TSR040 Remarks Listing For Leaksite = 9520
Report Date: July 08, 1998

Leaksite ID# 9520	Tank Facility ID
VACANT WAREHOUSE	L.W. SAMUELSON CONSTRUCTION
Site Name	Responsible Party

LEAKSITE REMARKS

07/30/96 Tim McGlennen of GME Consultants reported the release. A 12,000 gal fuel oil tank was removed from the site some time in the 1970's. High vapor readings are 30 ppm PID. Analytic results are 260 ppm DRO. GW was encountered during the site assessment at 19' b.g. Native soil is sand. EMH

09/10/96 EC: Reviewed the site assement report, a water sample from B-2 is ND, other results are above. Contamination is FO and levels are low. Site is in an industial area, and has municiple water supplied. The owners are going to build a warehouse with no basement. Also the current owners purchased the property after the tanks were removed. Based on the low risk at the site, this site is considered closed.

07/07/98 sent to archives kl

End of Remarks

TSR040 Remarks Listing For Leaksite = 9520
Report Date: September 10, 1996

Leaksite ID# 9520	Tank Facility ID
VACANT WAREHOUSE	L.W. SAMUELSON CONSTRUCTION
Site Name	Responsible Party

LEAKSITE REMARKS

07/30/96 Tim McGlennen of GME Consultants reported the release. A 12,000 gal fuel oil tank was removed from the site some time in the 1970's. High vapor readings are 30 ppm PID. Analytic results are 260 ppm DRO. GW was encountered during the site assessment at 19' b.g. Native soil is sand. EMH

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End of Remarks

To: MPCA TANKS

STATE OF MINNESOTA

DEPARTMENT OF PUBLIC SAFETY - DIVISION OF EMERGENCY MANAGEMENT
B-5 STATE CAPITOL, SAINT PAUL, MN 55155-1049

MINNESOTA DUTY OFFICER
HAZARDOUS MATERIAL INCIDENT REPORT: *TANKS*

REPORT DATE: 7-30-96 TIME: 1635 DUTY OFFICER: S

REPORTED BY:

NAME: Tim McGlennen
C/O: GME Consultants Inc.
ADDRESS: 14000 - 21st Ave. N.
CITY: Mpls. STATE:
PHONE: 559-1859 ZIP: 55447
ALT.PHONE:

RESPONSIBLE PARTY/PROPERTY OWNER: (current)

CONTACT: Lenny Samuelson
C/O: L.W. Samuelson Construction
ADDRESS: 7800 E. River Rd
CITY: Mpls STATE:
PHONE: 571-7980 ZIP: 55432
ALT.PHONE:

DISCOVERY DATE: 7-29-96 TIME: _____ PREVIOUSLY REPORTED SITE?: Y / (N) / UNK — LEAK #: _____

SITE NAME & ADDRESS: vacant warehouse
2717 E. 33rd St. CITY: Mpls. ZIP: 55406 COUNTY: Hennepin

NUMBER/SIZE OF TANK(S):	TANK CONTENTS	AGE OF TANKS	TYPES
___ @ ___	___	___	U.S.T. / A.S.T. – STEEL / FIBRE GLAS
___ @ ___	___	___	U.S.T. / A.S.T. – STEEL / FIBRE GLAS
___ @ ___	___	___	U.S.T. / A.S.T. – STEEL / FIBRE GLAS
___ @ ___	___	___	U.S.T. / A.S.T. – STEEL / FIBRE GLAS

NATIVE SOIL TYPE: Sand SURFACE WATER NEARBY? Y (N) / UNK _____
WELLS ON SITE?: Y (N) / UNK _____ WATER SOURCE: (MUNICIPAL) / PRIVATE WELL
CONTAMINATED SOIL EXCAVATED?: Y / N / UNK QUANTITY: _____
ABLE TO DIG OUT OF CONTAMINATION?: Y / N / UNK
GROUND WATER ENCOUNTERED?: (Y) / N / UNK _____ DEPTH TO GW: 19'
FREE PRODUCT FOUND?: Y (N) — STAINED SOIL?: (Y) / N — PETROLEUM ODORS: (Y) / N
HIGHEST VAPOR READING: 20ppm PID ANALYTICAL RESULTS: 260ppm DRO

NARRATIVE: 12,000 gal fuel oil tank removed mid-1970's pre-sale site assessment. Water sample clean.

DUTY OFFICER NOTIFICATIONS MADE (AGENCY, NAME, TIME)

MPCA TANKS, ATTN: KIM GREGG - FAX	

QUESTIONS? CONTACT THE MINNESOTA DUTY OFFICER AT 649-5451 OR 1-800-422-0798

This space for MPCA use only.
MPCA PROJECT MANAGER: E.C. LEAK NUMBER 9520

Minnesota Pollution Control Agency

September 11, 1996

Mr. Lenny Samuelson
L. W. Samuelson Construction
7800 East River Road
Minneapolis, Minnesota 55432

RE: Petroleum Tank Release Site File Closure
Site: Vacant Warehouse, 2717 East 33rd Street, Minneapolis
Site ID#: LEAK00009520

Dear Mr. Samuelson:

We are pleased to let you know that the Minnesota Pollution Control Agency (MPCA) Tanks and Emergency Response Section (TERS) staff has determined that your investigation and/or cleanup has adequately addressed the petroleum tank release at the site listed above. Based on the information provided, the TERS staff has closed the release site file.

Closure of the file means that the TERS staff does not require any additional investigation and/or cleanup work at this time or in the foreseeable future. Please be aware that file closure does not necessarily mean that all petroleum contamination has been removed from this site. However, the TERS staff has concluded that any remaining contamination, if present, does not appear to pose a threat to public health or the environment.

The MPCA reserves the right to reopen this file and to require additional investigation and/or cleanup work if new information or changing regulatory requirements make additional work necessary. If you or other parties discover additional contamination (either petroleum or nonpetroleum) that was not previously reported to the MPCA, Minnesota law requires that the MPCA be immediately notified.

You should understand that this letter does not release any party from liability for the petroleum contamination under Minn. Stat. ch. 115C (1994) or any other applicable state or federal law. In addition, this letter does not release any party from liability for nonpetroleum contamination, if present, under Minn. Stat. ch. 115B (1994), the Minnesota Superfund Law.

If future development of this property or the surrounding area is planned, it should be assumed that petroleum contamination may still be present. If petroleum contamination is encountered during future development work, the MPCA staff should be notified immediately.

For specific information regarding petroleum contamination that may remain at this leak site, please call the TERS File Request Program at 612/297-8499. The "Leak/Spill and Underground Storage Tank File Request Form" (TERS Fact Sheet #3.35) must be completed prior to arranging a time for file review.

Thank you for your response to this petroleum tank release and for your cooperation with the MPCA to protect public health and the environment. If you have any questions regarding this letter, please call me, Elizabeth Clysdale at 612/297-8366.

Sincerely,

for Elizabeth Clysdale
Project Manager
Cleanup Unit II
Tanks and Emergency Response Section

EC:dms

cc: Karen Nordby, Minnesota Pollution Control Division, Minneapolis
Timothy F. McGlennen, GME Consultants, Incorporated, Minneapolis
Minnesota Department of Commerce, Petrofund Staff

GME CONSULTANTS, INC.
CONSULTING ENGINEERS
14000 21st Ave. No. / Minneapolis, MN 55447
Phone (612) 559-1859 / Fax (612) 559-0721

August 14, 1996

Mr. Lenny Samuelson
L.W. Samuelson Construction, Inc.
7800 East River Road
Minneapolis, Minnesota 55432

GME Project No. 6251-B

RE: Environmental drilling at 2717 East 33rd Street in Minneapolis, Minnesota

Dear Mr. Samuelson:

We have prepared this report in accordance with your authorization of our July 12, 1996 written proposal. We are submitting three copies of this report to you. Submittal of this report concludes the scope of services outlined in our proposal.

We appreciate the opportunity to work with you on this project. If you have questions regarding this report, or if we can be of additional service, please contact us.

