Indian and Northern Affairs Canada

GEOTECHNICAL INVESTIGATION PLANS
SUBSURFACE EVALUTION OF GRANULAR RESOURCES
FORT GOOD HOPE, NT

EBA File: 1200209

October 2007

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1.0 INTRODUCTION

Under INAC Contract No. A7133-06-0017, EBA Engineering Consultants Ltd. (EBA) was retained by R.J. Gowan, Manager, Land Programs, Land and Water Management Directorate, Northern Affairs Program, Indian and Northern Affairs Canada, to carry out a study of granular sources on Crown Land near the community of Fort Good Hope, NT. The objective of the study was to prepare geotechnical site investigation plans for previously identified granular sources, including proposed locations of subsurface evaluation targets, suitable access routes for winter exploration and recommendations for subsurface investigation methods, cost and logistics. The project was motivated in response to foreseen increased granular demands in an area where existing developed sources are limited.

Recommendations and conclusions are based on air photo interpretation, aerial reconnaissance, reviews of previous reports and subsurface data, and experience in geological mapping and evaluation of granular sources in the study area.

This report incorporates and is subject to the attached General Conditions.

2.0 BACKGROUND

Increasing demands from growing industrial development and transportation infrastructure has a potential to impact the supply of granular resources near communities. This study was initiated by DIAND to follow its strategy for the continuous development of programs to effectively manage granular resources and ensure adequate future supply for communities. Given present and future projected demands for granular construction material, particularly in light of the proposed Mackenzie Gas Pipeline project, definition of existing and potential granular resources near the communities is fundamental.

Excellent sources of unconsolidated granular material exist in the vicinity of the settlement of Fort Good Hope, which is located in the deposition zone of a glaciofluvial delta. The glaciofluvial outwash and deltaic deposits east and northeast of Fort Good Hope, consisting of outwash plains, channel deposits and kames and eskers, are the principal sources of granular material in the general area and form one of the most extensive and accessible accumulations of sand and gravel in the Mackenzie Valley (GSC, 1972). Outside the community area, granular deposits are generally small and widely separated.

A desk-top study was completed to identify study area boundaries, locate potential granular resources and to review previous reports of known deposits (EBA, March 2006). In September 2006 EBA completed aerial reconnaissance and groundwork to further evaluate suitable granular resource deposits in the Fort Good Hope area.

Key deposits within the glaciofluvial complex east of the community are located mostly on private land. This study focuses on two prospective deposits near Ft. Good Hope that warrant

further exploration and assessment: Source 20.112 located about 16 km north of the community and Source 20.113 located about 15 km northeast. Source 6.089 - located about 27 km south of Ft. Good Hope on the proposed Mackenzie Highway right-of-way – was considered to be a low priority target for sub-surface evaluation. Source 6.089 is not considered for further work within the scope of this report, as the results of the desktop study and field assessment were unfavourable and its distance from Fort Good Hope is impractical.

3.0 METHODOLOGY

To develop a work plan and estimated costs for a geotechnical sub-surface investigation program at the Fort Good Hope community granular sites 20.112 and 20.113, the following tasks were undertaken:

- The results of previous geotechnical evaluation reports were reviewed.
- Preliminary recommendations from previous reports and the aerial reconnaissance survey were reviewed with the departmental representative;
- Revised boundaries and expansion limits of potential quarries were established based on the results of the aerial reconnaissance;
- Proposed access trail alignments indicated during the aerial reconnaissance were finalized and located on plan drawings;
- Proposed test sites located during the aerial and ground reconnaissance were revised or confirmed;
- Figures were prepared to illustrate potential development boundaries, access trail alignments, test site locations, geological boundaries and other pertinent information;
- Recommendations were developed on methodology for the subsurface geotechnical evaluation program, including equipment and personnel requirements, general drilling specifications, sampling and testing, anticipated costs and logistical considerations.

4.0 GRANULAR RESOURCE DEPOSIT 20.112

Deposit 20.112 is located about 16 km north of Ft. Good Hope (Figure 1). The deposit is referred to in earlier reports as Site FGH 6 (Pemcan, 1973) and 106I-B11(R) (Techman Ltd., 1976). Evaluation work is limited to winter as access to the deposit is through areas of poorly drained, sensitive permafrost terrain. Access to the deposit from Ft. Good Hope is by cutlines and trails linked to the cleared routes of previous winter trail transportation corridors (Figure 1). The deposit is about 6.5 km northeast of the proposed Mackenzie Gas pipeline right-of-way.

Deposit 20.112 is located in an area of prominent, low relief hummocky-ridged terrain where a glaciofluvial esker meets east-west-oriented eolian ridges. The north-trending, sinuous esker is about 200 m in width and 3 km in length (Figure 2). Relief is estimated at up to 50 m.

Ten detailed ground sites over a distance of about 3.5 km were assessed and documented during the field reconnaissance completed on September 16, 2006. Good quality granular material was exposed in hand test pits throughout the length of the esker. Soil texture in shallow hand pits was sand, varying from gravelly to trace gravel and trace to no silt. At the southern extent of the main esker where it intersects prominent SW-NE oriented landforms, surface soils were fine eolian sand. The results of the field reconnaissance are summarized in Table 1.

