GRAVEL BORROW SEARCH
SNARE HYDRO, NT

Project No. 0701-99-14092

November, 1999

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SNARE HYDRO, NT

Prepared by:

EBA ENGINEERING CONSULTANTS LTD.
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Submitted To:

NORTHWEST TERRITORIES POWER CORPORATION
HAY RIVER, NT

Project No. 0701-99-14092

November, 1999

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1.0 INTRODUCTION

1.1 General

This report present the results of a site investigation conducted by EBA Engineering Consultants Ltd. (EBA) at the Snare Hydro Facility along the Snare Riverand near Strutt Lake, N.W.T. The purpose of the investigation was to evaluate the surficial soil conditions and identify potential sources of gravel.

Authorization to proceed with the project was given by Northwest Territories Power Corporation (NWTPC) Service Agreement 105062.

1.2 Project Details

The Snare Hydro Facility comprises dams and power generating stations located along the Snare River approximately 150 km from Yellowknife. The facility is serviced by all-weather road, approximately 40 km in length. A source of gravel is desired to upgrade/resurface the road.

There is an existing gravel pit on the east side of Strutt Lake. However, it is only accessible by winter road. It is also located near the southern end of the all-weather road system. It is EBA's understanding that a gravel source located further north and along the all-weather road would be preferable.

An air photo terrain analysis was previously completed by EBA in which potential sources of granular material (sand or gravel) were identified. This analysis formed the basis of the field investigation. EBA's terrain analysis has been reproduced on 1:50,000 topographic maps and has been included in Appendix D for reference. EBA's written report has also been included in Appendix D.

At the time of report preparation EBA was not aware of a required gradation specification for the gravel. EBA's prior experience has indicated that a gravel content in the order of 50 percent is desirable for road surfacing.

1.3 Scope of Work

EBA's understanding of the scope of work was outlined in a facsimile sent to NWTPC on October 6, 1999. It is summarized as follows:

- Complete a visual reconnaissance of several sites, identified in EBA's terrain analysis. NWTPC will determine the sites to be investigated;
- Excavate test pits by hand at the requested sites;
- Complete laboratory testing on recovered samples if potentially suitable gravel is encountered; and
- Prepare a report that documents the results of the investigation and provides estimates for gravel quantities.

2.0 METHODOLOGY

2.1 Site Investigation

A total of 10 sites were identified by NWTPC for investigation. The site locations are summarized below. These sites have also been indicated on the terrain analysis maps in Appendix D.

Area	Northing	Easting
1	7 038 700	545 500
2	7 039 200	547 000
3	7 021 400	532 500
4	7 032 200	542 000
5	7 033 600	543 000
6	7 035 000	545 500
7	7 036 000	544 000
8	7 021 100	534 700
9	7 020 500	535 000
10	7 038 000	547 800

The sites were investigated on October 7, 8 and 9, 1999 by Mr. Gary Koop, M.I.T., of EBA and Mr. Sandy Kunst of NWTPC. Due to time constraints, Areas 2, 8, 9 and 10 could not be investigated. Selected site photographs are included in Appendix C.

A total of 32 test pits were excavated by hand in 6 areas. Test pit locations are indicated on Figures 1 through 6. A test pit summary is presented in Table 1. Samples were collected from the test pits and returned to EBA's Yellowknife laboratory for further examination and testing.

2.2 Laboratory Testing

Grain size analyses and moisture contents were completed on selected. Laboratory test results are included in Appendix B.

For reference, grain size test results have been compared against a typical GNWT road surfacing specification (C-1).

3.0 SURFACE TOPOGRAPHY AND SOIL CONDITIONS

3.1 Area 1

Area 1 is located near the north end of the all-weather road. It is depicted on Figure 1. The area is approximately 700 m long and runs in a northwest-southeast direction. Most of the area is located south of the service road with a small portion falling along the north side.

The ground surface slopes down to the southeast for approximately 250 m. The remaining portion of the site, from approximately Test Pit 4 to Test Pit 6 comprises an elevated ridge or hill, peaking towards its center.

Vegetation generally comprises pine trees and scattered birch trees. Outcropping bedrock was observed on the southeastern portion of the area, as indicated in Figure 1. A north-south trail providing access to the power lines extends from the road for approximately 250 m. A stockpile of sandy material was observed at the end of this trail. Areas of sparse vegetation were observed in the vicinity of Test Pits 6 and 7.

A total of 7 test pits were excavated in Area 1. Test Pit 3 was inadvertently dug outside the area perimeter. Test pit observations and subsequent lab testing indicated that the surface soil generally comprised sand with varying quantities of gravel. Test Pit 1 contained the largest proportion of gravel. Sieve results indicate 73 percent sand and 26 percent gravel.

3.2 Area 3

Area 3 is located along the winter road, approximately 700 m southwest from the end of the all-weather road. It's location is indicated on Figure 2.

A large portion of the area comprises outcropping bedrock, as indicated in Figure 2. Generally the area is on a topographic high, however elevation variations within the area do exist.

Local "low" areas are typically located between bedrock outcrops. Vegetation in these areas is dense and comprises spruce and infrequent birch trees. Short trees and brush are also frequent. Local "high" areas generally correspond to bedrock outcrops. Pine trees were observed in these areas.

A total of 5 test pits were excavated in Area 3. Observations indicated the surficial soil to comprise fine grained sand and silt. No gravel source was identified.

3.3 Area 4

Area 4 comprises two areas, designated Area 4A and Area 4B. They are located approximately 1200 m south of the existing air strip as indicated on Figure 3.

3.3.1 Area 4A

Area 4A is bordered on its east side by an open sand pit. Material in the pit generally comprises fine grained sand with trace amounts of gravel. A slight increase in gravel content was observed in the region immediately adjacent to Area 4A.

Area 4A runs from the south extent of the sand pit and curves around a bedrock outcrop as indicated in Figure 3. The land slopes down to the north from approximately Test Pit 11 to Test Pit 13. Beyond Test Pit 13 the land is relatively flat. Vegetation within Area 4A comprises spruce and birch trees.

A total of 3 test pits were excavated in this Area. Gravel and sand was encountered in Borehole 11 near the ground surface. The sand and gravel layer was 0.2 m thick

and underlain by sand with some gravel. No other gravel was encountered in Area 4A.

3.3.2 Area 4B

Area 4B is approximately 250 m long and is bordered to the west by bedrock outcrops and to the east by a low, marshy area. It is approximately 50 m wide. Vegetation in area 4B generally comprises birch and pine trees.

Three test pits were excavated in this area. Surface soil conditions generally comprised sand with trace amounts of gravel.

3.4 Area 5

Area 5 consists of three areas located approximately 1100 m east of the existing air strip. The areas have been designated Area 5A, 5B and 5C and are presented in Figure 4. Area 5 is accessible by a service road branching off the main all-weather road.

3.4.1 Area 5A

Area 5A is located approximately 500 m from the service road. It comprises an elevated ridge or hill, peaking near the center of the area. Vegetation generally consists of birch and pine trees. Outcropping bedrock in the area is infrequent.

A total of 4 test pits were excavated in Area 5A. A gravelly sand was encountered in Test Pit 16 under 0.3 m of sand. The gravelly sand extended to the termination depth of the test pit. 75 mm minus gravel was also encountered in the upper 0.3 m of Test Pit 17. This was underlain by sand with trace gravel. Gravel was not encountered in the other two test pits dug in Area 5A.

3.4.2 Area 5B

Area 5B is located east and adjacent of the service road. Area 5B comprises a topographic high, peaking towards the center of the area. Bedrock outcrops were observed on the east side of the area, as indicated on Figure 4. Scattered boulders were observed near the road, north of Test Pit 23.

Vegetation generally consists of pine and birch trees. A grove of birch trees was observed on a plateau in the vicinity of Test Pit 25.

Three test pits were excavated in Area 5B Sand and gravel was encountered in Test Pit 24. Gravel was not encountered in the other two test pits.

3.4.3 Area 5C

Area 5C is located west of the service road, approximately 100 m south of the beaver dam. It is bordered to the south by bedrock outcrops and to the north by what appears to be a low-lying area.

Vegetation consists primarily of spruce trees and scattered birch trees in some areas. Several bedrock outcrops were observed within Area 5C.

Four test pits were dug in this area. All test pits indicated the surface soil to comprise sand with trace to some gravel.

3.5 Area 6

Area 6 is located approximately 1200 m southeast of the all-weather road. It is bordered to the west by a low-lying swampy area.

Surface conditions within Area 6 were varied. Outcropping bedrock was observed towards the center of the area, as indicated in Figure 5. West of the bedrock outcrops, in the vicinity of Test Pits 26 and 27, the ground surface was hummocky. Test pits indicated surface soil to comprise peat underlain by silt and clay. Vegetation in the area generally consisted of spruce trees.

The area east of the bedrock outcrop generally comprised sand. Vegetation consisted of pine trees. Open, unvegetated areas of sand were also observed in this portion of Area 6. No gravel was observed in this area.

3.6 Area 7

Area 7 comprises four areas located north and south of the all-weather road. The four sub-areas have been identified in Figure 6.

3.6.1 Area 7A

Area 7A is located south of the all-weather road. It comprises a local topographic high, peaking towards the center of the area. Vegetation comprises a mix of spruce, pine and birch trees. Scattered boulders were also observed.

A shallow test pit indicated silty sand with a trace of gravel.

3.6.2 Area 7B

Area 7B is located north of the all-weather road. A visual inspection of the area indicated the soil to generally comprise sand. Vegetation consisted of short willow-type trees and birch.

3.6.3 Area 7C

Area 7C, located northwest of Area 7B consisted largely of outcropping bedrock. Test pits were not excavated in this area.

3.6.4 Area 7D

Area 7D, located at the end of area 7B, is located on a local topographic high, south of a small lake. Bedrock outcrops were observed over a large portion of the site. Vegetation and surficial soil conditions were similar to those encountered in Area 7A, i.e. silty sand with a trace of gravel.

4.0 GRAVEL SOURCES & VOLUME ESTIMATES

Generally, EBA's field investigation did not indicate large quantities of gravel. Surface soil conditions typically comprised sand with a trace of gravel to gravelly sand. Assuming a surfacing gravel specification, as discussed in the Project Details (Section 1.2) and Laboratory Testing (Section 2.2), the majority of soils encountered would be unsuitable for use as road surfacing material.

Three small areas of gravel were observed during the investigation. Gravel was encountered in Test Pit 11 of Area 4A. The gravel was contained in seam, 0.2 m thick and was located 0.2 m below the ground surface. Sieve analysis indicated 45 percent gravel, 53 percent sand and 2 percent fines. Gravel was not encountered at Test Pit 13, the next closest test pit. Assuming an area of 7500 m^2 and an average thickness of 0.1 m, the volume of gravel in Area 4A is estimated to be in the order of 750 m^3.

A second source of gravel was identified in Test Pit 17 of Area 5A. Sieve analysis of the upper 0.3 m of the test pit indicated 55 percent gravel, 41 percent sand and 4 percent fines. A large portion of the gravel (31 percent) was larger than 20 mm in size. Sieve analysis of soil below 0.3 m indicated a gradation unsuitable for surfacing aggregate (15 percent gravel, 78 percent sand and 7 percent fines). Based on an assumed thickness of 0.3 m and area of 3750 m^2 the volume of gravel in this region is estimated to be in the order of 1125 m^3. Because a large portion of the gravel is greater than 20 mm, crushing would be required to bring the gravel closer to specified gradation limits.

A third source of gravel was identified in Test Pit 24 of Area 5B. Sieve analysis indicated 41 percent gravel, 49 percent sand and 10 percent fines. Assuming an area of 2500 m^2 and an average thickness 0f 0.4 m, the volume of gravel in this area is estimated to be in the order of 1000 m^3. Sieve results from Test Pit 24 indicate 15 percent of the material being greater than 20 mm in size. Crushing would therefore be required to bring the material closer to specified gradation limits.

In all three cases, the presently identified extent and thickness of the deposits are limited. Therefore extraction with heavy equipment is not expected to be practical.

5.0 LIMITATIONS

This report presents the findings in 32 test pits at discrete locations in 12 different areas. Volume estimates are considered to be in the order of ±50 percent, due to the limited number of test pits at each location and the shallow depths of the pits. Additional test pits would be required to delineate gravel boundaries and refine quantity estimates.

This report has been prepared for the exclusive use of the Northwest Territories Power Corporation, and their agents, for specific application to the development described in Section 1 of this report. It has been prepared in accordance with generally accepted soil engineering practices. No other warranty is made, either expressed or implied.

Reference should be made to the General Conditions attached in Appendix A of this report for further limitations.

6.0 CLOSURE

We trust that this report satisfies you present requirements. If you require any additional information or monitoring services, please contact our Yellowknife office.

Respectfully submitted,

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TABLES

TERMS USED ON BOREHOLE LOGS

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on 0.075mm sieve): includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as inferred from laboratory or in situ tests.

DESCRIPTIVE TERM	RELATIVE DENSITY	N (blows per 0.3m)
Very Loose	0 to 20%	0 to 4
Loose	20 to 40%	4 to 10
Compact	40 to 75%	10 to 30
Dense	75 to 90%	30 to 50
Very Dense	90 to 100%	greater than 50

The number of blows, N, on a 51mm O.D. split spoon sampler of a 63.5kg weight falling 0.76m, required to drive the sampler a distance of 0.3m from 0.15m to 0.45m.

