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MEMBER  
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November 3, 1998

City of Saskatoon  
Asset Management Department  
1100 Avenue P North  
Saskatoon, Saskatchewan  
S7L 7K6

**ATTENTION: MR. JIM GREENSHIELDS, F.M.A.**

Dear Sir:

**RE: WATER INFILTRATION  
CITY OF SASKATOON  
TRANSIT TERMINAL  
301 - 24<sup>TH</sup> STREET NW  
SASKATOON, SASKATCHEWAN  
PMEL FILE NO. S98-3169**

### Introduction

The following letter report has been prepared on the basis of the results of a subsurface soils investigation conducted at the City of Saskatoon Transit Terminal located at 301 - 24<sup>th</sup> Street NW in Saskatoon, Saskatchewan. Authorization to conduct this investigation was given to us verbally on September 22, 1998. The field test drilling and soil sampling were conducted on October 9, 1998.

### Field Investigation

Two test holes, located as shown on the Site Plan, Drawing No. S98-3169-1, were drilled at this site. Test Hole No. 98-1 was drilled north of the existing building using our truck-mounted, continuous flight, solid stem auger drill rig. The test hole was 150 mm in diameter and extended to a depth of 4.5 metres. Test Hole No. 98-2 was completed below the basement floor slab in the bus driver's locker room. A 150 mm diameter hole was first cored through the concrete floor slab using a diamond impregnated diamond core barrel. A 135 mm diameter test hole was hand augered to a depth of 750 mm below the top of the floor slab.

Test hole drill logs were compiled during test drilling to record the soil stratification, the groundwater conditions and the position of unstable sloughing soils.

Disturbed samples of auger cuttings, collected during test drilling, were sealed in plastic bags to minimize moisture loss. The soil samples were taken to our laboratory for analysis.

Standpipe piezometers (slotted, 50 mm diameter PVC pipe) were installed in each Test Hole to monitor static groundwater levels.

### Field Drill Logs

The field drill logs recorded during test drilling have been shown plotted on Drawing Nos. S98-3169-2 and 3. The ground surface and top of piezometer elevations were referenced to the basement floor slab elevation at Test Hole No. 2. An assumed datum elevation of 100.0 metres was used for the top of the floor slab.

Clay fill was encountered at the surface of Test Hole No. 98-1. Glacial till was encountered below the clay fill and extended to a depth of 1.8 metres below ground surface. The upper till was followed by a wet sand layer in the zone 1.8 and 2.8 metres below ground surface. The intertill sand stratum was underlain by glacial till which extended to a depth of at least 4.5 metres, the maximum depth drilled. In Test Hole No. 98-2, the 125 mm thick floor slab was underlain by sand fill overlying glacial till. As a result of encountering cobblestones in the glacial till, the Test Hole was terminated at a depth of 750 mm.

Groundwater seepage and sloughing conditions were encountered in Test Hole No. 98-1 during test drilling. The depth at which groundwater seepage and sloughing conditions were encountered have been shown on the Field Drill Log, Drawing No. S98-3169-2.

Groundwater levels recorded in standpipe piezometers installed at the completion of test drilling/hand augering have been summarized in Table I.

**TABLE I. RECORDED GROUNDWATER LEVELS**

TEST HOLE NO.	GROUND SURFACE ELEVATION (metres)	PIEZOMETER RIM ELEVATION (metres)	PIEZOMETER TIP ELEVATION (metres)	*RECORDED GROUNDWATER ELEVATION (metres)			
				Oct. 9 1998	Oct. 13 1998	Oct. 21 1998	Oct. 30 1998
98-1	102.0	102.0	98.0	99.3	99.4	99.4	99.5
98-2	100.0	100.0	99.3	DRY	DRY	99.4	99.5

\* The recorded water levels may not have been stabilized. Higher static water levels, particularly after spring thaw or periods of extensive precipitation, are possible.

Laboratory Analysis

The soil classification and index tests performed during this investigation consisted of a visual classification of the soil, water contents and grain size distribution analysis. The results of the soil classification and index tests conducted on samples of soil have been shown plotted alongside the corresponding drill logs, opposite the depth at which soil samples were recovered, as shown on Drawing Nos. S98-3169-2 and 3. The results of the grain size distribution analyses have been shown plotted on Drawing Nos. S98-3169-4 and 5.

