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EVALUATION OF SIX GRANULAR BORROW PROSPECTS IN THE MACKENZIE DELTA AREA PHASE 1: ASSESSMENT OF INVESTIGATION PROGRAM REQUIREMENTS

Kiggiak-EBA Project No.: KE1002
EBA Project No.: 1100018

DECEMBER 2002

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Submitted to:

INUVIALUIT LAND ADMINISTRATION
INUVIK, NT

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CALGARY, ALBERTA

Kiggiak-EBA Project No.: KE1002
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EXECUTIVE SUMMARY

This report presents observations and recommendations arising from a reconnaissance visit to select granular resource prospects in the Aklavik, Tununuk (Yaya) and Tuktoyaktuk areas of the Inuvialuit Settlement Region (ISR). The work was conducted as Phase 1 of a program to develop management plans for critical granular resource prospects in the ISR. The contract was authorized by Mr. James Thorbourne of the Inuvialuit Lands Administration (ILA) on September 10, 2002 and was funded jointly by the ILA and Inuvialuit Regional Corporation (IRC). Mr. Phil Chidgzey was the client's technical manager for the program.

Kiggiak-EBA Consulting Ltd. provided an engineering geologist and a geophysical specialist to conduct the three day reconnaissance program. On the first day, the project team visited two regions of the Yaya Source Area on Richards Island, near Tunuuk Point. On the second day, they visited a rock quarry prospect, approximately 40 km northwest of Aklavik, and the Willow River pit, which is 20 km west of Aklavik. On the third day, they visited Pit 177, approximately 20 km south of Tuktoyaktuk, and Source Areas 160 and 161 on the east side of Tuktoyaktuk Harbour.

The Aklavik rock quarry prospect appears to be too far from the community and too costly to develop to economically compete with the Willow River Pit. Otherwise, the quality of the site and quality of the material appear to be suitable for quarry development. Suggestions are provided for further assessment of the quarry prospect, if it is deemed to be necessary.

The Yaya Pit is a significant resource in the Mackenzie Delta region of the ISR. Previous pit development activities have been undertaken in two areas of the deposit; however, little effort has been put into reclamation. Kiggiak-EBA recommends that pit development be restricted to the two developed areas and provides recommendations for the assessment of those areas for input to preparing Pit Development and Reclamation (D&R) Plans.

Similar recommendations are provided for the pits at Source Areas 177, 160 and 161 near Tuktoyaktuk. The pit at Source Area 177 is a critical and limited source of gravel for the community. Consequently, there is a need to ensure that it is developed appropriately, that the limited supply of gravel is not misused and the site is reclaimed progressively. Some of the information acquired by Public Works Canada, in the mid to late 70s, for this area has been included in Appendix A. The report suggests that Source Areas 160 and 161 should be used to provide the general fill (non-gravel fill) needs of the community and that the community should operate the pits. Through this arrangement, the community would be encouraged to reclaim areas that have been damaged by previous borrow pit operators and would be able to balance the level of effort to local material demands.

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1.0 INTRODUCTION

This report has been prepared for the Inuvialuit Land Administration (ILA) and Inuvialuit Regional Corporation (IRC) to document observations and recommendations arising from a recent review of select granular resource deposits in the Mackenzie Delta area. Kiggiak-EBA Consulting Ltd. (Kiggiak-EBA) through its subconsultant EBA Engineering Consultants Ltd. (EBA) provided these services in response to a request from ILA during a meeting on August 8, 2002.

A revised proposal, work plan and budget was submitted to the ILA's Granular Resources Coordinator Mr. Phil Chidgzey on September 5, 2002. Mr. James Thorbourne, Chief Administrator for the ILA, authorized the work on September 10.

Briefly, the project objectives outlined in the September 5 letter included the following:

- Evaluate natural conditions and the extent of previous workings at each of the seven sites.
- Review available engineering and geological data for each of the subject source areas.
- Visit the subject source areas to consider requirements for subsurface evaluations (geophysical, drilling and testpitting) of each (Phase 2).
- Prepare recommendations for preferred methodology, level of effort and target areas for Phase 2 of the evaluations. The ultimate goal of Phase 2 is to prepare Pit Development and Reclamation Plans for each viable site.

The seven sites originally included in the study were:

- in the Tuktoyaktuk area – Source Areas 177, 160, and 161;
- in the Aklavik area – Source Areas 455, 467, and 464; and
- in the Tununuk area – the Yaya Lake Source Area.

Some work scope changes and additions were requested by the client's representative, Mr. Chidgzey, since the project was initiated. They include:

- Preparation of a standalone report for the rock quarry prospect identified as Source Area 464-SE.

- Source Area 455 (also referred to as the Willow Creek Site) was not examined because of favourable observations at Source Area 467 (also called the Willow River Site).

- Providing indirect liaison with ColtKBR which is planning a winter drilling program as part of engineering and permitting studies for the Mackenzie Gas Project at some Inuvialuit Settlement Region (ISR) sites.

- Providing a budget estimate for Phase 2 work at Pit 177, 160 and 161, on the basis of shared mob and de-mob with the Mackenzie Gas Project (separate document).

2.0 RECONNAISSANCE TRIP SUMMARY

The site work was conducted in mid September before snow cover obscured the ground. The field reconnaissance team consisted of:

Phil Chidgzey, the ILA Granular Resources Management Coordinator;
Calvin Pokiak, an ILA representative;
Neil MacLeod, a Sr. Engineering Geologist from Kiggiak-EBA's Calgary office; and
Neil Parry, a Sr. Geophysical Specialist from EBA's Edmonton office.

On September 17 the project team visited the Yaya Lake site and scouted several other granular prospects on Richards Island. James Thorbourne joined them for that day.

On September 18, the crew visited the sites in the Aklavik area. Inuvialuit beneficiaries Mr. Dennis Arey, Mr. Wayne Gordon, and Mr. Jacob Archie joined the group for the work northwest of Aklavik in the ISR. Later when the project team visited the Willow River area and Pit 455, Messrs. Arey, Gordon, and Archie returned to Aklavik with Mr. Pokiak, and Mr. Eugene Pascoe, a Gwich'in representative, joined the team. The Willow River site is within the Gwich'in Settlement Area (GSA).

On September 19, the original project team visited the Tuktoyaktuk area sites.

3.0 SITE ASSESSMENTS

3.1 Yaya Lake Source Area

3.1.1 Description

The Inuvialuit Final Agreement identifies the Yaya Deposit as a preferred source for industry use. It has been previously worked by industry and local contractors and was extensively studied by Imperial Oil Ltd. (IOL) on behalf of the Arctic Petroleum Operators Association in the 70s (EBA, 1975). At that time it was identified that the deposit, which extends for approximately 8 km, contained approximately 7.5M m^3 of recoverable and 13.2M m^3 total granular soil. Industry operators partially developed and reclaimed two areas during the 70s. Subsequent activity, mostly by local contractors, appears to have stayed within those two areas, which are indicated on Figure 1. IOL may still have a reserve stockpile of material in the western worked area.

EBA (1975) describes the Yaya Deposit to be comprised mostly of well graded, sandy, medium gravel to medium sand. The top size of the material is typically about 7.5 cm; although, cobbles are common on the undisturbed surface. Silt and fine sand lenses, of 1.0 m to 1.5 m thickness, are more common in the kame knobs than in the central esker ridge. Area C (the east end) consists of well graded sand with a trace of fine gravel.

Extensive massive ground ice is an unusual feature of the Yaya Deposit, and it represents a significant variable in determining the quantity of recoverable material. During pit development, massive ice can thaw leaving sinkholes and ponds that cut off access to worked area. Ultimately, pit development plans should consider which areas of massive ice should be preserved and which can be encouraged to thaw by removing the protective cover of gravel as the final stage of reclamation. Consequently, it is necessary to map the massive ice deposits, if possible.

The physical relief of the central part of the deposit will provide a challenge for any site assessment program. Photos 1 and 2 (from near GPS Waypoint 69° 05.843'N 134o 42.508'W) show the steep sided isolated ridges of gravel with some ponds in the central part of the western previously developed area. These ridges will necessitate advance planning of access routes and the incorporation of

appropriate models for the interpretation of geophysical profiles. Photos 3 and 4 from the eastern stripped area (near GPS Waypoint 69° 06.408'N 134o 36.436'W) show terrain which has lower relief and is typical of this area.

3.1.2 Recommendations

The objectives for further work in the Yaya Source Area should consider the following:

- There is sufficient subsurface information for resource definition purposes in the undisturbed areas (west end or Area A in EBA, 1975) and undisturbed parts of Areas B and C, i.e., no further investigation work is required in these areas.

- There remains a significant volume of developable gravel in the previously worked part of Area B and perhaps considerable coarse sand and fine gravel in the previously worked part of Area C.

- Both previously worked areas require reclamation before additional undisturbed areas are exploited.

- The quantity of recoverable material remaining in the previously worked parts of the deposit (Area B and Area C in EBA, 1975) is unknown at present.

EBA recommends that the ILA not allow any development of the west end of the deposit (Area A in EBA, 1975) to occur until the previously developed areas have been cleaned out and reclaimed. Subsequent phases of development should focus on the reserves immediately adjacent to and between the two existing disturbed areas. Consequently, the assessment program recommendations that follow are limited to developing pit operating and reclamation plans for those areas only.

The program should have three main components: topographic survey, geophysical survey and borehole evaluation. It would be best if they were conducted in stages so that there is time to interpret each and apply that knowledge to the next task. That may not be practical, however.

The topographic survey should try to establish the quantity of material that has been removed from the deposit, where it was taken from and where subsidence occurred because massive ground ice has thawed. EBA (1975) contains baseline and offset profiles for both disturbed areas. If these lines can be resurveyed, the differences will indicate the extent to which conditions have changed (i.e., material has been removed). If there has not been much change, the previous borehole data can provide a basis for geophysical and quantity interpretations. Alternately, it may become evident that additional drilling work is required in only some parts of the disturbed area and not in others.

Before any fieldwork is done, an experienced terrain interpretation geologist or geographer should review recent and pre-disturbance air photos, if stereographic coverage can be found. Subsequently, geophysical profiling of the two disturbed areas is recommended to assess the distribution of gravel and massive ice.

Resistivity measurements made during the site reconnaissance visit indicate that there is little conductivity contrast between the gravel and surrounding tundra areas. Measured conductivity ranged from 5.2 mSiemens/m on the western gravel ridge, 2 to 3 mSiemens/m in drier parts of the eastern region and 10 to 11 mSiemens/m in wetter areas vs. 2 to 4 mSiemens/m on the tundra. These values were measured with an EM-38 electromagnetic induction conductivity meter and are representative of materials in the upper 1.5 m of the deposit only.

Ground Penetrating Radar (GPR) techniques should work well; although, some problems can be expected in resolving layers around ponds. Careful consideration should be given to the frequency at which data is collected to maximize resolution and to minimize scattering. GPR data would be collected using a mixture of foot and snowmobile methods and it will be necessary to accurately locate stations for slope breaks and to measure snow pack thickness.

Seismic Common Offset Refraction Profiling (CORP) may also have some application to assess ice content. It should be done for fewer lines because of the much greater cost per line-km.

Boreholes drilled using air rotary methods, perhaps with a downhole hammer or reverse circulation methods are appropriate for probing the thickness of the deposit and areas of massive ice. Generally, these methods are suitable for assessing quantity aspects of a gravel deposit but not for assessing the quality issues. Because of the extensive amount of testing reported in EBA (1975) more representative sampling methods are not considered to be necessary.

3.2 Source Area 464-SE

3.2.1 Description

Preliminary information on the potential rock quarry site located northwest of Aklavik was provided on November 15. Significant comments are repeated below.

The site location is indicated on Figure 2. For future identification purposes, it has been numbered as Site Number 464-SE because it is 8 km southeast of Site 464 and appears to be of similar genesis. The GPS Waypoint coordinates recorded for the site are 68° 29.486'N 135o 44.016'W. It is within the ISR on 7 (1) (a) Lands, and, as shown on Figure 3, it is only about 4 km to water access in the Mackenzie Delta. Photo 5 shows the view to the river from the top of the outcrop. By barge or ice road, it is approximately 53 km from the quarry prospect to Aklavik. Figure 3 shows the recommended alignment of the access/haul road from the site to the river.