Sincerely,

GME CONSULTANTS, INC.

Timothy F. McGlennen
Environmental Biologist
Project Manager

TFM:smc
C:\TFM\6251-B.DBL

TABLE OF CONTENTS

ENVIRONMENTAL DRILLING REPORT
2717 EAST 33RD STREET
MINNEAPOLIS, MINNESOTA
GME PROJECT NO. 6251-B

I. INTRODUCTION

A. Purpose and Scope

On July 11, 1996, you authorized us to proceed with the environmental drilling adjacent to a former petroleum underground storage tank (UST) at 2717 East 33rd Street in Minneapolis, Minnesota. The scope of work for this project consisted of drilling one environmental soil boring, collecting soil and groundwater samples, and laboratory analysis of the soil and groundwater samples. This report summarizes our field observations, field measurements, and laboratory results.

II. BACKGROUND

In late June, 1996, we were in the process of conducting a Phase I Environmental Site Assessment (ESA) on the site for a potential buyer. Our Phase I ESA data revealed the presence of a former 12,000 gallon fuel oil tank which was associated with the original grain elevator which occupied the site for about 90 years. According to the original Site Survey, the tank was located for many years at the north end of the Property near East 33rd Street. The currently existing warehouse was constructed in 1987.

A City of Minneapolis Records Review report which you obtained did not list the fuel oil tank. It is likely that the tank was removed during demolition of the grain elevators and associated buildings. However, there is no documentation of its removal.

Our Phase I ESA data also showed that the Moto Mart gasoline station located to the west across the railroad tracks has been an active station since the 1930s.

We were requested by the potential buyer to drill an environmental boring in a fenced-in storage area for ice cream trucks, because stains from oil drippage were observed on the gravel surface. The boring, B-1, as drilled to 24 feet near the southeast corner of the building. The soils consisted of silty sand and silty clay fill to about 9 feet, overlying brown, fine to coarse sand. Groundwater was encountered at about 22 feet.

Generally, significantly elevated organic vapors were not detected in the soil samples. Laboratory analysis did not indicate the presence of volatile organic compounds (VOCs) in the soil sample collected from 16 to 18 feet below grade, and diesel range organics (DRO), gasoline range organics (GRO), and VOCs were not detected in the groundwater sample.

III. ENVIRONMENTAL SOIL BORING NEAR FORMER UST

On July 15, 1996, we drilled one environmental soil boring near the estimated southwest corner of the former 12,000 gallon fuel oil tank. The boring location was based on the Site Survey which you provided. Prior to drilling, we contacted Gopher State One Call to clear utilities. The soil boring was drilled with a CME 55D rig using continuous flight hollow stem augers. All of the sampling equipment

was steam cleaned prior to drilling and the equipment was washed with TSP and rinsed with distilled water between uses on the site.

We performed headspace tests on the collected soil samples using an HNU PI-101 photoionization detector (PID) with a 10.2 eV lamp. We collected soil and water samples in laboratory-supplied glass jars with Teflon-lined lids. The jars were labeled, placed in a cooler with ice, and transported to EN CHEM for analysis under chain of custody. The collected soil and groundwater samples were analyzed for DRO, GRO, and benzene, toluene, ethylbenzene, and total xylenes (BTEX). A copy of the laboratory report is attached.

The attached GME Soil Boring Log includes information on the sampling procedures, observed groundwater levels, PID measurements, and soil classifications. We surveyed the boring elevation to the building's floor slab with an assigned elevation of 100.0 feet.

IV. RESULTS

A. Site Geology

Based on our previous soil boring and on this environmental boring, the soils mostly consist of silty sand and silty clay fill to approximately 7 to 9 feet, overlying brown fine to coarse sand and silty sand. The maximum depth of our exploration was 26 feet.

B. Hydrogeology

Groundwater was encountered between 19 and 25 feet below grade. The estimated regional groundwater flow direction is to the east-northeast.

C. Headspace Measurements

We recorded elevated detections of 11 to 30 parts per million (ppm) in the samples collected from 4 to 8 feet below grade. The maximum 30 ppm was recorded in a 1 foot layer of gray-brown silty clay from 6 to 7 feet. Elevated readings above the MPCA action level of 10 ppm were not recorded below 8 feet.

D. Laboratory Analysis

Laboratory analysis of the soil sample collected from 6 to 7 feet indicated no detection of BTEX. GRO was detected at 29 ppm and DRO was detected at 260 ppm. However, the laboratory report indicates that the GRO detection was more indicative of DRO fuel contamination.

Laboratory analysis of the groundwater sample indicated no detection of GRO, DRO, or BTEX at or above the laboratory's method detection limits.

V. DISCUSSION AND CONCLUSIONS

Phase I ESA data revealed the presence of a 12,000 gallon fuel oil tank (formerly) located on the north end of the site. Our environmental

boring, drilled near the southwest corner of the tank, indicated an isolated detection of DRO range petroleum at the base of the fill. However, petroleum parameters were not detected in the groundwater sample collected from the boring. Because petroleum was detected near the former UST, we reported the release to the State of Minnesota on July 30, 1996, following your authorization.

The environmental boring previously drilled in the storage area also did not indicate the presence of petroleum parameters in the soil or groundwater.

Based on the study results, petroleum parameters were not detected in the groundwater at either environmental boring location, but a minor isolated detection of petroleum was encountered at the base of the fill in the boring drilled adjacent to the former tank. Additional borings could be drilled in the area to further assess the soils around the former tank.

VI. GENERAL QUALIFICATIONS

The environmental assessment and recommendations submitted in this report are based on data produced during this study and previous studies of the Property. The scope of this report is limited to this specific project and location described herein. This report does not account for any variations that may occur between the soil probes/borings. Furthermore, we conducted only limited exploration outside of the study area boundaries. Thus, conclusions concerning

off-site characteristics for future degradation of groundwater only are speculative.

Water level measurements, and soil and groundwater samples were collected and analyzed under the conditions stated in this report. These data have been reviewed, and an interpretation made in the text of this report. However, it must be noted that seasonal and annual fluctuations in hydrogeologic characteristics likely will occur.

Our description of this project represents our understanding of significant aspects relative to soil and groundwater conditions. Conclusions in this report represent our professional judgement. No warranty, expressed or implied, is made.

Prepared by: Timothy F. McGlennen
Environmental Biologist
Project Manager

Reviewed by: Sandra J. Forrest
Senior Hydrogeologist
Regional Environmental Division Manager

