

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

INTERCOMMUNITY STUDY AREA

FORT SIMPSON TO WRIGLEY, N.W.T.



PEMCAN SERVICES "72"



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PEMCAN SERVICES

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PREFACE

The Government of Canada anticipated the potential need for extensive volumes of granular material for proposed major construction projects in the area of the Mackenzie River Valley and initiated an investigation of granular materials in this region during 1972 and 1973.

In September, 1972 the Department of Indian Affairs and Northern Development engaged PEMCAN Services "72" to conduct Stage 1 of the Territorial Granular Materials Inventory. Stage 1 is defined as the area from Fort Simpson to Fort Good Hope, N.W.T.

The objectives of this investigation were specified as:

Part 1: An investigation of the availability of granular material deposits within a ten mile radius of the communities of Fort Simpson, Wrigley, Fort Norman, Norman Wells and Fort Good Hope.

Part 2: An investigation of the availability of granular material deposits in the intermediate areas between the respective communities.

Part 1 of the investigation for the granular materials has been carried out by PEMCAN Services "72" in accordance with the Terms of Reference as specified by the Department of Indian Affairs and Northern Development. The results of the investigation pertaining to Part 1 are submitted in five separate reports which cover the respective communities within the Study Area. Part 2 of the investigation includes four separate inter-community area reports and a summary section.

The Terms of Reference specified the following definitions and procedures:



1. "Granular Material" is defined as all naturally occurring unconsolidated material, and bedrock which can be processed for suitable engineering construction.
2. Compilation and evaluation of the Geological Survey of Canada's surficial geology and granular material maps and all other relevant information prior to the undertaking of the field investigation.
3. Location, testing and classification of all granular and potential bedrock quarry materials within the specified search area and recommendations for their best use.

The data compiled for each site will include:

- a) The quantity and quality of usable material available, and recommendations as to its suitability as a construction material. Recommendations shall be substantiated by including results of tests on applicable material samples; these tests include:

Grain size distribution

Petrographic analysis

Moisture content

Ice content

Organic content

Hardness test

(In addition to the above tests, PEMCAN Services "72" recommended the use of Los Angeles Abrasion tests on samples from potentially high priority granular material and bedrock quarry sites).

- b) The location of borrow pits, and recommendations for development.



- c) Recommendations on the most efficient sequence of development where several pits can be developed in the same general area.
 - d) Evaluate the best access routes from prospective sites to the center of each community or to existing or proposed utilities.
 - e) Recommendations for development, exploitation, disposal of overburden and waste, and restoration of proposed borrow pits in such a manner to minimize terrain disturbance.
4. Development of a method of mapping, rating and reporting the deposits within the Study Area.
 5. Identification on the plan of granular deposits exposed in, or along banks of streams and rivers adjacent to the communities but exclusion of such deposits in the material availability for the community unless no other sources of granular materials are available.
 6. If satisfactory granular materials are not available within the designated Study Area around the communities, then recommendations pertaining to either alternate sources outside of these areas, or bedrock quarry development will be required.

The successful completion of this study was enhanced by the cooperation and contributions of the respective Territorial Land Use Agents and other Federal and Territorial Government personnel including the Federal Department of Public Works and their respective consultants. In particular, we wish to acknowledge the assistance, guidance and liaison provided by Mr. H.D. Dekker, Chairman, and other members of the Granular Materials Working Group.



INVESTIGATION PROCEDURE

Pertinent geological information was compiled for the study from correlation of previous reports of investigations conducted within the Study Area. These included Geological Survey of Canada reports and open files; pipeline route investigations, previous PEMCAN studies and field investigations, and personal communication with noted authorities of the region.

Airphoto interpretation of prospective sites was undertaken prior to the field work with J.D. Mollard and Associates Ltd. Recent airphotos, scaled at 1"=3,000', provided by The Department of Indian Affairs and Northern Development, were utilized to outline sites, estimate the areal extent of sources and note locations of test holes and required access roads. Pertinent parts of these airphotos have been reproduced and are used as location plans for catalogued sites. Air mosaics scaled at 1"=1,000', showing revised route locations for the Mackenzie Highway were provided by The Federal Department of Public Works or their respective engineering consultants. In accordance with the terms of reference as established for the studies of both PEMCAN and the respective consulting groups under The Federal Department of Public Works, integrated field programs were initiated between the parties in order to facilitate orderly and systematic investigations in the field.

The preliminary field work, carried out in September and October, 1972, commenced with aerial reconnaissance in order to catalogue and assess sites within the Study Area. Sites were evaluated by means of aerial and ground reconnaissance and, in some cases, by test pits, which were excavated, logged and sampled to depths ranging to seven feet below the ground surface. Natural outcrops were also catalogued and respective samples secured. On the basis of the airphoto interpretation and preliminary field reconnaissance, fifty-nine sites were catalogued and assessed in the Fort Simpson to Wrigley Intercommunity Study Area.

Of the fifty-nine catalogued sites, thirty-two were evaluated in detail by means of drill



hole and/or test pit data. These sites were investigated by both PEMCAN and the respective consultants undertaking studies on the proposed Mackenzie Highway by authority of The Federal Department of Public Works. Data from these investigations is incorporated in the Site Description section of this report.

All sites catalogued and assessed within the Fort Simpson to Wrigley Intercommunity Study Area are shown on the location map in the Summary section of this report. Sites which have been drilled and/or test pitted within the Intercommunity Study Area are shown on the location map by means of a solid triangle. Sites within this category which are "Not Recommended" for development are followed by the suffix "X". Drilled and/or test pitted sites are discussed individually in the Site Description section of the report.

All other sites within the Study Area which have been recorded and catalogued are shown on the map by an open triangle symbol. These sites are evaluated in the Site Description section of the report with respect to location, geomorphic characteristics, material type, overburden and vegetation, access, suitability of material and environmental considerations. These sites were not drilled for various reasons including remoteness, poor quality and/or limited quantity of material, limited and/or severe access requirements and environmental considerations including thermally sensitive terrain conditions.

Material samples secured from outcrops, test pits and drill holes were shipped to Calgary for laboratory analyses which included grain size distribution, petrographic analysis, moisture content determination and hardness tests. In specific cases the samples or combined samples were tested for resistance to mechanical abrasion.

Results of the investigation are summarized in this report and detailed information of the studied sites is compiled in the section on Site Description. The areal extent of the individual deposits is based upon airphoto interpretation, field reconnaissance and field drilling records. Except on sites where drill holes penetrated the total depth of the granular deposit the average thickness of individual deposits was generally estimated from morphological and geological features or with respect to thickness indicated by natural outcrops. However,

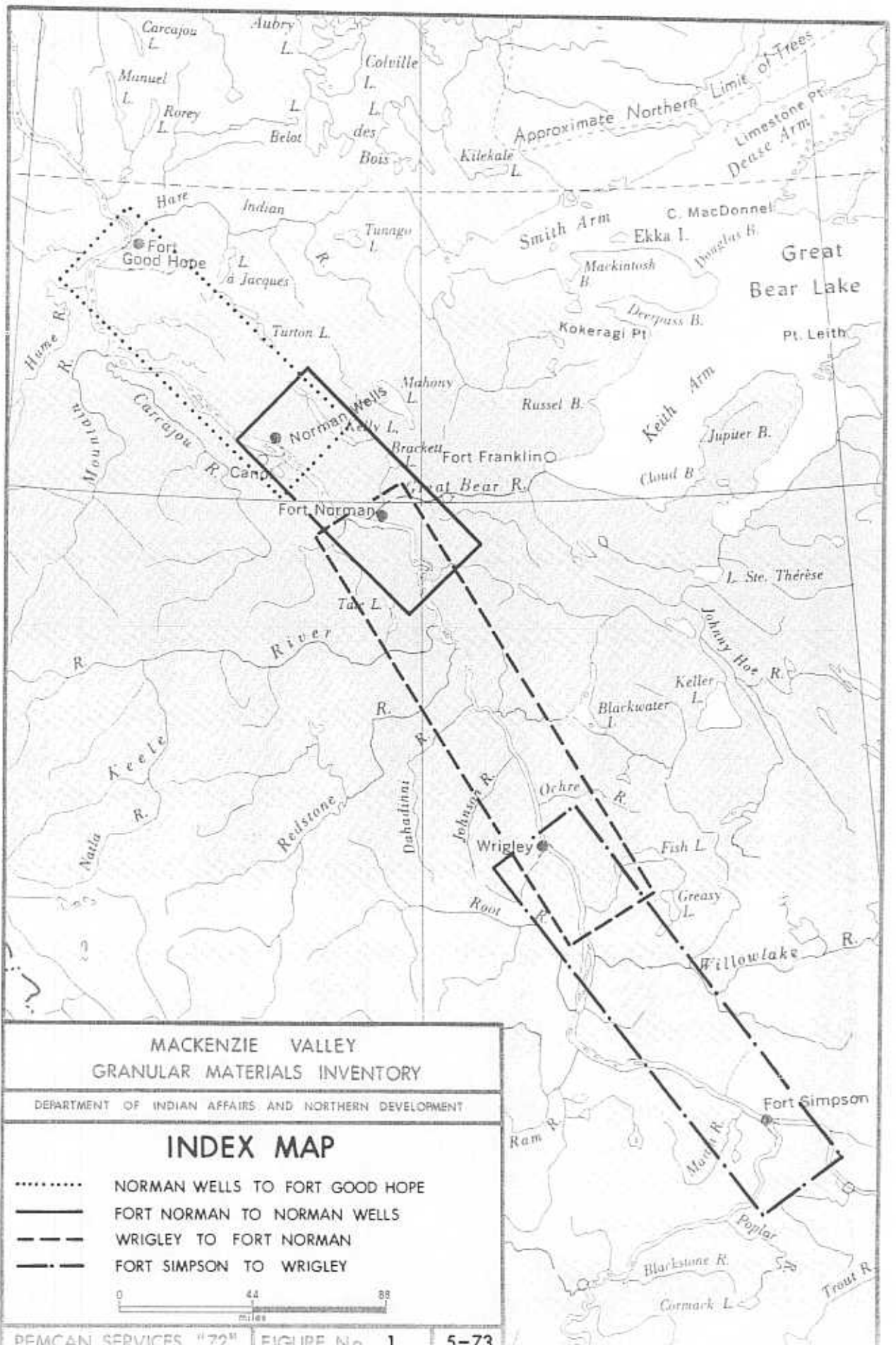


the estimated volumes should be conservative since adjustments were made for variables such as drainage conditions and sloping ground along the outer limits of the deposit.

The Fort Simpson to Wrigley Intercommunity Study Area is shown in relation to the other Intercommunity Study Areas on the Index Map (Figure 1).

In addition to the sites in the Intercommunity Study Area, the location map included in the Summary section of the report also illustrates the sites catalogued and assessed in the communities of Fort Simpson and Wrigley. These reports are submitted under separate cover.

Test pit logs, drill hole logs, outcrop descriptions and laboratory test results are attached to the individual Site Descriptions. Symbols, terminology and classification systems used are explained in the glossary.



MACKENZIE VALLEY
GRANULAR MATERIALS INVENTORY

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

INDEX MAP

- NORMAN WELLS TO FORT GOOD HOPE
- FORT NORMAN TO NORMAN WELLS
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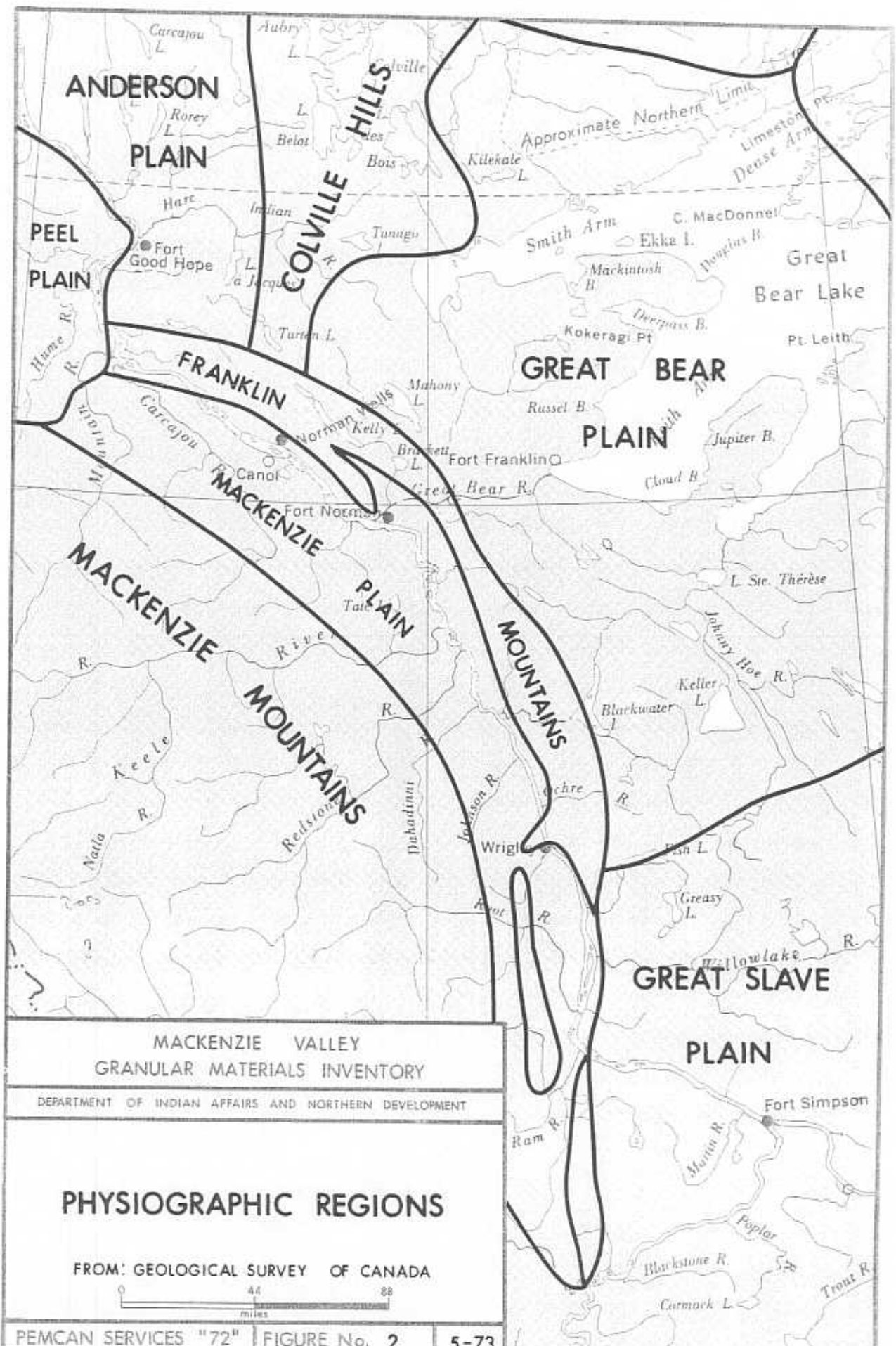
GEOMORPHOLOGY

The Fort Simpson to Wrigley Intercommunity Study Area, as illustrated by Figure 2, lies within three major physiographic subdivisions, namely:

- Great Slave Plain - which encompasses the Study Area from Fort Simpson, westwards along the Mackenzie River to the Willowlake River and borders the east side of Franklin Mountains north of this river.
- Mackenzie Plain - which encompasses both sides of the Mackenzie River north of Camsell Bend.
- Franklin Mountains - which border the eastern side of the Mackenzie Plain and in the area between the Willowlake River and the River Between Two Mountains separates the Mackenzie Plain from the Great Slave Plain.

Physiographic subdivisions differ considerably as to the morphologic character, geologic conditions, environment and, consequently, the types and occurrence of granular deposits. Both the Mackenzie and Great Slave Plains exhibit, in general, flat surfaces. While the Great Slave Plain is commonly marked with poorly drained zones, thermokarst features and muskeg bogs and granular deposits are sparse, the studied segment of the Mackenzie Plain is better drained and various landforms containing granular materials are relatively abundant. Because of their geomorphic setting, the rugged ridges and bedrock hills of the Franklin Mountains contain only post glacial deposits, such as variably reworked rock debris.

The Great Slave Plain within the Study Area exhibits in general, a very low relief which forms the lowlands along the Mackenzie River. River channels and relatively infrequent erosional gullies are the only major features which disturb the generally flat character of the land surface

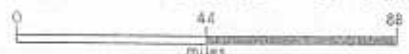


MACKENZIE VALLEY
GRANULAR MATERIALS INVENTORY

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

PHYSIOGRAPHIC REGIONS

FROM: GEOLOGICAL SURVEY OF CANADA





The bedrock across most of the studied segment of this Plain is formed by greenish grey shales and siltstones of Devonian and Cretaceous age. Devonian sandy limestone, interbedded with shale and siltstone of the Root River syncline, is indicated in a relatively narrow band east of Camsell Bend. The bedrock is covered with morainal, glaciofluvial and glaciolacustrine deposits.

The overburden is primarily comprised of glaciolacustrine deposits, consisting mainly of fine grained sand and silt which locally contains buried beach ridges and glaciofluvial gravels. In most cases these coarse granular deposits are too deep to be identified. With the exception of relatively narrow strips along deeply incised water courses, the glaciolacustrine plain is poorly drained. This inadequate drainage usually results in high water tables, thick organic covers and generally, fair ground ice content.

Glaciolacustrine material has been blown by wind into dunes and duned ridges. These deposits are located within the southern section of the Study Area, along the Mackenzie River, between Fort Simpson and Camsell Bend. Eolian deposits generally consist of poorly graded, medium to fine grained, dry sands, with little or no ground ice.

Morainal deposits, consisting of till, which is a heterogeneous mixture of silt, sand and clay interspersed with pebbles and cobbles are primarily covered with a relatively thin veneer of glaciofluvial and glaciolacustrine sediments on the northern side of the Mackenzie River. Glacial till, which represents the major soil stratum, overlies the bedrock in areas adjacent to Ebbutt Hills. Outwash and ice contact deposits consisting of variably washed silty sands and gravels are sparsely scattered west and southwest of Ebbutt Hills.

Alluvial deposits consist of silts and sands with localized gravel beds, usually at greater depths. Alluvial flood plains border present water courses while terraces are well above the recent channels.

The Mackenzie Plain is primarily covered by morainal deposits commonly topped by a thin veneer of glaciolacustrine sediments. Glaciofluvial plains and terraces and their segments,



containing variably washed and irregularly stratified sandy gravel and deltaic sand, are relatively common south of Wrigley. The glaciation has resulted in a generally flat to gently rolling topography. After the final retreat of the glaciers, melt waters and subsequent development of recent drainage patterns has resulted in numerous channels, gullies and stream courses incised below the glaciated plain. Rivers and streams have reworked both eroded and unconsolidated materials into terrace and alluvial plain deposits. Alluvial fans usually mark the confluence of streams with the Mackenzie River.

The bedrock within the Mackenzie Plain region is mostly covered by thick layers of unconsolidated material, except for occasional exposures in walls of deeply incised valleys. The bedrock, consisting basically of Devonian calcareous sandstones, shales and siltstones, are generally too soft and incompetent for construction purposes.

The Franklin Mountains unit, represented by the rugged and faulted McConnell Range which parallels the Mackenzie Plain from the Willowlake River, exhibits numerous exposures of Devonian limestone of the Nahanni Formation, with inclusions of brecciated limestone of the Bear Rock Formation and of Devonian dolomites of the Mount Kindle and Franklin Formations. These rocks are mostly competent and are good sources for the manufacturing of construction materials. Rock walls are usually mantled with talus accumulations at the base and fluvial fans are frequently formed at the mouths of erosional gorges.

A moderately thick organic soil layer topped with several inches of peat and moss is usually encountered outside of rugged or recently eroded areas. High terraces and sloping grounds are covered with a shallow organic soil layer while low and poorly drained terrain contains a thicker organic section and scattered muskeg bogs.

In the Fort Simpson to Wrigley Intercommunity Study Area the following landforms usually contain exploitable natural granular materials:

- Glaciofluvial outwash plains, terraces, trains and their segments contain predominantly sandy gravel of good quality. However, plains and ridges containing deltaic



sands are located south of Wrigley and along the Willowlake River. Trains of sandy material which would not suit requirements for better quality construction materials, are deposited south of Ebbutt Hills.

- Ice contact deposits, such as eskers, kames and esker-kame complexes, contain both sand and gravel, with occasional silt and clay pockets. They are frequent within the northern segment of the Study Area, sparse in its center part and are discontinued west of Fort Simpson.
- High terraces on both sides of the Mackenzie River are encountered at several locales throughout this sector, and represent sources of good quality sandy gravel south of Wrigley; within the southern portion of the Study Area, the terraces contain mostly unsuitable or poor quality fine grained materials. West of Fort Simpson the terrace deposits cover localized pockets or layers of glaciofluvial gravel.
- Alluvial cones and shallow talus deposits at several locations along the ridges of the Franklin Mountains, consist of variously sized, angular to rounded carbonate rock fragments which usually occur in a sand and silt sized matrix.
- Dunes and duned ridges generally contain poorly graded, fine grained sands. These deposits are widespread south and southwest from Fort Simpson.
- Alluvial terraces along the Mackenzie River, consist mostly of silts and sands. The meandering flood plains of the Martin, Willowlake River, River Between Two Mountains and Smith Creek contain both fine grained and coarse deposits.
- Carbonate rocks exposed in the Franklin Mountains, namely in the foreslopes of the ridges which parallel the main massifs, are generally suitable for manufactured aggregates.

This sector of the Study Area lies within the discontinuous permafrost zone. Excess ice is



fairly common in fine grained, poorly drained glaciolacustrine and glaciofluvial deposits whereas, little or no excess ice exists in coarse and well drained deposits. The average depth of the seasonal freezing and thawing cycles is generally less than four feet in the Fort Simpson area and ranges from two to five feet in the northern sector of the Study Area in the vicinity of Wrigley. However, these values will vary according to the drainage, type of material and vegetation characteristics at respective sites.



TERRAIN PHOTOGRAPHS - FORT SIMPSON TO WRIGLEY



Sand dune complex approximately 30 miles northwest of Fort Simpson (Ref. Site 105).



Large esker-kame complex south of River Between Two Mountains (Ref. Site 142).



ENVIRONMENT

The Fort Simpson to Wrigley Intercommunity Study Area lies within an area which varies from relatively flat monotonous terrain to areas with high relief and scenic attributes. The southeastern segment of the Study Area in the Mackenzie and Liard River Valleys is enhanced by natural components such as vegetation and water whereas the areas around Camsell Bend and Wrigley are favored with natural attributes which include mountainous terrain and well developed and varied vegetation and water resources.

Terrain sensitivity is generally less pronounced in the Fort Simpson to Wrigley Intercommunity Study Area than in regions further to the north because of discontinuous permafrost, lower ground ice content and generally, greater depths to permafrost tables.

The relatively flat, low-profiled and generally fine grained terrain types such as silt-clay plains, beaches, river deposits and organic terrain generally contain minimal ground ice content. Therefore, disturbance because of low strength and high compressibility values is generally less than in similar terrain types at higher latitudes. However, vegetated sites are still susceptible to subsidence, slumping and gulying if the vegetation is removed or highly compressed and disturbed. Thermokarst subsidence, undercutting and channel shifting can also be expected, especially in fine river deposit terrain.

Hummocky and rolling terrain as characterized by the till plains in the southeastern segments of the Study Area generally contains moderate ground ice content. Localized contrasts in material type and ice content is oftentimes evident between well drained slopes and low depressions. This terrain in general exhibits minor to moderate susceptibility to thermokarst, ground ice slumping and gulying. Usefulness of till material as fill is usually limited by its ice content.

Upland mountainous terrain, as characterized by rock outcrops or bedrock thinly covered with a veneer of debris, as in the Franklin Mountains, usually contains minimal ice content. Creep, slides and rock falls are common on steep slopes in this terrain as are mudflows and



flash floods.

In general, the more favorable granular material sites in the Fort Simpson to Wrigley Intercommunity Study Area tend to be located on geomorphic features that contain relatively minor amounts of ground ice. Therefore, properly managed development procedures should minimize the detrimental terrain reaction to acceptable levels. In many cases, the access routes to these sites will traverse areas of low wet terrain that generally will contain higher ice contents and will therefore, be more susceptible to adverse reaction when disturbed. In such cases, terrain reaction can be limited by sound development procedures such as the incorporation of protective measures for retainment of vegetation ground-insulation layers and the selection and utilization of adequate fill materials for access roads.

Vegetation

In the Upper Mackenzie Valley, the Boreal forest region of Canada is restricted to a narrow band which extends along and parallels the Inner Mackenzie Valley. The Fort Simpson to Wrigley Intercommunity Study Area lies within the southernmost reaches of this Boreal forest extension (Figure 3).

In the Study Area the dominant tree species are black and white spruce, tamarack, poplar, birch, willows, alder and occasional pine. The ground cover is predominantly mosses, lichens, sedges, herbs and shrubs. The vegetation ranges from commercial growths on river islands and alluvial flats to shrubby growth and treeless muskeg.

Poorly drained alluvial sites commonly support growths of black spruce, tamarack, willow and alder. Muskeg areas generally support black spruce, tamarack and occasionally, birch; relatively shallow permafrost areas may support white spruce, especially if the permafrost acts as a media to maintain relatively high surficial moisture contents. Well drained sites commonly support white spruce and poplar, with lesser growths of birch and pine.

Benchmark areas that are underlain by fine-grained materials with discontinuous permafrost



generally support growths of spruce, with occasional tamarack, willow and alder. Well drained benchland areas are characterized by growths of poplar, with lesser pine and spruce.

Mountain slope vegetation ranges from mixtures of deciduous and evergreen growths near the base to spruce, birch and occasional poplar on the overburden-covered flanks.

In the Fort Simpson to Wrigley Intercommunity Study Area, natural regrowth of vegetation on existing trails and cutlines indicates that in general, regeneration of disturbed areas will occur, especially if the nutrient levels within the topsoil layer are left undisturbed. However, in areas where permafrost acts as a favourable moisture retention media for vegetation that normally would not grow because of lack of moisture, disturbances such as clearing, may sufficiently alter moisture conditions to a point where timber growth is inhibited. It may be feasible to reseed and fertilize abandoned borrow pit areas with short and long term seed stocks in order to promote growth cover prior to reestablishment of natural vegetation.

Wildlife

Wildlife species that are predominantly characteristic of the Boreal forest utilize the Fort Simpson to Wrigley Intercommunity Study Area and adjacent regions. For the most part, the utilization of this area by wildlife, waterfowl and fishery resources is based upon seasonal migration patterns that generally follow the Mackenzie River Valley. Although various wildlife species inhabit the Study Area, and in some cases serve as a means of livelihood for local residents, there are no known wildlife habitats within the section of the Study Area from Fort Simpson to the vicinity of McGern Island north of Camsell Bend that are classified as either important or critical by the Canadian Wildlife Service.

Northward, from McGern Island to Wrigley, the Study Area traverses the broad Mackenzie Valley flyway which is utilized by various waterfowl including swans, geese and ducks during spring and fall migration.

West and southwest of Wrigley, in the area around the mouth and upstream portions of

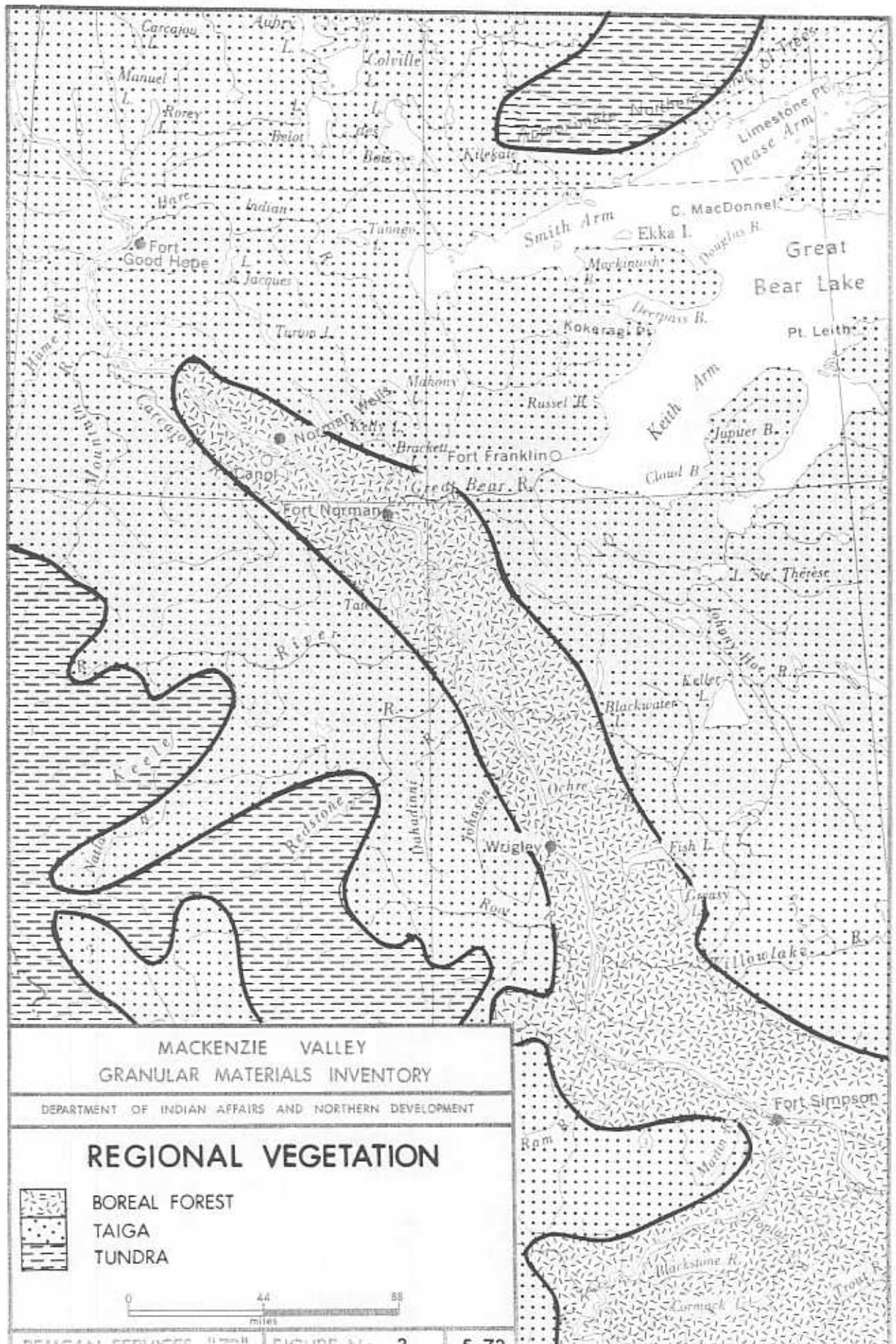


Wrigley River, the Study Area is adjacent to a region which is classified as a critical wintering range for woodland caribou.

Fishery resources in the Fort Simpson to Wrigley Intercommunity Study Area are predominantly those found in the Mackenzie River and its major tributaries, and includes both resident species and those that seasonally migrate through the river systems. Many of the watercourses in the Study Area are believed to support spawning runs of various species, including grayling, pike, pickerel and sucker. Two streams that are particularly noted for their potential spawning sections are Martin River, located northwest of Fort Simpson townsite and Harris River, which flows into the Mackenzie at a point directly north of Fort Simpson townsite. Other watercourses in the Study Area which are of potential spawning and/or migration importance to fishery resources include Trail River, Root River, Willowlake River and River Between Two Mountains. Known domestic fishing areas are located on the Mackenzie River approximately twenty miles west of Trail River, at the mouth of Willowlake River and near the mouth of River Between Two Mountains.

Seasonal hunting and trapping along the bank areas of the Mackenzie River occurs throughout the entire Study Area from Fort Simpson to Wrigley. Other large regions which have an established hunting and trapping history includes the area extending about twenty miles east and northeast of Camsell Bend and the area between and adjacent to the Willowlake River and River Between Two Mountains. The most common pelts taken from these regions are marten, lynx, beaver and mink. Moose and occasionally, caribou are hunted from the camps which are established in these trapping regions.

Known archeological sites in the Study Area are located approximately nine miles west of Martin River near the mouth of a small unnamed creek on the south bank of the Mackenzie River, near the mouth of Trail River, on the north bank of the Mackenzie River at a point directly opposite the mouth of the North Nahanni River and near the mouth of the Willowlake River.





RECOMMENDATIONS AND CONCLUSIONS

The recommendations and conclusions, which are presented herewith, have been based on air-photo interpretation, office literature studies, preliminary field reconnaissance and detailed field drilling data.

The results of the completed study indicate that the availability of quality granular materials in certain segments of the Intercommunity Study Area between Fort Simpson and Wrigley, N.W.T., is quite limited. The scarcity of quality granular materials is especially acute north of Fort Simpson to Willowlake River. In this portion of the Study Area the natural granular deposits are limited to gravel pockets overlain by glaciolacustrine and alluvial sediments. A few ridges containing sand and gravel deposits were noted in the area southwest and west of Ebbutt Hills. Exploitable outcrops of competent crushable bedrock were not encountered between Fort Simpson and Willowlake River, whereas the catalogued bedrock ridges northeast of the Camsell Bend area are mantled by glacial drift. Reasonable quantities of exploitable granular materials were established during the winter field drilling program in the northern portion of the Study Area from Willowlake River to Wrigley.

On the basis of the airphoto interpretation and preliminary field reconnaissance data, a total of 32 sites was investigated in detail during the winter drilling program of which eleven sites were confirmed to contain exploitable granular materials. These sites are categorized and grouped as follows:

1. The better quality granular materials were encountered in prominent and larger esker ridge deposits and esker-kame complexes west of Ebbutt Hills, north of Willowlake River and in the area adjacent to the River Between Two Mountains. These esker-kame sediments consist of well graded, clean, medium to coarse grained gravel deposits which are considered suitable for the production of aggregates for most construction requirements.

These esker ridge deposits are represented by Sites 118, 124, 139, 142, 143 and 146



and are estimated to contain in excess of 10,000,000 cubic yards of good quality granular materials. The location of these sites are noted on the Site Location Map in the Summary section of the report.

2. Fair to good quality granular materials were confirmed in the glaciofluvial outwash deposits immediately adjacent to the east bank of the Mackenzie River in the Study Area from the River Between Two Mountains and Wrigley. These deposits consist of well graded, fine to medium grained sand and gravel with a highly variable silt content.

These glaciofluvial outwash deposits are represented by Sites 140, 151, 153 and 154 and are estimated to contain in excess of 17,000,000 cubic yards of fair quality granular materials suitable for quality embankment fill in the pit run condition. Base and surface course aggregates may be produced if selective harvesting of pockets of better quality gravel is conducted.

3. Site 101 which was investigated during the winter drilling program consists of a high fluvial terrace and is considered to contain sizable, scattered pockets of good quality granular materials. However, before this site is considered for development, a more detailed drilling program would be required to more accurately locate, delineate and assess the material quality of these anticipated gravel pockets.

The detailed assessment and recommendations for Site 101 are outlined in the Site Description section of the report.

In addition to the preceding eleven sites, which contain exploitable quantities of granular materials suitable for engineering construction materials, 21 sites were drilled during the winter field program which did not contain materials of good granular quality or potential sources of granular materials were located within various active stream and river channels. These sites have been catalogued and recorded in the Site Description section of the report, and have been identified with the suffix "X" after the site number to designate "Not Recommended" as granular material sources.



However, although Sites 104X, 107X, 109X, 110X, 115X, 119X, 134X and 135X do not contain materials of good granular quality, the poorly graded, fine grained, silty sands from these sites may be considered for very marginal fill material in the construction of road subgrades. These fine sands are mostly easily eroded if exposed to wind and rain action; therefore proper protection measures would have to be implemented to minimize the detrimental effects of erosional agents on any embankments constructed from these fine sands.

All catalogued and assessed sites in the Intercommunity Study Area, including the eleven sites which were confirmed to contain granular type materials are discussed in detail in the Site Description section of the report.

In addition, all site locations within the Intercommunity Study Area from Fort Simpson to Wrigley, are presented on the Site Location Map in the Summary section of the report.

A synopsis of tabulation of pertinent information for each site has been provided. Each potential site has been evaluated in terms of material type, suitability of material, estimated volume, recoverable depth, overburden characteristics, ground ice content, drainage, method of extraction, haul distance, environmental considerations and assessment.

ESTIMATED VOLUME is calculated by means of various parameters including drill hole and test pit data, airphoto interpretation and geomorphology. Adjustments have been made for irregular topography and stream dissection.

RECOVERABLE DEPTH is determined by various methods including drill hole and test pit data, geomorphology and in the case of bedrock, projected stratigraphic thickness.

GROUND ICE CONTENT is reported as high, medium or low by visual inspection of both samples and test pit walls.

METHOD OF EXTRACTION refers to the type of equipment required for development and exploitation of granular materials. "Conventional" as used, indicates the utilization of



standard excavation equipment such as bulldozers, overhead loaders, backhoes and light rippers.

HAUL DISTANCE is the distance along existing and/or proposed access from the site to the designated location on the proposed Mackenzie Highway right-of-way.

ENVIRONMENTAL CONSIDERATIONS include any salient factors related to wildlife, waterfowl and fishery resources, archeological sites and potential terrain sensitivity of the site and adjacent areas including proposed access routes. If any environmental implications are considered to exist at a particular site they are synopsized in this column. Further comments on the importance of these conditions as related to potential development are made within the text of the respective sites in the Site Description section of the report.

ASSESSMENT OF SITE relates to the evaluation of each site in terms of recommendations for development, nondevelopment or possible development of potentially recoverable granular materials at each site investigated in the Study Area. The catalogued but not drilled sites are rated as poor, fair and good prospects relative to anticipated availability of granular materials. These sites which apparently do not contain suitable materials or, if their development would entail possible environmental hazards, are not suggested for development.

These recommendations are based upon an assessment of all known data on each respective site including location, access, physical characteristics, environmental considerations, development procedures and quantity, quality and suitability of material as related to currently proposed or future requirements within the Study Area.

The terrain sensitivity relative to the development of borrow pits, quarries and required access roads differs considerably throughout this section of the Study Area and an assessment of local conditions pertinent to prospective sites and access routes is contained in the Site Description section of the report.

Geomorphic landforms containing coarse granular deposits, such as kame fields, large eskers,



glaciofluvial outwash plains or bedrock ridges usually represent well drained and stable terrain, therefore, controlled extraction of material should not adversely affect the environment of the site and adjacent terrain. Conversely, the poorly drained areas and landforms formed by fine grained sediments, such as low alluvial terraces, deltaic sand deposits and sand dunes are easily eroded if the vegetation cover is disturbed either because of transportation activity or borrowing of material. In general, any activity within thermally sensitive terrain would require careful planning and supervision in order to restrict and minimize potential adverse effects.

A detailed evaluation of each site investigated in the Study Area is documented in the Site Description section of the report.

