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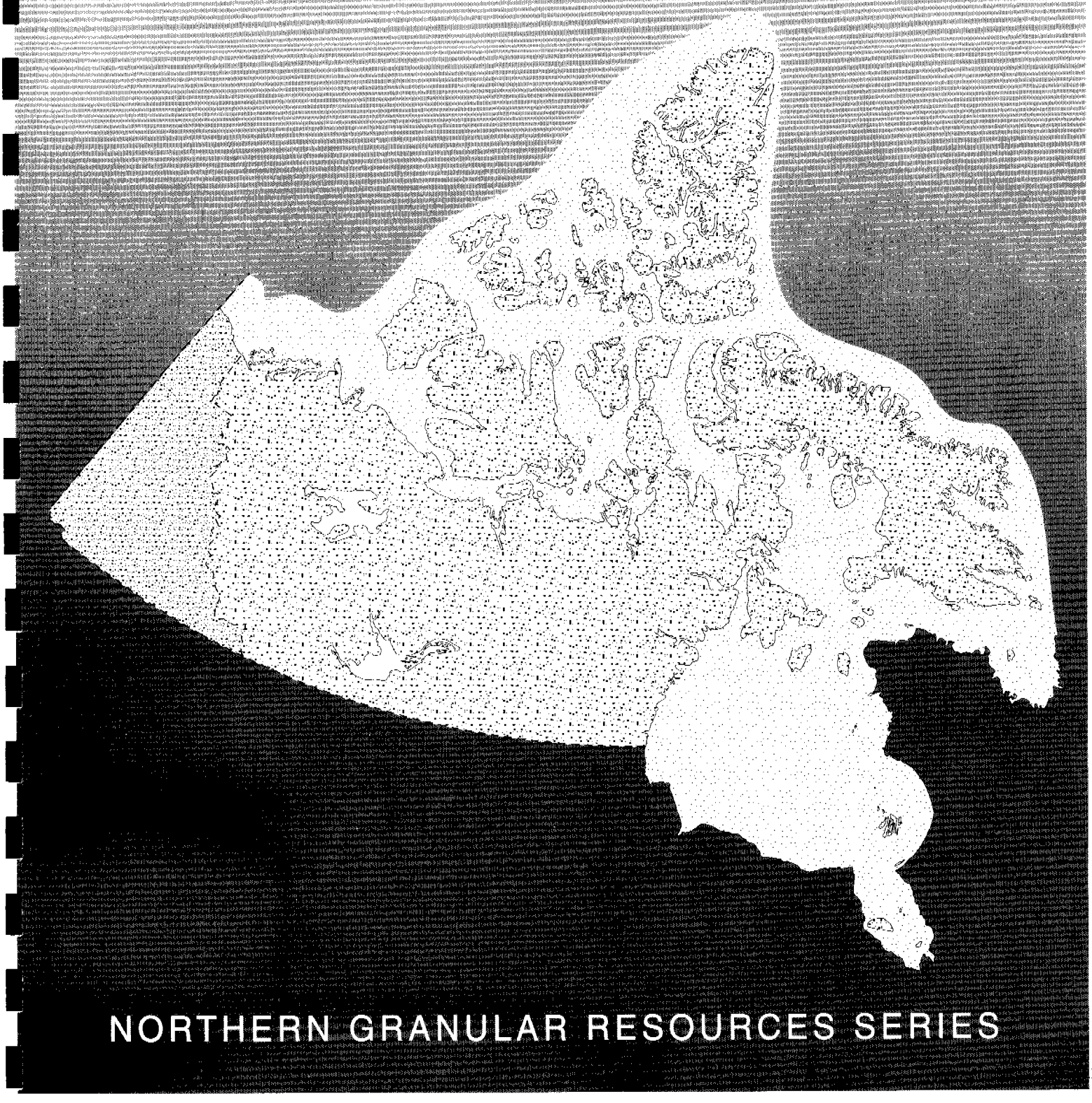
Creation of the Slave Province Geotechnical Database

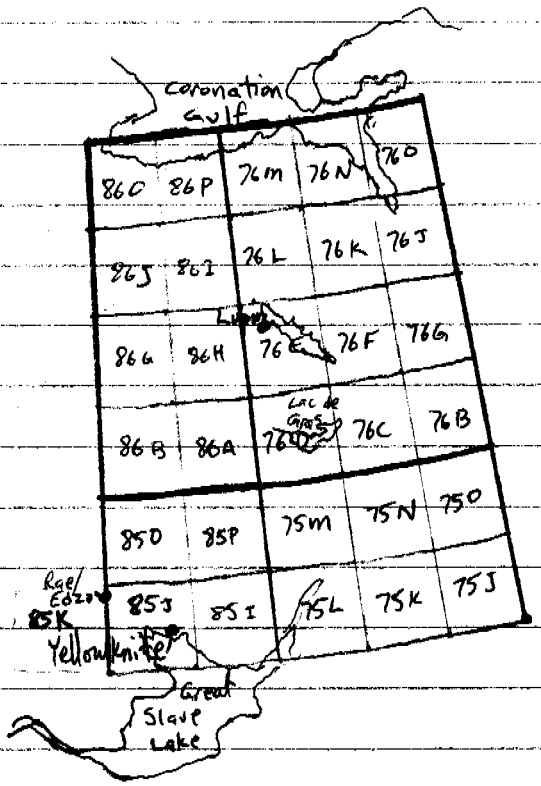


NORTHERN GRANULAR RESOURCES SERIES

SLAVE PROVINCE : NTS - SHEETS

85 - I - Hearne Lake
- J - Yellowknife
- K
- O - Wecho River
- P - Carp Lakes

86 - A - Wiser Lake
- B - Indin Lake
- G - Redrock Lake
- H - Point Lake
- I - Takiyuak Lake
- J - Hepburn Lake
- P - Kikerk Lake

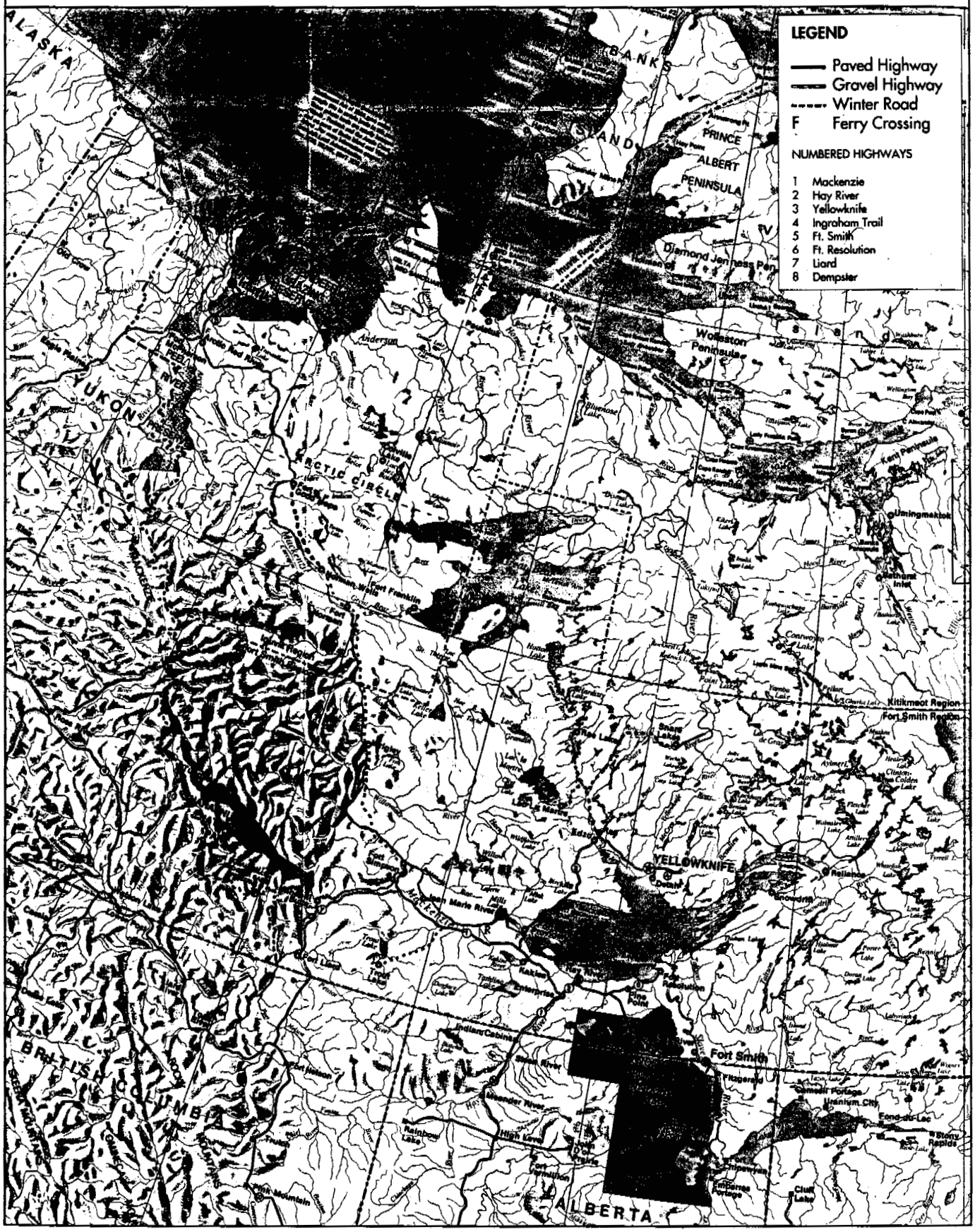


75 - J - Lynx Lake
- K - Fort Reliance
- L - Snowdrift
- M - Mackay Lake
- N - Walmsley Lake
- O - Artillery Lake

76 - B - Healey Lake
- C - Aylmer Lake
- D - Lac de Gras
- E - Contwoyto Lake
- F - Nose Lake
- G - Beechey Lake
- J - Tinney Hills
- K - Mara River
- L - Kathawachaga Lake

76 - M - Hepburn Island
- N - Arctic Sound
- O - Rideout Island.

NORTHWEST TERRITORIES HIGHWAYS



Creation of the Slave Province Geotechnical Database

Prepared for
Land Management Division, Natural Resources & Environment Branch,
Department of Indian Affairs & Northern Development

by
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May 10, 1996

Executive Summary

The Slave Structural Province is a region of enormous development potential. Several communities and mines already exist in this mostly undeveloped region, but the near future may see several new mines being built, bringing jobs and revenue to the Northwest Territories.

One requirement for the building of structures in this permafrost environment is an insulating granular pad. Granular resources must be identified and evaluated with respect to this purpose. Geotechnical site investigations are usually completed for granular evaluations, but this information is not often available to the primary users of the granular resources in a format that would increase general knowledge of the deposits.

This report initiated the compilation of the Slave Province Geotechnical Database, an ESEBase database of all geotechnical data gathered to date in the Slave Province. The database will be a useful reference to the NWT mining industry, the West Kitikmeot Slave Study, and other government departments.

The task of assembling the database required extensive library and file searches, both at DIAND Headquarters, and at the Yellowknife Regional Office. Several sources were investigated in order to recover reports containing geotechnical data suitable for inclusion in the Slave Province Geotechnical Database. These sources include Territorial Land Use Permits, Mining Assessment Reports, and searches of bibliographic databases.

The Slave Province Geotechnical Database now contains 137 borehole logs from eight technical papers. Four additional reports have been identified as containing geotechnical data that should also be included.

Through the investigation of the potential sources of geotechnical data, many possible sources of information were unavailable for viewing within the limited duration of this project. These reports should be sought out and reviewed for geotechnical content applicable to the Slave Province Geotechnical Database. As well, many past developments would have required some geotechnical site investigation, but no pertinent information is on record in the public domain. In these cases, the owners of the developments, and/or the consultant company who supervised the work, should be contacted and asked to contribute any geotechnical data that they may possess. Any support-in-kind contributions made to the Slave Province Geotechnical Database should be recognized by the West Kitikmeot Slave Study.