TFM:smc
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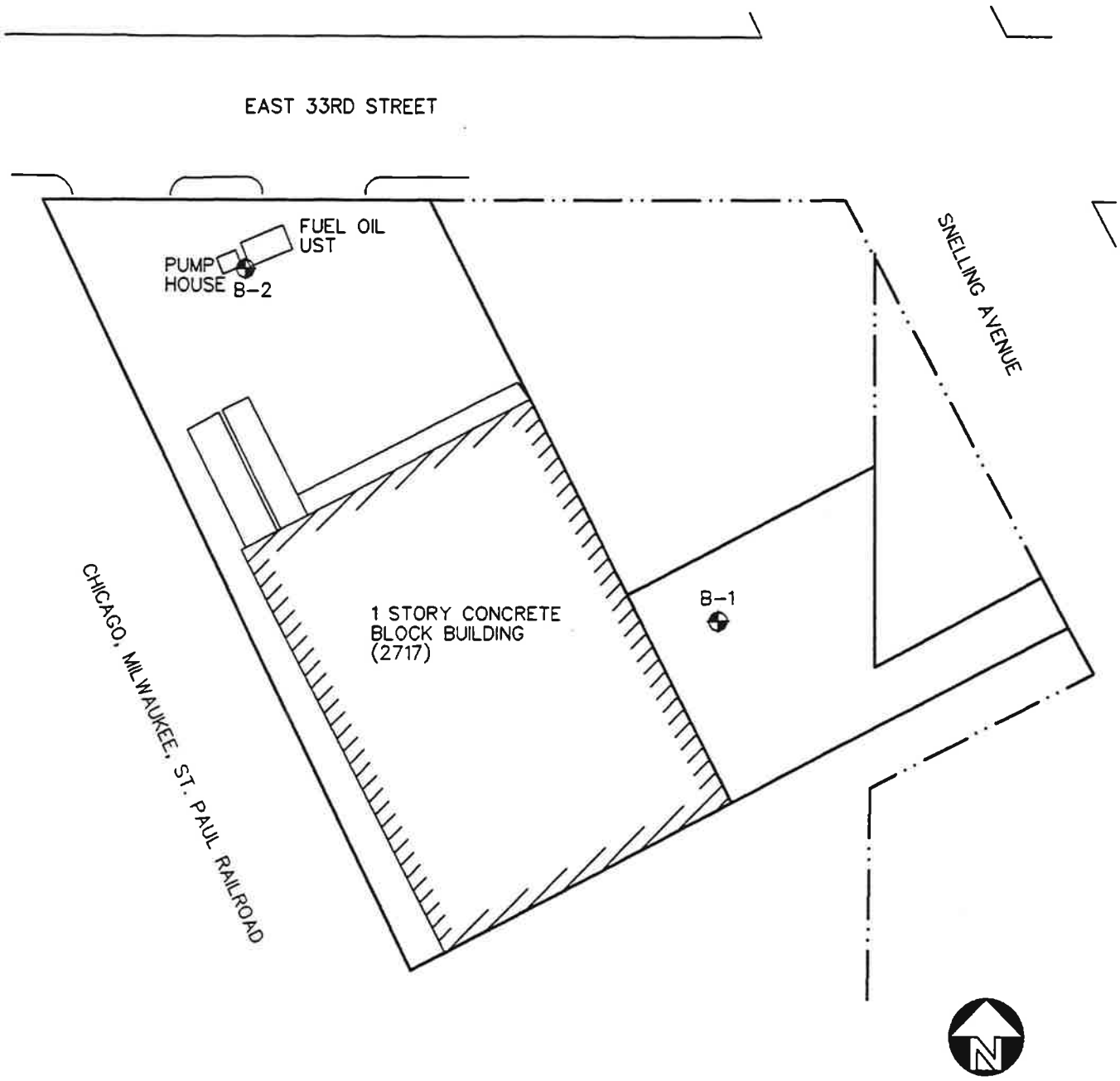


GME CONSULTANTS, INC.
Geotechnical • Materials • Environmental
14000 21st Avenue N.
Minneapolis, Minnesota 55447
(612) 559-1859

SOIL BORING LOCATION DIAGRAM

2717 EAST 33RD STREET
MINNEAPOLIS, MINNESOTA

VJL	TFM	8/96	GME Project No. 6251-B

GME SOIL BORING LOG

LOG OF BORING B- 2

PROJECT: Environmental Drilling
SITE: 2717 East 33rd Street, Minneapolis, Minnesota
CLIENT: Lenny Samuelson
ARCHITECT-ENGINEER:

SURFACE ELEVATION: 98.6

DEPTH, FEET	SAMPLE NUMBER AND TYPE	WATER LEVEL	STRATA CHANGE, FEET	DESCRIPTION OF MATERIAL	SPECIAL TEST RESULTS PID READINGS (ppm)	N-VALUE (BLOWS/FT.)
	1AS		0.2	2 inches bituminous pavement	6.4	
			2.0	Black fine to medium SILTY SAND, trace clay, gravel - moist - (SM) (FILL)		
	2SS		2.5	Dark gray SILTY CLAY, trace sand - (CL) (FILL)	2.2	16
5	3SS		6.0	Brown gray SILTY CLAY, trace sand - very stiff to stiff - (CL) (FILL)	11	11
	4SS		7.0	Gray brown SILTY CLAY, trace sand, gravel, slight odor - (CL) (FILL)	30	
	5SS			Light brown fine to medium SAND, trace silt, - medium dense - damp - (SP)	12	19
10					2.2	20
	6SS				3.0	21
	7SS		14.5		3.6	16
15	8SS		16.0	Brown fine to medium SAND, trace silt, gravel - medium dense - moist - (SP)	1.0	27
	9SS		18.0	Red brown fine to medium SILTY SAND WITH CLAY, trace gravel - medium dense - moist - (SM-SC)	0	28
	10SS	▼		Red brown SILT, trace sand, clay - medium dense - wet - (ML)	0	22
20			20.5			
	11SS	▽		Red brown fine to medium SAND WITH SILT - medium dense to dense - moist - (SP-SM)	0	38
	12SS				2.0	16
25	13SS				0	45
			26.0	End of boring at 26 feet Hollow stem auger used full depth Borehole backfilled with cuttings		

Qp (tsf): 1 2 3 4 5
WATER CONTENT %
STANDARD PENETRATION (BLOWS/FOOT): 10 20 30 40 50

WATER LEVEL OBSERVATIONS

W.L. ▽ 22.0 feet while drilling
W.L. ▼ 19.0 feet after auger removal
W.L.

Boring caved at 20 feet after auger removal

GME CONSULTANTS, INC.
Geotechnical · Materials Environmental
14000 21st Avenue North
Minneapolis, Minnesota 55447
(612) 559-1859

BORING STARTED	7/15/96
BORING COMPLETED	7/15/96
RIG CME-55	DRILLER TA
DRAWN TLW	APPROVED TM
JOB # 6251-B	SHEET 1 of 1

The stratification lines represent approximate boundaries between soil types; insitu the transition may be gradual.

645-6446

Soil Exploration Company

FORMERLY OPERATED AS A DEPARTMENT OF
TWIN CITY TESTING AND ENGINEERING LABORATORY, INC.

OFFICERS
CHARLES W. BRITZIUS - President
ROBERT F. WITTMAN - Executive Vice-President
NORMAN E. HENNING - Vice-President
CLINTON R. EUE - Secretary
JOHN F. GISLASON - Treasurer

662 CROMWELL AVENUE
SAINT PAUL, MINNESOTA 55114

September 6, 1967

Danielson Brothers
2912 Hiwatha Avenue
Minneapolis, Minnesota 55407

Attention: Raleigh Danielson

Re: Soil Investigation - Proposed Building - Minneapolis, Minnesota

Gentlemen:

We have conducted a soil investigation and foundation analysis for the above referenced project. We are transmitting five copies of our report. This work was conducted in accordance with your verbal authorization on August 28, 1967.

About 50% of the soil samples will be held at this office for a period of two months and will then be discarded unless we are notified to hold them for a longer period of time.

If there are any questions regarding our report, or if we can be of any further service to you, please do not hesitate to contact us.

Very truly yours,

SOIL EXPLORATION COMPANY

Wilfred A. Wahl, P.E.

GE/WAW:pb
encs.

REPORT OF SOIL INVESTIGATION

PROPOSED BUILDING

MINNEAPOLIS, MINNESOTA

INTRODUCTION

On August 31, 1967, we put down two soil test borings to aid in evaluating the soil conditions for a proposed office-warehouse-garage building to be located at the southwest corner of East 33rd Street and Snelling Avenue South in Minneapolis, Minnesota.

INVESTIGATION METHODS

The borings were put down at the locations discussed with you and are shown on the attached sketch. Surface elevations were referenced to the top of the hydrant located near the southwest corner of 33rd Street and Snelling Avenue where shown, taken as 100.0' (an assumed elevation).

The borings were put down uncased, and were cleaned and advanced with a 2-3/8 inch pipe drill. Soil samples were taken with a 2 inch O.D. split sampler and the blows per foot (BPF) as given along the right side of the logs were recorded on this sampler driven by a 140 lb. weight falling 30 inches. The consistency of the cohesive soil was rated by the penetration of the sampler.

SOIL AND SITE CONDITIONS

The logs of the borings and a chart showing the method of soil classification (U.S. Bureau of Soils) are attached. The soil was visually classified in accordance with the above method.

The ground surface of the site is quite level and at about the same elevation as the nearby street grades. Surface elevations at the boring locations differ by only about 1'.

