CLYDE RIVER SEWAGE LAGOON
GEOTECHNICAL INVESTIGATION

Report Submitted

to

GOVERNMENT OF THE NORTHWEST TERRITORIES
MUNICIPAL AND COMMUNITY AFFAIRS
IQALUIT, NWT

Thurber Engineering Ltd.
Yellowknife, NWT

THE ASSOCIATION OF PROFESSIONAL ENGINEERS, GEOLOGISTS and GEOPHYSICISTS OF THE NORTHWEST TERRITORIES
PERMIT NUMBER
P 176
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October 18, 1991
File: 15-23-47

TABLE OF CONTENTS

SECTION 1

INTRODUCTION

1.1 General

This report presents the results of a geotechnical investigation carried out in connection with the design and construction of a new sewage lagoon in the community of Clyde River, NWT.

The work was carried out in accordance with GNWT Service Contract 290739 and at the direction of Mr. Rick Armstrong, Municipal and Community Affairs, Baffin Region. Verbal authorization to proceed was received from Mr. Armstrong on August 27, 1991.

The use of this report is subject to the Statement of General Conditions which is included at the end of the text. The reader's attention is specifically drawn to these conditions as it is considered essential that they be followed for the proper use and interpretation of this report.

1.2 Proposed Development

The proposed development, as we understand from the drawings provided, will involve the construction of a sewage lagoon and access road with provision for the addition of a future sewage lagoon. The proposed lagoon will be designed to hold a volume of approximately 19500m³ with an average fluid depth of 2.85 m.

In addition, the development will include a solid waste disposal area, bulky metal storage and a honey bag dump site.

The geotechnical recommendations were specifically prepared for the sewage lagoon site.

SECTION 2

METHOD OF INVESTIGATION

2.1 Field Program

The field investigation was carried out under the direction and supervision of Mr. R. Lachance, of Thurber Engineering Ltd. A total of four test pits were excavated on September 16, 1991, using a front end loader provided and operated by the Hamlet. The test pits were excavated approximately at the locations specified by Reinders Northern as shown on Drawing No. 1, Appendix A.

The subsurface conditions were logged based on a visual examination of the test pit walls and on representative samples taken from the excavated material. Test Pit logs are presented in Appendix B along with the Modified Soil Classification System and a description of the symbols and terms used to describe the test pit logs.

2.2 Laboratory Testing

Visual classifications and water content determinations were completed on all samples. Atterberg Limit tests and grain size analyses were carried out on selected samples to determine their suitability as berm material.

Laboratory test results are presented on the Test Pit logs in Appendix B.

SECTION 3

SITE DESCRIPTION

3.1 Surface Conditions

The proposed sewage lagoon site is to be located on a presently undisturbed area of native ground immediately west of the existing garbage dump site. The ground surface is generally flat lying to gently sloping tundra with numerous boulders and cobbles visible on the surface. The tundra cover is approximately 0.1 m thick at the test pit locations.

3.2 Subsurface Conditions

A wide range of soils were encountered in the test pit excavations at the proposed lagoon site. Test Pits 91-1, 91-2, and 91-3 consist primarily of clay materials with a range in plasticity from low to high with variable sand and silt content. The clay is generally light grey, silty with a trace of some sand, some gravel and a trace of organics.

Silty sand with some gravel was found in TP91-4 and at the bottom of all other test pits.

All test pits were terminated when permafrost was encountered at depths ranging from 0.8 m to 1.1 m below ground surface. Given the time of year, these depths are representative of the maximum active layer thaw for this year.

3.3 Groundwater

Water was encountered in TP91-3 at a depth of 0.7 m at completion of digging. Conditions in TP91-1 were very soft however, no free water was encountered. Groundwater encountered at this site is primarily a result of runoff and active layer thaw.

3.4 Permafrost

Permafrost was encountered at depths ranging from 0.8 m to 1.1 m at the test pit locations. Excavations into the permafrost were only possible for a few centimetres with the available equipment. Samples of the permafrost taken from these top few centimetres indicate a high excess ice content. The bagged samples turned to water with traces of soil when thawed. The potential for thaw settlement of the new lagoon is therefore a concern. As well the excavation is likely to be very wet and soft as the permafrost thaws.

SECTION 4

GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

4.1 General

We understand from Municipal and Community Affairs that construction of the proposed sewage lagoon is presently planned as a cut and fill operation utilizing dozer equipment. In view of the fact that sand was encountered under a portion of the site and the proposed construction methods, it is not considered feasible to construct a conventional earth berm lagoon without suffering significant seepage (or leakage) through the berm.