Acknowledgements

I would like to sincerely thank all of those who assisted with the production of this report. Mr. Bob Gowan, of DIAND's Land Management Division, gave full support throughout the duration of the research and preparation of the paper, and his comments and guidance are greatly appreciated. Mr. Stephen Traynor, of DIAND's NWT Land's Administration Division, co-ordinated portions of the research work that were completed in the Yellowknife Offices. Many thanks are also due to the staff of the Land Admistration Division in the NWT Regional offices, for assistance in searching the regional filing system, especially Charlene Coe and Stacey O'Donnell. Mr. Tom Caine provided invaluable information, both verbally and in literature, on mineral exploration and development in the Slave Province, and Mr. Steve Rozak provided technical assistance in preparation of maps and graphics.

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1

Introduction

The Slave Geological Province is part of the northwestern Canadian Shield, and is located in central Northwest Territories. It is often viewed as a vast barrenland, but those who look through the window of opportunity see enormous mineral potential. It is composed of Precambrian rocks which are host to many different economic minerals, such as gold, silver, copper, zinc, lead, and, most recently discovered, diamonds. While there are several operating mines in the Slave Province, this vast quantity of resources remain largely untapped, due to the isolated location of the Slave Province, and the associated lack of infrastructure.

In recent years, exploration activity has increased in the area, and several large deposits have been discovered. These deposits could be mined economically, if adequate infrastructure was available. The Izok Lake base metal project is one such deposit. This project has undergone environmental and engineering evaluations, but has been put on hold, probably until a 300 km long road can be built to tide water on Coronation Gulf. This road would require large quantities of granular materials, as would the plant site of such a mine. If a road were to be constructed, other economic activity would increase greatly in the area, due to the access the road would provide. This activity would in turn generate large revenues for both the territorial and federal governments.

With all of the current exploration activity in the Slave Province, it is surely only a matter of time before more development is proposed for the area. Any development will have large associated granular requirements, because the majority of the Slave Province is positioned in the zone of continuous permafrost. Building in this region requires special consideration of frost heaving and differential settling due to the thawing of underlying permafrost. Insulating granular pads must be laid below any type of heated structure or ones designed to carry significant loads. The larger the site, the greater the granular requirements.

For development to proceed in an efficient and sustainable manner, granular deposits must be identified and evaluated with respect to volume, grade, and structural properties. The best way to accomplish this is through geotechnical borehole drilling of potential granular targets, often identified by remote sensing techniques. Many deposits have been identified through airphoto interpretation (J.D. Mollard & Associates Ltd., 1993 and 1994), and some have been field checked and surface sampled (Boles, 1995; Harrison, 1994; and Mueller, 1995), but little is known about conditions at depth. In order to develop a better understanding of subsurface conditions, an effort has been initiated here to create the "Slave Province Geotechnical Database", a database of all geotechnical borehole logs that have been drilled to date in the Slave Province. Such sources of geotechnical information are site investigations of proposed developments, existing and abandoned mine sites, tourist lodges, roads, and scientific research. A database of all available geotechnical borehole logs would greatly improve knowledge of surficial deposits, and potentially save time and money for those who require the granular materials[1].

[1] Potential users of the geotechnical database are reminded that this information is assembled for reference purposes only, and should not be assumed to be precisely accurate. While an attempt has been made to duplicate information contained on the original logs, it is inevitable that some differences will occur, or that disclaimers or qualifiers contained elsewhere in the original reports may apply to this information. The original logs shall remain the authoritative source. The user should consult the original logs to verify the database information. The user is requested to report any discrepancies to: Geotechnical Advisor, NREB, INAC, 10 Wellington St, Hull, PQ, K1A 0H4, ph : (819) 953-5835, FAX : (819) 953-2590, email : LandCo.LandCo@INAC.inac-ainc.x400.gc.ca.

The Slave Province Geotechnical Database will likely be of use immediately on its completion as a reference material for the West Kitikmeot Slave Study (WKSS). This project is jointly sponsored and funded by both Federal and Territorial Governments, aboriginal groups, and industry. One of the goals of the study is to assemble all available information on the Region, to assist in better understanding its biophysical setting and potential cummulative impacts of continued development. DIAND's NWT Region has submitted a proposal for an esker management study. A better understanding of the quantity and quality of granular materials available with respect to eskers will require consideration of geotechnical borehole data.

A brief overview of the Slave Province and development within it is given. This is intended to show both the potential sources of existing borehole information, and to indicate the potential demand for this information as development proceeds in the future. The procedure of acquiring geotechnical borehole logs, and associated information is outlined, with a description of the database and its contents following. Several recommendations have been made with the hopes of making the Slave Province geotechnical database as complete and up to date as possible.

2

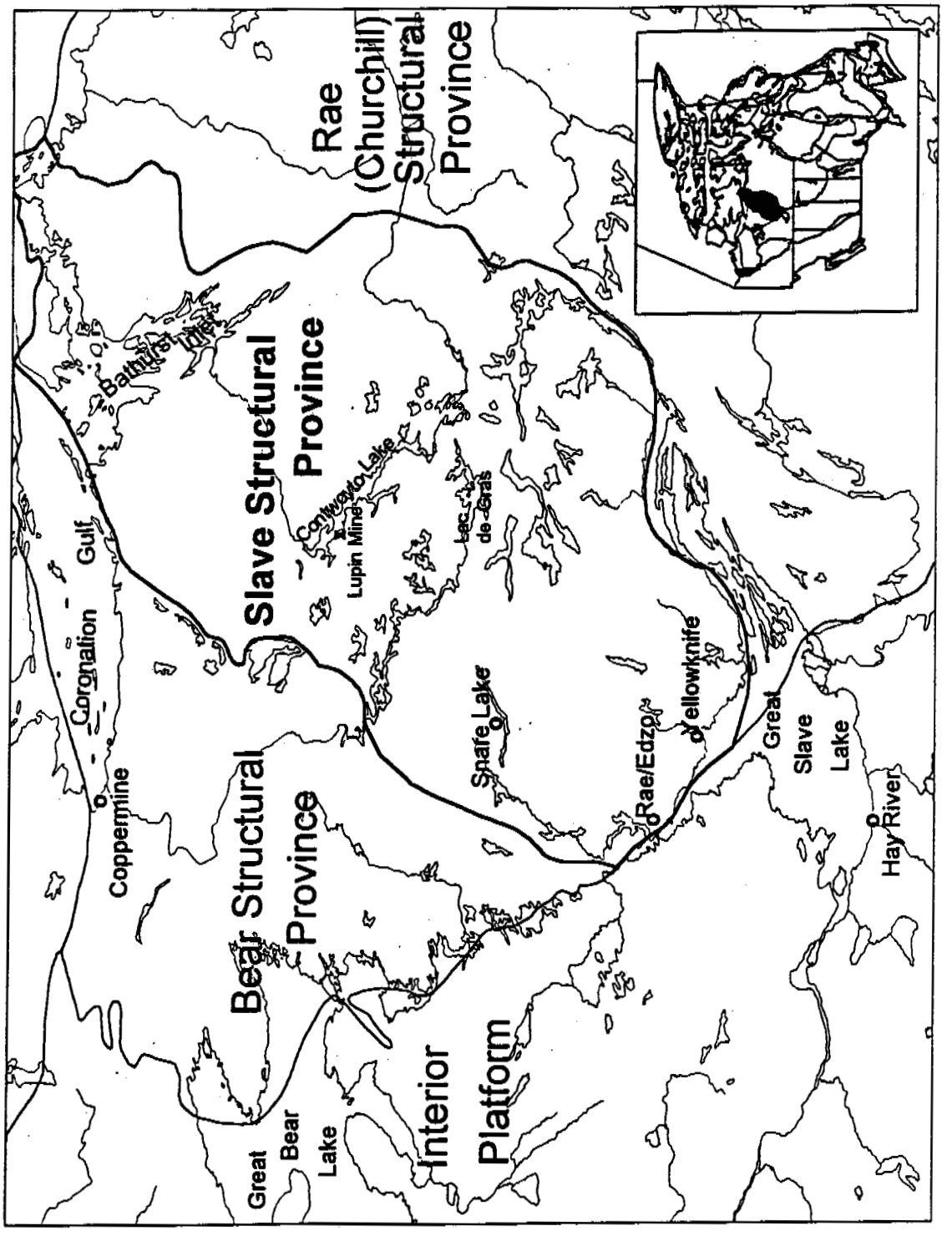
The Slave Geological Province

2.1 Geology

The Slave Structural Province of the northwestern Canadian Shield, occupies an area of approximately 225 000 sq. km. between Great Slave Lake and Coronation Gulf (Atkinson et al., 1995) (Fig. 2.1). About one third of the Slave Province is underlain by highly deformed, variably metamorphosed Archaean supracrustal rocks, with granitic complexes making up the remaining two thirds. The supracrustal rocks are composed mostly of greywacke-mudstone turbidite sediments overlying subaqueous mafic volcanics, while the granitic rocks consist of migmatites, mixed gneisses and granitic gneisses. These rocks have been radiometrically dated to 2.4 - 2.7 billion years, which suggests that formation of the Slave Province occurred during the Kenoran Orogeny (McGlynn and Henderson, 1972).

The Slave Province has undergone intense glacial deformation, evidenced by the thin, discontinuous glacial drift, and the predominance of exposed bedrock. The most recent glacial episode to mold the Slave Province was the Wisconsin, which began approximately 100 000 years ago, lasting until only 10 000 to 9 000 years

Figure 2.1 - Slave Structural Province, N.W.T.



ago (Dyke and Dredge, 1989). Evidence of this glaciation is widespread, in the form of broad esker systems, outwash plains, kames, and kettle holes and lakes. It is the glacial deposits such as eskers and outwash plains that provide the important granular materials required for building and development in this permafrost environment.