Site 464-SE is comprised of well cemented, clean quartzitic sandstone in a sheepback rock ridge (roche moutonnee) that is oriented northwest-southeast approximately parallel to the edge of the delta. The outcrop is generally blocky with a central spine of relatively large blocks (approximately 1.25 m by 2.0 m joint spacing) grading to smaller sized (0.2 m to 0.3 m) blocks on the west side. Photo 6 shows this side of the outcrop. The bedding appears to dip at about 10° to the east.

The central portion of the deposit is about 20 m high on the back (west) side and about 45 m high on the river (east) side. The deposit extends for about a kilometer but the most likely area for a quarry is estimated to be only about 250 m long. The width of the outcrop is estimated to be 150 m at the base. The volume of recoverable rock is estimated to be about 625,000 m^3. A proper survey is required to reliably define the dimensions. Photo 7 shows the lower ridge tailing northward from the central part of the site.

3.2.2 Assessment

Physically, the outcrop would be amenable to quarry development because of its relief, natural exposed faces and short haul distance to the river. Economically, however, it does not appear to be as suitable, at present. Some of the potential issues to be dealt with include the large open jointing in the upper zone of the quarry, the very hard or abrasive rock and the relatively long haul distance to Aklavik. Because of the open jointing, drilling and blasting in the upper portion of the quarry may be inefficient and oversized waste rock may be common. Because of the abrasive rock, wear on drill steel and crusher jaws will be high. Furthermore, such material when crushed may be highly angular and can be very hard on tires in the quarry and if the material is used to surface local roads or the airstrip.

Natural gravel is presently produced in sufficient quantity for almost all local (Aklavik) demand from the Willow River site (Source Area 467) which is more than 30 km nearer town than Site 464-SE. It is understood that Willow River gravel is suitable, although of only modest quality, for all grades of local demand except concrete aggregate (Class 5 grade). Currently, the limited requirements for aggregate (<500 m^3 per year) is supplied from quarries near Inuvik and trucked over the Delta in the winter.

Crushed rock from Site 464-SE probably would be suitable for concrete aggregate; although, this must be confirmed by specific engineering testing. Petrographic analyses reported in R. M. Hardy et al. (1976) for rock samples from Deposit 464, which is 8 km away and believed to be of the same formation, indicate suitable properties. In addition, the rock appears durable and the blocks appear large enough that it would likely be suitable for some riprap (erosion protection) uses.

3.2.3 Recommendations

Detailed assessment of this site is not appropriate given that alternate sources of suitable granular material and aggregate are available to Aklavik residents. Economic studies regarding the cost of developing a quarry and crushing operations and of hauling to town may be valuable if only to provide an indication of the supply cost that would be required to operate at a breakeven scale.

3.3 Other Aklavik Area Reconnaissance Sites

Two other sites in the Aklavik area of the ISR were visited at the suggestion of the local guides. The first was called the Stink Creek site (located at GPS Waypoint 68° 30.870' 135° 42.616') because it was the site of a sulphurous spring. The second was along Cache Creek, approximately 3 km northwest of Site 464SE. The GPS Waypoint for this site was 68° 30.176' 135° 48.517'. Both locations are indicated on Figure 2.

The Stink Creek site was suggested because our guides had noted that gravel was exposed in the creek bed and nearby. The reconnaissance team found that the gravel layer was thin and was mostly confined to the creek bed. This suggests that the gravel is a lag deposit, remaining after the fines (silt and clay matrix of the till) were washed out by flow from the spring. The large amphitheater-like bowl around the spring suggests that a considerable volume of material has been eroded over time. The quantity of lag gravel was not economic.

The Cache Creek site was identified as a prospect because it is closer to Aklavik and to the river than the original prospect (Site 464) and because quartzitic sandstone was exposed with a well defined cliff face where a quarry could be easily started. Upon closer examination, the reconnaissance team concluded that the prospective quarry site was likely too near a watercourse (Cache Creek) for permitting.

3.4 Source Area 467 (Willow River Site)

3.4.1 Description

This site is located within the Gwich'in Settlement Area, approximately 20 km west of Aklavik (see Figure 2). The GPS Waypoint recorded for the site was 68° 12.424' N 135° 28.403' W. It is the nearest source to Aklavik of moderately good quality granular material; although, it is only accessible during the winter. The base of the pit is about 50 m above the level of the Willow River floodplain over which the road passes through the Lower Canyon section between the mountains and the Delta. The road through the canyon area, which is a little more than 1 km long, is probably difficult to keep free from drifting snow and debris during the winter. Figure 4 shows the access route to the Willow River Source Area.

The recovery scheme used at the Willow River Pit is relatively simple and very efficient. The pit face is perhaps 100 m long and 30 m high, slopes at about 2.5H:1V (approximately 22°) and faces south. Summer thawing and gravity assisted drainage allows a poorly ice bonded zone of up to about 8,000 m^3 to be harvested each following winter. The depth of seasonal thaw can be increased by ripping the pit face at the end of winter or, if more material is required, the pit face length along the top of slope can be increased somewhat. There was no evidence of sorting or processing on site, no stockpiles of previously handled material and no piles of waste-rock or oversized material.

The material exposed on the pit face was typically sandy gravel with occasional rounded cobbles. At the end of summer the material was loose and dry. There were few signs of collapse areas or small slumps that would suggest ice rich zones had thawed during the past summer. At the toe of the deposit, there were signs of a modest level of drainage runoff cutting into the haul road and over it onto the slope below. The overburden cover at the level of the upland plateau was very thin. Photo 8 shows the east end of the pit face and in the background the Lower Canyon can also be seen.

3.4.2 Assessment

A preliminary investigation of this site in 1989 by Hardy BBT Limited for DIAND included five boreholes drilled by a Nodwell mounted CME 750 auger drill rig. Only two of those holes penetrated to more than 5 m, primarily because of encounters with cobbles and boulders. Hardy BBT (1990) concluded the probable volume of the deposit was 2.29M m^3 (East Area) and 3.5M m^3 in the west area. Most of the material has been identified as being Class 3 (fair) quality. The pit area currently being worked appears to contain fewer cobbles and be of better quality than the previous work would suggest.

3.4.3 Recommendations

A combination of drilling and geophysical techniques would be required to extend knowledge of the deposit and prepare pit development or reclamation plans. At the scale and apparent level of efficiency of the present operations it is perhaps unreasonable to undertake this level of effort. However, it could be necessary if a significant supply contract was being considered or if there are reclamation concerns.

Drainage from the pit is an issue that may require additional consideration. At present, a relatively small quantity of snowmelt, rain and thawing ground ice drainage flows uncontrolled down the slope below the pit. Thermal erosion caused by this drainage, sedimentation and the potential for the off-site distribution of contaminants from pit operating equipment crossing the lower slope and reaching the Willow River floodplain should be considered. In this area, the Willow River is on the far side of the floodplain, approximately 600 m from the toe of the slope.

Realistic objectives for a geophysical survey of this site would be:

- defining the limits of recoverable borrow material;
- identifying if ice rich material is present; and
- establishing the borrow volumes.

Surface conductivity readings were taken on the tundra to the north of the site and within the borrow area. These values were 0.8 mSiemens/m and 5.3 mSiemens/m, respectively; however, the conductivity values within the borrow deposit were highly variable with the highest values being seen at locations where the permafrost was thawing and surface water was visible. This contrast is sufficient that resistivity techniques could be used, with caution, to map the aerial extend of the borrow area. In this area, the borrow areas appear to have higher conductivity values than the surrounding soil. This is the reverse of what is commonly encountered in more temperate climates when conducting borrow searches using resistivity techniques. Resistivity would be the least expensive option at this site to map the aerial extent of the borrow deposit but it should be used with care. It would be prudent to have a backup technique, such as GPR or seismic techniques. GPR would be a viable technique for determining the borrow deposit limits, mapping stratigraphy (volumes) and for identifying potentially ice rich soils. Seismic techniques may have some application in mapping ice rich soil locations but will be the most expensive option.

Air rotary drilling or hammer drill techniques should work in this deposit. While neither method is ideal for sampling the deposit for quality, they will be best to evaluate the quantity question. An air rotary drill equipped with a downhole hammer is expected to be the most efficient means for identifying the thickness and, with geophysics, confirming the extent of the deposit.

The existing pit face offers the best source of samples for testing the quality of the deposit. If quality is a concern, representative samples could be obtained from a few testpits excavated by a large hoe equipped with a hydraulic chisel (say a track-mounted 235 Cat). To improve efficiency, a second hoe equipped with a bucket should be also be used. The testpits would also provide information on the thickness of over burden and organic soils.

An experienced terrain interpreter should review air photos of the pit area prior to developing geophysical or borehole survey plans.

3.5 Source Area 177

3.5.1 Description

There is an existing gravel pit located approximately 20 km south-southeast of Tuktoyaktuk that has been operated by local contractors for the past few years. The GPS measured coordinates for the pit are 69° 16.180'N 132o 16.180'W. Figure 5 indicates the location relative to Tuktoyaktuk.

Photo 9 (from September 2001) shows that the main deposit is located on the crest of a hill approximately 25 m above the tundra level to the north. The best materials appear to be confined to a narrow ridge along the hill crest. Typically, it is comprised of gravelly sand to sand with some gravel (top-size about 150 mm). There are also some silt, occasional isolated boulders and rafted sandstone blocks. The ends of the deposit appear to be of finer gradation than the central region. In several areas there are thaw slumping features that suggest the deposit contains ice rich zones (see Photo 10, also from September 2001).

3.5.2 Assessment

The site has been stripped to promote drainage and deep thawing. The stripped pit area, which is approximately 400 m by 60 m, was enlarged during the winter of 2002. Two smaller related areas, located about 1.8 km to south, have been testpitted and abandoned, previously. Testpit logs in Hardy (1977) indicate gravel in these areas. The reconnaissance visit did not include a landing at the second area.

Previous investigations by Public Works Canada (PWC) (1976) included 14 boreholes in this site and at least 5 others very nearby. Copies of the PWC data, which have been provided by Mr. Robert Gowan at DIAND's Hull/Ottawa office, are presented in Appendix A. On the basis of that work, it was estimated that there might be 1.9M m^3 recoverable granular borrow at this site, including some Class 1 material (Hardy, 1977 and EBA, 1987).

3.5.3 Recommendations

The PWC borehole logs provide enough data for a relatively complete assessment of the northern-most gravel ridge where material has been excavated in recent years. However, there are records for only two testpits in the other areas of the deposit. It appears prudent to evaluate the others areas more thoroughly. First, a geophysical survey using GPR techniques should be completed. GPR should be able to map the extent of coarse sand, such as are found in the northern ridge, and would be able to map massive ice or very ice rich zones. Conductivity measurements made during the reconnaissance visit ranged from 2.2 to 8 mSiemens/m on the gravel ridge and were about 5.4 mSiemens/m on the surrounding tundra. Therefore, resistivity techniques are not recommended.

The GPR surveys should include the existing pit area and the previously identified satellite deposits. If the GPR indicates similar conditions exist in one or more of the satellites, boreholes should be completed to confirm these interpretations. Air photo interpretation techniques should also be applied to assess the potential of the satellite deposits and plan appropriate access routes.

3.6 Source Area 161 (69° 25.193'N 132° 25.193'W)

3.6.1 Description

Source 161 and Source 160, which follows it in this report, are similar and contiguous. Figure 5 shows their previously identified limits. The southern area (Source 161) is approximately 2,500 m long by 800 m wide with coarse sand and fine gravel occurring in low ridges and hummocks. A number of these have been partially exploited and abandoned without reclamation. ILA's primary objective with these sites is to ensure that as much useable material as possible has been taken from each area and to ensure that the sites are reclaimed to acceptable standards.

3.6.2 Assessment

The intrinsic value of the hummocky deposits is that they are located approximately 5 km from the Hamlet of Tuktoyaktuk on the east side of Tuktoyaktuk Harbour. Borrow material could be transported to the community either by barge in the summer or by truck during the winter. For development, these deposits must be stripped, helped to thaw by windrowing and active drainage management, and the dried material must be stockpiled such that it does not re-freeze in well-bonded state before it can be transported. The stockpiles could be located in the pit or in the Hamlet. Some development issues include the small size of the developable hummocks, drainage limitations because of the low relief, the slow thaw rates on the coast and the relatively high ice content of the material.