FINE GRAINED SOILS (major portion passing 0.075mm sieve): includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as estimated from laboratory or in situ tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH (kPa)
Very Soft	Less Than 25
Soft	25 to 50
Firm	50 to 100
Stiff	100 to 200
Very Stiff	200 to 400
Hard	Greater Than 400

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil.

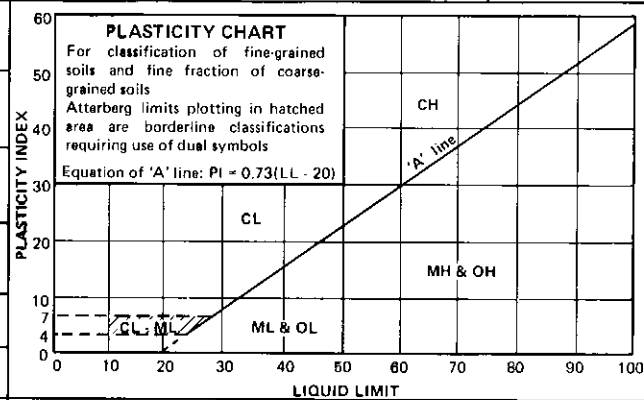
GENERAL DESCRIPTIVE TERMS

Slickensided	- having inclined planes of weakness that are slick and glossy in appearance.
Fissured	- containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated	- composed of thin layers of varying colour and texture.
Interbedded	- composed of alternate layers of different soil types.
Calcareous	- containing appreciable quantities of calcium carbonate.
Well Graded	- having wide range in grain sizes and substantial amounts of intermediate particle sizes.
Poorly graded	- predominantly of one grain size, or having a range of sizes with some intermediate size missing.

UNIFIED SOIL CLASSIFICATION†

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES	CLASSIFICATION CRITERIA	
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	$C_u = D_{60}/D_{10}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			GP	Poorly-graded gravels and gravel-sand mixtures, little or no fines	Not meeting both criteria for GW	
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits plot below 'A' line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand clay mixtures	Atterberg limits plot above 'A' line and plasticity index greater than 7	
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines	$C_u = D_{60}/D_{10}$ Greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			SP	Poorly-graded sands and gravelly sands, little or no fines	Not meeting both criteria for SW	
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures	Atterberg limits plot below 'A' line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures	Atterberg limits plot above 'A' line and plasticity index greater than 7	
FINE-GRAINED SOILS 50% or more passes No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			OL	Organic silts and organic silty clays of low plasticity		
	SILTS AND CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts		
			CH	Inorganic clay of high plasticity, fat clays		
			OH	Organic clays of medium to high plasticity		
HIGHLY ORGANIC SOILS			PT	Peat, muck and other highly organic soils		

Classification on basis of percentage of fines
Less than 5% pass No. 200 sieve: GW, GP, SW, SP
More than 12% pass No. 200 sieve: GM, GC, SM, SC
5% to 12% pass No. 200 sieve: Borderline classification requiring use of dual symbols



*Based on the material passing the 3 in. (75 mm) sieve
†ASTM Designation D 2487, for identification procedure see D 2488

GROUND ICE DESCRIPTION

ICE NOT VISIBLE

GROUP SYMBOLS	SYMBOLS	SUBGROUP DESCRIPTION	
N	Nf	Poorly-bonded or friable	
	Nbn	No excess ice, well-bonded	
	Nbe	Excess ice, well-bonded	

VISIBLE ICE LESS THAN 50% BY VOLUME

GROUP SYMBOLS	SYMBOLS	SUBGROUP DESCRIPTION	
V	Vx	Individual ice crystals or inclusions	
	Vc	Ice coatings on particles	
	Vr	Random or irregularly oriented ice formations	
	Vs	Stratified or distinctly oriented ice formations	

VISIBLE ICE GREATER THAN 50% BY VOLUME

ICE	ICE + Soil Type	Ice with soil inclusions	
	ICE	Ice without soil inclusions (greater than 25 mm (1 in.) thick)	

NOTE:
1. *Dual symbols are used to indicate borderline or mixed ice classifications*
2. *Visual estimates of ice contents indicated on borehole logs ± 5%*
3. *This system of ground ice description has been modified from NRC Technical Memo 79, Guide to the Field Description of Permafrost for Engineering Purposes*

LEGEND
Soil ☐ Ice ■

Test Pit	Area	Depth (m)	Stratigraphy	Comments
1	1	0.0 – 0.4 0.4 – 0.8 0.8 – 1.0 1.0	SAND – trace gravel, med. grained, brown SAND – some gravelly, 40m minus brown/red SAND – some silt, fine grained, grey End of Hole	- 1 sample collected
2	1	0.0 – 0.3 0.3 – 0.6 @0.6 0.6	SAND – trace gravel, grey, roots in top 0.2 m SAND - some gravel, 16 mm minus SAND – fine to med. grained, light brown, End of Hole	- 2 samples collected
3	1	0.0 – 0.5 @0.5 0.65	SAND – silty, fine grained - becoming plastic End of Hole	- TP3 outside Area 1 boundary - in low area; hummocky
4	1	0.0 – 0.4 0.4 – 0.5 0.5	SAND – trace gravel (10 mm minus), fine to med. grained, red/brown SILT – some sand, grey End of Hole	- 1 sample collected
5	1	0.0 – 0.2 0.2 – 0.7 0.7	SAND – trace silt, fine grained, roots & trace cobbles in top 75 mm SAND – trace gravel (5mm minun) End of Hole	
6	1	0.0 – 0.5 0.5 – 0.8 @0.8 0.8	SAND – trace cobbles, orange SAND – trace fine gravel, grey/brown - decreasing gravel End of Hole	- test pit in open area - on a crest, scattered boulders at surface - 1 sample collected
7	1	0.0 – 0.4 @0.4 0.9	SAND – gravelly, sand med. to coarse grained - decreasing gravel End of Hole	- test pit at edge of open area - located on a ridge - 2 samples collected
8	3	0.0 – 0.3 0.3	SAND – silty End of Hole – refusal on boulders & cobbles	- 2 holes dug in area; first hole abandoned due to boulders at surface - scattered boulders at surface
8A	3	0.0 – 0.2 0.2 – 0.4 0.4	SAND – trace to some gravel, red SAND – grey End of Hole	- surficial hole dug while walking
9	3	0.0 – 0.3 0.3 – 0.6 0.6	PEAT CLAY – silty End of Hole – bottom of hole wet at completion	- test pit wet at bottom
10	3	0.0 – 0.2 0.2 – 0.5 0.5	PEAT – numerous roots SILT – some clay End of Hole	- ground surface hummocky - willows, birch & spruce

11	4A	0.0 – 0.2 0.2 – 0.4 0.4 – 0.8 0.8	PEAT – fibrous with moss & roots SAND and GRAVEL – trace fines SAND – some gravel, trace fines, increasing gravel with depth End of Hole – refusal on possible bedrock	- 2 samples collected
12	4A	0.0 – 0.1 0.1 – 0.8 0.8	PEAT SAND – fine grained, clean End of Hole	- 1 sample collected
13	4A	0.0 – 0.3 @0.3 0.3	SAND – some gravel, trace fines, red SAND – fine grained End of Hole	- 1 sample collected
14	4B	0.0 – 0.2 0.2 – 0.6 0.6	PEAT SAND – fine to med. grained, trace fine gravel in top 0.1 m End of Hole	
14A	4B		similar to TP14, cobbles in upper 0.2 m below peat	
15	4B	0.0 – 0.2 0.2 – 0.7 0.7	PEAT SAND – trace gravel, sand fine grained End of Hole	- 1 sample collected
16	5A	0.0 – 0.1 0.1 – 0.3 0.3 – 0.9 0.9	SAND – organic, black SAND – med. grained, red/brown, clean SAND – gravelly, trace fines sand med. to coarse grained End of Hole	- test pit on elevated ridge - 2 samples collected
17	5A	0.0 – 0.3 0.0 – 0.8 0.8	GRAVEL and SAND – 75 mm minus SAND – some gravel, 40 mm minus End of Hole	- on crest of slope - 2 samples collected
18	5A	0.0 – 0.1 0.1 – 0.2 0.2 – 0.3 0.3	PEAT SAND – brown/red SAND – trace silt, sand fine grained End of Hole	
19	5A	0.0 – 0.1 0.1 – 0.3 0.3	PEAT SAND – trace gravel End of Hole	- 1 sample collected
20	5C	0.0 – 0.1 0.1 – 0.4 0.4 – 0.6 0.6	PEAT SAND – trace fine gravel, sand fin grained, red/brown SAND – trace fine gravel, sand med. grained, grey/brown End of Hole	- 1 sample collected

21	5C	0.0 – 0.1 0.1 – 0.4 0.4	PEAT SAND – fine grained, grey/brown End of Hole	
21A	5C	0.0 – 0.2 0.2	SAND – trace to some gravel End of Hole	- probe hole dug while walking - trees less dense than TP19 & TP20 - predominantly birch trees - 20 m from bedrock outcrop
22	5C	0.0 – 0.1 0.1 – 0.4 0.4	PEAT SAND – fine grained, clean End of Hole	- spruce & scattered birch
23	5B	0.0 – 0.1 0.1 – 0.3 0.3	PEAT SAND – fine grained, tan End of Hole	
24	5B	0.0 – 0.1 0.1 – 0.4 0.4	PEAT SAND and GRAVEL – some fines, 40 mm minus End of Hole	- lightly wooded area; boulders & bedrock visible in area - 1 sample collected
25	5B	0.0 – 0.1 0.1 – 0.3 0.3	PEAT – roots SAND – fine grained, red/brown End of Hole	- test pit in grove of birch trees
26	6	0.0 – 0.1 0.1 – 0.2 0.3	PEAT SILT – sandy End of Hole	- probe hole excavated while walking
27	6	0.0 – 0.2 0.2 – 0.3 0.3	PEAT CLAY – silty End of Hole	- probe hole excavated while walking
28	6	0.0. – 0.2 0.2	SAND End of Hole	- probe hole excavated while walking
29	7A	0.0 – 0.2	SAND – siltys, trace gravel	- 1 sample collected