SITE NO.	MATERIAL TYPE		SUITABILITY OF MATERIAL	ESTIMATED VOLUME (cu. yds.)	ESTD. RECOV DEPTH (feet)	OVERBURDEN			GROUND ICE (Content)	DRAINAGE	METHOD OF EXTRACTION	HAUL DIST. (miles)	ENVIRONMENTAL CONSIDERATIONS	ASSESSMENT OF SITE
	DESCRIPTION	SYM.				TYPE	DEPTH (feet)	DISPOSAL						
* 101	Gravel; sandy	GW-GP	General Fill	N.D.	—	Topsoil, Peat & Till	+6	Strip, Waste & Stockpile	Low to Medium	Fair to South	Conventional	+12	No Critical Wildlife Areas	Possible Development Based on Additional Studies
102	Gravel; sandy	GW	General Fill	N.D.	—	Topsoil & Silt	—	Strip & Stockpile	N.D.	Good to South	Conventional	3%	No Critical Wildlife Areas	Poor Prospect
* 103X	Gravel; sandy	GW	General Fill, Base & Surface Courses	N.D.	—	Silt & Topsoil	+1½	—	Low	Into Adjacent Stream	Conventional with Dredging	0	No Critical Wildlife Areas	Not Recommended
* 104X	Sand; fine	SP	Unsuitable	N/A	—	Peat & Topsoil	2	—	Low to Medium	—	—	+10	No Critical Wildlife Areas; Sensitive Terrain	Not Recommended
105	Sand; fine	SP	Marginal General Fill	N.D.	—	Topsoil	—	Strip & Stockpile	N.D.	Fair into Adjacent Terrain	Conventional	5	No Critical Wildlife Areas; Sensitive Terrain	Fair Prospect; Difficult Access
106	Sand; fine	SP	Marginal General Fill	N.D.	—	Topsoil	—	Strip & Stockpile	N.D.	Fair into Adjacent Terrain	Conventional	4½	No Critical Wildlife Areas; Sensitive Terrain	Poor Prospect; Difficult Access
* 107X	Sand; silty	SP-SM	Unsuitable	N.D.	—	Topsoil	1	—	Low to Medium	Good to South	—	+5	No Critical Wildlife Areas	Not Recommended
* 108X	Till; silty, clayey	MH-GI	Unsuitable	N/A	—	Topsoil	1	—	Low to Medium	Good to North	—	½	No Critical Wildlife Areas	Not Recommended
* 109X	Sand; silty, fine	SM-ML	Very Marginal Fill	N/A	—	Topsoil	1	—	Low to Medium	Good to North & West	—	0	No Critical Wildlife Areas	Not Recommended
* 110X	Sand; silty, fine	SM-ML	Unsuitable	N/A	—	Topsoil	1	—	Low	Good to South	—	½	No Critical Wildlife Areas	Not Recommended
111	Sand & Silt; Gravel Pockets	SM-ML; GM	Very Marginal Fill	N.D.	—	Topsoil & Silt	—	Strip & Stockpile	N.D.	Fair to South	Conventional	5	Adjacent to River Channel; No Critical Wildlife Areas	Poor Prospect
112	Sand; silty	SM-ML	Very Marginal Fill	N.D.	—	Topsoil & Silt	—	Strip & Stockpile	N.D.	Good to Northwest	Conventional	7	Adjacent to Stream Channel; No Critical Wildlife Areas	Poor Prospect
* 113X	Sand; silty	SM-ML	Unsuitable	N/A	—	Topsoil & Silt	2 to +10	—	Low to Medium	Good to South	—	10	No Critical Wildlife Areas	Not Recommended
114	Till; silty, sandy & clayey	—	Not Granular; Very Marginal Fill	N.D.	—	Topsoil	—	Strip & Stockpile	N.D.	Fair into Adjacent Terrain	Conventional	3½	No Critical Wildlife Areas; Sensitive Terrain	Poor Prospect
* 115X	Sand; silty	SM-SC	Very Marginal Fill	N.D.	—	Topsoil	1	—	N.D.	Fair to Southwest	—	0	No Critical Wildlife Areas	Not Recommended
* 116X	Glacial Till; silty	CI	Unsuitable	N/A	—	Topsoil	1½	—	Low to Medium	Good to West	—	4	No Critical Wildlife Areas	Not Recommended
117	Sand; gravelly & silty	SM-GM	Marginal General Fill	N.D.	—	Topsoil	—	—	N.D.	Fair into Adjacent Terrain	—	3	No Critical Wildlife Areas; Sensitive Terrain	Not Suggested for Development
* 118	Sand & Gravel	SW-GW	Most Construction Aggregates	2,000,000	4 to +15	Topsoil & Silt	1 to 6	Strip & Waste or Stockpile	Low	Good to West	Conventional	0	No Critical Wildlife Areas	Recommended for Development
* 119X	Sand; silty	SM-SP	Marginal General Fill	N.D.	—	Topsoil & Peat	+1	—	N.D.	Fair to Southwest	—	0	No Critical Wildlife Areas	Not Recommended
120	Sand; silty & clayey	SM-SW	Marginal General Fill	N.D.	—	Topsoil	—	Strip & Stockpile	N.D.	Fair into Adjacent Terrain	Conventional	2½	No Critical Wildlife Areas	Poor Prospect
121	Sand; silty	SM-ML	Very Marginal Fill	N.D.	—	Topsoil	—	Strip & Stockpile	N.D.	Poor into Adjacent Terrain	Conventional	10	No Critical Wildlife Areas; Sensitive Terrain	Poor Prospect
122	Bedrock; Shale	—	Marginal General Fill	Unlimited	—	Topsoil & Silt	—	Strip & Waste	N.D.	Good into Adjacent Terrain	Quarry; ripping & blasting	12	No Critical Wildlife Areas; Sensitive Terrain	Poor Prospect
* 123X	Glacial Till	ML-CI	Unsuitable	N/A	—	Topsoil & Peat	+1	—	Low to Medium	Good to West	—	3	No Critical Wildlife Areas	Not Recommended
* 124	Sand & Gravel	SW-GW	Most Construction Aggregates	4,000,000	5 to +19	Topsoil & Silt	1 to 6	Strip & Waste or Stockpile	Low	Good to West	Conventional	0	No Critical Wildlife Areas	Recommended for Development
125	Bedrock; Limestone	—	Most Construction Aggregates	N.D.	—	Topsoil & Silt	—	Strip, Stockpile & Waste	N.D.	Fair to Poor into Adjacent Terrain	Quarry; Blast-crushing	5%	No Critical Wildlife Areas; Sensitive Terrain	Fair Prospect; Difficult Access
126	Bedrock; Limestone & Shale	—	Most Construction Aggregates	Unlimited	—	Topsoil & Silt	—	Strip, Stockpile & Waste	N.D.	Good to Fair into Adjacent Terrain	Quarry; Blast-crushing	5	No Critical Wildlife Areas; Sensitive Terrain	Fair Prospect; Difficult Access
127	Bedrock; Limestone & Shale	—	Most Construction Aggregates	N.D.	—	Topsoil & Silt	—	Strip, Stockpile & Waste	N.D.	Fair to Good into Adjacent Terrain	Quarry; Blast-crushing	4%	No Critical Wildlife Areas; Sensitive Terrain	Fair Prospect; Difficult Access
* 128X	Glacial Till	ML-CI	Unsuitable	N/A	—	Topsoil	1	—	Low to Medium	Poorly Drained to West	—	½	No Critical Wildlife Areas	Not Recommended
129	Gravel & Sand; silty; Washed Till	GM	Marginal General Fill	N.D.	—	Topsoil & Silt	—	—	N.D.	Into Adjacent River Arms	—	5	Within River Channel; No Critical Wildlife Areas; Sensitive Terrain	Not Suggested for Development
* 130X	Glacial Till	ML-CI	Unsuitable	N/A	—	Topsoil	1½	—	Very Low	Fair to Adjacent Terrain	—	5	No Critical Wildlife Areas	Not Recommended
* 131X	Glacial Till; silty	ML-CI	Unsuitable	N/A	—	Topsoil	1	—	Low	Well Drained to Adjacent Terrain	—	4	No Critical Wildlife Areas	Not Recommended
* 132X	Sand; silty, fine	SP-SM	Unsuitable	N/A	—	Topsoil	1	—	None	Fair to Adjacent River	—	1½	No Critical Wildlife Areas; In River Channel	Not Recommended
133	Gravel & sand; silty; Washed Till	GM	Marginal General Fill	N.D.	—	Topsoil & Silt	—	—	N.D.	Into Adjacent River Arms	—	1	Within River Channel; No Critical Wildlife Areas	Not Suggested for Development

SITE NO.	MATERIAL TYPE		SUITABILITY OF MATERIAL	ESTIMATED VOLUME (cu. yds.)	EST'D RECOV DEPTH (feet)	OVERBURDEN			GROUND ICE (Content)	DRAINAGE	METHOD OF EXTRACTION	HAUL DIST. (miles)	ENVIRONMENTAL CONSIDERATIONS	ASSESSMENT OF SITE
	DESCRIPTION	SYM.				TYPE	DEPTH (feet)	DISPOSAL						
*134 X	Sand; silty, fine	SM-SP	Very Marginal Fill	N/A	—	Topsoil	1	—	Low to Medium	Good to North & East	—	0	No Critical Wildlife Areas Adjacent to River	Not Recommended
*135 X	Sand; silty, fine	SM-SP	Very Marginal Fill	N/A	—	Topsoil	1	—	Low to Medium	Good to North & East	—	1	No Critical Wildlife Areas	Not Recommended
*136 X	Gravel; silty	GM-GP	General Fill	N.D.	—	Silt	+1	—	None	Into Stream Channel	—	0	Within Active Stream Channel	Not Recommended
*137 X	Glacial Till; Sand & Gravel Pockets	ML-CI	Unsuitable	N/A	—	Topsoil & Peat	+2	—	Low to Medium	Poor to South	—	3	No Critical Wildlife Areas	Not Recommended
*138 X	Glacial Till	ML-CI	Unsuitable	N/A	—	Topsoil & Peat	+1	—	Low to Medium	Poorly Drained	—	3	No Critical Wildlife Areas	Not Recommended
*139	Sand & Gravel	SW-GW	Various Construction Aggregates	500,000	+20	Topsoil & Silt	1	Strip & Stockpile	Low	Fair to Northwest	Conventional	3	No Critical Wildlife Areas; Adjacent to Lake	Recommended for Development
*140	Sand, fine	SW-SP	Marginal General Fill	3,000,000	—	Topsoil	1	Strip & Stockpile	N.D.	Fair to Southwest	Conventional	0	No Critical Wildlife Areas	Possible Development
141	Gravel & Sand	GW-SW	Most Construction Aggregates	N.D.	—	Topsoil	—	Strip & Stockpile	—	Fair to Good to Adjacent Terrain	Conventional	+8	No Critical Wildlife Areas; Adjacent to Lake	Good Prospect
*142	Sand & Gravel	SW-GW	Most Construction Aggregates	+ several million	+10	Topsoil & Silt	1 to +5	Strip & Waste or Stockpile	Low	Well Drained to Adjacent Terrain	Conventional	1%	No Critical Wildlife Areas; Sensitive Terrain	Recommended for Development
*143	Gravel; sandy	GW	Most Construction Aggregates	1,000,000	+10	Topsoil & Silt	2 to +5	Strip & Waste or Stockpile	Low	Fair to North & South	Conventional	3%	No Critical Wildlife Areas; Local Trapping	Recommended for Development
143A	Sand & Gravel	SW-GW	Most Construction Aggregates	N.D.	—	Topsoil	—	Strip & Stockpile	N.D.	Fair to Good to Adjacent Terrain & Streams	Conventional	8	No Critical Wildlife Areas; Local Trapping; Adjacent to Stream Channels	Good Prospect
144	Sand & Gravel; silty	SM-GM	General Fill	N.D.	—	Topsoil	—	Strip & Stockpile	N.D.	Good to Northeast	Conventional	1%	No Critical Wildlife Areas	Poor Prospect, Low Volume
*145 X	Silt, sand & clay	ML-CI	Unsuitable	N/A	—	Topsoil & Peat	+1	—	High	Good to Adjacent Stream	—	0	Within Stream Channel; Domestic Fishing	Not Recommended
*146	Sand & Gravel	SW-GW	Most Construction Aggregates	800,000	+10	Topsoil & Silt	2	Strip & Stockpile	Low	Good to West	Conventional	2%	No Critical Wildlife Areas; Local Trapping	Recommended for Development
147	Sand, Gravel & Silt	SM-GW	General Fill	N.D.	—	Topsoil & Silt	—	Strip & Stockpile	—	Good to West	Conventional	1%	No Critical Wildlife Areas	Fair Prospect
148	Gravel & Sand	GW-SM	Most Construction Aggregates	N.D.	—	Topsoil	—	Strip & Stockpile	—	Fair to Good to Adjacent Terrain	Conventional	4	No Critical Wildlife Areas	Good Prospect
149	Bedrock; Limestone	—	Various Construction Aggregates	Unlimited	—	Drift & Screes	—	Strip & Waste	—	Well Drained	Quarry, Blasting & Crushing	2	No Critical Wildlife Areas	Good Prospect; Possible Development
150	Sand & Gravel; silty	SM-GM	General Fill	N.D.	—	Topsoil	—	Strip & Stockpile	—	Good to West	Conventional	3	No Critical Wildlife Areas	Fair Prospect; Difficult Access
*151	Gravel & Sand	GW-SW	General Fill	1,500,000	+10	Topsoil & Peat	1	Strip & Stockpile	N.D.	Fair to West	Conventional	0	No Critical Wildlife Areas	Recommended for Development
152	Sand & Sand, silt gravel mixture	SP, SM, SM-GM	Marginal and Very Marginal Fill	N.D.	—	Topsoil	—	Strip & Stockpile	—	Fair to Adjacent Terrain & River	Conventional	1%	No Critical Wildlife Areas; Adjacent to River	Poor to Fair Prospect
*153	Gravel	GW-GP	Most Construction Aggregates	3,000,000	+15	Topsoil & Silt	+1%	Strip & Stockpile	Very Low	Fair to West	Conventional	1%	No Critical Wildlife Areas; Local Trapping	Recommended for Development
*154	Gravel & Sand	GW-SW	General Fill; Base & Surface Courses	10,000,000	+10	Topsoil & Silt	+1	Strip & Stockpile	Low	Fair to West	Conventional	0	No Critical Wildlife Areas	Recommended for Development
155	Sand & Gravel; silty	SM-GM	Marginal General Fill	N.D.	—	Topsoil & Silt	—	Strip & Stockpile	N.D.	Fair to Good into Adjacent Terrain & Stream	Conventional	+4	Adjacent to Stream Channel & River	Poor to Fair Prospect
156	Sand & Gravel; silty	SM-GM	Marginal General Fill	N.D.	—	Topsoil	—	Strip & Stockpile	N.D.	Good to West	Conventional	2%	No Critical Wildlife Areas; Sensitive Terrain	Poor Prospect
157	Gravel & Sand; some silt	GW-GM	General Fill	N.D.	—	Discontinuous Topsoil	—	Strip & Waste	N.D.	Good to West	Conventional	+4	No Critical Wildlife Areas; Sensitive Terrain	Good Prospect; Difficult Access
158	Gravel & Sand; some silt	GW-GM	General Fill	N.D.	—	Discontinuous Topsoil	—	Strip & Waste or Stockpile	N.D.	Good to West	Conventional	+5	No Critical Wildlife Areas; Sensitive Terrain	Good Prospect; Difficult Access

Notes:

— SITE NUMBER:

* Represents sites that have been drilled and/or test pitted; these sites are shown as solid triangles on the topographic strip maps.
X Drilled and/or test pitted sites "Not Recommended" for development.

— ESTIMATED VOLUME:

N/A Not Applicable because the site does not contain materials of granular quality.
N.D. Not Determined.

— DRAINAGE:

Rainfall as shown generally refers to drainage conditions within the site.

— METHOD OF EXTRACTION:

"Conventional" indicates use of standard excavation equipment such as dozers, overhead loaders, backhoes and light rippers.

— HAUL DISTANCE:

is distance along existing and/or required access from the site to the nearest Mile Post on the proposed Mackenzie Highway (Ref. Text). "0" Haul Distance indicates site is on or immediately adjacent to the proposed Highway location.

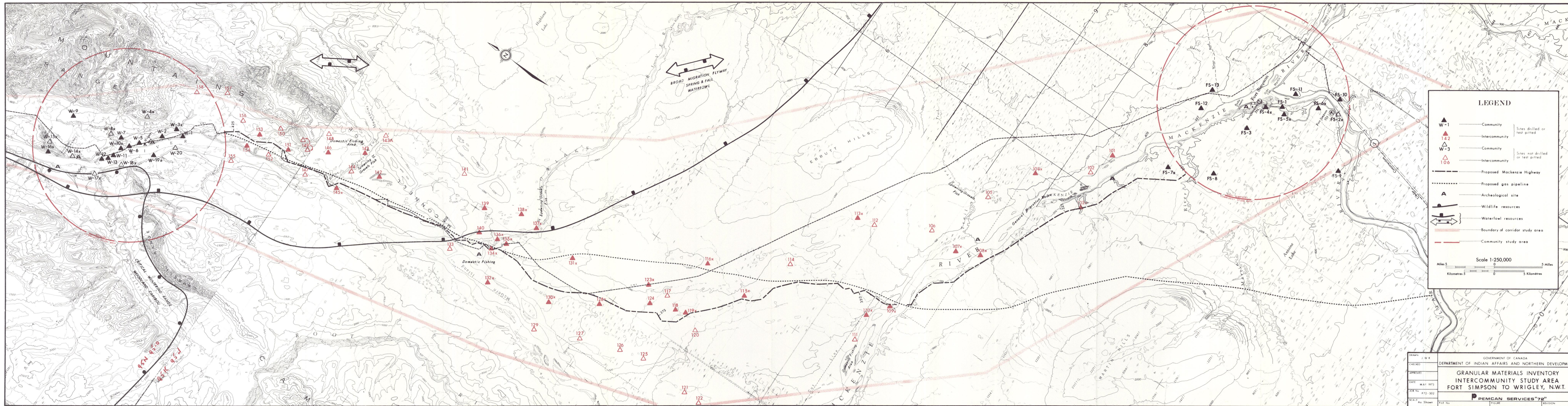
— ENVIRONMENTAL CONSIDERATIONS:

"Sensitive Terrain" refers to thermal and/or erosional sensitivity at, or adjacent to the site (Ref. Text).

— ASSESSMENT OF SITE:

Ref. Text "Recommendations and Conclusions" and "Site Description" sections.

Fig. 1



LEGEND

- ▲ W-1 Community
- ▲ 142 Intercommunity
- ▲ W-3 Community
- ▲ 106 Intercommunity
- Proposed Mackenzie Highway
- Proposed gas pipeline
- ▲ Archaeological site
- Wildlife resources
- Waterfowl resources
- Boundary of corridor study area
- Community study area

Sites drilled or test pitted

Sites not drilled or test pitted

Scale 1:250,000

Miles 5 0 5 Miles

Kilometres 5 0 5 Kilometres

DRAWN: J.W.K.
 CHECKED: _____
 APPROVED: _____
 DATE: MAY 1973
 JOB No: P72-502
 SCALE: As Shown
 FILE No: _____
 FIGURE: _____
 REVISION: _____

GOVERNMENT OF CANADA
 DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT
**GRANULAR MATERIALS INVENTORY
 INTERCOMMUNITY STUDY AREA
 FORT SIMPSON TO WRIGLEY, N.W.T.**
PEMCAN SERVICES "72"

INTERCOMMUNITY STUDY AREA
 FORT SIMPSON TO WRIGLEY, N.W.T.
 SITE DESCRIPTIONS

Site Number	Page	Site Number	Page	Site Number	Page
101	101-1	121	121-1	141	141-1
102	102-1	122	122-1	142	142-1
103X	103-1	123X	123-1	143	143-1
104X	104-1	124	124-1	143A	143A-1
105	105-1	125	125-1	144	144-1
106	106-1	126	126-1	145X	145-1
107X	107-1	127	127-1	146	146-1
108X	108-1	128X	128-1	147	147-1
109X	109-1	129	129-1	148	148-1
110X	110-1	130X	130-1	149	149-1
111	111-1	131X	131-1	150	150-1
112	112-1	132X	132-1	151	151-1
113X	113-1	133	133-1	152	152-1
114	114-1	134X	134-1	153	153-1
115X	115-1	135X	135-1	154	154-1
116X	116-1	136X	136-1	155	155-1
117	117-1	137X	137-1	156	156-1
118	118-1	138X	138-1	157	157-1
119X	119-1	139	139-1	158	158-1
120	120-1	140	140-1		

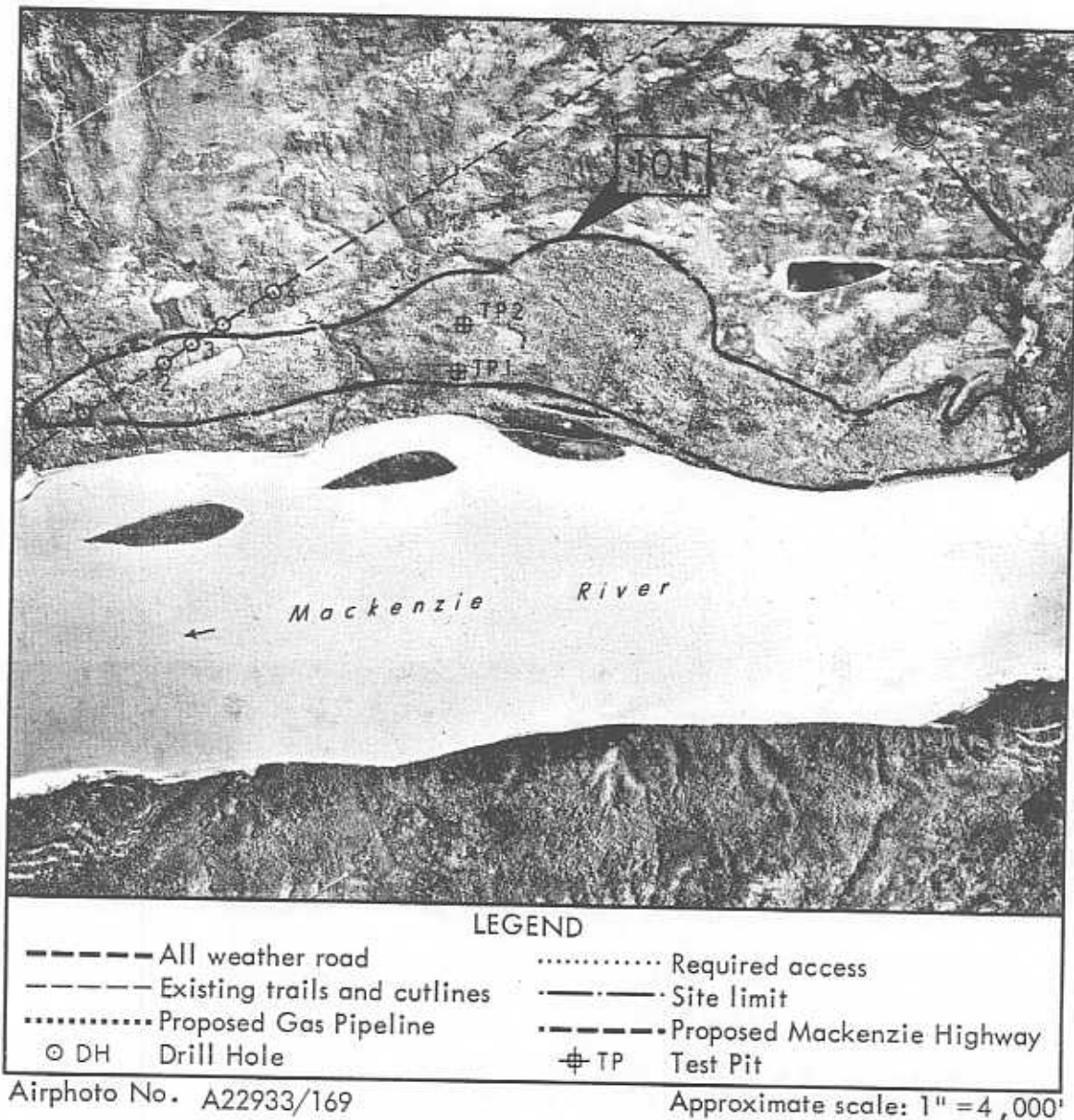
SITE NO. 101

Located approximately 12 miles downstream from Fort Simpson along the north bank of the Mackenzie River, Site 101 consists of a high fluvial terrace containing remnants of glacio-fluvial deposits.

Type of Material: Gravel; some sand, trace silt, coarse grained.

Estimated Volume: Not determined.

Assessment: Fair quality granular materials may be encountered in isolated pockets; therefore, Site 101 may be considered for development subject to the findings of a more detailed site investigation program.



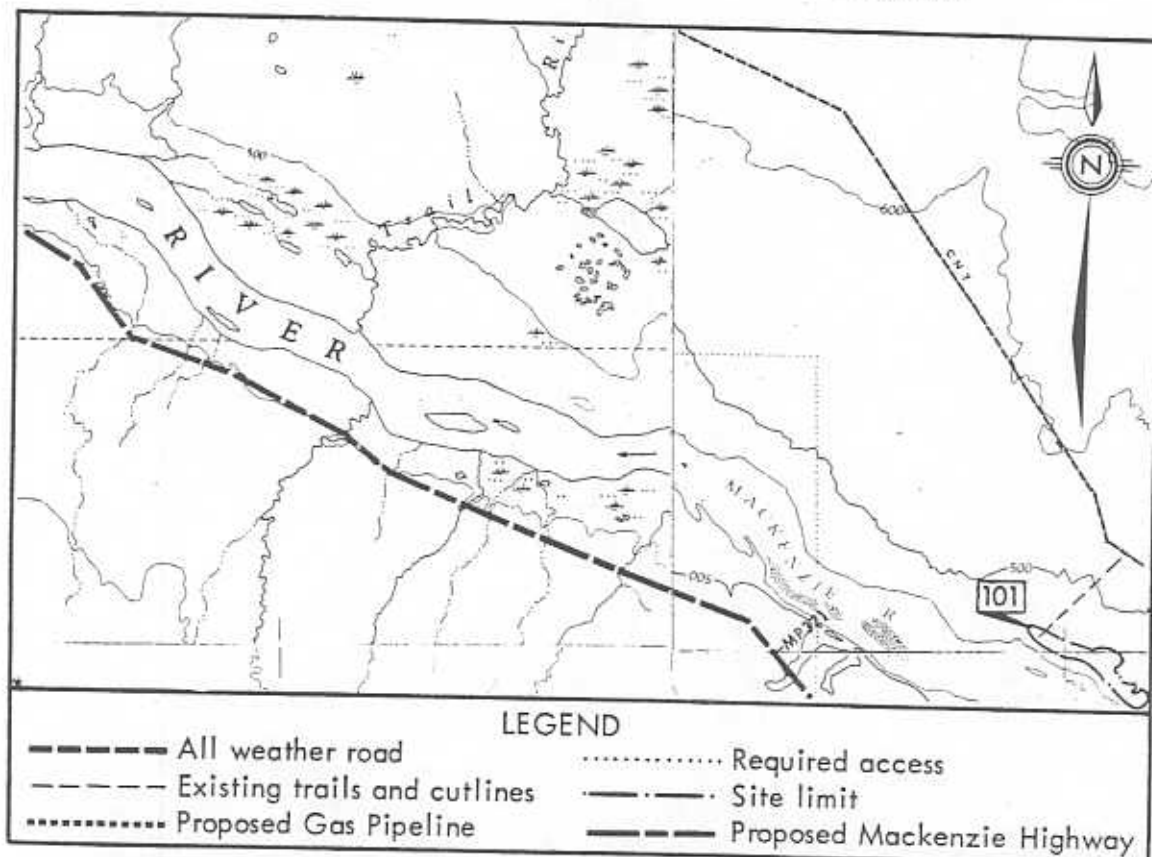


ENVIRONMENT

Located approximately 12 miles downstream from Fort Simpson along the north bank of the Mackenzie River, Site 101 consists of a high fluvial terrace with possibly large pockets of glaciofluvial deposits. Site 101 includes the western section of the same glaciofluvial terrace which comprises Site FS 12 located in the Fort Simpson Community Study Area. The site area exhibits fair surficial drainage into the Mackenzie River and encompasses an area approximately 4 miles in length and $\frac{1}{2}$ mile in width. The terrain, which is pitted with numerous muskeg bogs is gently rolling and rises some 40 to 60 feet above the Mackenzie River water level.

The material at Site 101 consists of coarse glaciofluvial gravels with sand, silt and occasional clay layers. These deposits are mantled by a surficial layer of fluvial sand and silt with a thickness ranging from 6 feet to in excess of 10 feet. The granular deposits apparently represent erosional remnants of glaciofluvial outwash plains or channel filling of the depressions within the underlying glacial till sheet. The site area is generally, densely wooded with stands of spruce, birch and poplar. The poorly drained muskeg bog areas are characterized by sparse growths of tamarack.

There are no known critical wildlife areas in the immediate vicinity of the site although the area is occasionally hunted and trapped by residents of Fort Simpson.



Section of Map No. 95 J & 95 I

Scale: 1:250,000



Surficial drainage is relatively good along the Mackenzie River bank and along the unnamed stream channel dissecting the site area. The northern boundary of the site area as well as localized depressional portions of the terrain exhibit poor drainage.

The access to the northwest tip of the site area from the CNT pole line may be achieved along existing seismic cutlines. The Mackenzie River affords good access to Site 101 relative to water transportation.

DEVELOPMENT

Although detailed airphoto interpretation, preliminary field reconnaissance and evaluation of existing Geological Survey of Canada data indicated very promising potential for granular materials, the results of the winter drilling program carried out on Site 101 showed a predominance of stratified gravelly sands, silts and clays exhibiting a "washed till-like" texture. Only drill hole DH-3, located at the northwestern extremity of Site 101, encountered thin layers of gravel. As noted on the preceding Site Description airphoto (ref. page 12-1), the drill holes were conducted on reasonably accessible existing trails and seismic cutlines which traverse a relatively widespread area of Site FS 12.

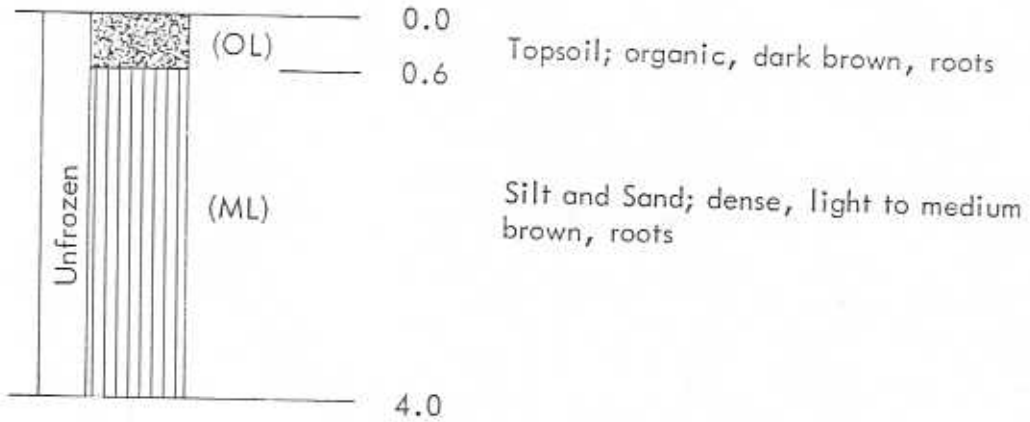
Therefore, based on the results and assessment of the investigations conducted to date, Site 101 is not recommended for immediate development.

However, it is considered likely that large isolated pockets of fair quality granular materials occur within the outlined limits of Site 101. Since the surficial texture of the site area is well masked by heavy tree and understory growth, a detailed subsurface investigation consisting of systematically gridding the site area by drill holes or hand dug test pits would be required to search, locate and delineate the extent of these gravel pockets.

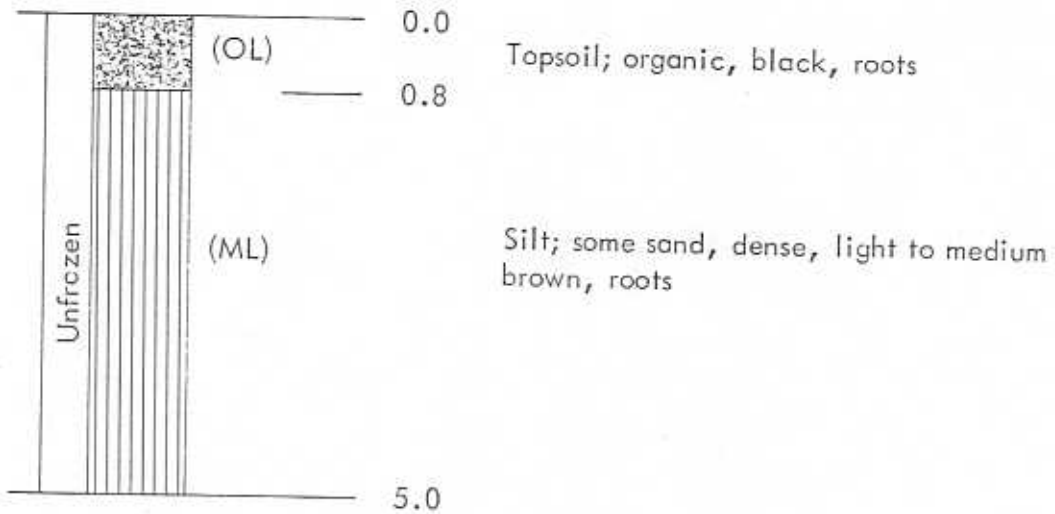
If Site 101 is considered for development of granular materials, subject to the findings of a more detailed site investigation program, then development procedures, compatible with existing land use regulations, should be employed.

DETAILED TEST PIT LOG

101/TP1



101/TP2



DETAILED DRILL HOLE LOG

SITE NO. 101

HOLE NO. DH-1

DATE: FEB. 18, 1973


LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR AIR REVERSE OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	1.0 — TOPSOIL: some silt, organic, trace sand, roots, brown					0
2		ML-SM	SILT: some sand, fine grained, poorly graded, brown		Vs			2
4							L- M	4
6						Vx		6
8								8
10				UF				10
12								12
14			14.0 — TOTAL DEPTH 14.0'					14

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GRANULAR MATERIALS INVENTORY

 **PEMCAN SERVICES "72"**

DETAILED DRILL HOLE LOG

SITE NO. 101

HOLE NO. DH-2

DATE: FEB.18, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	1.0 TOPSOIL: some silt, organic, trace sand, roots, dark brown		Vs			0
2		ML	SILT: little sand, frequent cobbles, brown		Vx	L-M		2
4			6.0 SAND AND SILT: fine grained, poorly graded, brown becoming damp from 8.0'					
6		SM			UF			6
8			- becoming layered and greyish brown from 15.0'					8
10								10
12								12
14								14
16								16
18								18
20			20.0 TOTAL DEPTH 20.0'					20

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GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 101

HOLE NO. DH-3


DATE: FEB. 18, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	TOPSOIL: some silt and sand, trace organic, frequent pebbles to 1½ inch size, brown					0
2		GW-GM	GRAVEL AND SAND: trace silt, fine to medium grained, well graded, coal specks, predominantly rounded and subangular limestone, dolomite igneous and quartzite pebbles to 1½ inch size, light brown		N	L		2
4	4							
6	6							
8	8							
10							G5 POS	10
11.0			TOTAL DEPTH 11.0'					11.0
12								12

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GRANULAR MATERIALS INVENTORY

 **PEMCAN SERVICES "72"**

DETAILED DRILL HOLE LOG

SITE NO. 101

HOLE NO. DH-4

DATE: FEB. 18, 1973 LOGGED BY: PEMCAN
 DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	TOPSOIL: some silt, organic, trace sand, greyish brown		Vx			0
1								1
1.5								
2			SILT: trace sand, fine grained, brown					2
3								3
4		ML			N	L-M		4
5								5
6								6
6.0			trace clay, low plastic, from 6.0'					6
7		ML-CL		UF				7
8								8
9								9
10			TOTAL DEPTH 10.0'					10

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GRANULAR MATERIALS INVENTORY



DETAILED DRILL HOLE LOG

SITE NO. 101

HOLE NO. DH-5

DATE: FEB. 18, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	TOPSOIL: some silt, little organic, trace sand, brown					0
1								1
1.5								
2								2
3		ML-SM	SILT: little sand, fine grained, few pebbles, brown		Vx	L-M		3
4								4
5								5
5.0								
6		SW-SM	SAND: some gravel, trace silt, medium to coarse grained, well graded, silt and clay pockets, pebbles to 1" size, brown					6
7								7
8								8
9							GS	9
10								10

▼ TOTAL DEPTH 10.0'

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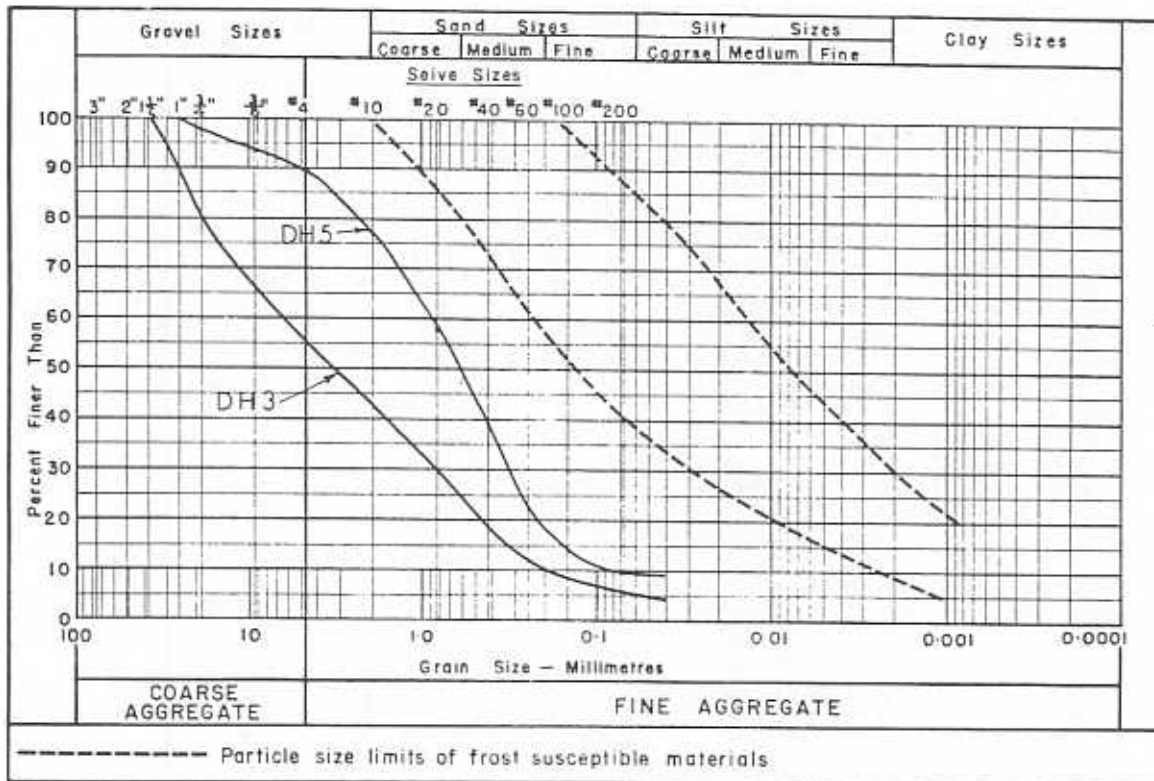
GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	101/DH 3	101/DH 5
Sample Depth (Feet):	8.0	8.0-9.0
Moisture Content (%):	-	-
Ice Content (%):	-	-
Organic Content (%):	2.9	-

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS: (101/DH 3 @ 8.0')

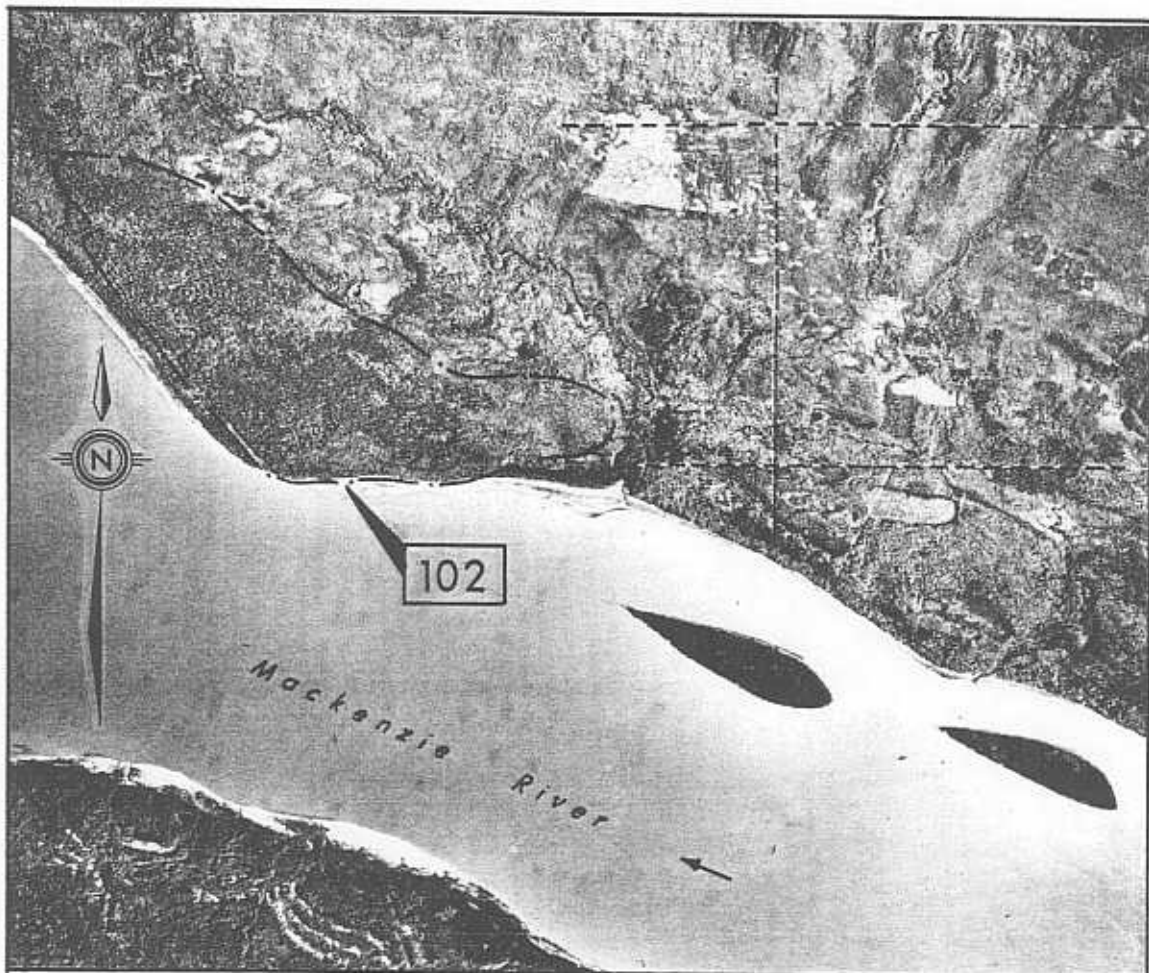
	Percentage	Hardness
Limestone and dolomite (sound)	41.9%	3-4
Igneous	25.5%	6-7
Quartzite	26.5%	7-8
<u>Deleterious</u>		
Ironstone, shale	2.8%	2-3
Siltstone and sandstone		4-5

SITE NO. 102

LOCATION

Located on the north side of the Mackenzie River and approximately 14 miles downstream from Fort Simpson, Site 102 encompasses a crescent shaped high terrace.

Both the Mackenzie Highway and proposed gas pipeline right-of-ways are located on the opposite, southern side of the Mackenzie River. The Highway right-of-way at Mile 319 is located approximately $3\frac{1}{2}$ miles southwest of Site 102.



LEGEND	
----- All weather road	..... Required access
----- Existing trails and cutlines	--- Site limit
..... Proposed Gas Pipeline	----- Proposed Mackenzie Highway

Airphoto No. A22933/168

Approximate scale: 1" = 3,000'



GENERAL

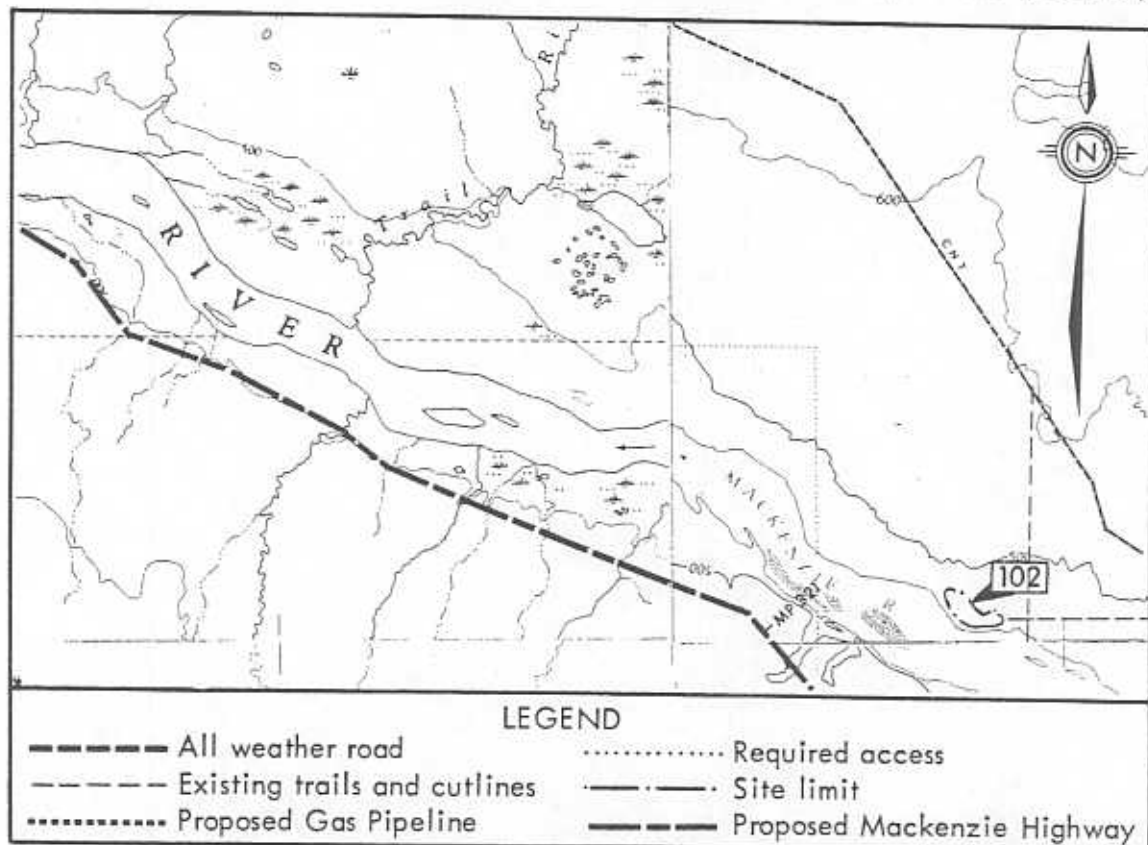
Site 102 consists of a terrace segment, morphologically and geologically similar to terraces comprising Sites 101 and FS 12, the latter being located in the Fort Simpson Community Study Area.

The site area is about 2 miles long and ranges to $\frac{1}{2}$ mile in width. The steep, locally eroded Mackenzie River bank forms the southern and southwestern site boundary while the terrace terrain descends gently into the flat glaciolacustrine Great Slave Plain along the remainder of its perimeter. The site area exhibits fair surficial drainage into the Mackenzie River and an unnamed stream paralleling the northeastern perimeter of the terrace. The adjacent terrain to the north is slightly depressional and poorly drained.

The material at Site 102 is expected to consist of glaciofluvial gravel, sand and washed till which is covered by a surficial layer of fluvial sand and silt. Granular deposits may exist as randomly scattered pockets or layers and the overburden thickness is variable and may be substantial.

The site area is densely wooded with good stands of spruce, birch and poplar. There are no known critical wildlife areas in the immediate vicinity of the site although the area is occasionally hunted and trapped by residents of Fort Simpson.

Existing cutlines which provide access to the site from the CNT pole line traverse poorly



Section of Map No. 95 J & 95 I

Scale: 1:250,000



drained and thermally sensitive terrain. The Mackenzie River offers relatively good access to the site relative to water transportation.

The site was not investigated in detail because of difficult access to the site from proposed utilities and doubtful quality of the material. Also, open water in the unnamed stream prevented the transportation of the rig to the site. Site 102 is rated as a poor prospect for granular materials.