Previously, shallow testpits have been used to define the extent of useable material and not boreholes. Testpits are limited to probing the upper, seasonally unfrozen part of the deposits. They do not help much to identify large bodies of massive ice and some of the thaw ponds that have developed in the pits in Source Area 161 appear to indicate massive ice.

3.6.3 Recommendations

Although there is some fine grained gravel, most of the material is clean, medium to coarse sand that is suitable for general fill purposes only. Furthermore, the relatively small volume of useable material is found in a number of small, disconnected low hills. Generally, this type of deposit is not suitable for a contractor to develop on a pay-for-volume project because the cost of reclamation is relatively high. Consequently, previous efforts by local contractors to testpit the hills and high-grade recovery of granular material have not been executed properly and have resulted in the abandoned unreclaimed pits.

It has been suggested that the Hamlet should be encouraged to develop the better "hills" in the area and assist in the reclamation of the existing pits. The small volume of material that could be produced from the existing pits would be suitable for a limited scale operation supplying "local needs". In the process, existing pits could be reclaimed and some local benefits could be realized.

To prepare for a Hamlet-managed operation, it is necessary to identify the extent of developable resources in the area and prepare Development and Reclamation (D&R) Plans for the existing pits and other "hills" that could be developed. The first task should be to complete topographic and GPR surveys of the area. A grid-based approach utilizing GPR equipment towed behind snowmobiles should be employed. Conductivity measurements made during the reconnaissance program have indicated that conductivity/resistivity methods will not be as effective.

The second task would be to use the GPR data to identify borehole locations. The boreholes will provide gradation information on the gravel site and will be useful to map the extent of massive ice.

The boreholes should be drilled with a track-mounted rig. A Texoma piling rig (there is one in Inuvik on tracks) would provide good sized samples for qualitative assessment of the site, but these are slow (two to three shallow holes per day), not very mobile (top heavy) and costly (approximately $7,000/day). An air rotary (seismic type) drill, if equipped with a cyclone for sample collection, would provide some data for quantitative analyses and would allow for more effective probing to delineate the limits of the deposit or to map massive ice bodies. The quality of samples obtained by the air rotary method would not be as good as those that could be obtained by the Texoma; however, it is a question of quality vs. quantity. The rotary rig would allow six to eight shallow holes per day at a cost of about $3,500/day.

The third task will be to prepare D&R Plans for the existing and newly developed pits. These should include a priority ranking to ensure that most pits have been reclaimed before too many new ones have been opened. Clearly, the first priority should be related to reclaiming existing pits.

3.7 Source Area 160 (69° 25.437'N 132° 54.757'W)

3.7.1 Description

As noted previously, Source Area 160 is the northward extension of Source Area 161. Many of the previous comments about features and conditions in Source Area 161 apply to Source Area 160 as well.

Source Area 160 is approximately 3 km long by 1.5 km wide and only about 2.5 km across the Harbour to Tuktoyaktuk. Hardy, 1977 interpreted that there was approximately 535,000 m^3 of gravel and 3.36M m^3 of recoverable sand in the area. Furthermore, the gravel is disbursed in thin pockets and likely cannot be economically separated from the sand. Only those high ridges and hills that have relatively little overburden should be developed.

3.7.2 Recommendation

The hamlet should be given the authority to remove sand and gravel from this source area and the responsibility to reclaim the existing pit in Source Area 160. A GPR survey (as above) and a few (six to eight) confirmation boreholes would help to identify areas more suitable for development and provide information with which to prepare pit development and reclamation plans.

Recommendations for geophysical and borehole testing of Source Area 160 are the same as for Source Area 161, above.

4.0 SUMMARY

This report provides recommendations for resource management activities for granular resource prospects in three areas: Aklavik, Tununuk and Tuktoyaktuk.

The rock quarry prospect north of Aklavik does not appear to be economic at present considering that the Willow River site provides most of Aklavik's needs effectively.

The Yaya source area, near Tununuk, is arguably the most significant granular deposit in the ISR. Kiggiak-EBA strongly advises that Pit D&R Plans are required to control orderly and responsible development of these resources. By restricting operations to the two areas that have previously been developed, the ILA can manage the progressive reclamation of these areas through on-going activities.

Similarly, the pit at Source Area 177 provides the most economic source of gravel for Tuktoyaktuk, and community needs have the highest priority. Development of a comprehensive Pit D&R Plan for this site is required for responsible management. The data recently obtained from Public Works Canada (1976) along with a recommended topographic and GPR survey program should provide the basis for preparing the D&R Plan.

For Source Areas 160 and 161, on the east side of Tuktoyaktuk Harbour, the issues are less critical. Local contractors have high-graded several small pit areas without regard to maximizing use of the resource or reclamation of the site. Kiggiak-EBA recommends that ILA prepare D&R Plans for these areas and allow the Hamlet to manage the sites. An assessment program is outlined herein which would provide the information required to develop the D&R Plan.

5.0 CLOSURE

Kiggiak-EBA is pleased for the opportunity to provide the services associated with Phase 1 of this project. The suggestions and recommendations presented in this report are intended to allow the ILA to develop an understanding of some of the resources it must manage and to prepare plans for that management.

There are different ways of doing this, and there are options for the level of management control. The recommendations presented in this report assume that the ILA will be an active manager. Alternately, the ILA could issue licenses to local contractors to operate and manage individual pits. The licensees would be obligated by their license to prepare D&R Plans and to demonstrate progressive reclamation on an annual or bi-annual basis. ILA Inspectors should be trained to monitor for compliance with these licensing obligations.

Should there be any questions regarding this report or the recommendations presented, please contact Mr. MacLeod in our Calgary office.

Kiggiak-EBA Consulting Ltd.

REGISTERED PROFESSIONAL ENGINEER
NEIL R. MacLEOD
LICENSEE
N.W.T.
Dec 24/02

Neil R. MacLeod, M.Sc. P.Eng.
Senior Engineering Geologist
Direct Line (403) 723-6870

for Neil S. Parry, B. Sc. (Hon)
Sr. Geophysical Scientist
Direct Line (780) 451-2121 ext 274

NRM:NSP\kls

PERMIT TO PRACTICE
KIGGIAK -EBA CONSULTING LTD.
Signature
Date 24 Dec 02
PERMIT NUMBER: P 0449
The Association of Professional Engineers, Geologists and Geophysicists of the NWT / NU

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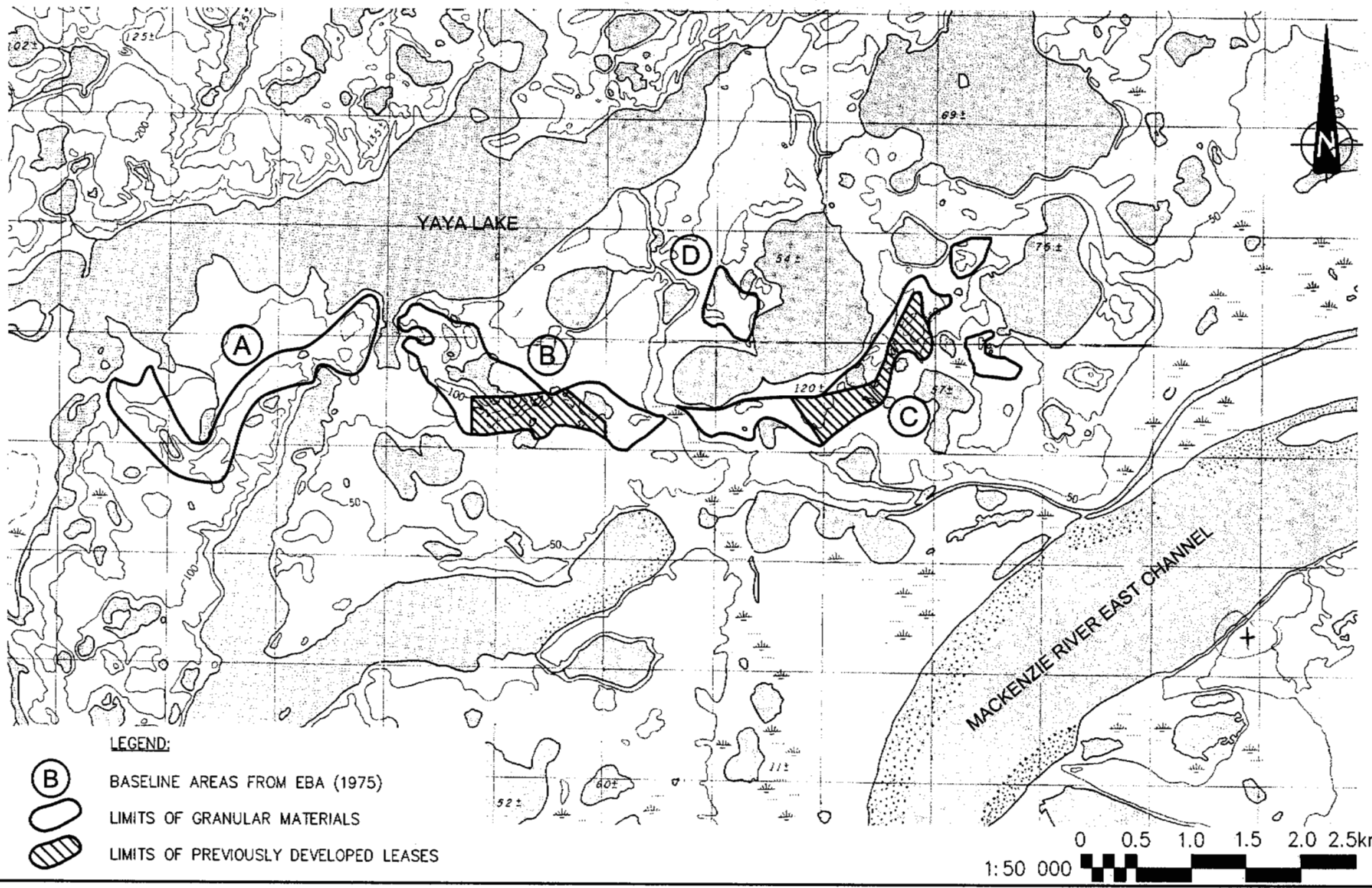
FIGURES



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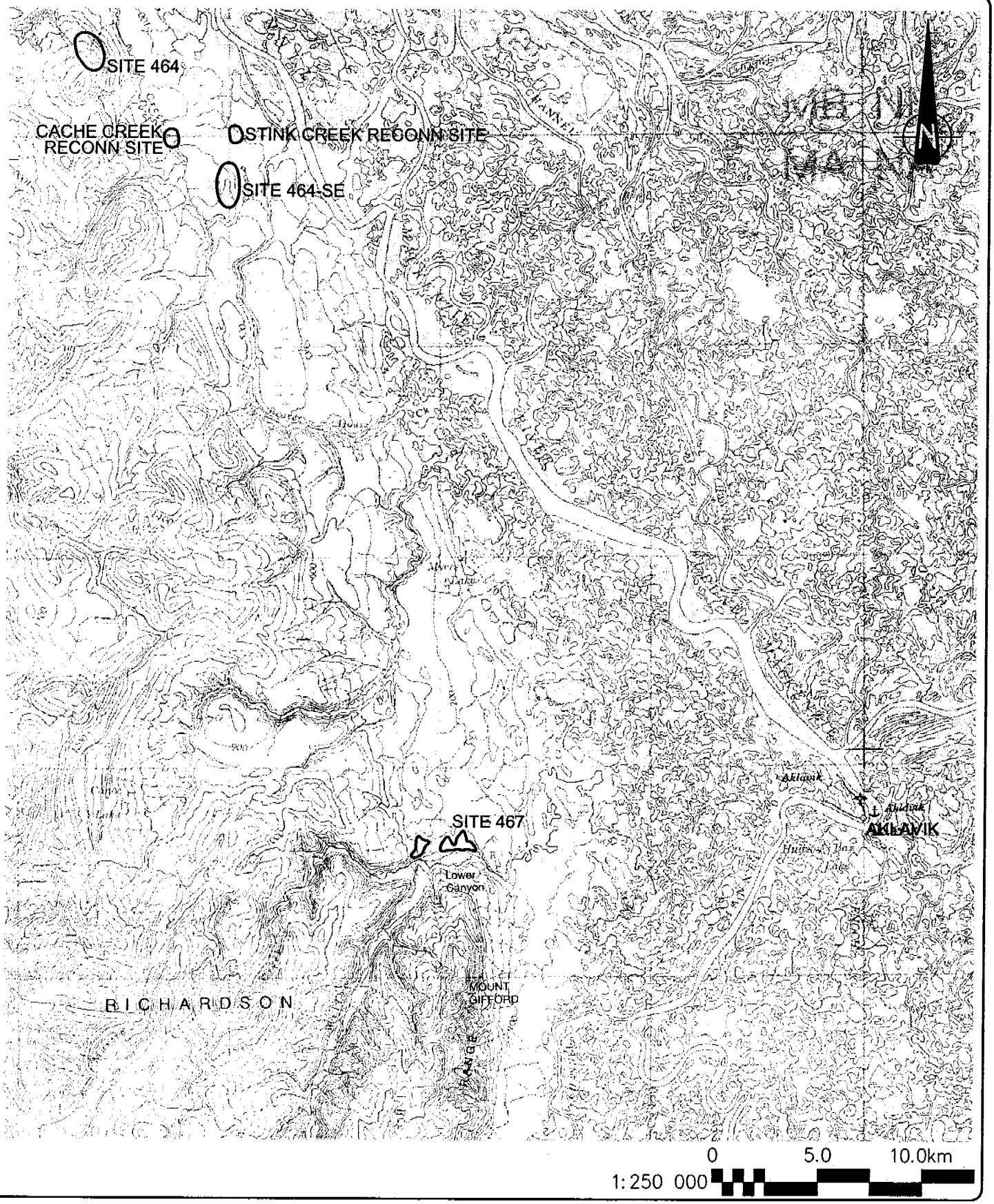
CLIENT/PROJECT DESCRIPTION

INUVIALUIT LAND ADMINISTRATION
ISR GRANULAR RESOURCE ASSESSMENT

EBA Engineering Consultants Ltd.