FIGURES

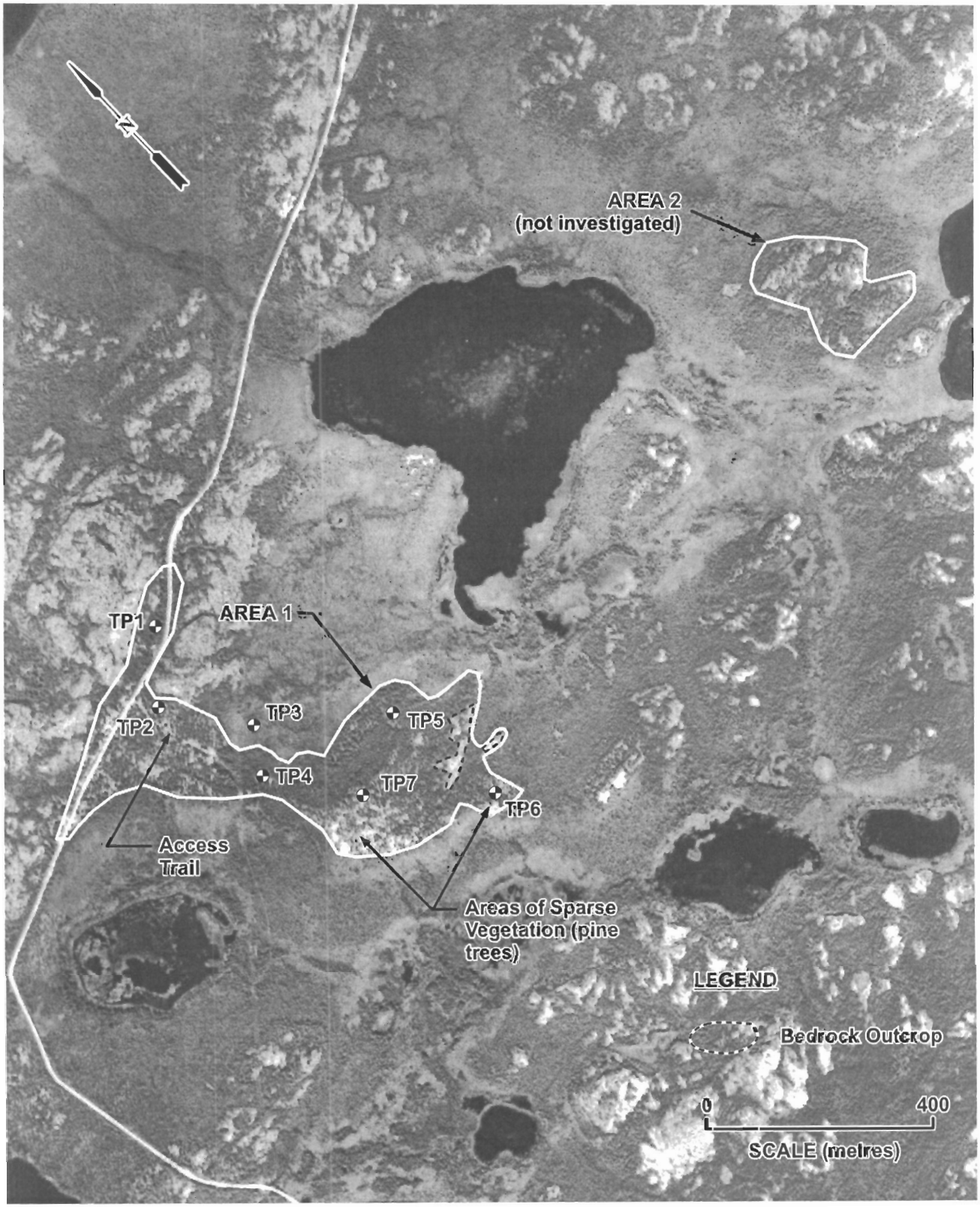


Figure based on Air Photo G9907033-4-295

Figure 1
Test Pit Locations - Area 1
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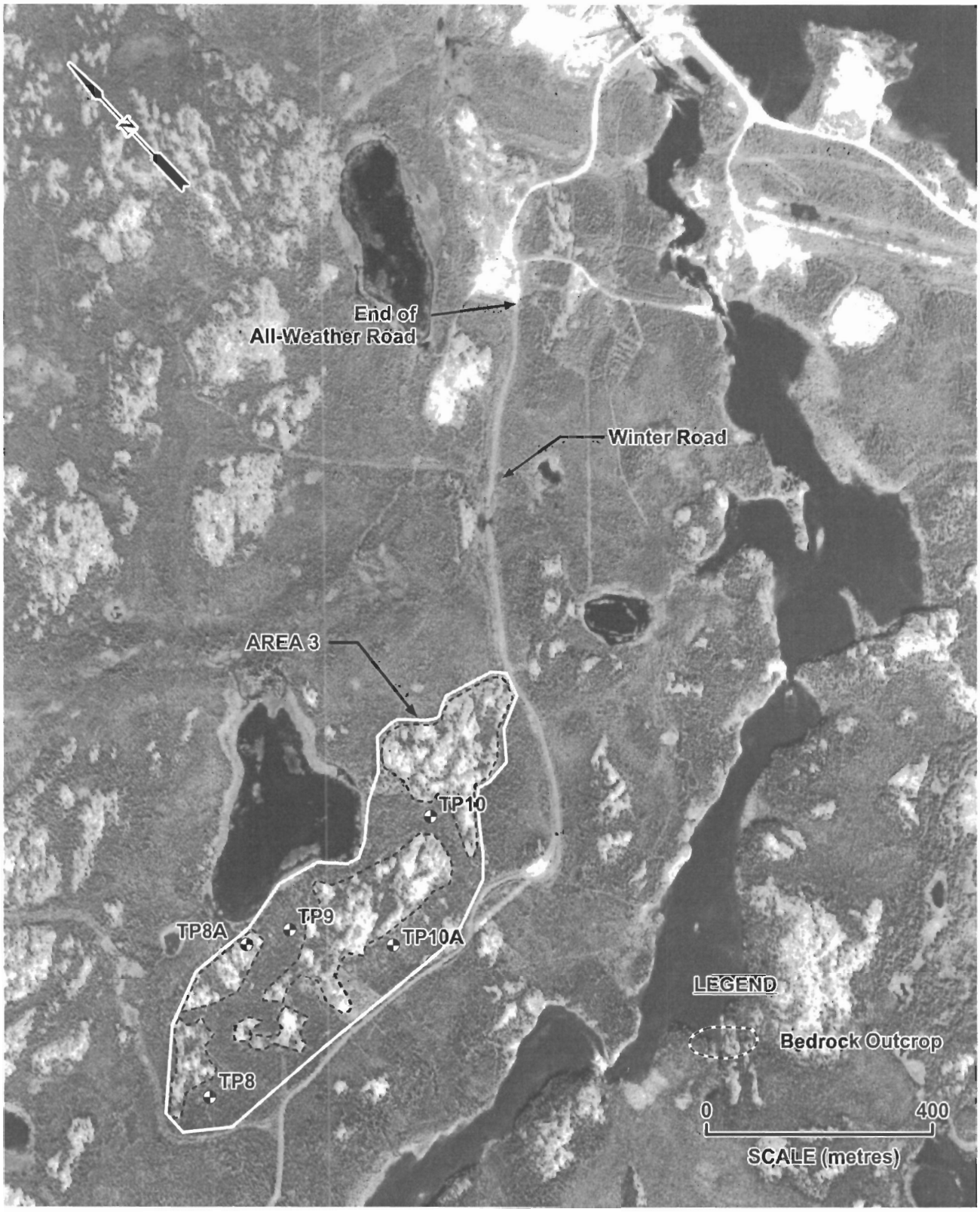

Figure based on Air Photo G9907033-5-318

Figure 2
Test Pit Locations - Area 3
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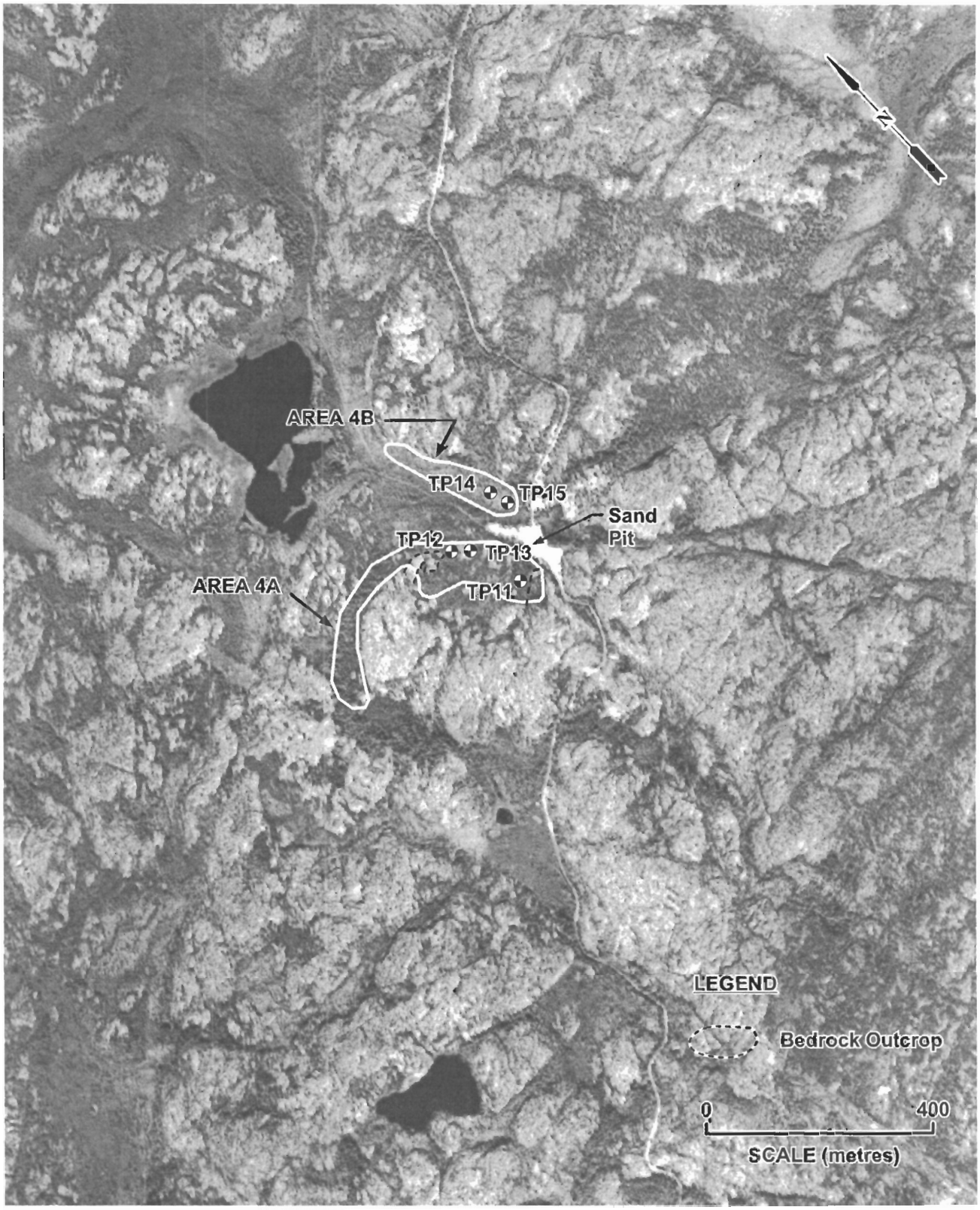

Figure based on Air Photo G9907033-4-291

Figure 3
Test Pit Locations - Area 4
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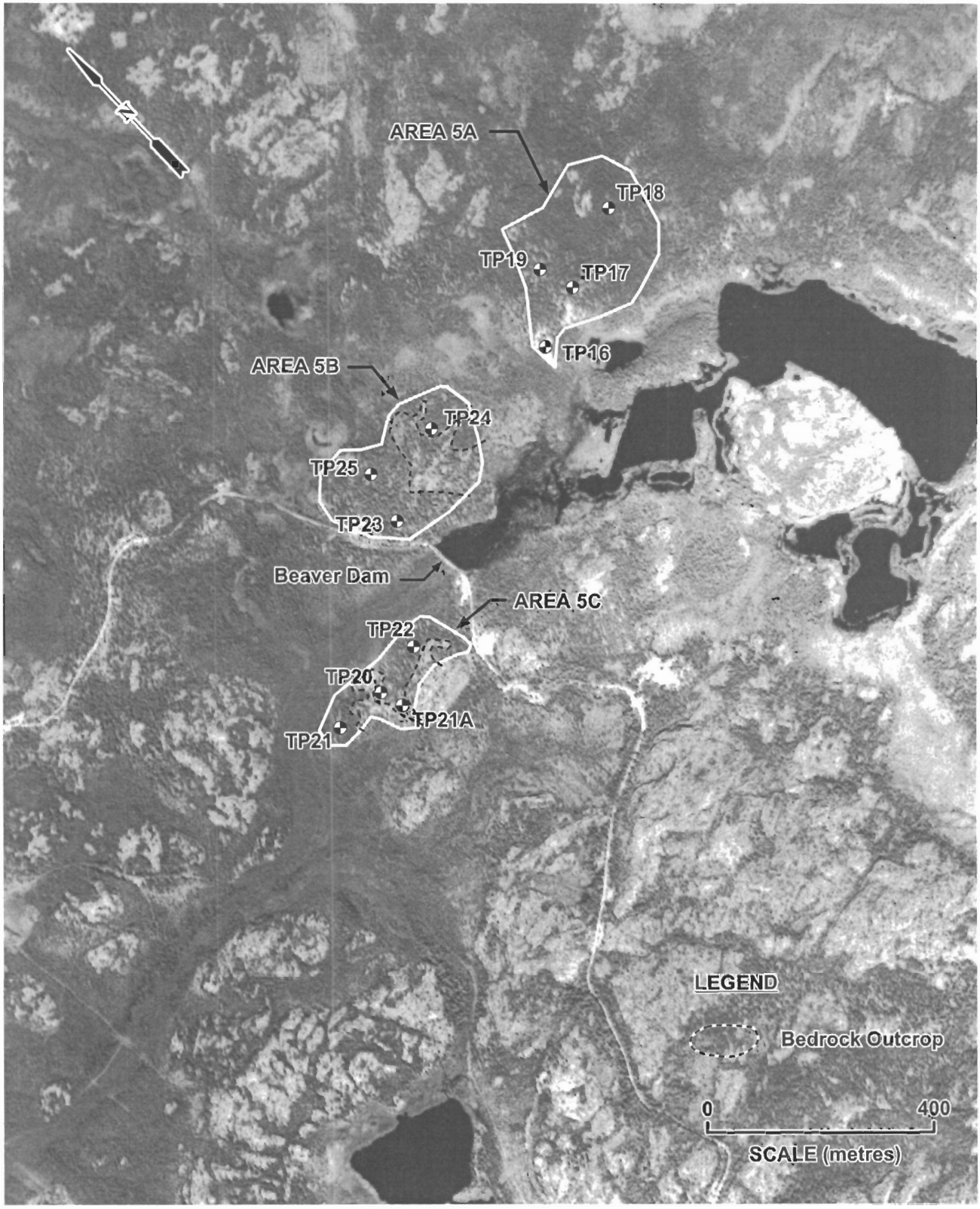