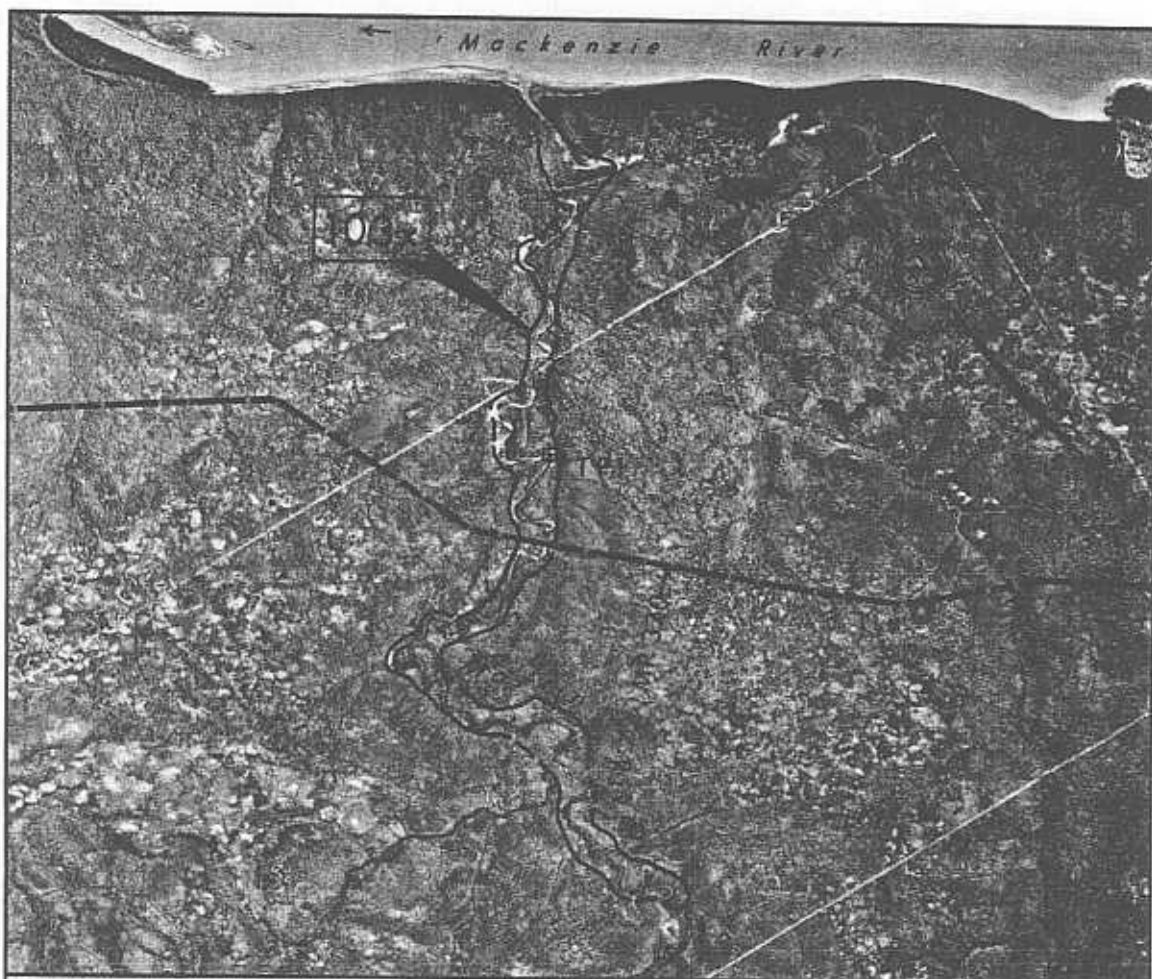
SITE NO. 103X

Located in the immediate vicinity of Mile 320 of the Mackenzie Highway, Site 103X consists of an alluvial floodplain and terraces within the active stream channel of the Martin River.

Type of Material: Gravel; medium grained, well graded, trace silt.

Estimated Volume: Not applicable.

Assessment: Site 103X is not recommended for development because the gravel deposits are located immediately adjacent to the active stream channel and may have severe environmental implications.



LEGEND

- | | |
|------------------------------------|----------------------------------|
| ----- All weather road | Required access |
| ----- Existing trails and cutlines | ----- Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |
| ⊙ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A22889/16

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 103X consists of the alluvial floodplain and terraces immediately adjacent to the active stream channel of the Martin River valley. The site extends approximately 3 miles upstream from the south bank of the Mackenzie River. The Martin River crosses the Mackenzie Highway right-of-way at Mile 320. The Martin River is a small meandering stream which has been incised into the underlying silty basal till deposit to depths in excess of 100 feet below the adjacent terrain.

The granular materials, consisting of well graded, medium grained, clean gravels are located in shallow bars in the active stream channel. Gravels are also found in the terraces of the fossil floodplain which has been isolated by the meandering river channel. These gravel bars and terraces are overlain by $1\frac{1}{2}$ to 2 feet of alluvial silt. The active stream channel of the Martin River is paved with cobbles and boulders.

There are no known critical wildlife areas in the immediate vicinity of Site 103X.

The Mackenzie Highway right-of-way which crosses this site area provides good access.

DEVELOPMENT

Site 103X is not recommended for development because the granular material deposits are located within or immediately adjacent to the active stream channel of the Martin River.

If local needs require the exploitation of granular materials from this site at a future date, then guidelines that are based upon the physical status of the site should be established at that time. Some of these guidelines should include:

- Procedures should be established whereby only dry bars and other areas removed from the stream channel are developed.
- Procedures should be established whereby the exploitation of borrow areas can be geographically flexible within the site in order to allow for periodic shifting of the stream channel.
- Procedures should be established relating to the periodic stripping of granular materials so that excavation does not occur more than 2 or 3 feet below the ground water table. In such cases, wet material should remain isolated from the active stream channels.
- Procedures should be established to maintain buffer zones and sediment settling ponds that separate the working areas from the active stream channel.
- Procedures should be established for adequate aesthetic buffer zones along the stream banks.



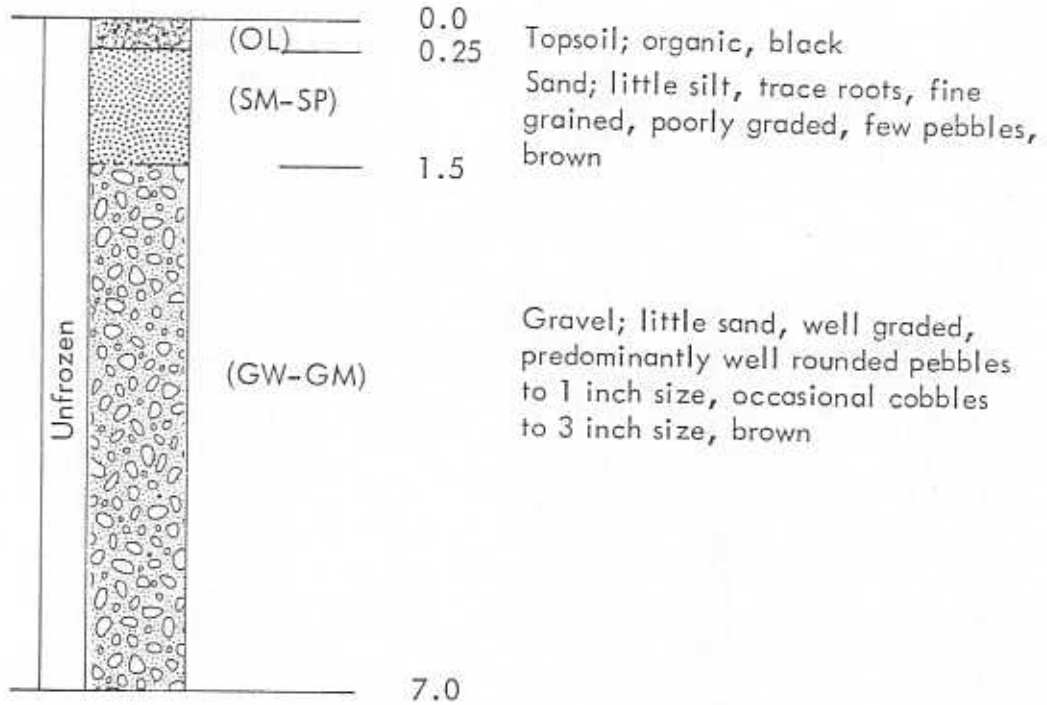
ABANDONMENT AND REHABILITATION

If Site 103X is developed at a future date an assessment should be made that relates to the current status of the area and the proposed development of borrow pits. This assessment should result in guidelines on abandonment and rehabilitation procedures that would include:

- Terracing and recontouring procedures for pit areas should be established.
- Procedures should be established whereby restored pit areas are breached into existing channels so that high water flows will naturally cleanse and restore such areas.

DETAILED TEST PIT LOG

103X/TP 1



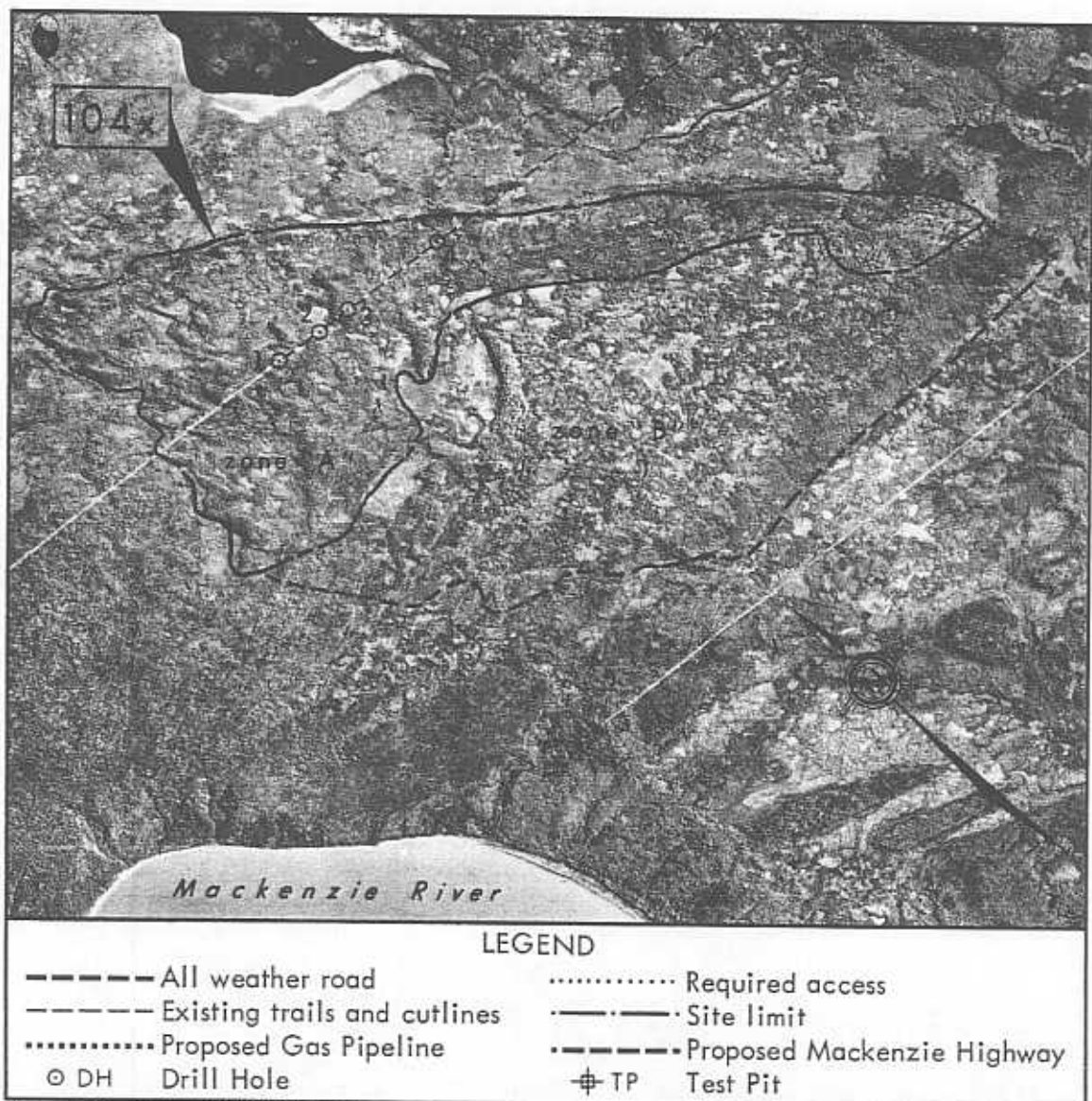
SITE NO. 104X

Located on the north bank of the Mackenzie River and 4 miles north of the Mackenzie Highway at Mile 323, Site 104X consists of a large field of sand dunes of various sizes.

Type of Material: Sand; fine grained, poorly graded, eolian.

Estimated Volume: Not determined.

Assessment: Site 104X is not recommended for development because materials of very poor quality were established during the field drilling program and, in addition, the access to the site area is very difficult.



Airphoto No. A22933/165

Approximate scale: 1" = 3,000'



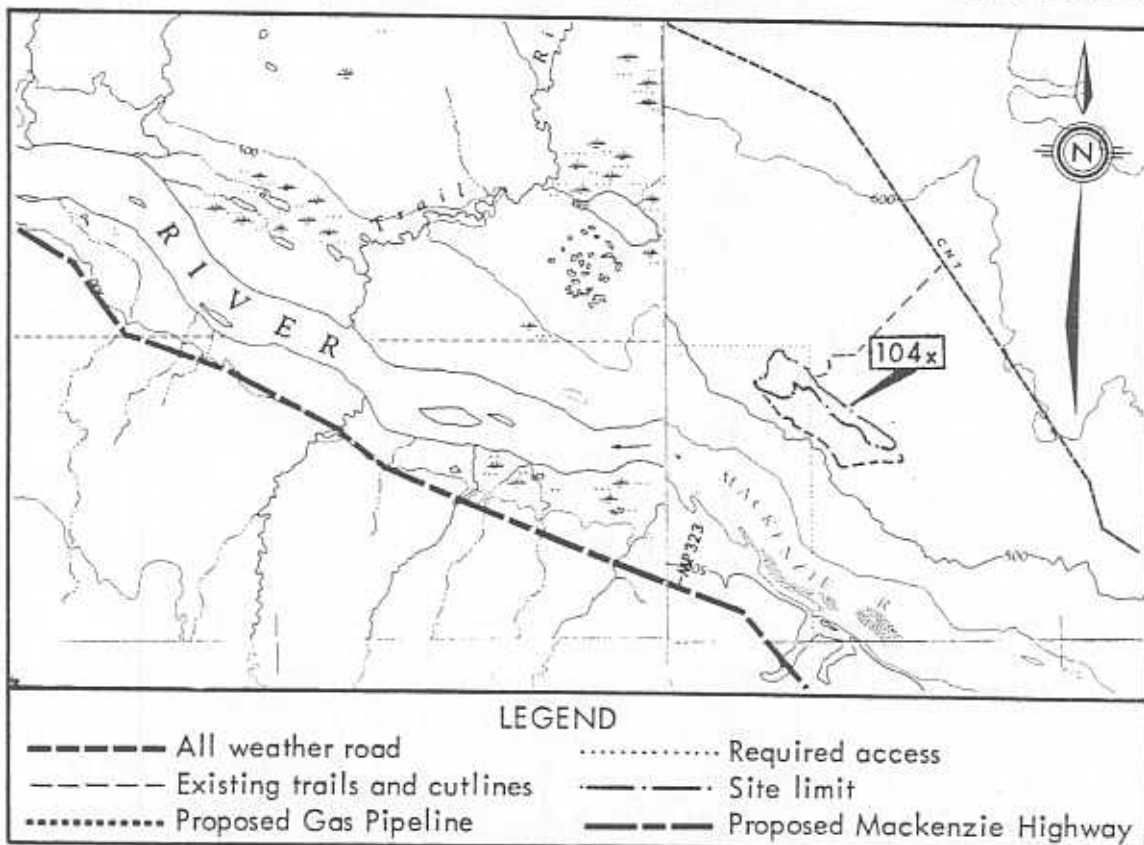
ENVIRONMENT

Site 104X is located across the Mackenzie River approximately 4 miles north of the Mackenzie Highway right-of-way at Mile 323. The southwestern perimeter of the site area is approximately 1 mile north of the Mackenzie River channel. The site, which encompasses an area 3 miles in length and 1¼ miles in width, consists of a large field containing numerous sand dunes of various sizes. The site area has been divided into zone "A" and "B" as noted on the preceding site airphoto (ref. page 104-1).

Zone "A" is comprised of more prominent and larger sand dunes and duned ridges which are surficially well drained.

Zone "B" is slightly depressional and poorly drained and consists of smaller sand dunes with numerous areas of interdune muskeg bogs.

The material in these dunes and duned ridges consists of poorly graded, fine grained sands with a little silt which are of very poor granular quality. However, these fine sands may be suitable as very marginal fill material in the construction of subbases for roads. These fine grained sand deposits are easily eroded if exposed to wind and rain action. A layer of peat and topsoil, generally less than 1 foot in depth, covers these sand deposits and supports



Section of Map No. 95 J & 95 I

Scale: 1:250,000



moderate growths of spruce.

There are no known critical wildlife areas in the immediate vicinity of Site 104X.

There are no existing land access routes from the site area to the locations of the currently proposed utilities. The CNT pole line, which is $4\frac{1}{2}$ miles east of Site 104X is only accessible from the site area by utilizing existing seismic cutlines which traverse muskeg terrain and an unnamed stream.

DEVELOPMENT

Site 104X is not recommended for development because materials of very poor quality were established. In addition, the access from currently proposed utility routes to this site area is very difficult and would involve crossing of the Mackenzie River.

DETAILED DRILL HOLE LOG

SITE NO. 104X

HOLE NO. DH-1

DATE: FEB. 17, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D			
0		SP	1.0 SAND: trace organic, fine grained, rust brown					0	
3								3	
6			SAND: trace silt, fine grained, poorly graded, light brown					6	
9		SM-SP			Nf	L		9	
12								12	
15								15	
18								18	
21			21.0 TOTAL DEPTH 21.0'					21	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 104 X

HOLE NO. DH-2

DATE: FEB. 17, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C CLASS	EST'D CONT.		
0		Pt	PEAT: organic, fibrous, dark brown		Vx	M		0
2			2.0					2
4		SP-SM	SAND: trace silt, fine grained, poorly graded, light brown		Nf	L		4
6								6
8								8
10								10
12			12.0					12
			TOTAL DEPTH 12.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



DETAILED DRILL HOLE LOG

SITE NO. 104X

HOLE NO. DH-3

DATE: FEB. 17, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		SP	1.0 SAND: trace organic, rust brown					0
3								3
6			SAND: trace silt, fine grained, poorly graded, light brown		Nf	L		6
9		SP-SM						9
12								12
15								15
18								18
21								21
23.0			TOTAL DEPTH 23.0'					23.0
24								24

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

 **PEMCAN SERVICES "72"**

DETAILED DRILL HOLE LOG

SITE NO. 104X

HOLE NO. DH-4

DATE: FEB. 17, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.			
0		Pt	0.5 PEAT: organic, fibrous, muskeg, dark brown		Nf	L		0	
3			SAND: trace silt, fine grained, poorly graded, light brown from 4.0' change to medium grey					3	
6			4' to 8' - damp	UF				6	
9		SM-SP			Nf	L		9	
12								12	
15			from 17.0' saturated					15	
18								18	
21				UF				21	
24			22.0 TOTAL DEPTH 22.0'					24	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

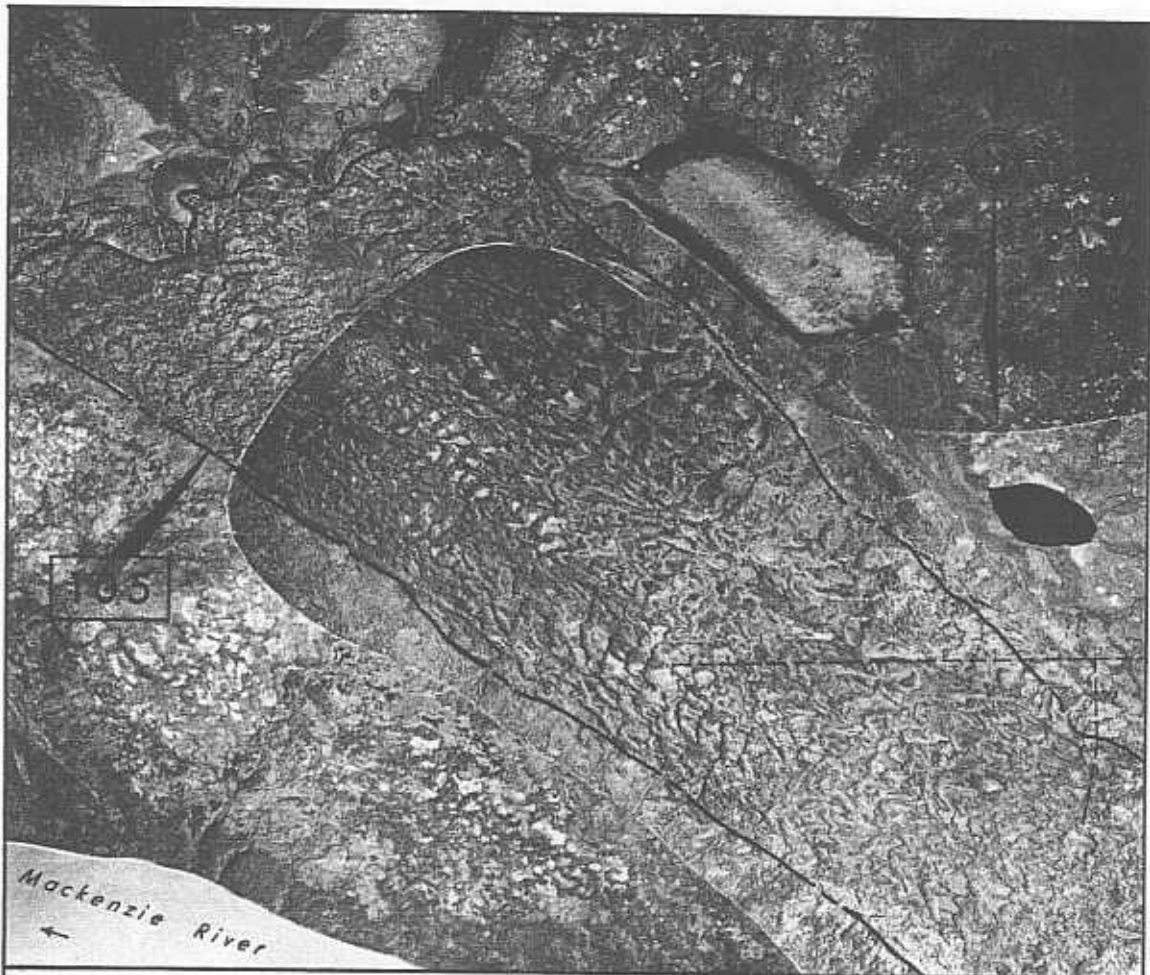
P PEMCAN SERVICES "72"

SITE NO. 105

LOCATION

Paralleling the north Mackenzie River bank at a distance in excess of 1½ miles and located approximately 30 miles downstream from Fort Simpson, Site 105 consists of a large sand dune complex.

The proposed Mackenzie Highway route at Mile 331 is located approximately 5 miles southwest of Site 105.



LEGEND	
———— All weather road	..... Required access
- - - - Existing trails and cutlines	— · — Site limit
..... Proposed Gas Pipeline	———— Proposed Mackenzie Highway

Airphoto No. A18210/20

Approximate scale: 1" = 5,000'



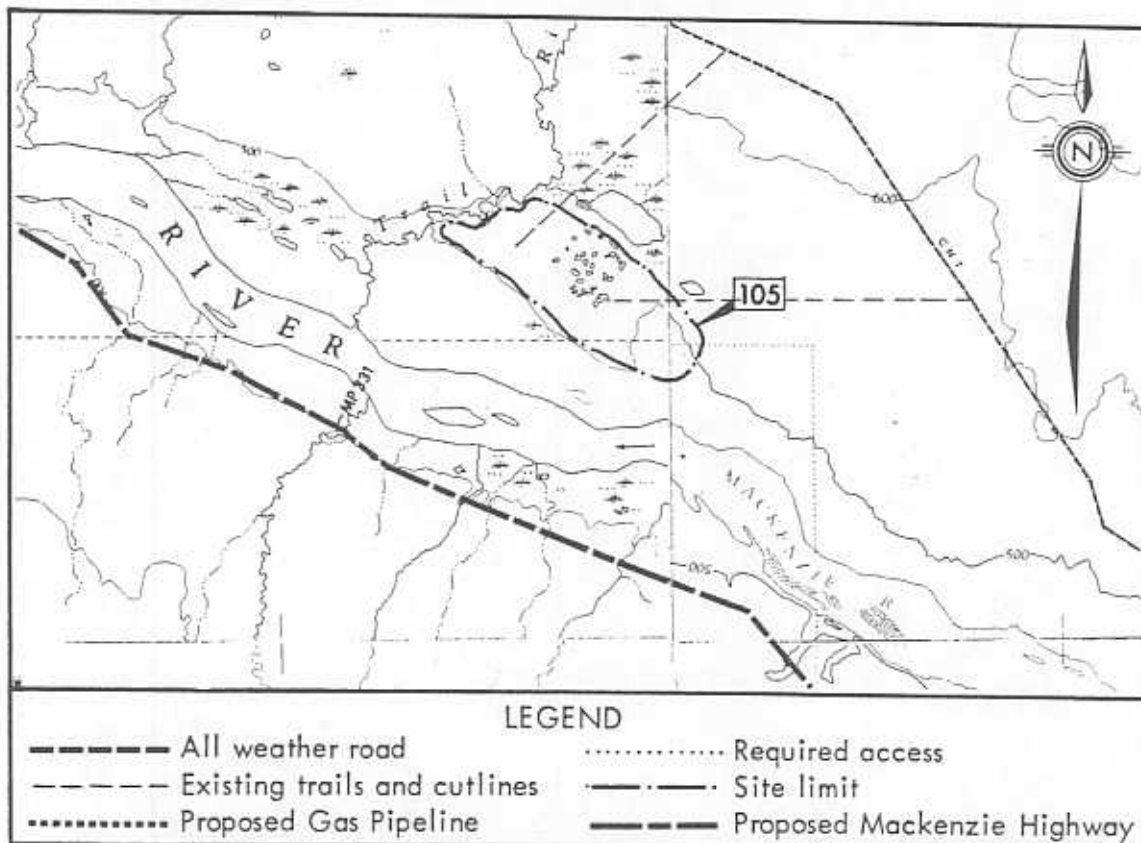
GENERAL

Site 105 consists of a large sand dune complex consisting of individual dunes and dune ridges, geologically similar but more prominent than the dunes comprising Site 104. This complex encompasses an area more than 5 miles long and about 2 miles wide. The Trail River borders the northwestern perimeter of the site while flat, locally depositional and thermally sensitive terrain mantles other sides of the dune complex.

Individual dunes and dune ridges are well drained and support good stands of poplar, birch and spruce. Inter-dune depressions have collected surficial runoff water resulting in small and shallow muskeg bogs. There are no critical wildlife areas in the vicinity of Site 105; however, the area is periodically trapped and hunted by residents from Fort Simpson. Dunes are comprised of eolian, poorly graded, fine grained sand which may be suitable as very marginal fill material. These sands are easily erodible.

Existing cutlines provide access to the site from the CNT pole line which is approximately 5 miles northeast of the site area. Open water in the small streams which parallel the northeast side of the dune complex prevented the transportation of the drill rig to the site area. Poorly drained and thermally sensitive terrain also exists adjacent to the southern perimeter of the dune complex.

Site 105 is rated as a poor prospect for granular materials.



Section of Map No. 95 J & 95 I

Scale: 1:250,000

SITE NO. 106

LOCATION

Located about 2 miles northwest of Trail River and approximately 3 miles north of the Mackenzie River channel, Site 106 encompasses a longitudinally shaped area covered with wind-blown sands.

The proposed Mackenzie Highway parallels the opposite southwest side of the river channel, and the Highway at Mile 337 is located approximately 5 miles south of Site 106.



LEGEND

- | | |
|--|----------------------------------|
| ----- All weather road | Required access |
| - - - - - Existing trails and cutlines | - · - · - Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |

Airphoto No. A22933/159

Approximate scale: 1" = 3,000'

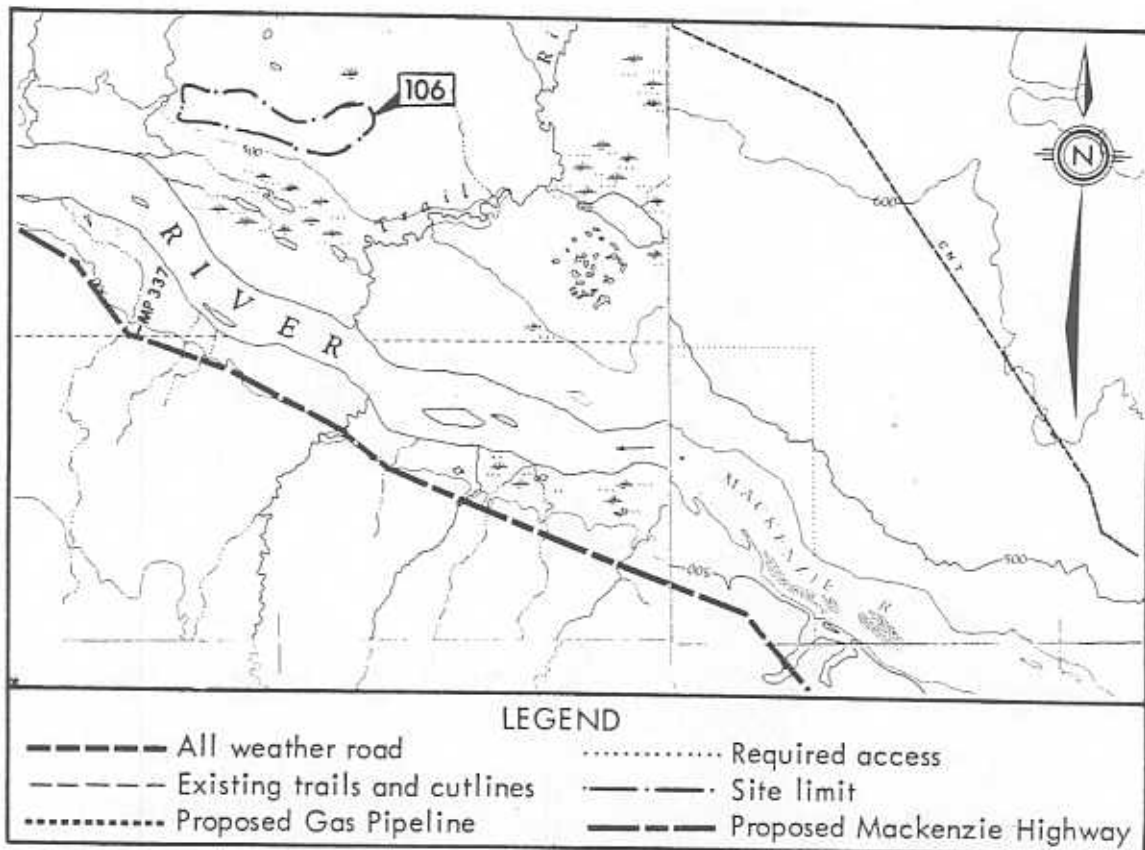


GENERAL

Site 106 encompasses an area in excess of 3 miles in length and approximately $\frac{1}{2}$ mile in width and consists of slightly elevated terrain rising above the adjacent flat and locally depressional Great Slave Plain. The lacustrine silt, sand and clay deposits of the Plain are covered by varying thicknesses of windblown, poorly graded, fine grained sands. These sands are of poor granular quality and may only be suitable for very marginal general fill material.

Drainage conditions within the site are fair while the adjacent terrain is poorly drained. The better drained portions of the site support growths of birch, poplar and spruce with relatively dense understory vegetation. The adjacent, muskeg terrain supports growths of black spruce, tamarack and willow. There are no critical wildlife areas in the vicinity of Site 106, however, this region is periodically trapped and hunted by residents from Fort Simpson.

Site 106 is rated as a poor prospect because of doubtful quality of the material and its remoteness from both of the currently proposed utilities. There are no existing cutlines in the vicinity of the site and any access to the site will cross thermally sensitive and poorly drained terrain.



Section of Map No. 95 J & 95 I

Scale: 1:250,000

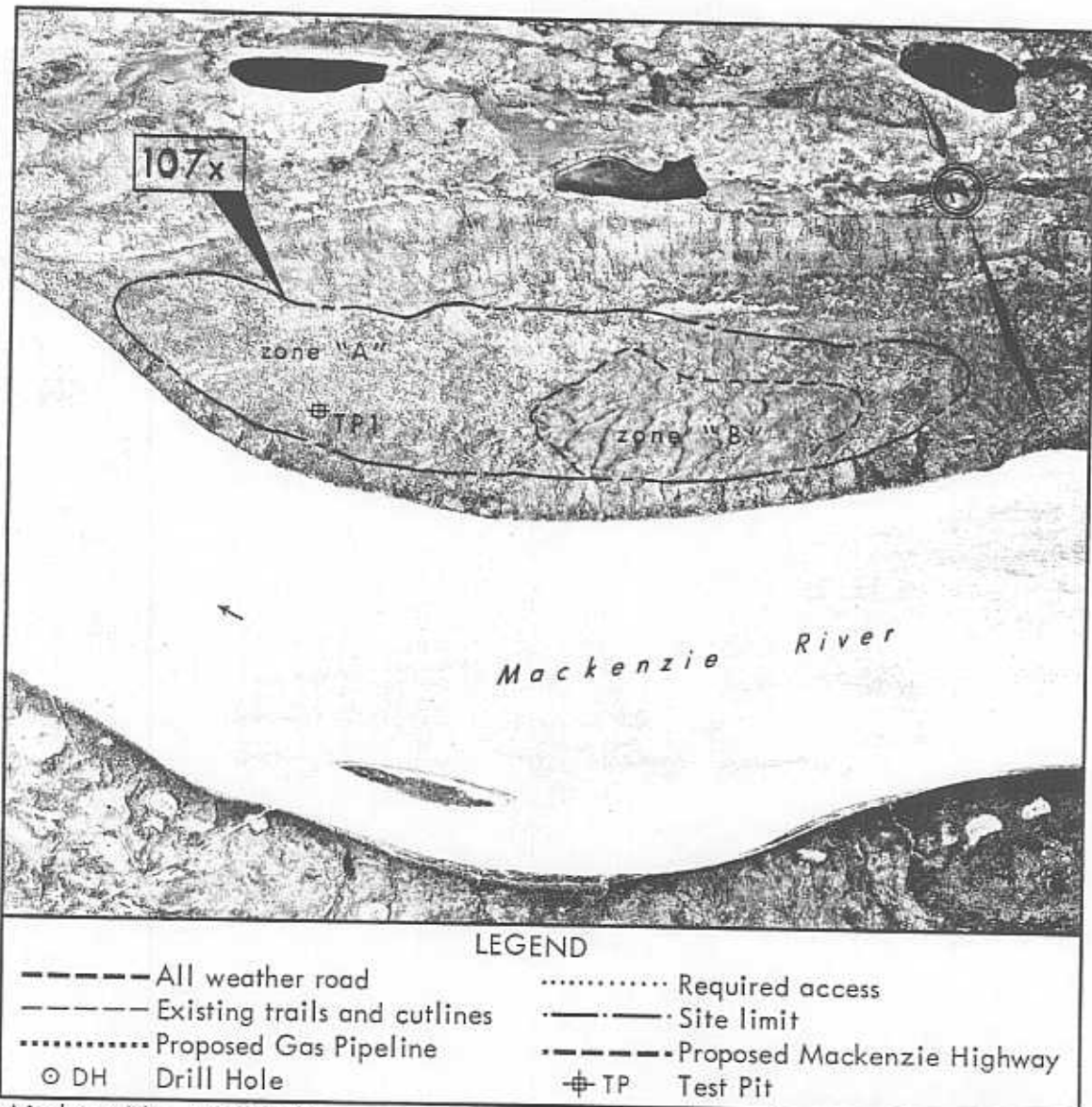
SITE NO. 107X

Located on the north bank of the Mackenzie River and 3 miles north of the proposed Mackenzie Highway at Mile 334, Site 107X consists of a high fluvial terrace.

Type of Material: Sand; trace silt, fine grained, poorly graded.

Estimated Volume: Not applicable.

Assessment: Site 107X is not recommended for development because materials of granular quality were not encountered during the field drilling program.



Airphoto No. A22889/9

Approximate scale: 1" = 3,000'



ENVIRONMENT

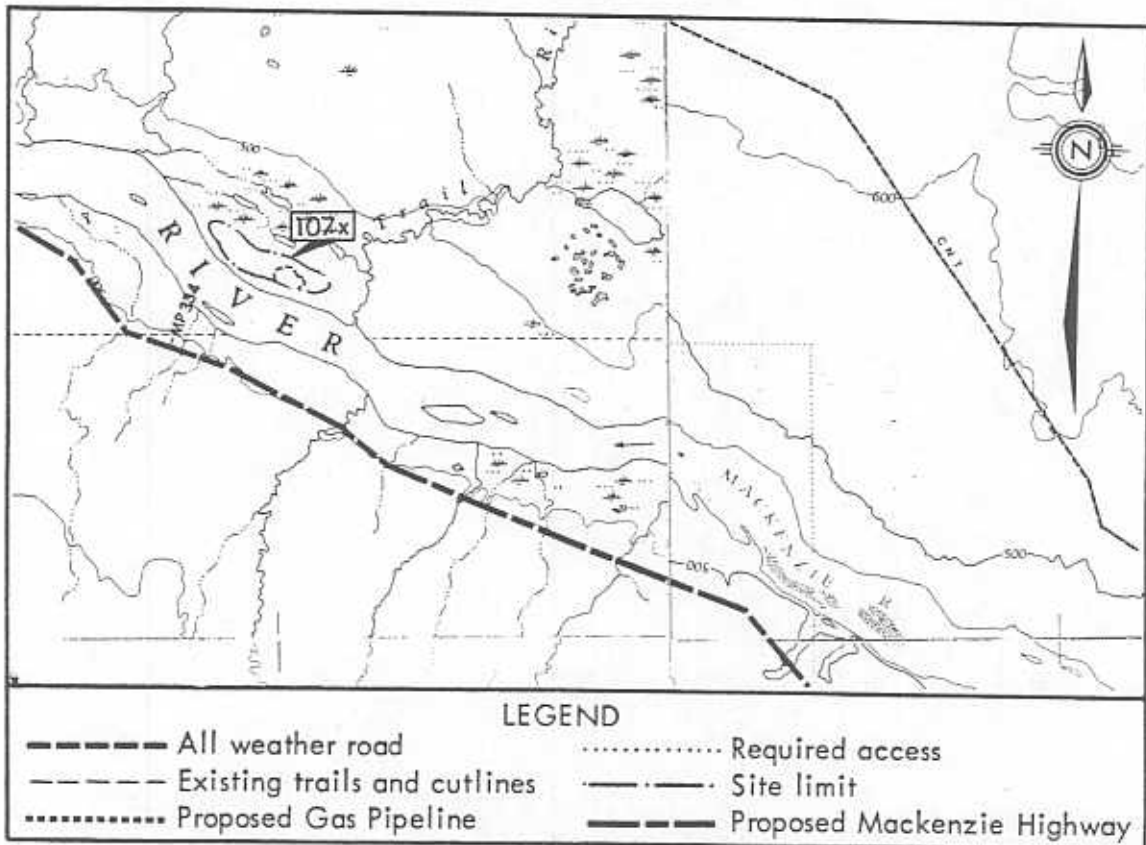
Site 107X is located across the Mackenzie River and approximately 3 miles north of the Mackenzie Highway right-of-way at Mile 334. The site consists of a high fluvial terrace which is located on the north bank of the Mackenzie River. The total site including zone "A" and "B" as designated on the preceding airphoto (ref. page 107-1) encompasses an area 1½ miles in length and ¼ mile in width.

Zone "A" is relatively flat and only very gently rolling but exhibits good surficial drainage to the south into the Mackenzie River.

Zone "B" has been surficially reworked by wind action and is characterized by numerous small sand dunes. This area also exhibits good drainage to the south into the Mackenzie River.

The adjacent terrain to the north of the site is slightly depressional and is poorly drained.

The material in the terrain deposit consists of poorly graded, fine grained sands with a trace of silt which are not of granular quality. However, these sands may be suitable as very marginal fill material in the construction of subbases for roads. These fine grained sand deposits are easily eroded if exposed to rain and wind action. A layer of organic



Section of Map No. 95 J & 95 I

Scale: 1:250,000



topsoil, less than 1 foot in depth, overlies the site area and supports dense growths of spruce, birch and poplar.

There are no known critical wildlife areas in the immediate vicinity of Site 107X.

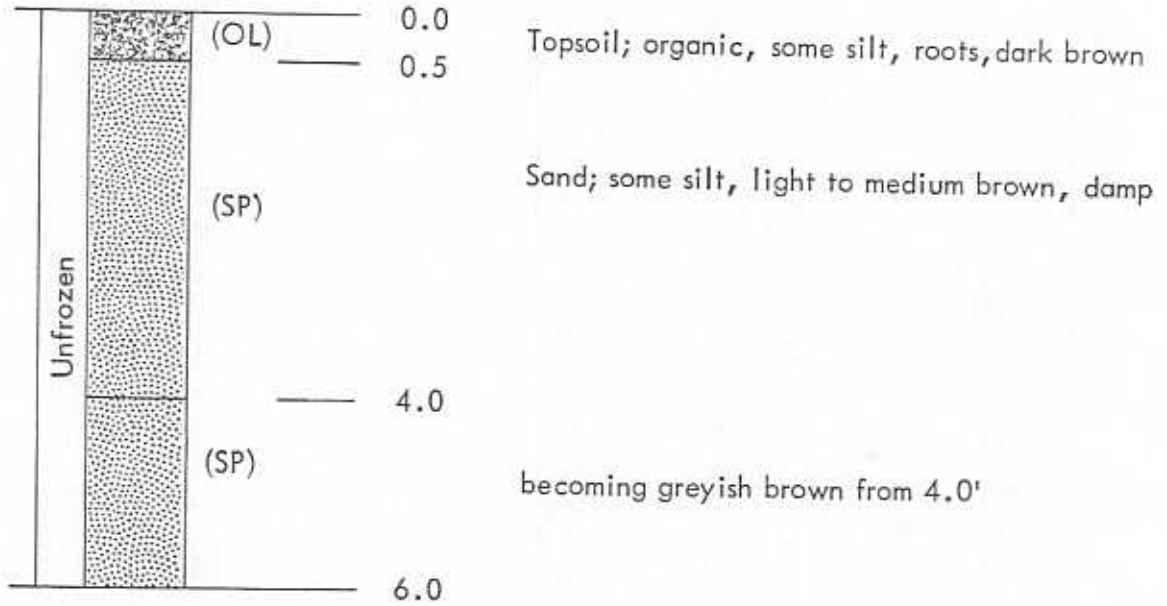
There is no existing land access to the site area from any of the proposed utility routes. The Mackenzie River does afford good water transportation if removal of material from Site 107X is anticipated.

DEVELOPMENT

Site 107X is not recommended for development because materials of granular quality were not established. In addition, the remoteness of this site area makes the exploitation of material from this site questionable.

DETAILED TEST PIT LOG

107X/TP 1



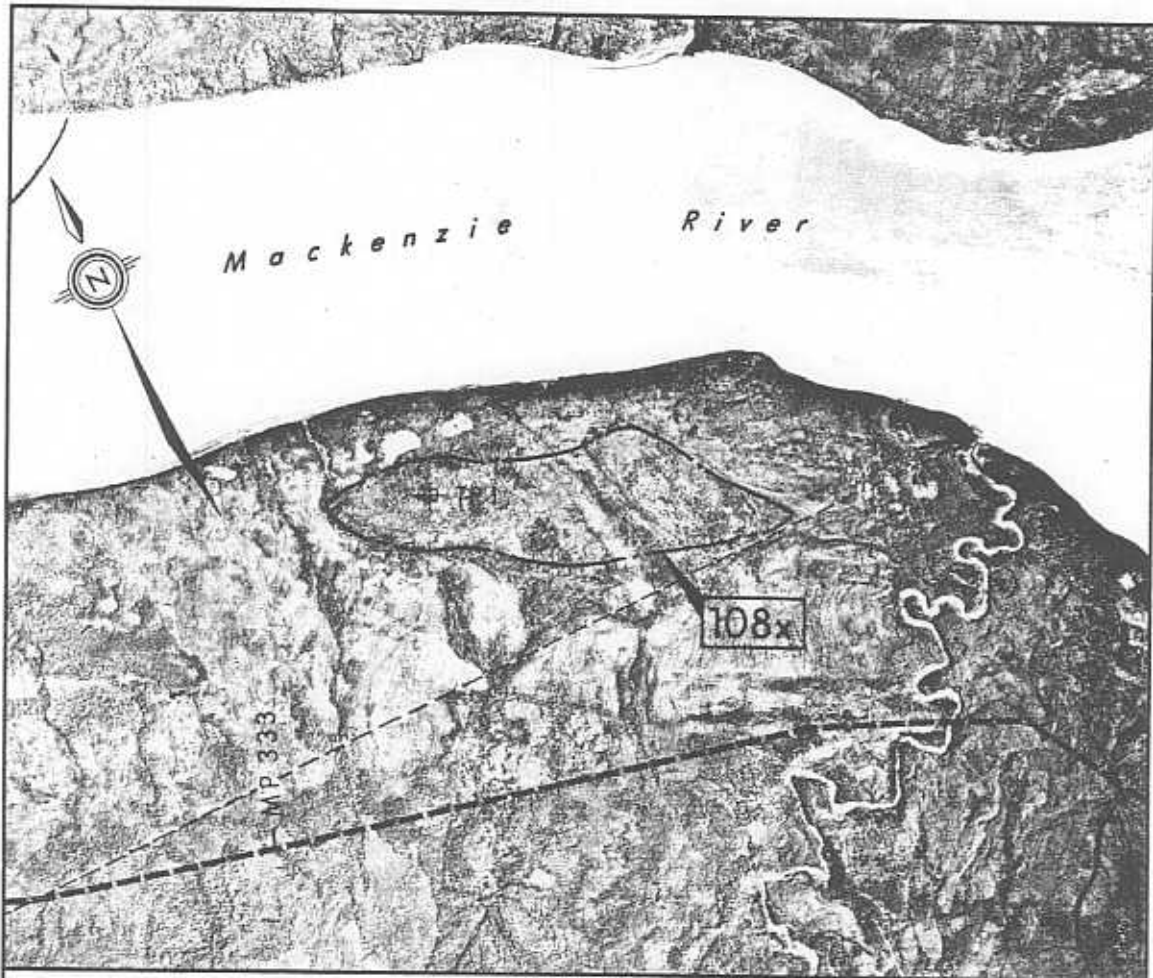
SITE NO. 108X

Located on the south bank of the Mackenzie River and $\frac{1}{2}$ mile north of the proposed Mackenzie Highway at Mile 332, Site 108X consists of an alluvial river terrace.

