION C  
UNIV. HOSP. RENEWAL PROJ.  
120-6850

SCALE:  
0 10 25 50 100

## SIEVE ANALYSIS TESTS

PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT DATE 1-13-81  
MINNEAPOLIS, MINNESOTA  
 REPORTED TO Ellerbe/Hellmuth Obata & Kassabaum JOB NO. 120-6850

BORING NO.	B-3	B-5	B-6	B-7
SAMPLE NO.	8	5	6	7
DEPTH (ft)	25-26	10-11	12½-13½	20-21
TYPE OF SAMPLE	SS	SS	SS	SS
CLASSIFICATION (ASTM: D 2487)				
Symbol	SM	SP-SM	SP	SM
Description	SILTY SAND	SAND, medium grained	SAND, medium grained	SILTY SAND
MECHANICAL ANALYSIS:				
Dry Weight of Total Sample (grams)	183	196	265	199
Based on Total Sample				
Gravel - % (On# 4)	4	17	15	5
Based on - 4 Material				
Sand - % (# 4 - #10)	5	13	11	8
(# 10 - #40)	22	53	49	36
(# 40 - #100)	31	23	32	29
(# 100 - #200)	10	3	3	6
Fines - % (# 200 Down)	32	8	5	21

## SIEVE ANALYSIS TESTS

PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT DATE 1-13-81  
MINNEAPOLIS, MINNESOTA

REPORTED TO Ellerbe/Hellmuth Obata & Kassabaum JOB NO. 120-6850

BORING NO.	B-10	B-12	B-17	B-20
SAMPLE NO.	3	8	8	7
DEPTH (ft)	7½-8½	20-21	20-21	20-21
TYPE OF SAMPLE	SS	SS	SS	SS
CLASSIFICATION (ASTM: D 2487)				
Symbol	SP-SM	SM	SC-SM	SP-SM
Description	SAND, medium grained	SILTY SAND	CLAYEY SAND	SAND, medium grained
MECHANICAL ANALYSIS:				
Dry Weight of Total Sample (grams)	266	149	198	215
Based on Total Sample				
Gravel - % (On # 4)	35	31	8	8
Based on - 4 Material				
Sand - % (# 4 - #10)	22	8	3	7
(# 10 - #40)	52	27	15	57
(# 40 - #100)	13	32	27	24
(# 100 - #200)	3	8	11	3
Fines - % (# 200 Down)	10	25	44	9



## SIEVE ANALYSIS TESTS

PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT DATE 1-13-81  
MINNEAPOLIS, MINNESOTA

REPORTED TO Ellerbe /Hellmuth Obata & Kassabaum JOB NO. 120-6850

BORING NO.	22			
SAMPLE NO.	11			
DEPTH (ft)	20-21			
TYPE OF SAMPLE	SS			
CLASSIFICATION (ASTM: D 2487)				
Symbol	SM			
Description	SILTY SAND			
MECHANICAL ANALYSIS:				
Dry Weight of Total Sample (grams)	206			
Based on Total Sample				
Gravel - % (On # 4)	28			
Based on - 4 Material				
Sand - % (# 4 - #10)	6			
(# 10 - #40)	20			
(# 40 - #100)	32			
(# 100 - #200)	10			
Fines - % (# 200 Down)	32			

CALIFORNIA BEARING RATIO TESTS

PROJECT: UNIVERSITY HOSPITALS RENEWAL PROJECT

DATE: 1-13-81

REPORTED TO: Ellerbe/Hellmuth Obata & Kassabaum

LABORATORY NO: #120-6850

SAMPLE IDENTIFICATION:

LABORATORY MOISTURE-DENSITY RELATIONSHIP OF SOIL: (See attached curve)

Method - ASTM: D698-78 Method "B."  
 Classification - CLAYEY SAND, BROWN (SC)  
 Maximum Dry Density (pcf) - 124.7  
 Optimum Moisture (%) 11.0

CALIFORNIA BEARING RATIO TEST:

Method - ASTM: D 1883-73

Molding Data:

Compaction Hammer -	Standard (5.5 lb, 12" DROP, SEGMENT FACE)			
Number of layers -	3	3	3	3
Blows per layer -	13	18	25	65
Molding Moisture (%) -	11.1	11.1	11.1	11.1
Molding Dry Density (pcf) -	113.5	113.5	122	126.2
Relative Density (%) -	91	91	98	101

Penetration Test: (3 sq in. piston)

Surcharge (lb) -	25	25	25	25
At 0.1 in penetration (%) -	3.5	3.6	8.5	8.1
At 0.2 in penetration (%) -	3.6	3.8	8.8	9.6
At 0.3 in penetration (%) -	3.3	3.8	8.9	10.6

Moisture Content After Penetration:

Top 1 in of specimen (%) -	15.6	15.7	13.0	11.6
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Swell Test: (4 day soaking)

Surcharge (lb) -	26	26	26	26
Swell after 4 days (%) -	0.09	0.09	0.09	00
Moisture Content after soaking (%) -	15.0	15.0	12.2	11.5

# MOISTURE - DENSITY CURVE

PROJECT UNIVERSITY HOSPITALS RENEWAL PROJECT- MINNEAPOLIS MN DATE 1-13-81

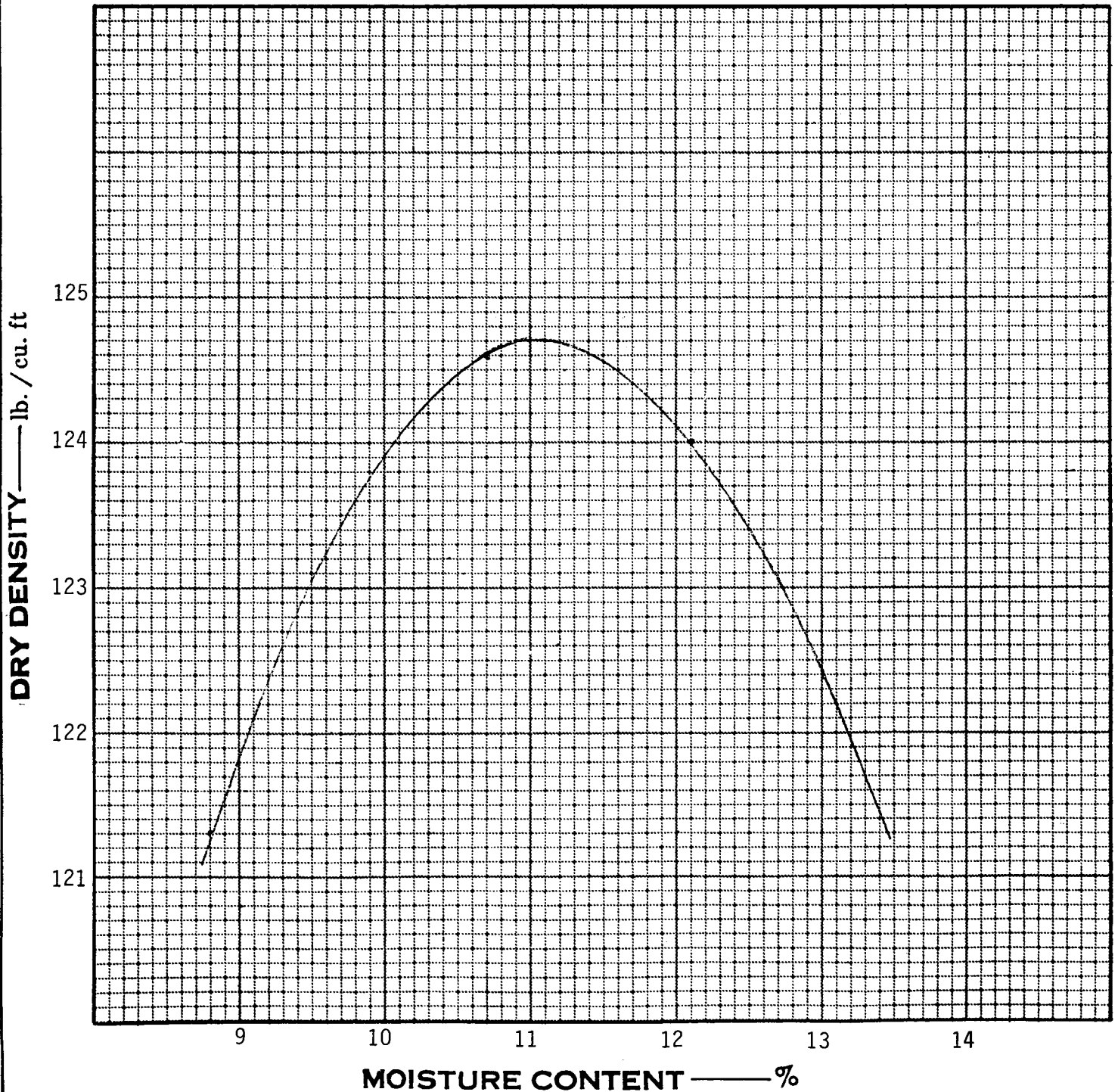
REPORTED TO Ellerbe/ Hellmuth Obata & Kassabaum JOB NO. 120-6850