Figure based on Air Photo G9907033-4-291

Figure 4
Test Pit Locations - Area 5
14092g04a.cdr

Figure based on Air Photo G9907033-4-293

Figure 5
Test Pit Locations - Area 6
14092g05a.cdr

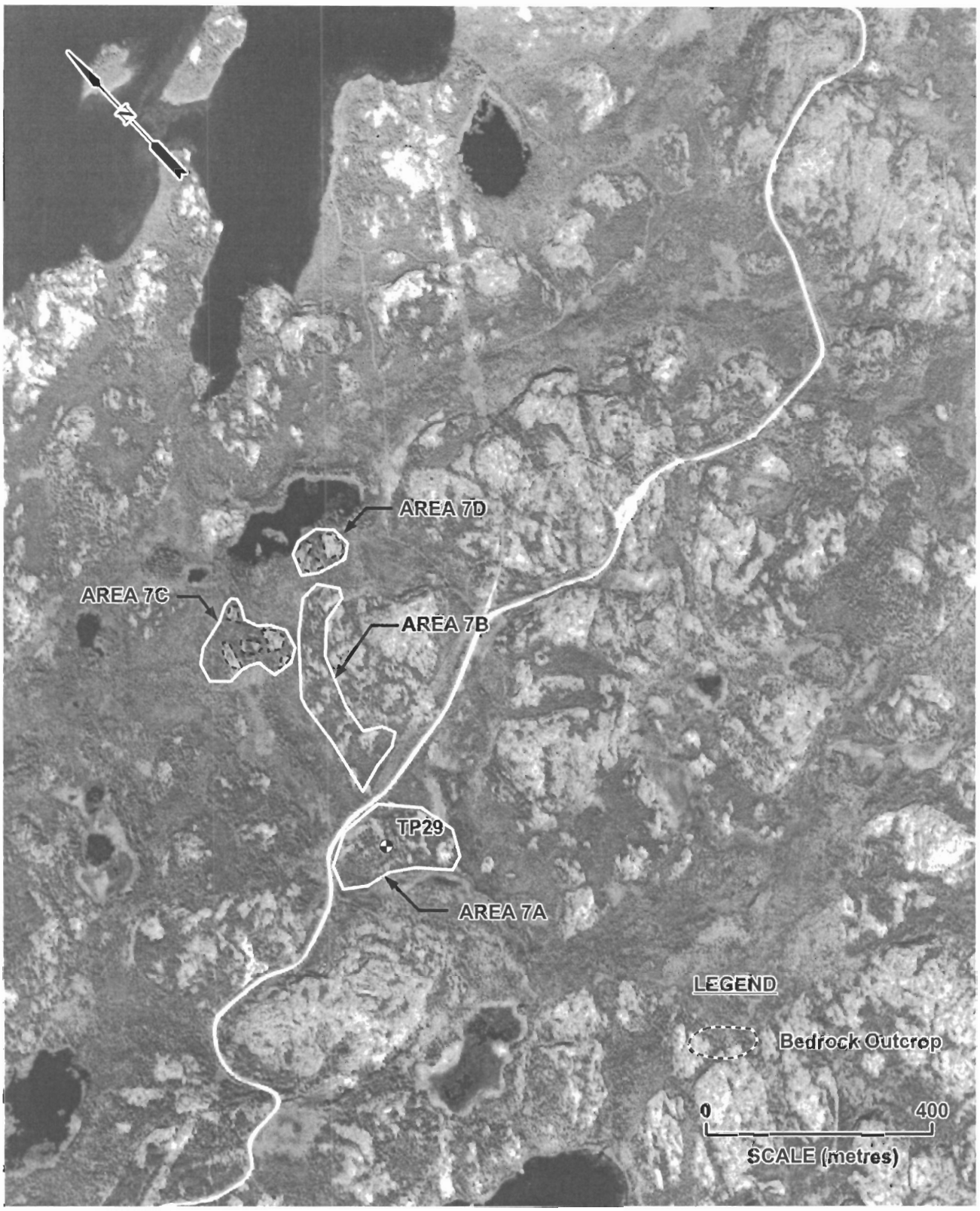


Figure based on Air Photo G9907033-4-293

Figure 6
Test Pit Locations - Area 7
14092g06a.cdr

APPENDIX A
General Terms and Conditions

This report incorporates and is subject to these "General Conditions".

A.1 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA's client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

A.2 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

A.3 LOGS OF TEST HOLES

The test hole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

A.4 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

A.5 SURFACE WATER AND GROUNDWATER CONDITIONS

Surface and groundwater conditions mentioned in this report are those observed at the times recorded in the report. These conditions vary with geological detail between observation sites; annual, seasonal and special meteorologic conditions; and with development activity. Interpretation of water conditions from observations and records is judgmental and constitutes an evaluation of circumstances as influenced by geology, meteorology and development activity. Deviations from these observations may occur during the course of development activities.

A.6 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

A.7 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

A.8 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

A.9 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

A.10 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

A.11 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

A.12 SAMPLES

EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the client's expense upon written request, otherwise samples will be discarded.

A.13 STANDARD OF CARE

Services performed by EBA for this report have been conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practising under similar conditions in the jurisdiction in which the services are provided. Engineering judgement has been applied in developing the conclusions and/or recommendations provided in this report. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of this report.

A.14 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

A.15 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by EBA shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancies, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by EBA shall be deemed to be the overall original for the Project.

The Client agrees that both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. The Client warrants that EBA's instruments of professional service will be used only and exactly as submitted by EBA.

The Client recognizes and agrees that electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

APPENDIX B
Laboratory Test Results

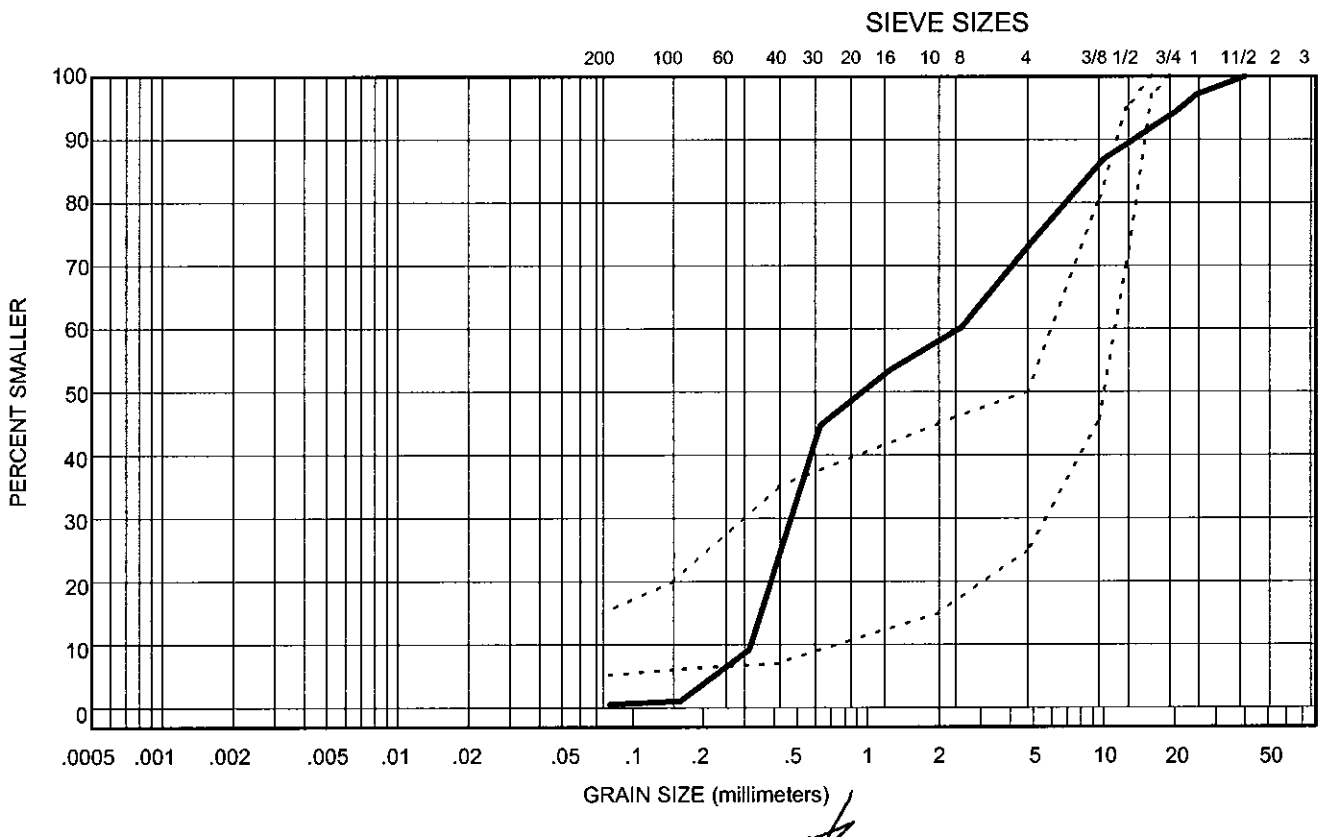
EBA Engineering Consultants Ltd.

GRAIN SIZE DISTRIBUTION

Project: Gravel Borrow Search
Snare Hydro, N.W.T.
Project Number: 0701-99-14092
Date Tested: October 31, 1999
Borehole Number: Area 1, TP 01
Depth: 0.4 - 0.75 m
Soil Description: SAND - gravelly, trace fines
Cu: 7.7
Cc: 0.3
Natural Moisture Content: 2.8%
Remarks: Sample by EBA on October 7, 1999
Spec band as per GNWT C1 Surfacing Aggregate Specification

SIEVE	PERCENTAGE PASSING
40	100
25	98
20	94
16	92
12.5	89
10	87
5	74
2.5	60
1.25	53
0.63	45
0.315	9
0.16	1
0.08	1

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



Reviewed By: _____ P.Eng.

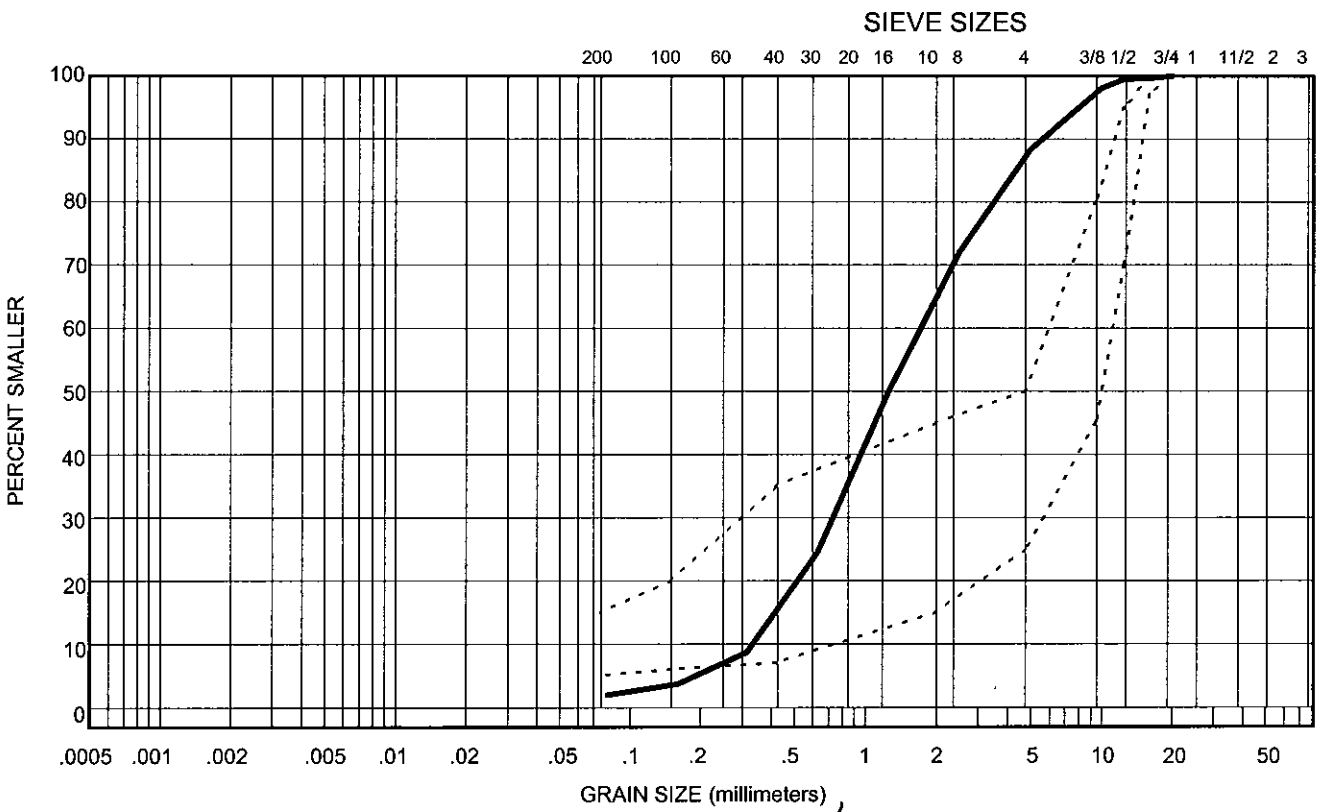
EBA Engineering Consultants Ltd.

GRAIN SIZE DISTRIBUTION

Project: Gravel Borrow Search
Snare Hydro, N.W.T.
Project Number: 0701-99-14092
Date Tested: October 31, 1999
Borehole Number: Area 1, TP 02
Depth: 0.3 - 0.6 m
Soil Description: SAND - some gravel, trace fines
Cu: 5.2
Cc: 0.9
Natural Moisture Content: 6.1%
Remarks: Sample by EBA on October 7, 1999
Spec band as per GNWT C1 Surfacing Aggregate Specification

SIEVE	PERCENTAGE PASSING
40	
25	
20	100
16	100
12.5	99
10	98
5	88
2.5	72
1.25	50
0.63	25
0.315	9
0.16	4
0.08	2

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



Reviewed By: _____ P.Eng.