Type of Material: Silt; clay and sand with little gravel.

Estimated Volume: Not applicable.

Assessment: Site 108X is not recommended for development because granular type materials were not established during the field investigation.



LEGEND

- | | |
|--|----------------------------------|
| ----- All weather road | Required access |
| - - - - - Existing trails and cutlines | --- Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |
| ⊙ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A22889/10

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 108X is located $\frac{1}{2}$ mile north of the proposed Mackenzie Highway right-of-way at Mile 332 and immediately adjacent to the south bank of the Mackenzie River. The site, which rises 40 to 50 feet above the Mackenzie River channel, is comprised of an effaced erosional remnant of a river terrace. The site, encompassing an area approximately $1\frac{1}{2}$ miles in length and $\frac{1}{4}$ mile in width, exhibits good surficial drainage to the north into the Mackenzie River. The terrain adjacent to the site area is poorly drained and consists of younger alluvial silt and sand deposits of the fossil Mackenzie River floodplain.

The material in the site area consists of a heterogeneous mixture of clay, silt, sand and fine grained gravel. The site is covered by an organic topsoil layer less than 1 foot in depth, which supports moderately dense growths of birch and poplar interspersed with spruce.

There are no known critical wildlife areas in the immediate vicinity of Site 108X.

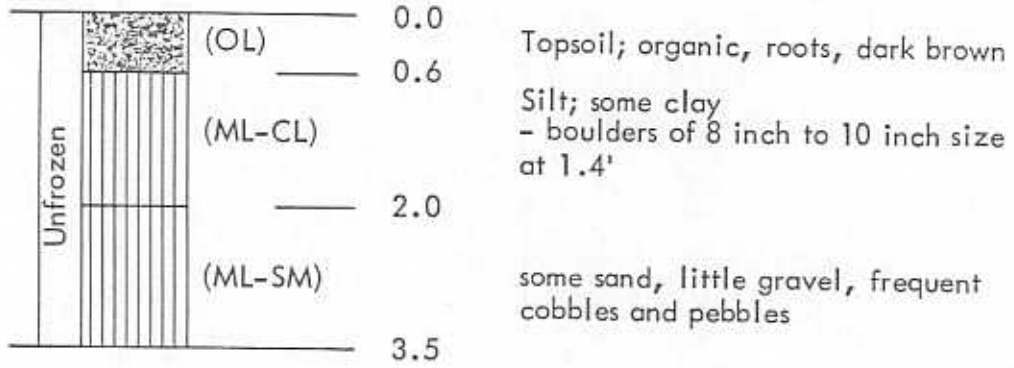
The only existing land access to the site area from the Mackenzie Highway right-of-way consists of a seismic cutline. The Mackenzie River affords good access to the site area via water.

DEVELOPMENT

Site 108X is not recommended for development because materials of granular quality were not established in the outlined site area.

DETAILED TEST PIT LOG

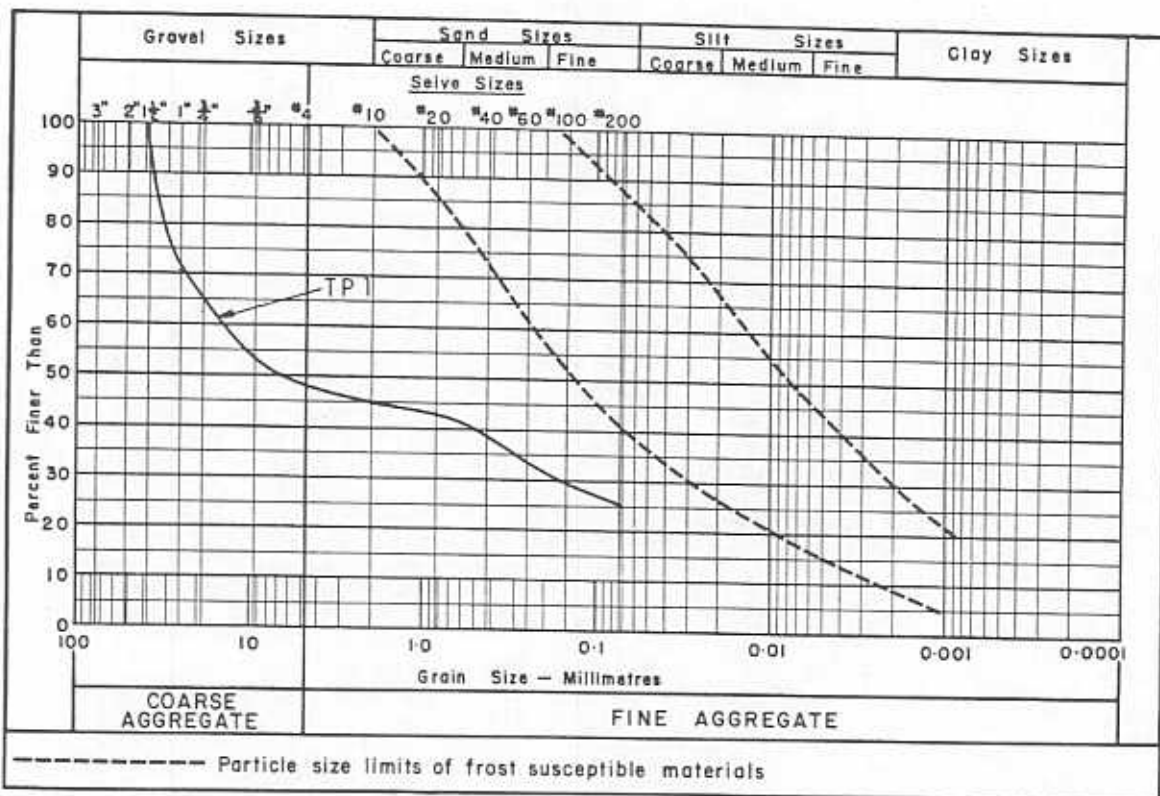
108X/TP 1



SUMMARY OF LABORATORY TEST DATA

Sample Location: 108X/TP 1
 Sample Depth (Feet): 2.5
 Moisture Content (%): -
 Ice Content (%): -
 Organic Content (%): -

GRAIN SIZE DISTRIBUTION:



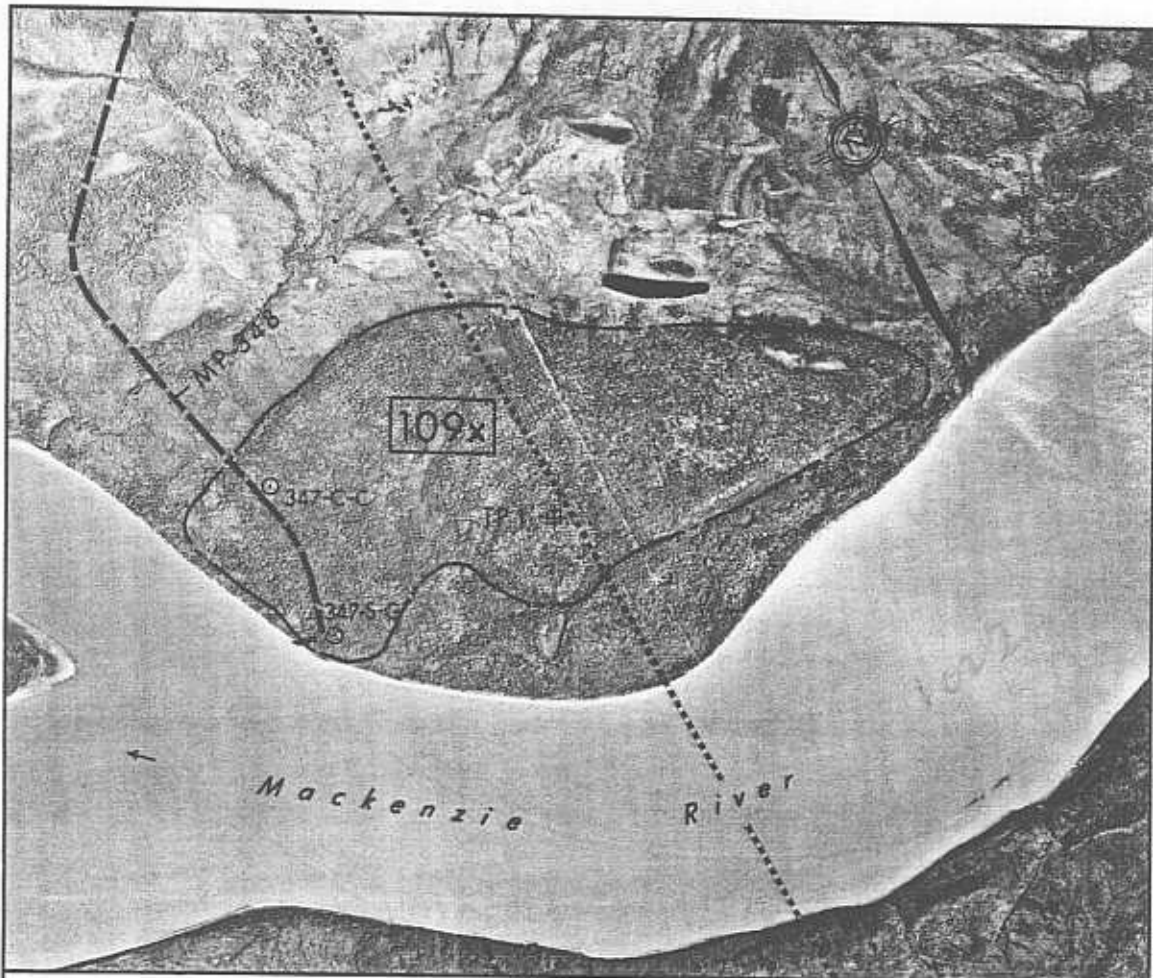
SITE NO. 109X

Located on the northbank of the Mackenzie River and immediately adjacent to the eastside of the proposed Mackenzie Highway between Mile 347 and Mile 348; Site 109X consists of a large alluvial river terrace.

Type of Material: Sand; little silt, fine grained, poorly graded.

Estimated Volume: Not applicable.

Assessment: Site 109X is not recommended for development because materials of granular quality were not established during the field investigation. However, these fine silty sands may be considered for use as fill material in the construction of subgrades for roads.



LEGEND

- | | |
|--|--------------------------------------|
| ----- All weather road | Required access |
| - - - - - Existing trails and cutlines | - · - · - Site limit |
| Proposed Gas Pipeline | - - - - - Proposed Mackenzie Highway |
| ⊙ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A22889/5

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 109X is located within and immediately adjacent to the eastside of the Mackenzie Highway right-of-way between Mile 347 and Mile 348. The site consists of a large, alluvial river terrace located on the north bank of the Mackenzie River and encompasses an area approximately 2 miles in length and 1 mile in width. Site 109X rises 100 to 150 feet above the adjacent Mackenzie River channel and exhibits good surficial drainage into the river.

The material in the alluvial terrace consists of poorly graded, fine grained sands with a little silt. These sands are not of granular material quality but may be suitable as very marginal fill material in the construction of subbases for roads. These fine sand deposits are easily eroded if exposed to wind and water action. A layer of organic topsoil, less than 1 foot in depth, overlies the site area and supports moderately dense growths of spruce, poplar and birch.

There are no known critical wildlife areas in the immediate vicinity of Site 109X; however, the site lies within the region periodically trapped and hunted by residents from Fort Simpson.

The proposed Mackenzie Highway and gas pipeline right-of-ways traverse the breadth of Site 109X and afford good future access to the site area. In addition, the Mackenzie River provides good access by water to this site.

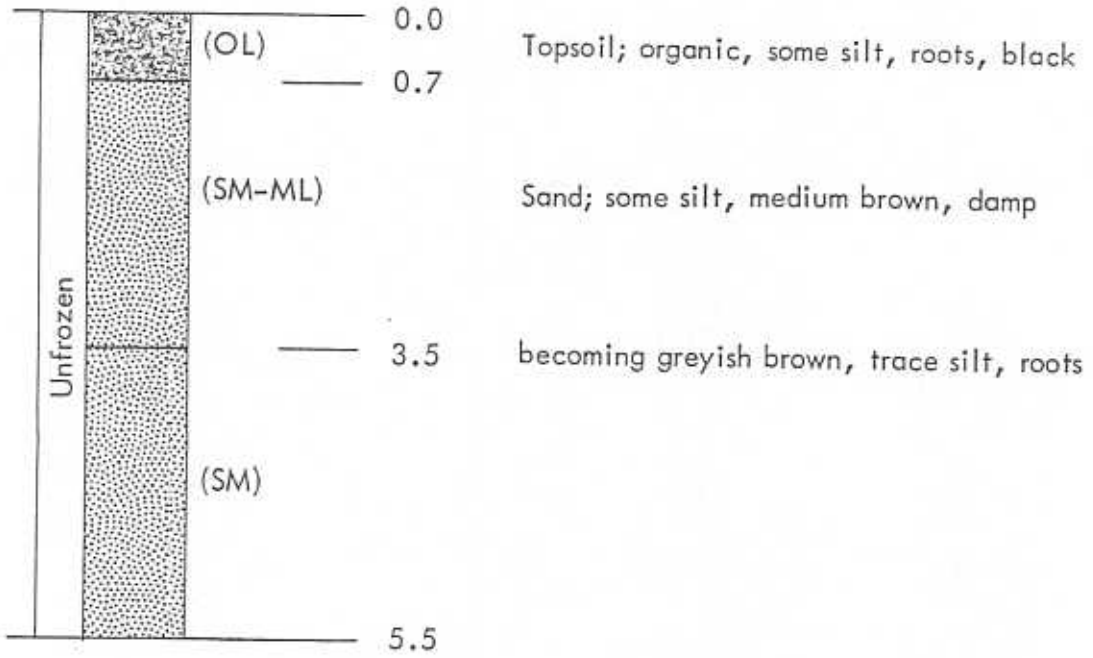
DEVELOPMENT

Site 109X is not recommended for development because materials of granular quality were not established. However, because of the scarcity of construction materials in this portion of the Study Area, these poorly graded, fine grained sands may be considered for use as very marginal fill material in the construction of subbases for roads.

If Site 109X is developed for the exploitation of marginal fill material, then proper development procedures, compatible with the physical and biological framework of the site area, should be established in accordance with the land use guidelines which are in effect at that time.

DETAILED TEST PIT LOG

109X/TP 1



DETAILED DRILL HOLE LOG

SITE NO. 109X

HOLE NO. S G

DATE: MAR. 7, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)	
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.			
0								0	
4			Brown silt with some clay and sand		Nbn		GS	4	
6.0									
8		SM	Brown sand with some silt and a trace of clay		Vx		MC GS	8	
12									
14.0									
16		CL	Grey silt and clay		Vx		MC GS	16	
20									
23.0					UF			20	
24									
24		ML	Grey silt with some clay and a trace of sand		Nbn			24	
28		ML							
32					UF			28	
36									
40					UF			32	
40.0									

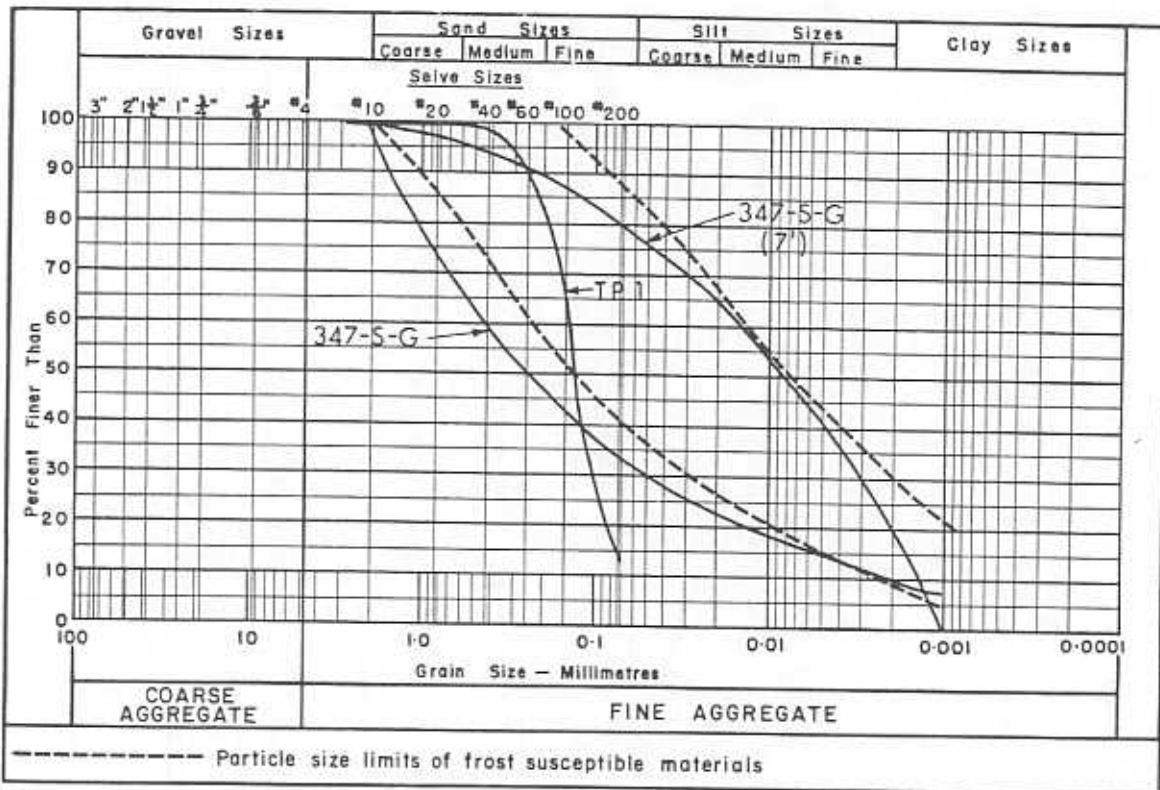
40.0 — END OF HOLE 40.0'

GOVERNMENT OF CANADA DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT	PEMCAN SERVICES "72"
GRANULAR MATERIALS INVENTORY	

SUMMARY OF LABORATORY TEST DATA

Sample Location:	109X/TP 1	109X/347-S-G	109X/347-S-G
Sample Depth (Feet):	4.5	2.5	7.0
Moisture Content (%):	5.35	-	12.0
Ice Content (%):	-	-	-
Organic Content (%):	-	-	-

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

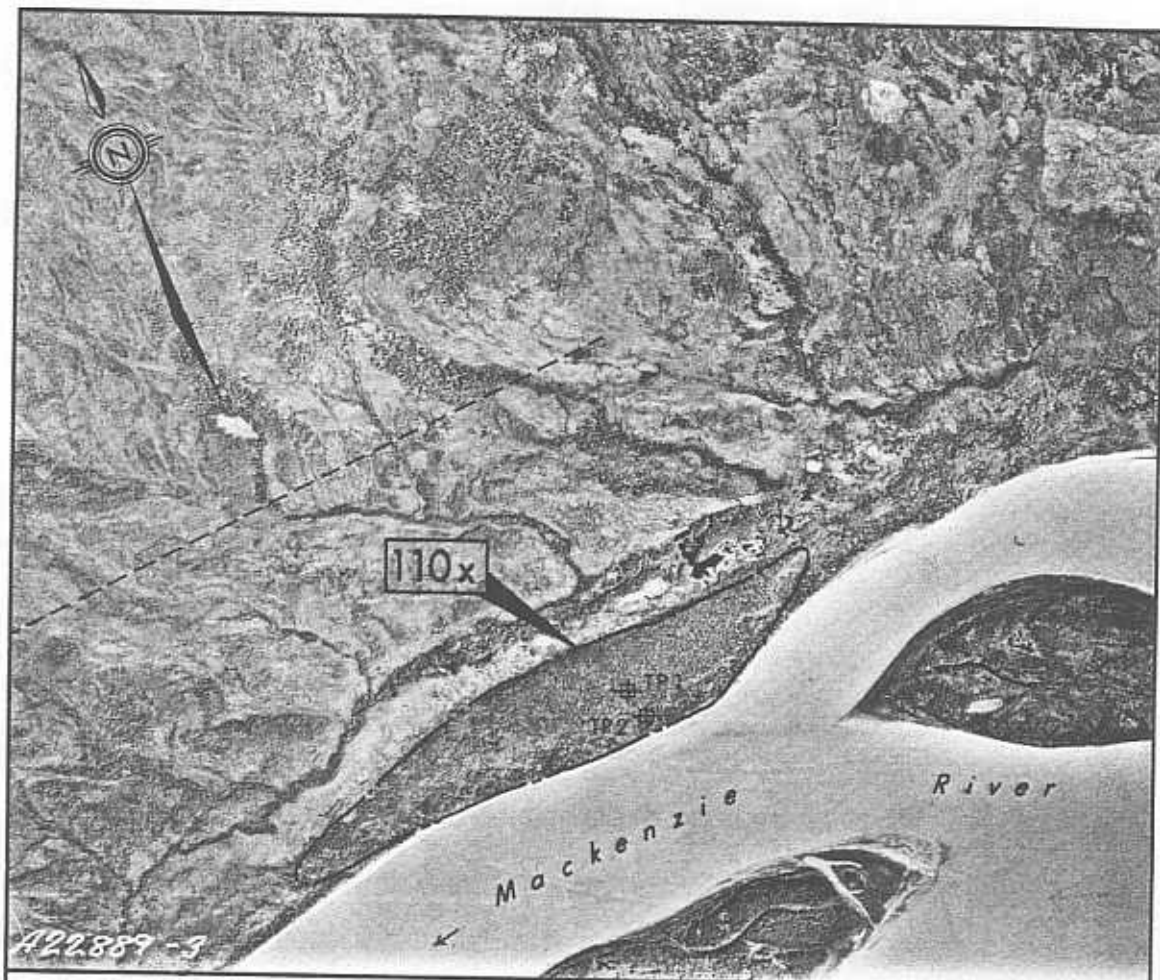
SITE NO. 110X

Located on the north bank of the Mackenzie River and less than $\frac{1}{2}$ mile west of the proposed Mackenzie Highway at Mile 348, Site 110X consists of a narrow, alluvial terrace.

Type of Material: Sand; little silt, fine grained, poorly graded.

Estimated Volume: Not applicable.

Assessment: Site 110X is not recommended for development because materials of granular quality were not established during the field investigations. However, these fine, silty sands may be considered for use as low quality fill in the construction of road subgrades.



LEGEND			
-----	All weather road	.....	Required access
- - - - -	Existing trails and cutlines	— · — · —	Site limit
.....	Proposed Gas Pipeline	-----	Proposed Mackenzie Highway
⊙ DH	Drill Hole	⊕ TP	Test Pit

Airphoto No. A22889/3

Approximate scale: 1" = 3,000'



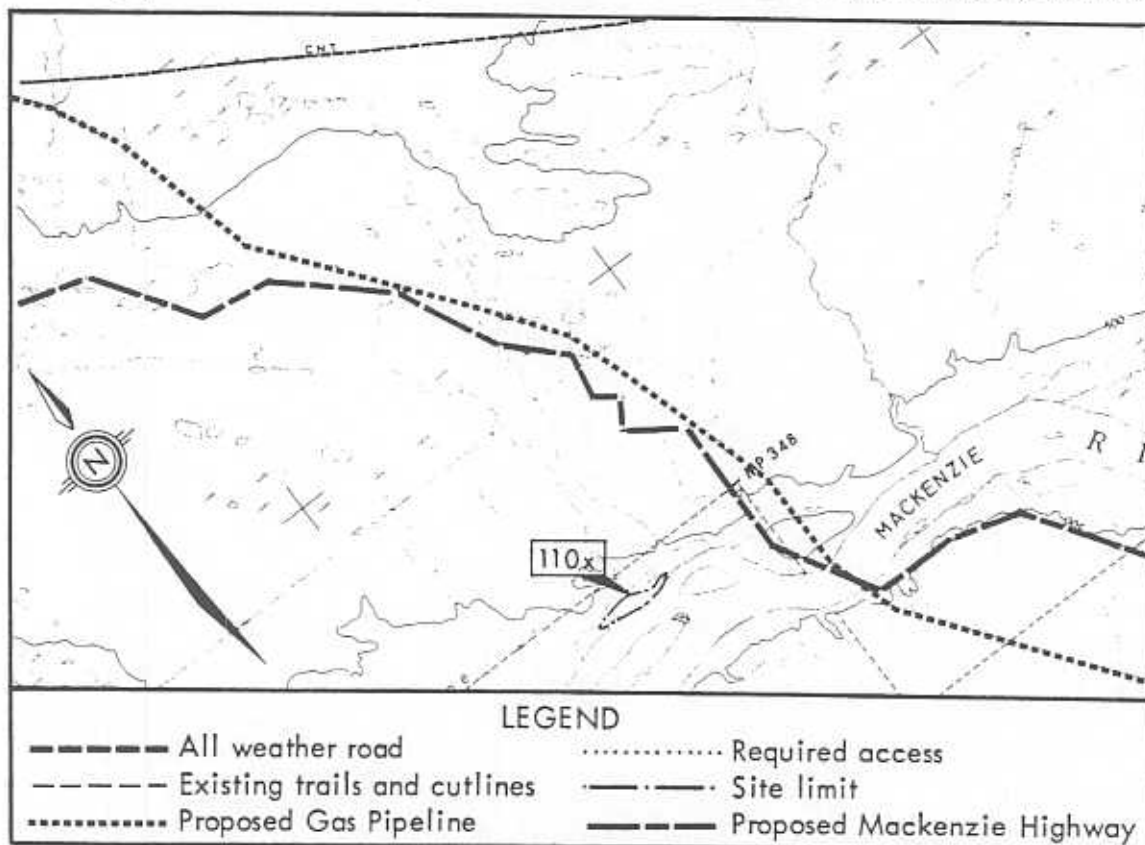
ENVIRONMENT

Site 110X is located less than $\frac{1}{2}$ mile west of the proposed Mackenzie Highway right-of-way at Mile 348 and consists of a narrow, alluvial river terrace on the north bank of the Mackenzie River. The site area is approximately $1\frac{1}{2}$ miles in length, $\frac{1}{4}$ mile in width and rises 100 to 150 feet above the level of the Mackenzie River. The site area exhibits good surficial drainage to the south into the Mackenzie River. A narrow belt of the terrain immediately adjacent to the northern periphery of the site area is slightly depressional, poorly drained and exhibits muskeg and peat bog conditions in addition to occasional small shallow ponds.

The material in the alluvial terrace consists of poorly graded, fine to medium grained sands with a trace of silt. These sands are not of granular material quality; although they may be used as very marginal fill material in the construction of subbases for roads. A layer of organic topsoil, less than 1 foot in depth, overlies the site area and supports moderately dense growth of spruce and poplar.

There are no known critical wildlife areas in the immediate vicinity of Site 110X.

There are no existing land access routes to the site area from the proposed Mackenzie Highway or gas pipeline routes although a seismic cutline is located approximately $2\frac{1}{2}$ miles



Section of Map No. 95 J

Scale: 1:250,000



north of Site 110X. The Mackenzie River channel provides excellent access if removal of material by barge haul is envisioned.

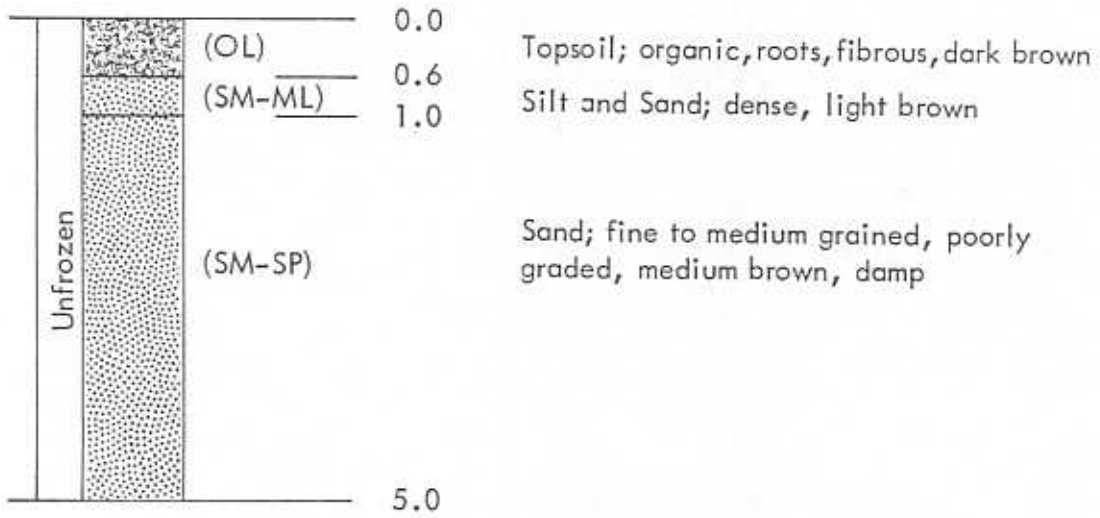
DEVELOPMENT

Site 110X is not recommended for development because materials of granular quality were not established. However, because of the scarcity of construction materials in this portion of the Study Area, the poorly graded, fine grained sands may be considered for use as very marginal fill material in the construction of subbases for roads provided that utilization of these materials is such that exposure to wind and water erosional agents is minimized.

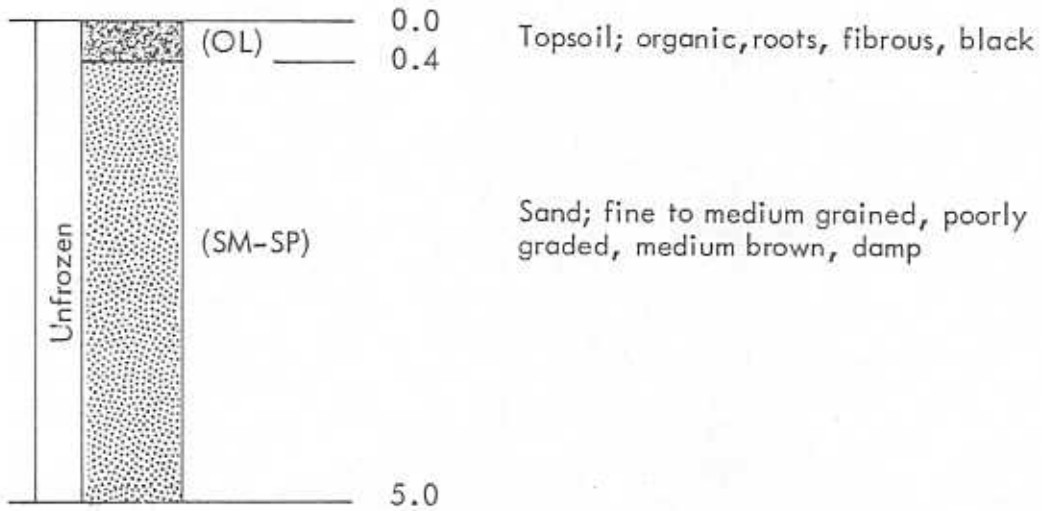
If Site 110X is developed for the exploitation of marginal fill material, then proper development procedures which would be compatible with the physical and biological framework of the site area will have to be established in accordance with the land use guidelines which are in effect at that time.

DETAILED TEST PIT LOG

110X/TP 1



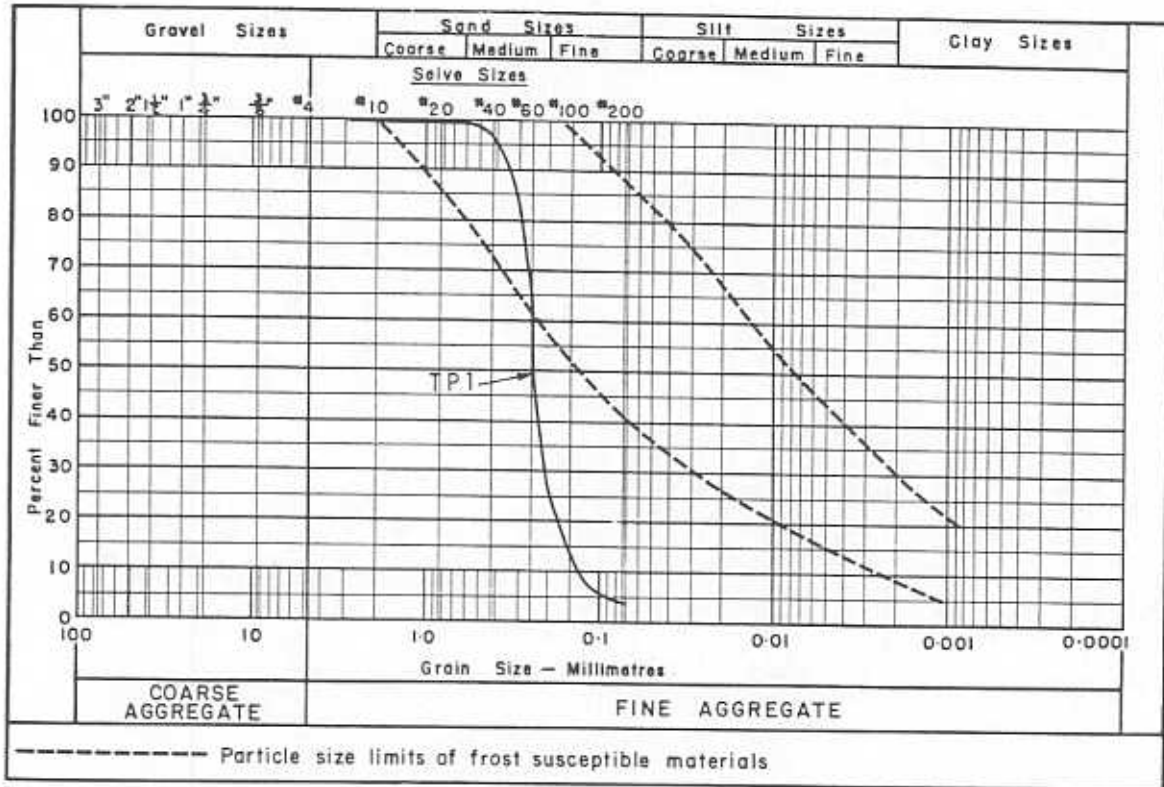
110X/TP 2



SUMMARY OF LABORATORY TEST DATA

Sample Location: 110X/TP 1
 Sample Depth (Feet): 5.0
 Moisture Content (%): 3.75
 Ice Content (%): -
 Organic Content (%): -

GRAIN SIZE DISTRIBUTION:



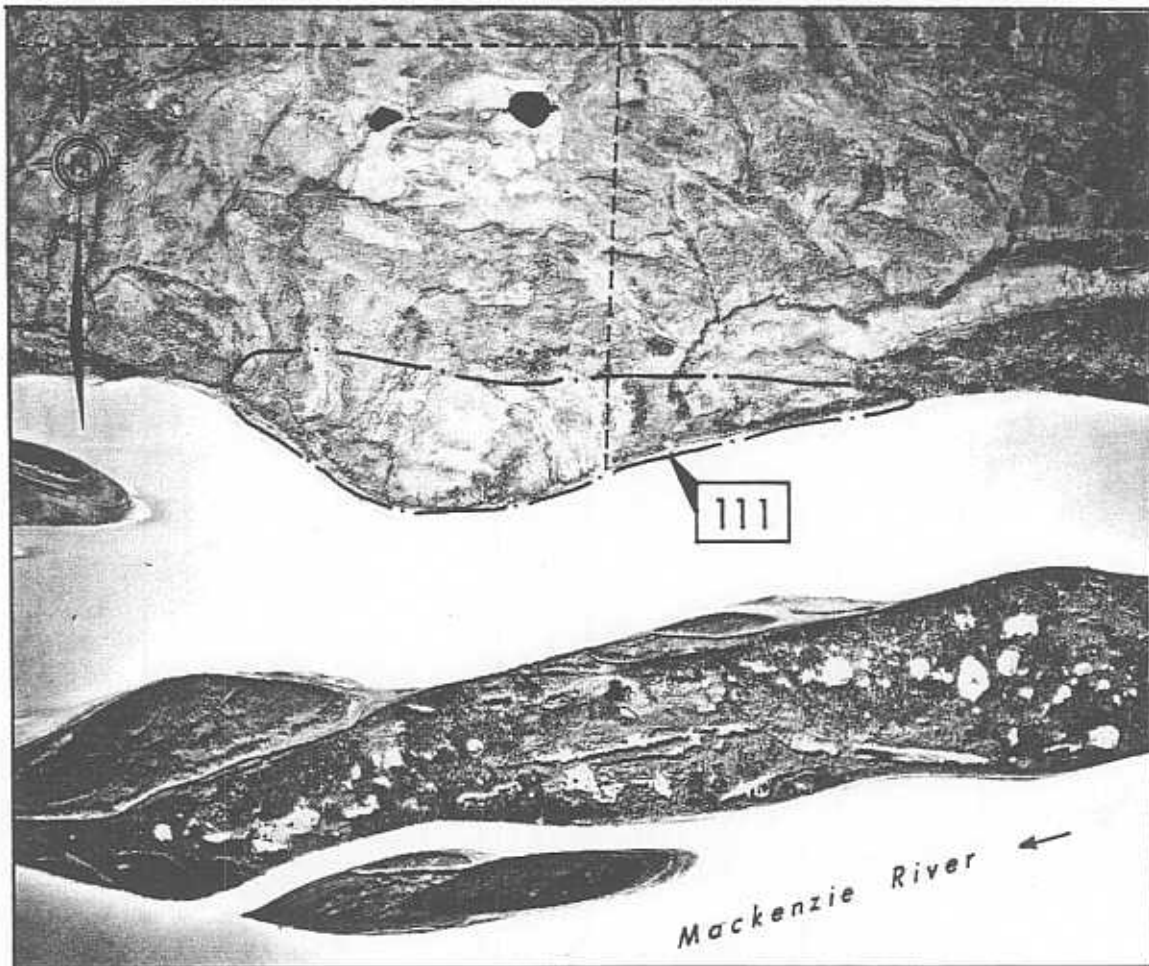
PETROGRAPHIC ANALYSIS:

SITE NO. 111

LOCATION

Located on the north side of the Mackenzie River and approximately 6 miles downstream from the proposed Mackenzie Highway river crossing at Camsell Bend, Site 111 encompasses a high river terrace.

The site is located about 5 miles west of the proposed Mackenzie Highway right-of-way at Mile 348 and 6 miles from the proposed gas pipeline route.



LEGEND

- | | |
|--|----------------------------------|
| ----- All weather road | Required access |
| - - - - - Existing trails and cutlines | - · - · - Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |

Airphoto No. A22304/33

Approximate scale: 1" = 3,000'



GENERAL

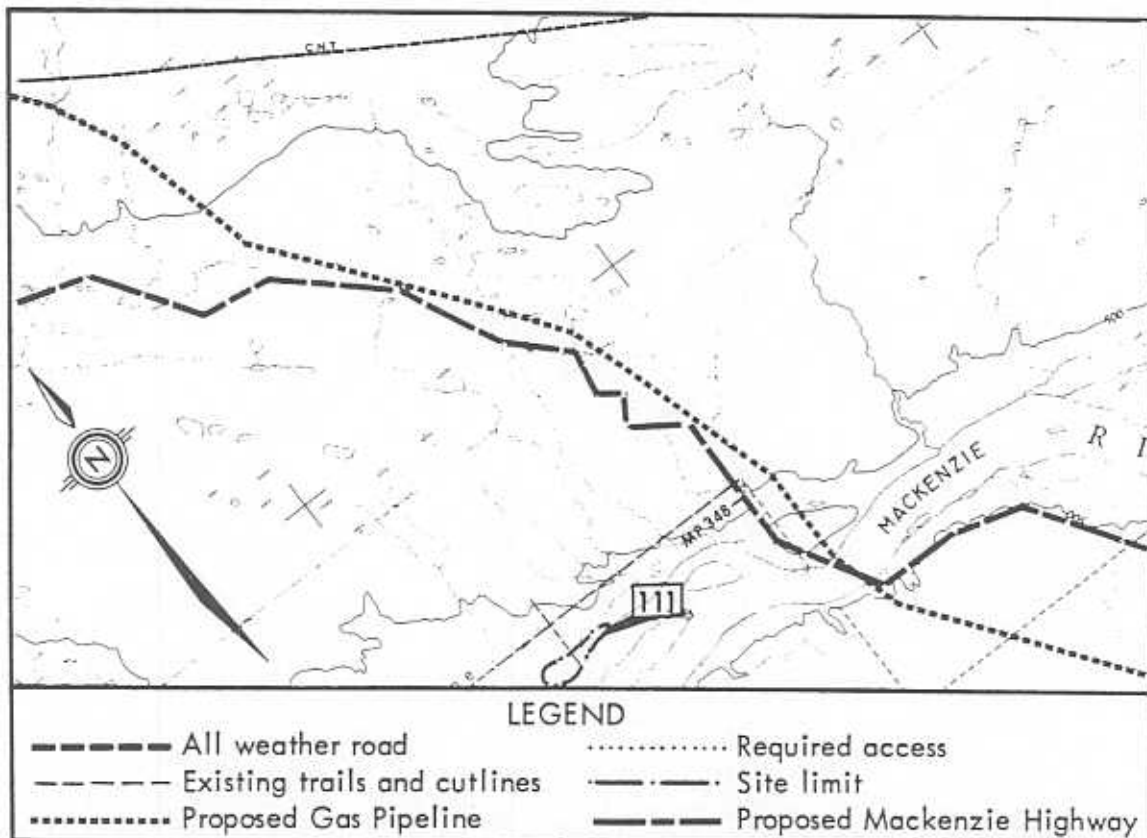
Site 111 consists of a terrace segment, morphologically and geologically similar to terraces comprising Sites 109 and 110 located on the same side of the Mackenzie River channel.

The site area is about 2 miles long and $\frac{1}{2}$ mile in width. The steep, locally eroded Mackenzie River bank forms the southern site boundary while the terrace terrain descends gently into the flat glaciolacustrine Great Slave Plain along the northern perimeter. The site area exhibits fair surficial drainage into the Mackenzie River and an unnamed stream is incised across the eastern tip of the terrace. The adjacent terrain to the north is poorly drained.

The material at Site 111 is expected to consist of fine grained fluvial sand and silt. Granular deposits may exist in randomly scattered pockets or layers and the overburden thickness may be variable and substantial.

The site area is wooded with fair stands of spruce, birch and poplar. There are no known critical wildlife areas in the immediate vicinity of the site, although the area is occasionally hunted and trapped by residents of Fort Simpson.

Existing seismic cutlines provide access from the site to the proposed utility routes, but require traversing poorly drained and thermally sensitive terrain. The site was not investigated by test pits nor drill holes because of its geological similarity with Sites 109 and 110. Site 111 is rated as a poor prospect because materials of granular quality are not anticipated.