Boring No. C-3 Sample No. \_\_\_\_\_ Depth (ft) 1/2 - 4' Location \_\_\_\_\_

Method of Test \_\_\_\_\_ ASTM: D 698-78 METHOD "B"

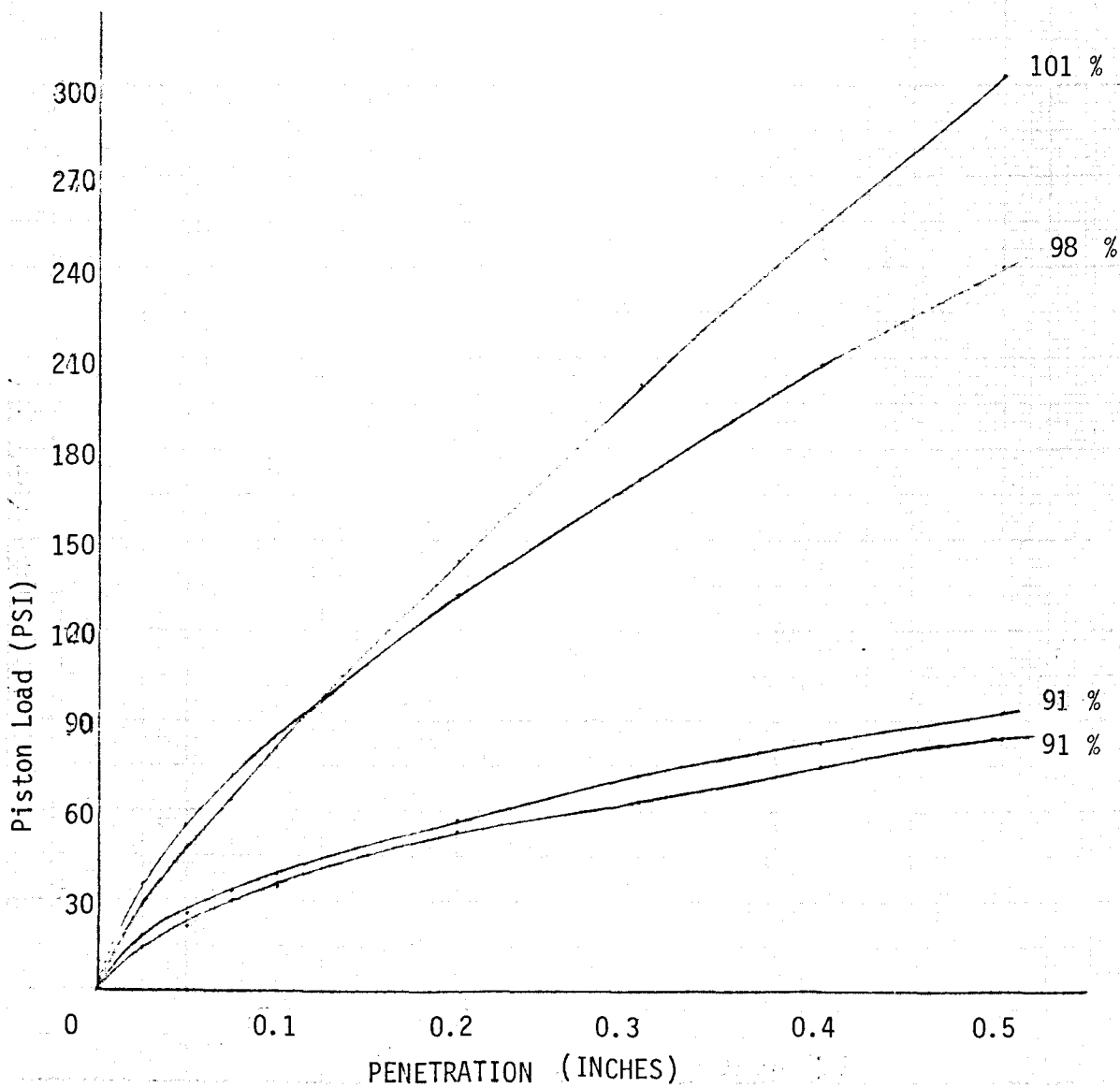
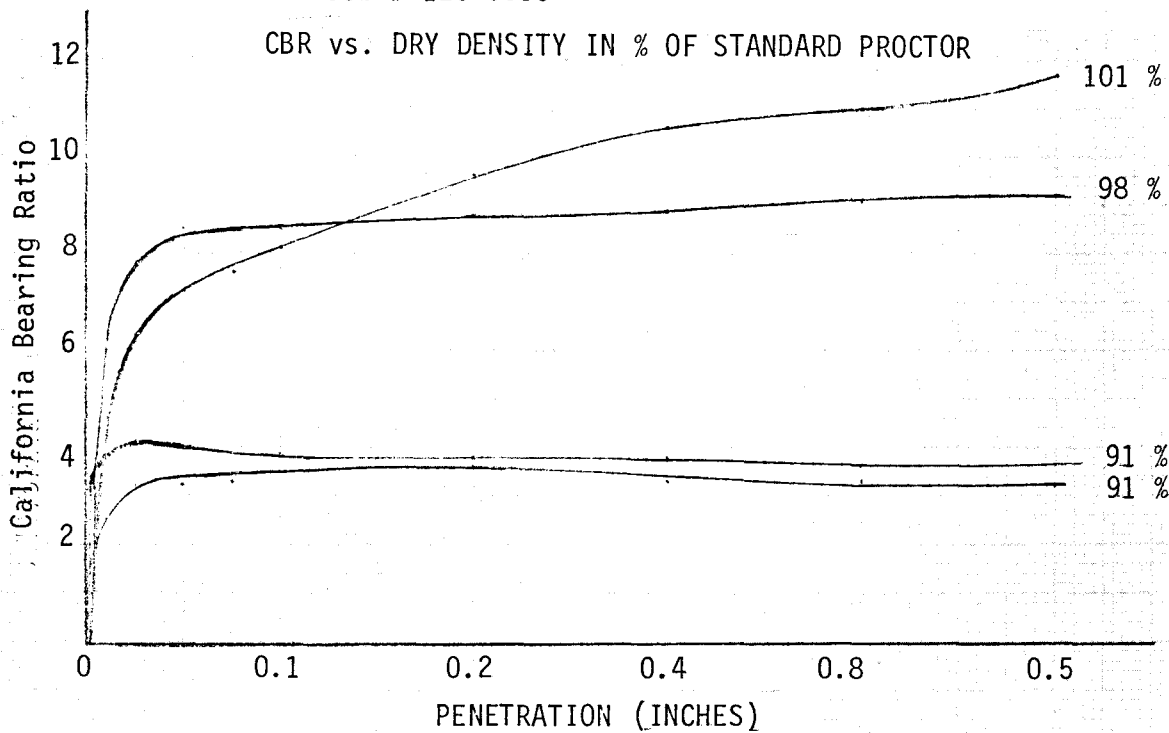
Type of Material CLAYEY SAND , BROWN (SC)