Results of the field reconnaissance suggest that ridges at the south end of the deposit previously mapped as till are eolian dunes. There is potential for granular material underlying eolian sand on the ridge intersecting the south end of the esker.

Winter access to the deposit was located by air photograph interpretation and aerial reconnaissance. The route follows a trail and cutlines that originate at the Mackenzie River at the mouth of the Hare Indian River. A cleared trail was located at the deposit that provides access to the northern end of the esker (Figure 2).

A subsurface geotechnical evaluation program is recommended to characterize deposit thickness, verify consistency of material texture, sample material masked by eolian deposits, map stratigraphy to aid further exploration and mapping and test for potential reserve expansion. The most effective subsurface evaluation would be advanced with a combined program of air rotary drilling and excavator testpitting. Seasonal site access necessitates a winter program and will allow equipment mobilization to Fort Good Hope by winter road.

Air photo interpretation and field reconnaissance indicate that the esker deposit is quite extensive and a prospective granular volume of 4,000,000 m^3 is estimated based on an average thickness of 4.5 m over the length of the esker.

TABLE 1 SITE 20.112 FIELD STATIONS – SEPTEMBER 15, 2006 RECONNAISSANCE

FIELD SITE	UTM LOCATION Zone 9		DRAINAGE	MATERIAL and TEXTURE		DESCRIPTION
	NORTHING	EASTING				
JD-1	7365845	0523277	well drained	FG	gravelly SAND, tr. silt	unstratified, ~20% clasts, sub-rndd; esker
JD-2	7366001	0523123	well drained	FG	gravelly SAND, tr. silt	unstratified, ~20% clasts, sub-rndd; esker
JD-3	7366205	523174	well drained	FG	SAND, some gravel, tr. silt	unstratified, 15-20% clasts, sub-rndd; esker
JD-4	7364870	522911	well to rapid	FG	SAND, some gravel, tr. silt	unstratified, ~10% clasts, sub-rndd; esker
JD-5	7364475	522648	well drained	FG	SAND, tr. gravel	unstratified, <5% clasts, sub-rndd; esker
JD-6	7363973	522600	well drained	E	fine SAND	unstratified; poorly graded; dune
JD-7	7364041	522720	well drained	E	fine SAND	unstratified; poorly graded; dune
JD-8	7364737	522784	well drained	FG	gravelly SAND	unstratified, ~20% clasts, sub-rndd; esker
JD-9	7363392	522490	well drained	E	fine SAND	unstratified; poorly graded; dune
JD10	7363265	522755	moderately well drained	E	fine SAND	unstratified; poorly graded; dune

Abbreviations: tr.= trace; FG = glaciofluvial; E = eolian; rndd =rounded;

5.0 GRANULAR RESOURCE DEPOSIT 20.113

Deposit 20.113 is located about 15 km northeast of Fort Good Hope on the north side of Ontadek Lake. The deposit is referred to as Site FGH 9 (EBA, 1973) and 106I-B12(R) (Techman Ltd., 1976). It is part of a large glaciofluvial esker-kame complex and is reported to consist of poorly graded sand with varying proportions of silt and gravel. Relief is estimated at about 50 m. There were no records found of previous assessments within this part of the deposit and it remains a potential source of granular material. There is favourable access to this area from the Ft. Good Hope – Colville Lake winter road.

Site 20.113 is located mostly on private land. The part of the potential granular deposit that is located on crown land is limited to a small area at the eastern extent of the deposit. A modest testpitting program is recommended to test for potential granular material underlying the eolian blanket observed during the field reconnaissance. The close proximity of the study area to the Colville Lake Winter Road and the potential for granular material underlying an eolian blanket warrants further exploration and assessment.

TABLE 2 SITE 20.113 FIELD STATIONS – SEPTEMBER 15, 2006 RECONNAISSANCE

FIELD SITE	UTM LOCATION - Zone 9		DRAINAGE	MATERIAL and TEXTURE	DESCRIPTION
	NORTHING	EASTING			
JD-11	7356257	530108	well drained	E fine SAND	unstratified; poorly graded; dune; ridged
JD-12	7356291	530414	well drained	E fine SAND	unstratified, poorly graded; dune; ridged
JD-13	7356445	530022	well drained	E fine SAND	unstratified; poorly graded; dune; ridged

Abbreviations: tr.= trace; FG = glaciofluvial; E = eolian; rndd =rounded;

6.0 PROPOSED SUBSURFACE EVALUATION PROGRAM

Geotechnical sub-surface evaluation programs of drilling and testpitting at Source 20.112 and testpitting at 20.113 are recommended. A track-mounted air rotary drill is required for the drill program. A minimum 59,000 – 68,000 lbs Class excavator (Caterpillar 325 or equivalent) is recommended for testpit excavation. A bulldozer (minimum size Caterpillar D6 or equivalent, Class 130-190 FWHP) is required to clear access trails, to mobilize a temporary emergency shelter and to support equipment mobilization at the Hare Indian River valley slopes. Suggested locations of test sites were determined by stereographic analysis of air photographs and field reconnaissance.