Section of Map No. 95 J

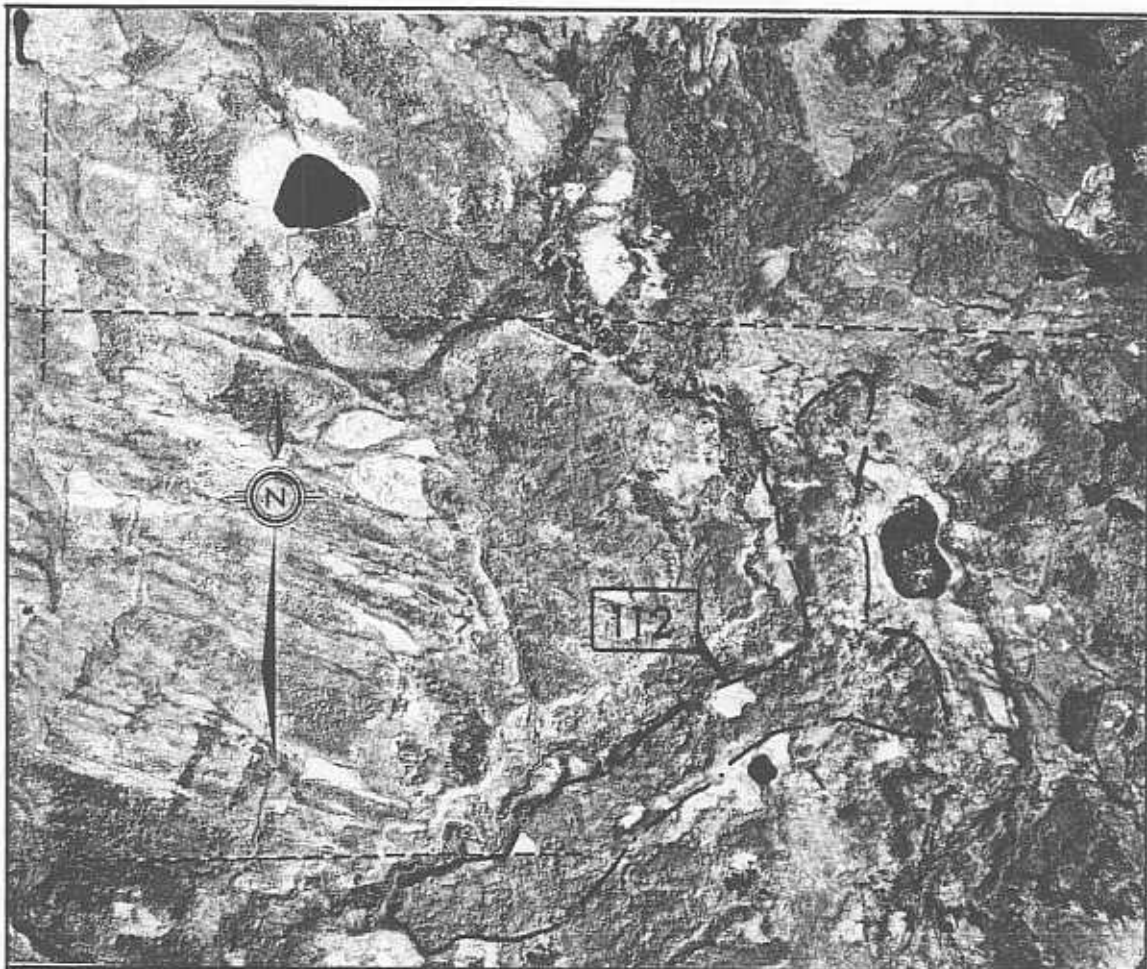
Scale: 1:250,000

SITE NO. 112

LOCATION

Located between the southern reaches of Ebbutt Hills and the north bank of the Mackenzie River and approximately 10 miles west northwest of the Trail River, Site 112 consists of glaciofluvial outwash deposits forming a pitted, longitudinal field.

The currently proposed right-of-ways of the Mackenzie Highway at Mile 353.5 and the gas pipeline are located approximately $6\frac{1}{2}$ miles west of Site 112.



LEGEND

- | | |
|------------------------------------|----------------------------------|
| ----- All weather road | Required access |
| ----- Existing trails and cutlines | - - - - - Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |

Airphoto No. A22933/212

Approximate scale: 1" = 3,000'



GENERAL

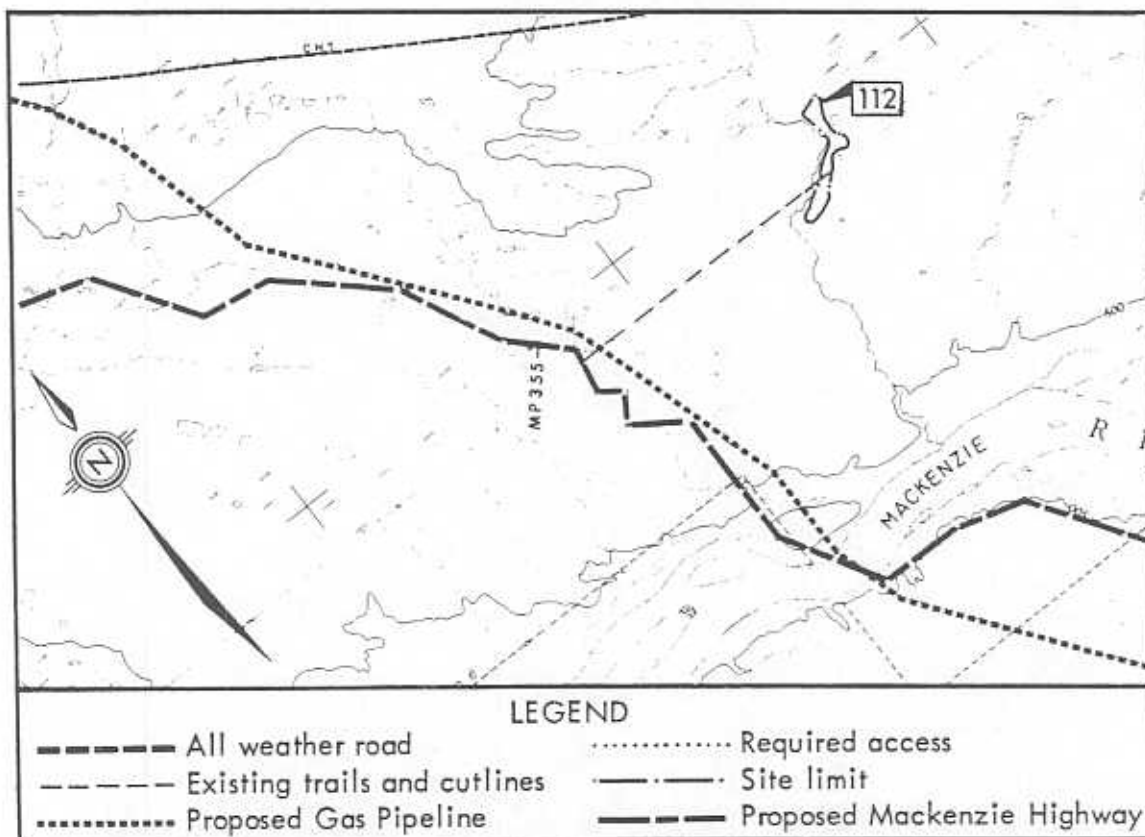
Site 112 consists of numerous knolls and ridges which are partly effaced and interconnected, and encompasses an area approximately 1000 feet in width and 2½ miles in length. The site is comprised of glaciofluvial outwash deposits and parallels an unnamed stream. These deposits are geologically and morphologically similar to those comprising Site 113, located immediately north of this site area.

Based on inferred data from Site 113, these outwash deposits consist of variably washed, well graded sands and silts and may also contain localized till bodies or variably washed till. These deposits are considered suitable for very marginal fill material.

The site area exhibits fair to good surficial drainage conditions into the adjacent stream channel, and supports moderately dense growths of spruce, birch and poplar. There are no known critical wildlife areas in the immediate vicinity of this site.

Existing seismic cutlines, which traverse generally flat, poorly drained and thermally sensitive terrain, provide access to the site from the CNT pole line and the proposed utility right-of-ways. The site was not drilled because of its relative remoteness from the proposed utilities and apparent similarity with Site 113.

Site 112 is rated as a poor prospect for granular materials.



Section of Map No. 95 J

Scale: 1:250,000

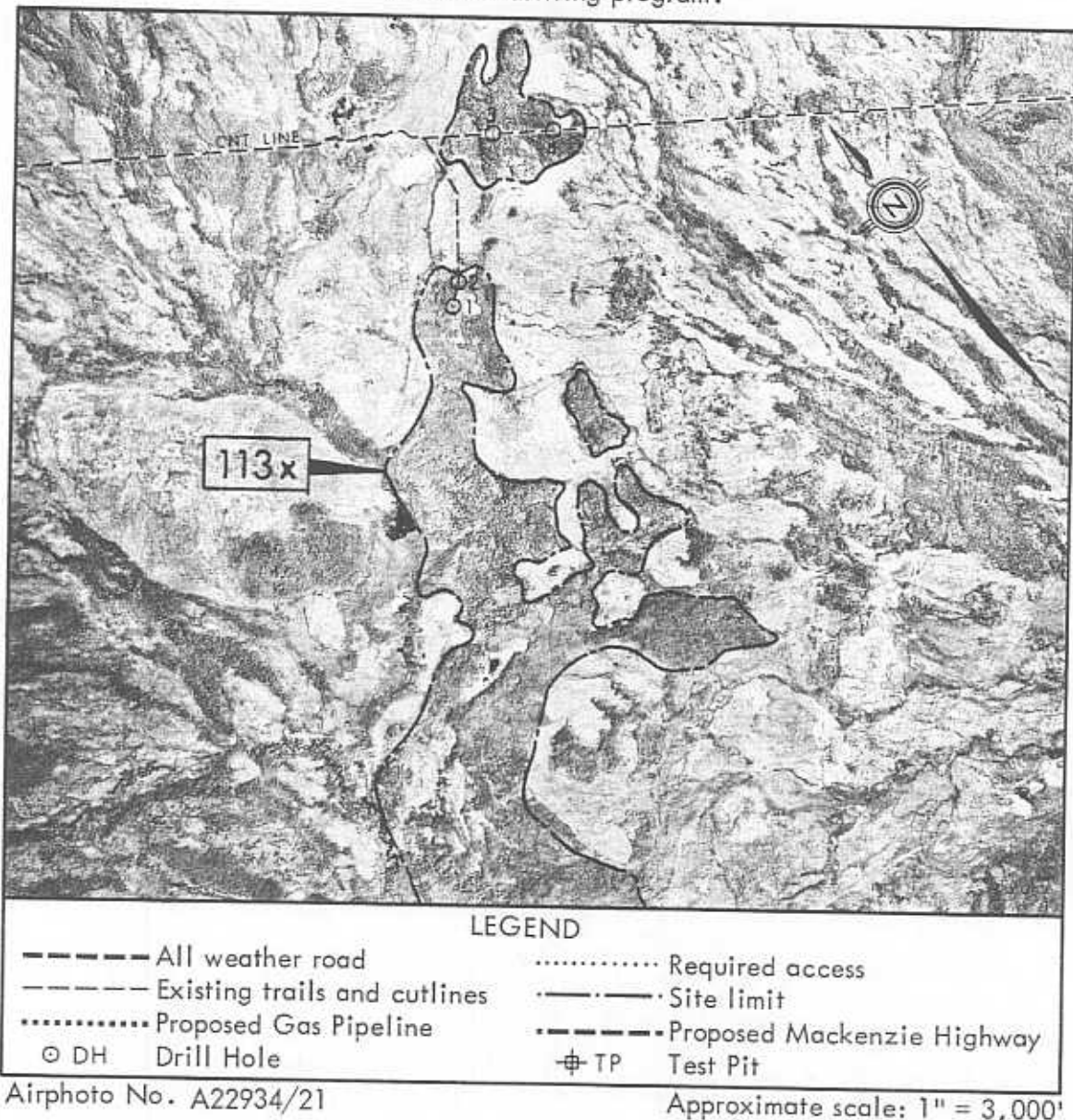
SITE NO. 113X

Located approximately 11 miles north of Trail River and 10 miles east of the proposed Mackenzie Highway at Mile 354, Site 113X consists of shallow and scattered glaciofluvial outwash deposits overlying glacial till.

Type of Material: Sand; some silt, little gravel, medium to coarse grained, (TILL-LIKE).

Estimated Volume: Not applicable.

Assessment: Site 113X is not recommended for development because materials of granular quality were not established during the field drilling program.





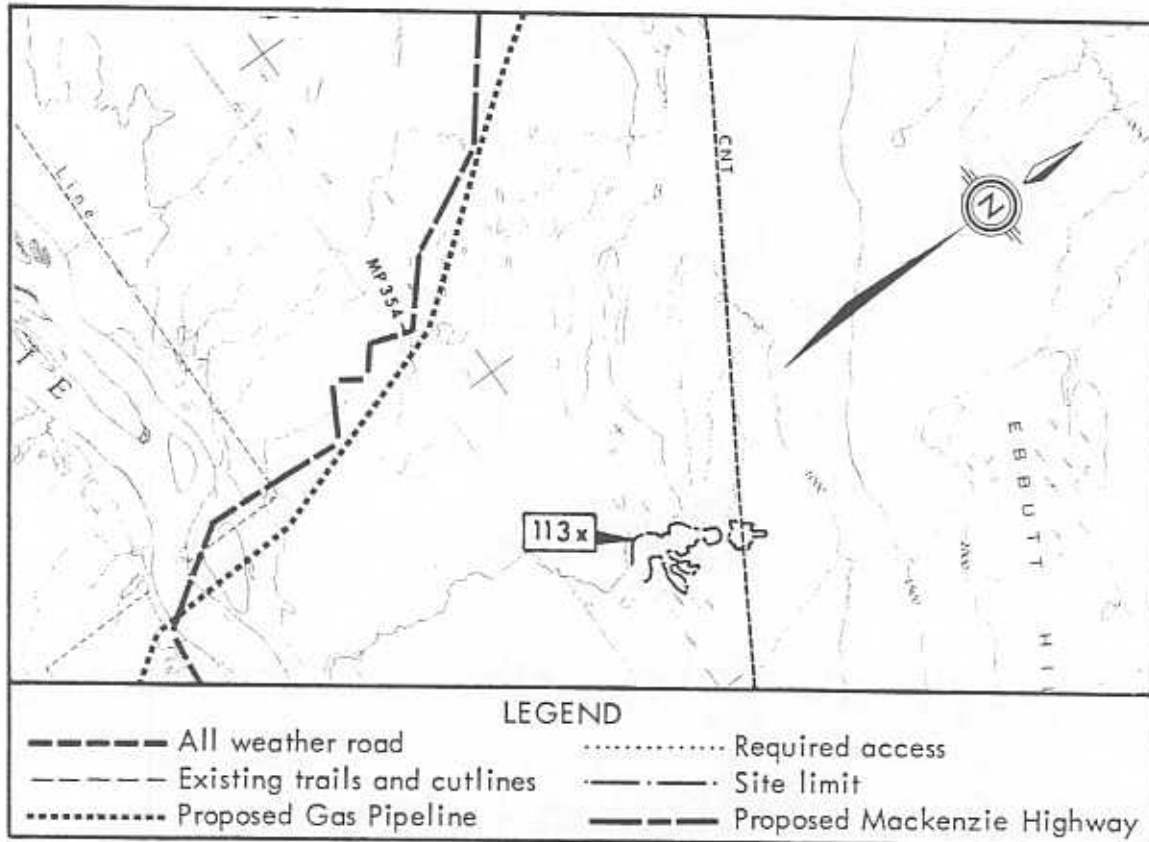
ENVIRONMENT

Site 113X is located approximately 11 miles north of Trail River and 10 miles east of the proposed Mackenzie Highway right-of-way at Mile 354. The site, consisting of shallow and scattered glaciofluvial outwash deposits which overlie glacial till, encompasses an overall area approximately 3½ miles in length and ½ mile in width. Site 113X is situated on the southern slopes of the Ebbutt Hills and exhibits good drainage to the south.

The material in the glaciofluvial outwash deposits consists of medium to coarse grained sands with a high silt content. In general, these outwash sands exhibit characteristics of reworked or washed till material and also contain localized till bodies. The ground ice content of the outwash deposits is low and these materials may be suitable for very marginal fill in the construction of road subbases. A layer of organic topsoil generally less than 1½ feet in thickness covers the site area and supports moderately dense growths of spruce and poplar.

There are no known critical wildlife areas in the immediate vicinity of Site 113X.

The CNT pole line traverses the northeastern extremity of the site and, in general, represents the only existing access to the site area.



Section of Map No. 95 J .

Scale: 1:250,000



DEVELOPMENT

Site 113X is not recommended for development because materials of granular quality were not established by the results of the winter drilling program. In addition, the location of Site 113X is quite removed from the routes of the currently proposed utilities.

DETAILED DRILL HOLE LOG

SITE NO. 113X

HOLE NO. DH-1

DATE: FEB.17, 1973

LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR AIR REVERSE OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	1.0 TOPSOIL: some silt, trace sand, light brown			VL		0
2		ML	SILT: little sand, occasional pebbles to 2 inch size, (TILL-LIKE)		Nf	L		2
4				4				
6				6				
8				8				
10				10				
12				12				
14				14				
16				15.0				
18				16				
20				16				
				18				
				20				
				20.0				
		20.0	TOTAL DEPTH 20.0'					20

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 113X

HOLE NO. DH-2

DATE: FEB. 17, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	TOPSOIL: some silt, organic, roots, dark brown		Vx Vs			0
2		ML	SILT: trace clay and sand, few pebbles and cobbles, greyish brown (TILL-LIKE)		Vx	M		2
4							4	
6							6	
8							8	
10								10
12			TOTAL DEPTH 11.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 113X

HOLE NO. DH-3

DATE: FEB.17,1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	1.0 — TOPSOIL: some silt, trace sand, organic, roots, brown		Vx	M		0
2		SW-SM	SAND: some silt, little gravel, fine to coarse grained, well graded, occasional subangular limestone, dolomite and igneous pebbles to 1/4 inch size, greyish brown		Nbn	L		2
4	4							
6	6							
8	8							
10			11.0 — TOTAL DEPTH 11.0'				GS P	10
12								12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 113X

HOLE NO. DH-4

DATE: FEB. 17, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE EST'D CONT.	SAMPLE TYPE	DEPTH (feet)		
				GEN'L CLASS	N.R.C. CLASS						
0		OL	TOPSOIL: some silt, trace sand, organic, roots, dark brown		Vx			0			
1										1	
2		SM	SAND AND SILT: trace clay, occasional subangular pebbles to 1½ inch size, greyish brown					2			
3										3	
4										L	4
5											5
6										Nbn	6
7											7
8											8
9											9
10								10			

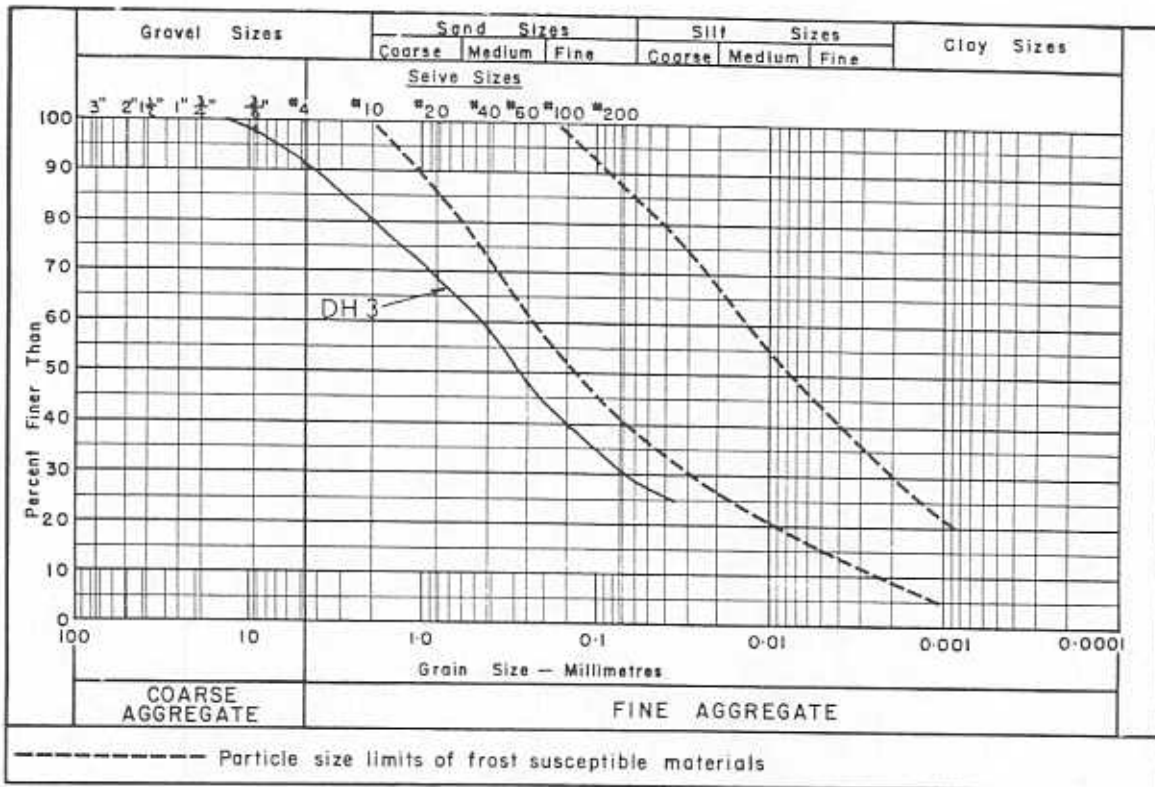
10.0 TOTAL DEPTH 10.0'

GOVERNMENT OF CANADA DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT	PEMCAN SERVICES "72"
GRANULAR MATERIALS INVENTORY	

SUMMARY OF LABORATORY TEST DATA

Sample Location: 113X/DH 3
 Sample Depth (Feet): 8.0
 Moisture Content (%): -
 Ice Content (%): -
 Organic Content (%): -

GRAIN SIZE DISTRIBUTION:

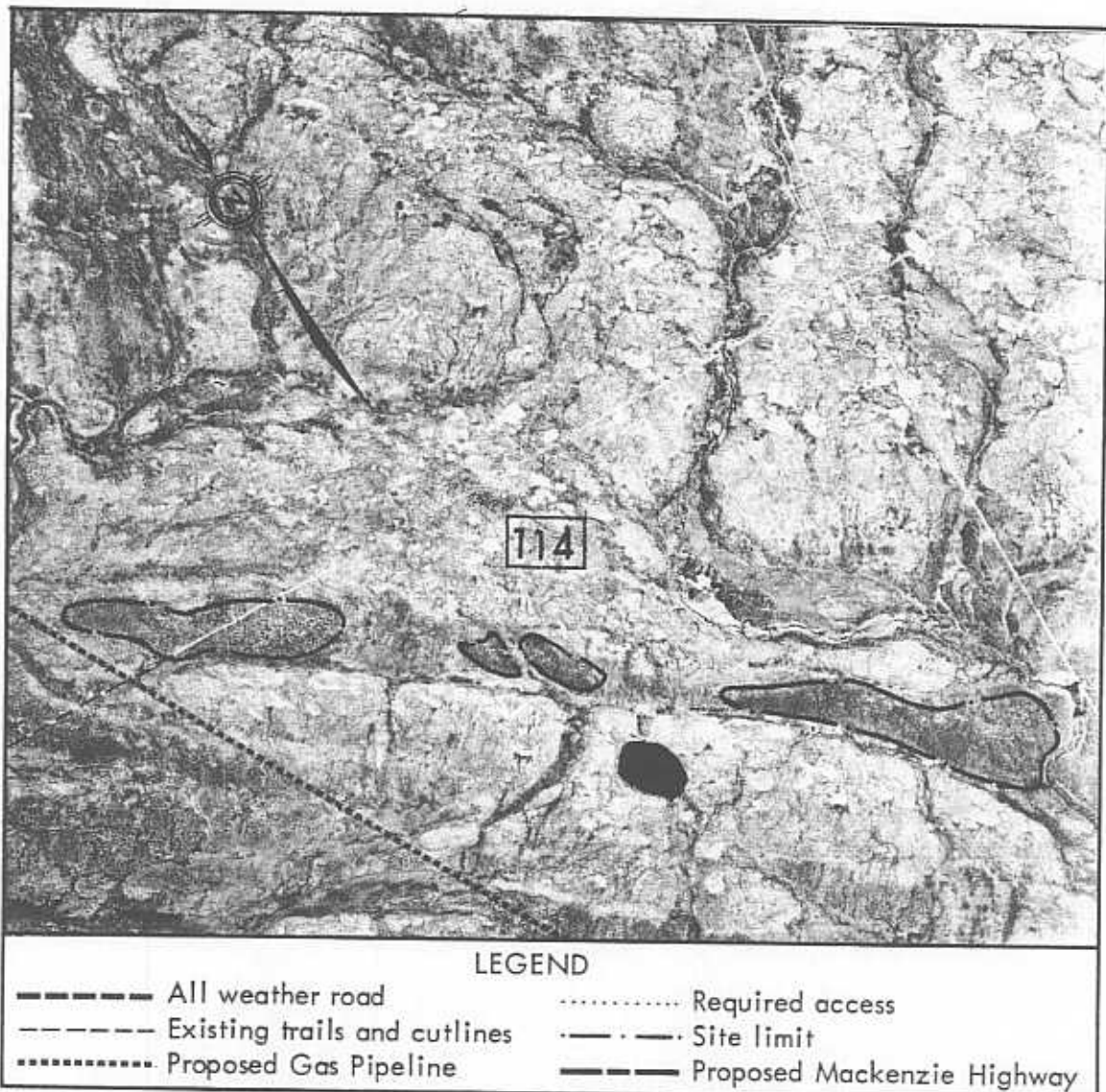


SITE NO. 114

LOCATION

Located west of Ebbutt Hills and approximately $1\frac{1}{2}$ miles northeast of the proposed Mackenzie Highway right-of-way, Site 114 consists of four hummocks of partly reworked glacial till.

The proposed Mackenzie Highway route between Miles 360 and 362 and the alignment of the proposed gas pipeline parallel the site area at a distance of 3 and 4 miles respectively. The haul distance from the site area to the Highway at Mile 365 along the existing seismic cutlines is approximately $3\frac{1}{2}$ miles.



Airphoto No. A22933/217

Approximate scale: 1" = 3,000'



GENERAL

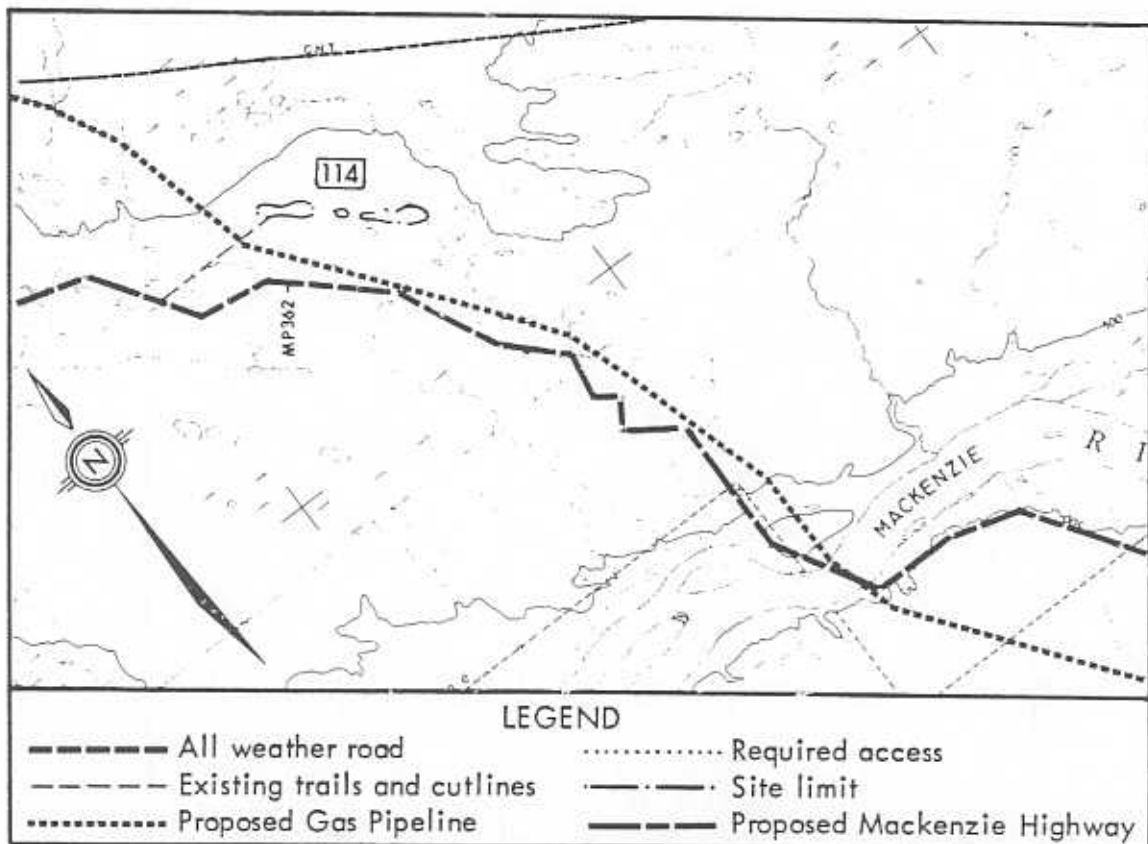
Site 114 consists of shallow till ridges rising slightly above the adjacent flat, depressional terrain of the Great Slave Plain. Two of the ridges are approximately one mile in length while the two centre ridges would be classified as small hummocks. The ridges range from 400 to 1500 feet in width.

The ridges are surficially fairly well drained while the surrounding terrain exhibits poor drainage conditions as evidenced by frequent bogs and small depressions indicating thermally sensitive terrain. Better drained ridges support relatively dense stands of spruce, poplar and birch.

There are no known critical wildlife areas in the immediate vicinity of Site 114.

The material at Site 114 is expected to consist of glacial till, which may be reworked or even washed at the ground surface. This till is very likely composed of a heterogeneous mixture of silt, sand and clay interspersed with pebbles and cobbles. This till is not of granular quality, but may be suitable for very marginal fill material because of scarcity of better quality deposits in this general area.

Site 114 is considered to be a poor prospect.



Section of Map No. 95 J

Scale: 1:250,000

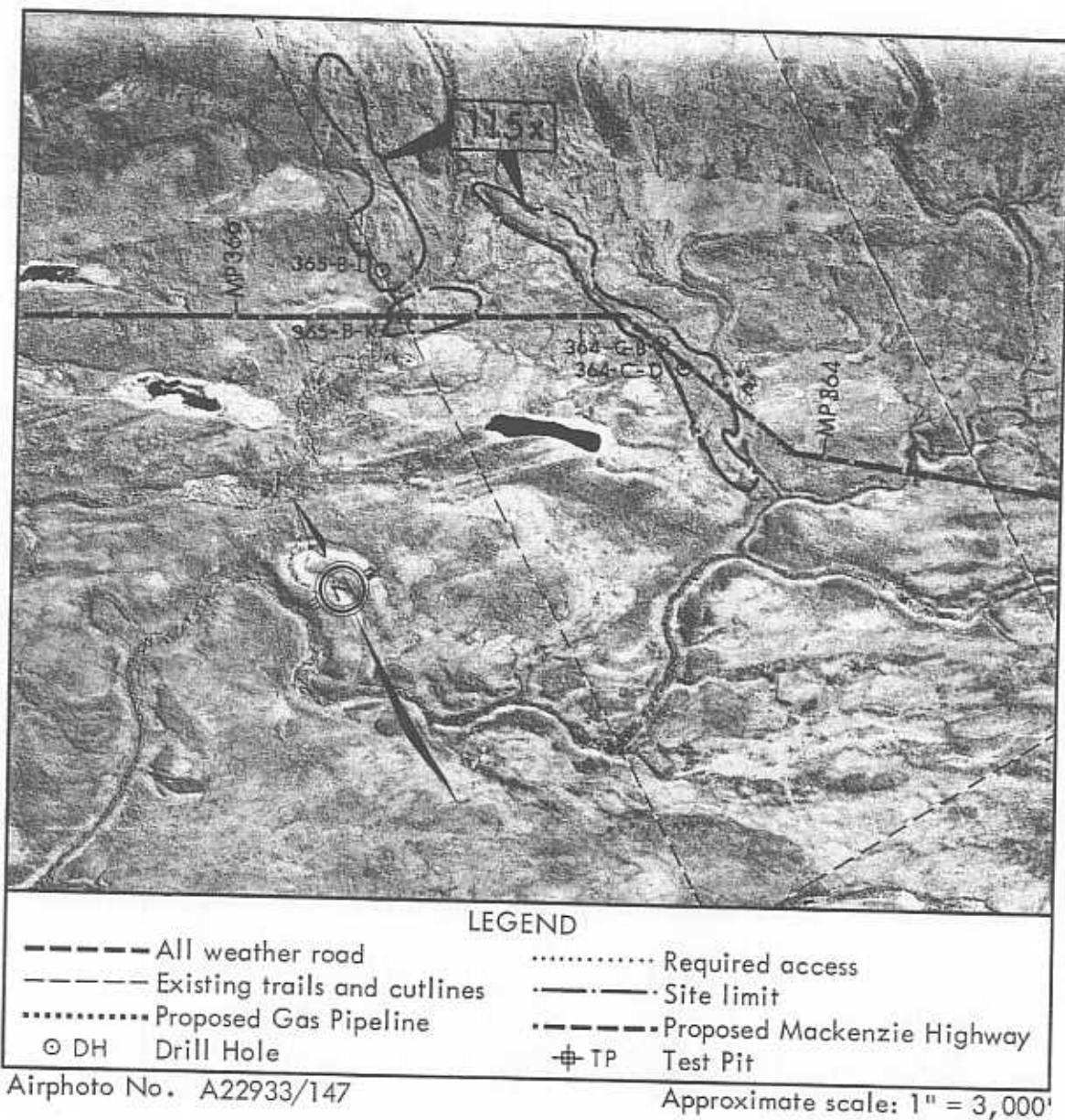
SITE NO. 115X

Located approximately 26 miles southeast of Willowlake River and adjacent to the east side of the proposed Mackenzie Highway between Mile 364 and Mile 366, Site 115X consists of two shallow esker-kame ridges.

Type of Material: Sandy; some silt, little clay, fine grained.

Estimated Volume: Not applicable.

Assessment: Site 115X is not recommended as a source of granular materials; however, these fine silty sand deposits may be used as very marginal fill in the construction of road subgrades.





ENVIRONMENT

Site 115X is located approximately 26 miles southeast of Willowlake River and immediately adjacent to the east side of the proposed Mackenzie Highway between Mile 364 and Mile 366. The site consists of two shallow, narrow and partly eroded esker-kame ridges and one kame hollock which are approximately 2 miles in length and 500 to 700 feet in width. The site area and the adjacent terrain exhibits fair surficial drainage to the southwest, whereas the adjacent terrain to the southwest is slightly depressional, poorly drained and incised with shallow, meandering creek channels.

The material in these shallow ridges consists of silty, fine grained sands which may be suitable for very marginal fill material in the construction of subbases for roads. A layer of organic topsoil, less than 1 foot in depth, overlies the site area and supports moderate growths of spruce, poplar and birch.

There are no known critical wildlife areas in the immediate vicinity of Site 115X.

The proposed Mackenzie Highway right-of-way traverses the western periphery of the site area. The CNT pole line and the proposed gas pipeline routes are located approximately 3 to 4 miles east of the site area.

DEVELOPMENT

The information from the drill holes conducted on Site 115X by the engineering consultant for The Federal Department of Public Works is incorporated in this report and has established that materials of granular quality are not available. Therefore, Site 115X is not recommended for development; however, in view of the scarcity of construction materials in this portion of the Study Area, these fine silty sands may be considered for use as very marginal fill in the construction of subbases for roads.

If Site 115X is developed for the exploitation of very marginal fill material, then proper development procedures, compatible with the physical and biological framework of the site area, should be established in accordance with the land use guidelines which are in effect at that time.

DETAILED DRILL HOLE LOG

SITE NO. 115X

HOLE NO. B K

DATE: MAR. 4, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE CONT.	SAMPLE TYPE	DEPTH (feet)									
				GEN'L CLASS	N.R.C. CLASS	EST'D												
0	[Graph Symbol]	SM	Brown sandy silty till with cobbles	[Ground Class]	Nf				0									
2									2									
4		4																
6		6																
8		8																
10		SC	Brownish/grey sandy silty till with some clay	[Ground Class]	Nf					8								
10										10								
12										12								
14										14								
16										16								
18										18								
20										20								
20.0 — END OF HOLE 20.0'																20		

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 115X

HOLE NO. B L

DATE: MAR. 11, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0								0
2		SC	Brown sandy till with some clay		Nf			2
4								4
6								6
8								8
10			Grey sandy clayey till with coarse gravel		Nf			10
12								12
14								14
16								16
18								18
20								20
			20.0 — END OF HOLE 20.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 115X

HOLE NO. C B

DATE: MAR. 3, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.			
0	[Graph Symbol]	SP	Light brown sand with traces of clay and silt	[Ground Conditions]	Nbn			0	
2								4	6
8		SP	Brown silty sand till with traces of clay, gravel and cobbles	UF				10	
10		12						14	
12		14						16	
15.0				END OF HOLE 15.0'					15.0

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 115X

HOLE NO. C D

DATE: MAR. 3, 1973

LOGGED BY: PEMCAN

ACRES CONSULTING SERVICES

DRILLING METHOD: CONVENTIONAL

AIR REVERSE CIRCULATION

OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS				
0									0
2		SM	Sand with some silt and traces of clay and fine gravel	[Cross-hatch pattern]	Nbn				2
4		SM							4
6		SM							6
8		SM							8
10									10
12		SM							12
14									14
16		SM							16
18									18
20									20

20.0 — END OF HOLE 20.0'

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

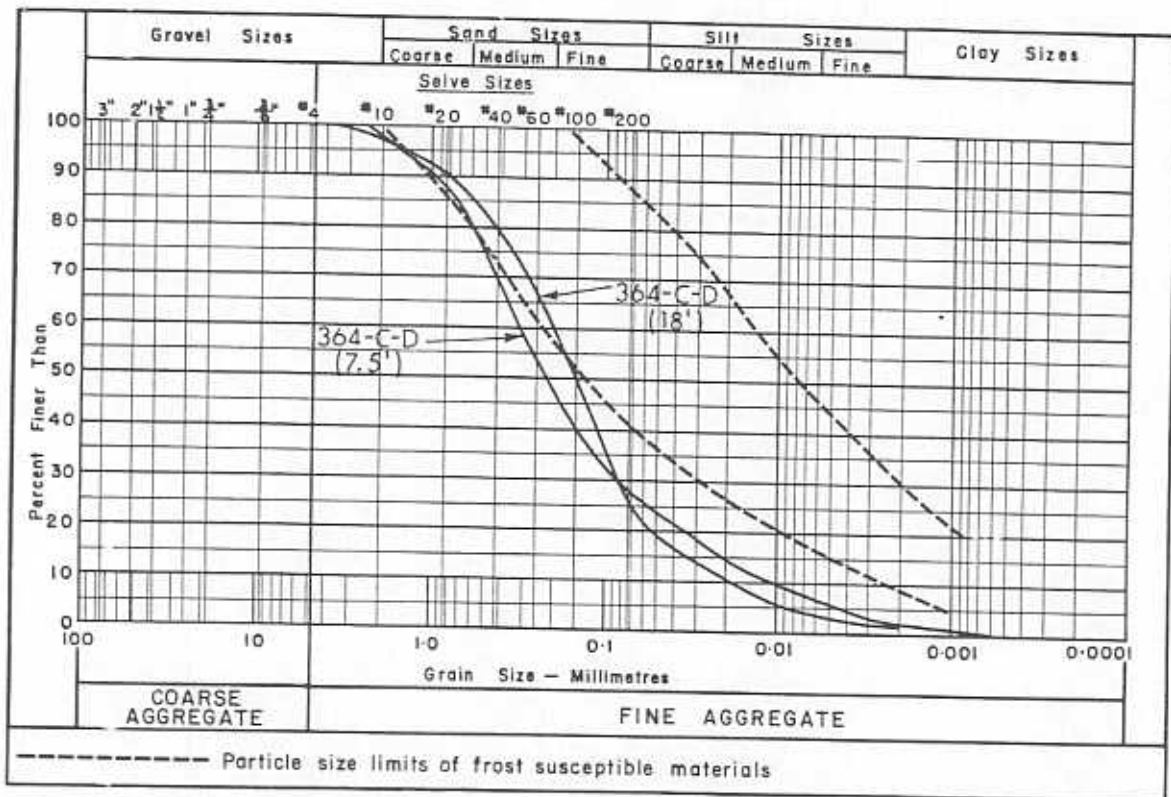


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	115X/364-C-D	115X/364-C-D
Sample Depth (Feet):	7.5	18.0
Moisture Content (%):	18.0	-
Ice Content (%):	-	-
Organic Content (%):	-	-

GRAIN SIZE DISTRIBUTION:



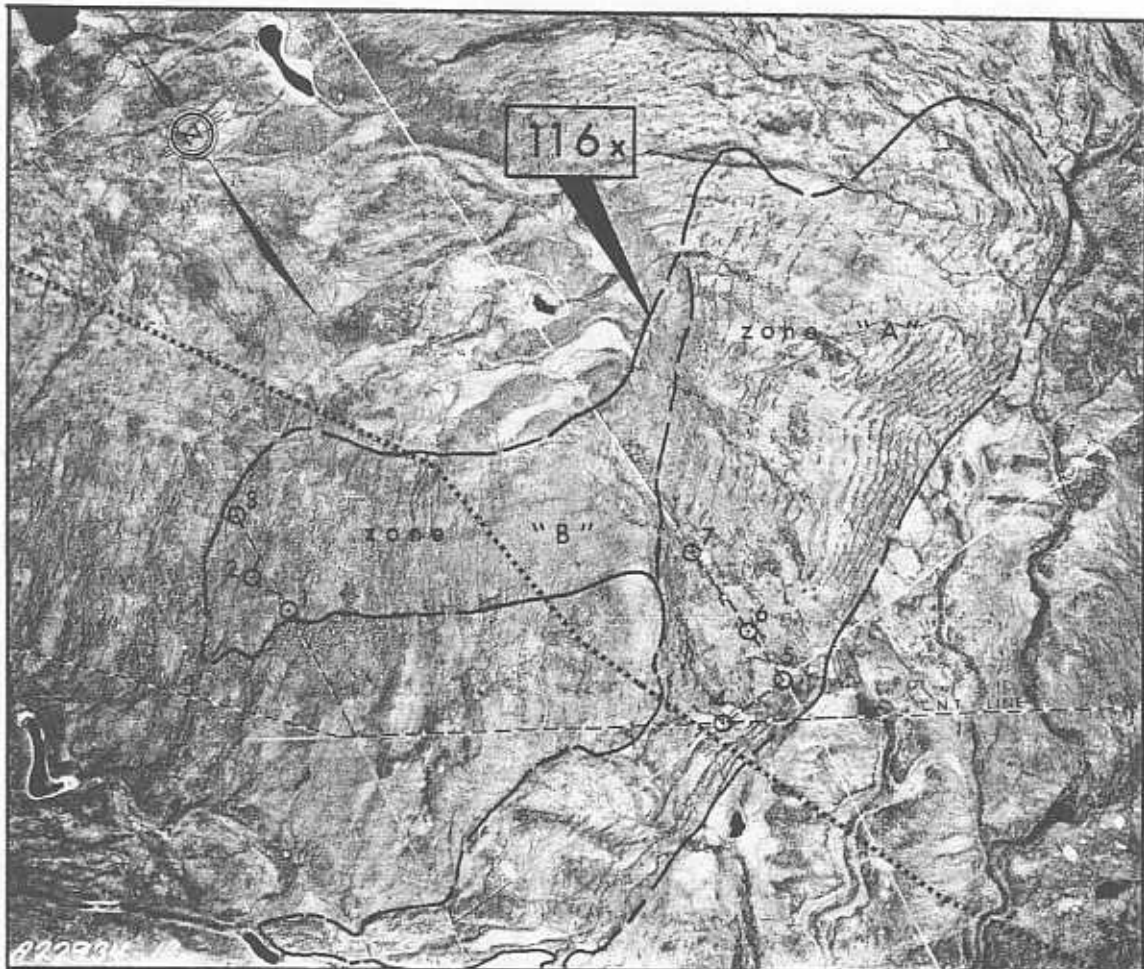
SITE NO. 116X

Located approximately 25 miles southeast of the Willowlake River and 4 miles northeast of the proposed Mackenzie Highway at Mile 370, Site 116X consists of segments of "De Geer" and Terminal moraines.

Type of Material: Glacial Till; silty, some sand and gravel pockets.

Estimated Volume: Not applicable.

Assessment: Site 116X is not recommended for development because the field drilling program did not establish any granular quality materials.