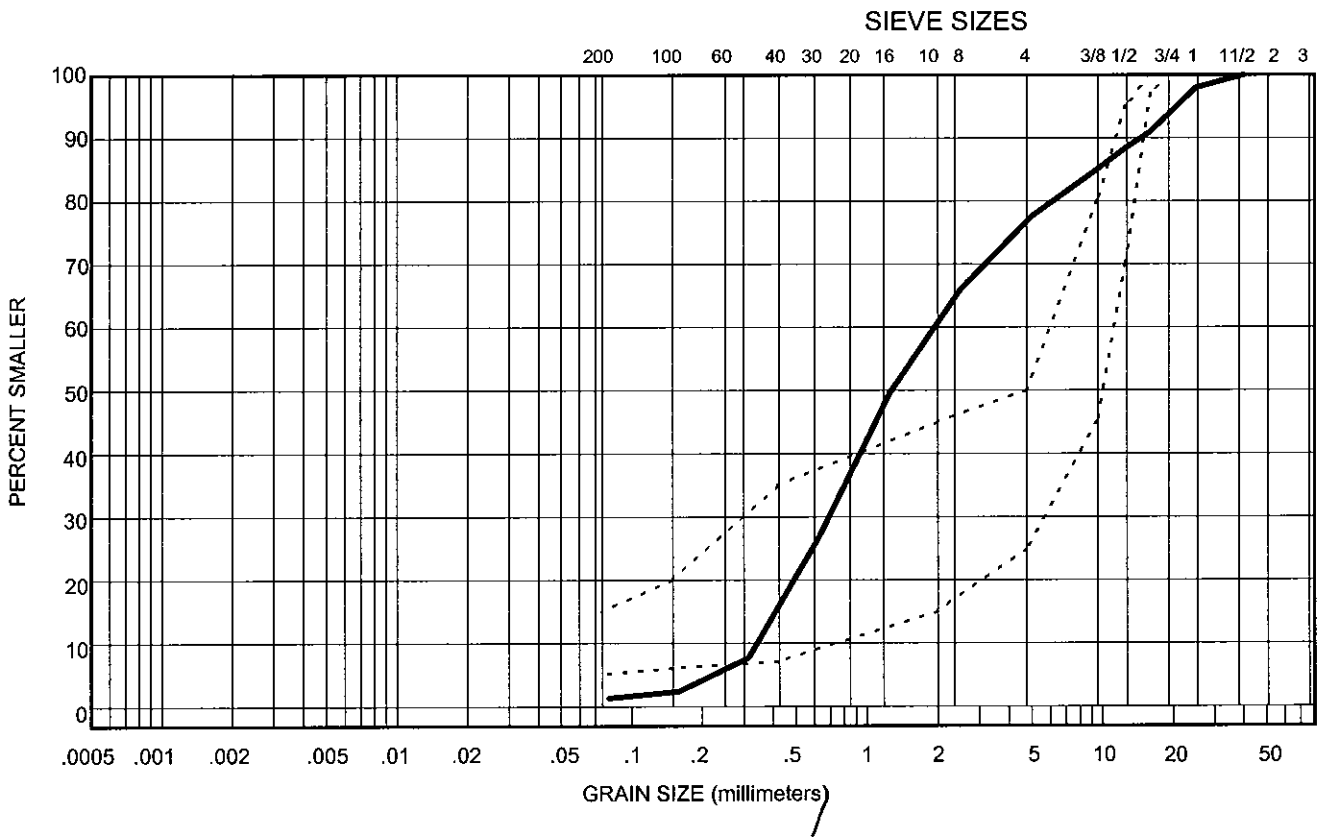
EBA Engineering Consultants Ltd.

GRAIN SIZE DISTRIBUTION

Project: Gravel Borrow Search
Snare Hydro, N.W.T.
Project Number: 0701-99-14092
Date Tested: October 20, 1999
Borehole Number: Area 1, TP 07
Depth: 0.2 - 0.4 m
Soil Description: SAND - gravelly, trace fines
Cu: 5.7
Cc: 0.7
Natural Moisture Content: 3.4%
Remarks: Sample by EBA on October 7, 1999
Spec band as per GNWT C1 Surfacing Aggregate Specification

SIEVE	PERCENTAGE PASSING
40	100
25	98
20	95
16	91
12.5	88
10	86
5	78
2.5	66
1.25	50
0.63	27
0.315	8
0.16	2
0.08	1

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



Reviewed By: _____ P.Eng.

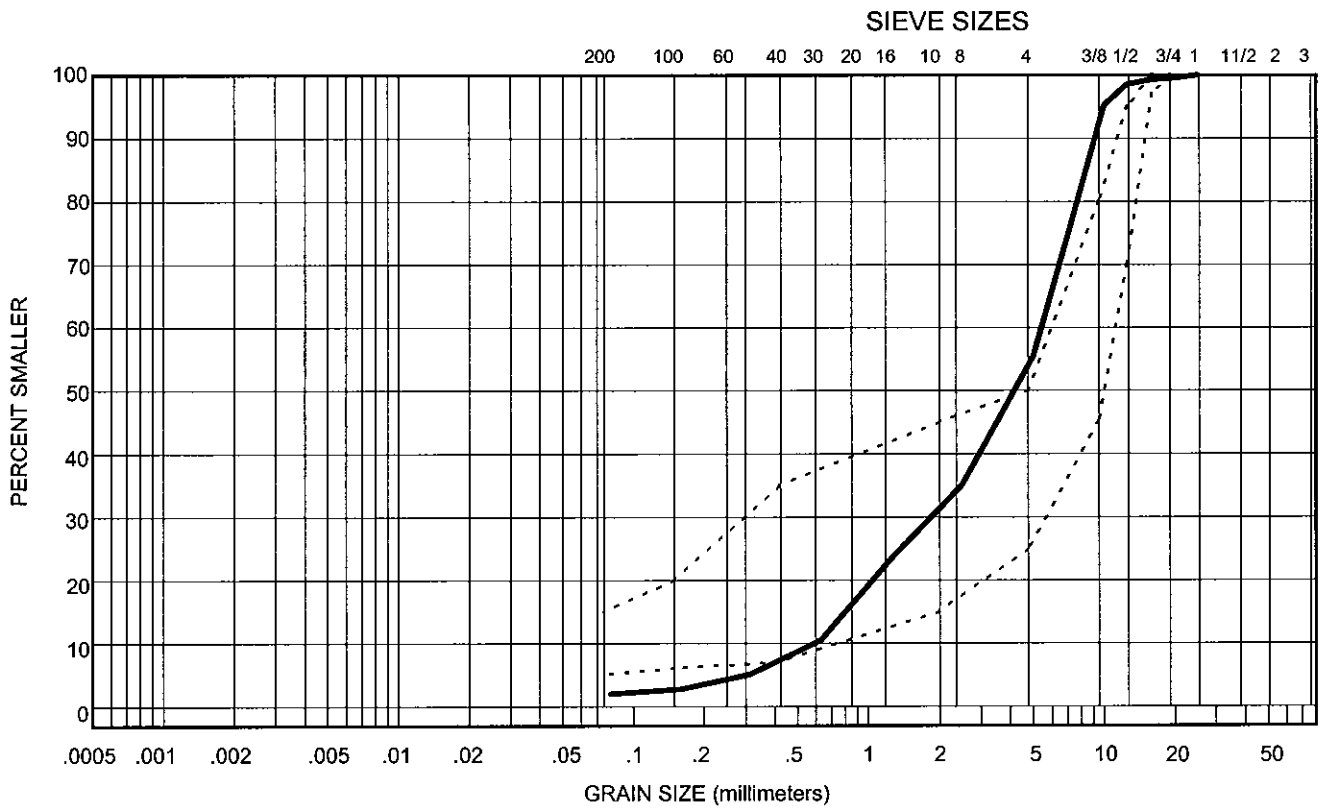
EBA Engineering Consultants Ltd.

GRAIN SIZE DISTRIBUTION

Project: Gravel Borrow Search
Snare Hydro, N.W.T.
Project Number: 0701-99-14092
Date Tested: October 26, 1999
Borehole Number: Area 4A, TP 11
Depth: 0.2 - 0.4 m
Soil Description: SAND and GRAVEL - trace fines
Cu: 9.1
Cc: 1.1
Natural Moisture Content: 2.8%
Remarks: Sampled by EBA on October 8, 1999
Spec band as per GNWT C1 Surfacing Aggregate Specification

SIEVE	PERCENTAGE PASSING
40	
25	
20	100
16	99
12.5	99
10	95
5	55
2.5	35
1.25	23
0.63	10
0.315	5
0.16	3
0.08	2

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



Reviewed By: _____ P.Eng.

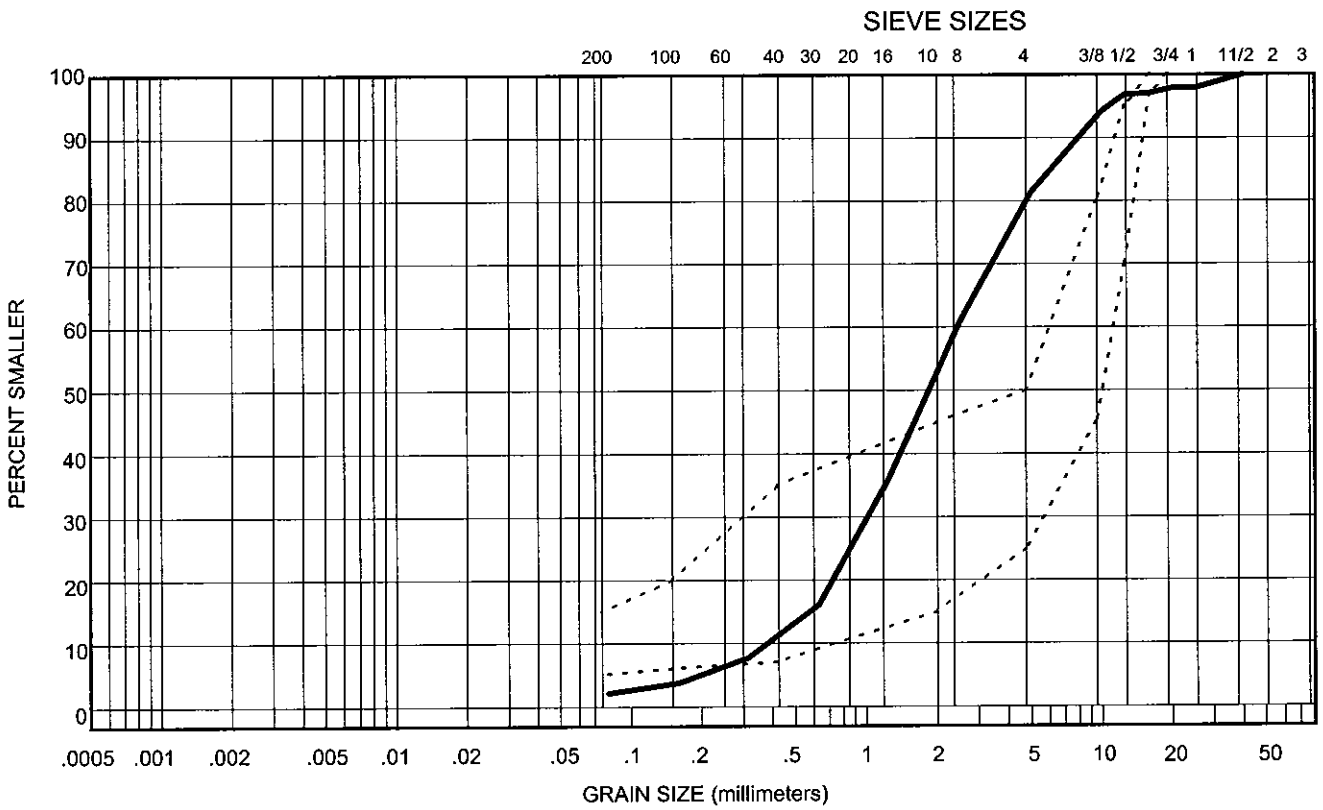
EBA Engineering Consultants Ltd.

GRAIN SIZE DISTRIBUTION

Project: Gravel Borrow Search
Snare Hydro, N.W.T.
Project Number: 0701-99-14092
Date Tested: October 26, 1999
Borehole Number: Area 4A, TP 11
Depth: 0.4 - 0.8 m
Soil Description: SAND - some gravel, trace fines
Cu: 6.4
Cc: 1.1
Natural Moisture Content: 3.5%
Remarks: Sample by EBA on October 8, 1999
Spec band as per GNWT C1 Surfacing Aggregate Specification

SIEVE	PERCENTAGE PASSING
40	100
25	98
20	98
16	97
12.5	97
10	94
5	81
2.5	61
1.25	36
0.63	16
0.315	8
0.16	4
0.08	2

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



Reviewed By: _____ P.Eng.