The program must be completed during the winter to ensure minimum environmental impact and to allow equipment mobilization to Fort Good Hope by winter road. Prior to drill mobilization, access routes should be located and flagged to confirm locations, to check grades on the north slope of the Hare Indian River and to locate any areas where a slashing crew is required to clear vegetation. Staging for the geotechnical program crews would be from Fort

Good Hope with daily transport to the site by four-wheel drive truck on the Colville Lake winter road and to the test sites by truck and/or snowmobile.

Access trail routes should meet the following objectives:

- Sufficient width and grade to accommodate a track-mounted drill;
- Follow existing cutlines and trails wherever possible;
- Minimize environmental impact (tree cutting) by taking advantage of natural openings or sparsely forested areas.
- Minimize the length of access trails
- Where possible, consider an alignment for access trails that could be upgraded to an all-season road for future quarry development.

Representative samples from testpitting and drilling should be selected for testing. A modest lab testing program to determine grain size at the deposits should be completed to correlate and complement field logs.

6.1 SOURCE 20.112

A geotechnical program of testpitting and drilling is recommended to evaluate the extent, quality and consistency of the Source 20.112 granular deposit. Six boreholes and 12 testpits are recommended over an area of about 90 ha along the 3 km length of the esker (Figure 2).

If the initial results of the geotechnical program are favourable it would be prudent to expand the program to test adjacent to the esker and to evaluate SW-NE landforms located southwest of the main esker.

An estimate of about 6 km of new trails are required to access the test sites. Access from the Mackenzie River at the mouth of the Hare Indian River, about 4.5 km north of Fort Good Hope, follows about 12 km of existing cutlines and trails. Open aspen and spruce forest dominates the study area and some hand clearing may be necessary to prepare parts of the access trails.

Two exceptional costs arise for the field program as Source 20.112: drill mobilization to Fort Good Hope and construction of an ice bridge across the Hare Indian River. Drill mobilization from Alberta was quoted at $50,000, about 65% of the overall drilling costs. It would be prudent to defer drilling at Source 20.112 until a drill rig is located in the region.

6.2 SOURCE 20.113

Testpitting is recommended to investigate the Source 20.113 deposit. Six testpits are recommended (Figure 3). If the results of the testpits are favourable, a borehole program should be considered to assess the vertical extent of the deposit.

An estimate of about 2 km of new trails are required to access the test sites from about KP16 on the Colville Lake Winter Road. Open spruce and post-forest fire juvenile aspen forest dominates the study area and some hand clearing may be required to construct access trails.

7.0 COST ESTIMATE

Cost estimates for an arctic winter program with access across undeveloped terrain are problematic. Unknown factors such as trail conditions, vegetation growth, snow depth, availability of equipment, and potential equipment breakdowns make it impossible to ascertain definitive access logistics. A contingency has been included to cover unforeseen cost overruns but it is prudent to recognize the nature of the exercise and the potential for additional costs. Cost estimates assume that an excavator and bulldozer would be contracted from Fort Good Hope. Table 3 shows cost estimates for the geotechnical evaluation program.

TABLE 3 SUBSURFACE EVALUATION PROGRAM COST ESTIMATE

TRAIL CLEARING				
Slashing crew	$1200/day	4	$4800	$4800
TESTPIT EXCAVATION				
Construct ice-bridge across Hare Indian River		5	$15,000	
Trail clearing and support-D7 Cat	$1650/day	4	$6,600	
Mob/demob excavator Ft. Good Hope to		½ day	$1375	
Move excavator to 20.112		1 day	$2750	
Testpitting (20.113) - 12TP's	$2250/day	6	$16,500	
Testpitting (20.112) – 6 TP's	$2250/day	4	$11,000	
Fuel haul with Snow Cat	$180/hour	24 hrs	$4320	
Truck with tidy tank	$250/day	12	$3000	
				$45,545
DRILLING				
Mobilize and demobilize drill rig from outside			see Note 1 below	$50,000
Drilling and mob to Site 20.112	$3500/day	6	$21,000	
Expendables	$8/m	120 m	$960	
Fuel	200 L/day	5	$1500	
Truck	$250/day	8	$2000	
Room and Board (FGH) (2p)	$250/day	8	$4000	
				$29,460
GEOTECHNICAL SUPPORT				
Test site and access road layout		2	$2400	
Supervision, logging and sampling		12	$14,400	
Travel			$960	
Truck rental	$250/day	14	$3500	
Accommodation and meals	$250/day	14	$3500	
Airfare			$1200	
Report		30 hrs	$3600	
Senior Review		4 hrs	$820	
				$30,380
SAMPLE TESTING			$3000	$3000
SUB-TOTAL				$163,185
Suggested contingency (15%)				$24,478
TOTAL				$187,663

The costs in Table 3 are estimates prepared for preliminary budgeting purposes and are based in part on past experience. As costs will vary depending on timing, availability of equipment, and non-fixed expenses, direct quotes should be sought from contractors prior to establishing a final budget. Total cost does not include mob/demob of drill to Ft. Good Hope.
Note 1: mob/demob from Alberta was quoted at $50,000. It is assumed that drilling at Source 20.112 would be deferred until a drill is located in the region to reduce mob/demob costs.