LEGEND	
----- All weather road	..... Required access
----- Existing trails and cutlines	--- Site limit
..... Proposed Gas Pipeline	----- Proposed Mackenzie Highway

Airphoto No. A22934/12

Approximate scale: 1" = 3,600'



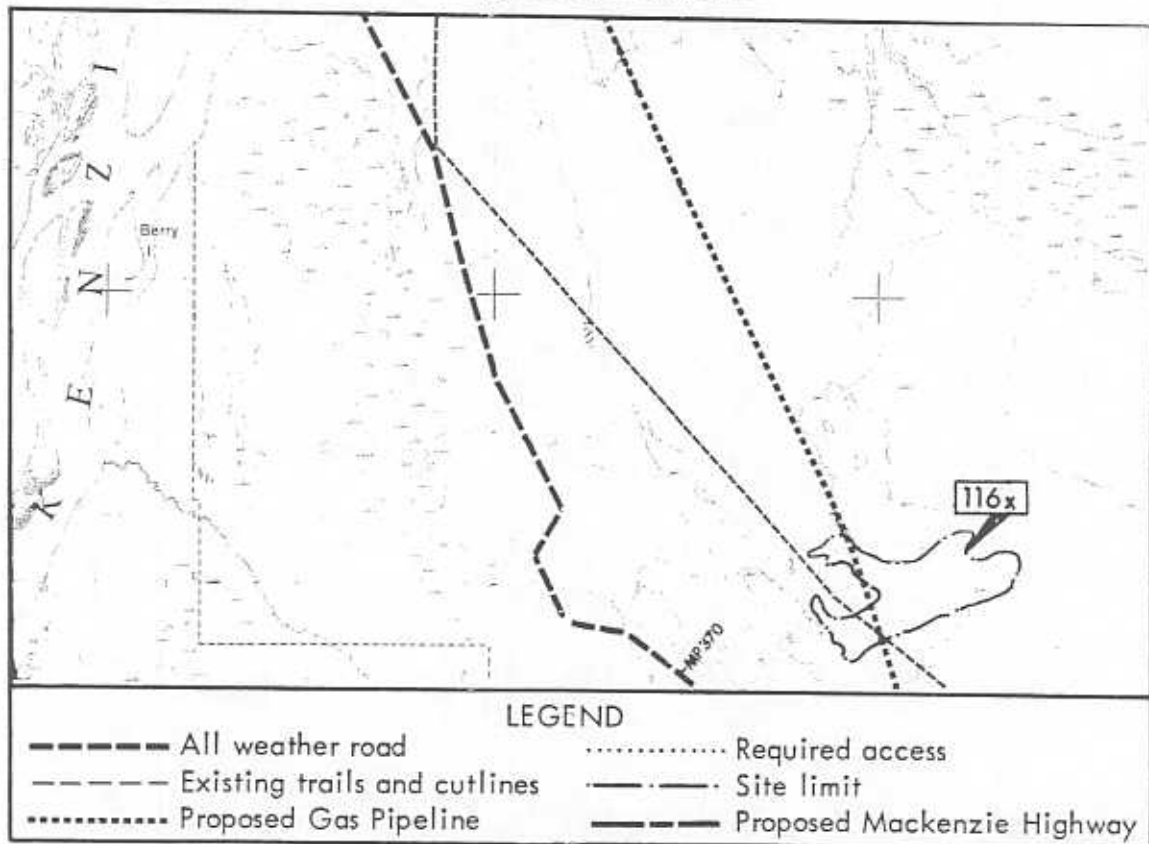
ENVIRONMENT

Site 116X is located approximately 25 miles southeast of the Willowlake River and 4 miles northeast of the proposed Mackenzie Highway right-of-way at Mile 370. The site area which is approximately 3 miles in length and averages 1½ miles in width, is comprised of two distinct geomorphic areas, designated as zone "A" and "B", on the preceding site air-photo (ref. page 116-1).

Zone "A" consists of the De Geer moraine ridges which were formed along the receding terminus of a glacier in a pro-glacial lake. These ridges consist basically of a fine grained silty till which have been reworked by water. Strata of coarse grained material are found within the washed till.

Zone "B" consists of a terminal moraine which is comprised of silty till material with sand and gravel inclusions.

The site area and adjacent terrain in general exhibits good surficial drainage to the west. An organic topsoil layer which is less than 1½ feet in depth, overlies the site area and supports moderately dense growth of spruce and poplar. The glacial till material, frozen to depths investigated, exhibits medium ground ice content.



Section of Map No. 95 J

Scale: 1:250,000



Zone "A" of the site area contains a succession of small curvilinear ridges which are oriented in a series of parallel rows.

There are no known critical wildlife areas in the immediate vicinity of Site 116X.

The CNT pole line and the proposed gas pipeline routes traverse the western sector of the site area. The only existing access from the site area to the proposed Mackenzie Highway right-of-way consists of seismic cutlines.

DEVELOPMENT

Site 116X is not recommended for development because materials of granular quality were not established by the winter drilling program.

DETAILED DRILL HOLE LOG

SITE NO. 116X

HOLE NO. DH-1

DATE: FEB. 17, 1973

LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR AIR REVERSE OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	TOPSOIL: some silt, organic, roots, dark grey		Vs			0
1.5								
2		ML	SILT: trace sand, occasional pebbles to 1½ inch size, brown		Vx	M		2
4								4
6								6
8								8
8			some clay, layered, grey, from 8.0'		Vs			8
10								10
11.0			TOTAL DEPTH 11.0'					11.0
12								12
14								14

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 116X

HOLE NO. DH-2

DATE: FEB. 17, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	TOPSOIL: organic, little silt, fibrous, dark brown		Vs			0
1		ML	1.0 SILT: little sand, brown					1
2			3.0					2
3		GC-SM	GRAVEL: some sand, little clay, trace silt, fine to coarse grained, poorly graded, predominantly subangular and angular quartzite with limestone and dolomite fragments to 1 inch size, few 1½ inch size, rust brown (WASHED TILL)		Vx			3
4								4
5							GS P	5
6								6
7							7	
8			8.0 SILT: some clay, little sand, medium plastic, brown					8
9							9	
10			10.0 TOTAL DEPTH 10.0'					10

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 116X

HOLE NO. DH-3

DATE: FEB.17, 1973

LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	TOPSOIL: organic, little silt, fibrous, dark brown		Vr			0
2			SILT: little sand, trace clay, medium plastic, brown					2
4								4
6		ML			Vx			6
8						M		8
10								10
12					Vs			12
14								14
16			TOTAL DEPTH 15.0'					16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 116X

HOLE NO. DH-4

DATE: FEB. 17, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		(OL)	1.0 TOPSOIL: some silt, little organic, trace sand, roots, grey		Vs			0
2		GW-ML	GRAVEL, SAND AND SILT: trace clay, fine to coarse grained, well graded, pebbles to 1½ inch size, greyish brown (WASHED TILL) becoming grey from 10.5'		Vx	M		2
4	4							
6	6							
8	8							
10	10							
12	12							
14	14							
16	16							
18	18							
20	20							
20.0 TOTAL DEPTH 20.0'								20

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 116X

HOLE NO. DH-5

DATE: FEB. 17, 1973

LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	TOPSOIL: some silt, organic, dark grey		Vs			0
1					Vx			1
1.5								
2		ML	SILT: little sand, trace clay, occasional pebbles to 2 inch size, greyish brown		Vx	M		2
3							3	
4							4	
5							5	
6							6	
7							7	
8							8	
9							9	
10		10.0	TOTAL DEPTH 10.0'				10	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 116X

HOLE NO. DH-6

DATE: FEB. 17, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	PEAT: organic, fibrous, muskeg, dark grey		Nf	L		0
2								2
4			SILT: little sand, trace clay, greyish brown					4
6		ML			Vs	M		6
8			----- becoming grey from 8.0'					8
10								10
12			TOTAL DEPTH 11.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 116X

HOLE NO. DH-7

DATE: FEB. 17, 1973 LOGGED BY: PEMCAN
 DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	TOPSOIL: some silt, trace sand, roots, greyish brown		Vx			0
1					Vs			1
1.5								
2		ML	SILT: little sand and gravel, greyish brown		Vs	M		2
3							3	
4							4	
5							5	
6							6	
7							7	
8							8	
9							9	
10							10	

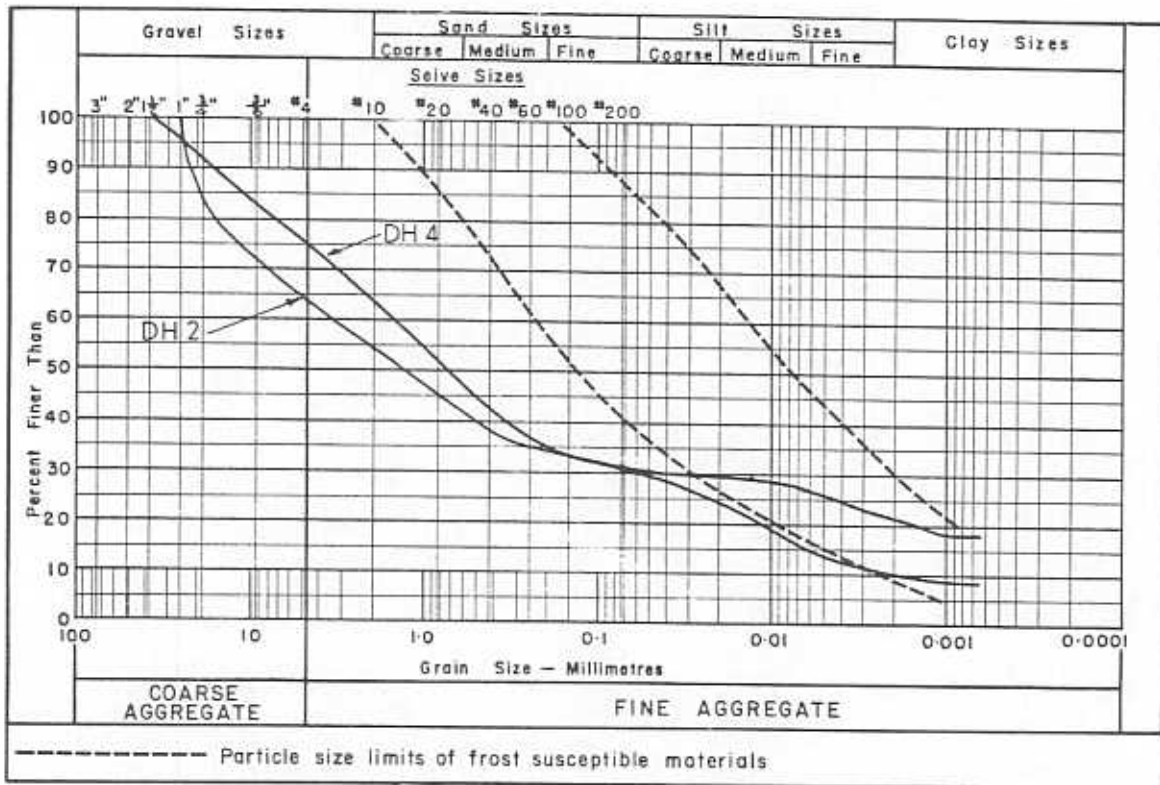
10.0 — TOTAL DEPTH 10.0'

GOVERNMENT OF CANADA DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT	PEMCAN SERVICES "72"
GRANULAR MATERIALS INVENTORY	

SUMMARY OF LABORATORY TEST DATA

Sample Location:	116X/DH 2	116X/DH 4
Sample Depth (Feet):	5.0	16.0
Moisture Content (%):	-	-
Ice Content (%):	-	-
Organic Content (%):	-	4.8

GRAIN SIZE DISTRIBUTION:

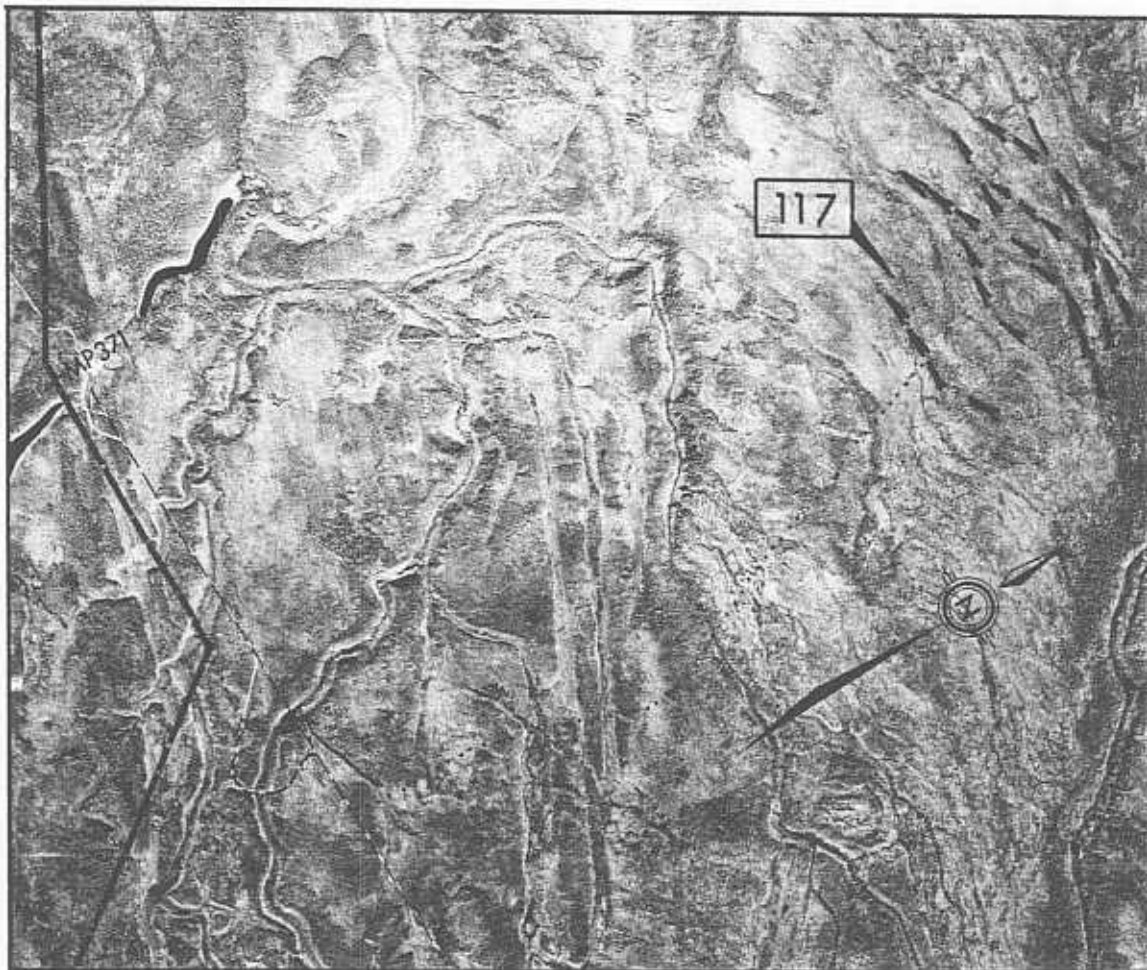


SITE NO. 117

LOCATION

Located along the northwest periphery of Ebbutt Hills and approximately 3 miles east of the proposed Mackenzie Highway at Camsell Bend, Site 117 consists of widely scattered crevasse fillings.

The proposed Mackenzie Highway right-of-way at Mile 369.5 is located approximately $3\frac{1}{2}$ miles south of Site 117, while the proposed gas pipeline route is approximately 3 miles to the north.



LEGEND

- | | |
|--|----------------------------------|
| ----- All weather road | Required access |
| - - - - - Existing trails and cutlines | - · - · - Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |

Airphoto No. A22933/222

Approximate scale: 1" = 3,000'



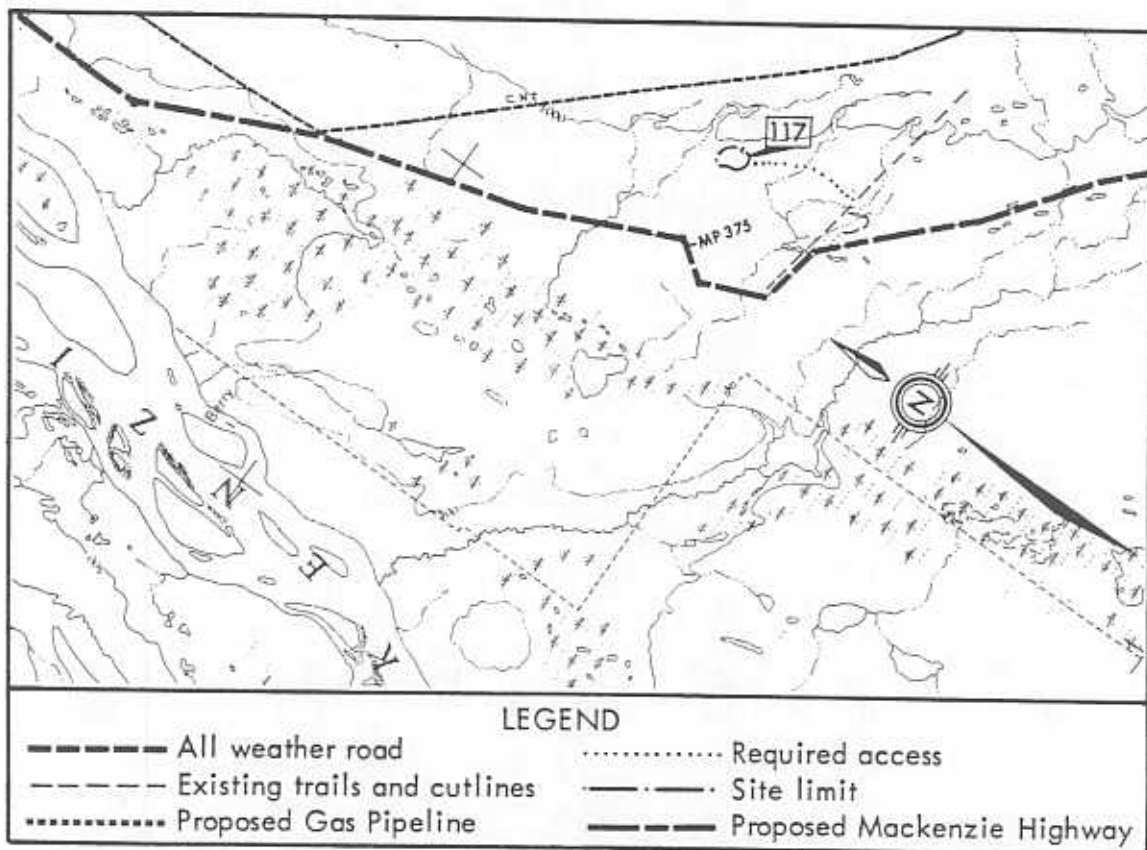
GENERAL

Crevasse fillings form relatively straight, narrow ridges which rise a few feet above the gently sloping adjacent terrain. They are marked with stands of spruce, while the surrounding area, which exhibits only fair drainage, supports sparse growths of black spruce.

There are no known critical wildlife areas in the immediate vicinity of Site 117.

The crevasse fillings are spread over a 1 square mile area and individual ridges are usually less than $\frac{1}{2}$ mile in length. These deposits likely contain stratified sand, some gravel and possibly till, suitable for fair quality material for general fill.

Development of the site is questionable because of difficult access and the necessity of clearing large tracts of land in order to recover relatively small volumes of material. The surrounding terrain indicates thermally sensitive conditions. Site 117 is therefore not suggested for development.



Section of Map No. 95 J

Scale: 1:250,000

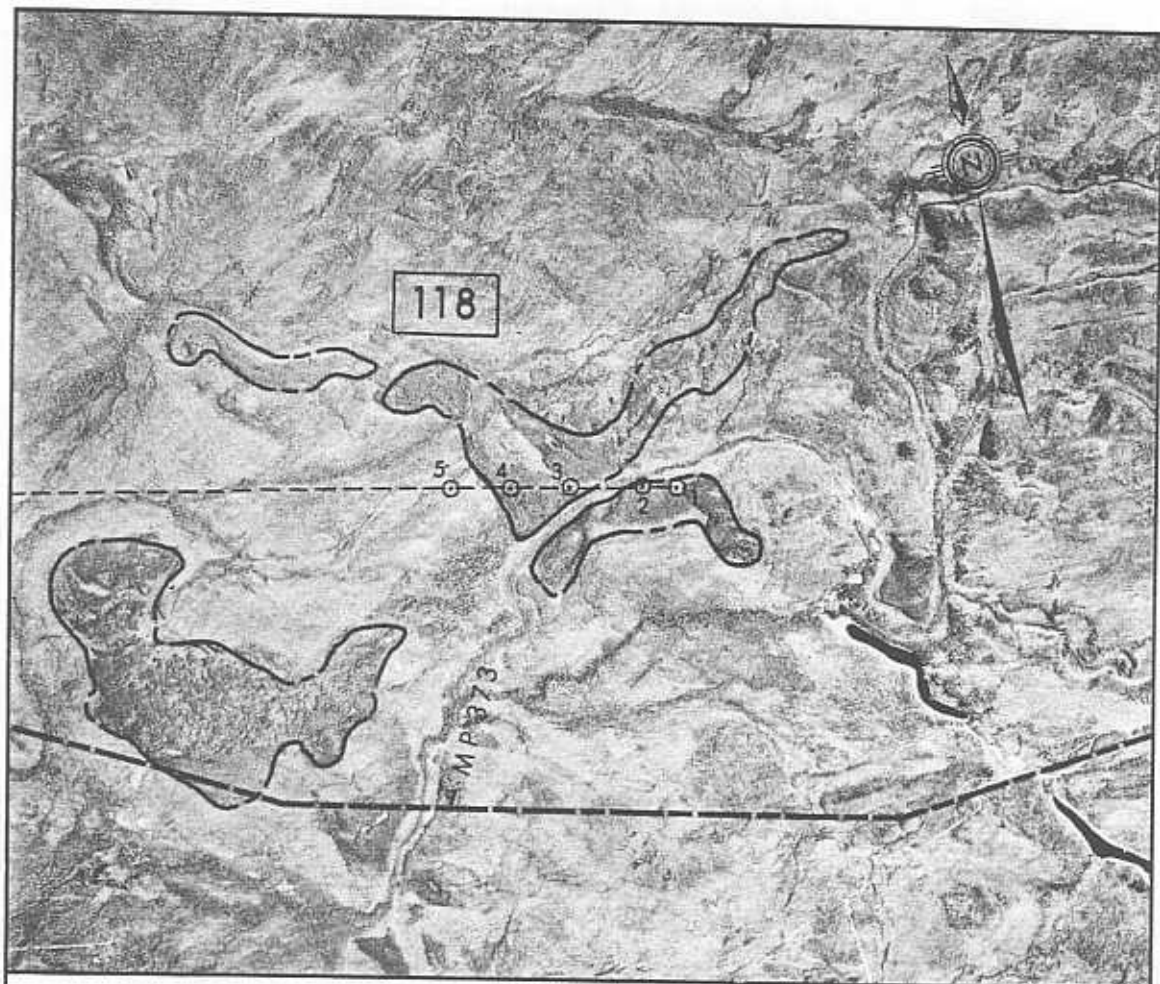
SITE NO. 118

Located approximately 21 miles south of the Willowlake River, Site 118 consists of numerous segmented esker ridges. The proposed Mackenzie Highway from Mile 373 to Mile 374 crosses the western extremity of the site area.

Type of Material: Sand and Gravel; variable gradation, trace silt, stratified.

Estimated Volume: 2,000,000 cubic yards.

Assessment: Good quality granular materials which are suitable for various construction requirements. Site 118 is recommended for development.



LEGEND	
----- All weather road	..... Required access
- - - - Existing trails and cutlines	— Site limit
..... Proposed Gas Pipeline	- - - Proposed Mackenzie Highway
○ DH Drill Hole	⊕ TP Test Pit

Airphoto No. A22933/223

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 118 is located approximately 21 miles south of the Willowlake River and the western extremity of the site area is located within the proposed Mackenzie Highway right-of-way from Mile 373 to Mile 374. The site, encompassing an area approximately $2\frac{1}{2}$ miles in length and averaging 1 mile in width, consists of the eastern portion of the major esker field located at Site 124. The esker ridges are segmented and are generally 200 to 600 feet wide at the base and rise 5 to 30 feet above the adjacent terrain which consist of glaciolacustrine silt deposits. The esker ridges are surficially well drained whereas the adjacent terrain exhibits poor to fair drainage to the west.

The material in the esker ridges consists of stratified sands and gravels, generally low in silt content, but highly variable in gradation. These sands and gravels are considered suitable for most construction requirements. A thin veneer of topsoil and silt, ranging from 1 to 6 feet in depth, covers the esker ridges and supports moderately dense growth of spruce, birch, poplar and pine.

There are no known critical wildlife areas in the immediate vicinity of Site 118.

The only existing access to the various esker ridges in Site 118 from the CNT pole line or the proposed Mackenzie Highway right-of-way consists of existing seismic cutlines and the access trails which were cleared during the winter drilling program.

DEVELOPMENT

The exploratory drilling which was conducted on Site 118 showed the following conditions relative to the quality and quantity of available granular materials:

- Good quality granular materials consisting of stratified sands and gravels of variable gradation suitable for various construction requirements are available in these esker ridges.
- The overburden material on the esker ridges, consisting of topsoil and inorganic silt, varies in depth from 1 to 6 feet.
- On the basis of the drill hole information, the stratified sand and gravel deposits in the esker ridges vary from 4 to in excess of 15 feet in thickness.
- An estimated quantity of granular materials in excess of 2,000,000 cubic yards is considered available from Site 118.

Site 118 may represent a very significant source in view of the general scarcity of granular materials in this portion of the Study Area. Therefore, Site 118 is recommended for development and exploitation of granular materials, and the following development guidelines should be considered:



- The existing tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The topsoil and inorganic silt overburden should be stripped, removed and stockpiled adjacent to borrow pit areas in designated locations, preferably along the base of the esker ridges.
- A natural stand of tree growth and related vegetation should be retained between borrow pit areas to be developed adjacent to the proposed Mackenzie Highway right-of-way for aesthetic values.
- Stands of natural growth should be retained between borrow pit areas in order to facilitate regrowth through natural regeneration.
- The use of dozers, overhead loaders and conventional ripping equipment should adequately remove the material from this site.
- The production of quality surface course and concrete aggregate material may be possible by exercising selective excavation procedures during the development of borrow pits. The production of higher quality aggregates will dictate the need of screening, crushing and washing plants to ensure aggregate properties for specified construction requirements.
- Additional laboratory tests to evaluate specific physical and chemical properties of the granular materials will be required, if the material is to be considered for the production of concrete aggregates.

ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation procedures should include:

- Recontouring of the pit areas to provide general drainage that is compatible with the natural drainage of the adjacent terrain.
- Replacing stockpiled surficial waste material and organic topsoil on the abandoned recontoured pit areas.
- Reseeding of the recontoured pit and/or secondary access should be considered in areas that may pose erosional problems. At these locations, the artificial reseeding of annuals and perennials will result in a semi-permanent cover growth prior to reestablishment of native species.

DETAILED DRILL HOLE LOG

SITE NO. 118

HOLE NO. DH-1

DATE: FEB. 16, 1973

LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	PEAT: organic, fibrous, muskeg, dark brown		N	L		0
2		SP-SM	SAND AND SILT: little clay, occasional pebbles to 3/4 inch size, medium brown (TILL)		Vs	M		2
4			becoming medium grey from 4.0'					4
6								6
8					Nf	L		8
10								10
12							GS	12
14								14
16			TOTAL DEPTH 15.0'					16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 118

HOLE NO. DH-2

DATE: FEB. 16, 1973

LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)		
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.				
0	[Pattern]	Pt	PEAT: organic, fibrous, muskeg, black - very wet from 3.0' to 8.0'	[Pattern]	Vx	H		0		
3									3	
9				UF				9		
12	[Pattern]	ML-CL	SILT: some clay, little gravel, pebbles to 1 inch size, medium brown (TILL) - some sand, trace coal and rust specs, grey, from 16.0'	[Pattern]	Vs			12		
15									15	
18								Vx	M	18
21										21
24								24		
			TOTAL DEPTH 22.0'							

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



DETAILED DRILL HOLE LOG

SITE NO. 118

HOLE NO. DH-3

DATE: FEB.16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	PEAT: organic, fibrous, muskeg, dark brown		Nf	L		0
2		GM-GP	GRAVEL: some sand, trace silt, pebbles to 2 inch size, frequent boulders, medium brown		Vs	M		2
4								4
6								6
8								8
10		ML-CL	SILT: some clay, low plastic, frequent pebbles to 1 inch size, medium brown (TILL)		Nbn	L		10
12								12
14								14
16			TOTAL DEPTH 15.0'					16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 118

HOLE NO. DH-4

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	0.5 PEAT: organic, fibrous, muskeg, dark brown		Nf	L		0
2		ML-SM	SILT: some sand, trace organic, pebbles to 1½ inch size, medium brown		Vs	M		2
4		GW	3.0 GRAVEL: some sand, trace silt, medium grained, well graded, subrounded and subangular pebbles to 1½ inch size, few cobbles to 4½ inch size, predom- inantly limestone and dolomite with quartzite, medium brown		Nf	L		4
6							6	
8							8	
10							10	
12							GS P O	12
14								14
16			15.0 TOTAL DEPTH 15.0'					16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 118

HOLE NO. DH-5

DATE: FEB.16, 1973

LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		Pt	PEAT: organic, fibrous, muskeg, dark brown		N	L		0
2		ML-CL	SILT: some clay, frequent pebbles to 3/4 inch size, medium brown (TILL)		Vs	M		2
4								4
6								6
8				UF				8
10								10
12			TOTAL DEPTH 12.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

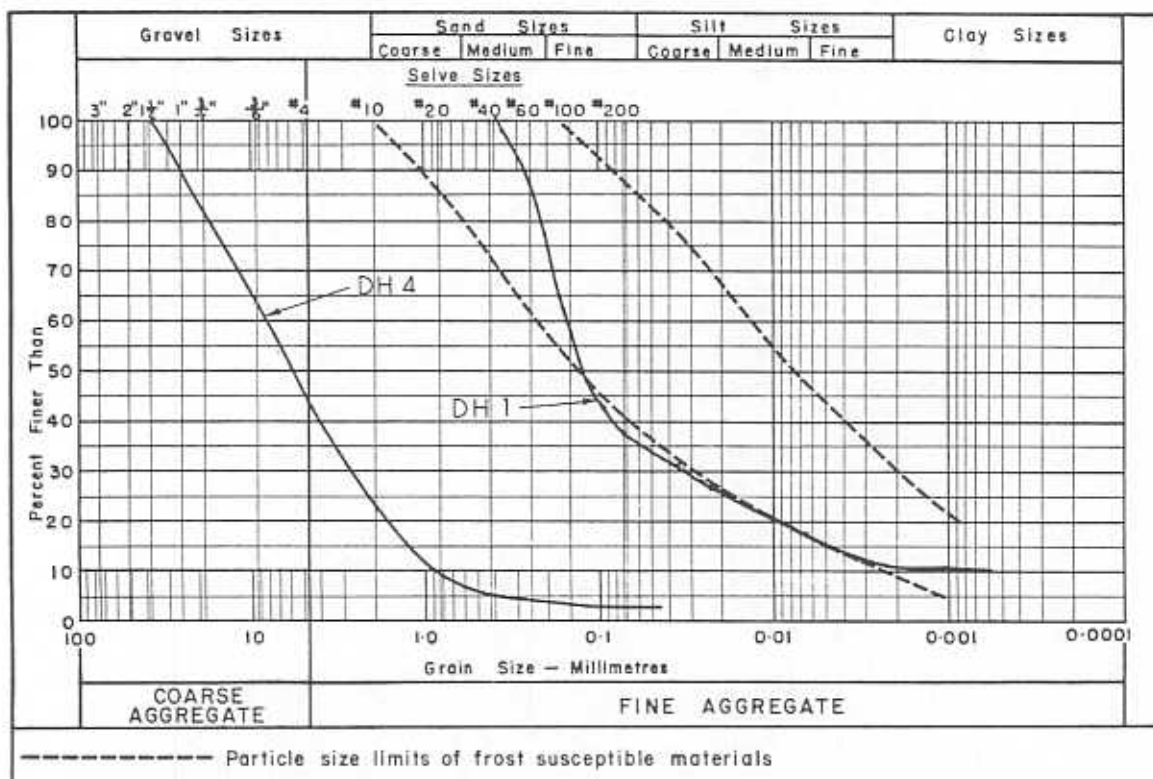


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	118/DH 1	118/DH 4
Sample Depth (Feet):	11.0	11.0-13.0
Moisture Content (%):	-	-
Ice Content (%):	-	-
Organic Content (%):	-	2.1

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS: (118/DH 4 @ 11.0' - 13.0')

Limestone and dolomite (sound)	56.9%	3-4
Igneous	20.0%	6-7
Quartzite	15.2%	7-8
<u>Deleterious</u>		
Limestone and dolomite (porous)	5.7%	3-4)
Siltstone, sandstone and ironstone	2.1%	

SITE NO. 119X

Located approximately 22 miles southeast of Willowlake River, Site 119X consists of a series of shallow, till ridges topped with outwash material and encompasses the proposed Mackenzie Highway from Mile 370 to Mile 372.

Type of Material: Sand; some silt, variable gradation.

Estimated Volume: Not determined.

Assessment: Site 119X is not recommended as a source of granular materials; however, these fine silty sands may be used as very marginal fill in the construction of road subgrades.



LEGEND

----- All weather road	..... Required access
- - - - Existing trails and cutlines	--- Site limit
..... Proposed Gas Pipeline	----- Proposed Mackenzie Highway
⊙ DH Drill Hole	⊕ TP Test Pit

Airphoto No. A22889/54

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 119X is located approximately 22 miles southeast of Willowlake River and encompasses the proposed Mackenzie Highway right-of-way from Mile 370 to Mile 372. The site consists of a series of shallow, till ridges topped with outwash materials, which are located at the southern extremity of the large esker field comprising Sites 118 and 124. The site area is approximately 2 miles in length and varies from 1000 to 1500 feet in width. These till ridges are surficially well drained and the adjacent terrain which is braided by numerous dry stream channels exhibits fair drainage to the southwest.

The till ridges are topped with shallow layers of reworked material consisting of fine grained sand with a variable gradation and silt content. These sand deposits are considered suitable for marginal general fill requirements. The adjacent terrain and the depressional areas between the ridges consists of lacustrine silts. The surficial topsoil and peat layer, generally less than 1 foot in thickness, supports moderate growths of spruce, poplar and birch.

There are no known critical wildlife areas in the immediate vicinity of Site 119X.

The proposed Mackenzie Highway right-of-way traverses the entire length of the site area and provides good future access. The CNT pole line and the proposed gas pipeline routes are located 4 and 6 miles, respectively, east of the site area.

DEVELOPMENT

The information from the drill holes conducted on Site 119X by the engineering consultant for The Federal Department of Public Works confirmed the availability of very poor quality fill material consisting of silty sand with a highly variable silt content. The drill hole log data provided by the consultant has been incorporated in the report.

Site 119X is not recommended as a source of granular materials because of the poor quality and shallow depths of the available sand deposits and, in addition, an extensive esker field containing considerable volumes of quality granular materials is located immediately adjacent to this site area.

However, if Site 119X is developed for the exploitation of marginal general fill material, then proper development procedures, compatible with the physical and biological framework of the site area, should be established in accordance with the land use guidelines which are in effect at that time.

DETAILED DRILL HOLE LOG

SITE NO. 119X

HOLE NO. C B

DATE: MAR. 1, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		Pt	1.0 PEAT					0
3		SM	Silty sand with a trace of clay and gravel					3
6		SM						6
9		SM			Nbn			9
12		SM	- brown - grey					12
15								15
18								18
21		SM						21
24		SM			Nbn			24
27								27
30			30.0 END OF HOLE 30.0'					30

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 119X

HOLE NO. C D

DATE: MAR. 1, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)					
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.							
0	[Graph Symbol]	SM	Brown silty sand	[Gen'l Class]				0					
2		SM	Grey sand with some silt and a trace of gravel					[Nbn]				2	
4													
6												6	
8		SP										8	
10												10	
12												12	
14												14	
16								END OF HOLE 15.0'					16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 119X

HOLE NO. C F

DATE: MAR. 1, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)				
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.						
0	[Graph Symbol]	SM	Brown silty sand	[Ground Conditions]				0				
1.0												
2		SP	Grey brown sand with a trace of silt					2				
4.0												
6								6				
8		SM	Grey silty sand Till with a trace of gravel and clay	[Ground Conditions]	Nbn			8				
10											10	
12		SM										12
14												14
15.0			END OF HOLE 15.0'					15.0				
16								16				

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 119X

HOLE NO. C H

DATE: MAR. 2, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0	[Graph Symbol]	SM	1.0 ——— Brown silty sand	[Gen'l Class]	Nbn		0	
2		SW	Brown gravelly sand with a trace of silt		Nf		2	
4					6.0 ———	Nbn		4
6	[Graph Symbol]	SM	Silty sand	[Gen'l Class]	Nbn		6	
8							8	
10							10	
12							12	
14	[Graph Symbol]		15.0 ——— END OF HOLE 15.0'	[Gen'l Class]			14	
16							16	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

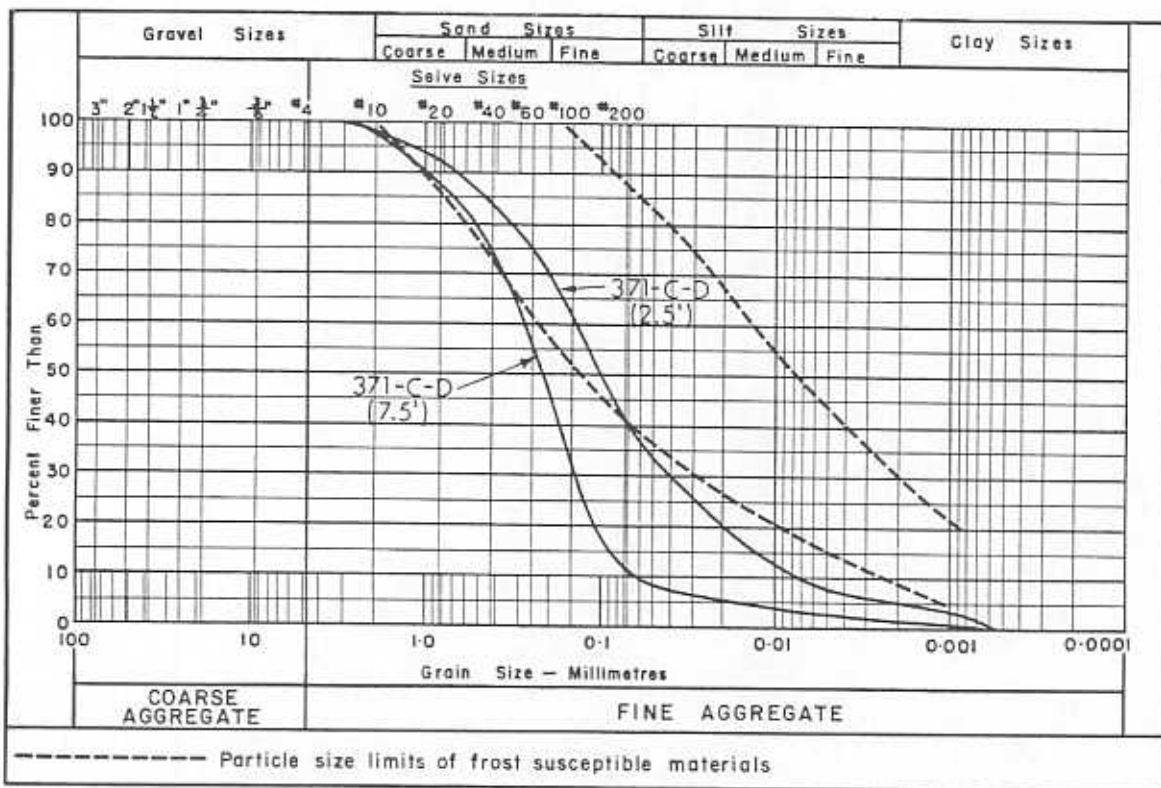


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	119/371-C-D	119/371-C-D
Sample Depth (Feet):	2.5	7.5
Moisture Content (%):	10.0	12.0
Ice Content (%):	-	-
Organic Content (%):	-	-

GRAIN SIZE DISTRIBUTION:



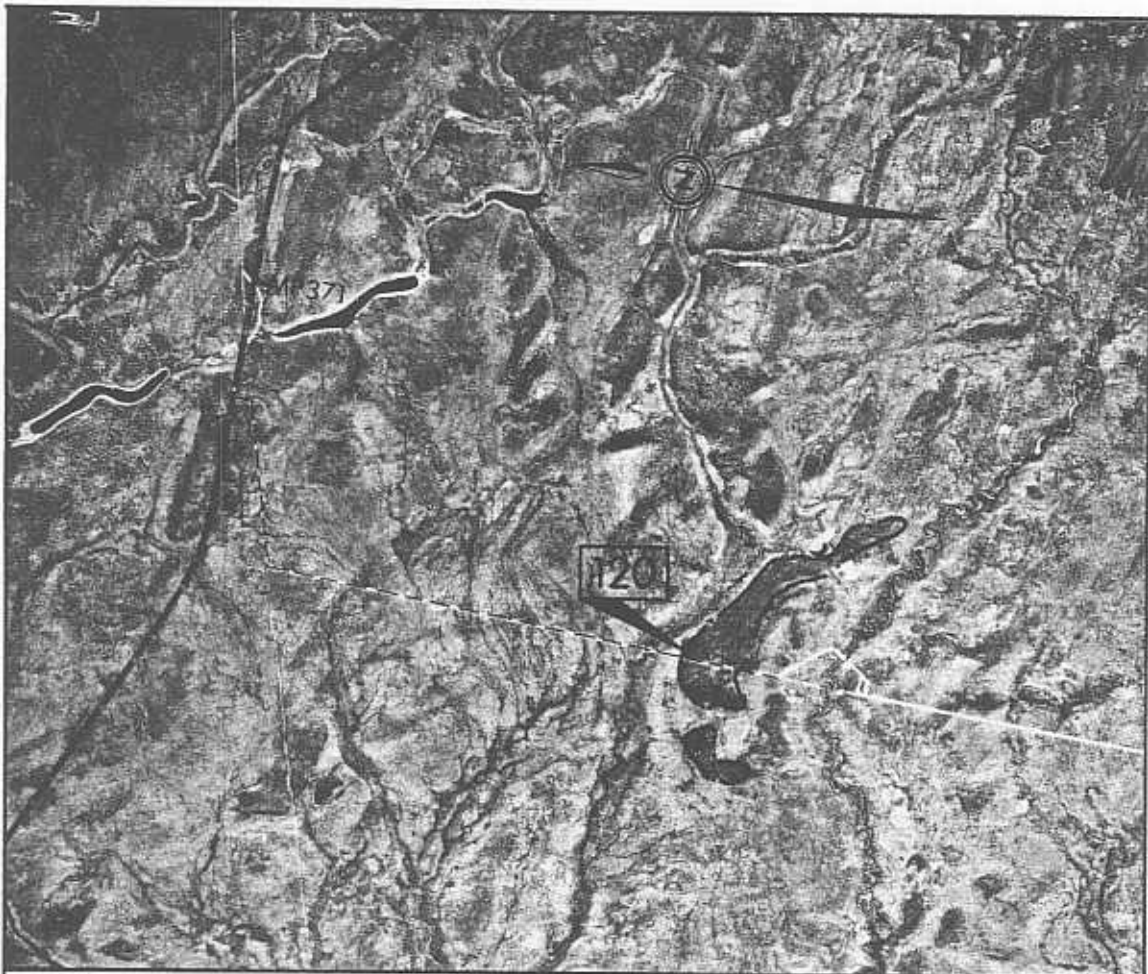
PETROGRAPHIC ANALYSIS:

SITE NO. 120

LOCATION

Located approximately 22 miles south of Willowlake River and 20 miles west of Ebbutt Hills, Site 120 consists of two till ridges.

The proposed Mackenzie Highway right-of-way at Mile 371.5 is located approximately 2½ miles north of Site 120. The proposed gas pipeline route runs approximately 6 miles east of the site area.