MAXIMUM DENSITY: 124.7 lb. /cu. ft. OPTIMUM MOISTURE: 11.0 %



Job # 120-6850

CBR vs. DRY DENSITY IN % OF STANDARD PROCTOR



## PRESSUREMETER TEST METHOD

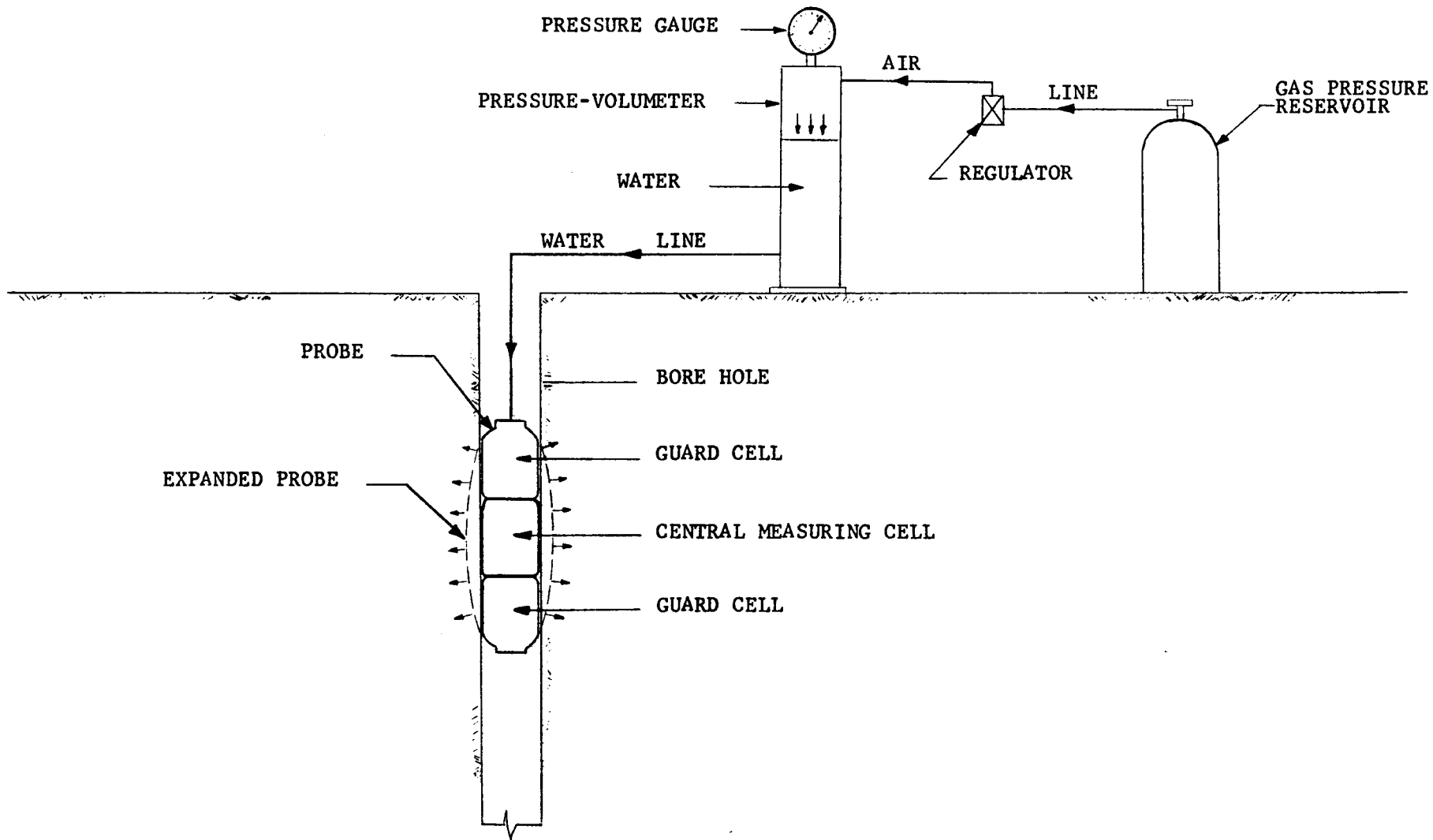
The pressuremeter is a device used to measure the in-situ strength and deformation characteristics of soil or rock from within a bore hole. A schematic diagram of the pressuremeter is attached to the back of this report. The pressuremeter consists of two main components, a pressure-volumeter at the surface and a downhole probe. The surface apparatus consists of a water reservoir and volumeter, pressure controls and gauges for both gas and water circuits and a gas pressure reservoir. The downhole probe consists of an inner water-filled cell for applying pressure and measuring displacement at the bore hole walls, and gas-filled, outer guard cells.