8.0 SUMMARY AND PROJECT SCHEDULE

A subsurface geotechnical program of testpitting and drilling is recommended for the two granular sources of interest, Source 20.112 and Source 20.113. Twelve testpit sites and six borehole sites have been proposed for Source 20.112 to be completed concurrently (Figure 2). Six initial testpit sites are proposed for Source 20.113. If the testpit results are favourable, further testpits and boreholes should be advanced at this source. A schedule for the proposed field program is shown on Table 4. Testpit depth should typically be about 5 m. Borehole depth should be a minimum of 5 m and a maximum of 20 m. Boreholes should be terminated following a sequence of greater than 3 m of non-granular material.

Access to the potential granular sources will follow existing trails, cutlines or winter roads. Some new trail development will be required to provide access to test sites within the source areas.

Observations to assess drainage conditions, potential access routes, environmental considerations and other issues that may aid in future stages of development should be documented during drilling or testpitting. The results of the geotechnical program should provide key information to support a Quarry Development Plan.

180 m of drilling is estimated based on an average borehole depth of 15 m. About 6 km of access trails are required for Site 20.112 and 2 km for Site 20.113. The program must be advanced during the winter to ensure minimum environmental impact. The cost of the combined testpit excavation and drill program, including sample testing and reporting, is estimated at about $188,000 including a contingency of 15%.

The 3 km long landform that forms the target of Source 20.112 has high potential for quality granular material. The large esker covers an area of about 69 ha and a prospective volume of granular material is estimated at about 4 million m^3. If the results of the geotechnical program indicate that granular material continues to 2 m below the elevation of the surrounding plain, then this figure could double.

TABLE 4 PROJECT FIELD SCHEDULE

TASK \ DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Travel and mob / demob to Ft. Good Hope	■																		
Winter trail reconnaissance and clearing		■	■	■	■														
Mob excavator to 20.113				■															
Testpitting at 20.113				■	■	■	■												
Mob excavator and drill to 20.112								■											
Testpitting at 20.112									■	■	■	■	■	■	■	■	■		
Drilling at 20.112									■	■	■	■	■						
Demob equipment to Fort Good Hope														■				■	
Demob equipment south; travel																			■

9.0 CLOSURE

The information and recommendations contained in this report and figures are based on the results of previous reports, air photograph interpretation, current understanding of regional terrain and geology, and on limited observations of land-surface conditions. In most of the study area, subsurface conditions (e.g., characteristics of subsurface materials and subsurface hydrologic conditions) are interpreted from surface observations or air photo interpretation with only reconnaissance scale field checking. The terrain and soil conditions indicated are intended as a useful guide for regional planning purposes and should not be used to guide specific development until local material textures have been evaluated by sub-surface investigation.

Further information regarding the use of this report is presented in the attached General Conditions that form a part of this report.