LEGEND

- | | |
|--|----------------------------------|
| ----- All weather road | Required access |
| - - - - - Existing trails and cutlines | - · - · - Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |

Airphoto No. A22889/53

Approximate scale: 1" = 3,000'



GENERAL

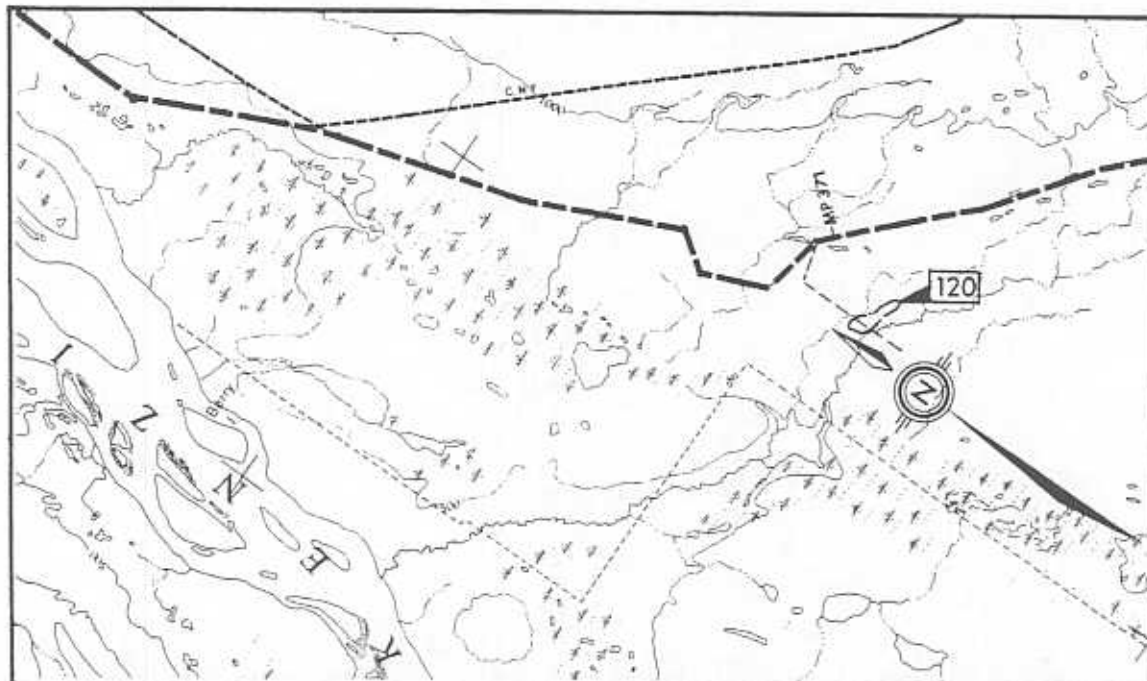
Site 120 consists of two ridges, 4000 and 1000 feet in length and ranges from 200 to 900 feet in width. Based on inferred data from the adjacent Site 119, which was drilled by the engineering consultant for The Federal Department of Public Works, Site 120 is considered to be composed of similar glacial till topped with outwash materials.

The two ridges are surficially well drained and the adjacent terrain which is braided by numerous dry channels exhibits fair to good drainage to the south into the only active stream channel which parallels the site area at a distance of approximately 1000 feet. The surficial topsoil and peat layer supports moderate growths of spruce, poplar and birch.

There are no known critical wildlife areas in the immediate vicinity of Site 120.

It is anticipated that the surficial but relatively shallow layer within the ridges consists of fine grained, variably graded and washed silty sands, possibly suitable for marginal general fill requirements. The existing seismic line provides good access to the proposed Mackenzie Highway right-of-way.

Site 120 is rated as a poor prospect because of the anticipated poor quality of fine grained materials and their shallow thickness.



LEGEND	
———— All weather road	..... Required access
- - - - Existing trails and cutlines	— · — Site limit
..... Proposed Gas Pipeline	———— Proposed Mackenzie Highway

Section of Map No. 95 J

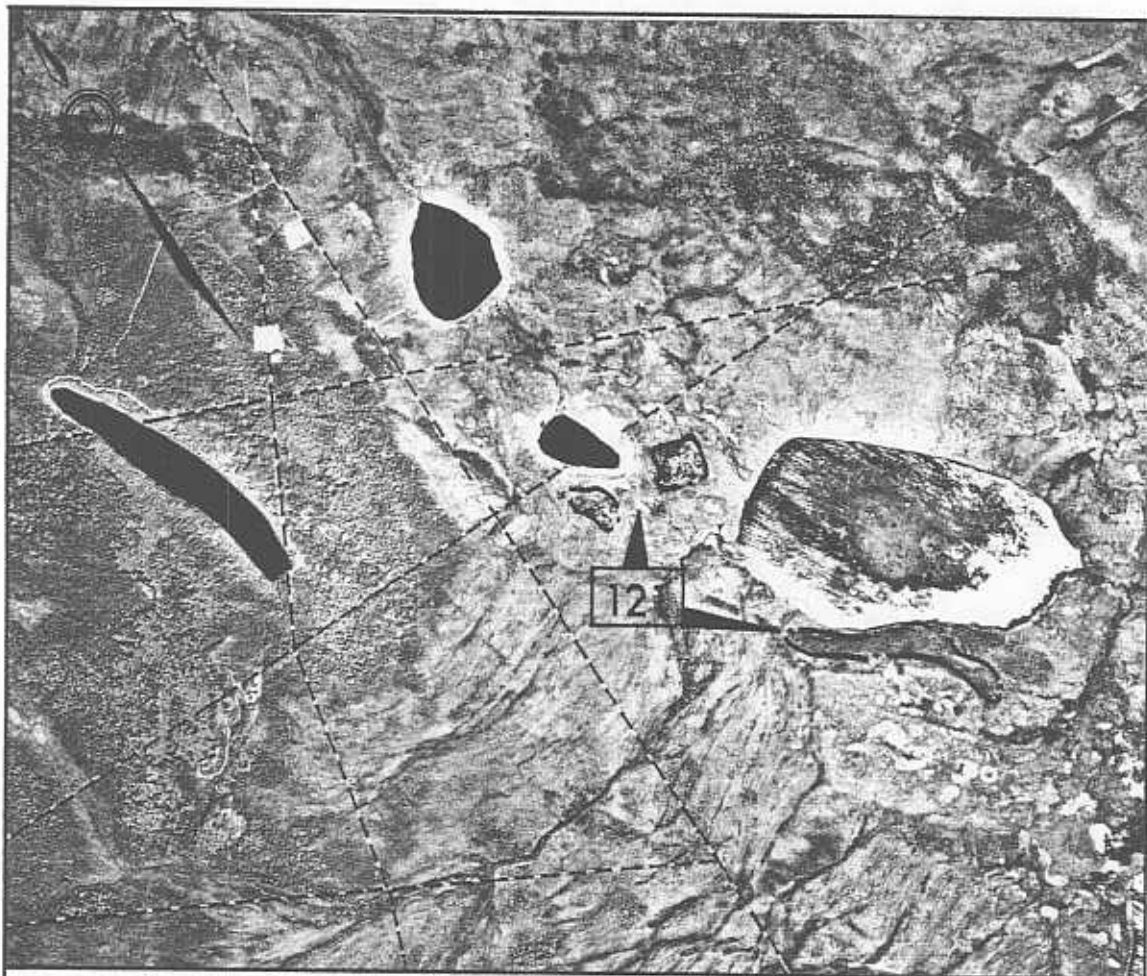
Scale: 1:250,000

SITE NO. 121

LOCATION

Located approximately 9 miles northeast of Camsell Bend, Site 121 consists of two small hummocks and a shallow ridge probably comprising graded glaciofluvial outwash material.

The proposed Mackenzie Highway right-of-way at Mile 371 is located approximately 10 miles northeast of Site 121. The proposed gas pipeline route runs approximately 11 miles northeast of the site area.



LEGEND

- | | |
|------------------------------------|----------------------------------|
| ----- All weather road | Required access |
| ----- Existing trails and cutlines | --- Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |

Airphoto No. A22889/43

Approximate scale: 1" = 3,000'

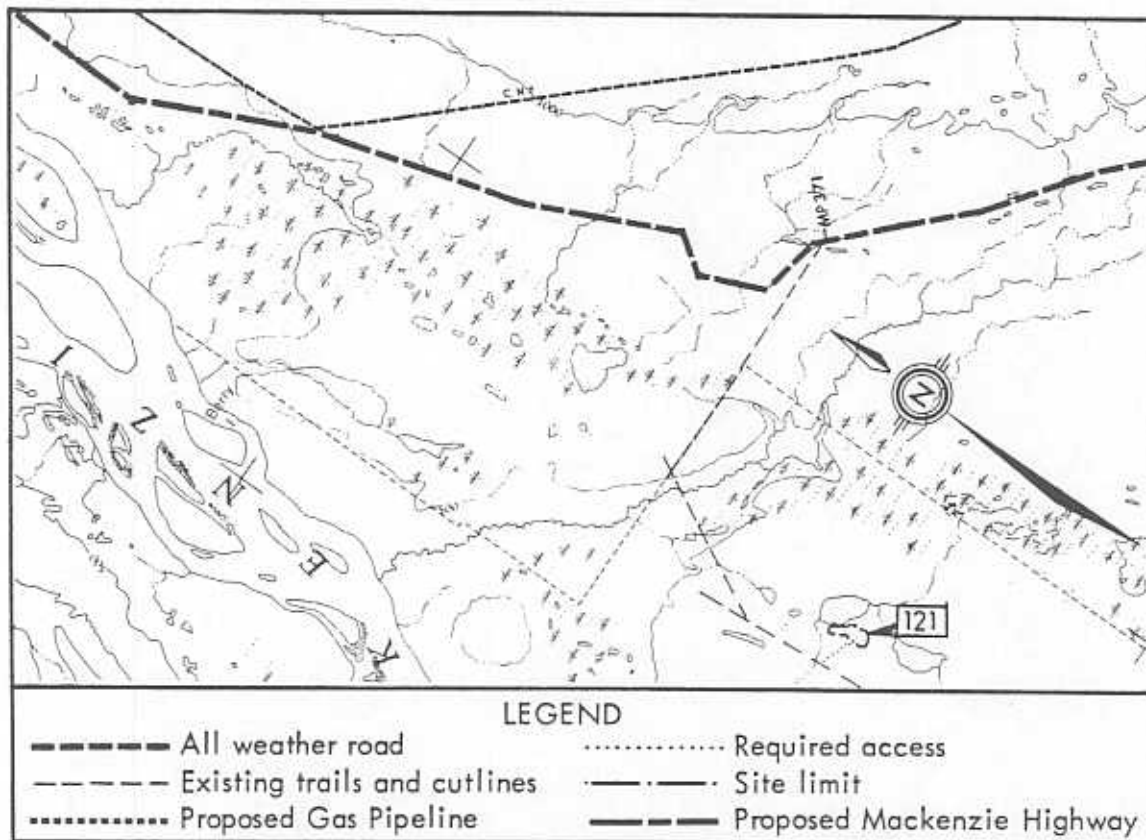


GENERAL

Site 121 consists of two small knolls and a shallow ridge. The ridge, bordering the southwestern side of an unnamed lake, is about 300 feet wide and less than 3000 feet long and rises approximately 10 to 20 feet above the adjacent flat muskeg terrain. The two knolls, located on the northwestern side of the lake, are less than 700 feet in diameter. These features, which likely represent erosional remnants of a minor glaciofluvial train, probably contain sand with some silt.

The ridge and knolls are well drained into the adjacent terrain and lakes, respectively. The surficial drainage of the adjacent depressional terrain is poor and exhibits numerous muskeg bogs and thermokarst lakes. There are no known critical wildlife areas in the immediate vicinity of Site 121.

It is anticipated that the sandy deposits may be suitable for marginal general fill materials. However, because of the doubtful quality of materials and long access across thermally sensitive terrain, Site 121 is rated as a poor prospect.



Section of Map No. 95 J

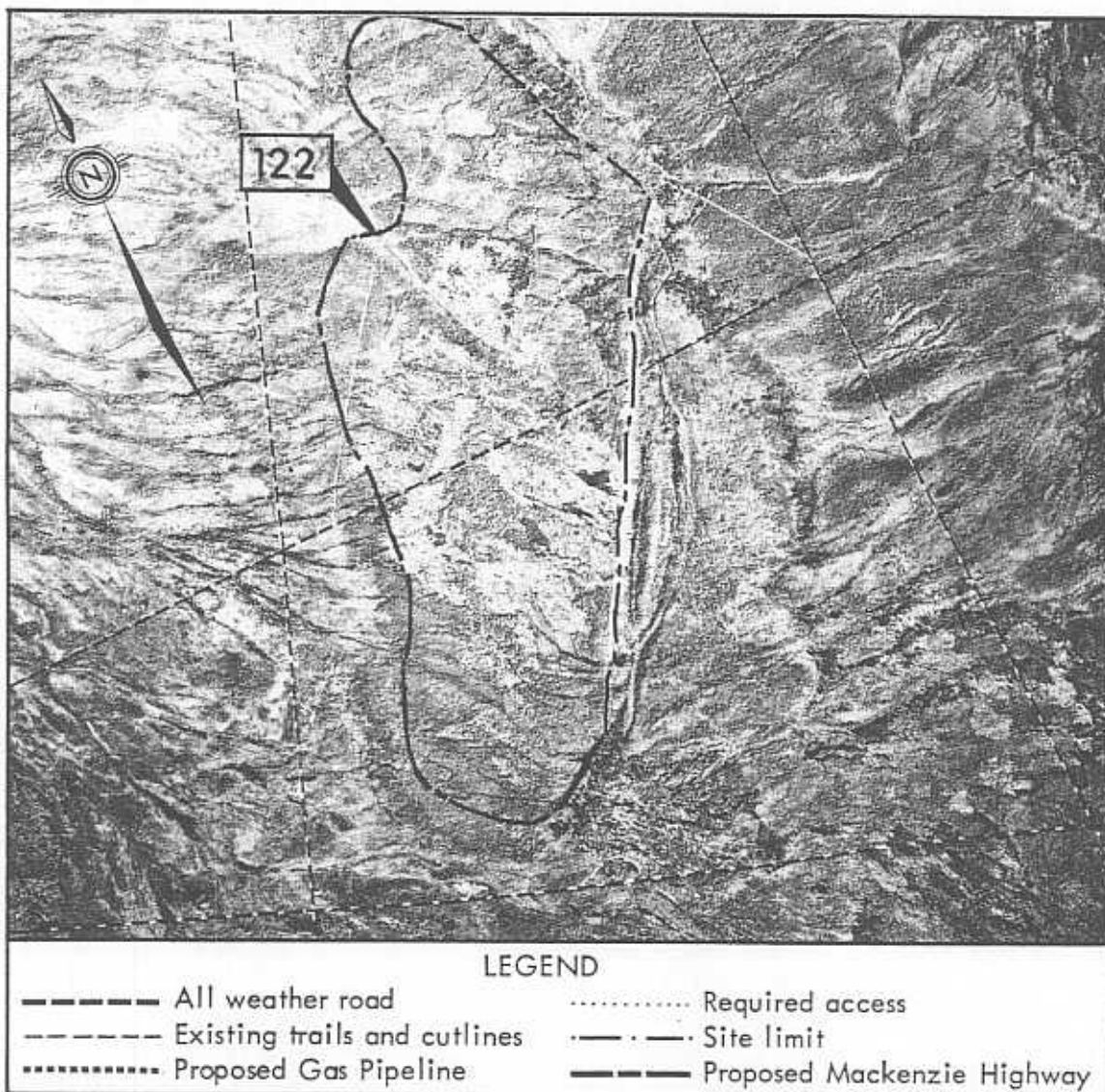
Scale: 1:250,000

SITE NO. 122

LOCATION

Located approximately 5 miles east of Camsell Bend on the east side of the Mackenzie River, Site 122 encompasses a bedrock ridge covered with glaciolacustrine deposits.

The proposed Mackenzie Highway right-of-way at Mile 371 is located approximately 13 miles northeast of Site 122. The direct distance from the site area to the proposed gas pipeline route is approximately 11 miles.



Airphoto No. A22304/24

Approximate scale: 1" = 3,000'



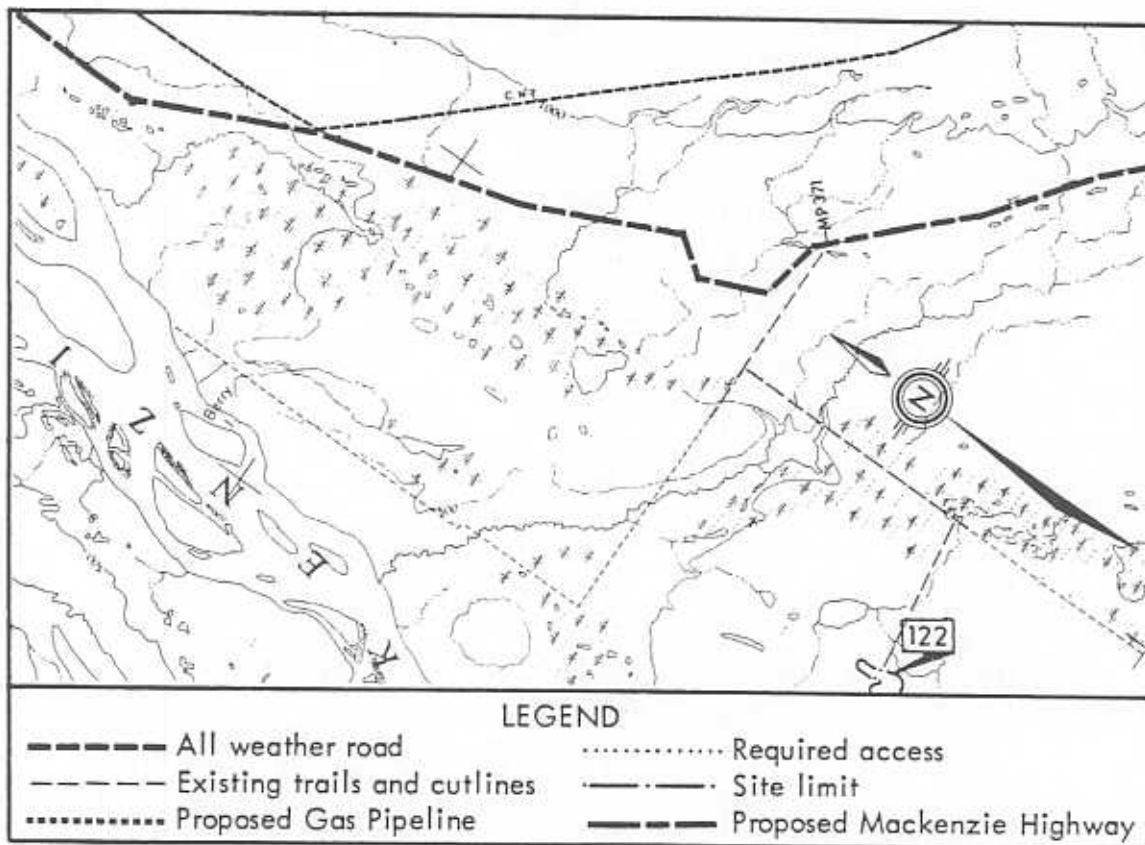
GENERAL

The ridge gradually rises above the flat terrain which forms the interior portion of the Camsell Bend area. The west side of the ridge is, however, bordered with a relatively steep escarpment which locally exposes dark grey concretionary and gypsiferous shale of the Root River syncline.

With exception of the escarpment, the bedrock is covered with glaciolacustrine sediments which support mixed growths of spruce, alder, poplar and birch. The top of the ridge is relatively well drained, while drainage conditions of the surrounding terrain are only fair to poor. There are no known critical wildlife areas in the immediate vicinity of Site 122.

The development of the site would require a quarry operation and the removal of a relatively thick layer of overburden. Ripping combined with blasting likely would be required for extraction of the shale. This shale, which may easily deteriorate if exposed to weathering agents, is only suitable for marginal general fill.

Because of doubtful quality of available materials and difficult access across depressional and thermally sensitive terrain, Site 122 is rated as a poor prospect.



Section of Map No. 95 J

Scale: 1:250,000

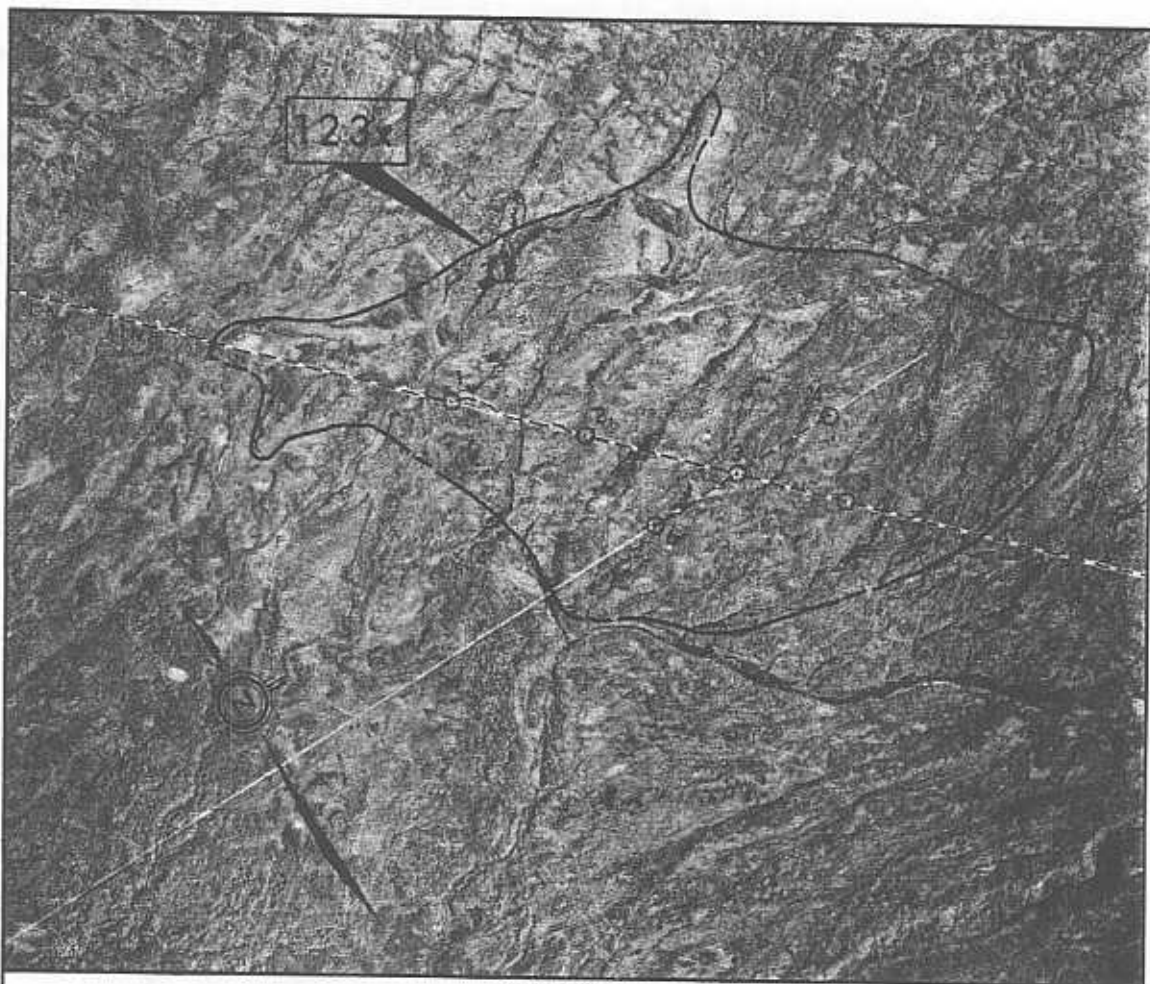
SITE NO. 123X

Located approximately 17 miles south of the Willowlake River and 3 miles east of the proposed Mackenzie Highway at Mile 377, Site 123X consists of ground moraine which has been surficially reworked during the development of drainage patterns.

Type of Material: Glacial Till; silt, sand and clay matrix with some pebbles.

Estimated Volume: Not applicable.

Assessment: Site 123X is not recommended for development because materials of granular quality were not encountered during the field drilling program.



LEGEND

- | | |
|--------------------------------------|------------------------------------|
| ----- All weather road | Required access |
| - - - - Existing trails and cutlines | — · — Site limit |
| Proposed Gas Pipeline | - - - - Proposed Mackenzie Highway |
| ⊙ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A22934/8

Approximate scale: 1" = 3,000'



ENVIRONMENT

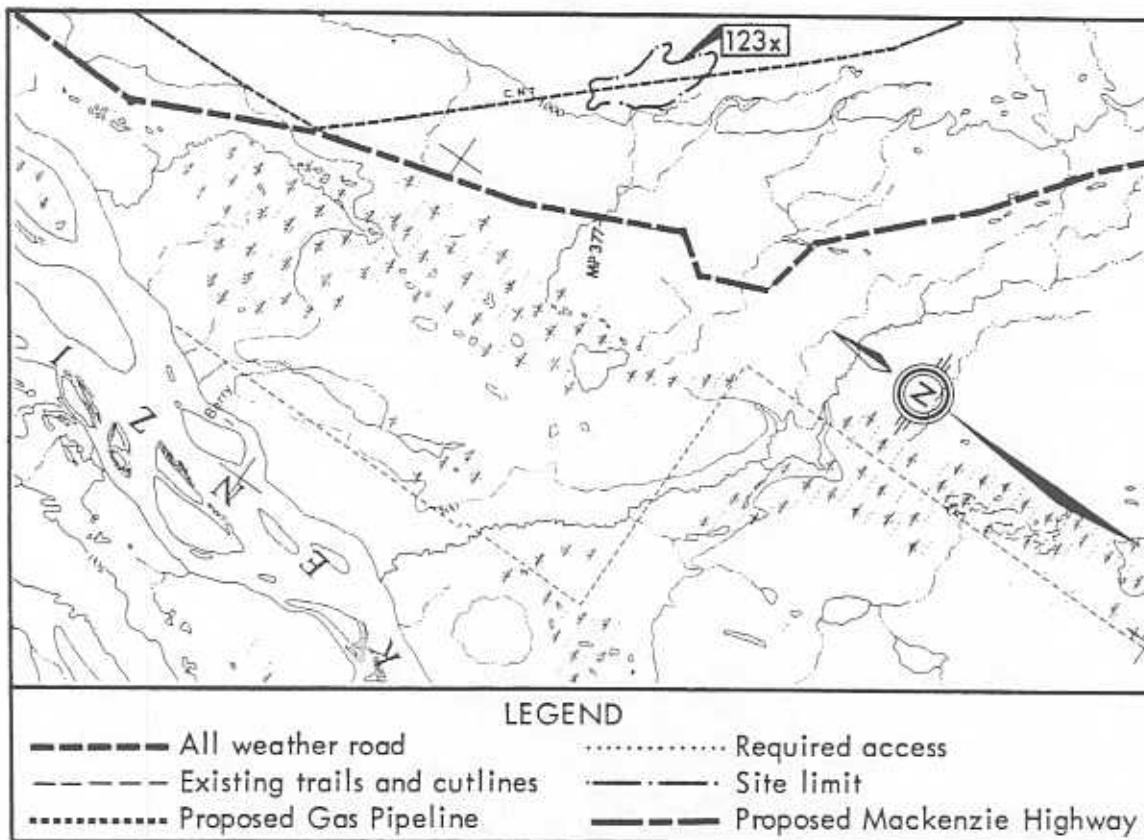
Site 123X is located approximately 17 miles south of Willowlake River and 3 miles east of the proposed Mackenzie Highway right-of-way at Mile 377. The site encompasses an area approximately 2 miles in length and 1½ miles in width and consists of ground moraine which has been surficially reworked during the development of the drainage pattern. The ground moraine is locally topped with slope wash from the adjacent upslope terrain and very small and narrow esker segments. The site area and adjacent terrain is generally surficially well drained to the west.

The ground moraine which comprises Site 123X consists of heterogeneous mixtures of silt, sand and clay interspersed with pebbles. A layer of topsoil and peat, ranging in depth from 1 to 2½ feet, overlies the site area and supports moderate growths of spruce, pine and birch. There are no known critical wildlife areas in the immediate vicinity of Site 123X.

The CNT pole line traverses the site area whereas a seismic cutline represents the only existing access to the proposed Mackenzie Highway right-of-way.

DEVELOPMENT

Site 123X is not recommended for development because materials of granular quality were not established by the drilling program.



Section of Map No. 95 J

Scale: 1:250,000

DETAILED DRILL HOLE LOG

SITE NO. 123X

HOLE NO. DH-1

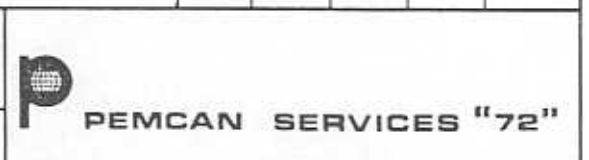
DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)				
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.						
0		OL	1.0' TOPSOIL: some silt, trace sand, greyish brown					0				
2		ML	SILT: little sand, medium brown (TILL)		Vx	L		2				
4										4		
6										6		
8										8		
10										10		
12										12		
14										14		
16				ML-SM			16.0' SILT and SAND: layered, greyish brown	UF				16
18							18.0' TOTAL DEPTH 18.0'					18

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



DETAILED DRILL HOLE LOG

SITE NO. 123X

HOLE NO. DH-2

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	1.0 TOPSOIL: some silt, trace sand, roots, brown		Vs			0
2		ML	SILT: little sand, trace clay and gravel, brown (TILL)		Vx	L		2
4					Vs			4
6								6
8								8
10				- occasional cobbles and boulders from 9.0'			Nbn		10
12			12.0 TOTAL DEPTH 12.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 123 X

HOLE NO. DH-3

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	PEAT: organic, fibrous, muskeg, black		N			0
1.5								
2		ML-GM	SILT: little sand and gravel, trace clay, brown (TILL)		Vx	L		2
4								4
6								6
8								8
10								10
12								12
13.0								
14		GM-SM	GRAVEL, SAND and SILT: well graded, pebbles to 3/4" size, occasional cobbles and boulders (TILL)				MC GS O	14
16								16
17.0			TOTAL DEPTH 17.0'					17.0
18								18

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 123X

HOLE NO. DH-4

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)		
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.				
0		OL	TOPSOIL: some silt, organic, fibrous, dark brown		Vs	M		0		
1.5										
2		ML	SILT: little sand, trace clay, occasional pebbles to 2" size, brown (TILL)					2		
4								4		
6								6		
8								Vx	L	8
10								10		
12								12		
14								14		
16								- little gravel, predominantly subangular and subrounded to 1/4" size, grey, from 16.0'	16	
18									MC	18
20								20.0	TOTAL DEPTH 20.0'	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 123 X

HOLE NO. DH-5

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0								0
2		Pt	PEAT: organic, fibrous, muskeg, dark brown		Nf			2
2.5								
4								4
6			SILT: little sand and gravel, trace clay, brown (TILL)		Vx	L		6
8		ML						8
10								10
12								12
14								14
16			- some gravel, predominantly limestone and quartzite pebbles and cobbles to 3" size, occasional boulders, grey, from 14.0'				MC	16
18			TOTAL DEPTH 18.0'					18

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AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"





DETAILED DRILL HOLE LOG

SITE NO. 123X

HOLE NO. DH-6

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		Pt	PEAT: organic, fibrous, muskeg, dark brown		Nf			0
2			SILT: little sand, trace clay, occasional pebbles to 2" size, brown		Vx	L		2
4								4
6								6
8		ML						8
10			- few boulders at 9.0' - becoming grey and little gravel at 9.5'					10
12			TOTAL DEPTH 12.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

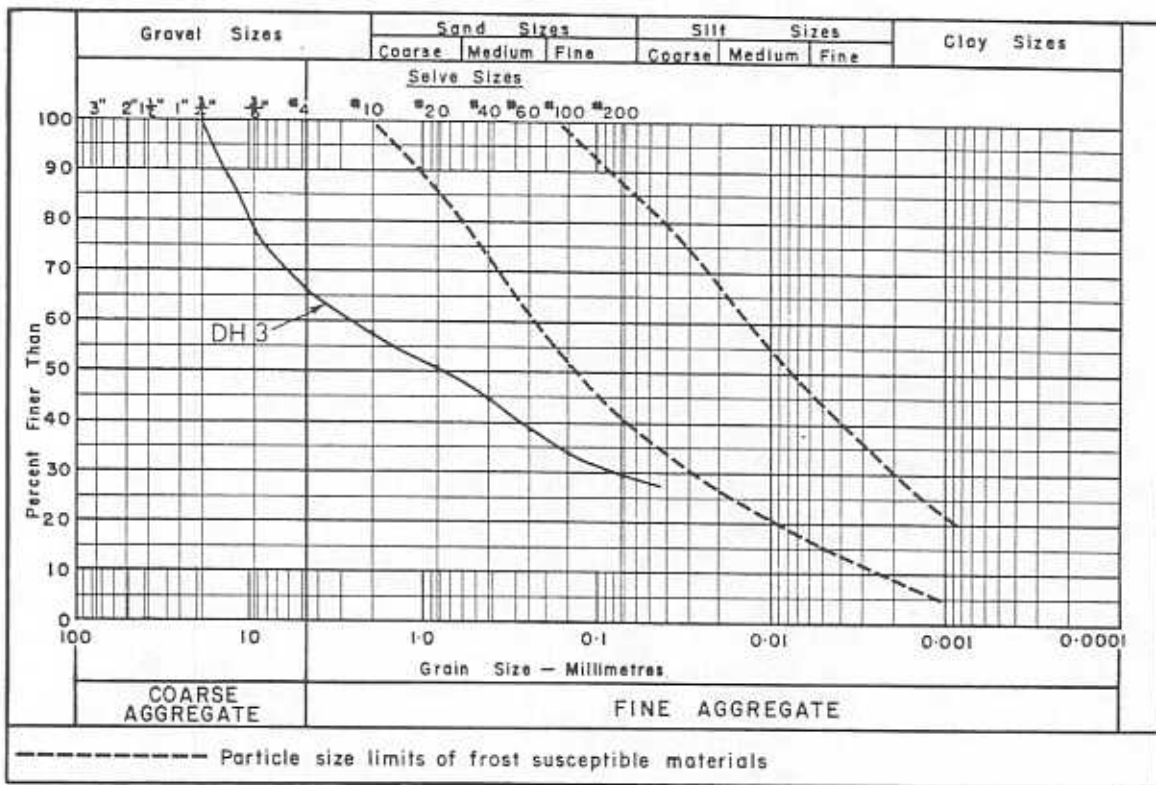


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	123X/DH 3	123X/DH 4	123X/DH 5
Sample Depth (Feet):	15.0	18.0	16.0
Moisture Content (%):	4.9	6.5	8.2
Ice Content (%):	-	-	-
Organic Content (%):	4.3	-	-

GRAIN SIZE DISTRIBUTION:



SITE NO. 124

Located approximately 19 miles south of the Willowlake River and adjacent to the eastern side of the Mackenzie Highway from Mile 374 to Mile 377, Site 124 consists of an extensive esker field.

Type of Material: Sand and Gravel; trace silt, variable gradation, stratified.

Estimated Volume: 4,000,000 cubic yards.

Assessment: Good quality granular materials which are suitable for most construction requirements, Site 124 is recommended for development.



LEGEND

- | | |
|--------------------------------------|------------------------------------|
| ----- All weather road | Required access |
| - - - - Existing trails and cutlines | — · — Site limit |
| Proposed Gas Pipeline | - - - - Proposed Mackenzie Highway |
| ⊙ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A22889/55

Approximate scale: 1" = 3,600'



ENVIRONMENT

Site 124 is located approximately 19 miles south of the Willowlake River and the western extremity of the site area is adjacent and parallel to the proposed Mackenzie Highway right-of-way from Mile 374 to Mile 377. The site, consisting of an extensive esker field, encompasses a total area approximately 4 miles in length and $1\frac{1}{2}$ miles in width. The esker ridges are relatively shallow, very sinuous and are segmented and separated into several arms which illustrates the glaciofluvial drainage pattern. The esker ridges are generally 200 to 600 feet wide at the base and rise 5 to 30 feet above the adjacent terrain which consist of glaciolacustrine silt deposits. The esker ridges are surficially well drained whereas the adjacent terrain exhibits poor to fair drainage to the west.

The material in the esker ridges consists of stratified sands and gravels, generally low in silt content but highly variable in gradation. These sands and gravels are considered suitable for most construction requirements. A thin veneer of topsoil and silt, ranging from 1 to 6 feet in depth, covers the esker ridges and supports moderately dense growths of spruce, birch poplar and pine.

There are no known critical wildlife areas in the immediate vicinity of Site 124.

The only existing access to the various esker ridges in Site 124 from the CNT pole line or the proposed Mackenzie Highway right-of-way consists of existing seismic cutlines and the access trails which were cleared during the winter drilling program.

DEVELOPMENT

The exploratory drilling which was conducted on Site 124 showed the following conditions relative to the quality and quantity of available granular materials:

- Good quality granular materials suitable for various construction requirements and consisting of stratified sands and gravels of variable gradation are available at Site 124.
- The overburden material on the esker ridges consists of topsoil and inorganic silt which varies in depth from 1 to 6 feet.
- The stratified sand and gravel deposits in the esker ridge formations varies from 5 to in excess of 19 feet, on the basis of the drill hole information.
- An estimated quantity of granular materials in excess of 4,000,000 cubic yards is considered available from Site 124.

Site 124 may represent a very significant source in view of the general scarcity of granular materials in this portion of the Study Area. Therefore, Site 124 is recommended for development and exploitation of granular materials and the following development guidelines should be considered:



- The existing tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The topsoil and inorganic silt overburden should be stripped, removed and stockpiled adjacent to borrow pit areas in designated locations, preferably along the base of the esker ridges.
- A natural stand of tree growth and related vegetation should be retained between borrow pit areas to be developed adjacent to the proposed Mackenzie Highway right-of-way for aesthetic values.
- Stands of natural growth should be retained between borrow pit areas in order to facilitate regrowth through natural regeneration.
- The use of dozers, overhead loaders and conventional ripping equipment should adequately remove the material from this site.
- The production of quality surface course and concrete aggregate material may be possible by exercising selective excavation procedures during the development of borrow pits. The production of higher quality aggregates will dictate the need of screening, crushing and washing plants to ensure aggregate properties for specified construction requirements.
- Additional laboratory tests to evaluate specific physical and chemical properties of the granular materials will be required, if the material is to be considered for the production of concrete aggregates.

ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation procedures should include:

- Recontouring of the pit areas to provide general drainage that is compatible with the natural drainage of the adjacent terrain.
- Replacing stockpiled surficial waste material and organic topsoil on the abandoned recontoured pit areas.
- Reseeding of the recontoured pit areas should be considered in areas that may pose erosional problems. At these locations, the artificial reseeded of annuals and perennials will result in a semi-permanent cover growth prior to reestablishment of native species.

DETAILED DRILL HOLE LOG

SITE NO. 124

HOLE NO. DH-1

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	TOPSOIL: organic, fibrous, dark brown		Vs			0
2		ML-SM	SILT and SAND: fine grained, brown					2
4		SM-SP	SAND: little gravel, trace silt, fine grained, poorly graded, medium brown		Vx	L		4
6								6
8								8
10				UF			GS O	10
12		GM	GRAVEL: little sand and silt, trace clay, predominantly sub-angular and subrounded pebbles to 2" size, greyish brown		Vr Vx	L	MC	12
14								14
16								16
18		SM-SP	SAND: little silt, fine grained, poorly graded, brown		Vx			18
20		ML	SILT: little sand, trace clay, brown					20
			TOTAL DEPTH 20.0'					20

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 124

HOLE NO. DH-2

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	TOPSOIL: organic, fibrous, little silt, dark brown		Vs			0
1.5								
2		ML	SILT: little sand, trace clay, brown		Vs	L		2
4					Vx			4
6								6
8								8
10								10
12					UF			12
14								14
15.0			TOTAL DEPTH 15.0'					15.0
16								16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 124

HOLE NO. DH-3

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	1.0 TOPSOIL: some silt and sand, light brown					0
2		ML-SM	SILT and SAND: fine grained, poorly graded, light brown		Nf	VL		2
4								4
6			6.0					6
8		GM	GRAVEL: little sand and silt, predominantly subangular and sub-rounded limestone pebbles to 2" size, brown		Vx	L		8
10							MC	10
12		SM-SP	SAND: little silt, trace gravel, fine grained, poorly graded, brown		Nbn	L		12
14								14
			14.0 TOTAL DEPTH 14.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



DETAILED DRILL HOLE LOG

SITE NO. 124

HOLE NO. DH-4

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	TOPSOIL: some silt, little sand, organic, roots, light brown					0
1			1.0					1
2			SAND: some silt, very fine grained, poorly graded, light brown					2
3		SM-SP	- little silt and gravel from 3.0', fine grained, poorly graded, subangular and subrounded pebbles to 2" size, brown		Nf	VL		3
4								4
5								5
6		ML	SILT: little sand, trace clay, brown		Vx	L		6
7			7.0					7
			TOTAL DEPTH 7.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 124

HOLE NO. DH-5

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	1.0 TOPSOIL: little silt, trace sand, organic, light brown		Nf	VL	MC GS O	0
2		SM	SAND: some silt, occasional pebbles to 1" size, brown					2
4		GW-GM	4.0 GRAVEL and SAND: medium to coarse grained, well graded, predominantly subrounded and subangular limestone and dolomite with quartzite pebbles to 2" size, grey, boulders at 11.0'					4
6								6
8								8
10								10
11.0			11.0 TOTAL DEPTH 11.0'					11.0
12								12
14								14
16								16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



DETAILED DRILL HOLE LOG



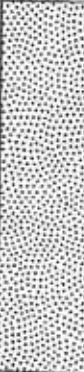


SITE NO. 124

HOLE NO. DH-6

DATE: FEB. 16, 1973

LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D			
0		OL	1.0 TOPSOIL: some silt and sand, organic, roots, light brown					0	
2		SM-SP	SAND and SILT: fine grained, poorly graded, light brown			VL		2	
4								4	
6								6	
7.0					Nf			7.0	
8		GW-GM	GRAVEL: little sand, trace silt, fine to medium grained, well graded, predominantly subangular and subrounded limestone and quartzite pebbles to 1 1/2" size, grey			L		8	
10								10	
12							MC	12	
13.0		ML	SILT and SAND: trace clay, brown		Vx			13.0	
14								14	
15.0			TOTAL DEPTH 15.0'					15.0	
16								16	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 124

HOLE NO. DH-7

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	TOPSOIL: some silt, little sand, organic, roots, light brown		Nf			0
1.5		ML	SILT and SAND: fine grained, poorly graded, brown					2
2								
3.5			SAND: trace silt, fine to medium grained, poorly graded, brown		Vx	L		4
4			- little gravel from 5.0' to 7.0'					6
6								8
8		SM-SP						10
10								12
12								14
14				UF				16
15.0			TOTAL DEPTH 15.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 124

HOLE NO. DH-8

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE CONT.		
0		OL	TOPSOIL: some silt, organic, roots, brown		Vr	L-M		0
1								1
2		ML	SILT: some clay, medium plastic, light brown		Nf	L		2
3								3
4								4
5								5
6		MH	- becoming high plastic and brown from 6.0'					6
7								7
8			TOTAL DEPTH 8.0'					8

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"




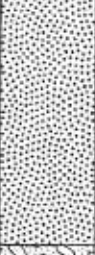


DETAILED DRILL HOLE LOG

SITE NO. 124

HOLE NO. DH-9

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	1.0 TOPSOIL: some silt, organic, roots, greyish brown		V _x V _r	L	0	
2		ML	SILT: some sand, light brown		N		2	
4							4	
5.0							5.0	
6		SM-SP	SAND: trace silt, fine grained, poorly graded, brown	V _x	6			
8					8			
9.0					9.0			
10		GM	GRAVEL: little sand, trace silt, predominantly rounded to sub-angular pebbles to 1 1/2" size, greyish brown	UF		10		
12						12		
14						14		
14		SM	14.0 SAND and SILT: brown			14		
15.0			15.0 TOTAL DEPTH 15.0'			15.0		
16						16		

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 124

HOLE NO. DH-10

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	1.0 PEAT: organic, fibrous, muskeg, dark brown					0
2		ML	SILT: some clay, occasional pebbles to 1" size, light brown					2
4								4
6			5.0 - some clay and sand pockets, rust specks, occasional pebbles to 1" size, medium brown, from 5.0'		N	L		6
8		ML-CL	(TILL)					8
10								10
12			12.0 TOTAL DEPTH 12.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



DETAILED DRILL HOLE LOG

SITE NO. 124

HOLE NO. DH-11

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)				
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.						
0		Pt	0.5 PEAT: organic, fibrous, muskeg, dark brown					0				
2		GW-GP	GRAVEL: some sand, little silt, occasional sand layers, pebbles to 2½" size, few cobbles, rust brown		Nf	L		2				
4				4								
6				6								
8				8								
10				10								
12				12								
14				14								
16				16								
								UF				
				16.0				TOTAL DEPTH 16.0'				

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

P PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 124

HOLE NO. DH-12

DATE: FEB. 16, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	1.0 PEAT: organic, fibrous, muskeg, dark brown		N			0
2		ML	SILT: light brown		Vs	L		2
4		ML-SM	4.0 - becoming sandier, coarse grained, poorly graded from 4.0' to 9.0', medium brown					4
6		ML-SM						6
8		ML-SM						8
10		ML-CL	9.0 - becoming clayier from 9.0' (TILL)					10
12		ML-CL	12.0 TOTAL DEPTH 12.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 124

HOLE NO. B D

DATE: FEB. 28, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0								0
2		SP	▼ ——— Brown fine to coarse sand and gravel (Very dense)					2
4				UF				4
6								6
8								8
10								10
12								12
14								14
16			15.0 ——— END OF HOLE 15.0'					16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 124

HOLE NO. BT 1

DATE: MAR. 2, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER: Trench Pit

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.			
0		SM	Brown, fine silty sand with some organic matter		Nbn			0	
1									1
2		GP	Brown sand and gravel		Nf			2.0	
3								3	GS
4								4	
5			5.5					5	
6			END OF TRENCH 5.5'					6	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

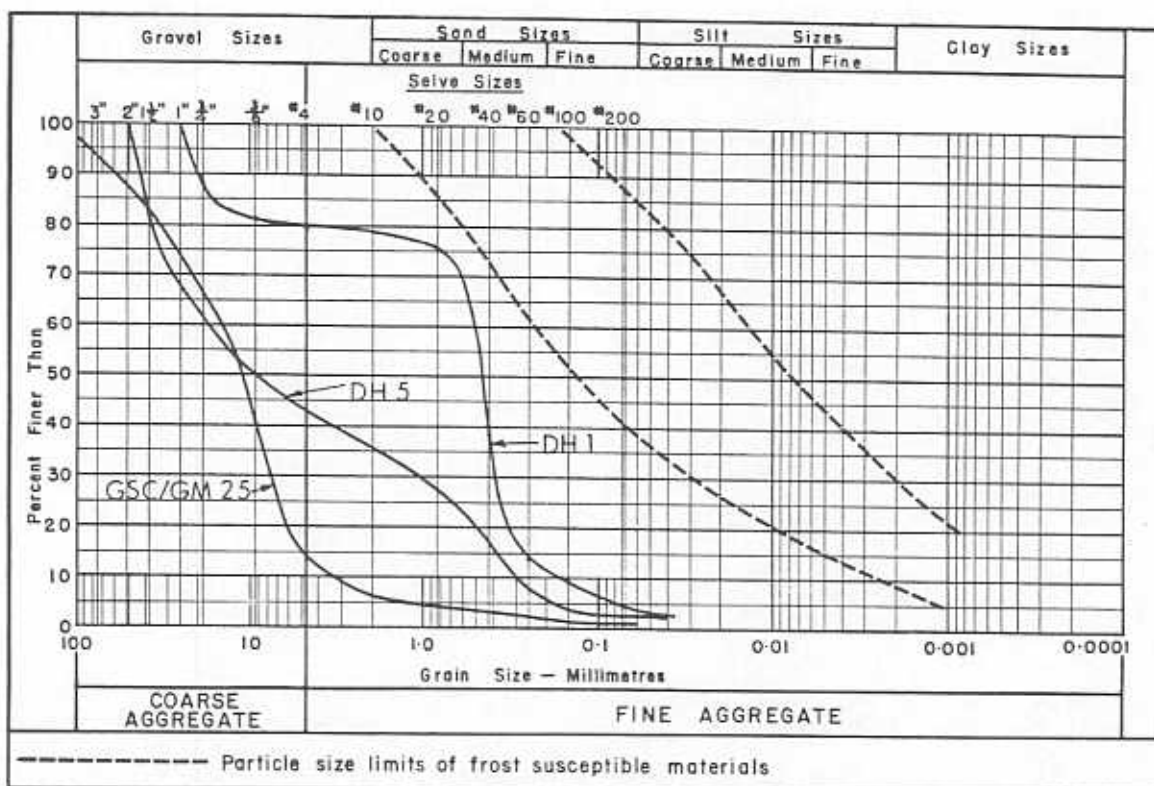
GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	124/DH 1	124/DH 5	GSC/GM 25
Sample Depth (Feet):	9.0	8.0-10.0	-
Moisture Content (%):	-	3.3	..
Ice Content (%):	-	-	-
Organic Content (%):	2.4	-	..