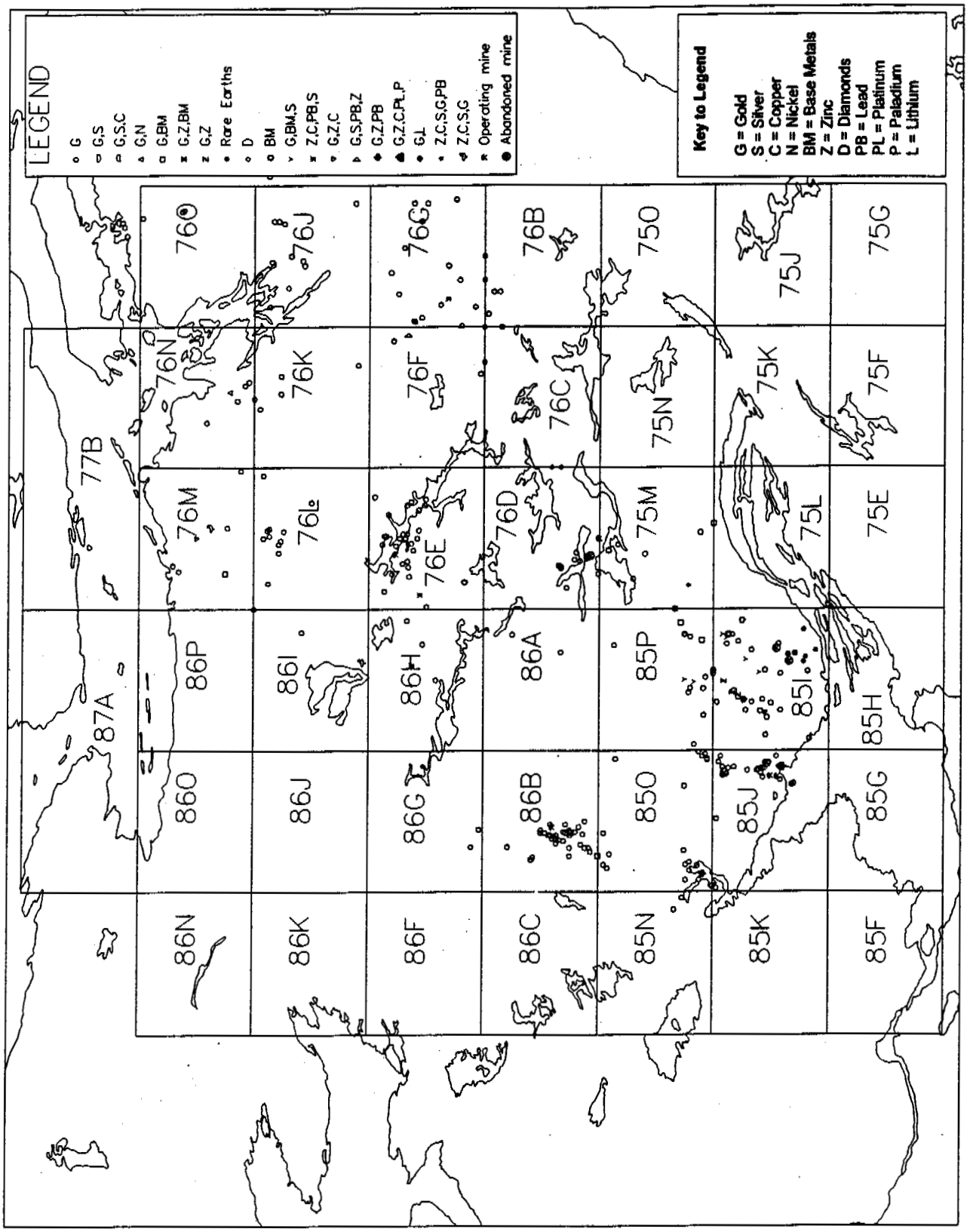
The Slave Province is host to many mineral deposits, including iron formation hosted gold, shear hosted gold, quartz veins containing gold, volcanogenic massive sulphide deposits, rare earth pegmatites, and diamond bearing kimberlite pipes (Atkinson et al., 1995). A summary of mineral deposits in the Slave Province has been compiled in a flat file database (Dbase III format) entitled Slave Province Minerals Database - 1989 (filename "Minerals.dbf"), using the most up-to-date information available, given in the DIAND publication "Mineral Industry Report 1988-89 - Northwest Territories". Unfortunately, this data set does not contain the recent boom in diamond exploration, but several known diamond deposits have been included. Locations of the identified mineral occurrences are shown on a map in Figure 2.2.

2.2 Existing Development

2.2.1 Mines

At the time of writing in early 1996, there were six operating mines in the Slave Geological Province, all recovering gold. A brief description of each is given below, and their locations can be seen on Figure 2.2. Table 2.1 gives a summary of the six mines. There are a number of abandoned mines in the Slave Province as well, such as the Discovery, Salmita, Tundra, and Bullmoose mines, which also brought gold to the surface.

Figure 2.2 - Slave Province Mines and Mineral Deposits, with NTS Grid.



Name	Operator	Latitude	Longitude	Commodity	Forecasted Closure*
Lupin	Echo Bay Mines Ltd.	65° 46'N	111° 13'W	Gold/silver	1998
Giant	Royal Oak Mines Ltd.	62° 30'N	114° 22'W	Gold	2000
Con	Miramar Mining Corp.	62° 26'N	114° 22'W	Gold/silver	2004
Mon	Ger-Mac Contracting Ltd.	62° 54'N	114° 19'W	Gold	2000
Ptarmigan	Treminco Resources Ltd.	64° 00'N	111° 00'W	Gold	1996
Colomac	Royal Oak Mines Ltd.	64° 24'N	115° 05'W	Gold	2001

*Source : Bernard et al., 1995, p. 15.

Table 2.1 - Existing Mines in the Slave Province

2.2.1.1 Lupin Mine

The Lupin Mine, operated be Echo Bay Mines Ltd., is located approximately 400 km north-northeast of Yellowknife on the southwest shore of Contwoyto Lake. The gold and silver deposit was initially discovered in 1960, and production from the underground mine began in 1982. The mine is serviced by a gravel airstrip, as well as a 580 km winter road from Yellowknife, which is usually open from February to April (Ellis and Hearn, 1990). As of early 1994, the mine had reserves of 2.67 million tonnes grading 8.6 grams gold/tonne (DIAND, 1994), which would allow the mine to continue operating at the present scale of operations until 1998 (Bernard et al., 1995). Life of the mine is expected to increase when ore from the Ulu property (described in Section 2.3.3) is transported to the facilities already in place at the Lupin site for processing. Also, plans have been made for a kimberlite processing facility to be constructed at the Lupin Mine site in the near future.

2.2.1.2 Giant Mine

The Giant Gold Mine, located 2.4 km north of Yellowknife, is operated by Royal Oak Mines Inc. The deposit was discovered in 1935, and production began in 1939. Operations have occurred both underground and in open pits (Ellis and Hearn, 1990). In early 1994, the mine had reserves of 2.36 million tonnes, with a grade of 10.97 grams gold/tonne (DIAND, 1994). Reserves of this extent will allow the mine to operate at the present scale until the year 2000 (Bernard et al., 1995).

2.2.1.3 Con Mine

The Con Mine is located 1.4 km south of Yellowknife. It is operated by the Miramar Mining Corp. who purchased the mine in 1993 from NERCO Con Mine Ltd. The gold/silver deposit was discovered in 1935, with underground production beginning in 1938 (Ellis and Hearn, 1990). Proven reserves were 3.36 million tonnes in early 1994, grading 10.62 grams gold/tonne (DIAND, 1994). It has been estimated that these reserves will last until 2004 (Bernard et al., 1995).

2.2.1.4 Mon Mine

The underground Mon Mine is operated by Ger-Mac Contracting Ltd., and is located 48 km north of Yellowknife. This gold deposit was discovered in 1937, and seasonal mining began in 1992, for about four months per year (Ellis and Hearn, 1990). Reserve estimates were unavailable at the time of writing, but it has been predicted that the mine will remain open until the year 2000 (Bernard et al., 1995).

2.2.1.5 Ptarmigan Mine

This underground gold mine is located 21 km northeast of Yellowknife, and is operated by Treminco Resources Ltd. The deposit was discovered in 1936, and

production began in 1986 (Ellis and Hearn, 1990). As of mid-1993, reserves were 55 000 tonnes of grade 8.57 grams gold/tonne (DIAND, 1994). These reserves are small, and it has been predicted that the Ptarmigan mine will close in the very near future (possibly 1996).

2.2.1.6 Colomac Mine

The Colomac Mine is an underground gold mine operated by Royal Oak Mines Inc. It is located approximately 215 km north of Yellowknife, 50 km northwest of Snare Lake, and is accessed by a winter road from Rae/Edzo. The deposit was discovered in 1945, and was opened for a short time in 1989. The mine was reopened for production in 1993, with reserves of 26.7 million tonnes at 1.56 grams gold/tonne (Caine, 1993). Current reserves will allow the mine to remain open until 2001(Bernard et al., 1995). Royal Oak Mines Inc. is planning to increase the life expectancy of the Colomac Mine by constructing a 20 km all-weather road conecting the Kim/Cass gold deposit (to the southwest) to the existing processing facilities at Colomac. While the Kim/Cass deposit would not be economical by itself, it will make an excellent satellite deposit for the Colomac Mine.

2.2.2 Communities

The Slave Province is a largely unpopulated area, with most of its estimated (1995) population of less than 20 000, based in Yellowknife. The remainder live in the four established Dene communities of Rae/Edzo, Snare Lake, N'dilo, and Dettah. Table 2.2 is a summary of the five communities in the Slave Province. All population estimates are from BHP (1995).

Name	Latitude	Longitude	Estimated 1995 Population	Proximity to Yellowknife (km)
Yellowknife	62° 27'N	114° 22'W	17,350	na
Rae/Edzo	62° 50'N	116° 03'W	1,963	113
N'dilo	62° 27'N	114° 22'W	138	3
Dettah	62° 25'N	114° 18'W	156	27(road), 6(water)
Snare Lake	64° 11'N	114° 11'W	128	200

Table 2.2 - Existing Communities in the Slave Province

2.2.2.1 Yellowknife

Yellowknife is the largest community and capital of the Northwest Territories, having a population of about 17 350 in 1995 (BHP, 1995). Located on the west shore of Yellowknife Bay on Great Slave Lake, about 1500 km north of Edmonton, AB, Yellowknife is a major point in the shipping of goods to smaller communities in the NWT. Several major gold mines and deposits are located just outside of Yellowknife, which lead to the initial settlement of the city in the 1940's. On January 1, 1970, Yellowknife was incorporated as the first city in the Northwest Territories. Yellowknife is connected by the all-weather Yellowknife Highway to Rae/Edzo, and to the Mackenzie Highway which travels to Hay River, as well as cities to the south. Granular supplies for Yellowknife are usually explored, developed, and managed by the municipal government and private sector organizations. Information on past usage, available sources and forecasted demands were unavailable at the time of writing.

2.2.2.2 Rae/Edzo

The community of Rae/Edzo is located 113 air km northwest of Yellowknife on Marion Lake. This Dogrib settlement of 1 693 people was incorporated on April 1,

1975, and is the largest Dene community in the NWT. It is connected to Yellowknife by the Yellowknife Highway, which also adjoins the Mackenzie Highway to the south. As of 1990, Rae/Edzo had two granular borrow sites in use. According to a study by GNWT Public Work (Collins, 1991), the Russell Lake Pit is located about 6.5 km north of Rae, and the Edzo sand pit is approximately one km from Edzo on Highway #3. It was thought that these sources would be exhausted in the early 1990's. Several potential alternative sources were identified in the above study. At least one is most likely to be in current use. It was estimated in 1990, that the 20 year demand for granular materials in Rae/Edzo would be 360 000 m^3 (GVM Geological Consultants Ltd., 1995).

2.2.2.3 N'dilo

The Dene settlement of N'dilo is located a few kilometres from Yellowknife, on a narrow island in Yellowknife Bay. This community has a population of 138, and is closely tied to Yellowknife, both for employment, and supplies. Granular needs for N'dilo are met by the stocks for Yellowknife.

2.2.2.4 Dettah

Dettah is located on the east side of Yellowknife Bay, being 27 km from Yellowknife by all-weather road, or 6 km by water or winter road. This community has a population of 156, and is also closely tied with Yellowknife. As with N'dilo, Dettah's granular needs are met by the stocks for Yellowknife.

2.2.2.5 Snare Lake

Snare Lake has a population of 128, and is located 200 km north of Yellowknife on Snare Lake. Snare Lake is part of the Snare River System, which houses several hydroelectric power plants, supplying electricity to Yellowknife, Rae/Edzo, and

several mines. Access to Snare Lake is by air from Yellowknife, with a land-based airport being constructed in 1994-95. Estimates of granular requirements were unavailable at the time of writing, but several potential sources of varying quality granular materials have been identified in a report by GVM Geological Consultants Ltd. (1995).

2.3 Potential Future Development

While most mineral deposits in the Slave Province are uneconomical at the current market conditions, several are in a stage of advanced exploration, and are in good positions to developed in the near future. Also, a hydroelectric plant on the Snare River is in the planning and pre-development stage. Table 2.3 summarized these potential developments, and they are described more fully below. Details of the mineral deposits are from Department of Energy, Mines, and Petroleum Resources (1995).

2.3.1 Koala Lake

The Koala Lake area, located off Lac de Gras, is the home of many diamondiferous kimberlite pipes. BHP Minerals Canada Ltd. operates the property, and has conducted extensive environmental and geotechnical studies of the claim. A bulk sampling program has been completed, yielding very promising results. BHP is now awaiting final government approval for the development of this site, and hopes to be the first producing diamond mine in Canada by 1998. Operations will commence as open pit mining, and will progress underground as required.