We further understand that the costs associated with installing a flexible membrane liner are high and therefore this option is not suitable to the GNWT. In addition, proper installation and maintenance of a flexible liner may not be adequately achieved with local equipment and personnel.

It is therefore recommended that the lagoon berms be constructed with sufficient width so that the permafrost table will aggrade (rise) into the berms and create a permafrost bowl to retain the sewage. With this design it will be required to maintain a minimum 2 m freeboard height if seepage is to be minimized.

It should be understood that the rate of permafrost aggradation is not known. Without a detailed geothermal analysis, we are unable to predict how long it will take for the required rise in the permafrost table to occur. It is, therefore, strongly recommended that a series of thermistors be installed in the berms at various depths to monitor freezeback.

Since the lagoon will be containing sewage which is environmentally hazardous, pond filling should be delayed until permafrost levels in the berms are confirmed.

Detailed recommendations are provided in the following sections.

4.2 Berm Construction

As discussed, berm construction will be carried out by Cat dozer equipment utilizing a cut and fill procedure.

It is recommended that pond depth be created by excavating into the permafrost, rather than building berms above existing grade, to the maximum extent possible. If construction is begun in July as planned, it should be

possible to execute a staged excavation where permafrost is continually removed as it thaws.

Our test pit observations indicate that this excavation is likely to be very wet and soft. It is very likely that heavy equipment will get bogged down in the thawing permafrost. The contractor should be prepared to install a sump(s) and pump(s) in order to provide drainage and maintain a reasonably dry excavation.

Since the lagoon construction will create a permanent depression in the permafrost table, it will be important to prevent seasonal active layer melt water from collecting in this depression. This may be achieved by constructing perimeter berms to a minimum height of 2.0 m above existing ground. This will allow the permafrost to rise above its present level and isolate the lagoon from active layer melt water.

A geothermal analysis has not been carried out, as this was not part of our scope of work, to determine the required berm thickness in order to achieve the necessary permafrost aggradation. However, based on past experience, we recommend a minimum crest width of 10 m with 4:1 horizontal to vertical interior slopes and 3:1 horizontal to vertical exterior slopes.

It is recommended that all tundra and other organic soil be removed from the entire area for the reservoir, prior to placing any fill.

All fill for berm construction should consist of unfrozen, inorganic soil. Boulders in excess of 300 mm diameter should be avoided in the fill.

Fill should be placed in lifts not exceeding 300 mm in thickness and compacted as well as possible with available equipment. A minimum of 8 passes with a large dozer should be used for compaction if a vibratory roller is not available.

4.3 Slope Protection

It is recommended that both the interior and exterior slopes be protected from erosion. The slopes should be carefully trimmed to the recommended slopes and compacted prior to placing any granular protection. Ideally, a 200 mm thickness of rip-rap should be placed on the slope. The following gradation limits are recommended:

PARTICLE SIZE (MM)	FRACTION FINER BY WEIGHT (%)
100	100
50	70 - 100
20	15 - 50
10	0 - 30
5	0 - 10

It is recognized that rip-rap meeting the above requirements may be prohibitively expensive to produce. As an alternative, a clean well graded pit run gravel with a minimum thickness of 300 mm may be used.

4.4 Freeboard

It is recommended that the lagoon be designed with a minimum freeboard of not less than 2.0 m. This greater than normal freeboard is suggested for several reasons. Most importantly, this will accommodate the seasonal thaw (lowering of permafrost table within the berm) yet maintain the permafrost above the high water line. In addition, a large freeboard will provide further protection from erosion damage.

As a cautionary note, it should be recognized that the permafrost below the site could not be excavated significantly and has not been thoroughly examined for excess ice content. The potential for thaw settlement of the lagoon base in particular is not well defined. Observations in one test pit, however, indicate high excess ice immediately below the active layer.

Some thaw settlement is expected to occur, particularly under the pond base, however, the magnitude of this settlement cannot be accurately estimated from the available data. This thaw settlement is expected to cause some cracking at the toe of the berms.

The relatively large freeboard recommended will accommodate some thaw settlement of the berms.

4.5 Closure

This report has been prepared on the basis of information obtained from four shallow test pits excavated on the site. It has been assumed that the information from the test pits is representative of the entire site.