To perform a test, the probe is lowered in the bore hole to the desired elevation and pressure is applied to the probe cells. The probe expands, radially stressing the bore walls while the volume expansion is measured at the surface volumeter. The pressure is increased incrementally and the associated pressures and volumes are recorded until failure is reached or approached as evidenced by a relatively rapid expansion at constant pressure.

The pressure-volume data is plotted to provide a stress-strain curve. The typical pressuremeter curve exhibits three parts. The initial curved portion represents taking up slack in the bore hole. The middle straight line portion represents the pseudo-elastic phase of the test. The final curved portion represents the plastic phase of the test.

Three pressure levels are noted at the transition points between the portions of the curves.  $P_0$  is the lateral earth pressure or at-rest pressure. This is the point at which the bore hole wall is restored to its original size and stress distribution.  $P_f$  is the creep pressure or the pseudo-elastic limit. This defines the upper limit of the pseudo-elastic portion of the curve and the beginning of the plastic portion.  $P_l$  is the limit pressure where the pressure curve becomes asymptotic to a given pressure value. This is the theoretical point at which continuous deformation would occur at a constant pressure.

The deformation modulus ( $E$ ) is calculated from the slope of the straight line portion of the curve using a factor to convert volume deformation to linear radial deformation. The field data used for computations are corrected for inertia and compressibility characteristics of the probe system and for differential pressure due to water head at the probe depth.



SCHMATIC DIAGRAM OF THE PRESSUREMETER

## GENERAL NOTES

### DRILLING & SAMPLING SYMBOLS

SYMBOL	DEFINITION
C.S.	Continuous Sampling
P.D.	2-3/8" Pipe Drill
C.O.	Cleanout Tube
3/4 HSA	3/4" I.D. Hollow Stem Auger
4 FA	4" Diameter Flight Auger
6 FA	6" Diameter Flight Auger
2 1/2 C	2 1/2" Casing
4C	4" Casing
D.M.	Drilling Mud
J. W.	Jet Water
H. A.	Hand Auger
NXC	Size NX Casing
BXC	Size BX Casing
AXC	Size AX Casing
SS	2" O.D. Split Spoon Sample
2T	2" Thin Wall Tube Sample
3T	3" Thin Wall Tube Sample

### LABORATORY TEST SYMBOLS

SYMBOL	DEFINITION
W	Moisture content - percent of dry weight
D	Dry density-pounds per cubic foot
LL, PL	Liquid and plastic limits determined in accordance with ASTM D 423 and D 424
Qu	Unconfined compressive strength-pounds per square foot in accordance with ASTM D2166-66
Additional insertions in Qu column	
Pq	Penetrometer reading-tons/square foot
Ts	Torvane reading-tons/square foot
G	Specific gravity - ASTM D 854-58
SL	Shrinkage limit - ASTM D 427-61
pH	Hydrogen ion content-meter method
O	Organic content-combustion method
M.A.*	Grain size analysis
C*	One dimensional consolidation
Qc*	Triaxial compression

\*See attached data sheet and/or graph

### WATER LEVEL

SYMBOL - 

Water levels shown on the boring logs are the levels measured in the borings at the time and under the conditions indicated. In sand, the indicated levels can be considered reliable ground water levels. In clay soil, it is not possible to determine the ground water level within the normal scope of a test boring investigation, except where lenses or layers of more pervious waterbearing soil are present and then a long period of time may be necessary to reach equilibrium. Therefore, the position of the water level symbol for cohesive or mixed texture soils may not indicate the true level of the ground water table. The available water level information is given at the bottom of the log sheet.