Name/ Location	Developer	Latitude	Longitude	Commodity	Comments
Koala Lake	BHP Minerals Canada Ltd.	64° 43'N	110° 36'W	Diamonds	waiting final gov't approval
Izok Lake	Inmet Mining Corp.	65° 38'N	112° 48'W	Base Metals	feasibility study completed
Ulu	Echo Bay Mines Ltd.	66° 55'N	110° 00'W	Gold	underground workings
Damoti Lake	Consolidated Ramrod Gold Corp.	64° 10'N	115° 05'W	Gold	
Nicholas Lake	Royal Oak Mine Ltd.	63° 15'N	113° 46'W	Gold	
Discovery	GMD Resource Corp.	62° 54'N	114° 19'W	Gold	underground workings
Tundra (Fat)	Hemlo Gold Mines Ltd.	64° 07'N	111° 16'W	Gold	largest undevel. gold deposit in N.W.T.
George Lake	Homestake Canada Inc.	63° 56'N	107° 26'W	Gold	
Boston	BHP Minerals Canada Ltd.	67° 37'N	106° 21'W	Gold	bulk sampled underground
Hackett River	Cominco Ltd.	65° 56'N	108° 28'W	Base Metals	
Diavik	Kennecott Canada Ltd.	64° 16'N	110° 06'W	Diamonds	
Jericho	Lytton Minerals Ltd.	66° 00'N	111° 30'W	Diamonds	bulk sampling in 1996
Snare Cascades	NWT Power Corp.	63° 25'N	116° 13'W	Hydro-electricity	

Table 2.3 - Potential Development in the Slave Province

2.3.2 Izok Lake

The Izok Lake base metal deposit is located some 70 km west of the Lupin Mine, and is owned by Inmet Mining Corporation (formerly Metall Mining Corp.). This

deposit underwent environmental and feasibility studies in the early 1990's, and plans were made for the mine site, a port site on the Coronation Gulf, and for a haul road between the two. Unfortunately, the cost of construction of a 300 km long road to tide water is too expensive for the mine to be economically feasible at current base metal prices.

2.3.3 Ulu

The Ulu property is a gold deposit owned by Echo Bay Mines Inc., who purchased it from BHP Minerals Canada Ltd. This deposit is located 205 km east-southeast of Coppermine, and approximately 120 km north of the Lupin Mine. It has been proposed that when this deposit is mined, the ore should be trucked (via a winter road) to the Lupin mine for processing. This would be much more economical than constructing processing facilities at the Ulu site.

2.3.4 Damoti Lake

The Damoti Lake gold deposit is located 190 km north of Yellowknife, and only 12 km southwest of the Colomac Mine Winter Road. The property is owned by the Consolidated Ramrod Gold Corporation, who have undertaken an extensive drilling exploration program of the deposit since 1993. Development of the property would involve construction of all facilities, such as tailings ponds, a processing plant, and accomodations.

2.3.5 Nicholas Lake

The Nicholas Lake property is host to a gold deposit owned by Royal Oak Mines Ltd. It is located 90 km north of Yellowknife, 10 km northeast of the closed

Discovery Mine site. Upon development of the deposit, Royal Oak Mines Ltd. plans to truck to ore to it's Giant Mine facilities for processing. Transportation of the ore would likely be on a winter road. This would significantly reduce the on-site facilities required to support the mine.

2.3.6 Discovery

The Discovery gold deposit has been actively mined in the past, but was closed in the 1960's. Renewed interest in this property by the GMD Resource Corporation has lead to further exploration of the area. Unfortunately, the old Discovery Mine site has been dismantled, requiring complete reconstruction for revived mining activity on the property.

2.3.7 Tundra (Fat)

The Tundra (Fat) deposit is the largest undeveloped gold deposit in the N.W.T. It is located 230 km northeast of Yellowknife, and very close to two past producing gold mines - Salmita and Tundra. Infrastructure is still available from these closed mines, with a 1350 m airstrip located 5 km to the southeast and an inactive 160 tonne per day mill 5 km to the south at Salmita. Roads are also present, connecting the deposit to the abandoned mine sites and the airstrip. What is now the south section of the Lupin Winter Road was originally used to service the Tundra Mine. Exploration work was done on the property by Hemlo Gold Mines, Inc., over 1988-89, but little has been done since.

2.3.8 George Lake

The George Lake gold deposit is operated by Homestake Canada Inc., and is located 175 km east of the Lupin Mine, and 100 km south of Bathurst Inlet. Exploration drilling of the property was intense from 1983-91, but has since subsided. Development of this property would require all processing and support facilities to be constructed. No infrastructure is available to access the property at the present time.

2.3.9 Boston

The Boston gold property is owned by BHP Minerals Canada Ltd., and is located 170 km south-southeast of Cambridge Bay. 1991-94 saw a major exploration program being conducted on the property, with detailed mapping being completed. A 16, 000 tonne bulk sample has been processed, yielding high quality results. Mining of the deposit would require all facilities to be constructed on-site.

2.3.10 Hackett River

The Hackett River base metal deposit is owned by Cominco Ltd., and is situated 125 km east of the Lupin Mine. The property was the home of major exploration from the mid 1960's to the mid 1970's, with a preliminary economic study being completed in 1976. Activity subsided until Cominco again began a diamond drilling exploration program in 1993. Access to the site is limited, and facilities would need to be constructed for the deposit to be mined.

2.3.11 Diavik

A second potential diamond mine in the Lac de Gras area is at the Diavik property, owned by Kennecott Canada Ltd. This property has seen very much exploration, and several kimberlite pipes have been bulk sampled. Information released to date indicates that the pipes are very similar in diamond quantity and quality to the pipes at the Koala Lake propery. Kennecott Canada Ltd. hopes to be the second diamond mine in Canada, with expectations of coming into production a few years behind BHP's Koala Lake kimberlites.

2.3.12 Jericho

Another diamondiferous kimberlite is being explored by Canamera Geological for Lytton Minerals Ltd. The Jericho property is located 80 km north of Lupin Mine, and is accessed by the extension of the Lupin Winter Road to the Ulu property (Section 2.3.3). A bulk sampling program is being conducted in 1996, with the expectations of high quality results, comparable to those at the Koala Lake and Diavik properties.

2.3.13 Other Diamond Deposits

Diamond exploration activity in the Slave Province has boomed in recent years, with many kimberlite pipes being discovered and drilled in hopes of recovering economical quantities of diamond. The Lac de Gras Region has been the major focus of such activity, with the above mentioned Koala Lake kimberlites (Section 2.3.1), along with many other less advanced sites being explored.

2.3.14 Snare Cascades Hydro

The Snare Cascades Hydroelectric Development is a proposed site on the Snare River System for a hydroelectric power plant. Several reports have been prepared for the project, including W.F.Kelly & Associates (1975), and Thurber Engineering Ltd. (1991) (see Section 4.1.4). This hydroelectric plant would provide additional power to Yellowknife, and to several mines in the area. A geotechnical site investigation has been performed, with a winter road to the Snare Falls Hydroelectric plant, located three kilometres upstream, providing access to the site.

3

Methodology / Procedure

The task of finding and obtaining copies of reports containing geotechnical borehole data and logs was a lengthy one. Before the project was undertaken, it was known that formal published reports on granular resources of the Slave Province were not abundant, and that obtaining unpublished reports and other "gray literature" would require both library searches, as well as file searches. Several methods were used to attempt to track down any relevant reports or documents. The most important part of this procedure was to become familiar with the study area, both geographically and historically. This aided in recognition of potential sources of information on the Slave Province without requiring the phrase "Slave Province" to be present. With some familiarity of the area, the list of keywords was expanded considerably, so that literature searches, reviews of references, and browsing of files could be completed effectively and efficiently, with less risk of passing over possible sources. Upon identification of the most likely sources, they were then tracked down and scanned for geotechnical data, or reference to another report containing such data. Once data was found, copies were made, and the borehole log database was created on return to HQ. The preparatory work was especially important to this project because most of the information to be reviewed was located in the DIAND Yellowknife office. This necessitated a two week trip to

Yellowknife in March, 1996 (with an additional two weeks spent on the field program referred to in Section 4.2).

3.1 Orientation

An important part of any research project is becoming familiar with the study area. Learning the names of communities, mines, lakes, and rivers helps greatly when doing a literature search. Similarly, the names of the NTS Map Sheets of the area, and of any proposed development projects and their developers also help when searching for literature. The name of a lake may show up as a proposed mine site, and recognizing the name may lead to a report containing a wealth of geotechnical information.

Familiarity of the area was accomplished in several steps. First, the study area was outlined in terms of NTS Map Sheets. The NTS grid was digitized in the QUIKMap Mapping package and can be seen on Figure 2.2.

Following identification of the pertinent NTS Sheets, mines and mineral claims in the area were reviewed by "studying" the DIAND publication entitled "Mineral Industry Report - 1986 - 87", and the same publication for 1988 - 89. Sections on Operating Mines and the Slave Province were reviewed in both volumes, and all mines and mineral claims were entered into the "Slave Province Minerals Database - 1989" flat file database. When available, information such as latitude and longitude, claim name, claim holder name, commodity, and discovery date were recorded for all claims, and additional data of opening date and closing date (if applicable) were entered for mines. The "Slave Province Minerals Database - 1989" contains 307 records of mineral claims and operating or abandoned mines. A sample record from this database is found in Appendix I. Locations of mines and mineral occurrences are plotted on Figure 2.2.

3.2 Literature Search

3.2.1 Libraries and Databases

Initially, the DIAND Departmental Library's on-line catalogue was searched using such keywords as NTS sheet names, community names, mine names, mineral claim names, company names, names of major lakes and rivers, and other development prospects in the Slave Province. Results of the on-line searches were viewed on the screen, and potential sources of geotechnical information were noted. When available from the Headquarters Library, the documents were checked-out and reviewed. When held in district libraries, interlibrary loan requests were made, and documents were received in a few days, then reviewed.

Upon studying the documents and reports, copies were made when the report contained geotechnical data. Reference lists contained in these reports were also reviewed, in hopes of finding other papers of geotechnical significance. These report names and authors were recorded, and attempts were made through the on-line catalogue to recover them. Often, the reports identified through references were internal reports for consultant or exploration companies, and have not been filed with DIAND, so copies must be obtained through the owner of the report.

Several trips were made to the Canadian Geoscience Library located in the Geological Survey of Canada building in Ottawa. Searches were performed using the GeoRef CD-Rom set, and the GeoScan and Arctic Science and Technology Information System (ASTIS) bibliographic databases. Several papers discussing the geology of the Slave Province were located, but geotechnical information was not found.

The GeoScan keyword search was performed by GSC library staff, using keywords of soil sampling, geotechnical drilling, sand, gravel, glacial deposits, and overburden drilling. Results of this search were forwarded on floppy disk, and re-searched for possible geotechnical sources by the author. The GeoScan search resulted in 245 potential sources, which was narrowed down to 18 references which seemed to have the highest probability of containing geotechnical information. These reports included seven Mining Assessment Reports, four Economic Geology Series (EGS) reports, five GSC papers and open files, and two reports from other sources. The reports available in Ottawa/Hull were viewed without success .

3.2.2 Mining Assessment Reports and Economic Geology Series Reports

Mining Assessment Reports, and EGS Reports are available for review in the DIAND Yellowknife Office, and were studied there. The EGS reports were found to be of little help in contributing to a borehole database, but one of the Mining Assessment Reports contained six geotechnical borehole logs, which were photocopied and entered into the borehole database. Mining Assessment Reports filed within the past three years remain confidential, and are thus unavailable for public viewing. None of the reports identified were confidential, so this was not an issue.