STATEMENT OF GENERAL CONDITIONS

1. STANDARD OF CARE

This report has been prepared in accordance with generally accepted geotechnical engineering practices in this area. No other warranty, expressed or implied, is made.

2. BASIS OF THE REPORT

This report has been prepared for the specific site, design objective, development and purpose that was described to Thurber Engineering Ltd. ("TEL") by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the report are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to TEL, unless TEL is specifically requested by the Client to review and revise the report in light of such alteration or variation.

3. USE OF THE REPORT

The information and opinions expressed in this report are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THIS REPORT OR ANY PORTION THEREOF WITHOUT TEL'S EXPRESS WRITTEN CONSENT. TEL WILL CONSENT TO ANY REASONABLE REQUEST BY THE CLIENT TO APPROVE THE USE OF THIS REPORT BY OTHER PARTIE(S) AS APPROVED USERS. The contents of this report remain the copyright property of TEL, who authorizes only the Client and Approved Users to make copies of the report, and only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof, or any copy of the report or portion thereof, to any other party without the express written permission of TEL.

4. COMPLETE REPORT

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to TEL by the Client, communications between TEL and the Client, and to any other reports prepared by TEL for the Client relative to the specific site described in the report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS, AND OPINIONS EXPRESSED IN THE REPORT, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. TEL CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

5. INTERPRETATION OF THE REPORT

(a) Nature and Exactness of Soil Description: Classification and identification of soils, rocks, and geologic units have been based upon commonly accepted methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from these systems have been used they are specifically mentioned. Classification and identification of the type and condition of soils, rocks and geologic units are judgmental in nature. Accordingly, TEL cannot warrant or guarantee the exactness of the descriptions of insitu ground conditions set forth in the Report.

(b) Logs of Test Holes, Pits, Trenches, etc.: The test hole logs are a record of information obtained from field observations and laboratory testing of selected samples as well as an interpretation of the likely subsurface stratigraphy at the test hole sites. In some instances normal sampling procedures do not recover a complete or any sample. Soil, rock or geologic zones have been interpreted from the available data. The change from one zone to another, indicated on the logs as a distinct line, may be transitional. The same limitations apply to test pit and other logs.

(see over . . .)

(c) Stratigraphic and Geologic Sections: The stratigraphic and geologic sections indicated on drawings contained in this report are interpreted from logs of test holes, test pits or other available information. Stratigraphy is inferred only at the locations of the test holes or pits to the extent indicated by items 5(a) and (b) above. The actual geology and stratigraphy, particularly between these locations, may vary considerably from that shown on the drawings. Since natural variations in geologic conditions are inherent and a function of the historic site environment, TEL does not represent or warrant that the conditions illustrated are exact and the user of the report should recognize that variations may exist.

(d) Groundwater Conditions: Groundwater conditions shown on logs of test holes and test pits, and/or given within the text of this report, record the observed conditions at the time of their measurement. Groundwater conditions may vary between test hole and test pit locations and can be affected by annual, seasonal, and special meteorologic conditions, or by tidal conditions for sites near the sea. Groundwater conditions can also be altered by construction activity. These types of variation need to be considered in design and construction.

(e) Changes of Exposed Ground: Many geologic materials deteriorate rapidly upon exposure to climatic elements. Deterioration may be caused by precipitation and/or the action of frost. Therefore, site conditions may vary considerably from the time of the making of the tests performed for preparation of the report and the time of actual construction.

(f) Influence of Construction Activity: Construction activities can alter and damage the insitu ground conditions. The influence of all anticipated construction activities on the geologic environment should be considered in formulating and implementing the final design and construction techniques.

Wherever changes in the site occur after the preparation of the report or conditions are observed which indicate results clearly incompatible with the test results on which the report is based, the client and any other users of this report should notify TEL as soon as possible so that TEL will be able to provide necessary revisions to its report prior to any commencement of or alteration in design and construction.

6. OBSERVATIONS DURING CONSTRUCTION

Observations of geologic conditions should be carried out during site preparation, excavation and construction to verify the conditions predicted by the report. Such observations should be communicated to TEL to allow for confirmation and/or alteration of the geotechnical recommendations or design guidelines presented in the report.