SCALE	EBA PROJECT NO.	DATE/DRAWN BY:	TITLE/EBA DRAWING NO.
AS SHOWN	1100018	02/12/10 ANS/NRM	YAYA SOURCE AREA FIGURE 1



CLIENT/PROJECT DESCRIPTION
INUVIALUIT LAND ADMINISTRATION
ISR GRANULAR RESOURCE ASSESSMENT

EBA Engineering Consultants Ltd.

SCALE/EBA PROJECT NO.
AS SHOWN
1100018

DATE/DRAWN BY:
02/12/10
ANS/NRM

TITLE/EBA DRAWING NO.
AKLAVIK AREA BORROW PROSPECTS
FIGURE 2

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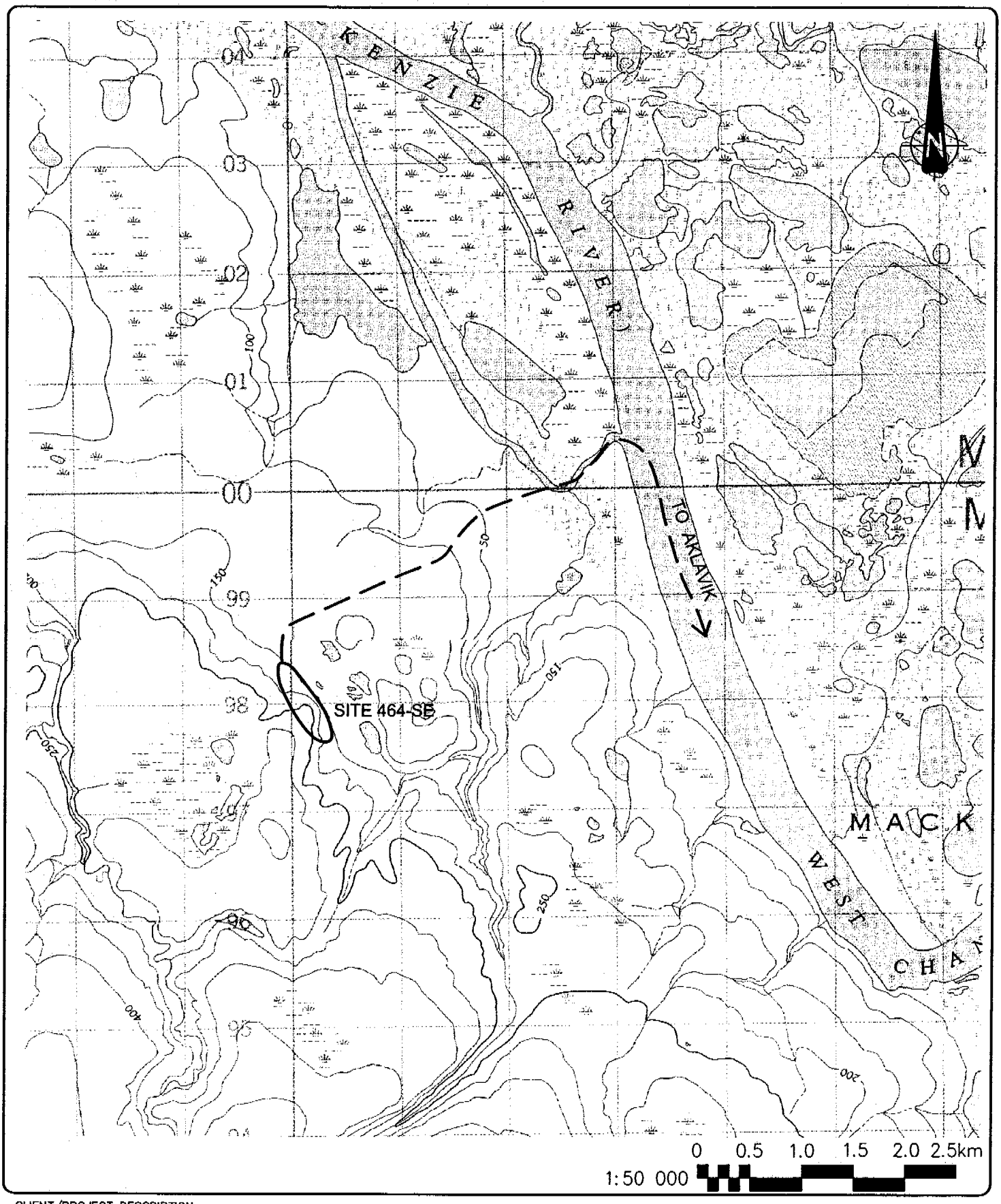

CLIENT/PROJECT DESCRIPTION
INUVIALUIT LAND ADMINISTRATION
ISR GRANULAR RESOURCE ASSESSMENT

EBA Engineering Consultants Ltd.

SCALE/EBA PROJECT NO.
AS SHOWN
1100018

DATE/DRAWN BY:
02/12/10
ANS/NRM

TITLE/EBA DRAWING NO.
BORROW PROSPECT 464-SE ACCESS TO/FROM AKLAVIK
FIGURE 3

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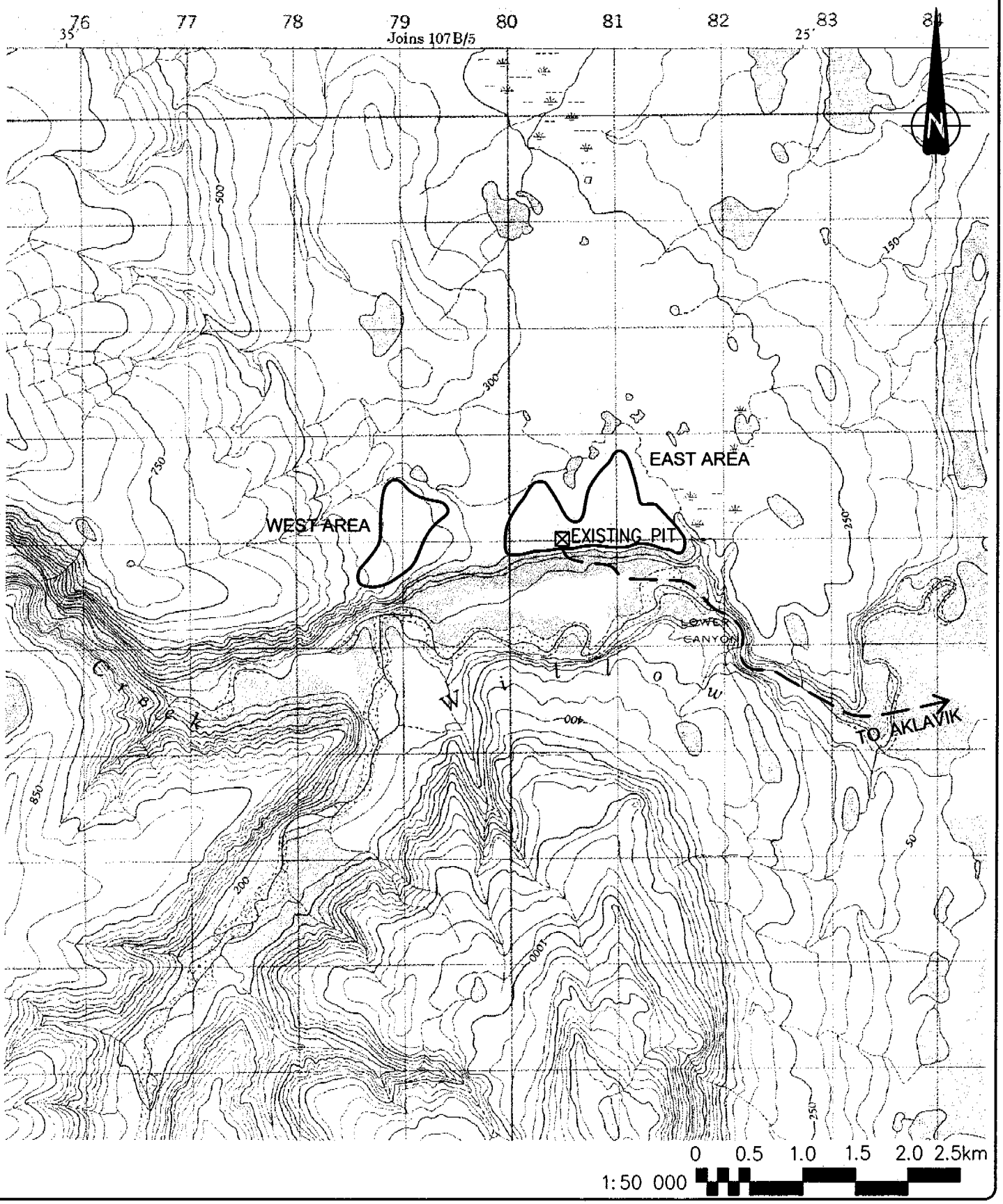

CLIENT/PROJECT DESCRIPTION
INUVIALUIT LAND ADMINISTRATION
ISR GRANULAR RESOURCE ASSESSMENT

EBA Engineering Consultants Ltd.