The "Index to Mining Assessment Reports - 1986", was reviewed as well. This index is organized by NTS Sheet number, and contains the report number, company, and a list of keywords of the topics covered in the reports. Thirty-seven reports were identified as possibly containing geotechnical information, but with the limited time available at the DIAND Yellowknife office, none of these reports were investigated. A list of all potential Mining Assessment Reports and EGS papers, showing the report number, NTS Sheet number, company, key words, and source of the reference is found in Appendix II. Reports that have been reviewed are noted.

3.2.3 Land Use Permit Files

Another potential source of information on geotechnical site investigations is Territorial Land Use Permit (LUP) Files. LUP's must be issued by the DIAND Yellowknife Office before any work can be done on a parcel of Crown land. These permits include information such as the type of work to be done, equipment used, personnel, area to be worked, along with other administrative details. Records of these files are kept on paper until the permit is closed, at which time it is microfilmed and archived. Ledgers are kept of the LUP permits, listing permit number, company, location of area to be worked, type of work to be done, and associated fees for land use. The permit numbers are in the form of seven characters - an administrative letter N, the last two digits of the year applied for (eg. 1996), a descriptive letter code for type of work (eg. K for Hydro Projects), and a three digit permit number. For example, N96K472 would be a LUP for a hydro project applied for in the year 1996. Table 3.1 lists the Type of Work letter codes (fourth character in the LUP number) that were recorded as potentially containing geotechnical borehole information.

Two LUP ledgers were available for reviewing at the DIAND Yellowknife Office, each containing thousands of entries. The first ledger covers March, 1977 to December, 1989, with the second covering January, 1990 to the present.

Upon examination of the first ledger, seventy-one LUP's were identified as possibly containing geotechnical information. Of these seventy-one potential sources, thirty-two were unavailable, and five were for winter roads[2]. Of the remaining thirty-four records available on microfiche, none contained geotechnical information in the file, but several were for developments that would have required some sort of

[2] Several winter road LUP's represent recurring activities on the same corridors.

Letter Code	Type of Work
E	Public Road
F	Private Road
G	Airstrips
J	Campsites
K	Hydro Projects
N	Research
Q	Quarrying
S	Geotechnical / Soil Testing

Table 3.1 - Land Use Permit Type of Work Letter Codes

geotechnical site investigation. These include permits for constructing airstrips, roads, mine sites, and tailings ponds.

The second LUP ledger for January, 1990, to the present included some seventy-five entries potentially holding geotechnical data. Unfortunately, forty of these files were unavailable[3], and another eighteen were permits for winter roads. Of the remaining seventeen records for which files were reviewed, only three had mention of geotechnical data - two of test pitting, and one of borehole drilling. Again, several were for development that would require a geotechnical site investigation. For these developments, there is likely an internal report that contains geotechnical data. Appendix III shows a list of unavailable LUP's which should be reviewed, and LUP files containing no geotechnical data, but for which there should be some associated geotechnical information in a separate report.

The LUP files for winter roads were not investigated, although it was subsequently speculated that some may contain geotechnical data. This would be related to quarrying activity as granular materials may have been required for construction and maintenance of overland portions of the winter roads. Quarry Permit Ledgers

[3] Reasons for a large number of files being unavailable at a given time may include their being used by other staff, or they may be out of the office for microfilming.

should be correlated with the winter road LUP numbers, and matching LUP's searched for information on geotechnical investigations.

3.2.4 Other Sources

Territorial Quarry Permits were also considered potential sources of geotechnical borehole information. These permits are issued at the DIAND Yellowknife office, and are listed in a ledger, showing the company, location of quarry, type and amount of material to be removed, and fees for the permit and materials. No files are associated directly with a quarry permit, but they have a corresponding Land Use Permit, with details of the operation. Thus, after looking through the LUP's, all quarry information should be located, and the Quarry Permit ledger need not be consulted.

Several other reports containing geotechnical borehole data were obtained from the personal libraries of staff in the Land Management Division's Headquarters and Yellowknife Office's. Examples include the Izok Project's Port Site, Mine Site, and Proposed Haul Road reports, BHP's Koala Mine Airstrip Esker Evaluation, and the Northwest Territories Power Corporation's Snare Cascades Geotechnical Program.

3.3 Database Creation

All geotechnical borehole logs were entered into ESEBase, a relational database system created by ESE Software, a subsidiary of EBA Engineering Consultants Ltd. of Edmonton, AB. The database structure and features are well described and outlined in a report by Thompson (1995) entitled "A Geotechnical Borehole Database - Presentation and Introductory Reference."

A new database was created in the ESEBase directory, entitled Slave Province Geotechnical Database. All borehole logs were entered into this database from the ESEBase menu, with attempts to preserve all of the information available on the original logs. Project and Borehole Numbers were modified to identify the consultant or company who prepared the borehole logs and report, as well as their original project and borehole numbers. Several logs obtained were prepared in the ESEBase system, and thus were easily reentered into the new database. Other logs were created by various methods, such as hand drafting. These logs required slightly more interpretation and extrapolation to get accurate depths and associated depth comments.

Several formats were created in ESEBase for the presentation of Slave Geotechnical Borehole Database borehole logs. These formats were created by modifying one of the existing standard formats in the ESEBase system, and have been called GRAN-5M, GRAN-10M, and GRAN-15M. These different formats are used for logs of varying depths, or detail:

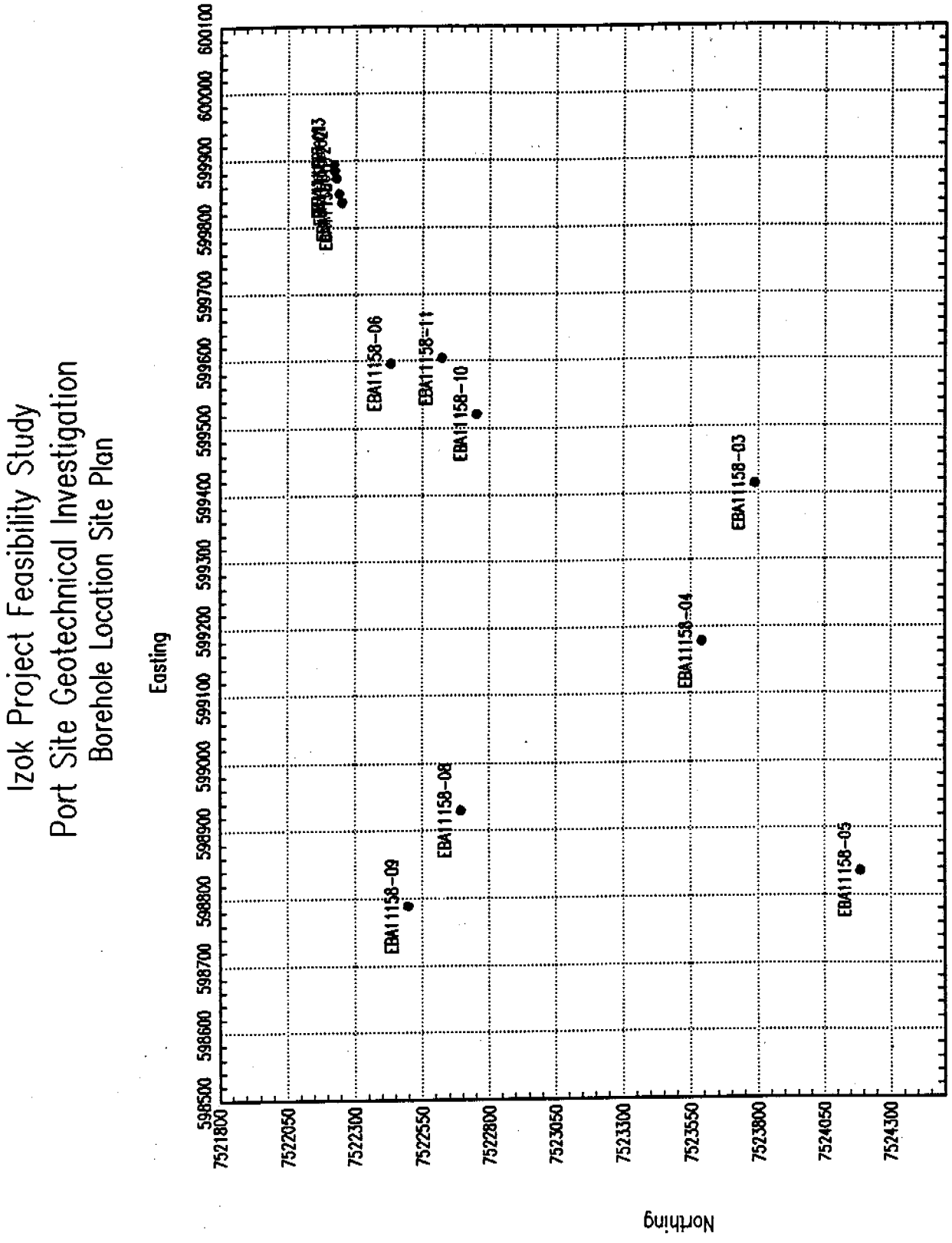
- GRAN-5M shows five metres of a borehole log per page. This format is useful to display logs with moderate detail, up to about ten metres in depth.
- GRAN-10M will present ten metres of borehole per page. This format is best for logs of moderate depth, with relatively general depth comments.
- GRAN-15M shows fifteen metres of borehole per page. This format will display deep boreholes on fewer pages than would the other formats, thus it is good for deep boreholes with general depth comments.

If highly detailed logs are desired, and number of pages of output are not a factor, then any log may be produced on any of the above formats. For example, a 30 metre deep borehole may be printed on six pages in GRAN-5M format if such a level of detail is required, or on two pages in the GRAN-15M format, if little detail is shown.

Appendix IV displays an explanatory log for data entry into the three formats discussed above. This log shows which fields are used to display information on the printed borehole logs, and the codes that are used to determine the sample type, and boundary lines in the Soil Description column. These formats may be further modified to accommodate additional information, by entering the "Log Output - Update BH Format Data" view from the ESEBase menu. Appendix V shows several sample borehole logs from the Slave Geotechnical Borehole Database, displaying the various formats.

ESEBase is also capable of producing plan maps of borehole locations, which is useful when trying to determine which areas have a wealth of information, and which areas are lacking in geotechnical data. Figure 3.1 displays an example of a site plan map produced by the ESEBase software package.

Figure 3.1 - Example of ESEBase Plan Map, Using the Izok Project Port Site Boreholes.



4

Results

4.1 Geotechnical Reports Included in Database

To date, some 137 borehole logs from eight geotechnical reports have been obtained and entered into the Slave Province Geotechnical database. Appendix VI is a copy of the ESEBase directory for the Slave Geotechnical Borehole Database, showing all of the boreholes entered into the database. Below is a summary of the eight reports, giving a brief description of the contents, and the number of boreholes for each project. Table 4.1 shows the project names, owners, consultants, and number of boreholes for each report.

4.1.1 Izok Project Feasibility Study - Port Site Geotechnical Investigation

This is one volume of a three part geotechnical investigation for the Izok Project Feasibility Study, prepared by EBA Engineering Consultants Ltd. (EBA). The study evaluated the proposed Izok Project deep water port site on the Coronation Gulf. Field work was completed in April, 1993, and the report was submitted to Metall Mining Corporation in November, 1993. The study consisted of thirteen boreholes, eight of which were offshore, with the remaining five holes being drilled on land.