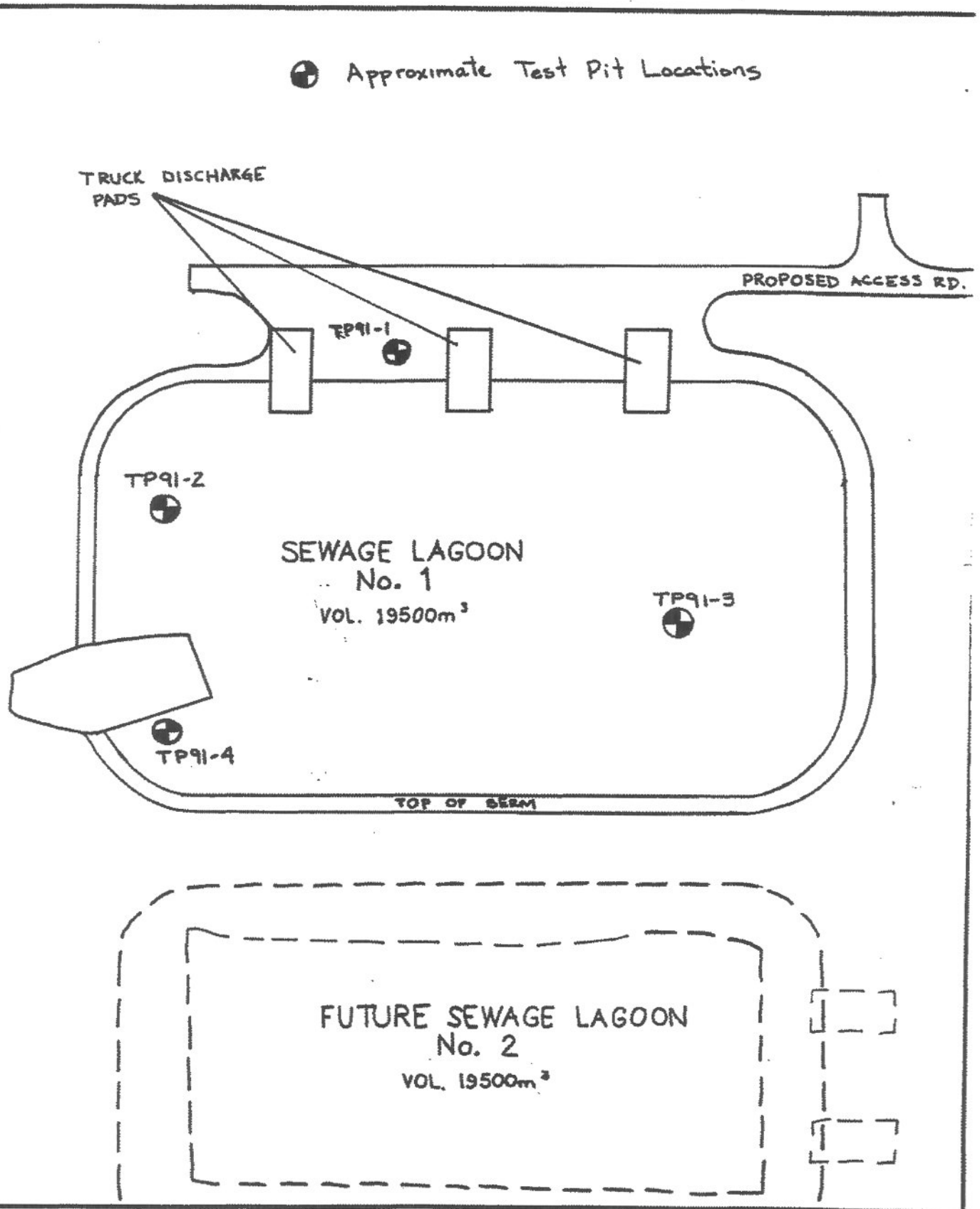
Wherever changes in the site occur after the preparation of the report or conditions are observed which indicate results clearly incompatible with the test results on which the report is based, then the client should notify TEL as soon as possible so that TEL will be able to provide necessary revisions to its report prior to any commencement of or alteration in design and construction.

7. SAMPLES

TEL normally disposes of all unused soil and rock samples after 30 days of completing the testing program for which the samples were obtained. Further storage or transfer of samples can be made at the owner's expense upon written request.