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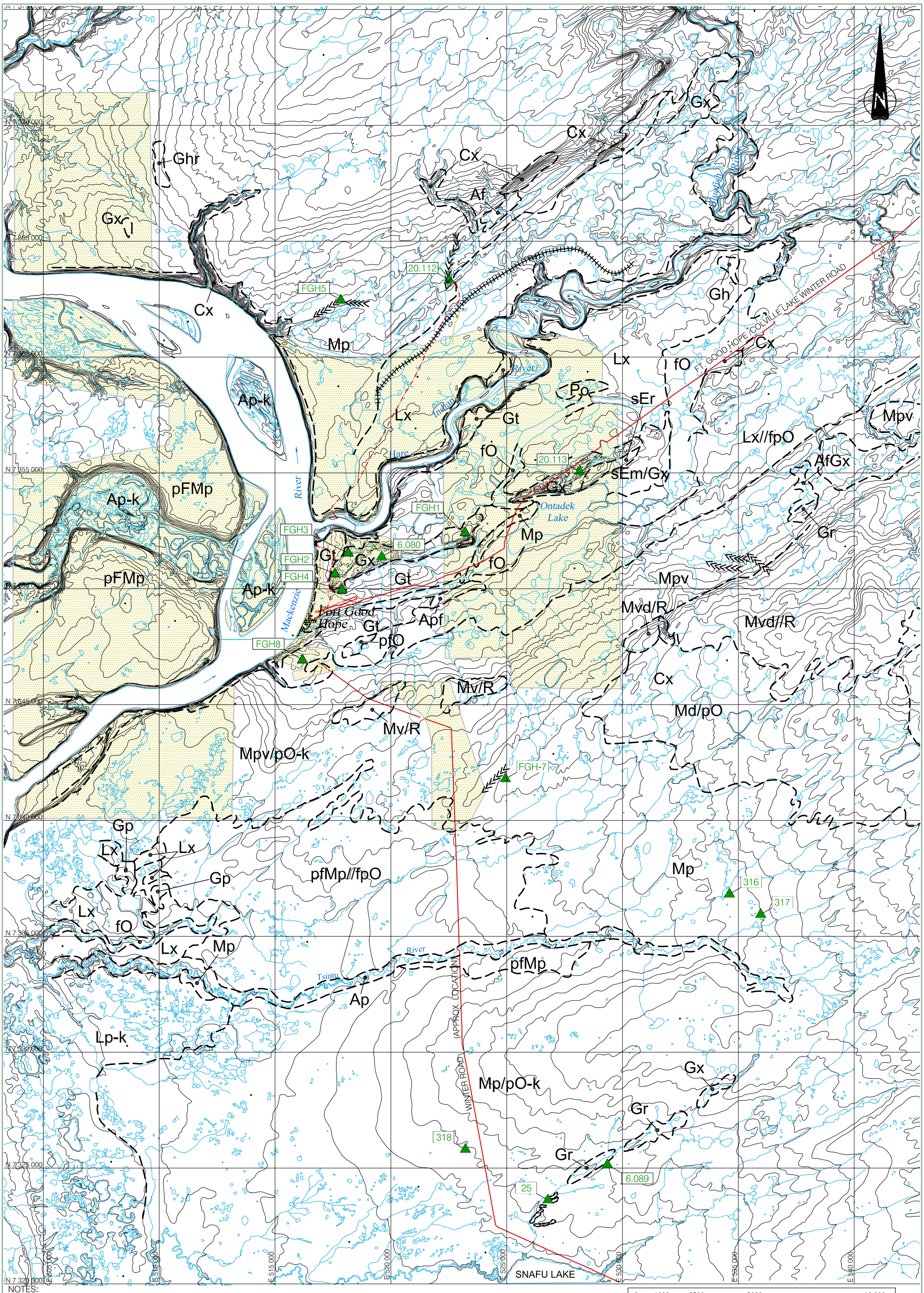
REFERENCES

EBA Engineering Consultants Ltd. Indian and Northern Affairs Canada. Preliminary Geotechnical Study of Community Granular Resources. Inuvik, Ft. Good Hope and Tulita, NT. March 2006.

EBA Engineering Consultants Ltd. Indian and Northern Affairs Canada. Field Reconnaissance Study of Community Granular Resources. Fort Good Hope, NT. January 2007.

FIGURES



NOTES:
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2. THIS DRAWING HAS BEEN PRODUCED IN COLOR, ANY REPRODUCTIONS MAY NOT BE REPRESENTATIVE OF ORIGINAL.

0m 1000 2500 5000 10,000m

SCALE 1 : 150,000

LEGEND:

- SAHTU PRIVATE LAND OR MUNICIPAL LAND
- 316 GRANULAR DEPOSIT
- LIMIT OF OUTCROP OR SHALLOW BEDROCK
- PRACTICAL LIMIT OF FUTURE DEVELOPMENT
- ALL SEASON ACCESS ROAD
- POTENTIAL ROAD ACCESS ROUTE

EBA Engineering Consultants Ltd.