Project Name	Location	Owner	Consultant	Number of Holes
Izok Project	Port Site - Coronation Gulf	Metall Mining Corporation	EBA Engineering Consultants Ltd.	13 boreholes (8 offshore)
Izok Project	Mine Site - Izok Lake	Metall Mining Corporation	EBA Engineering Consultants Ltd.	26 boreholes
Izok Project	Winter Haul Road	Metall Mining Corporation	EBA Engineering Consultants Ltd.	41 test pits
Snare-Cascades Hydro	Snare-Cascades Hydroelectric Development	Northwest Territories Power Corp.	Thurber Engineering Ltd.	13 boreholes
Strutt Lake Hydro	Strutt Lake Hydroelectric Development	Northern Canada Power Commission	W.F. Kelly Associates Consulting Engineers	12 boreholes
Giant 1 Claim	Salmita Mine	Giant Yellowknife Mines Ltd.	Engineering Department (Giant Mines)	6 boreholes
Koala Mine	Airstrip Esker	BHP Diamonds Inc.	EBA Engineering Consultants Ltd.	7 boreholes
Joint Research on Eskers	Slave Province	DIAND/GNWT	DIAND/GNWT	19 test pits

Table 4.1 - Reports included in Slave Province Geotechnical Database

4.1.2 Izok Project Feasibility Study - Mine Site Geotechnical Investigation

The second volume of the Izok Project Feasibility Study's geotechnical investigation, prepared by EBA, this report is an evaluation of the proposed mine site of the Izok Project. The report was submitted to Metall Mining Corporation in November, 1993, with field work being completed in March of the same year. This study included twenty-six boreholes, two of which were drilled to considerable

depths for exploration purposes. Borehole logs of these two holes were included in the Slave Geotechnical Borehole Database, but only to a depth of a few metres into bedrock.

4.1.3 Izok Project Feasibility Study - Winter Haul Road

The final volume of the Izok Project Feasibility Study's geotechnical investigation was a study of the proposed winter haul road connecting the mine site on Izok Lake to the port site on the Coronation Gulf. This test pitting field program was completed in July, 1993, with a revised study being submitted to Metall Mining Corporation in October, 1993. Forty-one test pits were dug and sampled during this study. Stratigraphic details were not available, but sample descriptions and grain size analysis results have been entered into the Slave Geotechnical Borehole Database.

4.1.4 Snare Cascades Development Geotechnical Program

This geotechnical report was completed by Thurber Engineering Ltd., and was submitted to the Northwest Territories Power Corporation in September, 1991. The report describes a geotechnical program with the goal of determining the depth and nature of the overburden in the area of the proposed Snare Cascades Hydro Project. Thirteen boreholes were drilled and have been entered into the Slave Geotechnical Borehole Database. In the absence of appropriate geographic referencing, the general latitude and longitude coordinates of the proposed development were taken from a site location plan, and the same set of coordinates were entered into the database for all of the boreholes for this project. Notes were included on each of the borehole logs to reflect the inaccurate locations.

4.1.5 Strutt Lake Hydroelectric Development - Engineering Report

This report was prepared by W.F. Kelly Associates Consulting Engineers for the Northern Canada Power Commission, in January, 1974. Field work was performed in November, 1973. The report was a site investigation of a proposed hydroelectric development on Strutt Lake, part of the Snare River System. The drilling program was designed to provide a pattern of boreholes to establish the depth of overburden to bedrock, at the possible locations of the development. Twelve boreholes were drilled, with several samples taken from each. The borehole logs were not recorded in a continuous format, and contain data only over the sampling intervals. This information was entered into the database and the absence of distinct boundaries between soil types is reflected in the logs. Location data was unavailable, other than a sketch map, so approximate locations were determined as in Section 4.1.4, and noted on the logs.

4.1.6 Giant Yellowknife Mines Ltd. Overburden Drilling - Giant 1 Claim, Salmita Mine

This report was completed by the Exploration Department of Giant Yellowknife Mines Limited. The overburden drilling program was performed in November, 1982, for geotechnical and environmental purposes. The report was submitted to Giant Yellowknife Mines, and included with Mining Assessment Report #081809 for the DIAND Mining Recorders Office, in December, 1984. The program included six boreholes on the Giant 1 Claim, Salmita Mine. As with the Snare Cascades and Strutt Lake reports, precise borehole locations were not given, so approximate coordinates were entered on the logs, with the inaccuracy of the locations stated in a footnote on each log.

4.1.7 Koala Mine - Airport Esker Evaluation

This report by EBA was submitted to BHP Diamonds Inc., in March, 1995. Field work was performed in July, 1994. The purpose of this drilling/geophysics program was to evaluate the Airport Esker in terms of granular materials, and to prepare quarry development guidelines to ensure maximum efficiency upon extraction. The drilling portion of the program consisted of seven boreholes, along with laboratory studies of particle size and moisture contents.

4.1.8 DIAND/GNWT Joint Research on Eskers

This collection of nineteen test pits is the result of a joint effort between DIAND and the Government of the Northwest Territories (GNWT) Renewable Resources Department. This study was organized to gain baseline information on eskers in the Slave Province, to help determine their use as denning habitats by the wildlife of the region. Logs were entered into the Slave Geotechnical Borehole Database from field notes taken during the field program.

4.2 Sources of Geotechnical Data Not Included in Database

Several sources were identified as containing geotechnical borehole logs and data, but were unavailable for entry into the Slave Geotechnical Borehole Database. They are briefly summarized below, with a short description of the operation, and number of boreholes or test pits available.

4.2.1 NUNA Logistics - Carat Lake Diamond Project

One of such sources is work done by NUNA Logistics for Canamera Geological Ltd. at their Carat Lake Diamond Project site, NTS Sheet 76L. LUP # N95C481 is a permit for the construction of private roads on the above site. The LUP file discusses three possible granular borrow sites, and test pits dug in these source areas. The number of test pits is not given, nor are any logs of such pits. Also included in the file is a report discussing estimated granular requirements for the roads, mine site, and other support facilities for an operating diamond mine.

4.2.2 GSC - Rocking Horse Lake Area

LUP # N94N153 is a permit for Research, issued to the Geological Survey of Canada's Yellowknife Office. A surficial sampling and mapping program was performed in the Rocking Horse Lake area, and in portions of NTS Sheets 76E, 86H, and 86I. Several test pits were dug, but the number of pits was not available.

4.2.3 DIAND - 1996 Winter Field Program

A field program was performed, during the preparation of the Slave Province Geotechnical Database, by the DIAND Yellowknife Office, with a companion study by the GSC being executed at the same time. This program consisted of geophysical studies, and the drilling of several boreholes at the BHP Claims at Koala Lake (NTS Sheet 76D) and at the Canamera Carat Camp (NTS Sheet 76L). Boreholes were drilled on the Airstrip Esker at Koala Lake, the Misery Esker at Misery Point on Lac de Gras, and at one of the proposed borrow sites at Carat Lake. EBA Engineering Consultants Ltd. and Bruce Geotechnical Consultants Ltd.

supervised the drilling operations, and reports were being prepared at the time of writing of this paper.

4.2.4 GSC/DIAND - 1995 Summer Field Program

This 1995 summer field program was conducted by DIAND's Land Administration and the GSC's Terrain Sciences Division in the Coppermine (NTS Sheet 86O, east half) and Kikerk Lake (NTS Sheet 86P) area's of the northern Slave Province. In a GSC Report of Field Activities 1995/96 (Wolfe, 1996), the program is discussed, and reports that 240 till and suficial samples were taken. These samples were taken for grain size, moisture content, and basic engineering property analyses.

4.3 Potential Sources of Geotechnical Borehole Logs

Additional time and effort is needed to obtain and review many more potential sources of geotechnical borehole logs identified through literature searches.

The LUP Ledgers lead to numerous LUP's for development which would require some sort of geotechnical site investigation, such as the construction of mine sites, air strips, tailings ponds, roads, and quarries. Many of these files were either unavailable or contained only the permit and associated correspondence.

Construction of any substantial structure would require a subsurface site investigation, at least to determine the nature of the permafrost and to make estimates of granular insulation requirements. The LUP files viewed did not contain any specific reference to such reports because there is currently no requirement to do so. However, it is expected that the consultant or contracting company must have these reports filed in their archives. Companies who are associated with such LUP's should be contacted, and asked to contribute any geotechnical information

that they may have, with the offer of recognition for their "support in kind" contribution to WKSS regional research.

Similarly, active and inactive quarries would be expected to have some sort of geotechnical investigation to determine the nature of material before the ground was broken for the removal of material. Some of these investigations may have been very informal, with no report prepared, but some others probably have associated reports written by staff consultants who performed or supervised such studies. Companies associated with these operations should also be contacted.

The potential sources of additional information to the Slave Province Geotechnical Database are noted in Appendices II and III.

5

Conclusions

The Slave Structural Province in the Northwest Territories is one of little development, but with enormous potential. The Slave Province has a population of less than 20 000, with over 17 000 living in the capital city of Yellowknife, and the remainder inhabiting four Dene communities. Six gold mines are currently operating, several others, having exhausted gold reserves in the past, now lay abandoned. Most of the potential development is with mining, primarily gold and diamonds. Base metals are also a valuable and abundant commodity.

For development to proceed in the Slave Province, granular resources are needed in vast quantities to overcome the difficulties associated with building in the permafrost zone. Geotechnical site investigations are often completed to determine specific granular requirements for a particular location, and for evaluation of granular deposits. These site investigations often include borehole drilling or test pitting, which are usually logged on paper for a permanent record.

This study has taken the initiative of assembling a database of geotechnical information for the Slave Province. The database is entitled the Slave Province Geotechnical Database, and includes borehole log records from geotechnical investigations that were completed in the Slave Province. Such a collection of geotechnical information will be a useful reference to many organizations, including

the mining industry, the West Kitikmeot Slave Study Office, and other branches of the Federal and Territorial governments.

Geotechnical information on the Slave Province is far from abundant and finding relevant reports with borehole logs for inclusion into the database was not an easy task. Most of the papers located were unpublished consultant reports, and other associated "gray" literature. Obtaining these reports required extensive library and file searches, both in the DIAND Headquarters office, and in the NWT Regional Yellowknife office. Several sources were searched for geotechnical information, including Mining Assessment Reports, Land Use Permit Files, and the GeoScan and ASTIS bibliographic databases.

All geotechnical borehole logs were entered into an ESEBase database, and several formats were modified to present the boreholes in a fashion that efficiently conveys the geotechnical data contained within. The output formats may be further modified by the user to alter the presentation of the logs.

At the time of writing, the Slave Province Geotechnical Database contained 137 borehole logs from eight geotechnical reports. Several more borehole logs are, or will soon be, available for inclusion in the database (see Section 4.2). Many possible sources of geotechnical borehole logs have been identified as well (Section 4.3), and require viewing to assess their potential contributions to the database.

Several recommendations have been made (Chapter 6), with the hopes of making the Slave Province Geotechnical Database as complete as possible.

6

Recommendations

Several recommendations are made with regard to the addition of geotechnical borehole information to this project. They are as follows.

- The borehole logs for the 1996 DIAND Winter Field Program should be appended to the Slave Geotechnical Borehole Database as soon as the report for this project is available.
- Copies of the GSC/DIAND 1995 Summer Field Program test pit logs, and analyses results should be obtained and appended to the Slave Province Geotechnical Database.
- An additional effort should be made to track down Land Use Permit Files (LUP's) that were unavailable at the time of the initial visit to Yellowknife. They should be searched for geotechnical borehole data, or reference to geotechnical drilling during the work for the permit. These are listed in Appendix III.
- Mining Assessment Reports (listed in Appendix II) noted as not viewed, should be examined for potential geotechnical borehole data and logs.
- The owners of facilities (eg. mines) and consultants who supervised geotechnical investigations (i.e. mine sites, airstrips, tailings dam construction), as identified in the search of LUP files, should be contacted, and asked to contribute any geotechnical data that they may have for the developments

discussed in the LUP's, receiving "support in kind" recognition for their contributions.

- The LUP ledger should be consulted on a regular (at least annual or bi-annual) basis, to identify permits issued for work that may require geotechnical investigation. These files should be reviewed, and any geotechnical data should be retrieved and added to the Slave Geotechnical Borehole Database.
- Quarry operators should be contacted, and asked to contribute any geotechnical data that they may have for the site, with the offer of "support in kind" recognition.