APPENDIX A

DRAWINGS



DESIGNED	GNWT- MUNICIPAL AND COMMUNITY AFFAIRS	THURBER
DRAWN: RLV	TEST PIT LOCATIONS	
DATE: 18/10/91		
APPROVED		
SCALE: 1:1000	PROPOSED SEWAGE LAGOON - CLYDE RIVER, NWT	DRAWING NO: 1

APPENDIX B

TEST PIT LOGS

SYMBOLS AND TERMS USED ON TEST LOGS

1. VISUAL TEXTURAL CLASSIFICATION OF MINERAL SOILS

CLASSIFICATION	APPARENT PARTICLE SIZE
Boulders	Greater than 200mm
Cobbles	75mm to 200mm
Gravel	5mm to 75mm
Sand	Not visible to 5mm
Silt	Non-Plastic particles, not visible to the naked eye
Clay	Plastic particles, not visible to the naked eye

2. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	APPROXIMATE UNDRAINED SHEAR STRENGTH	
Very soft	Less than 10 kPa	
Soft	10 to 25 kPa	
Firm	25 to 50 kPa	
Stiff	50 to 100 kPa	
Very Stiff	100 to 200 kPa	Modified from National Building Code
Hard	200 to 300 kPa	
Very Hard	Greater than 300 kPa	

3. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	STANDARD PENETRATION TEST (Number of Blows per 300mm	
Very loose	0 to 4	
Loose	4 to 10	
Compact	10 to 30	
Dense	30 to 50	Modified from National Building Code
Very Dense	Over 50	

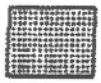
LEGEND FOR TEST HOLE LOGS

•	Water content (% by weight) as determined on soil samples
	Disturbed bag or split spoon sample
	Undisturbed Shelby Tube sample or core from UTM core barrel
	No recovery
	Number of blows per 300mm for Standard Penetration Test
Cu	Undrained Shear Strength determined by unconfined compression test
Cvane	Shear Strength determined by pocket vane
Cpen	Shear Strength determined by pocket penetrometer
⧗	Water Level

SYMBOLS AND TERMS USED ON TEST LOGS (CON'T)

4. PERMAFROST DESCRIPTION

4.1 LEGEND FOR TEST HOLE LOGS

4.2  Soil Frozen

 Soil Unfrozen

5. PERMAFROST CLASSIFICATION

Ice Content	Graph Symbol*	Description
Ice not visible by eye	Nf	Poorly Bonded or Friable
	Nbn	Well Bonded - No Excess Ice
	Nbe	Well Bonded - Excess Ice
Visible ice less than 2.5 cm thick	Vx	Individual Ice Crystals or Inclusions
	Vc	Ice Coating on Particles
	Vr	Random or Irregularly Oriented Ice
	Vs	Stratified or Distinctly Oriented Ice
	Vu	Ice Pattern Not Known
Visible ice greater than 2.5 cm thick	ICE+ soil type	Ice with Soil Inclusions
	ICE	Ice without Soil Inclusions

* Numbers in graph symbol column refer to the estimated percent visible ice content by volume.

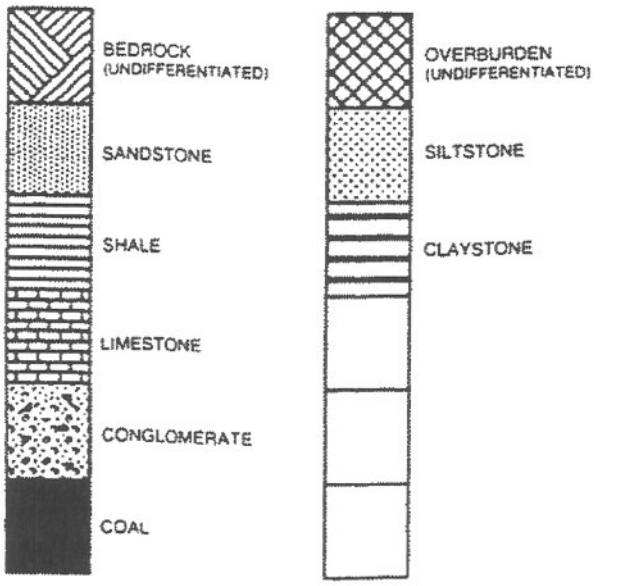
6. THERMISTOR DESCRIPTION

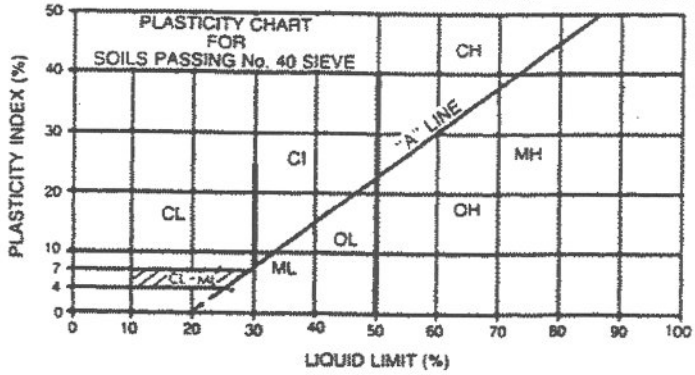
Thermistor string installed.
Dot indicates depth of each thermistor.