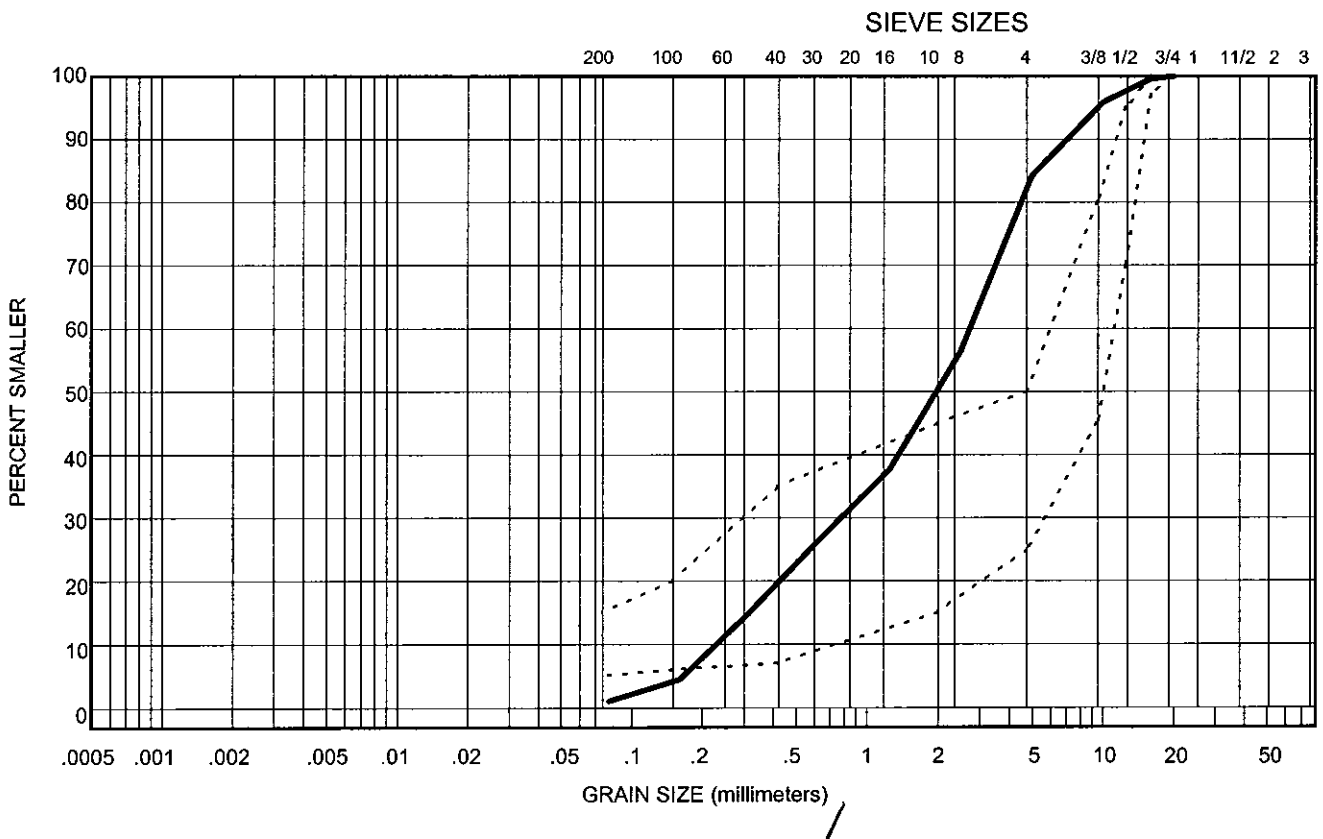
EBA Engineering Consultants Ltd.

GRAIN SIZE DISTRIBUTION

Project: Gravel Borrow Search
Snare Hydro, N.W.T.
Project Number: 0701-99-14092
Date Tested: October 26, 1999
Borehole Number: Area 4A, TP 13
Depth: 0.1 - 0.3 m
Soil Description: SAND - some gravel, trace fines
Cu: 11.9
Cc: 1.0
Natural Moisture Content: 2.6%
Remarks: Sampled by EBA on October 8, 1999
Spec band as per GNWT C1 Surfacing Aggregate Specification

SIEVE	PERCENTAGE PASSING
40	
25	
20	100
16	100
12.5	98
10	96
5	84
2.5	56
1.25	38
0.63	26
0.315	15
0.16	4
0.08	1

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



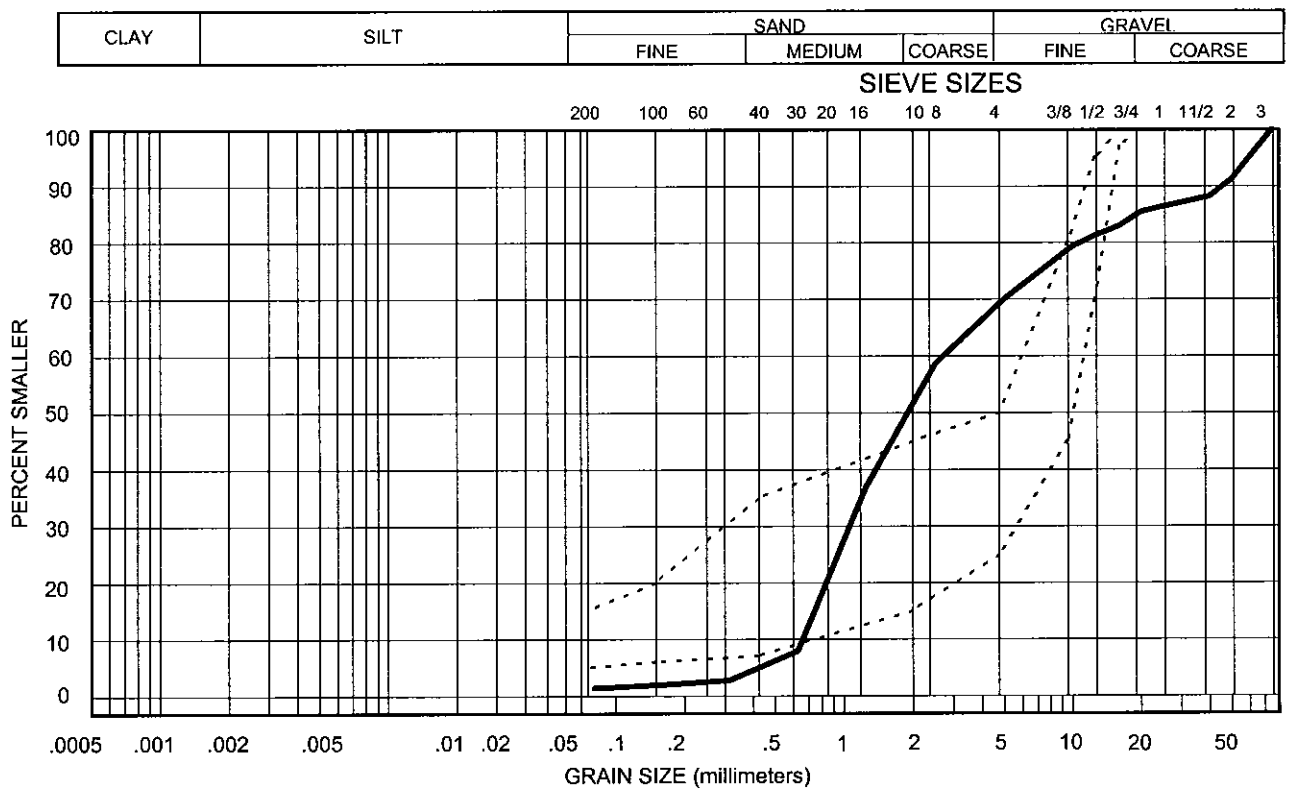
Reviewed By: _____ P.Eng.

EBA Engineering Consultants Ltd.

GRAIN SIZE DISTRIBUTION

Project: Gravel Borrow Search
Snare Hydro, N.W.T.
Project Number: 0701-99-14092
Date Tested: October 20, 1999
Borehole Number: Area 5A, TP 16
Depth: 0.4 - 0.6 m
Soil Description: SAND - gravelly, trace fines
Cu: 4.1
Cc: 0.6
Natural Moisture Content: 1.8%
Remarks: Sampled by EBA on October 8, 1999
Spec band as per GNWT C1 Surfacing Aggregate Specification

SIEVE	PERCENTAGE PASSING
75	100
50	91
40	88
25	86
20	86
16	83
12.5	81
10	79
5	70
2.5	59
1.25	37
0.63	8
0.315	3
0.16	2
0.08	1



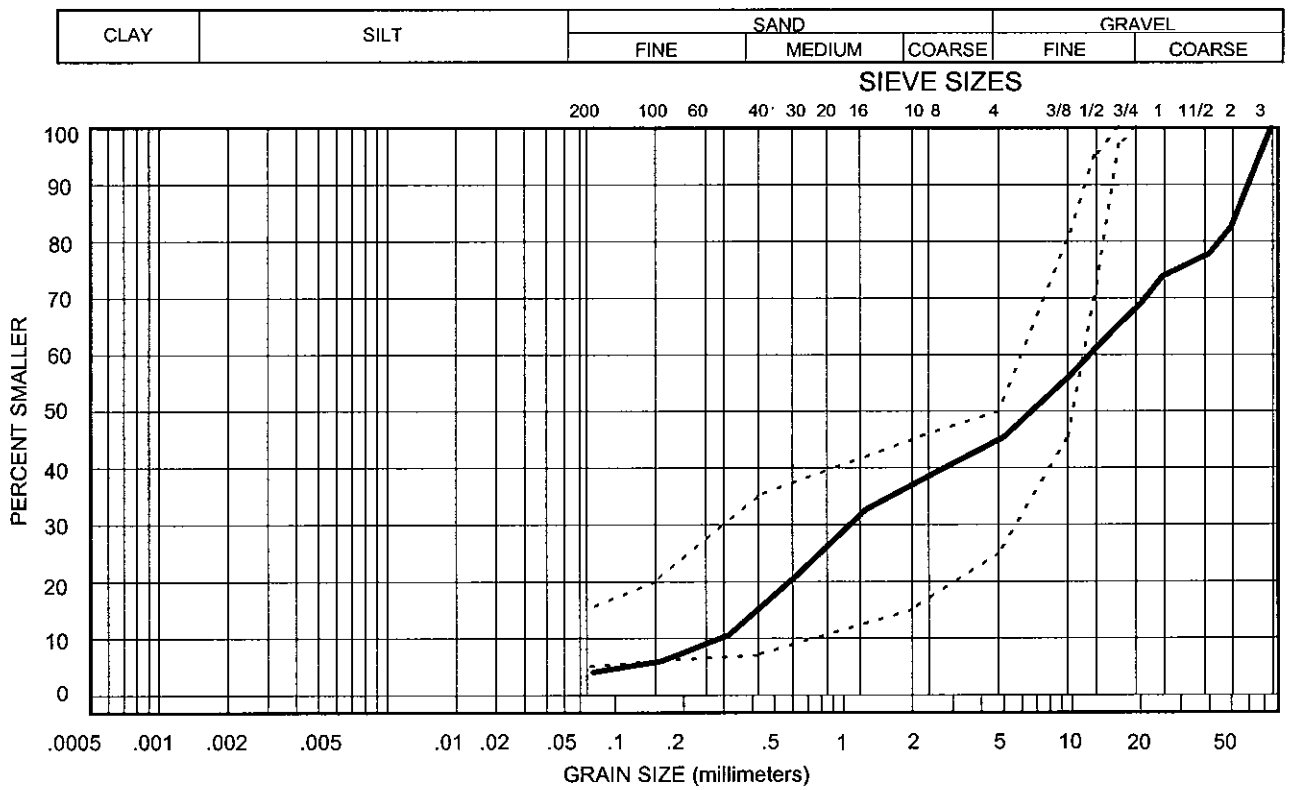
Reviewed By: _____ P.Eng.

EBA Engineering Consultants Ltd.

GRAIN SIZE DISTRIBUTION

Project: Gravel Borrow Search
Snare Hydro, N.W.T.
Project Number: 0701-99-14092
Date Tested: October 20, 1999
Borehole Number: Area 5A, TP 17
Depth: 0 - 0.3 m
Soil Description: GRAVEL and SAND - trace fines
Cu: 41.2
Cc: 0.3
Natural Moisture Content: 3.0%
Remarks: Sampled by EBA on October 8, 1999
Spec band as per GNWT C1 Surfacing Aggregate Specification

SIEVE	PERCENTAGE PASSING
75	100
50	83
40	78
25	74
20	69
16	65
12.5	61
10	57
5	45
2.5	39
1.25	33
0.63	21
0.315	11
0.16	6
0.08	4



Reviewed By: _____ P.Eng.

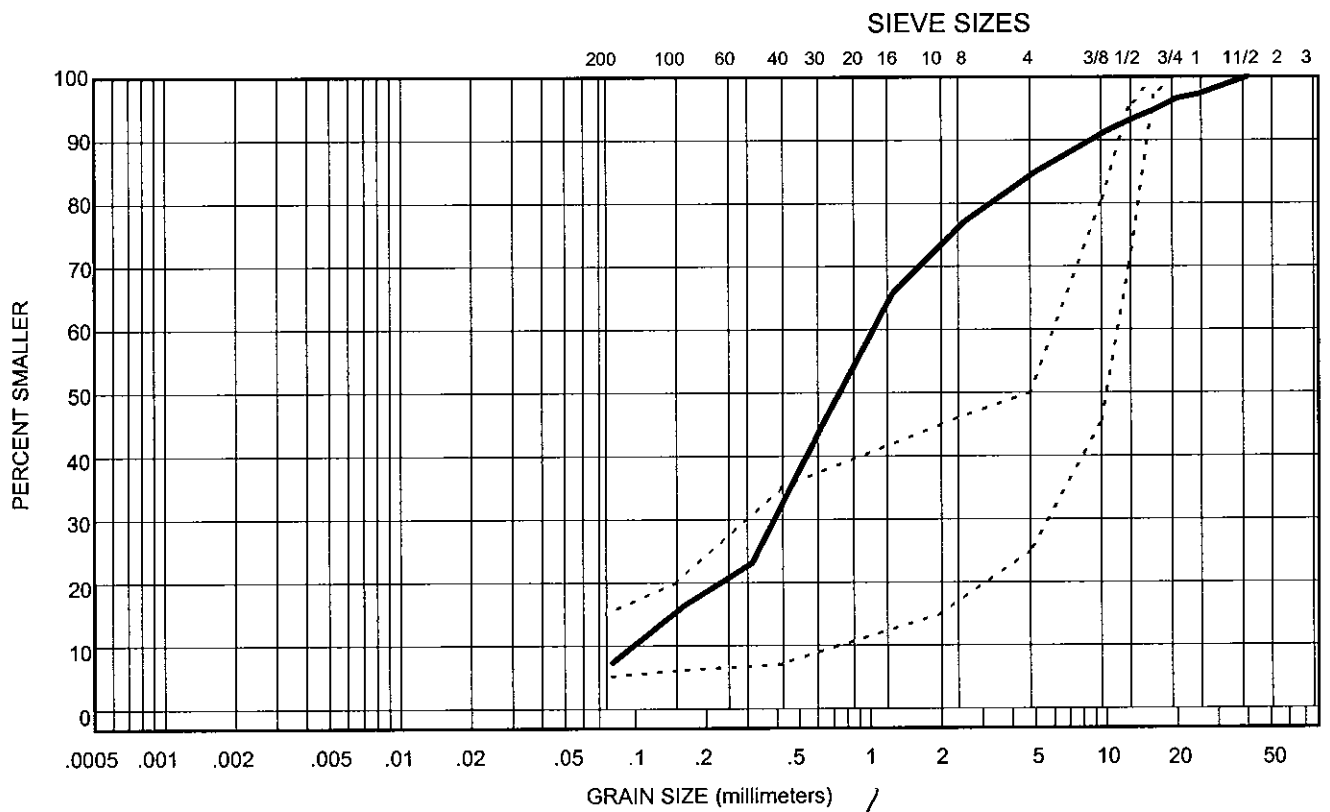
EBA Engineering Consultants Ltd.