It may be noted from the boring logs that the soil conditions are quite similar at both borings. A typical soil profile consists of topsoil overlying "medium fat" clay

which is underlain by sand. The consistency of the cohesive soil varies from rather stiff to very stiff and the penetration resistance of the granular soil varies from moderately good to good.

According to our available geological data, the first bedrock at the site would be the Platteville limestone formation at a depth of about 50'. The soil is primarily valley train sand and gravel deposit with some overlying local alluvium.

GROUND WATER

No ground water was noted in the borings at the time this work was done.

LABORATORY TESTS

One sample of the clay found at or slightly below footing depth was selected for testing to determine its density and unconfined compressive strength. The test results show a fairly good density and a very good shear strength.

FOUNDATION ANALYSIS

We understand the proposed structure will be one story slab-on-grade and will cover an area of 50' X 85'. The walls will be about 14' high and of concrete block construction. We assume the building loads will be moderate to light and that the bottom of the interior and exterior footings will be at about elevation 93' and 91', respectively, with respect to our benchmark.

The use of a normal spread footing foundation would be feasible. Based on the penetration resistance and test results we recommend a unit loading of 4,000 pounds per square foot on the underlying brown clay or granular soil. This loading will provide a theoretical factor of safety of 3 or more against an actual shear failure and will not result in detrimental settlement. For support of the floor slab we suggest removing at least the upper portion of topsoil containing sod and roots prior to placing a good well compacted fill to final floor elevation.

CLOSING REMARKS

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.

LOG OF TEST BORINGS

SOIL EXPLORATION COMPANY

PROJECT: PROPOSED BUILDING - MINNEAPOLIS, MINNESOTA

LABORATORY NO.: 11215

VERTICAL SCALE: 1" = 3'

BORING NO. 1

SURFACE ELEV. 96.4'

DEPTH		BPF
0'	Black silty clay loam (medium)	8
2'	Brown clay (rather stiff)	12
4'	Brown mottled clay (stiff) with a few lenses of silty loam	12
7'	Light brown fine sand (moist)	15
10'	Light brown fine to medium sand (moist) with a little gravel	22 17
15'		

Note: No water noted while sampling or above cave-in at 10' on completion.

BORING NO. 2

SURFACE ELEV. 95.5'

DEPTH		BPF
0'	Black silty clay loam (rather stiff)	13
1½'	Brown clay (very stiff)	16
4'	Brown mottled clay (very stiff to stiff) with a few lenses of silty loam	13
6'	Light brown fine sand (moist)	
7½'	Light brown fine to medium sand (moist) with a trace of gravel	21 19 10 12
17'		

Note: No water noted while sampling or above cave-in at 15' on completion.

SOIL EXPLORATION COMPANY
662 Cromwell Avenue
St. Paul, Minnesota 55114

REPORT OF TESTS OF SOIL

PROJECT: PROPOSED BUILDING
MINNEAPOLIS, MINNESOTA

September 5, 1967

REPORTED TO: Danielson Brothers

LABORATORY NUMBER: 11215

SAMPLE NUMBER:	#1
Boring No.	2
Depth Sample Taken	5' - 6'
Blows Per Foot	13
Color	Brown mottled
Classification (U.S. Bureau of Soils)	Clay

MOISTURE AND DENSITY TESTS:

Moisture (%)	28
Density (lbs./cu.ft.)	96

SHEAR STRENGTH TESTS:

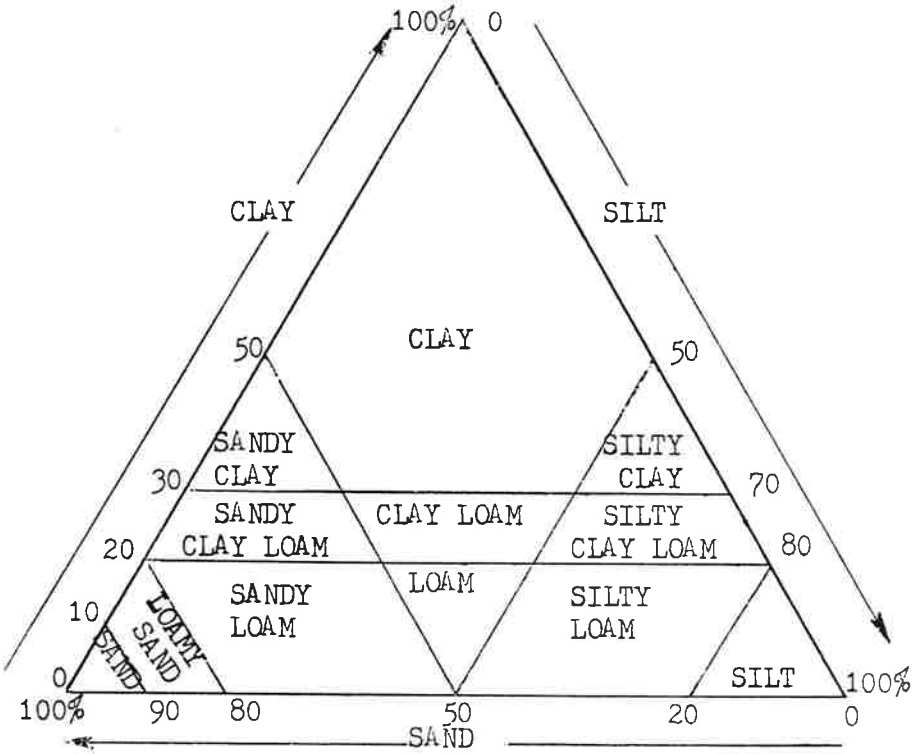
Unconfined Compression Test:	
Diameter of Sample (inches)	1-3/8
Maximum Load (lbs./sq.ft.)	10,000
Typical Angle of Internal Friction	Near 0°
Cohesion (lbs./sq.ft.)	5,060

U. S. BUREAU OF SOILS CLASSIFICATION SYSTEM

We use the U. S. Bureau of Soils method of soil classification which is based on the texture of the soil. The texture of a soil is influenced by the amount of the various sizes of soil particles in the soil. The soil particles are grouped into three particle size classifications as follows:

Particle-Size Classification	Diameter of Particles (Millimeters)	U. S. Standard Sieve
Sand	2.0 to 0.05	#10 to #270
Silt	0.05 to 0.005	(Cannot be separated by sieving)
Clay	Smaller than 0.005	

Soil is grouped into twelve basic classifications according to the percentages of sand, silt and clay present in the soil. These classifications are shown by the following triaxial graph.