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	GRAPH SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 200 SIEVE)	GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN No 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW		WELL GRADED GRAVELS, LITTLE OR NO FINES.	$C_u = \frac{D_{60}}{D_{10}} > 4$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3	
			GP		POORLY GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES.	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY GRAVELS (WITH SOME FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES.	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES.		ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7
	SANDS MORE THAN HALF FINE GRAINS SMALLER THAN No 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.	$C_u = \frac{D_{60}}{D_{10}} > 6$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3	
			SP		POORLY GRADED SANDS, LITTLE OR NO FINES.	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY SANDS (WITH SOME FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES.	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES.		ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES 200 SIEVE)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 50\%$	ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY.	CLASSIFICATION IS BASED UPON PLASTICITY CHART (see below)	
		$W_L > 50\%$	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS.		
	CLAYS ABOVE "A" LINE ON PLASTICITY CHART NEGLIGIBLE ORGANIC CONTENT	$W_L < 30\%$	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS.		
		$30\% < W_L < 50\%$	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS.		
		$W_L > 50\%$	CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS.		
	ORGANIC SILTS & CLAYS BELOW "A" LINE ON CHART	$W_L < 50\%$	OL		ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY.	WHENEVER THE NATURE OF THE FINE CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "F." E.G. SF IS A MIXTURE OF SAND WITH SILT OR CLAY.	
		$W_L > 50\%$	OH		ORGANIC CLAYS OF HIGH PLASTICITY.		
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS.	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE.	

SPECIAL SYMBOLS





1. ALL SIEVE SIZES MENTIONED ON THIS CHART ARE U.S. STANDARD, A.S.T.M. E.11.
2. BOUNDARY CLASSIFICATIONS POSSESSING CHARACTERISTICS OF TWO GROUPS ARE GIVEN COMBINED GROUP SYMBOLS, E.G. GW-GC IS A WELL GRADED GRAVEL SAND MIXTURE WITH CLAY BINDER BETWEEN 5% AND 12%.

THURBER CONSULTANTS LTD.

Geotechnical Engineers

CALGARY EDMONTON VANCOUVER VICTORIA

CLIENT: GNWT/MUNICIPAL AND COMM. AFFAIRS	PROJECT: NEW SEWAGE LAGOON – CLYDE RIVER	TESTHOLE No. TP91-1
DRILL CO.: HAMLET OF CLYDE RIVER	LOCATION: SEE DRAWING NO. 1, APPENDIX A	Project No: 15-23-47
RIG/METHOD: FRONT END LOADER	DATE EXCAVATED: SEPTEMBER 16, 1991	ELEVATION 0.00 (m)

SAMPLE TYPE: SHELBY TUBE | SPT | NO RECOVERY | A-CASING | GRAB | CORE

DEPTH (m)	SAMPLE TYPE	SAMPLE/SPT(N)	▲Cpen (kPa)▲ 50 100 150 200 / ■SPT (N blows/300mm)■ 10 20 30 40 / PLASTIC M.C. LIQUID 10 20 30 40	REMARKS	USC	SOIL DESCRIPTION	DEPTH (m)
0.0						TUNDRA	0.0
					CH	CLAY(TILL) light grey, silty, some sand, trace to some gravel, trace organics	
				–too soft for front end loader, hand excavate below 0.6m	CH	–very soft below 0.6m	
					SM		
1.0						END OF TEST PIT AT 0.8m PERMAFROST AT 0.8m	1.0
2.0							2.0
3.0							3.0
4.0							4.0
5.0							5.0

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COMPLETION DEPTH 0.8 m | DATE DRILLED: 16/09/91