Discussion of Results

Two standpipe piezometers were installed during this investigation; one outside of the north wall of the basement and one within the basement area. Groundwater monitoring between October 9, 1998 and October 20, 1998 revealed that the current groundwater level is approximately 500 mm below the top of the floor slab. Based on the recent flooding of the basement area after heavy rainfall events, it is suggested that higher groundwater levels outside of the basement have been experienced. A review of building drawings for the office and basement area (issued in 1981) revealed that weeping tile was to have been installed around the basement area during construction. The location of the outlet for the weeping tile, however, is not known. The drawings indicated that the weeping tile was to have been drained to an existing north-south storm sewer (located west of the basement area) draining down towards 24<sup>th</sup> Street. However, the drawings also indicate that the connection was later deleted.

Suspecting that the weeping tile may not have a drainage outlet or that it had been damaged, the weeping tile was exposed near the northwest corner of the basement. Water had previously been observed seeping through the basement wall at this location. The weeping tile was found to be collapsed at this location. A camera survey was conducted on the opened weeping tile. A second collapsed/plugged section was identified along the west basement wall. The weeping tile was found to be open along the remainder of the north wall and for a short distance along the east foundation wall (the camera could not be advanced very far past the northeast corner).

It is understood that the weeping tile was repaired with a rigid section of perforated pipe with a T-section extending towards the basement. It is also understood that a sump pit will be constructed within the basement area. As the sewer systems in the vicinity of the Transit building are reportedly overwhelmed during heavy precipitation events, it is recommended that the connection to the sump pit be equipped with a backflow prevention system and that the sump pit be equipped with a self-activated automatic sump which would pump out any accumulated water from the sump pit on an as required basis.

### Closure

This letter report has been prepared on the basis of our visual site review, a review of building drawings and the drilling of two test holes at the study site.

A hydrocarbon odour was detected in the subgrade soil in Test Hole No. 98-2 in the zone 500 to 600 mm. The source of this contamination appears to be the adjacent tank bed west of the basement. Further investigation of the underground storage tanks may be required.

This report has been prepared for the exclusive use of the City of Saskatoon (COS) Asset Management Department and their agents for specific application to the flooding of the basement in the COS Transit Department office on 24<sup>th</sup> Street in Saskatoon, Saskatchewan. It has been prepared in accordance with generally accepted geotechnical engineering practices and no other warranty, express or implied, is made. Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, are the responsibility of such Third Parties. P. Machibroda Engineering Ltd. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

The subsurface investigation necessitated the drilling of deep test holes. Standpipe piezometers were installed in each Test Hole at the completion of test drilling. Please be advised that some settlement of the backfill material will occur which may leave a depression or an open hole. It is the responsibility of the client to inspect the site and backfill, as required, to ensure that the ground surface at each Test Hole location is maintained level with the existing grade.

We trust that the report fulfills your requirements for this project. Should be required additional information, please contact us.

Yours very truly,

**P. MACHIBRODA ENGINEERING LTD.**

T. Werbovetski, P.Eng.

P. Machibroda, P.Eng., FCSCE

TW:PM:pfn

Association of Professional Engineers & Geoscientists of Saskatchewan		
<b>CERTIFICATE OF AUTHORIZATION</b>		
P. MACHIBRODA ENGINEERING LTD.		
Number 172		
Permission to Consult held by:		
Discipline	SK. Reg. No.	Signature
_____		
_____		
_____		



**P. MACHIBRODA  
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**DRAWINGS**

24 th STREET



TH 98-1  
TH 98-2



EXISTING OFFICE BUILDING

AVENUE C

NOTE:  
THIS DRAWING IS FOR  
CONCEPTUAL PURPOSES ONLY.  
ACTUAL LOCATIONS MAY VARY  
AND NOT ALL STRUCTURES ARE  
SHOWN.



**LEGEND**

-  -PMEL TEST HOLE
-  -BENCHMARK
-  -PROPERTY LINE



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SASKATOON, SK

DRAWING TITLE:

**SITE PLAN - TEST HOLE LOCATIONS**

PROJECT:

**C.O.S. TRANSIT TERMINAL BUILDING  
24 TH STREET AND AVENUE C, SASKATOON, SK**

SCALE:

**AS SHOWN**

DRAWING NUMBER:

DATE:

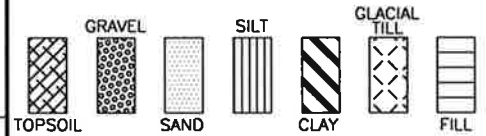
**OCTOBER, 1998**

**S98-3169-1**

PIEZO. ELEV.= 102.0 m

### TEST HOLE 98-1

**LEGEND:**



pp....POCKET PENETROMETER (kg/cm<sup>2</sup>)