## DESCRIPTIVE TERMINOLOGY

### DENSITY

TERM	"N" VALUE
Very loose	0-4
Loose	5-8
Medium Dense	9-15
Dense	16-30
Very Dense	Over 30

### CONSISTENCY

TERM	"N" VALUE
Soft	0-4
Medium	5-8
Rather Stiff	9-15
Stiff	16-30
Very Stiff	Over 30

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch OD split spoon.

## RELATIVE PROPORTIONS

TERM	RANGE
Trace	0-5%
A Little	5-15%
Some	15-30%
With	30-50%

## PARTICLE SIZES

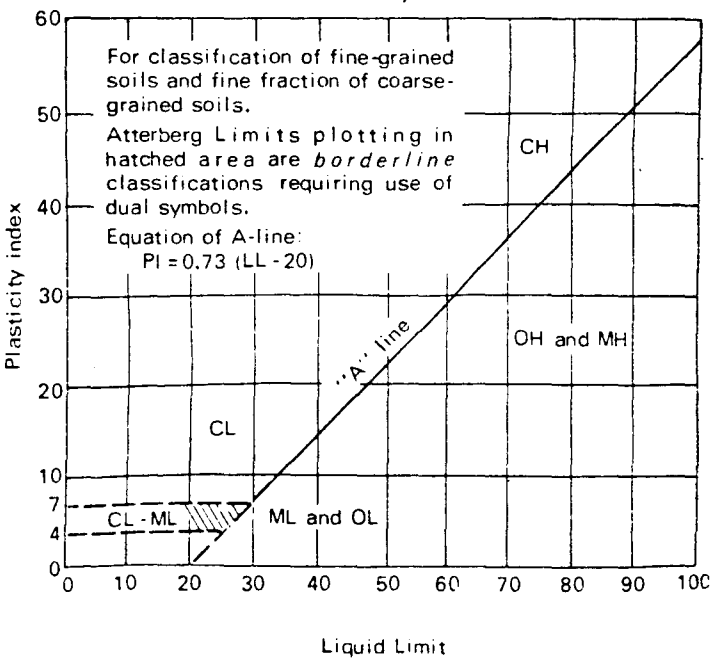
Boulders	Over 3"
Gravel	
Coarse	3/4"-3"
Fine	#4-3/4"
Sand	
Coarse	#4-#10
Medium	#10-#40
Fine	#40-#200
Silt and Clay	Determined by plasticity Characteristics