7

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Appendix I - "Slave Province Minerals Database - 1989" Sample Records

Name : LUPIN

Commodity: G,S

Status : M

Dates :
Discovered 1960
Opened 1982
Closed 0

Location: 65.76667 **°N latitude** 111.22500 **°W longitude**

Name : COLOMAC

Commodity: G

Status : M

Dates :
Discovered 1945
Opened 1993
Closed 0

Location: 64.40000 **°N latitude** 115.08889 **°W longitude**

Name : IZOK

Commodity: Z,C,PB,S

Status : D

Dates :
Discovered 1974
Opened 0
Closed 0

Location: 65.00000 **°N latitude** 112.00000 **°W longitude**

Name : CON

Commodity: G,S

Status : M

Dates :
Discovered 1935
Opened 1938
Closed 0

Location: 62.43944 °**N latitude** 114.36889 °**W longitude**

Name : GIANT

Commodity: G

Status : M

Dates :
Discovered 1935
Opened 1939
Closed 0

Location: 62.49917 °**N latitude** 114.36111 °**W longitude**

Name : SALMITA

Commodity: G,S

Status : C

Dates :
Discovered 1945
Opened 1983
Closed 1987

Location: 64.07500 °**N latitude** 111.24056 °**W longitude**

Name : BOSTON

Commodity: G

Status : D

Dates :
Discovered 1988
Opened 0
Closed 0

Location: 67.00000 °N latitude 106.00000 °W longitude

Name : ULU

Commodity: G

Status : D

Dates :
Discovered 1988
Opened 0
Closed 0

Location: 66.00000 °N latitude 111.00000 °W longitude

Commodity: G = gold C = copper
S = silver PB = lead
Z = zinc

Status: D = deposit
M = mine
C = closed/abandoned mine

Appendix II - Mining Assessment Reports &

Economic Geology Series Reports

Appendix II - Mining Assessment Reports & Economic Geology Series Reports

Report #	NTS Sheet	Company	Keywords	Source	Status
Mining Assessment Reports					
17417	85I	R.J. Stevens	5 DDH - 79.8m	IMAS	NV
19987	75L	Giant Yellowknife Mines Ltd.	Surficial Geol.	IMAS	NV
19989	75L	Giant Yellowknife Mines Ltd.	Surficial Geol.	IMAS	NV
19991	75N	Yale Lead & Zinc Mines Inc.	Surficial Geol.	IMAS	NV
19994	75O	Acroll Oil & Gas Ltd.	Surficial Geol.	IMAS	NV
19995	75O	Acroll Oil & Gas Ltd.	Surficial Geol.	IMAS	NV
60059	85I	D. Nickerson	5 DDH - 53.3m	IMAS	NV
60328	76C	Central Arctic Copper Ltd.	Surficial Geol.	IMAS	NV
60329	76C	Central Arctic Copper Ltd.	Surficial Geol.	IMAS	NV
60330	76E	Big Four Syndicate	Surficial Geol.	IMAS	NV
60467	86J	Trans-Canada Resources Ltd.	Surficial Geol.	IMAS	NV
60501	86I	Ecstall Mining Ltd.	Surficial Geol.	IMAS/ASTIS	NV
61665	75P	Urangesellschaft Canada Ltd.	Surficial Geol.	IMAS	NV
61718	86B	Indigo Consolidated Gold Mines Ltd.	Engineering Geol.	IMAS	NV
61719	85J	Negus Mines	Engineering Geol.	IMAS	NV
61720	76D	Taurcanis Mines Ltd.	Engineering Geol.	IMAS	NV
61873	76L	Borealis Exploration Ltd.	Misc.	IMAS	NV
62127	75L	Ridley Mines Holding Co.	Misc.	IMAS	NV
62128	75N	Consolidated Northland Mines Ltd.	Misc.	IMAS	NV
80169	75L	Inland Cement Industries Ltd.		IMAS	NV
80892	85I	A. Read	1 DDH - 9.4m	IMAS	NV
81346	76M	Noranda Exploration Co. Ltd.	Surficial Geol.	IMAS	NV
81462	85I	Powergem Resources Corp.	Surficial Geol.	IMAS	NV
81463	85I	Great Bear Development Corp.	Surficial Geol.	IMAS	NV
81644	85J	J. D. Mason	46 DDH - 48.9m	IMAS	NV
81652	85I	J. D. Mason	70 DDH - 74.7m	IMAS	NV

81653	85I	J. D. Mason	245 DDH - 261.3m	IMAS	NV
81654	85I	J. D. Mason	184 DDH - 196.3m	IMAS	NV
81690	85I	J. D. Mason	264 DDH - 1031.5m	IMAS	NV
81696	76E	Kidd Creek Mines Ltd.	Engineering Geol.	IMAS	NV
81701	86J	Anaconda Canada Exploration Ltd.	Surficial Geol.	IMAS/ASTIS	V-no geot.
81788	85I	J. D. Mason	496 rotary holes - 529.1m	IMAS	NV
81792	85I	T. Wesley	20 rotary holes - 21.3m	IMAS	NV
81793	85I	J. D. Mason	205 rotary holes - 250m	IMAS	NV
81794	85I	J. MacAlister	35 rotary holes - 32.0m	IMAS	NV
81795	85I	J. D. Mason	401 rotary holes - 427.8m	IMAS	NV
81809	76D	Giant Yellowknife Mines Ltd.	Overburden drilling	IMAS/ASTIS	V-6 bh logs
82107	86B	Suncor Inc. Resources Group	Soil samples	ASTIS	V-no geot.
82307	86B	Terra Mines Ltd.	Soil samples	ASTIS	V-no geot.
82308	85O	Terra Mines Ltd.	Soil samples	ASTIS	V-no geot.
82723	76	Hecla Mining Co. of Canada, Ltd.	Trenches, drillholes	ASTIS	V-no geot.
Economic Geology Series Reports					
1978-08	85J	DIAND	Sands	ASTIS	V-no geot.
1982-03	75L	DIAND	Beach deposits	ASTIS	V-no geot.
1990-03	85I/J	DIAND	Till deposits	ASTIS	V-no geot.
1992-03	76M	DIAND	Tills, Glaciofluvial deposits	ASTIS	V-no geot.

Source: IMAS - 1986 Index to Mining Assessment Report

ASTIS - Arctic Science & Technology Information System

Status: NV - not viewed

V-no geot. - viewed, no geotechnical data

V-6 bh logs - viewed, 6 borehole logs recovered

Appendix III - Land Use Permit Files

Appendix III - Land Use Permit Files

NA - not available, should be tracked down and viewed
V - viewed, but should be futher investigated

Permit Number	Permit Holder	Type of Work	Status
N96S504	Geological Survey of Canada	Sampling and Geological Studies	NA
N95E473	Echo Bay Mines Ltd.	Quarrying and Winter Road	V
N95E460	Echo Bay Mines Ltd.	Winter Road Construction	V
N95E433	City of Yellowknife	Construction	NA
N94E291	GNWT - PWS	Access Road	NA
N94E281	Rick Unruk	Diamond Drilling	NA
N94K214	Dogrib Power Corp.	Hydro Plan	NA
N93N153	Geological Survey of Canada	Geological Studies	V
N93I143	NWT Power Corp.	Hydro Line Maintanence	NA
N93G047	Dechi Laot'i Council	Airstrip Construction	NA
N93F033	Peter Hovat	Access Road	NA
N93G016	Echo Bay Mines Ltd.	Airstrip Construction	NA
N93C871	GNWT - Dept. of Transportation	Quarrying	NA
N92F864	Les Robertson	Access Road	NA
N92E813	Thomas Robert Hamilton	Access Road	NA
N92S795	GNWT - Dept. of Transportation	Granular Investigation	NA
N92E787	Shirley Borden	Access Road	NA
N91Q662	Robinson Enterpreses Ltd.	Test Pit Quarrying	NA
N91S643	GNWT - Dept. of Transportation	Soil Investigation	NA
N91E642	Orest & Bernice Lamponi	Access Road	NA
N91G617	GNWT - Dept. of Transportation	Airstrip Construction	NA
N91F536	Peter Hovat	Access Road	NA
N91G530	Echo Bay Mines Ltd.	Airstrip Construction	NA
N91E506	RCMP	Access Road	NA

N91F505	Edward Eggenberger	Maintanence - Access Road	NA
N90F414	Echo Bay Mines Ltd.	Road Construction	NA
N90G293	True North Safaris	Airstrip	V
N89J245	Echo Bay Mines Ltd.	Campsite	NA
N89F214	Hovat Construction	Private Rd.-Quarrying & Const.	V
N89G110	Trigg Wollett Olsen Consult.	Airstrip Construction	NA
N89F095	Robinsons Trucking Ltd.	Road Construction	NA
N88F072	not available	Road Construction	NA
N88F042	N. Arden	Road Construction	NA
N88F015	P. Beilstein	Road Repair	NA
N88C987	Bathurst Inlet Lodge	Geological Mapping	NA
N88S975	Ted Mehler	Soil Testing	V
N88G950	Neptune Resources	Airstrip Construction	NA
N88J939	Echo Bay Mines Ltd.	Campsite	V
N88F894	Echo Bay Mines Ltd.	Roads (Lupin Mine Site)	NA
N88I886	NWT Power Corp.	R/W Power lines	NA
N87F871	N. Can. Power Commission	Private road construction	V
N87F870	N. Can. Power Commission	Private road construction	NA
N87S787	DPW - Highways	Soil Testing	NA
N87F778	B. Ray	Upgrade of Existing Road	V
N87G770	Bathurst Inlet Lodge	Airstrip Construction	NA
N87F761	Noranda Exploration	Road Construction	NA
N87F739	F. Eggenberger	Access Road Construction	V
N87F696	C. Ward	Road Construction	V
N87F681	Branson's Lodge	Access Road Construction	V
N87J661	Echo Bay Mines Ltd.	Campsite	V
N86J533	Utah Mines Ltd.	Campsite	NA
N85C384	Cominco Mines	Geological Mapping	V
N85X337	Echo Bay Mines Ltd.	Tailings Pond	V

N84S242	Robinsons Trucking Ltd.	Winter Road Construction	V
N84S241	Robinsons Trucking Ltd.	Winter Road Construction	V
N84S240	Robinsons Trucking Ltd.	Winter Road Construction	V
N84G203	Echo Bay Mines Ltd.	Airstrip Expansion	V
N83G962	Echo Bay Mines Ltd.	Airstrip Expansion	NA
N81H577	Transport Canada	Non-directional Beacon Facility	V
N81C518	Echo Bay Mines Ltd.	Mineral Exp. & Campsite	V
N81D469	Giant Yellowknife Mines	Mine site, Airstrip, Tailings Pond	V
N80H383	GNWT - DPW	Gravel Search	V
N80J340	Echo Bay Mines Ltd.	Campsite	V
N80D318	Echo Bay Mines Ltd.	Surface Development	V
N80D206	Echo Bay Mines Ltd.	Mine Exploration	V
N80C198	S.M. Paulson & Assoc.	Site Prep., Reconditioning of workings, underground devel.	V
N79G135	Noranda Exploration Co.	Airstrip Construction	NA
N79G112	Noranda Exploration Co.	Airstrip Construction	NA
N79N095	Polar Gas	Soil Sampling	V
N79Q080	Echo Bay Mines Ltd.	Quarrying, Construction	NA
N78G863	Imperial Oil	Airstrip Construction	NA
N77F691	L&B Construction	Road Open/Maintanence	NA
N77F690	L&B Construction	Road Open/Maintanence	NA
N77F689	L&B Construction	Road Open/Maintanence	NA

Appendix IV - "Slave Province Geotechnical Database" Explanatory Log for Data Entry

Note Box 1	Client/Consultant Name	BOREHOLE NO: LOG REFERENC
Note Box 2	Drilling Information Box 1	PROJECT NO: Project Number
Note Box 3	UTM ZONE: - N - E -	ELEVATION:

SAMPLE TYPE ■ NO RECOVERY ⧄ SPT ☒ DISTURBED ▤ A-CASING ▥ SHELBY TUBE ▮ CORE

DEPTH(m)

SOIL DESCRIPTION

Enter soil descriptions in F7-'SOIL DESCRIPTIONS' view, and include USC codes. They will print in this column.