SCALE/EBA PROJECT NO.
AS SHOWN
1100018

DATE/DRAWN BY:
02/12/10
ANS/NRM

TITLE/EBA DRAWING NO.
BORROW PROSPECT 467 ACCESS TO/FROM AKLAVIK
FIGURE 4

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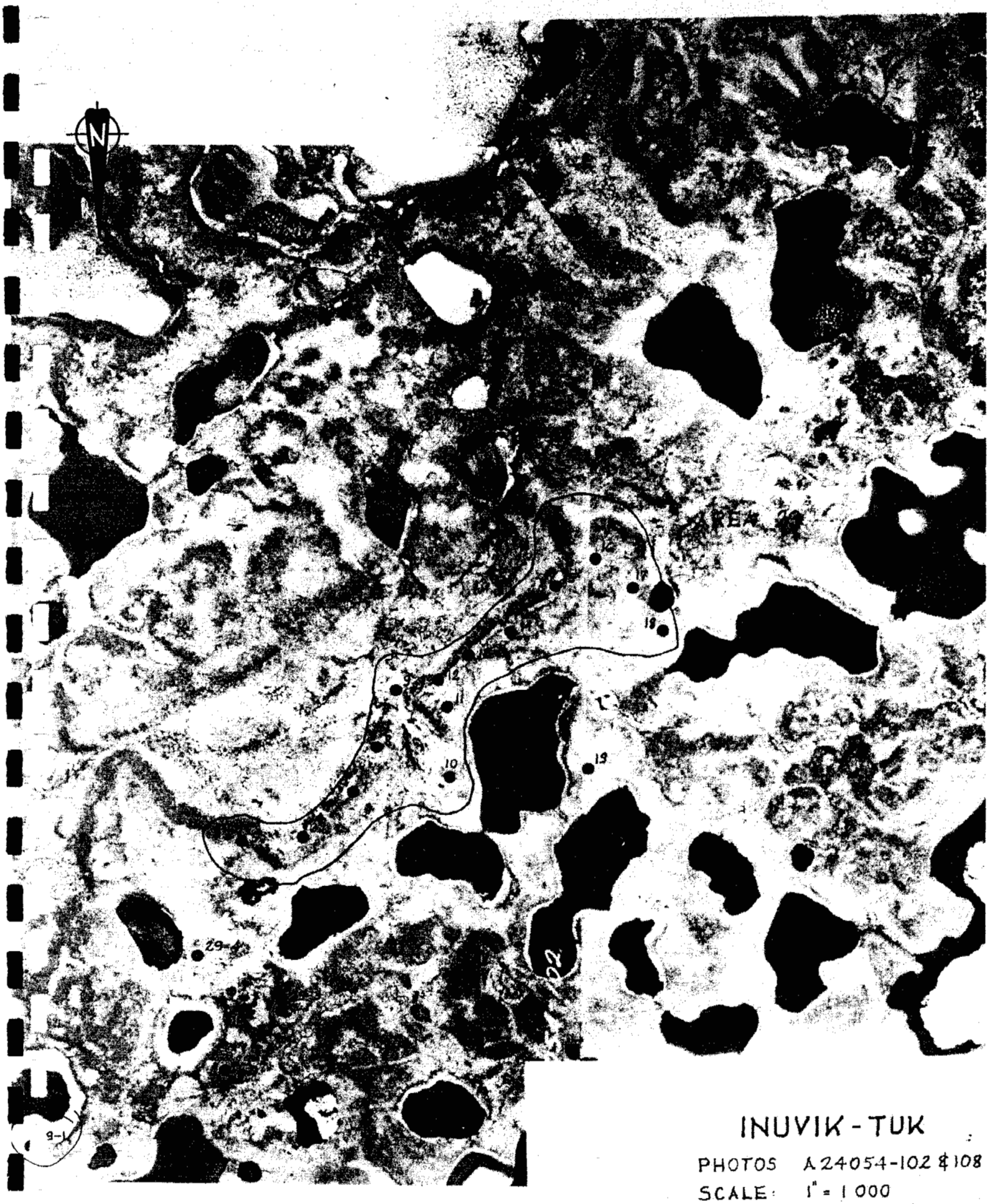
ARE
T4C
T4C



INUVIK - TUK

PHOTOS A 24054-102 & 108

SCALE: 1" = 1 000

DATE: JUNE 22/1975

SEARCH AREA #29

Landform and Location:	Glacio-fluvial outwash feature (small esker or crevasse filling) roughly 1 mile west of the alignment near Mile 1044.
Material:	Gravelly sand and sand gravel, some silt, wet or saturated on thawing.
Stripping:	Feature is a narrow elongate ridge - stripping on south side will increase as depth of excavation extends below adjacent terrain.
Conclusion:	A good viable source of borrow. Volume of material estimated at roughly 300,000 cu. yds. Extraction by stripping periodically throughout summer is recommended to eliminate ice in final product. Subsequent stockpiling, and winter haul to R.O.W. to avoid construction of haul road will be required.

INUVIK - TUK.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

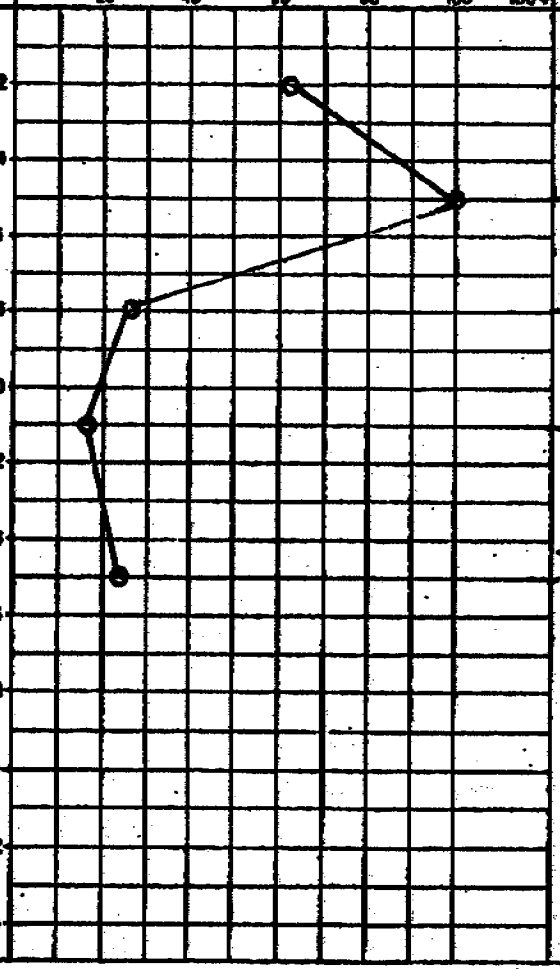
DWN | FIELD ENG. | DATE DRILLED 4-4-71 | AIRPHOTO NO: | CHAINAGE: | OFFSET
CKD | TECH PROJYCH | RIG: AIR | SURFACE DRAINAGE: | VEGETATION: | ELEV

TEST HOLE 29-1
MILE | B,C,S | NUMBER

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0					Pt	PEAT		
						1.5'		
2					SM	SAND - SILTY PEBBLES		V_S
4								
						5'		
6						CLAY - SILTY SANDY PEBBLES		
8					CL			
10						LOW - MED PLASTIC		$V_C - V_T$
12					CI			
14								
						15'		
16						BOTTOM OF HOLE - 15'		
18								
20								
22								
24								

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT ——— LIQUID LIMIT
20 40 60 80 100 100+



GRAIN-SIZE ANALYSIS				WET DENSITY (P.C.F.)	DRY DENSITY (P.C.F.)	REMARKS
CLAY %	SILT %	SAND %	GRAVEL %			
16	80	4				FREE WATER
68	30	2				FREE WATER
69	29	2				WET
53	45	2				MOIST
74	24	2				DAMP

INUVIK - TUK.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

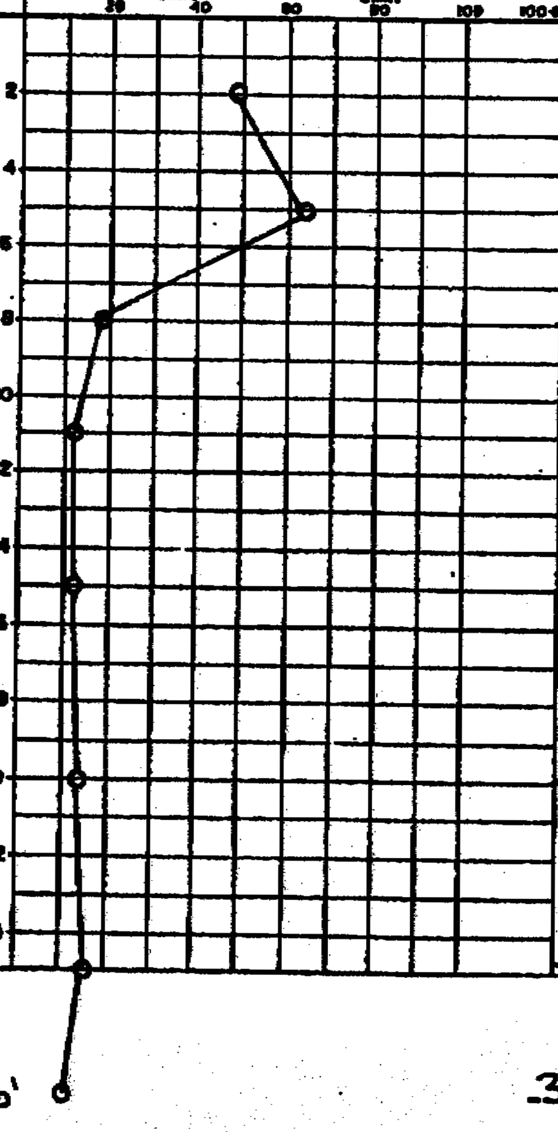
DWN	FIELD ENG.	DATE DRILLED 4/4/77	AIRPHOTO NO:
CKD	TECH PRONYCH	RIG: AIR	SURFACE DRAINAGE:
CHAINAGE:	OFFSET	VEGETATION:	ELEV

TEST HOLE 29-2

MILE	B.C.S	NUMBER
		[redacted]

DEPTH (FEET)	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	ICE DESCRIPTION
0–2'	Pt.	PEAT	
2'–6'	CL / CI	CLAY - SANDY, SILTY, PEBBLES	Vs
6'–	SM	SAND - SILTY, GRAVELLY	Vc - Vr

○ = WATER CONTENT (% OF DRY WEIGHT)
△ = ICE CONTENT (% OF SAMPLE VOLUME)
PLASTIC LIMIT — LIQUID LIMIT



GRAIN-SIZE ANALYSIS

CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (P.C.F.)	DRY DENSITY (P.C.F.)	REMARKS
-	40	53	7	Free Water		
-	39	43	18	Free Water		
-	35	54	11	Sat		
-	32	49	19	Moist		
-	33	46	21	Damp		
-	34	56	10	Damp		
-	43	50	7	Damp		
-	37	52	11	Damp		

30'

BOTTOM OF HOLE - 30'

Inuvik - Tuk.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED 7/4/73 | AIRPHOTO NO: | CHAINAGE: | OFFSET:
CKD | TECH PRONYKH | ING. AIR | SURFACE DRAINAGE: | VEGETATION: | ELEV

TEST HOLE 29-3

MILE	B,C,S	NUMBER
		[redacted]

REMARKS

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
					Pt	PEAT — 2'		
					CL	CLAY - SILTY SANDY PEBBLES		VS
					SC	CLAYEY SILTY SAND - PEBBLES — 13' — 15'		
						Bottom of Hole - 15'		

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT — LIQUID LIMIT
20 40 60 80 100 100+

GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (PCF)	DRY DENSITY (PCF)	
38	52	10				DAMP
48	43	9				FREE WATER
51	41	8				WET
96	4	0				SAT
40	59	1				FREE WATER

INUVIK - TUK.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED | AIRPHOTO NO: | CHAINAGE: | OFFSET

CKD | TECH PROMAH | RIG: AIR | SURFACE DRAINAGE: | VEGETATION: | ELEV

TEST HOLE 29-4

MILE | B,C,S | NUMBER

REMARKS

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
					Pt	PEAT — 1'		
					CL	CLAY - SILTY SANDY PEBBLES LOW PLASTIC		
						GRAVELLY — 15'		
						BOTTOM OF HOLE - 15		

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT — LIQUID LIMIT

GRAIN-SIZE ANALYSIS				WET DENSITY (PCF)	DRY DENSITY (PCF)
CLAY %	SILT %	SAND %	GRAVEL %		
68	28	4		SAT.	
65	30	5		WET	
47	48	5		WET	
51	36	13		WET	

INUVIK - TUK.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED 7/4/71 | AIRPHOTO NO: | CHAINAGE: | OFFSET
CKD | TECH PRONYCH | RIG AIR | SURFACE DRAINAGE: | VEGETATION: | ELEV

TEST HOLE 29-5

MILE	B,C,S	NUMBER

REMARKS

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (P.C.F.)	DRY DENSITY (P.C.F.)
0					Pt	PEAT 2"								
2					SM	SAND - SILTY GRAVELLY			20	45	35			MOIST
4					SC	CLAY BY			28	60	11			SAT.
6									31	50	19			SAT.
8						9'								
10					CL	CLAY - SILTY SANDY GRAVELLY LOW PLASTIC 13'		$V_c - V_r$	49	30	21			WET
12														
14					SM	SAND - SILTY GRAVELLY			12	75	13			WET
16						17'								
18						CLAY - SILTY SANDY PEBBLES								
20									79	20	1			
22					CL	MED - PLASTIC								
24									68	19	13			MOIST

○ = WATER CONTENT (% OF DRY WEIGHT)
△ = ICE CONTENT (% OF SAMPLE VOLUME)
PLASTIC LIMIT ⟷ LIQUID LIMIT
20 40 60 80 100 100+