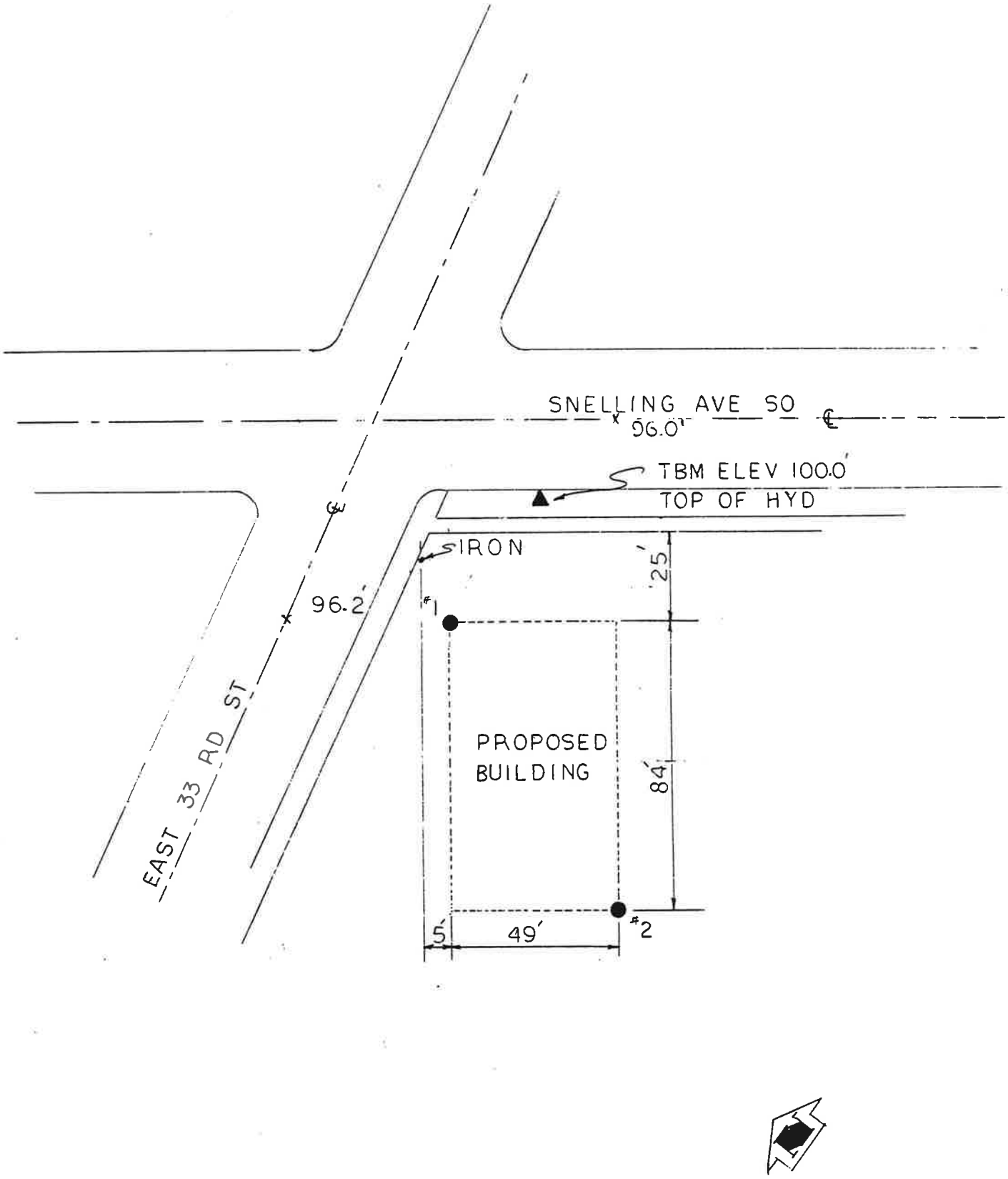


This same classification system in tabular form is as follows:

BASIC SOIL CLASSIFICATION	SAND	SILT	CLAY
Sand	90 - 100%	0 - 10%	0 - 10%
Loamy sand	80 - 90	0 - 20	0 - 20
Sandy loam	50 - 80	0 - 50	0 - 20
Loam	30 - 50	30 - 50	0 - 20
Silty loam	0 - 50	50 - 80	0 - 20
Silt	0 - 20	80 - 100	0 - 20
Sandy clay loam	50 - 80	0 - 30	20 - 30
Clay loam	20 - 50	20 - 50	20 - 30
Silty clay loam	0 - 30	50 - 80	20 - 30
Clay	0 - 50	0 - 50	30 - 100
Sandy clay	50 - 70	0 - 20	30 - 50
Silty clay	0 - 20	50 - 70	30 - 50

We classify the sand present in a soil as coarse (#10 - #20 sieves), medium (#20 - #40 sieves), fine (#40 - #100 sieves), very fine (#100 - #270 sieves), or as well graded. Soils with an appreciable amount of gravel present are classified "with a little gravel" (less than 15%), "with some gravel" (15 to 30%), "with gravel" (30 to 50%), "and gravel" (over 50%). Material over 3 inches is classified as boulders. Organic soil is classified as "peat" (over 2/3 organic material) or "muck" (1/3 to 2/3 organic material).

(3-15-61)



	DRAWN BY TV	CHECKED BY W.H
SOIL TEST BORINGS	SCALE 1"=40'	JOB NO. 11215

REPORT OF SUBSURFACE EXPLORATION PROGRAM

PROPOSED INDUSTRIAL BUILDING

MINNEAPOLIS, MINNESOTA

#4200 86-660

twin city testing
corporation

662 CROMWELL AVENUE
ST. PAUL, MN 55114
PHONE 612/645-3601

May 2, 1986

Leder Brothers Realty Company
2206 Edgewood Avenue South
St. Louis Park, MN 55416

Attn: Mr. Leonard Leder

Gentlemen:

SUBJ: Subsurface Exploration Program
Proposed Industrial Building
Minneapolis, Minnesota
#4200 86-660

We have conducted a subsurface exploration program and foundation review for the referenced project. We are transmitting two copies of our report. Additional copies are being sent as noted below. This work was done in accordance with your verbal authorization on April 16, 1986.

About 50% of the soil samples will be held at this office for one month and will then be discarded unless we are notified to hold them for a longer period of time.

We trust that this report will provide you with the needed information. If questions arise concerning interpretation of the data, please contact me at 641-9379.

Very truly yours,

Wilfred A. Wahl

Wilfred A. Wahl, P.E.

WAW/djs

Encls.

cc: (3) L. W. Samuelson Construction

REPORT OF SUBSURFACE EXPLORATION PROGRAM

PROPOSED INDUSTRIAL BUILDING

MINNEAPOLIS, MINNESOTA

#4200 86-660

INTRODUCTION

We understand that the proposed construction at this site will consist of a one-story, slab-on-grade warehouse type structure. The building will be 130' by 154' in plan dimensions. An additional building or buildings may be constructed to the south in the future.

In accordance with your verbal authorization on April 16, 1986, we have conducted a subsurface exploration program for the proposed construction. The scope of our work on this project is as follows:

1. Explore the subsurface conditions by means of six soil test borings.
2. Provide recommendations for foundation support including building foundation types and depths, allowable soil bearing pressures and estimates of settlement.
3. Provide recommendations for site preparation for support of the foundations and the floor slab.

The purpose of this report is to describe our field operations, to present the results of our field and laboratory tests and to provide you with our engineering recommendations.

EXPLORATION PROGRAM RESULTS

Site Conditions

The site is located west of Snelling Avenue South and south of East 33rd Street. The site is bounded on the west by railroad tracks. Several buildings previously occupied portions of the site. At least two of these borings were reported to have basements. The present ground surface is relatively level. The surface elevations at the boring locations vary from 95.8' to 97.2'.

Subsurface Conditions

The subsurface soil conditions encountered at the boring locations are shown on the attached boring logs. We wish to point out that the subsurface conditions at other times and locations on this site may differ from those found at other test locations. If different conditions are encountered during construction, it is necessary that you contact us so that our recommendations can be reviewed.

The test boring logs also indicate the probable geologic origin of the encountered soil.

It will be noted from the boring logs that the typical soil profile consists of fill overlying fine alluvial deposits which in turn are underlain by coarse alluvium. In some areas where the fill is somewhat deeper, the fine alluvial deposits were not encountered.

Fill was encountered at all of the boring locations and varies in depth from 2½' to 7½'. All of the borings except boring 6 are located within the area of previous construction. At these locations, the fill contains substantial amounts of miscellaneous debris such as concrete, blacktop and wood. Much of the fill shows relatively high N values, however, most of the higher penetrations appear to be influenced by the debris. At boring 6, the fill is composed of sand with silt and is quite loose.

Topsoil was encountered below the fill at boring 6. Only boring 6 is located outside of the area of previous construction.

The fine alluvium consists of fat and lean clay. These soils generally have a medium consistency.

The underlying coarse alluvium consists primarily of sand with some gravel content between 14' and 15.7' at boring 1. Boring 1 was obstructed on what appears to be a boulder at a depth of 15.7'.

WATER LEVELS

The borings were probed for the presence of ground water after completion. The underlying sands are quite pervious and the static water level lies below the depths of the boring. However, there did appear to be a little water perched in the fill above the lean clay at boring 4. Seasonal and annual fluctuations of the ground water level can be anticipated.

ENGINEERING REVIEW

Project Information

The following data represents our understanding of the project. It comprises an important part of our engineering review. If, as the project develops, there are changes from the stated values, we request that you contact us for additional review.