DWN. JSB | CHKD. JTD/JRT

EBA JOB NO. 1200209

CLIENT: DEPARTMENT OF INDIAN AFFAIRS & NORTHERN DEVELOPMENT LAND & WATER MANAGEMENT, NRE

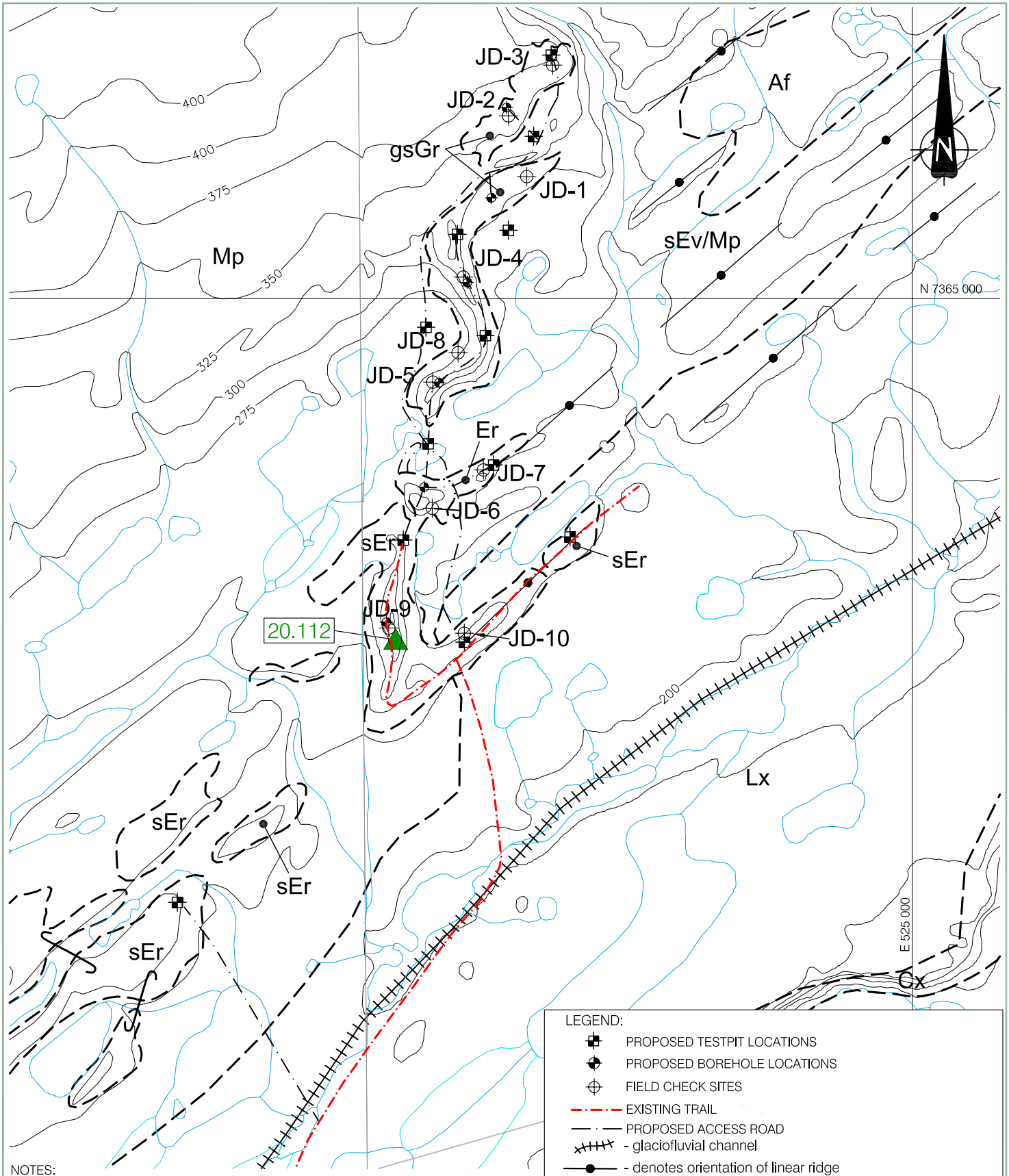
FILE: 1200209 Figure 1.dwg | REVISION NO.: 1

PROJECT: GEOTECHNICAL INVESTIGATION PLANS SUBSURFACE EVALUATION OF GRANULAR RESOURCES FORT GOOD HOPE, NT.

TITLE: SITE LOCATION & GEOLOGY FORT GOOD HOPE AREA

DATE: October 2007

Figure 1



LEGEND:
- PROPOSED TESTPIT LOCATIONS
- PROPOSED BOREHOLE LOCATIONS
- FIELD CHECK SITES
- EXISTING TRAIL
- PROPOSED ACCESS ROAD
- glaciofluvial channel
- denotes orientation of linear ridge