30'

BOTTOM OF HOLE - 30'

-22-21-2 DAMP

Inuvik - Tuk.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN	FIELD ENG.	DATE DRILLED 11/71	AIRPHOTO NO:	CHAINAGE:	OFFSET:
CKD	TECH. PRONYCH	RIG: AIR	SURFACE DRAINAGE:	VEGETATION:	ELEV

TEST HOLE 29-6

MILE	B,C,S	NUMBER
		[redacted]

REMARKS

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0					Pt	PEAT 1.5'		
2					SC	SAND-SILTY CLAYEY PEBBLES GRAVELLY		Vs
8					SM			
14						ICE		ICE
14					SP	SAND-FINE GRAVELLY		Vc-Vr
24								

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT — LIQUID LIMIT
20 40 60 80 100 100+

DEPTH (FEET)	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (P.C.F.)	DRY DENSITY (P.C.F.)
2	42	54	4		DAMP	
4	33	60	7		[illegible]	
8	20	61	19		[illegible]	
12	17	63	20		SAT.	
16	9	90	1		SAT.	
20	2	69	29		MOIST	
24	9	74	22		DAMP	

OVER

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN	FIELD ENG.	DATE DRILLED	AIRPHOTO NO.	CHAINAGE	OFFSET
CKD	TECH	RIG	SURFACE DRAINAGE:	VEGETATION	ELEV

TEST HOLE 29-6

MILE	B,C,S	NUMBER
		[redacted]

REMARKS

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0					SP	SAND - FINE		
2								
4						SILTY - PEBBLES		
6								
8					SM			
10						41		
12						BOTTOM OF HOLE-41		
14								
16								
18								
20								
22								
24								

○ = WATER CONTENT (% OF DRY WEIGHT)
△ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT ⟷ LIQUID LIMIT

DEPTH (FEET)	20	40	60	80	100	100+
30						
32						
34						
36						
38						
40						
42						

GRAIN-SIZE ANALYSIS

CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (PCF)	DRY DENSITY (P.C.F.)
4	96	0		DAMP	
19	77	4		WET	
29	71	0		SAT.	

INUVIK - TUK.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN	FIELD ENG.	DATE DRILLED	AIRPHOTO NO:	CHAINAGE:	OFFSET:
CKD	TECH. PRONYCH	RIG: AIR	SURFACE DRAINAGE:	VEGETATION:	ELEV

TEST HOLE 29-7

MILE	B,C,S	NUMBER
		[redacted]

REMARKS

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (PCF)	DRY DENSITY (P.C.F.)
0						PEAT 10"								
2					SM	SAND - SILTY PEBBLES		Vc-Vr	10	38	6		DAMP	
4									10	81	9		MOIST	
6														
8									15	79	6		WET	
10						GRAVELLY									
12									13	66	21		SAT.	
14														
16									19	64	17		SAT	
18								Vs						
20									18	59	23		SAT	
22														
24					ML	SILT - SANDY - PEBBLES			56	39	5		SAT	

○ = WATER CONTENT (% OF DRY WEIGHT)
△ = ICE CONTENT (% OF SAMPLE VOLUME)
PLASTIC LIMIT — LIQUID LIMIT
20 40 60 80 100+

OVER

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN	FIELD ENG.	DATE DRILLED	AIRPHOTO NO:	CHAINAGE:	OFFSET
CKD	TECH	RIG:	SURFACE DRAINAGE:	VEGETATION:	ELEV

TEST HOLE 25-7

MILE	B,C,S	NUMBER
		[redacted]

REMARKS

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0					CL	CLAY-SILTY-SANDY GRAVELLY		$V_C - V_f$
						32'		
					SM	SAND-SILTY GRAVELLY		
						37'		
					ML CL CI	SILT-CLAYEY CLAY-SILTY PEBBLES SANDY		
						45'		
						BOTTOM OF HOLE-45'		

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT — LIQUID LIMIT

DEPTH (FEET)	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (PCF)	DRY DENSITY (PCF)
0	50	38	12		SAT.	
32						
34	20	51	29		WET	
36						
38						
40	57	40	3		DAMP	
42						
44	73	24	3		DAMP	
46						
48						
0						
18						
20						
22						
24						

Inuvik - Tuk

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED: N/T | AIRPHOTO NO: | CHAINAGE: | OFFSET

CKD | TECH. PRONYCH | RIG: A12 | SURFACE DRAINAGE: | VEGETATION: | ELEV

TEST HOLE: 29-8

MILE	B,C,S	NUMBER

REMARKS

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0					Pt	PEAT — 10"		
2					SM	SAND - PEBBLES SILTY		
6						— 6'		
8					SW	SAND-GRAVELLY TO SAND-GRAVEL MIXTURES		Vc-Vr
12					GW			
20					CL	CLAY-SILTY SANDY P. — 21'		
22						BOTTOM OF HOLE		

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT — LIQUID LIMIT

20 40 60 80 100 100+

DEPTH (FEET)	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (P.C.F.)	DRY DENSITY (P.C.F.)
2	22	65	13			DAMP
6	17	75	8			SAT.
8	5	63	32			SAT.
12	5	64	31			SAT
16	3	52	45			SAT
20	15	77	8			SAT.

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P.13/26

INUVIK - TUK.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED: 4/11 | AIRPHOTO NO: | CHAINAGE: | OFFSET:

CKD | TECH PRONYCH | RIG: AIR | SURFACE DRAINAGE: | VEGETATION: | ELEV:

TEST HOLE 29-9

MILE	B,C,S	NUMBER
		[redacted]

REMARKS

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0					Pt	Peat — 4"		
2					SM	SAND-GRAVELLY		Vc-Vr
4								
6								
8								
10								
12						12'		
14						BOTTOM OF HOLE - 12'		
16								
18								
20								
22								
24								

○ = WATER CONTENT (% OF DRY WEIGHT)
△ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT ——— LIQUID LIMIT
20 40 60 80 100 100+

DEPTH (FEET)	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (P.C.F.)	DRY DENSITY (P.C.F.)
2	2	68	30		DAMP	
4						
6	14	53	33		SAT.	
8	5	55	40		SAT.	
10						
12	7	66	27		SAT.	

INUVIK - TUK

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED 7-11 | AIRPHOTO NO: | CHAINAGE: | OFFSET
CKD | TECH PRONYCH | RIG: AIR | SURFACE DRAINAGE: | VEGETATION: | ELEV.

TEST HOLE 29-10

MILE | B.C.S | NUMBER

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
					Pt	PEAT — 10"		
2					SM	SAND - SILTY PEBBLES		Vc-Vr
4					ML	SILT - SANDY PEBBLES		
8					SM	SAND - SILTY PEBBLES		Vs
10					ML	SILT - SANDY CLAYEY GRAVELLY		
14					SM	SAND - SILTY - PEBBLES 15'		
16						BOTTOM OF HOLE - 15		

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT → LIQUID LIMIT: 20 | 40 | 60 | 80 | 100 | 100+

GRAIN-SIZE ANALYSIS						REMARKS
CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (P.C.F.)	DRY DENSITY (P.C.F.)	
27	69	4		SAT.		
53	44	3		WET		H.I.B.
30	65	5		SAT.		
44	42	14		SAT.		
42	54	4		SAT		

1 of 2

INUVIK - TUK.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED 8/11 | AIRPHOTO NO: | CHAINAGE | OFFSET | TEST HOLE 29-12
CKD | TECH PRONYK | RIG AIR | SURFACE DRAINAGE: | VEGETATION: | ELEV | MILE | B,C,S | NUMBER

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0					Pt	Peat 1ft		
2						SAND - SILTY PEBBLES		
4								
6								
8								
10					SM			Vc-Vr
12								
14								
16								
18								
20						GRAVELLY		
22								
24								

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)
PLASTIC LIMIT — LIQUID LIMIT
20 40 60 80 100 100+

DEPTH (FEET)	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (P.C.F.)	DRY DENSITY (P.C.F.)
2	14	82	4		DAMP	
4	31	64	5		WET	
6	26	66	8		SAT	
8	24	72	4		SAT	
10						
12	24	73	3		SAT.	
14						
16						
18						
20	19	65	16		SAT.	
22						
24	17	51	32		SAT	

REMARKS

OVER

INUVIK - TUK

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED 4-11 | AIRPHOTO NO: | CHAINAGE: | OFFSET
CKD | TECH PROWYCH | RIG: AIR | SURFACE DRAINAGE: | VEGETATION: | ELEV:

TEST HOLE 29-10
MILE | B.C.S | NUMBER

REMARKS: H.I.B.

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0					Pt	PEAT — 10"		
2					SM	SAND - SILTY PEBBLES		Vc-Vr
4					ML	SILT - SANDY PEBBLES		
6					SM	SAND - SILTY PEBBLES		Vs
10					ML	SILT - SANDY CLAYEY GRAVELLY		
12					SM	SAND - SILTY - PEBBLES 15'		
14						BOTTOM OF HOLE - 15		
16								
18								
20								
22								
24								

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT — LIQUID LIMIT
20 40 60 80 100 100+

GRAIN-SIZE ANALYSIS				WET DENSITY (P.C.F.)	DRY DENSITY (P.C.F.)
CLAY %	SILT %	SAND %	GRAVEL %		
27	69	4		SAT.	
53	44	3		WET	
30	65	5		SAT.	
44	42	14		SAT.	
42	54	4		SAT	

INUVIK - TUK.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED 11/77 | AIRPHOTO NO: | CHAINAGE: | OFFSET:

CKD | TECH PRONYK | RIG AIR | SURFACE DRAINAGE: | VEGETATION: | ELEV:

TEST HOLE 29-11

MILE	B,C,S	NUMBER
		[redacted]

REMARKS

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0					Pt	PEAT — 8"		
2					SM	SAND - SILTY PEBBLES		
4								
6								
8								
10					CL	CLAY - SILTY SANDY — 9'		VS
12						— 12'		
14						SAND - SILTY PEBBLES		
16					SM			
18						GRAVELLY		
20								
22								
24								

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT — LIQUID LIMIT
10 20 30 40 50 60 100 100+

DEPTH (FEET)	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (PCF)	DRY DENSITY (P.C.F.)	
2	29	67	4		WET		
4	21	72	7		FREEWATER		
6	28	71	1		WET		
8							
10	67	33	0		FREEWATER		
12							
14							
16	20	77	3		WET		
18							
20	10	70	20		FREEWATER		
22							
24	37	45	18		SAT.		

PEBBLES

BOTTOM OF HOLE - 30

-70-26-4 WET.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN	FIELD ENG	DATE DRILLED	AIRPHOTO NO:	CHAINAGE:	OFFSET:
CKD	TECH	RIG	SURFACE DRAINAGE:	VEGETATION:	ELEV:

TEST HOLE 29-12

MILE	B,C,S	NUMBER

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0–2						SAND- SILTY PEBBLES		
2–4								
4–6								
6–8					SM	SILTY FINE		VS
8–10					SP			
10–12								
12–14								
14–16						BOTTOM OF HOLE - 45'		
16–18								
18–20								
20–22								
22–24								

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT — LIQUID LIMIT

DEPTH (FEET)	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (pcf)	DRY DENSITY (p.c.f.)	REMARKS
0–2	23	66	11	0			SAT.
2–4							
4–6	35	63	2	0			SAT
6–8							
8–10							
10–12	11	89	0	0			FREE WATER
12–14							
14–16	10	90	0	0			SAT. - FREE WATER
16–18							
18–20							
20–22							
22–24							

2 OF 2

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN	FIELD ENG.	DATE DRILLED	AIRPHOTO NO:	CHAINAGE:	OFFSET:	TEST HOLE 79-13
CKD	TECH	RIG	SURFACE DRAINAGE:	VEGETATION:	ELEV.	MILE / B,C,S / NUMBER

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0–4					SM	SAND - Silty Gravelly		
4–14					SM			
14						45'		
14–24						Bottom of Hole - 45		

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT ⟷ LIQUID LIMIT

GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (pcf)	DRY DENSITY (p.c.f.)	REMARKS
19	59	22		MOIST		
21	67	12		GRAVEL		
28	50	22		SAT.		
21	61	18		SAT.		