BN is boundary line at DEPTH(it goes right above the soil descrip. that was entered)
S=solid line,DA=dashed line,DO=dotted line

SAMPLE TYPE: DIST=Disturbed, NR=no recovery,SPT=SPT,ACASE=A-casing,CORE=core, SHEL=Shelby Tube.
Enter data in F1-'SAMPLE SUMMARY' view.

M.C., and all grain size percents are entered in F2-'BASIC TEST DATA' view, and may be entered for samples only.

THIS FORM IS A SUMMARY FOR LOG FORMATS - GRAN-5M, GRAN-10M, GRAN-15M. Header information above gives field (from INDEX view) that fills each header space.

Comments

Add any comments concerning ground ice conditions.

Enter this data in F8-'DEPTH COMMENTS' view.

SAMPLE TYPE

PLASTIC M.C. LIQUID
20 40 60 80

● Clay (%) ●
▲ Silt (%) ▲
● Sand (%) ●
■ Gravel (%) ■
20 40 60 80

DEPTH(ft)

0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0

0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0

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Ottawa, Ontario

LOGGED BY: INITIALS	COMPLETION DEPTH: *.*
REVIEWED BY: INITIALS	COMPLETE: / /
Fig. No:	Page 1 of 1

96/05/14 01:50PM (GRAN-10M)

Appendix IV - "Slave Province Geotechnical Database" Explanatory Log for Data Entry

Appendix V - "Slave Province Geotechnical Database" Sample Borehole Logs

Esker Research Program	DIAND/GNWT	BOREHOLE NO: D6-D
Yamba Lake, N.W.T.	Hand-dug test pit	PROJECT NO:
	UTM ZONE: 12 N7190391.14 E462637.13	ELEVATION:

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

DEPTH(m)	SOIL DESCRIPTION	COMMENTS	SAMPLE TYPE	PLASTIC / M.C. / LIQUID (20 40 60 80)	● Clay (%) ● 20 40 60 80	▲ Silt (%) ▲ 20 40 60 80	● Sand (%) ● 20 40 60 80	■ Gravel (%) ■ 20 40 60 80
0.0	FINE SAND (SW) - trace gravel, fines present, good grading, dry.							
	FINE SAND (SP) - high percent fines, poorly graded, dry.							
1.0	BOTTOM OF PIT							
2.0								
3.0								
4.0								
5.0								

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Ottawa, Ontario

LOGGED BY: SH	COMPLETION DEPTH: 0.9 m
REVIEWED BY: SH	COMPLETE: 22/07/94
Fig. No:	Page 1 of 1

94/05/15 10:58AM (SHAN-SM)

Snare Cascades Development Project	NWT Power Corporation	BOREHOLE NO: THURBTH91-10
Geotechnical Program	Drill – Ranger Rig	PROJECT NO: THURB17-368-43
Snare Cascades, Snare River System, NWT	UTM ZONE: 11 N7032837.62 E538784.42	ELEVATION: 188.38 (m)

SAMPLE TYPE ■ NO RECOVERY ⧄ SPT ☒ DISTURBED ☰ A-CASING ▯ SHELBY TUBE ▮ CORE

DEPTH(m)	SOIL DESCRIPTION	Comments	SAMPLE TYPE
0.0	ORGANICS	Unfrozen to 0.45 metres	
	CLAY (CL/ML) – gray, silty		
1.0		0.45m to 1.8m – estimated excess ice content – 90%	
2.0		Estimated excess ice content at 1.9m – 40–50%	
	SILT (ML) – gray, thinly laminated with sand and clay		
3.0			
4.0			
	– becomes sands, some clay – fine sand partings		
5.0		Below 4.6m – estimated excess ice content – 5–15%	
6.0	END OF TEST HOLE (5.9 metres) Auger refusal on possible bedrock		
7.0			
8.0	Note : All test holes for project assigned same location coordinates. Locations are for general study area – precise coords. not given on original logs.		
9.0			
10.0			

PLASTIC M.C. LIQUID 20 40 60 80

● Clay (%) ● 20 40 60 80

▲ Silt (%) ▲ 20 40 60 80

● Sand (%) ● 20 40 60 80

■ Gravel (%) ■ 20 40 60 80

DEPTH(ft) 0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0

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LOGGED BY: RLD	COMPLETION DEPTH: 5.9 m
REVIEWED BY: RCC/DAL	COMPLETE: 91/09/17
Fig. No:	Page 1 of 1

96/05/15 10:58AM (CRAN-10M)

Izok Project Feasibility Study	Metall Mining Corporation	BOREHOLE NO: EBA11158-12
Port Facilities Site Investigation	Drill - Heli 4150 Rotary Drill	PROJECT NO: EBA0101-11158
Coronation Gulf, N.W.T.	UTM ZONE: 11 N7522238.57 E599850.86	ELEVATION: -0.8 (m)

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

DEPTH(m)	SOIL DESCRIPTION	COMMENTS	SAMPLE TYPE	PLASTIC / M.C. / LIQUID (20 40 60 80)	Clay (%) / Silt (%) / Sand (%) / Gravel (%) (20 40 60 80)	DEPTH(ft)
0.0	SAND (SM) - some silt, fibrous organics, fine grained, uniform, saturated, dark gray to black (300mm thick)	Seasonal Frost				0.0
1.0	SILT (OL) - organic, with fibrous organics, some fine grained sand	Not Frozen				4.0
2.0	SILT (ML) - clayey, some fine grained sand, shell fragments disseminated throughout, moist, low to non plastic, dark gray					6.0
3.0						8.0
4.0						10.0
5.0	CLAY (CL) AND SILT - black organic pockets disseminated throughout, wet, low plastic, dark gray					12.0
6.0						14.0
7.0						16.0
8.0						18.0
9.0		Driller notes change in drilling, possibly ice lenses				20.0
10.0						22.0
11.0		Ice lense 25mm thick, angular orientation				24.0
12.0						26.0
13.0						28.0
14.0	- plasticity increasing	Ice lense 25mm thick				30.0
15.0						32.0
						34.0
						36.0
						38.0
						40.0
						42.0
						44.0
						46.0
						48.0

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Ottawa, Ontario

LOGGED BY: MAV	COMPLETION DEPTH: 20.4 m
REVIEWED BY: MAV	COMPLETE: 93/04/22
Fig. No:	Page 1 of 2

96/05/15 10:58AM (CRAN-1SM)

Izok Project Feasibility Study	Metall Mining Corporation	BOREHOLE NO: EBA11158-12
Port Facilities Site Investigation	Drill - Heli 4150 Rotary Drill	PROJECT NO: EBA0101-11158
Coronation Gulf, N.W.T.	UTM ZONE: 11 N7522238.57 E599850.86	ELEVATION: -0.8 (m)

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

DEPTH(m)	SOIL DESCRIPTION	COMMENTS	SAMPLE TYPE	PLASTIC M.C. LIQUID (20 40 60 80)	Clay (%) / Silt (%) / Sand (%) / Gravel (%) (20 40 60 80)	DEPTH(ft)
15.0	CLAY (CL) AND SILT - (continued)					50.0
16.0						52.0
17.0						54.0
18.0						56.0
19.0						58.0
20.0	BEDROCK SILTSTONE					60.0
21.0	END OF BOREHOLE (20.4 metres) Note: Thermistor string #913 installed to 10 metres below sea level. Note: Offshore borehole Water depth = 0.8 metres Ice thickness = 1.3 metres					70.0
22.0						72.0
23.0						74.0
24.0						76.0
25.0						80.0
26.0						82.0
27.0						84.0
28.0						86.0
29.0						88.0
30.0						90.0
						92.0
						94.0
						96.0
						98.0

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Ottawa, Ontario

LOGGED BY: MAV
REVIEWED BY: MAV
Fig. No:

COMPLETION DEPTH: 20.4 m
COMPLETE: 93/04/22

96/05/15 10:58AM (GRAN-15M)

Appendix VI - "Slave Province Geotechnical Database" Borehole Directory

A : "Slave.dbf" - metric units

B : "Slaveimp" - imperial units

Indian & Northern Affairs 96.05.17 10:07:42 am
ESEBASE
Current database: SLAVE(M)

	D1-G/C	D10-D	D10-G/C	D2-D
D2-G/C	D3-D	D3-G/C	D4-D	D4-G/C
D5-D	D5-G/C	D6-D	D6-G/C	D8-D
D8-G/C	D9-D	D9-G/C	EBA11157-01	EBA11157-02
EBA11157-03	EBA11157-04	EBA11157-05	EBA11157-06	EBA11157-07
EBA11157-08	EBA11157-09	EBA11157-10	EBA11157-11	EBA11157-12
EBA11157-13	EBA11157-14	EBA11157-15	EBA11157-16	EBA11157-17
EBA11157-18	EBA11157-18A	EBA11157-19	EBA11157-20	EBA11157-20A
EBA11157-21	EBA11157-22	EBA11157-23	EBA11157-24	EBA11157-25
EBA11157-26	EBA11157-28	EBA11157-29	EBA11158-01	EBA11158-02
EBA11158-03	EBA11158-04	EBA11158-05	EBA11158-06	EBA11158-07
EBA11158-08	EBA11158-09	EBA11158-10	EBA11158-11	EBA11158-12
EBA11158-13	EBA11439-E1	EBA11439-E2	EBA11439-E3	EBA11439-E4
EBA11439-E5	EBA11439-E6	EBA11439-E7	EBASOURCE1	EBASOURCE12
EBASOURCE13	EBASOURCE14	EBASOURCE18	EBASOURCE19A	EBASOURCE19B
EBASOURCE19C	EBASOURCE2	EBASOURCE20A	EBASOURCE20B	EBASOURCE22
EBASOURCE24	EBASOURCE25	EBASOURCE27A	EBASOURCE27B	EBASOURCE28
EBASOURCE31	EBASOURCE33	EBASOURCE36	EBASOURCE37	EBASOURCE38
EBASOURCE39	EBASOURCE3A	EBASOURCE3B	EBASOURCE3C	EBASOURCE3D
EBASOURCE3E	EBASOURCE43	EBASOURCE45A	EBASOURCE45B	EBASOURCE45C
EBASOURCE46	EBASOURCE47	EBASOURCE4A	EBASOURCE4B	EBASOURCE4C
EBASOURCE5	EBASOURCE6	EBASOURCE8	LOG REFERENC	R7-C
THURBTH91-01	THURBTH91-02	THURBTH91-03	THURBTH91-04	THURBTH91-05
THURBTH91-06	THURBTH91-07	THURBTH91-08	THURBTH91-09	THURBTH91-10
THURBTH91-11	THURBTH91-12	THURBTH91-3A	TP-1	

Indian & Northern Affairs 96.05.17 10:29:15 am
ESEBASE
Current database: SLAVEIMP(I)

	SALMITA82-01	SALMITA82-02	SALMITA82-03	SALMITA82-04
SALMITA82-05	SALMITA82-06	STRUTT-S1-5	STRUTT-S16.5	STRUTT-TC-7
STRUTT-TD-5	STRUTT-TD-51	STRUTT-TN-1	STRUTT-TN-2	STRUTT-TN-3
STRUTT-TN-4	STRUTT-TN-5	STRUTT-TN-6	STRUTT-TS-1	