0m 500 1000 2000 4000m

SCALE 1 : 25,000

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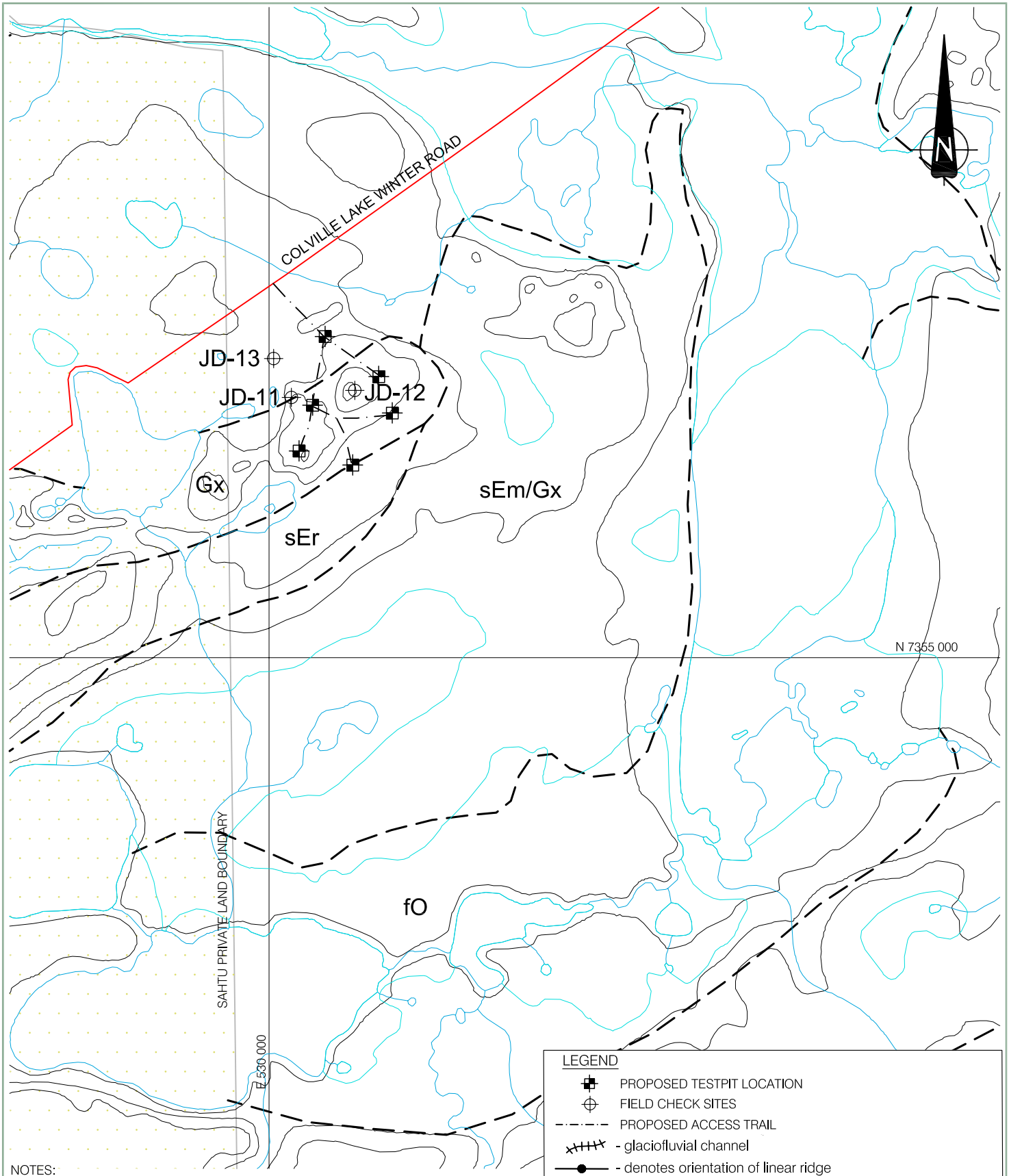
DWN. JSB / CHKD. JTD/JRT		TITLE: SITE MAP - DEPOSIT 20.112 FORT GOOD HOPE AREA	
EBA JOB NO. 1200209	FILE: 1200192 Figure 2.dwg	REVISION NO.: 1	DATE: October 2007	Figure 2



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DWN. JSB / CHKD. JTD/JRT		TITLE: SITE MAP - DEPOSIT 20.113 FORT GOOD HOPE AREA	
EBA JOB NO. 1200209	FILE: 1200209 Figure 3.dwg	REVISION NO.: 1	DATE: October 2007

Figure 3

LEGEND FOR SURFICIAL MATERIALS

Combined map units are used where two intermingled units cannot be delineated individually. The dominant unit (>50% of the map area) is followed by a "/" and the second unit (20-50% of the map area). "//" = 60-80% / 20-40% split.