Inuvik - Tuk.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG | DATE DRILLED | AIRPHOTO NO: | CHAINAGE | OFFSET
CKD | TECH Ronych | RIG Air | SURFACE DRAINAGE: | VEGETATION | ELEV

TEST HOLE 29-14

MILE | S,C,S | NUMBER

REMARKS

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (PCF)	DRY DENSITY (P.C.F.)	ATTERBERG LIMITS
0						Peat									
4					SM	SAND - SILTY GRAVELLY		VS	23	49	23				Free Water
8									22	61	17				Free Water
12									20	61	19				SAT.
16									23	59	18				SAT.
20									22	62	16				SAT.
24									23	70	7				SAT.

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)
PLASTIC LIMIT — LIQUID LIMIT
20 40 60 80 100 100+

ICE & SAND

ICE + SM

30'

Bottom of Hole - 30'

INUVIK - TUK

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED 8-11-70 | AIRPHOTO NO: | CHAINAGE: | OFFSET
CKD | TECH PRONYK | RIG: AIR | SURFACE DRAINAGE: | VEGETATION: | ELEV

TEST HOLE 29-17
MILE | B,C,S | NUMBER [redacted]

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0					Pt	PEAT 4"		
2					Cl	CLAY - SILTY SANDY PEBBLES		Vs
4					Cl	4'		
6					Sc	SAND - CLAYEY SILTY PEBBLES		
8						GRAVELLY		
10					Sm	SILTY - PEBBLES		Vc - Vr
12						GRAVELLY		
14								
16								
18								
20								
22								
24								

○ = WATER CONTENT (% OF DRY WEIGHT)
△ = ICE CONTENT (% OF SAMPLE VOLUME)
PLASTIC LIMIT ——— LIQUID LIMIT
20 40 60 80 100 120 140+

DEPTH (FEET)	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (P.C.F.)	DRY DENSITY (P.C.F.)	REMARKS
2	5	43	1		DAMP		
4	26	66	8		WATER		H.I.B.
8	19	57	24		SAT.		
10	33	58	5		WET		
14	27	54	19		WET		
20	26	70	4		WET		
24	21	61	18		WET		

30'

Bottom of Hole - 30'

-26-56-18 SAT.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN	FIELD ENG	DATE DRILLED	AIRPHOTO NO:	CHAINAGE:	OFFSET:
CKD	TECH	RIG	SURFACE DRAINAGE:	VEGETATION:	ELEV:

TEST HOLE 29-12

MILE	B,C,S	NUMBER
		[redacted]

REMARKS

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0–2					SM	SAND- SILTY PEBBLES		VS
2–4								
4–6								
6–8								
8–10					SP	SILTY FINE		
10–12								
12–14								
14–16						BOTTOM OF HOLE - 45		
16–18								
18–20								
20–22								
22–24								

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT — LIQUID LIMIT

DEPTH (FEET)	10	20	30	40	50	60	70	80	90	100+
0	O									
2										
4		O								
6										
8										
10			O							
12										
14										
16				O						
18										
20										
22										
24										

GRAIN-SIZE ANALYSIS

DEPTH (FEET)	CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (PCF)	DRY DENSITY (P.C.F.)	REMARKS
0–2	23	66	11	0			SAT
2–4							
4–6	35	63	2	0			SAT
6–8							
8–10							
10–12	11	89	0	0			FREE WATER
12–14							
14–16							
16–18	10	90	0	0			SAT. - FREE WATER
18–20							
20–22							
22–24							

INUVIK - TUK.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED 84 11 | AIRPHOTO NO: | CHAINAGE: | OFFSET

CKD | TECH FRANYCH | RIG: AMI2 | SURFACE DRAINAGE: | VEGETATION: | ELEV

TEST HOLE 29-13

MILE	S,C,S	NUMBER

REMARKS

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (P.C.F.)	DRY DENSITY (P.C.F.)
0-2						SAND - SILTY GRAVELLY			14	62	24			DRY
2-4														
4-6									20	60	20			MOIST
6-8						PEBBLES								
8-10					SM			Vc-Vr	26	70	4			SAT
10-12									25	70	5			WET
12-14														
14-16						GRAVELLY			23	65	12			WET
16-18														
18-20														
20-22									26	48	26			WET
22-24														
24-									24	61	15			WET

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT — LIQUID LIMIT
20 30 40 50 60 100+

OVER

2 OF 2

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN:	FIELD ENG:	DATE DRILLED:	AIRPHOTO NO:	CHAINAGE:	OFFSET:
CKD:	TECH:	RIG:	SURFACE DRAINAGE:	VEGETATION:	ELEV:

TEST HOLE 79-13

MILE	B,C,S	NUMBER
		[redacted]

REMARKS

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0–2						SAND-Silty Gravelly		
2–4								
4–6								
6–8					SM			
8–10								
10–12								
12–14								
14–16						45'		
16–18						Bottom of Hole - 45	45	
18–20								
20–22								
22–24								

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT — LIQUID LIMIT
10 20 30 40 50 60 100 100+

DEPTH (FEET)	CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (PCF)	DRY DENSITY (P.C.F.)
0–2	19	59	22		MOIST	
2–4						
4–6	21	67	12		COBBLES	
6–8						
8–10						
10–12	28	50	22		SAT.	
12–14						
14–16	21	61	18		SAT.	
16–18						
18–20						
20–22						
22–24						

INUVIK - TUK.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG | DATE DRILLED 24/11/71 | AIRPHOTO NO: | CHAINAGE | OFFSET

CKD | TECH R. Rausch | RIG AIR | SURFACE DRAINAGE: | VEGETATION | ELEV

TEST HOLE 29-14

MILE	B,C,S	NUMBER
		[redacted]

REMARKS

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION	DEPTH (FEET)	O = WATER CONTENT (% OF DRY WEIGHT) Δ = ICE CONTENT (% OF SAMPLE VOLUME) PLASTIC LIMIT / LIQUID LIMIT	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (PCF)	DRY DENSITY (P.C.F.)	REMARKS
0					PT	PEAT											
2					SM	SAND - SILTY GRAVELLY		VS	2		28	49	23				FREE WATER
4									4								
6									6		22	61	17				FREE WATER
8									8		20	61	19				SAT.
10									10		23	59	18				SAT.
12									12								
14									14		22	62	16				SAT.
16									16								
18									18								
20									20		23	70	7				SAT.
22									22								
24									24								

ICE & SAND — ICE + SM — 30'

BOTTOM OF HOLE - 30'

INUVIK - TUK.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED 84 11 | AIRPHOTO NO: | CHAINAGE: | OFFSET | TEST HOLE 29-15
CKD | TECH POONYCH | RIG: AIR | SURFACE DRAINAGE: | VEGETATION: | ELEV: | MILE | S,C,S | NUMBER [redacted]

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	% LIMITS FROZEN GROUND	ICE DESCRIPTION
2					SM	SAND - SILTY GRAVELLY		
4					SP			
6								
8					SP			$V_c - V_r$
10								
12								
14					SM	SILTY		
						15'		
16						Bottom of Hole - 15'		
18								
20								
22								
24								

○ = WATER CONTENT (% OF DRY WEIGHT)
△ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT ⟷ LIQUID LIMIT
20 30 50 80 100 100+

DEPTH (FEET)	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (P.C.F.)	DRY DENSITY (P.C.F.)	REMARKS
2	25	35	40		DAMP		
4	1	59	40		MOIST		
6	6	65	29		WET		
8	8	80	12		WET		
14	23	74	3		SAT.		

INUVIK - TUK.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED 8/11 | AIRPHOTO NO: | CHAINAGE | OFFSET
CKD | TECH PROKYCH | RIG: AIR | SURFACE DRAINAGE: | VEGETATION: | ELEV

TEST HOLE 29-16
N.W.T. | B,C,S | NUMBER [redacted]

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0					Pt	PEAT 4"		
2–10					SM	SAND - SILTY PEBBLES		VS
12						ICE & SAND		ICE & SM
14					SM	AS ABOVE		VS
16–24						ICE - DIRTY		ICE

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)
PLASTIC LIMIT — LIQUID LIMIT
20 40 60 80 100 100+

GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (P.C.F.)	DRY DENSITY (P.C.F.)	REMARKS
32	66	2				DAMP
33	65	2				PERMAFR.
35	61	4				PERMAFR.
27	62	1				PERMAFR.
21	68	11				PERMAFR.

30'

BOTTOM OF HOLE - 30'

INUVIK - TUK

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED Sept 17 | AIRPHOTO NO: | CHAINAGE: | OFFSET
CKD | TECH PRONYCH | RIG: Air | SURFACE DRAINAGE: | VEGETATION: | ELEV

TEST HOLE 29-17
MILE | B.C.S | NUMBER [redacted]

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
0					Pt	PEAT 4"		
2					CL	CLAY - SILTY SANDY PEBBLES		Vs
4					CL			
6					SC	SAND - CLAYEY SILTY PEBBLES 4'		
8					GM	GRAVELLY SILTY - PEBBLES		Vc-Vr
10								
12						GRAVELLY		
14								
16								
18								
20								
22								
24								

○ = WATER CONTENT (% OF DRY WEIGHT)
△ = ICE CONTENT (% OF SAMPLE VOLUME)
PLASTIC LIMIT — LIQUID LIMIT
20 40 60 80 100 100+

DEPTH (FEET)	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (P.C.F.)	DRY DENSITY (P.C.F.)	REMARKS
2	56	43	1				DAMP
4	26	66	8				POSS WATER H.I.B.
6							
8	19	51	24				SAT.
10							
12	37	58	5				WET
14							
16	27	54	19				WET
18							
20	26	70	4				WET
22							
24	21	61	18				WET

30'

Bottom of Hole - 30'

-26 56 18 SAT.

INUVIK - TUK.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED 8/11/77 | AIRPHOTO NO: | CHAINAGE: | OFFSET
CKD | TECH R. ROWICH | RIG: AIR | SURFACE DRAINAGE: | VEGETATION: | ELEV

TEST HOLE 29-18

MILE | S,C,S | NUMBER [redacted]

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
					Pt	Peat — 8'		
					SM	SAND - SILTY GRAVELLY		
					ML	SILT - SANDY - CLAYEY		
					SC	SAND - SILTY CLAYEY		VL - VR
						16'		
						CLAY - SILTY SANDY PEBBLES		
					CL	LOW PLASTIC		
						23'		
					SM	SAND - SILTY GRAVELLY		

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)

PLASTIC LIMIT ——— LIQUID LIMIT
20 30 50 80 100 150+

GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (PCF)	MOISTURE CONTENT (%)	REMARKS
13	75	12		DAMP		H.I.B
60	40	0		SAT.		
24	43	33		WET		
33	55	12		SAT.		H.I.B
29	51	20		WET		
60	35	5		WET		
29	59	12		WET		

SM SAND - SILTY 30' O
BOTTOM OF HOLE - 30

-23-55-0 WET

INUVIK - TUK.