Note: Sieve sizes shown are U.S. Standard

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

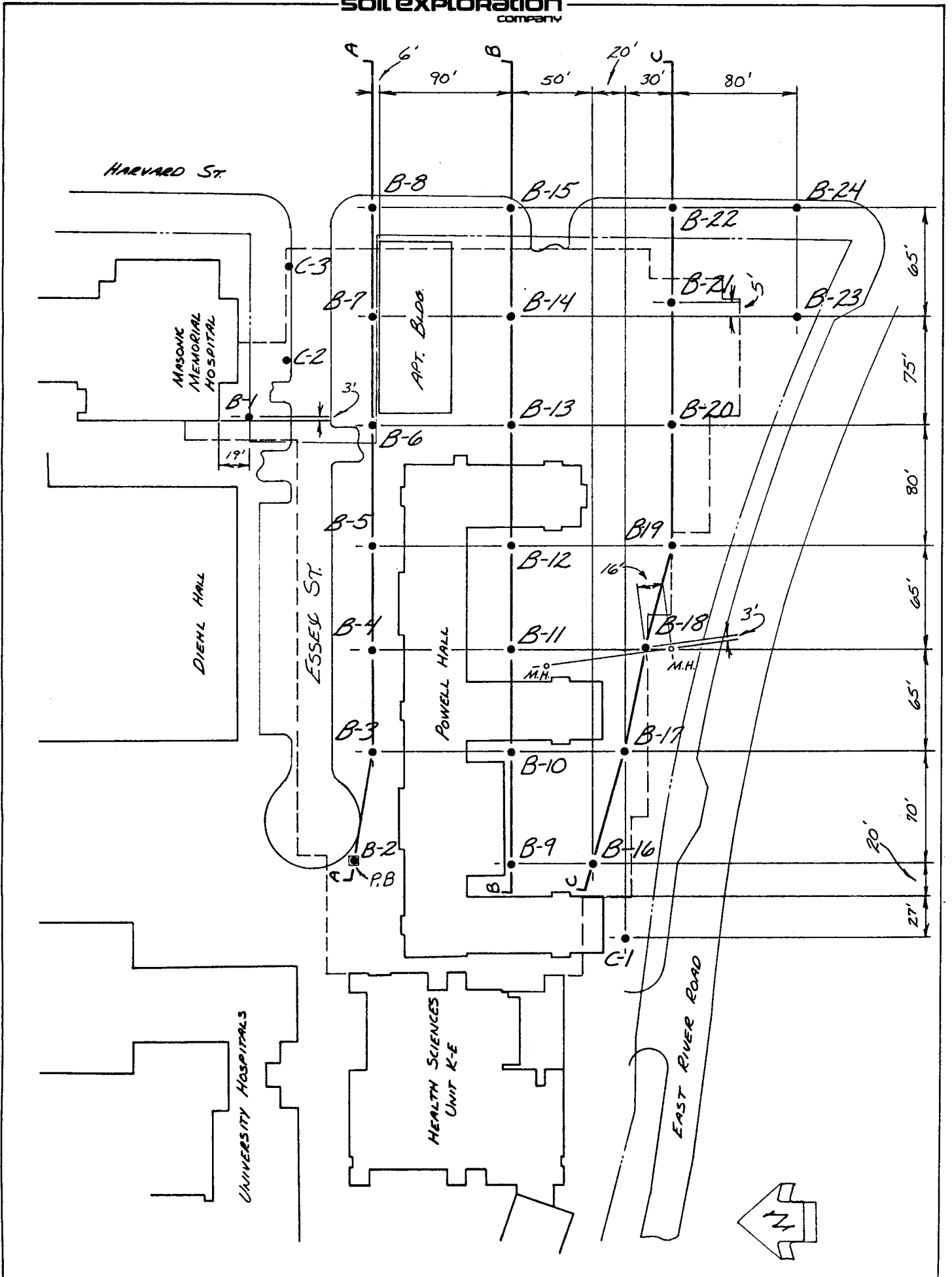
ASTM Designation: D 2487 - 69 AND D 2488 - 69

(Unified Soil Classification System)

Major divisions		Group symbols	Typical names	Classification criteria			
Coarse-grained soils More than 50% retained on No. 200 sieve*	Gravels 50% or more of coarse fraction retained on No. 4 sieve	Clean gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting both criteria for GW  Atterberg limits below "A" line or P.I. less than 4  Atterberg limits above "A" line with P.I. greater than 7  Atterberg limits plotting in hatched area are <i>borderline</i> classifications requiring use of dual symbols		
			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 No. 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-grained 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	<b>Plasticity Chart</b>  For classification of fine-grained soils and fine fraction of coarse-grained soils. Atterberg Limits plotting in hatched area are <i>borderline</i> classifications requiring use of dual symbols. Equation of A-line: $PI = 0.73 (LL - 20)$  		
			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				
		Pt	Peat, muck and other highly organic soils				
				Classification on basis of percentage of fines Less than 5% pass No. 200 sieve . . . . . GW, GP, SW, SP More than 5% pass No. 200 sieve . . . . . GM, GC, SM, SC 5 to 12% pass No. 200 sieve . . . . . <i>borderline</i> classifications requiring use of dual symbols			
				*Based on the material passing the 3 in. (76 mm) sieve.			



SOIL EXPLORATION  
company



SOIL TEST BORINGS

JOB NO. 120-6850

SCALE: 1" = 80'

DRAWN BY PO

CHECKED BY GJS