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw....LIQUID LIMIT

Pw....PLASTIC LIMIT

D.....DRY DENSITY (kg/m<sup>3</sup>)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

N.....STANDARD PENETRATION TEST

SO<sub>4</sub> ...SULPHATE CONTENT (PERCENT OF DRY SOIL)

TR....TRACE

\*.....SULPHATE CONTENT WATER SAMPLE (ppm)

▼....RECORDED WATER LEVEL



**LIMITATIONS:**THE FIELD DRILL LOG IS A SUMMARY OF THE FIELD CONDITIONS ENCOUNTERED AT A SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND IN TIME, MAY CHANGE AT THE SPECIFIC TEST HOLE LOCATION.

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### FIELD DRILL LOG AND SOIL TEST RESULTS

**PROJECT:**  
COS TRANSIT TERMINAL BUILDING  
24TH ST. AND AVE. C

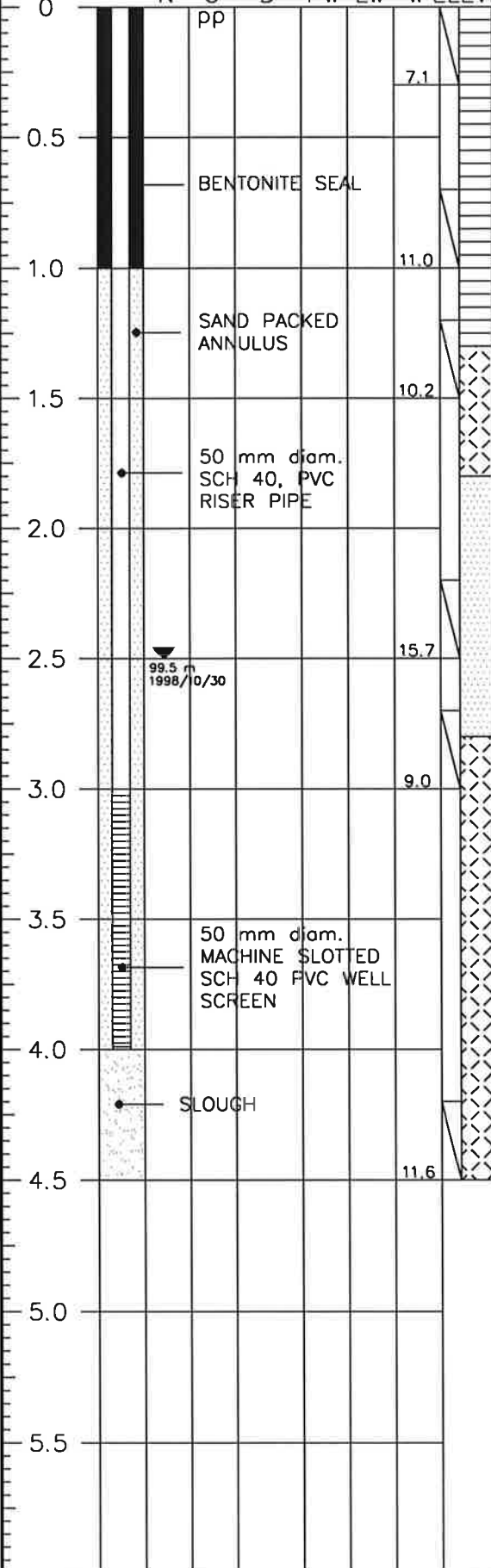
**LOCATION:**  
SASKATOON, SK

**DATE DRILLED:**  
OCT 9/98

**DRAWING NUMBER:**  
S98-3169-2

DEPTH (m)

N U D Pw Lw w ELEV: 102.0 m



**FILL-** Clay, silty, some sand, some organics, trace gravel, moist, olive to black in intervals.

**GLACIAL TILL-** Clay, silty, some sand, trace gravel, firm to stiff, low plastic, moist, olive, oxide stained, gypsum crystals.

**SAND,** silty, dense to medium dense, poorly graded, fine to medium grained, wet, oxide stained, sloughing.

**GLACIAL TILL-** Clay, silty, some sand, trace gravel, stiff to hard, highly plastic, moist, grey, unoxidized.  
-seepage at 3.0 m.

**NOTE:**  
1. Test Hole sloughed to 3.5 m immediately after drilling.  
2. Water level 2.7 m immediately after drilling.