We understand that the proposed building will be a one-story structure without a basement. The building will be 130' by 154' in plan dimensions. The building will have a loading dock along the north wall. On this basis we assume the first floor will be at about elevation 100' relative to our benchmark. We estimate typical wall loads will be on the order of 3 to 4 kips per lineal foot and column loads less than 100 kips.

Discussion

Although relatively high N values were recorded in much of the fill, the fill appears to contain relatively large amounts of miscellaneous debris. In this type of fill there can be voids. We do not recommend utilizing the existing fill for foundation or floor slab support. In our opinion, there would be a high potential for detrimental settlement to occur during the life of the structure.

Both the underlying fine alluvium and granular coarse alluvium are suitable for foundation and floor slab support. The fine alluvium soils are much weaker than the sands.

In our opinion, most feasible foundation plan is to strip the entire building area of all existing fill and topsoil and then place controlled fill to reach the required grade. The foundations can then be supported on the fill or natural soil at normal minimum elevation.

Foundation Recommendations

It is our opinion that the proposed structure can be supported on spread footing foundations. We recommend stripping the entire building area of all existing fill and topsoil. If the upper portion of the fine alluvium is quite soft, additional subcutting may be necessary. The necessary grade

should then be attained by placing controlled compacted fill. The excavation and compacted fill should extend beyond the edge of the footings a distance equal to the depth of compacted fill beneath the footings. We recommend compacting the fill to a minimum of 95% of standard Proctor density. Foundations supported on the fill or underlying fine alluvial clay should be designed for a maximum loading of 2000 psf (pounds per square foot). The fill or natural soils will provide a factor of safety of at least three against an actual shear failure. We estimate total and differential settlement will be less than 1" and ½', respectively.

It appears than in a large portion of the building no fine alluvial clays will be present below the fill. The design loading can be increased in areas where there are no fine alluvial clays beneath the foundations. Loadings of as high as 4000 psf can be utilized on the natural sands or controlled fill. However, for higher unit loadings on the controlled fill, we recommend that the compaction requirements be increased to a minimum of 98% of standard Proctor density.

It should be noted that the fine alluvial clays are sensitive to volume change with a change in moisture content. If these soils are exposed to extensive drying, they will tend to shrink with a reduction in moisture content. At a later date additional moisture reaching these soils could cause them to expand. In our opinion there is very little risk of differential movement if these soils are left in place beneath the structure as long

as the natural moisture content is maintained during construction. Therefore, the clays should not be exposed for an excessive length of time nor should water be allowed to pond on these soils during construction.

Borings 4 and 5 were put down in the area of possible future construction. The soil conditions in these areas are similar and the above recommendations would also apply.

Observation and Testing

We recommend that the excavation be observed by a soil engineer prior to the placement of foundations or controlled fill. We also recommend that density tests be taken as the fill is placed to document that proper compaction is being obtained.

FIELD EXPLORATION PROCEDURES

Six soil test borings were made on April 25 and 28, 1986. The borings were put down at the locations discussed with you or suggested by you as shown on the attached sketch. The surface elevations were referenced to the top of the hydrant were shown taken as 100.0'.

Soil sampling was done in accordance with ASTM: D 1586-84. Using this procedure, a 2" O.D. split barrel sampler is driven into the soil by 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 the cohesionless soils and the consistency of cohesive soils.

As the samples were obtained in the field, they were visually and manually classified by the crew chief in accordance with ASTM: D 2487-83 and D-2488. Representative portions of the samples were then returned to the laboratory for further examination and for verification of the field classification. Logs of the borings indicating the depth and identification of the various strata, the N value, 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.

EXPLORATION LIMITATIONS

The recommendations contained in this report represent our professional opinions. These opinions were arrived at in accordance with currently accepted engineering practices at this time and location. Other than this, no warranty is implied or intended.

This report was prepared by: Wilfred A. Wahl
Wilfred A. Wahl, P.E.

This report was reviewed by: Steven D. Koenes
Steven D. Koenes, P.E.

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

Wilfred A. Wahl
WILFRED A. WAHL
Date 5-5-86 Reg. No. 6984

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.

Steven D. Koenes
STEVEN D. KOENES
Date 5-5-86 Registration No. 13160

LOG OF TEST BORING

JOB NO. 4200 86-660 VERTICAL SCALE 1" = 3' BORING NO. 1

PROJECT PROPOSED INDUSTRIAL BUILDING, MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 96.8')	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LAB TESTS W	LAB TESTS D	LAB TESTS L.L./P.L.	LAB TESTS Qu
	FILL, MIXTURE OF SILTY SAND, SANDY LEAN CLAY AND LEAN CLAY, with concrete, a little gravel, a few cobbles, brown and black	FILL			1	HSA				
			60/0.6		2	SB				
4½	FAT CLAY, brown mottled, soft to rather stiff, a few lenses and laminations of silt (CH)	FINE ALLUVIUM			3	SB	41		60	Pq: 0.8 TSF
			6		4	SB				
7	SAND, fine grained, light brown, moist, medium dense (SP)	COARSE ALLUVIUM	15		5	SB				
			16		6	SB				
			9		7	SB				
14	SAND W/A LITTLE GRAVEL, medium grained, light brown (See #1)(SP)				8	SB				
15½	SAND (See #2) (SP)		20/0.2		9	SB				
15.7	OBSTRUCTION									
	#1 - moist, dense (SP)									
	#2 - W/GRAVEL, medium grained, some cobbles and boulders, brown, moist, very dense (SP)									

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL
					to	
4-25	2:30	15.7	15'	15'	to	None
4-25	2:40	15.7	None	9'	to	None
					to	

START 4-25-86 COMPLETE 4-25-86

METHOD HSA 0' - 15' @ 2:30

CREW CHIEF LeMay

twin city testing corporation

SE-12 (77-B)-3

LOG OF TEST BORING

JOB NO. 4200 86-660 VERTICAL SCALE 1" = 3' BORING NO. 2

PROJECT PROPOSED INDUSTRIAL BUILDING, MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 96.2')	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS W	D	L.L./P.L.	Qu
	FILL, MIXTURE OF PIECES AND SLABS OF CONCRETE, LEAN CLAY AND SANDY LEAN CLAY W A LITTLE GRAVEL, black, brown and gray	FILL			1	HSA				
			30/0.4		2	SB				
			20/0.1		3	SB				
7½	SAND, fine grained, light brown, moist, dense to medium dense (SP) to dense	COARSE ALLUVIUM	16		4	SB				
			17		5	SB				
			15		6	SB				
			16		7	SB				
17	End of Boring									
	Note: Initial attempt obstructed at depth of 2.3' on concrete slab. Then moved 5' east (location shown) and continued with sampling below 2.5'									

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL
					to	
4-28	9:00	17'	15'	17'	to	None
4-28	9:10	17'	None	14'	to	None
					to	

START 4-25-86 COMPLETE 4-28-86

METHOD HSA 0' - 15' @ 9:00

CREW CHIEF LeMay

LOG OF TEST BORING

JOB NO. 4200 86-660 VERTICAL SCALE 1" = 3' BORING NO. 3

PROJECT PROPOSED INDUSTRIAL BUILDING, MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 95.9')	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS W	D	L.L. / P.L.	Qu
	FILL, MIXTURE OF SILTY SAND, SAND, LIMESTONE, CONCRETE SLABS, BLACK-TOP, LEAN CLAY AND GRAVEL, brown and black, dark brown and gray	FILL			1	HSA				
			8		2	SB				
			26		3	SB				
6½	SAND, fine grained, light brown, moist, dense to medium dense (SP)	COARSE ALLUVIUM	18		4	SB				
			18		5	SB				
			13		6	SB				
14½	SAND, fine to medium grained, light brown, moist, medium dense (SP)		10		7	SB				
16½	End of Boring									

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL
					to	
4-28	9:55	16½'	14½'	16½'	to	None
4-28	10:05	16½'	None	12'	to	None
					to	