GRAIN SIZE DISTRIBUTION

Project: Gravel Borrow Search
Snare Hydro, N.W.T.
Project Number: 0701-99-14092
Date Tested: October 20, 1999
Borehole Number: Area 5A, TP 17
Depth: 0.8 m
Soil Description: SAND - some gravel, trace fines
Cu: 10.5
Cc: 1.5
Natural Moisture Content: 2.3%
Remarks: Sampled by EBA on October 8, 1999
Spec band as per GNWT C1 Surfacting Aggregate Specification

SIEVE	PERCENTAGE PASSING
40	100
25	97
20	97
16	95
12.5	93
10	91
5	85
2.5	77
1.25	66
0.63	45
0.315	23
0.16	16
0.08	7

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



Reviewed By: _____ P.Eng.

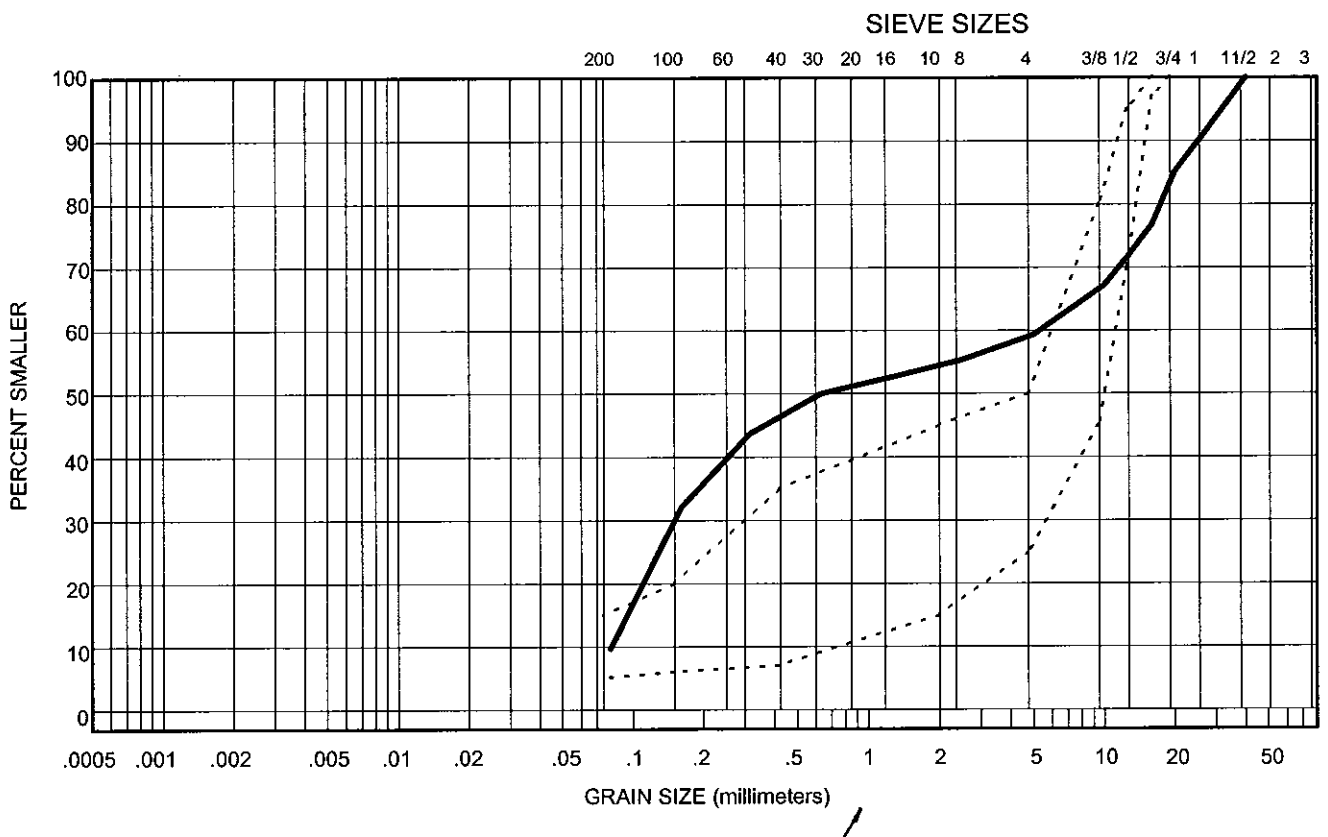
EBA Engineering Consultants Ltd.

GRAIN SIZE DISTRIBUTION

Project: Gravel Borrow Search
Snare Hydro, N.W.T.
Project Number: 0701-99-14092
Date Tested: October 31, 1999
Borehole Number: Area 5B, TP 24
Depth: 0.0 - 0.4 m
Soil Description: SAND and GRAVEL - some fines
Cu: 65.9
Cc: 0.1
Natural Moisture Content: 4.9%
Remarks: Sample by EBA on October 9, 1999
Spec band as per GNWT C1 Surfacing Aggregate Specification

SIEVE	PERCENTAGE PASSING
40	100
25	90
20	85
16	77
12.5	72
10	67
5	59
2.5	55
1.25	53
0.63	50
0.315	44
0.16	32
0.08	10

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



Reviewed By: _____ P.Eng.

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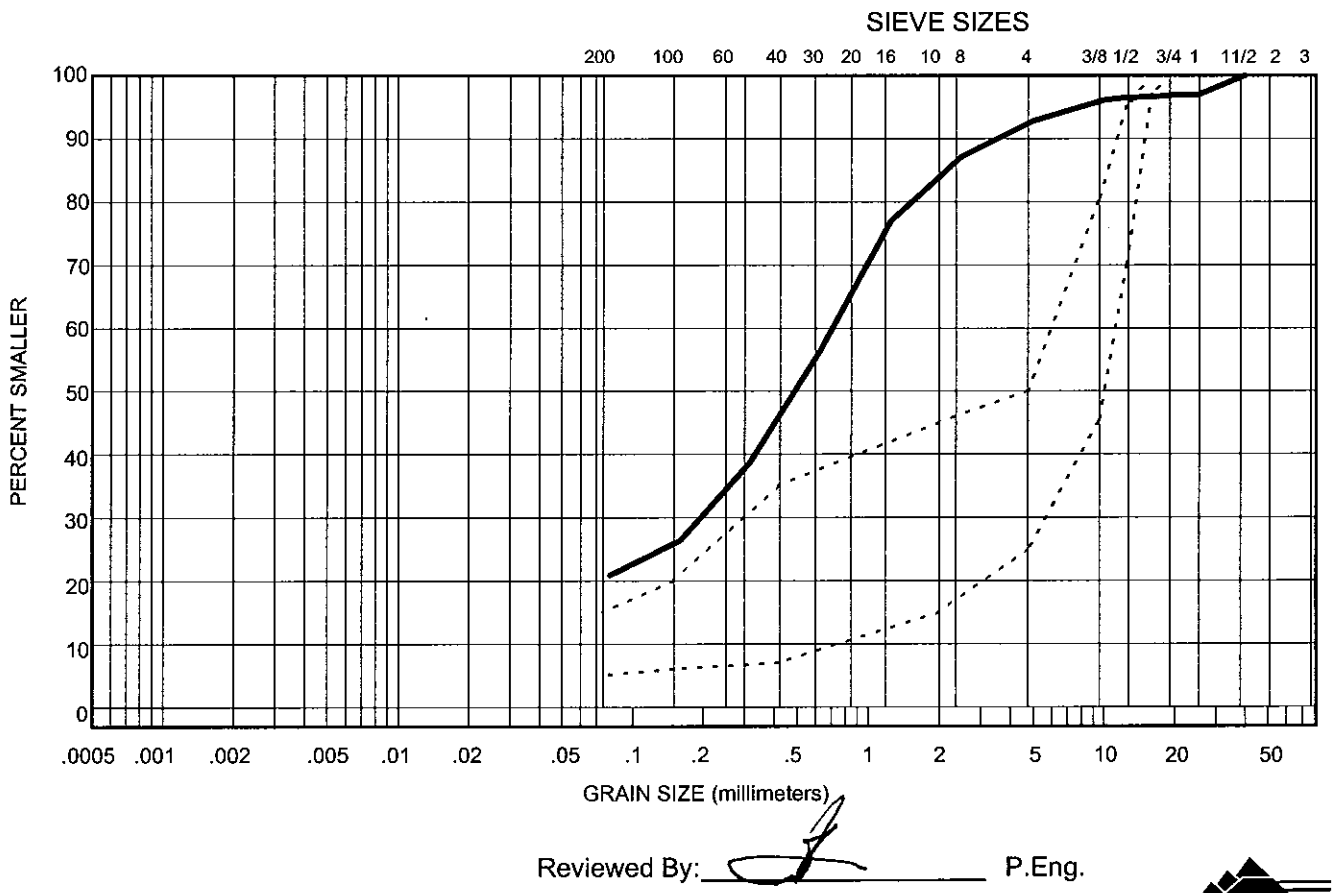
EBA Engineering Consultants Ltd.

GRAIN SIZE DISTRIBUTION

Project: Gravel Borrow Search
Snare Hydro, N.W.T.
Project Number: 0701-99-14092
Date Tested: October 31, 1999
Borehole Number: Area 7A, TP 29
Depth: 0.1 - 0.2 m
Soil Description: SAND - silty, trace gravel
Cu:
Cc:
Natural Moisture Content: 5.3%
Remarks: Sample by EBA on October 9, 1999
Spec band as per GNWT C1 Surfacing Aggregate Specification

SIEVE	PERCENTAGE PASSING
40	100
25	97
20	97
16	97
12.5	96
10	96
5	93
2.5	87
1.25	77
0.63	56
0.315	39
0.16	26
0.08	21

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



Reviewed By: _____ P.Eng.

APPENDIX C
Site Photographs

Photo 1

Area 1, facing south from all-weather road. Trail leading to powerline visible in centre of photo. Test Pit 2 visible to left of photo.

Photo 2

Area 1, facing southeast. Test Pit 7 visible to left of photo.

Photo 3

Sand pit area in Area 4A. Area 4A visible behind sand pit. Looking south from Area 4B.

Photo 4

Area 4B looking north from access road. Low area to left of photo. Area 4B visible to right of photo.

Photo 5

Test Pit 17 (Area 5A) facing south.

Photo 6

Test Pit 24 (Area 5B) facing east.

Photo 7

Area 6, facing southwest, near Tespt Pit 27. Test Pit 27 is in dense tress in the background.

Photo 8

Area 7A, facing southeast from Test Pit 29.

APPENDIX D
Terrain Analysis

September 25, 1999 EBA File: 0701-99-14092

Northwest Territories Power Corporation
4 Capital Drive
Hay River, NT, X0E 1G2

Attention: Mr. Greg Haist, P.Eng.
Manager, Civil Section

Subject: Identification of Potential Granular Borrow Sources
Snare Hydro Area, N.W.T.

Introduction

As requested, EBA has examined air photos and identified potential sources of granular material. This letter presents our results and comments. Two topographic maps of the area, that have potential sources of granular material indicated on them, are enclosed.

The work was completed in general accordance with a proposal faxed to the Northwest Territories Power Corporation (NWTPC) on August 17, 1999. Authorization to proceed was received by e-mail on August 22, 1999.

Background

NWTPC is intending to upgrade its all-weather road network at its Snare Hydro facilities. It is understood that the road system is approximately 40 km long. Primarily resurfacing will occur but there will also be some minor realignment.

NWTPC arranged for aerial photography of the area this summer. The road network was shot at a scale of 1:5,000 and the general area was shot at a scale of 1:20,000.

Scope of Work

EBA was requested to examine air photos and identify potential sources of granular material. The area of examination was to be within about 5 km of the present road, as this was considered to be the approximate range for practical access. The range of examination could be broadened at locations where winter crossing of water bodies was feasible.

Ground truthing of the interpretation is expected to follow but was not included in the present scope of work.

Methodology

Review of Available Information

Information in EBA's files and geological information was collected and reviewed concurrently with the air photo examination. The Bibliography provides a complete listing of the documents examined. The following information is relevant to this study.