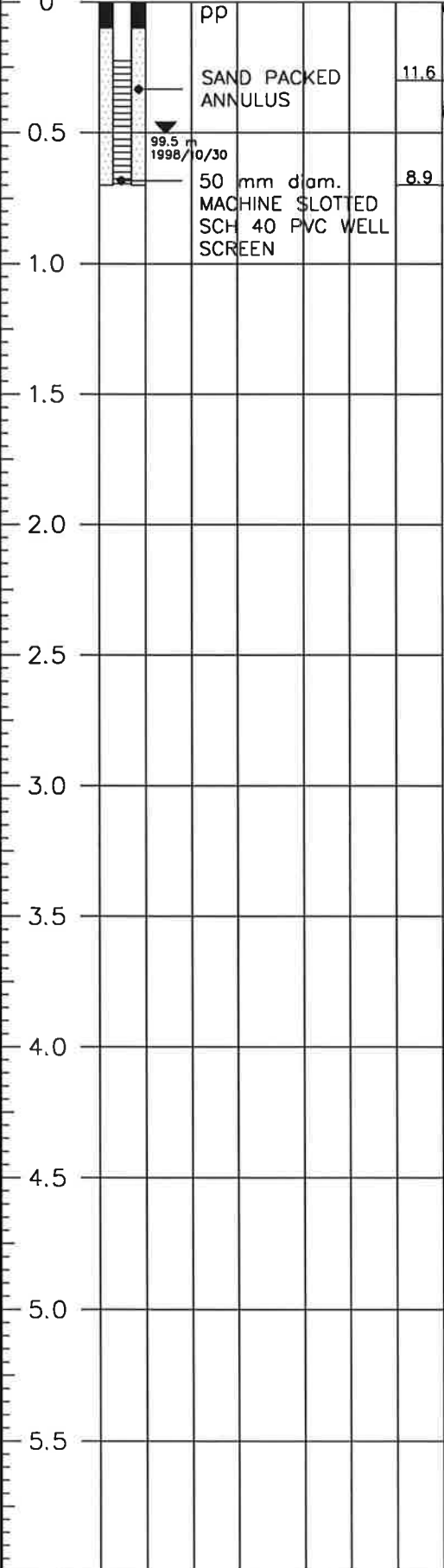


PIEZO. ELEV.= 100.0 m

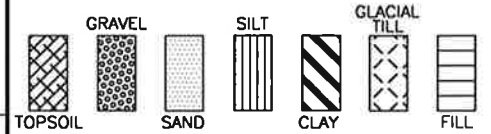
### TEST HOLE 98-2

DEPTH  
(m)

N U D Pw Lw w ELEV: 100.0 m



**LEGEND:**



- pp....POCKET PENETROMETER (kg/cm<sup>2</sup>)
- w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
- Lw....LIQUID LIMIT
- Pw....PLASTIC LIMIT
- D.....DRY DENSITY (kg/m<sup>3</sup>)
- U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
- N.....STANDARD PENETRATION TEST
- SO<sub>4</sub>...SULPHATE CONTENT (PERCENT OF DRY SOIL)
- TR....TRACE
- \*.....SULPHATE CONTENT WATER SAMPLE (ppm)
- ▼.....RECORDED WATER LEVEL
- SHELBY TUBE
- ⊗ SPLIT SPOON
- ◻ CUTTINGS

**LIMITATIONS:**THE FIELD DRILL LOG IS A SUMMARY OF THE FIELD CONDITIONS ENCOUNTERED AT A SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND IN TIME, MAY CHANGE AT THE SPECIFIC TEST HOLE LOCATION.

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### FIELD DRILL LOG AND SOIL TEST RESULTS

**PROJECT:**  
COS TRANSIT TERMINAL BUILDING  
24TH ST. AND AVE. C

**LOCATION:**  
SASKATOON, SK

**DATE DRILLED:** OCT 9/98  
**DRAWING NUMBER:** S98-3169-3

# GRAIN SIZE DISTRIBUTION TEST REPORT

Project: COS TRANSIT TERMINAL BUILDING  
 24TH STREET AND AVENUE C, SASKATOON, SK

Project No.: S98-3169

Date Tested: OCTOBER 14, 1998

Test Hole No.: 98-2

Sample No.: 7

Depth (m): 0.3

Remarks:

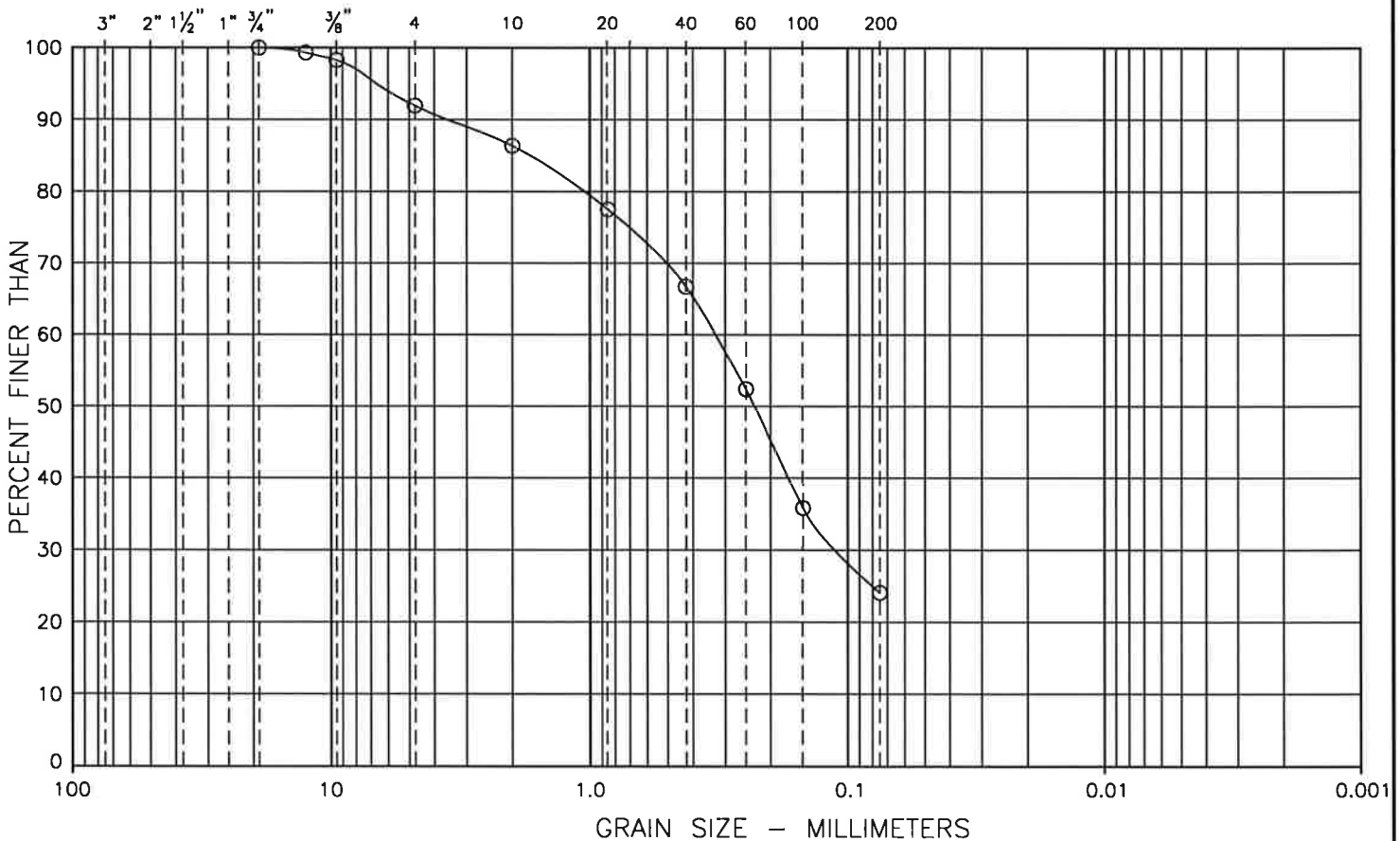
SIEVE SIZE (mm)	PERCENT PASSING
19.000	100.0
12.500	99.3
9.500	98.3
4.760	91.9
2.000	86.4
0.850	77.5
0.425	66.7
0.250	52.4
0.150	35.9
0.075	24.1

## Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
8	68	24

GRAVEL SIZES		SAND SIZES			SILT AND CLAY SIZES
COARSE	FINE	COARSE	MEDIUM	FINE	

← INCHES →      ← SIEVE SIZES →



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DRAWING NO.