LOGGED BY RL | REVIEWED BY NH | Page 1 of 1

CLIENT: GNWT/MUNICIPAL AND COMM. AFFAIRS	PROJECT: NEW SEWAGE LAGOON – CLYDE RIVER	TESTHOLE No. TP91-2
DRILL CO.: HAMLET OF CLYDE RIVER	LOCATION: SEE DRAWING NO. 1, APPENDIX A	Project No: 15-23-47
RIG/METHOD: FRONT END LOADER	DATE EXCAVATED: SEPTEMBER 16, 1991	ELEVATION 0.00 (m)

SAMPLE TYPE: SHELBY TUBE | SPT | NO RECOVERY | A-CASING | GRAB | CORE

DEPTH (m)	SAMPLE TYPE	SAMPLE/SPT(N)	▲ Open (kPa) ▲ 50 100 150 200 ■ SPT (N blows/300mm) ■ 10 20 30 40 PLASTIC M.C. LIQUID 10 20 30 40	REMARKS	USC	SOIL DESCRIPTION	DEPTH (m)
0.0						TUNDRA	0.0
					SM	SAND, light grey, silty, some gravel, trace organics	
					CI	CLAY(TILL) light grey, silty, some fine sand, trace to some gravel, occasional boulders	
						–sandy, some gravel	
1.0					SM	END OF TEST PIT AT 1.0m PERMAFROST AT 1.0m	1.0
2.0							2.0
3.0							3.0
4.0							4.0
5.0							5.0

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COMPLETION DEPTH 1.0 m		DATE DRILLED: 16/09/91
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CLIENT: GNWT/MUNICIPAL AND COMM. AFFAIRS	PROJECT: NEW SEWAGE LAGOON – CLYDE RIVER	TESTHOLE No. TP91-3
DRILL CO.: HAMLET OF CLYDE RIVER	LOCATION: SEE DRAWING NO. 1, APPENDIX A	Project No: 15-23-47
RIG/METHOD: FRONT END LOADER	DATE EXCAVATED: SEPTEMBER 16, 1991	ELEVATION 0.00 (m)

SAMPLE TYPE: SHELBY TUBE | SPT | NO RECOVERY | A-CASING | GRAB | CORE

DEPTH (m)	SAMPLE TYPE	SAMPLE/SPT(N)	▲Cpen (kPa)▲ 50 100 150 200 / ■SPT (N blows/300mm)■ 10 20 30 40 / PLASTIC M.C. LIQUID 10 20 30 40	REMARKS	USC	SOIL DESCRIPTION	DEPTH (m)
0.0						TUNDRA	0.0
					CL-CI	CLAY(TILL) light grey, silty, sandy, trace gravel and organics.	
				–too soft for front end loader, hand excavate below 0.6m.	SM/CL	–very silty and sandy, some gravel	
1.0							1.0
						END OF TEST PIT AT 1.1m PERMAFROST AT 1.1m WATER LEVEL AT 0.7m	
2.0							2.0
3.0							3.0
4.0							4.0
5.0							5.0

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COMPLETION DEPTH 1.1 m		DATE DRILLED: 16/09/91
LOGGED BY RL	REVIEWED BY NH	Page 1 of 1

CLIENT: GNWT/MUNICIPAL AND COMM. AFFAIRS	PROJECT: NEW SEWAGE LAGOON – CLYDE RIVER	TESTHOLE No. TP91–4
DRILL CO.: HAMLET OF CLYDE RIVER	LOCATION: SEE DRAWING NO. 1, APPENDIX A	Project No: 15–23–47
RIG/METHOD: FRONT END LOADER	DATE EXCAVATED: SEPTEMBER 16, 1991	ELEVATION 0.00 (m)

SAMPLE TYPE: SHELBY TUBE | SPT | NO RECOVERY | A–CASING | GRAB | CORE

DEPTH (m)	SAMPLE TYPE	SAMPLE/SPT(N)	▲Cpen (kPa)▲ 50 100 150 200 / ■SPT (N blows/300mm)■ 10 20 30 40 / PLASTIC M.C. LIQUID 10 20 30 40	REMARKS	USC	SOIL DESCRIPTION	DEPTH (m)
0.0						TUNDRA	0.0
						SAND light grey, trace clay, gravel and silt	
					SM		
1.0					SM	END OF TEST PIT AT 1.0m PERMAFROST AT 1.0m	1.0
2.0							2.0
3.0							3.0
4.0							4.0
5.0							5.0

Thurber Engineering Ltd.
Yellowknife, N.W.T.

COMPLETION DEPTH 1.0 m		DATE DRILLED: 16/09/91
LOGGED BY RL	REVIEWED BY NH	Page 1 of 1