Kelly and Associates (1975) reports: "The southern part of the basin has ice-rich lacustrine clays in low lying areas, with beach-like formations of sand at higher elevation. Thin glacial wash deposits have been identified in the area east of Strutt Lake."

Thurber (1991) reports: "Borrow sources were not specifically samples as part of this investigation; however, it can be recorded that there are substantial quantities of sand along the all-weather road from Snare Rapids to Snare Cascades. In particular there are large quantities of medium sand in the immediate vicinity of the electrical substation at Snare Falls.

There is an existing gravel pit near Strutt Lake which appears to have a wide range of sizes up to cobbles and boulders".

Jackson (1998) is a map of bedrock geology, but four Quaternary (sand and gravel) deposits are indicated east of Strutt Lake, excluding a previously developed area.

Girvan (1999) was involved with dam construction at Snare Forks in the mid 1970's. He reports that potential sources indicated in the vicinity of the abandoned airstrip near Snare Forks may have been depleted. The pit east of Strutt Lake was used for concrete aggregate at that time.

Air Photo Interpretation

Air photos were received directly from the photography Contractor, Geographic Air Survey Ltd., in early September. The desired study area was superimposed on a copy of the Flight Line map. Of the 160 air photos received, approximately 85 were determined to be within the area of interest and were examined.

Mr. Vlad Roujanski, a geomorphologist in EBA's Edmonton office, completed the air photo interpretation. Potential sources of granular material were identified on the air photos. This information was then transferred to overlays for 1:50,000 scale topographic maps.

Air photos have been forwarded to TGIT Geomatics Ltd., for mapping purposes.

Conclusions and Recommendations

Two maps fall within the study area: Strutt Lake (85 N/8) and Shoti Lake (85 N/1). Copies of these maps have been enclosed with this letter, with approximate locations of potential sources of granular material indicated on them. The sources have been placed into two categories: those interpreted to offer potential with a "high degree of probability" and those with "assumed" potential, i.e., a lower degree of probability. The potential for gravel versus sand could not be reliably discerned from the air photos. However, this was a consideration and deposits assigned a "high probability" are judged to have a greater potential for gravel than "assumed" deposits.

The Strutt Lake map sheet covers the majority of the road network and also covers the area considered to have the greatest potential for granular material. Further investigation is recommended in order to confirm the quantities and characteristics of the granular material. Two areas are recommended as priorities for further investigation:

- The area east of Strutt Lake is considered to offer the greatest potential for a large quantity of gravel. The largest deposit in the area is on the east shore of a bay at the north end of Strutt Lake. While somewhat centrally located, from north to south, with respect to the all-weather road network, it is approximately four to six kilometers east of the all-weather road This area has been accessed in the past by winter road across the lake. Three pits and a local road network are evident in these deposits.

- There is a small potential deposit along the existing all-weather road, approximately 5 km south of the Snare Rapids powerhouse and dam. This is towards the north end of the overall road network. Based on an estimated requirement of 30,000 m^3 to 40,000 m^3, sufficient quantity should exist if the average depth of the deposit is at least 1 m.

Closure

EBA appreciates being retained to complete this interpretation. We look forward to continuing to assist NWTPC on this interesting project. Please contact the undersigned if you have questions or comments.

Respectfully submitted,
EBA ENGINEERING CONSULTANTS LTD.

T.E. Hoeve, P.Eng.
Chief Engineer, N.W.T.

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Enclosures

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PROVISIONAL MAP

85 N/1

1:50,000

CANADA

(Joins Strutt Lake 85 N/8)

Refer to this map as: 85 N/1 EDITION 1 ASE SERIES A 733

EDITION 1 (1984)

CARTE PROVISOIRE

85 N/1

(Joins La Martre Falls 85 N/2)

(Joins Map 85 O/4)

6987000m. N.

526000m. E.

116°30′ 63°15′ — 116°00′ 63°15′

116°30′ 63°00′ — 116°00′ 63°00′

Tezonzon Lake

S L E M O N L A K E

S H O T I L A K E

J A M E S L A K E

M A R I A N L A K E

N A N V

Rapids

Produced and printed by the SURVEYS AND MAPPING BRANCH, DEPARTMENT OF MINES AND TECHNICAL SURVEYS, 1964, from air photographs taken in 1953 and 1961.

This map was compared with satellite imagery obtained in 1979 and found to be up to date in all major features

(Joins Map 85 K/16)

SHOTI LAKE

DISTRICT OF MACKENZIE

NORTHWEST TERRITORIES

On a comparé cette carte aux images prises par satellite en 1979 nous avons constaté que toutes ses caractéristiques principales étaient à jour

Établie et imprimée par la DIRECTION DES LEVÉS ET DE LA CARTOGRAPHIE, MINISTÈRE DES MINES ET DES RELEVÉS TECHNIQUES en 1964, d'après les photographies aériennes prises en 1953 et 1961.

NOTE: Boundaries and locations of the borrow sources are approximate. For precise boundaries and locations, refer to the airphotos. (Roll G9907033, August 7, 1999, Scale: 1:20,000)

GRID ZONE DESIGNATION	100,000 M SQUARE IDENTIFICATION
11 V	NA / NV 70

TO GIVE A REFERENCE TO NEARLST 100 METRES

EXAMPLE — LAKE

EASTING Read number on grid line immediately to left of point. Estimate tenths of a square from this line eastward to point: 38 . 7

NORTHING Read number on grid line immediately below point. Estimate tenths of a square from this line northward to point: 99 . 8

MILES: GRID REFERENCE 387998

Nearest similar grid reference 100 000 metres (about 61 miles)

ONE THOUSAND METRE
UNIVERSAL TRANSVERSE MERCATOR GRID
ZONE 11

Roads	Routes
all weather	toute saison
dry weather	période sèche
cart track	de terre
trail or portage	sentier ou portage
Railway, normal gauge, single track	Chemin de fer, voie unique (écartement normal) siding / station gare
Power transmission line	Ligne de transport d'énergie
Mine or Open cut	Mine ou fosse à ciel ouvert
Horizontal control point, with elevation	Point géodésique avec cote 454 △
Bench mark, with elevation	Repère de nivellement avec cote BM 157 →

LEGEND

Approximate location of prospective borrow material sources (SAND and/or GRAVEL)

- interpreted with a high degree of probability
- assumed

Miles 1 0 1 2 3 Miles

Metres 1000 500 0 1000 2000 3000 4000 Mètres

Yards 1000 500 0 1000 2000 3000 4000 Verges

CONTOUR INTERVAL 50 FEET
Elevations in Feet above Mean Sea Level
North American Datum 1927 (1953)
Transverse Mercator Projection
MAGNETIC DECLINATION 34°46′ EAST
AT CENTRE OF MAP 1964
Annual change (decreasing) 6.5′

ÉQUIDISTANCE DES COURBES: 50 PIEDS
Élévations en pieds au-dessus du niveau moyen de la mer
Réseau géodésique nord-américain unifié 1927 (1953)
Projection transverse de Mercator
DÉCLINAISON MAGNÉTIQUE AU CENTRE
DE LA FEUILLE EN 1964 : 34°46′ EST
Variation annuelle (décroissante) 6.5′

Some names on this map are not yet official. Corrections or additions are invited by the Surveys and Mapping Branch.

Certains noms inscrits sur cette carte ne sont pas encore officiels. La Direction des levés et de la cartographie saurait gré au public de lui signaler corrections et additions.

CONVERSION SCALE FOR ELEVATIONS

30 20 10 0 50 100 150 200 250 300 Metres

100 50 0 100 200 300 400 500 600 700 800 900 1000 Feet

Building	Bâtiment	Barn	Grange
School	École	Post Office	Bureau de poste P
Church	Église	Cemetery	Cimetière
Lighthouse	Phare		
River with bridge	Rivière avec pont		
Stream, intermittent or dry	Cours d'eau intermittent, ou à sec		
Lake intermittent, indefinite	Lac intermittent, rive imprécise		
Marsh or Swamp	Marais ou marécage		
Depression contours	Courbes de cuvette		

NATIONAL TOPOGRAPHIC SYSTEM
SYSTÈME NATIONAL DE RÉFÉRENCE CARTOGRAPHIQUE

T.N

0 40′ or 12 Mils

34 06′ or 606 Mils

Grid North

Magnetic North

Use diagram only to obtain numerical values.
APPROXIMATE MEAN DECLINATION 1964
FOR CENTRE OF MAP
Annual change decreasing 6.5′

85 N/1
EDITION 1 (1984)

PROVISIONAL MAP

85 N/8

1:50,000

CANADA

(Joins Labrish Lake 85 N/9)

Refer to this map as: 85 N/8 EDITION 1 ASE SERIES A 733

EDITION 1

CARTE PROVISOIRE

85 N/8

(Joins Tumi Lake 85 N/7)

(Joins Map 85 O/5)

AREA 1

AREA 2

AREA 10

AREA 7

AREA 6

SNARL FALLS

AREA 5

SNARE CASCADES

AREA 4

ROAD CONTINUES

SNARE FORKS

AREA 3

AREA 8 & AREA 9

S N A R E R I V E R

S T R U T T L A K E

S N A R E R I V E R

Slemon Lake

Rapids

Falls

Portage

7014000m. N.

526000m. E.

Produced and printed by the SURVEYS AND MAPPING BRANCH, DEPARTMENT OF MINES AND TECHNICAL SURVEYS, 1964, from air photographs taken in 1953 and 1961.

Copies may be obtained from the Map Distribution Office, Department of Mines and Technical Surveys, Ottawa.

GRID ZONE DESIGNATION	100 000 M. SQUARE IDENTIFICATION
11 V	N A

TO GIVE A REFERENCE TO NEAREST 100 METRES

EXAMPLE STREAM JUNCTION

EASTING Read number on grid line immediately to left of point	37	
Estimate tenths of a square from this line eastward to point		5
		375
NORTHING Read number on grid line immediately below point	24	
Estimate tenths of a square from this line northward to point		8
		248
MILITARY GRID REFERENCE	375248	

Nearest similar grid reference 100 000 metres (about 63 miles)

ONE THOUSAND METRE
UNIVERSAL TRANSVERSE MERCATOR GRID
ZONE 11

LEGEND

Approximate location of prospective borrow material sources (SAND and/or GRAVEL)

- interpreted with a high degree of probability
- assumed

Roads	Routes
all weather	toute saison
dry weather	période sèche
cart track	de terre
trail or portage	sentier ou portage
Railway, normal gauge, single track	Chemin de fer, voie unique (écartement normal)
Power transmission line	Ligne de transport d'énergie
Mine or Open cut	Mine ou fosse à ciel ouvert
Horizontal control point, with elevation	Point géodésique avec cote 454 △
Bench mark, with elevation	Repère de nivellement avec cote BM 157 →

CONVERSION SCALE FOR ELEVATIONS

30 20 10 0 50 100 150 200 250 300 Metres

100 50 0 100 200 300 400 500 600 700 800 900 1000 Feet

(Joins Shoti Lake 85 N/1)

STRUTT LAKE

DISTRICT OF MACKENZIE
NORTHWEST TERRITORIES

SCALE 1:50,000 ÉCHELLE

Miles 1 0 1 2 3 Milles

Metres 1000 500 0 1000 2000 3000 4000 Mètres

Yards 1000 500 0 1000 2000 3000 4000 Verges

CONTOUR INTERVAL 50 FEET
Elevations in Feet above Mean Sea Level
North American Datum 1927 (1953)
Transverse Mercator Projection

ÉQUIDISTANCE DES COURBES: 50 PIEDS
Élévations en pieds au-dessus du niveau moyen de la mer
Réseau géodésique nord-américain unifié 1927 (1953)
Projection transverse de Mercator

MAGNETIC DECLINATION 35°08' EAST AT CENTRE OF MAP 1964
Annual change (decreasing) 6.6'

DÉCLINAISON MAGNÉTIQUE AU CENTRE DE LA FEUILLE EN 1964 : 35°08' EST
Variation annuelle (décroissante) 6.6'

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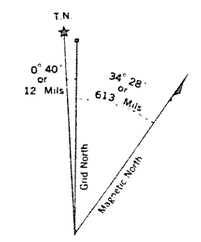
NOTE: Boundaries and locations of the borrow sources are approximate. For precise boundaries and locations, refer to the airphotos. (Roll G9907033, August 7, 1999, Scale: 1:20,000)

Building	Bâtiment	Barn	Grange
School	École	Post Office	Bureau de poste P
Church	Église	Cemetery	Cimetière C
Lighthouse	Phare		
River with bridge	Rivière avec pont		
Stream, intermittent or dry	Cours d'eau intermittent ou à sec		
Lake intermittent, indefinite	Lac intermittent, rive imprécise		
Marsh or Swamp	Marais ou marécage		
Depression contours	Courbes de cuvette		

NATIONAL TOPOGRAPHIC SYSTEM
SYSTÈME NATIONAL DE RÉFÉRENCE CARTOGRAPHIQUE

Établie et imprimée par la DIRECTION DES LEVÉS ET DE LA CARTOGRAPHIE, MINISTÈRE DES MINES ET DES RELEVÉS TECHNIQUES en 1964, d'après les photographies aériennes prises en 1953 et 1961.

Ces cartes sont en vente au Bureau de distribution des cartes, ministère des Mines et des Relevés techniques, Ottawa.



Use diagram only to obtain numerical values.
APPROXIMATE MEAN DECLINATION 1964
FOR CENTRE OF MAP
Annual change decreasing 6.6'

85 N/8
EDITION 1