DRILL HOLE REPORT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DWN | FIELD ENG. | DATE DRILLED 8/4 | AIRPHOTO NO: | CHAINAGE | OFFSET
CKD | TECH. RONYCH | RIG AIR | SURFACE DRAINAGE | VEGETATION | ELEV

TEST HOLE 29-19

MILE | B,C,S | NUMBER

REMARKS

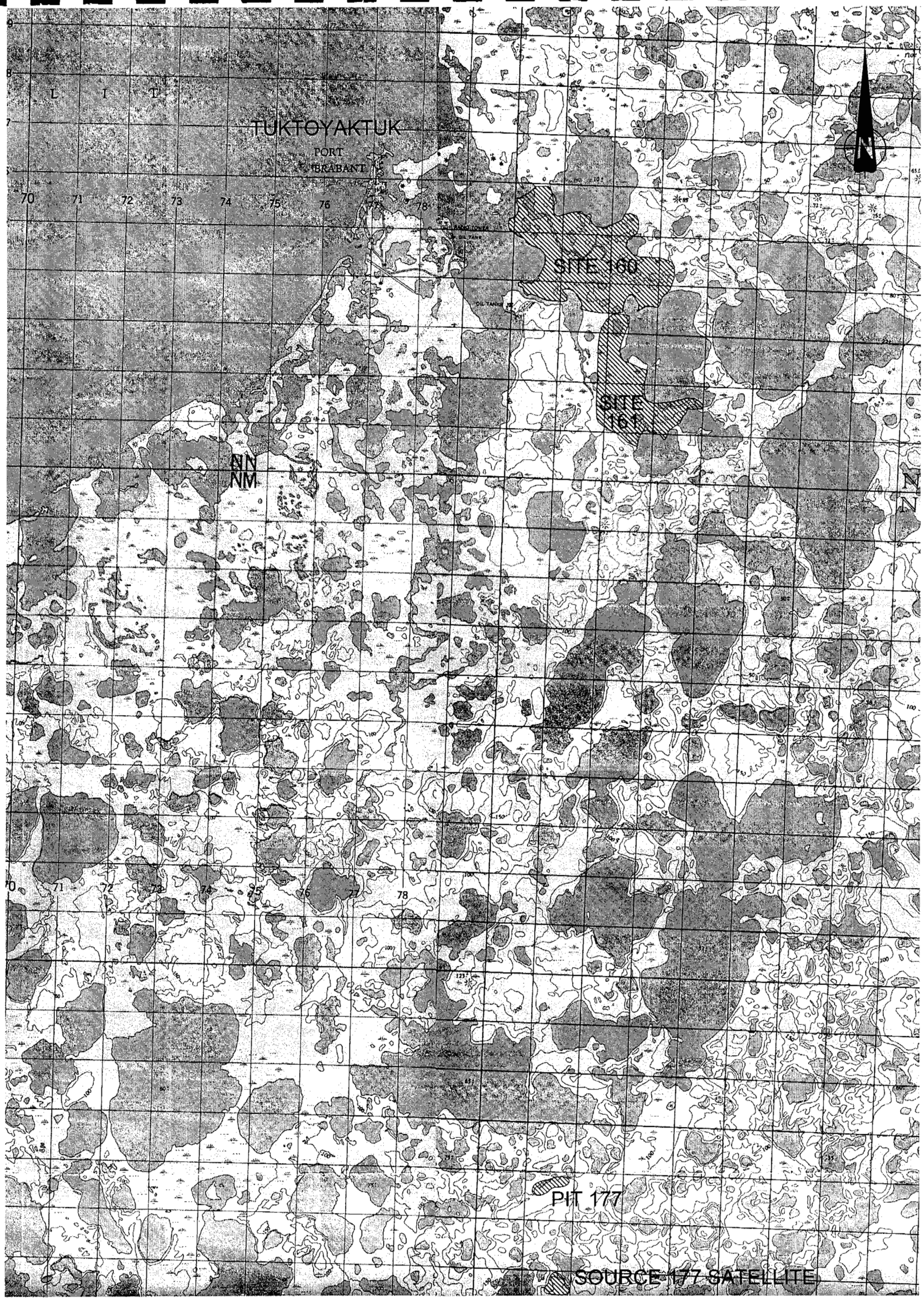
DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	WET DENSITY (P.C.F.)	DRY DENSITY (P.C.F.)
0					PEAT	PEAT 4"								
2						SAND-SILTY PEBBLES			30	66	4		DAMP	
4									19	66	15		WET	
6						GRAVELLY			22	67	11		WET	
8														
10														
12								$V_E - V_I$	41	48	11		DAMP	
14					SM				26	63	11		WET	
16														
18														
20									41	51	8		MOIST	
22														
24									16	71	13		WET	

O = WATER CONTENT (% OF DRY WEIGHT)
Δ = ICE CONTENT (% OF SAMPLE VOLUME)
PLASTIC LIMIT — LIQUID LIMIT
10 20 40 60 80 100 100+

PEBBLES 30'

BOTTOM OF HOLE - 30'

42 56 2 WET



LEGEND

APPROXIMATE SITE LOCATIONS

1: 75000 0 1 2 4km

CLIENT/PROJECT DESCRIPTION

INUVIALUIT LAND ADMINISTRATION
ISR GRANULAR RESOURCE ASSESSMENT

EBA Engineering Consultants Ltd.

SCALE	EBA PROJECT NO.	DATE/DRAWN BY:	TITLE/EBA DRAWING NO.
AS SHOWN	1100018	02/12/10 ANS/NRM	RECONNAISSANCE SITES FIGURE 5

G: \0101\1100018\dwg\1100018fg5.dwg, asupersad, 2002/12/11-08: 31

Photo 1
Previously worked area in the central part of the Yaya Deposit.

Photo 2
Steep sided, isolated gravel ridges on knobs separated by thaw ponds in central part of the Yaya Deposit.

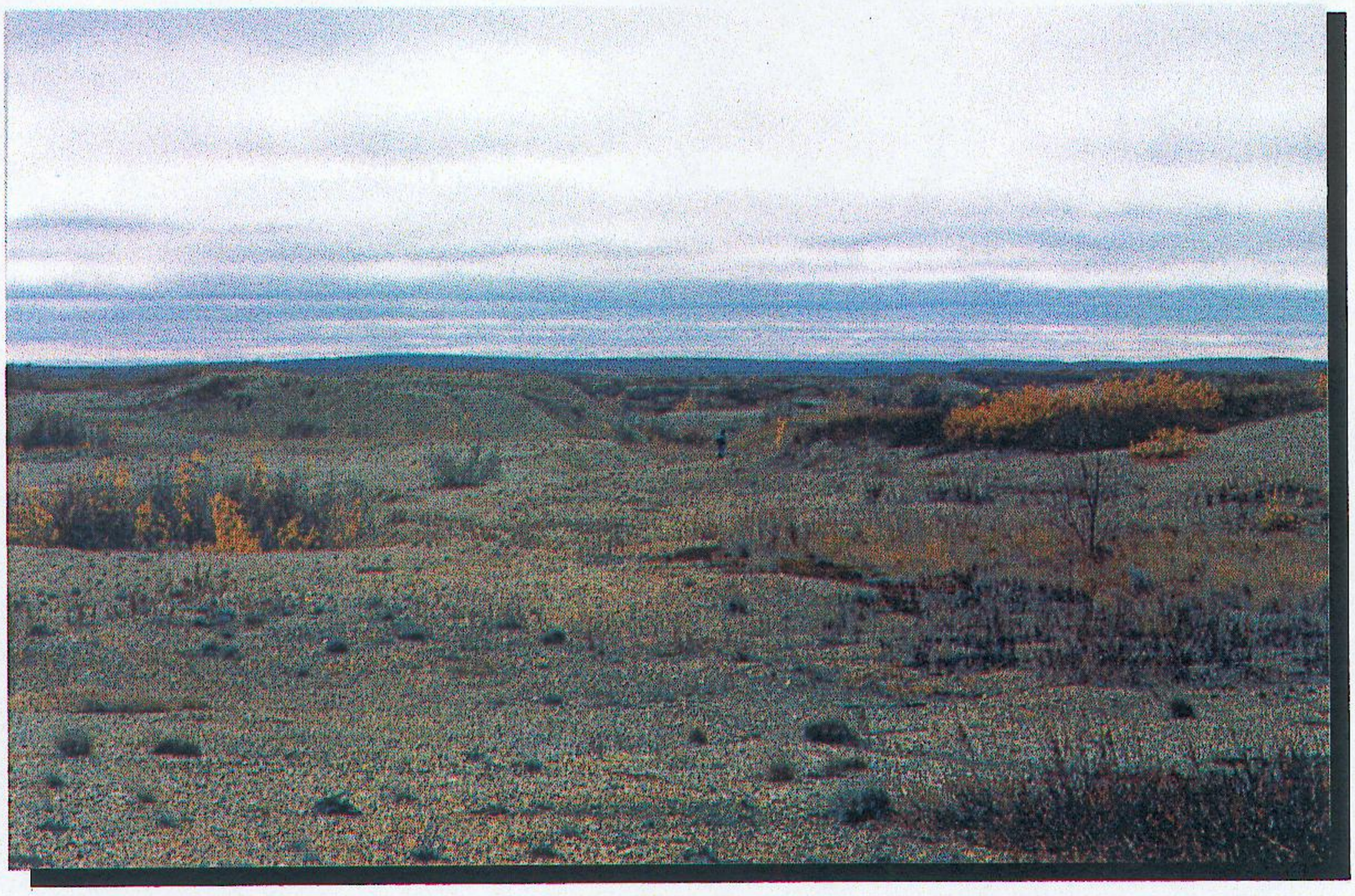


Photo 3
Eastern previously worked area in the Yaya Deposit showing low relief.

Photo 4
Gravelly sand ridge is along the edge of previously leased workings in eastern part of the Yaya Deposit.

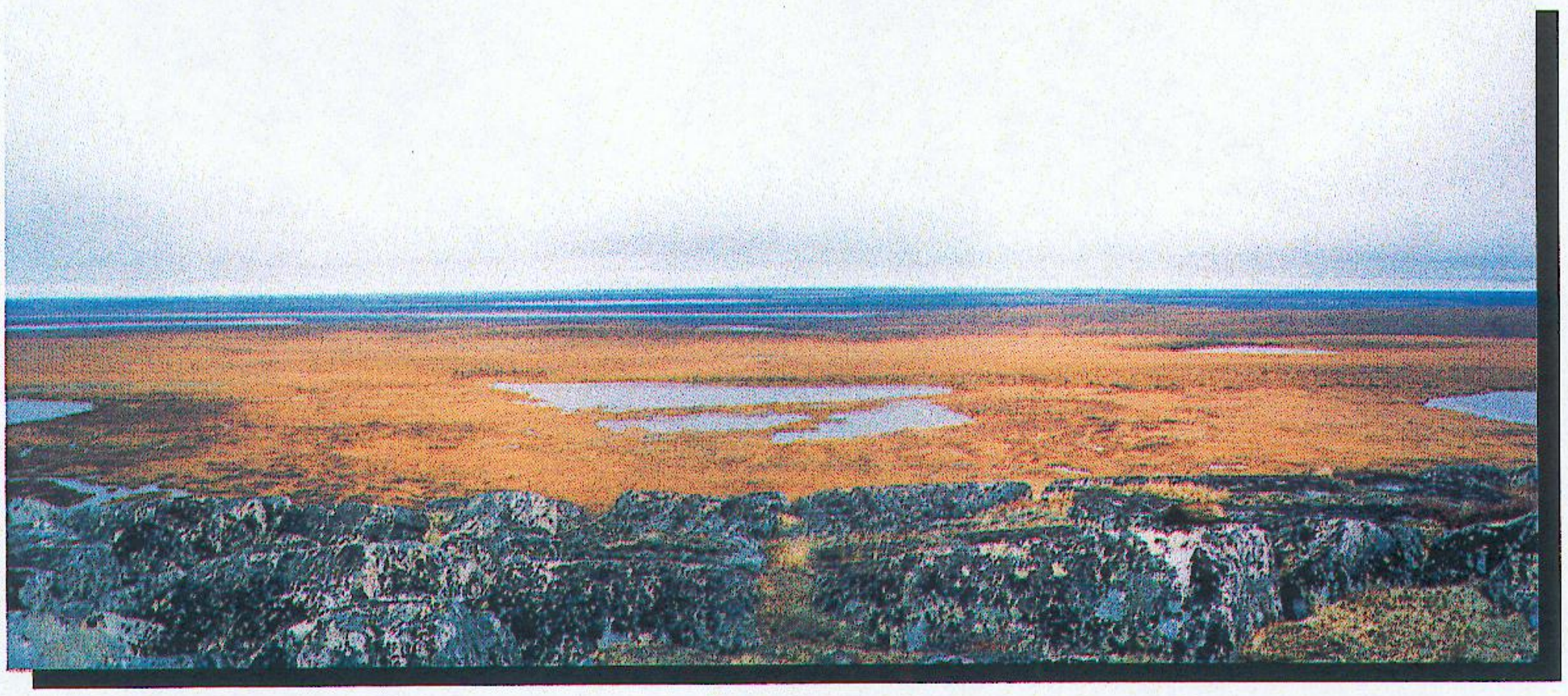


Photo 5
View to the river from the top of Site 464-SE.

Photo 6
View off the west side of Site 464-SE.

Photo 7
North end of Site 464-SE showing lower ridge tailing towards the northwest.

Photo 8
The face of the Willow River Pit appears in the foreground
and the Lower Canyon appears in the background.

Photo 9
Tuk Pit 177 in September 2001. Stripped area visible
is about 350 m long. (View to the southwest)

Photo 10
Tuk Pit 177 (view to west) in September 2001. Top of
ridge with ground-ice melt out cracks and minor slumps.