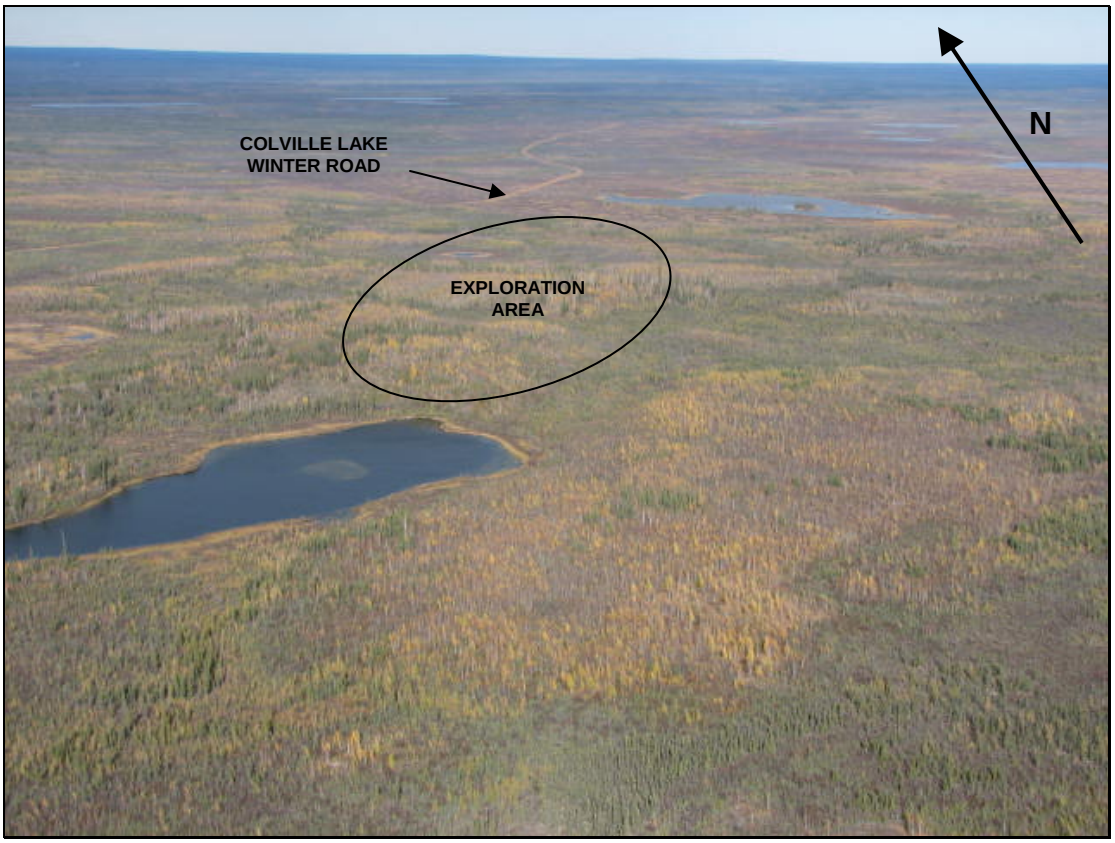
SYMBOL	DESCRIPTION	THICKNESS
Af	ALLUVIUM; sand, silt and minor gravel associated with modern drainage regime, occurring as fans and aprons.	
Ap	ALLUVIUM; coarse sand and gravel with silt and fine sand, occurring as channel and overbank floodplain sediments	3-5 m
Apf	ALLUVIUM; complex of Ap and Af; Ap is the dominant unit.	
Cx	COLLUVIUM; derived from bedrock or surficial material; slope complex consisting of a veneer to blanket of diamicton and rubble	
Gh	GLACIOFLUVIAL; sand and gravel ice contact deposits, hummocks	2-25 m
Gp	GLACIOFLUVIAL; sand and gravel outwash deposits with silt and peat in some channels, flat to gently sloping plain	2-20 m
Gr	GLACIOFLUVIAL; sand and gravel ice contact deposits, ridges	2-30 m
Ghr	GLACIOFLUVIAL; sand and gravel ice contact deposits, hummocky and ridged	
Gx	GLACIOFLUVIAL complex; undivided Gh, Gr and kettled Gp and Gt (terraced)	2-30 m
Lp	GLACIOLACUSTRINE (glacial lake) deposit; silt and clay with minor sand commonly overlain by a discontinuous veneer of organic deposits; thick sediments occurring as a flat to gently sloping plain	2- >15 m
Lp-K	GLACIOLACUSTRINE; contains thermokarst depressions	
Lx	LACUSTRINE complex or transitional between glaciofluvial and glaciolacustrine deposits with upper 0-5 m consisting of sand	
Mp	GLACIAL MORAINE; non-sorted silt, sand and clay with clasts (gravel) deposited by glacial ice; flat to gently sloping plain	3-20 m
pfMp	GLACIAL MORAINE; peatlands and fenlands make up 10-50% of map unit.	
Mv	GLACIAL MORAINE; non-sorted silt, sand and clay with clasts (gravel) deposited by glacial ice; veneer with slopes conforming to underlying bedrock topography	0-2 m
Mpv	GLACIAL MORAINE; non-sorted silt, sand and clay with clasts (gravel) deposited by glacial ice; Mp and Mv complex; Mp is the dominant unit	1-3 m
Mvd	GLACIAL MORAINE; non-sorted silt, sand and clay with clasts (gravel) deposited by glacial ice; thin till over glacially eroded streamlined bedrock ridges.	0-3 m
fO	ORGANICS; peat and muck occurring as flat to gently sloping plains; fenland, consisting of woody sedge peat.	2-3 m
pfO	ORGANICS; peat and muck occurring as flat to gently sloping plains; peatland (sphagnum peat generally underlain by woody sedge peat) and fenland undivided.	
pO-K	ORGANICS; peat and muck occurring as flat to gently sloping plains; peatland, sphagnum peat generally underlain by woody sedge peat; with thermokarst depressions	2-4 m
R	BEDROCK; prominent ridges, escarpments and hills of shale, sandstone and/or limestone.	
<<<<<	glaciofluvial esker ridge	
++++++	glaciofluvial meltwater channel	

After GSC, 1992.

PHOTOGRAPHS

Source 20.112. September 16, 2006. View of main sections of the esker landform.

Source 20.112. September 16, 2006. Soil texture at field site 20.112-JD-2.



Source 20.113. September 16, 2006. Overview of Source 20.113 Area.

APPENDIX A

APPENDIX A General Conditions *

GEOTECHNICAL REPORT – GENERAL CONDITIONS

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

1.0 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.

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2.0 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.

3.0 LOGS OF TESTHOLES

The testhole 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.

4.0 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.

5.0 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.

6.0 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.

7.0 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.

8.0 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.

9.0 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.

10.0 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.

11.0 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.

12.0 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.

13.0 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.

14.0 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.

15.0 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.