**S98-3169-4**

# GRAIN SIZE DISTRIBUTION TEST REPORT

Project: COS TRANSIT TERMINAL BUILDING  
 24TH STREET AND AVENUE C, SASKATOON, SK

Project No.: S98-3169

Date Tested: OCTOBER 14, 1998

Test Hole No.: 98-2

Sample No.: 7

Depth (m): 0.3

Remarks:

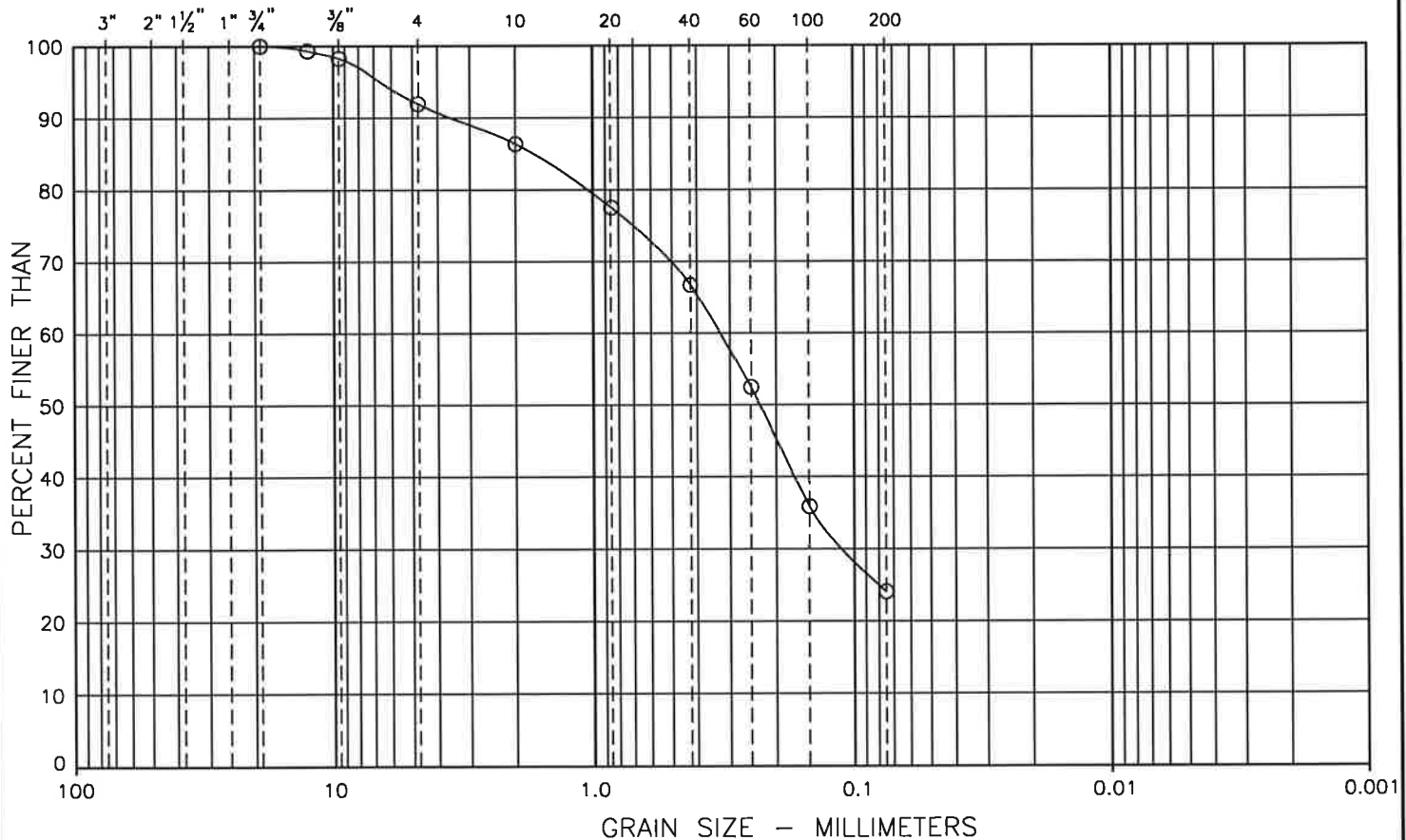
SIEVE SIZE (mm)	PERCENT PASSING
19.000	100.0
12.500	99.3
9.500	98.3
4.760	91.9
2.000	86.4
0.850	77.5
0.425	66.7
0.250	52.4
0.150	35.9
0.075	24.1

## Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
8	68	24

GRAVEL SIZES		SAND SIZES			SILT AND CLAY SIZES
COARSE	FINE	COARSE	MEDIUM	FINE	

INCHES
  SIEVE SIZES



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DRAWING NO.

**S98-3169-5**