START 4-28-86 COMPLETE 4-28-86

METHOD HSA 0' - 14½' @ 9:55

CREW CHIEF LeMay

SE-12 (77-B)-3

twin city testing corporation

LOG OF TEST BORING

JOB NO. 4200 86-660 VERTICAL SCALE 1" = 3' BORING NO. 4

PROJECT PROPOSED INDUSTRIAL BUILDING, MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 95.8')	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS W	D	L.L. / P.L.	Qu
	FILL, MIXTURE OF SILTY SAND AND LEAN CLAY W/A LITTLE GRAVEL, black, dark brown and brown	FILL	3		1	SB				
2	FILL, MOSTLY CONCRETE AND WOOD, a little lean clay, brown, water in fill below about 5½' (perched water condition)		9		2	SB				
			5	* ▼	3	SB				
6										
6½	LEAN CLAY, brown, medium (CL)	FINE**				NSR				
	SAND, fine grained, light brown, moist, medium dense to dense to medium dense, a few lenses of brownish gray sand (SP)	COARSE ALLUVIUM	14		4	SB				
			16		5	SB				
			13		6	SB				
14½	SAND, fine to medium grained, light brown, moist, dense (SP)		16		7	SB				
16½	End of Boring									
	* water level shown (5½') is an estimate bsed on observation while sampling and represents a perched water condition	**ALLUVIUM								
	*** source of water is perched, condition at depth of about 5½'									

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL
					to	
4-28	11:00	16½'	14½'	16½'	to	None
4-28	11:10	16½'	None	8½'	to	8'***
4-28	12:00	16½'	None	7'	to	7'***

START 4-28-86 COMPLETE 4-28-86

METHOD HSA 0' - 14½' @ 11:00

CREW CHIEF LeMay

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SE-12 (77-B)-3

LOG OF TEST BORING

JOB NO. 4200 86-660 VERTICAL SCALE 1" = 3' BORING NO. 5

PROJECT PROPOSED INDUSTRIAL BUILDING, MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 96.4')	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS W	D	L.L. / P.L.	Qu
	FILL, MIXTURE OF LEAN CLAY, SILTY SAND, LIMESTONE, CONCRETE, WOOD AND GRAVEL, black, brown and gray and dark brown	FILL			1	HSA				
			5		2	SB				
			10		3	SB				
7	SAND, fine grained, light brown, moist, dense to medium dense (SP)	COARSE ALLUVIUM	18		4	SB				
			18		5	SB				
			11		6	SB				
			13		7	SB				
16½	End of Boring									

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL
					to	
4-28	1:35	16½'	14½'	16'	to	None
4-28	1:40	16½'	None	13'	to	None
					to	

START 4-28-86 COMPLETE 4-28-86

METHOD HSA 0' - 14½' @ 1:35

CREW CHIEF LeMay

twin city testing corporation

SE-12 (77-B)-3

LOG OF TEST BORING

JOB NO. 4200 86-660 VERTICAL SCALE 1" = 3' BORING NO. 6

PROJECT PROPOSED INDUSTRIAL BUILDING, MINNEAPOLIS, MINNESOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 97.2')	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS W	D	L.L. / P.L.	Qu
	FILL, MOSTLY SAND W/SILT AND GRAVEL, brown	FILL	5		1	SB				
2½	LEAN CLAY, black, rather stiff (CL)	TOPSOIL	9		2	SB				
3½	FAT CLAY, brown, medium, some laminations of silt (CH/CL)	FINE ALLUVIUM	7		3	SB				
					4	SB				
7½	SAND, fine grained, light brown, moist, medium dense to dense to medium dense, a few lenses of brownish gray silty sand (SP)	COARSE ALLUVIUM	13		5	SB				
			16		6	SB				
			13		7	SB				
			10		8	SB				
16½	End of Boring									

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL
					to	
4-28	11:45	16½'	14½'	16½'	to	None
4-28	11:55	16½'	None	10'	to	None
					to	

START 4-28-86 COMPLETE 4-28-86

METHOD HSA 0' - 14½' @ 11:45

CREW CHIEF LeMay

twin city testing corporation

SE-12 (77-B)-3

GENERAL NOTES

DRILLING AND SAMPLING SYMBOLS

SYMBOL	DEFINITION
HSA	3 1/4" I.D. Hollow Stem Auger
_FA	4", 6" or 10" Diameter Flight Auger
_HA	2", 4" or 6" Hand Auger
_DC	2 1/2", 4", 5" or 6" Steel Drive Casing
_RC	Size A, B, or N Rotary Casing
PD	Pipe Drill or Cleanout Tube
CS	Continuous Split Barrel Sampling
DM	Drilling Mud
JW	Jetting Water
SB	2" O.D. Split Barrel Sample
_L	2 1/2" or 3 1/2" O.D. SB Liner Sample
_T	2" or 3" Thin Walled Tube Sample
3TP	3" Thin Walled Tube (Pitcher Sampler)
_TO	2" or 3" Thin Walled Tube (Osterberg Sampler)
W	Wash Sample
B	Bag Sample
P	Test Pit Sample
_Q	BQ, NQ, or PQ Wireline System
_X	AX, BX, or NX Double Tube Barrel
CR	Core Recovery - Percent
NSR	No Sample Recovered, classification based on action of drilling equipment and/or material noted in drilling fluid or on sampling bit.
NMR	No Measurement Recorded, primarily due to presence of drilling or coring fluid.
▼	Water Level Symbol

TEST SYMBOLS

SYMBOL	DEFINITION
W	Water Content - % of Dry Wt. - ASTM D 2216
D	Dry Density - Pounds Per Cubic Foot
LL, PL	Liquid and Plastic Limit - ASTM D 4318
Additional Insertions in Last Column	
Qu	Unconfined Comp. Strength-psf - ASTM D 2166
Pq	Penetrometer Reading - Tons/Square Foot
Ts	Torvane Reading - Tons/Square Foot
G	Specific Gravity - ASTM D 854
SL	Shrinkage Limits - ASTM D 427
OC	Organic Content - Combustion Method
SP	Swell Pressure - Tons/Square Foot
PS	Percent Swell
FS	Free Swell - Percent
pH	Hydrogen Ion Content, Meter Method
SC	Sulfate Content - Parts/Million, same as mg/L
CC	Chloride Content - Parts/Million, same as mg/L
C*	One Dimensional Consolidation - ASTM D 2435
Qc*	Triaxial Compression
D.S.*	Direct Shear - ASTM D 3080
K*	Coefficient of Permeability - cm/sec
D*	Dispersion Test
DH*	Double Hydrometer - ASTM D 4221
MA*	Particle Size Analysis - ASTM D 422
R	Laboratory Resistivity, in ohm - cm - ASTM G 57
E*	Pressuremeter Deformation Modulus - TSF
PM*	Pressuremeter Test
VS*	Field Vane Shear - ASTM D 2573
IR*	Infiltrometer Test - ASTM D 3385
RQD	Rock Quality Designation - Percent

* See attached data sheet or graph

WATER LEVEL

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 may be considered reliable ground water levels. In clay soil, it may not be possible to determine the ground water level within the normal time required for test borings, except where lenses or layers of more pervious waterbearing soil are present. Even then, an extended 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. Perched water refers to water above an impervious layer, thus impeded in reaching the water table. The available water level information is given at the bottom of the log sheet.

DESCRIPTIVE TERMINOLOGY

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

Standard "N" Penetration: Blows Per Foot of a 140 Pound Hammer Falling 30 inches on a 2 inch OD Split Barrel Sampler

Lamination	Up to 1/2" thick stratum
Layer	1/2" to 6" thick stratum
Lens	1/2" to 6" discontinous stratum, pocket
Varved	Alternating laminations of clay, silt and /or fine grained sand, or colors thereof
Dry	Powdery, no noticeable water
Moist	Below saturation
Wet	Saturated, above liquid limit
Waterbearing	Pervious soil below water

RELATIVE GRAVEL PROPORTIONS

CONDITION	TERM	RANGE
Coarse Grained Soils	A little gravel	2 - 14%
	With gravel	15 - 49%
Fine Grained Soils		
15-29% + No. 200	A little gravel	2 - 7%
15-29% + No. 200	With gravel	8 - 29%
30% + No. 200	A little gravel	2 - 14%
30% + No. 200	With gravel	15 - 24%
30% + No. 200	Gravelly	16 - 49%

RELATIVE SIZES

Boulder	Over 12"
Cobble	3" - 12"
Gravel	
Coarse	3/4" - 3"
Fine	#4 - 3/4"
Sand	
Coarse	#4 - #10
Medium	#10 - #40
Fine	#40 - #200
Silt & Clay	- #200, Based on Plasticity

CLASSIFICATION OF SOIL FOR ENGINEERING PURPOSES
ASTM Designation: D 2487 - 83
(Based on Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3^E$	GW	Well graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3^E$	GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3^E$	SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3^E$	SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K,L,M]
		organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OL	Organic clay[K,L,M,N] Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OH	Organic clay[K,L,M,P]
					Organic silt[K,L,M,Q]
Highly organic soils		Primarily organic matter, dark in color, and organic odor		PT	Peat
Fibric Peat >67% Fibers		Hemic Peat 33%-67% Fibers		Sapric Peat <33% Fibers	

[A] Based on the material passing the 3-in. (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

[D] Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥30% plus no. 200, predominantly sand, add "sandy" to to group name.

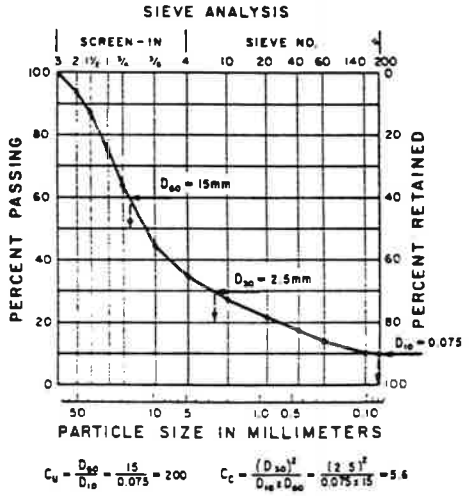
[M] If soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly" to group name.

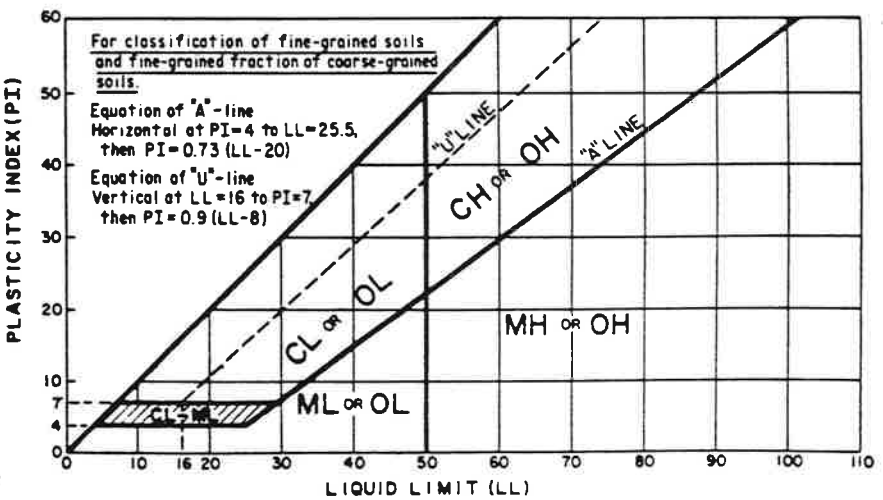
[N] PI ≥ 4 and plots on or above "A" line.

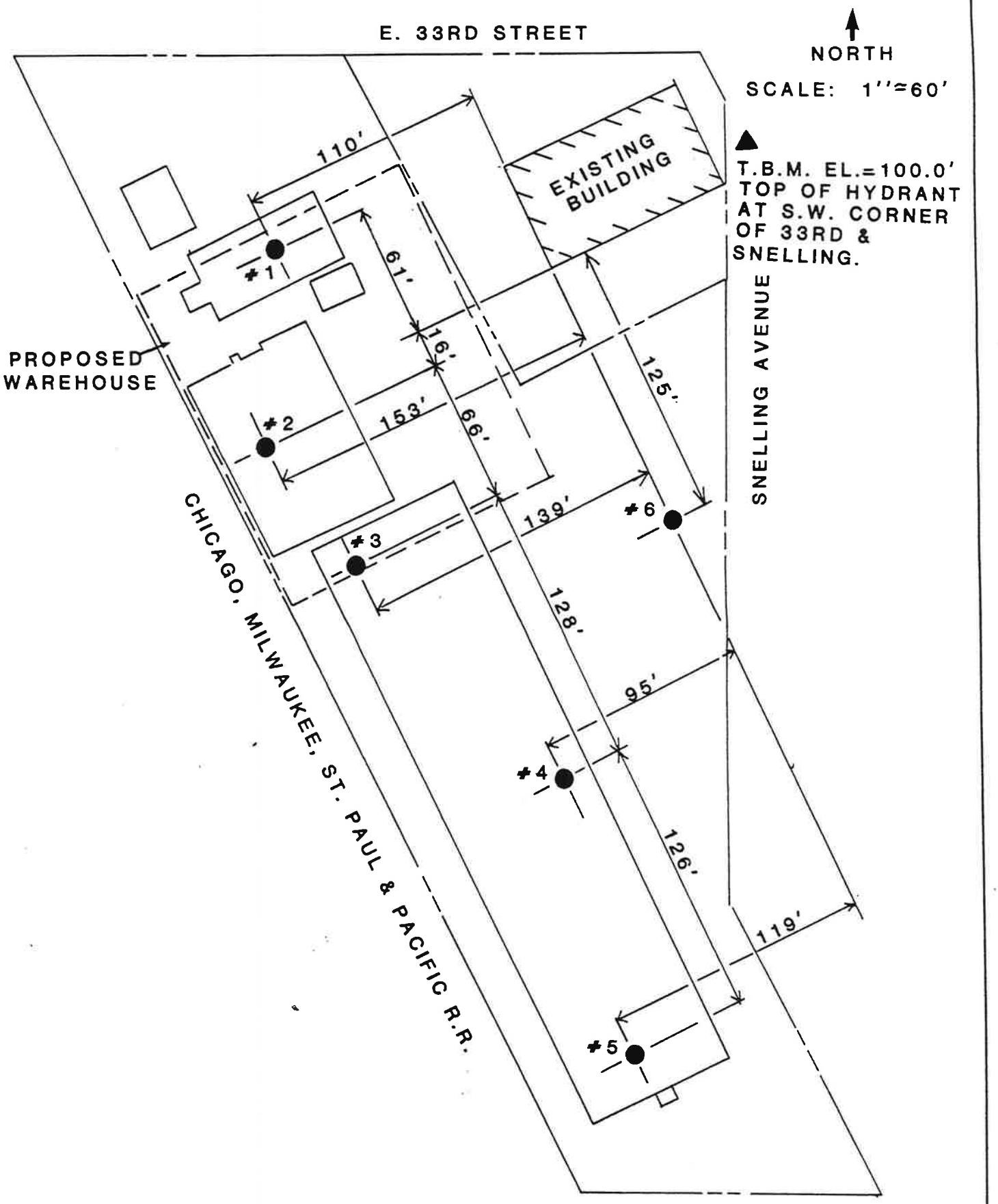
[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.






E. 33RD STREET
NORTH
SCALE: 1"=60'
T.B.M. EL.=100.0'
TOP OF HYDRANT
AT S.W. CORNER
OF 33RD &
SNELLING.
EXISTING
BUILDING
110'
61'
16'
66'
153'
125'
139'
128'
95'
126'
119'
#1
#2
#3
#4
#5
#6
PROPOSED
WAREHOUSE
SNELLING AVENUE
CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC R.R.