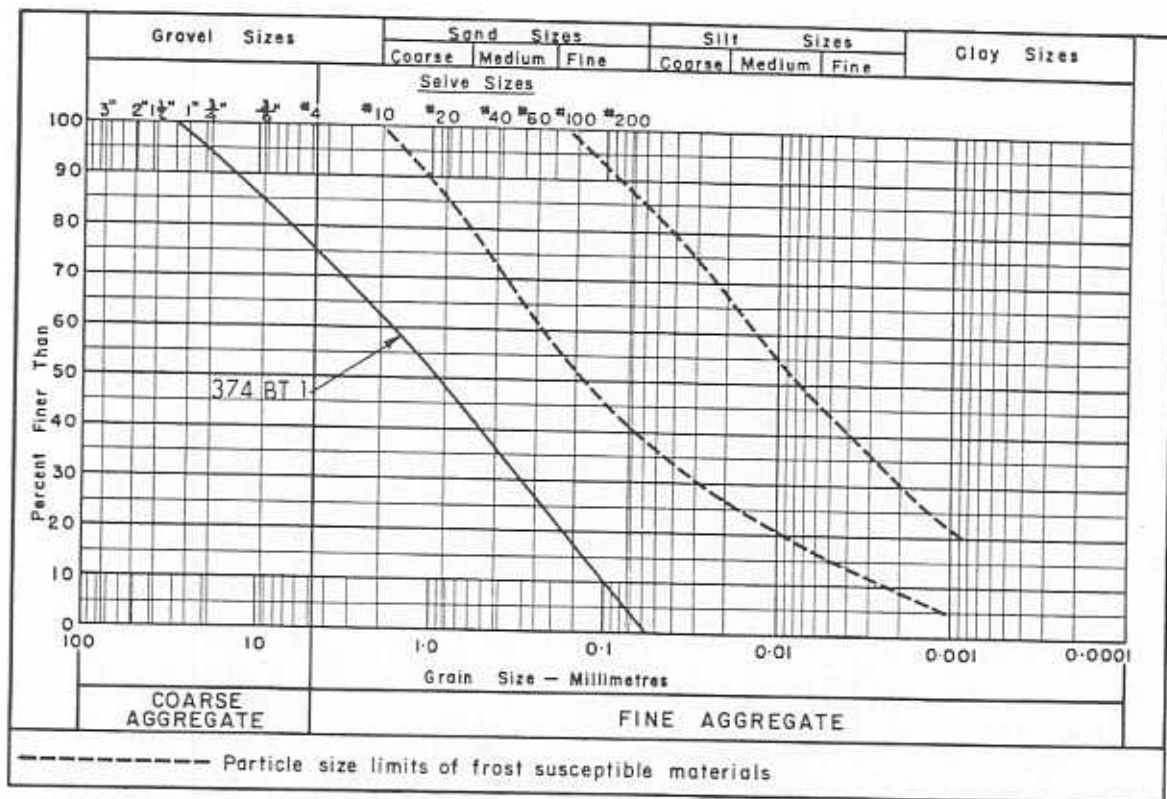
GRAIN SIZE DISTRIBUTION:



SUMMARY OF LABORATORY TEST DATA

Sample Location: 124/374 BT 1
 Sample Depth (Feet): 3.5
 Moisture Content (%): -
 Ice Content (%): -
 Organic Content (%): -

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

SUMMARY OF MOISTURE CONTENT DETERMINATIONS

<u>Sample Location</u>	<u>Sample Depth (Ft.)</u>	<u>Moisture Content (%)</u>
124/DH 1	13.0	3.2
124/DH 3	9.0	3.2
124/DH 6	12.0	3.7

SITE NO. 125

LOCATION

Located approximately 12 miles northeast of Camsell Bend on the east side of the Mackenzie River and within the flat terrain of the Great Slave Plain, Site 125 consists of a bedrock ridge, 1 mile in length and less than $\frac{1}{2}$ mile in width, covered with glaciolacustrine deposits.

The proposed Mackenzie Highway right-of-way at Mile 372 is located approximately $5\frac{1}{2}$ miles east of Site 125. The direct distance to the proposed gas pipeline route is in excess of 11 miles.



LEGEND

- | | |
|--|----------------------------------|
| ----- All weather road | Required access |
| - - - - - Existing trails and cutlines | - · - · - Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |

Airphoto No. A22933/142

Approximate scale: 1" = 3,000'

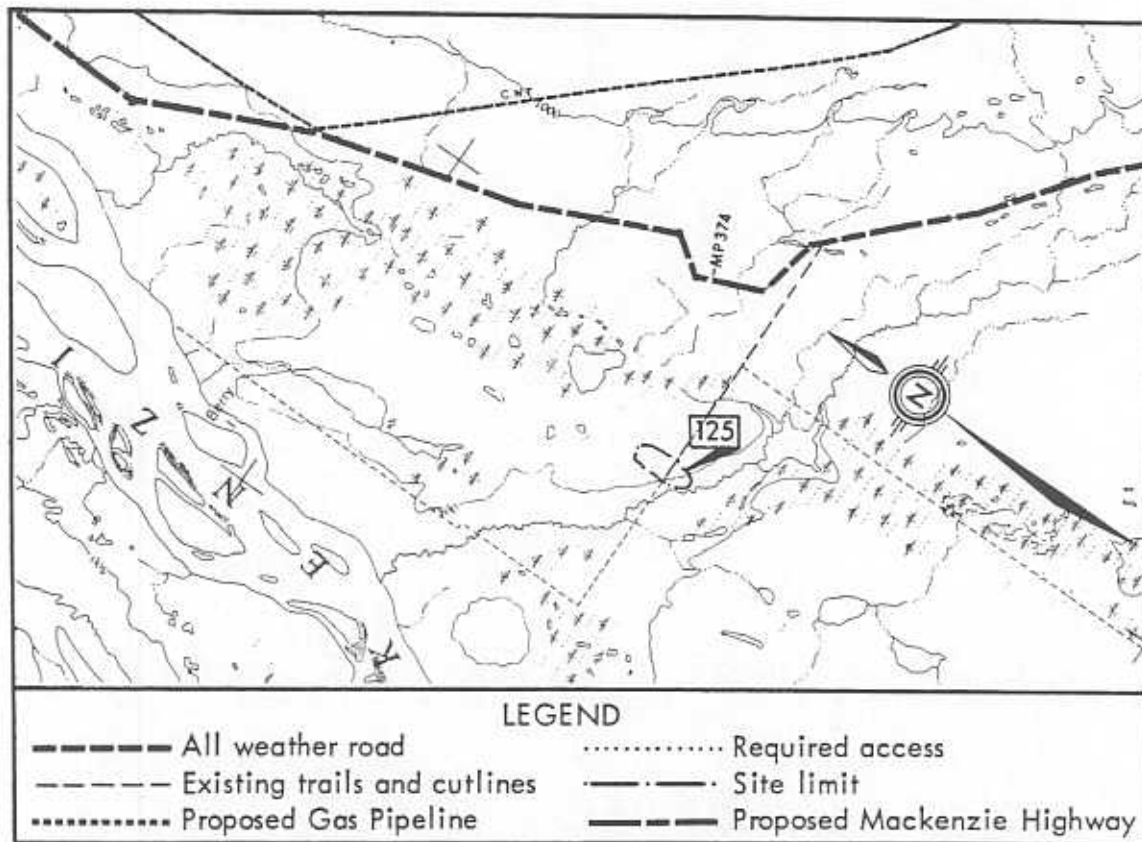


GENERAL

Site 125 encompasses a bedrock ridge rising above the flat surrounding terrain which is relatively well drained and covered with mixed stands of spruce, poplar, alder and birch. The adjacent terrain is poorly drained despite the existence of a small stream along the southwestern side of the ridge. Depressional terrain with thermokarst features exists between the proposed highway route and the site. There are no known critical wildlife areas in the vicinity of Site 125.

According to geological investigations, the ridge consists of Upper Devonian limestone interspersed with siltstone and shale. The bedrock is, however, completely covered by glacio-lacustrine sediments and bedrock outcrops were not noted during the field reconnaissance. The thickness of overburden may curtail the exploitation of the site. Therefore, Site 125 is rated as a fair prospect.

Open water was encountered along the access routes to the planned drill hole locations which prevented any detailed winter investigations. Access to the site from the proposed Mackenzie Highway crosses depressional, poorly drained and locally thermally sensitive terrain.



Section of Map No. 95 J

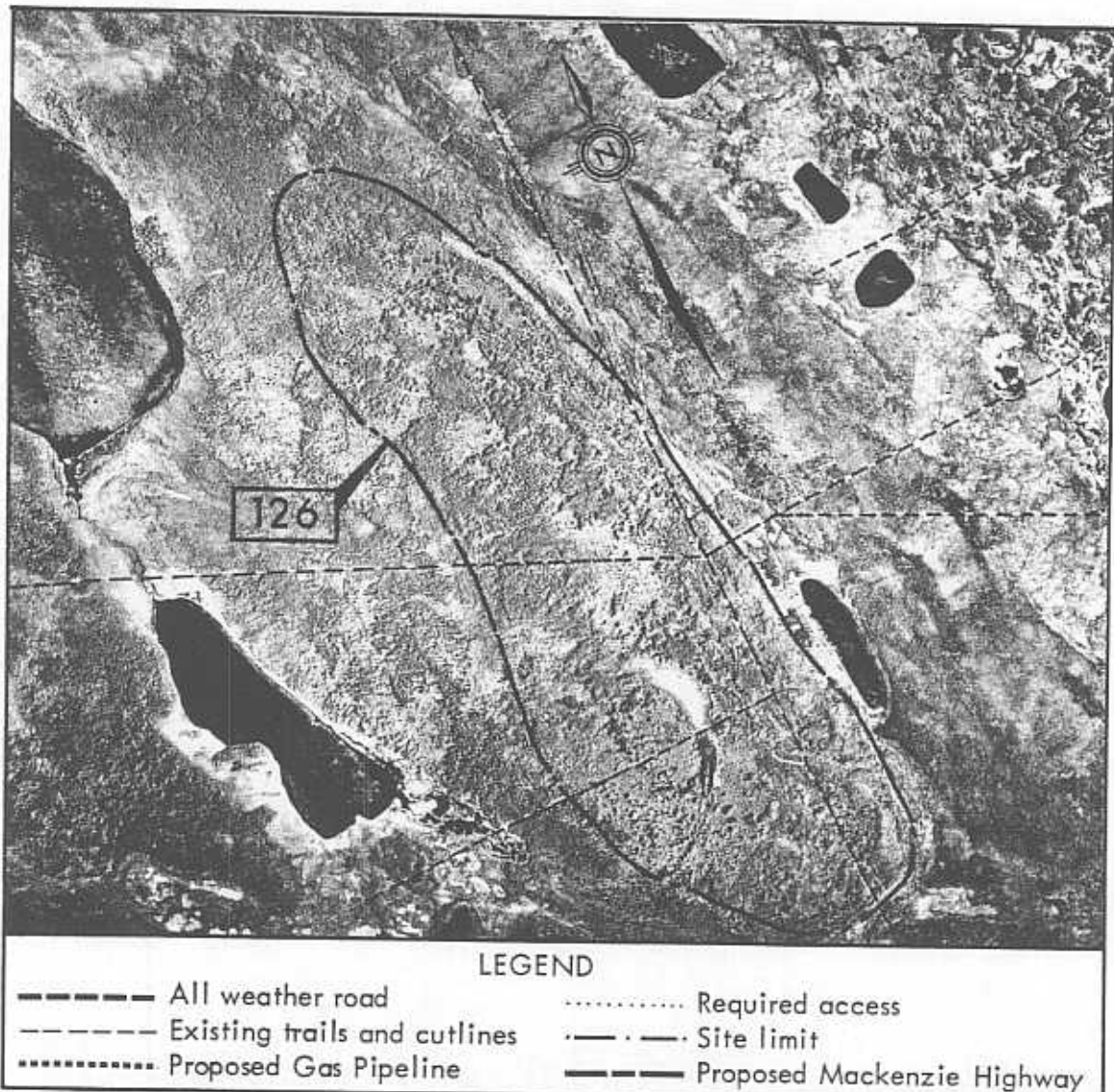
Scale: 1:250,000

SITE NO. 126

LOCATION

Located approximately 8 miles south of Willowlake River and 4 miles east of the Mackenzie River, Site 126 consists of a bedrock ridge covered with glaciolacustrine deposits.

The proposed Mackenzie Highway right-of-way at Mile 377 is located approximately $4\frac{1}{2}$ miles east of Site 126. The direct distance to the proposed gas pipeline route is approximately $11\frac{1}{2}$ miles.



Airphoto No. A22933/227

Approximate scale: 1" = 3,000'

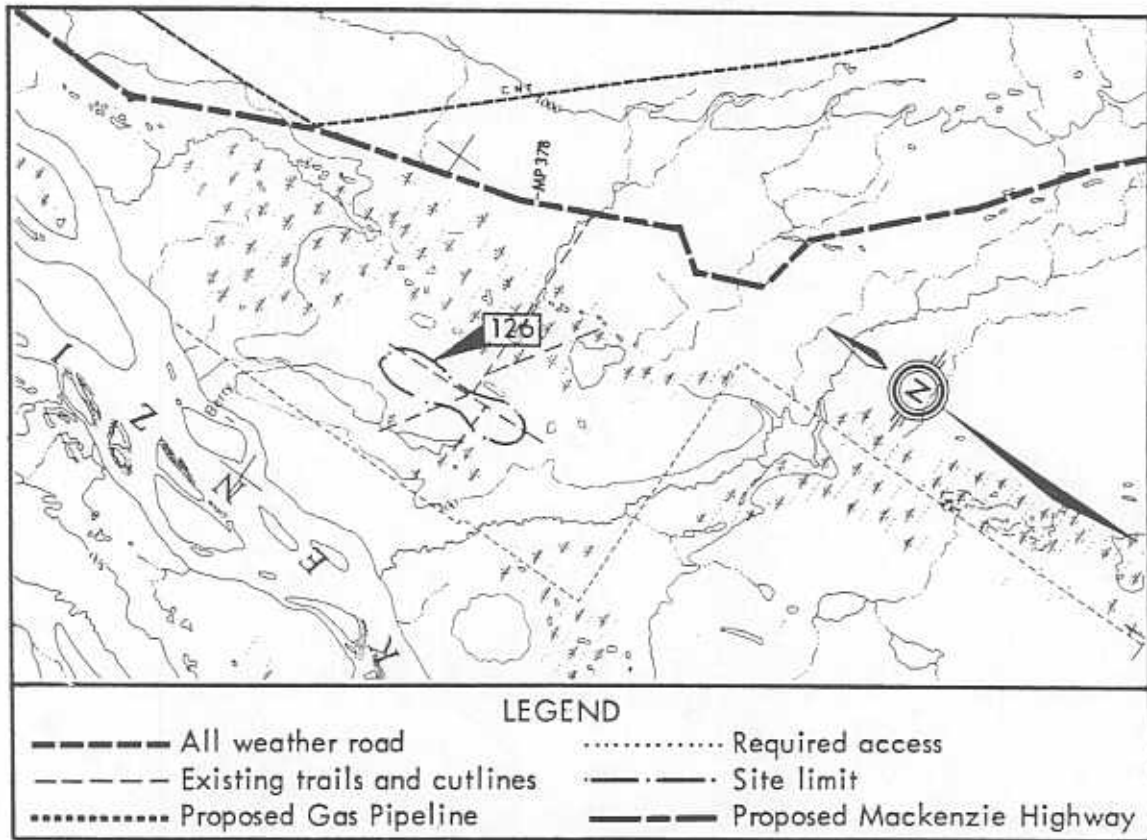


GENERAL

Site 126 encompasses a bedrock ridge approximately 3 miles in length and nearly 3/4 of a mile in width. The ridge rises relatively steeply on its east side above the flat and depressional Great Slave Plain. However, the ridge ascends relatively gently at other points along its perimeter. The ridge is relatively well drained and is densely vegetated, while the surrounding terrain is poorly drained with frequent thermokarst features. There are no known critical wildlife areas in the vicinity of Site 126.

According to geological investigations, the ridge consists of Upper Devonian limestone interspersed with siltstone and shale. No sizable outcrops of the limestone were encountered during the field reconnaissance. The shale interbeds may be quite frequent, which would considerably decrease the quality of manufactured granular materials. Moreover, the bedrock is covered with a relatively thick layer of overburden which in turn may curtail the economic exploitation of the source. Therefore, Site 126 is rated only as a fair prospect.

The planned drilling could not be accomplished because of open water encountered on access routes to the site. Access to the site from the proposed utilities will be extremely difficult and will require construction of an access road across thermally sensitive terrain.



Section of Map No. 95 J

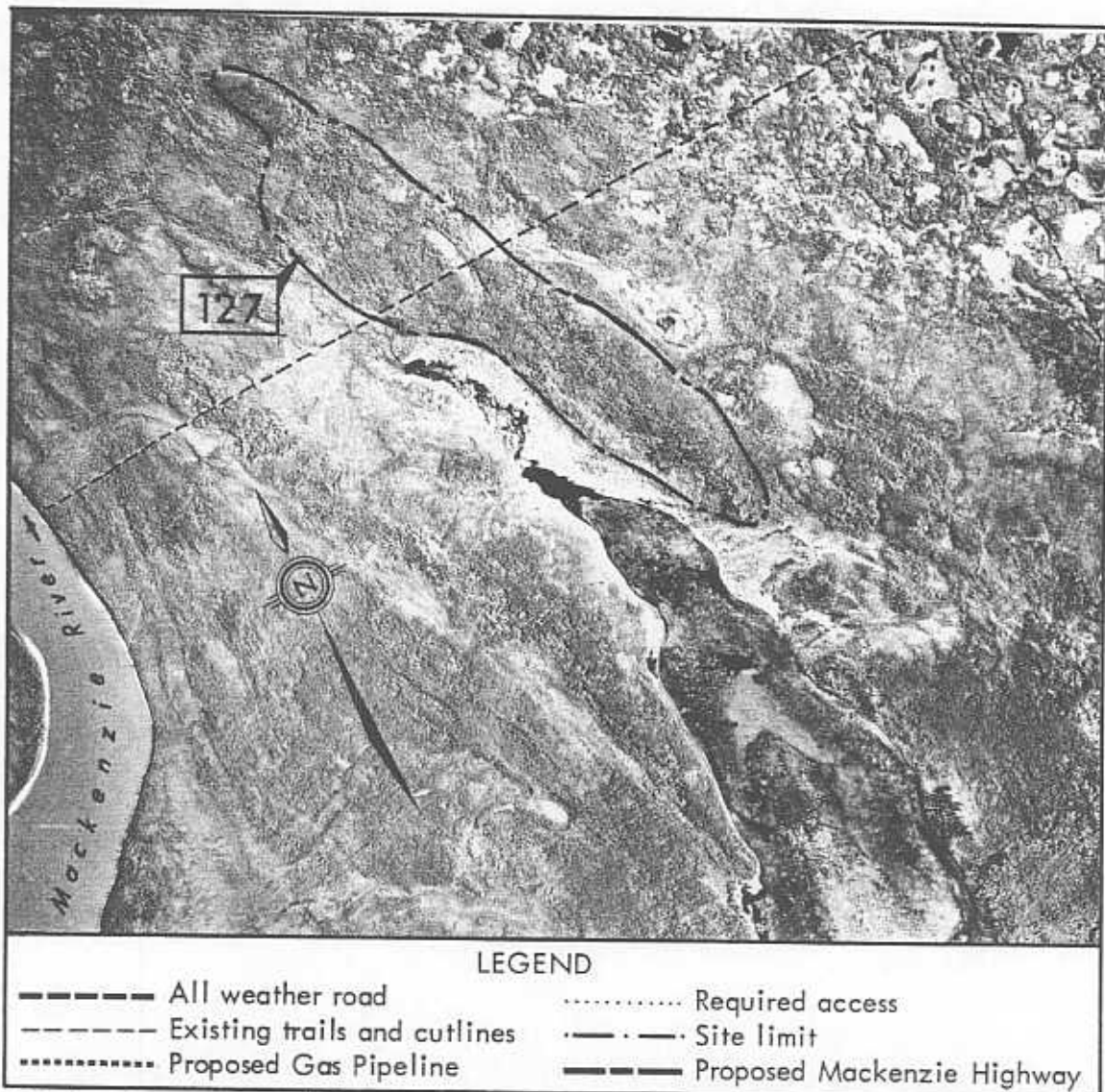
Scale: 1:250,000

SITE NO. 127

LOCATION

Located approximately $1\frac{1}{2}$ miles east of the Mackenzie River, between Camsell Bend and the Willowlake River, Site 127 consists of a large bedrock ridge covered with glacio-lacustrine deposits.

The proposed Mackenzie Highway right-of-way at Mile 383 is located approximately $4\frac{1}{2}$ miles east of Site 127. The proposed gas pipeline route runs approximately $5\frac{1}{2}$ miles east of the site area.



Airphoto No. A22933/228

Approximate scale: 1" = 3,000'



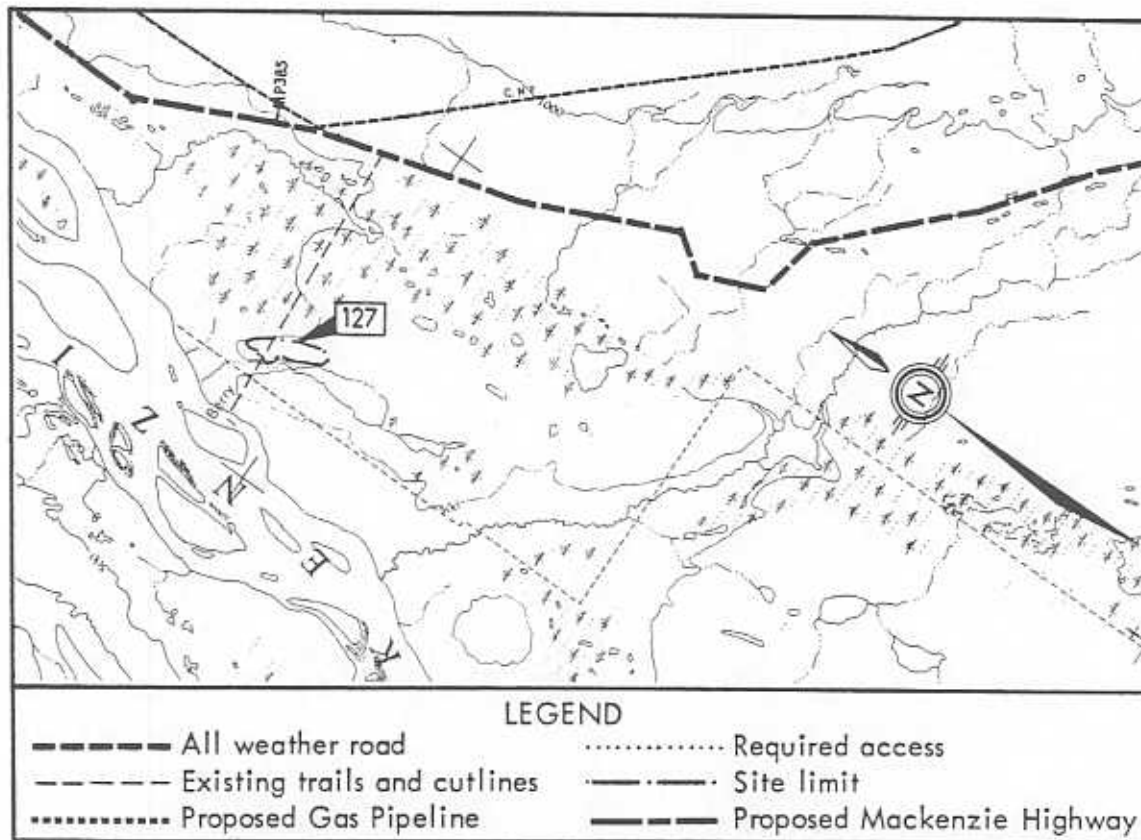
GENERAL

Site 127 consists of a bedrock ridge which forms a relatively prominent feature as it rises well above the adjacent flat and partly depressional terrain. According to geological investigations, the ridge is formed by Upper Devonian limestone interspersed with siltstone and shale. The ridge itself is fairly well drained and densely vegetated with good stands of poplar, alder and birch. The adjacent terrain is poorly drained with frequent thermokarst features, especially on the west side of the ridge. There are no known critical wildlife areas in the immediate vicinity of Site 127.

Limestone with minor siltstone and shale inclusions should be suitable for manufacturing various construction materials, such as general fill, base and possibly surface course aggregates. The development of the site would require a quarry operation including blasting and crushing.

The bedrock, however, is covered with a relatively thick layer of overburden which may limit the economic exploitation of the source. Planned drilling to determine the actual overburden thickness was not possible because of open water in the thermokarst terrain. Similarly, access to the site from the proposed utilities will be extremely difficult because of the thermally sensitive terrain.

Therefore, Site 127 is considered only to be a fair prospect for manufacturing of construction materials.



Section of Map No. 95 J

Scale: 1:250,000

SITE NO. 128X

Located 14 miles south of the Willowlake River and less than $\frac{1}{4}$ mile west of the proposed Mackenzie Highway at Mile 381, Site 128X consists of a group of flat topped erosional remnants of the glacial till sheet.

Type of Material: Glacial Till; partially reworked.

Estimated Volume: Not applicable.

Assessment: Site 128X is not recommended for development because materials of granular quality were not established during the field drilling program.



LEGEND

- | | |
|--------------------------------------|------------------------------------|
| ----- All weather road | Required access |
| - - - - Existing trails and cutlines | ·-·-· Site limit |
| Proposed Gas Pipeline | - - - - Proposed Mackenzie Highway |
| ⊙ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A22934/6

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 128X is located 14 miles south of Willowlake River and less than $\frac{1}{4}$ mile west of the proposed Mackenzie Highway right-of-way at Mile 381. The site area, which is approximately $1\frac{1}{2}$ miles in length and 1 mile in width, encompasses a group of flat topped, eroded till ridges which rise 10 to 20 feet above the adjacent terrain. The terrain to the west is poorly drained and consists of peat and muskeg bogs with numerous small lakes and ponds.

The till ridges are topped with reworked till material containing localized shallow patches of gravelly outwash material. The site area is overlain by topsoil, generally less than 1 foot in depth, which supports dense clustered growths of birch and poplar and light growths of spruce.

There are no known critical wildlife areas in the immediate vicinity of Site 128X.

The only existing access to the site area from the proposed Mackenzie Highway right-of-way or CNT pole line consists of seismic cutlines.

DEVELOPMENT

Site 128X is not recommended for development because materials of granular quality were not established during the winter drilling program.

DETAILED DRILL HOLE LOG

SITE NO. 128X

HOLE NO. DH-1

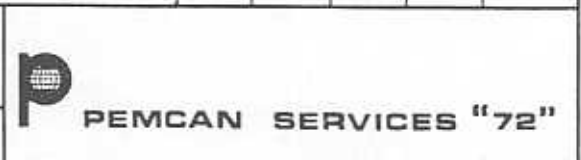
DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	1.0 TOPSOIL: organic, black					0
2		ML	2.0 SILT: some clay, light brown		Vs	H		2
4			5.0					4
6		SM-SP	6.0 SAND: some silt, medium brown					6
8			9.0					8
10		ML	10.0 SILT: some clay, medium brown					10
12			12.0 TOTAL DEPTH 12.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



DETAILED DRILL HOLE LOG

SITE NO. 128 X

HOLE NO. DH-2

DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	0.5 PEAT: organic, fibrous, muskeg, dark brown					0
2			SILT: some clay, light brown		Vs	H		2
4			4.0 - little sand, sensitive, medium brown from 4.0' (TILL)					4
6		ML						6
8				UF				8
10								10
12			12.0 TOTAL DEPTH 12.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"



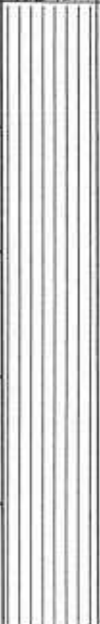
DETAILED DRILL HOLE LOG

SITE NO. 128X

HOLE NO. DH-3


DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D			
0		GM-GP	GRAVEL: some silt, little sand, organic, poorly graded, rust brown		Nf	L		0	
2			SILT: some clay, occasional pebbles to 1" size, light brown		Vs	L-M		2	
4		ML	5.0 - some sand, occasional pebbles to 1" size from 5.0', medium brown (TILL)	UF				4	
6								6	
8									8
10								10	
12			TOTAL DEPTH 12.0'					12	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

 **PEMCAN SERVICES "72"**

DETAILED DRILL HOLE LOG

SITE NO. 128X

HOLE NO. DH-4

DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		GM-GP	GRAVEL: some silt, little sand, trace organic, poorly graded, rust brown		Nf	L-M		0
2	2							
4		ML	SILT: some clay, frequent pebbles to 1" size, medium brown		Nf	L-M		4
6	6							
8	8							
10			- occasional pebbles to 1" size from 7.0' (TILL)					10
12			TOTAL DEPTH 12.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

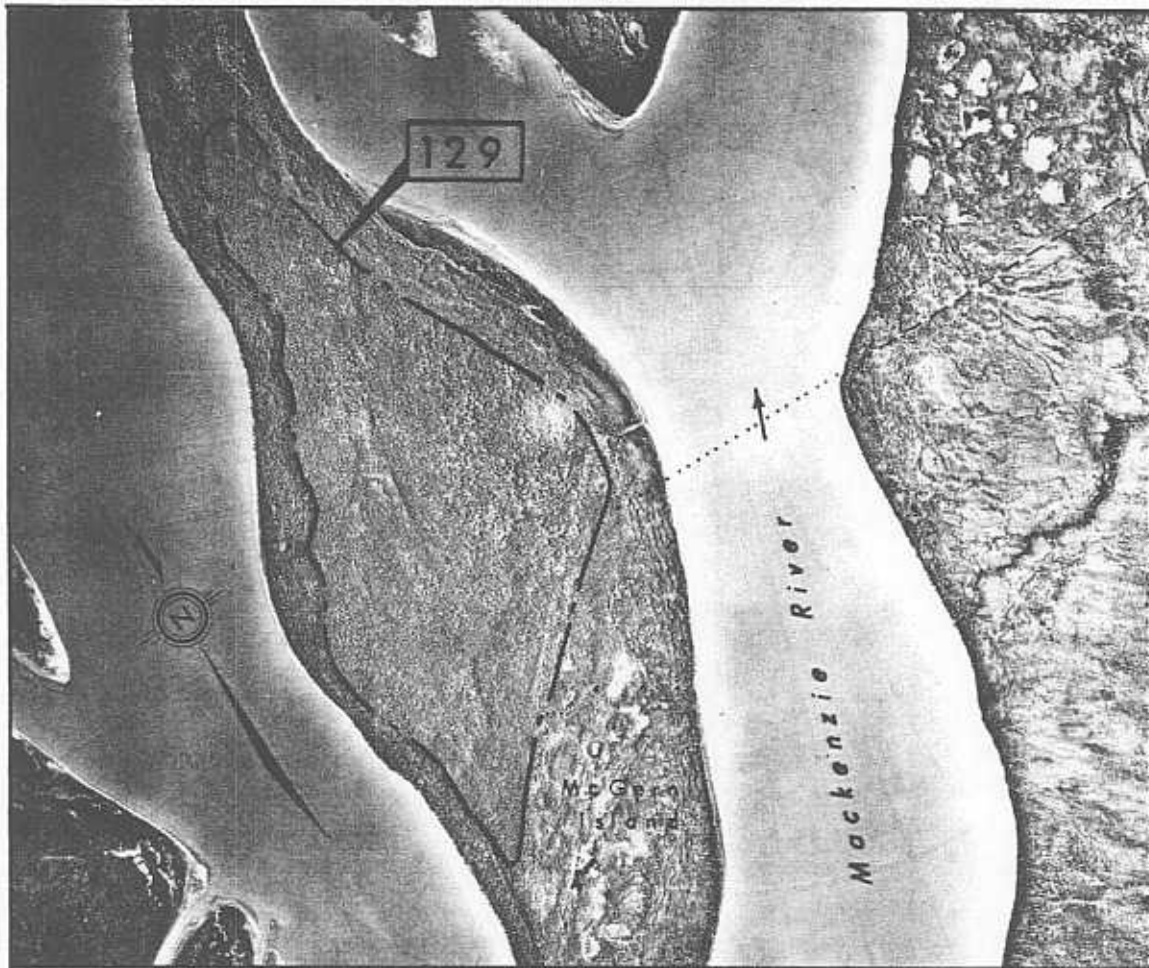
PEMCAN SERVICES "72"

SITE NO. 129

LOCATION

Located within the broad Mackenzie River channel, approximately 10 miles upstream from the mouth of Willowlake River, Site 129 encompasses the southern tip of McGern Island. The island is separated from the east bank of the Mackenzie River by a channel in excess of $\frac{1}{2}$ mile in width.

The currently proposed Mackenzie Highway right-of-way at Mile 386.6 is located approximately 5 miles east of Site 129. The proposed gas pipeline route runs approximately $8\frac{1}{2}$ miles east of the site area.



LEGEND

- | | |
|--|----------------------------------|
| ----- All weather road | Required access |
| - - - - - Existing trails and cutlines | - · - · - Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |

Airphoto No. A22934/3

Approximate scale: 1" = 3,000'

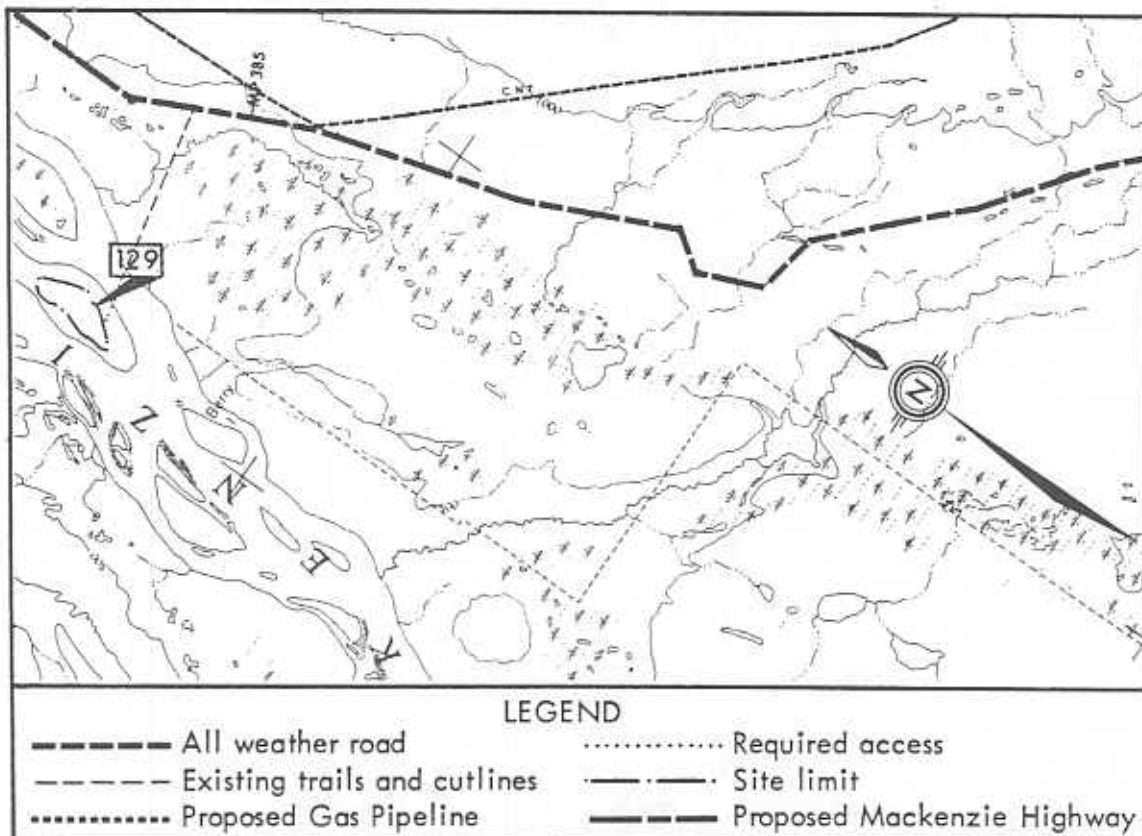


GENERAL

The site area, approximately $1\frac{1}{2}$ square miles in size, encompasses the southern tip of McGern Island which is connected with the main island section with a narrow isthmus. A narrow, gravel paved beach covers the island shorelines. The steep western banks of McGern Island have experienced extensive sloughing.

On the basis of the pits dug on the main portion of McGern Island, a relatively thick layer of stratified alluvial silt forms the upper part of the soil profile which in turn supports good stands of spruce mixed with poplar and birch. Gravel, sand, silt and clay mixtures with thin sand and gravel pockets are indicated at greater depth within an area outlined on the airphoto. These materials would be suitable for fair quality general fill. There are no known critical wildlife areas in the immediate vicinity of Site 129.

The exploitation of materials from this site would be, however, curtailed by difficult access and transportation involving the river arm crossing. Existing seismic cutlines connecting the proposed utility lines with the river bank traverse poorly drained and locally thermally sensitive terrain. Because of the foregoing and with respect to the vicinity of the river channel, Site 129 is not suggested for development.



Section of Map No. 95 J

Scale: 1:250,000

SITE NO. 130X

Located approximately 9 miles south of the Willowlake River and 1 to 2 miles west of the proposed Mackenzie Highway at Mile 384.5, Site 130X consists of two erosional remnants of the glacial till sheet.

Type of Material: Glacial Till; sand, silt and clay interspersed with pebbles

Estimated Volume: Not applicable

Assessment: Site 130X is not recommended for development because materials of granular quality were not established by the field drilling program.



LEGEND

- | | |
|------------------------------------|----------------------------------|
| ----- All weather road | Required access |
| ----- Existing trails and cutlines | ----- Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |
| ⊙ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A22934/4

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 130X is located 9 miles south of Willowlake River and consists of two erosional remnants of a glacial till sheet. The areas designated as "a" and "b" on page 130-1, are located 1 and 2 miles, respectively, west of the proposed Mackenzie Highway right-of-way at Mile 384.5. The adjacent terrain is slightly depressional and consists of muskeg bogs exhibiting thermokarst features. Area "b" is more pronounced and better drained than area "a", and may be topped with a thin veneer of reworked till material or outwash material. A small creek which flows between the two portions of Site 130X was unfrozen and prevented access to area "b" during the winter drilling program.

The glacial till material consists of a heterogeneous mixture of silt, sand and clay interspersed with numerous pebbles. The till stratum, which was frozen to depths of 5 to 7 feet below existing ground surface, exhibited very low ground ice content. A layer of organic topsoil, generally less than $1\frac{1}{2}$ feet in thickness, supports moderately dense growths of spruce with scattered clusters of birch.

There are no known critical wildlife areas in the immediate vicinity of Site 130X.

The only existing access from the proposed Mackenzie Highway right-of-way or CNT pole line to the site area consists of a seismic cutline. The seismic cutline traverses the muskeg terrain between areas "a" and "b" and would restrict any future access to area "b" to the winter months.

DEVELOPMENT

Site 130X is not recommended for development because materials of granular quality were not established during the winter drilling program.





DETAILED DRILL HOLE LOG

SITE NO. 130X

HOLE NO. DH-1

DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER: AIR

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	TOPSOIL: organic, black					0
2			1.5					2
4			SILT: some clay, occasional pebbles to 1/2" size, medium brown (TILL)		Nbe	L		4
6		ML-MH						6
8								8
10				UF				10
12			12.0					12
			TOTAL DEPTH 12.0'					

GOVERNMENT OF CANADA DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT	 PEMCAN SERVICES "72"
GRANULAR MATERIALS INVENTORY	




DETAILED DRILL HOLE LOG

SITE NO. 130X

HOLE NO. DH-2

DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	1.0 TOPSOIL: organic, black					0
2		ML-MH	SILT: some clay, few pebbles, medium brown (TILL) - wet from 5.0'		Nf	L		2
4								4
6								6
8				UF				8
10								10
12			12.0 TOTAL DEPTH 12.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

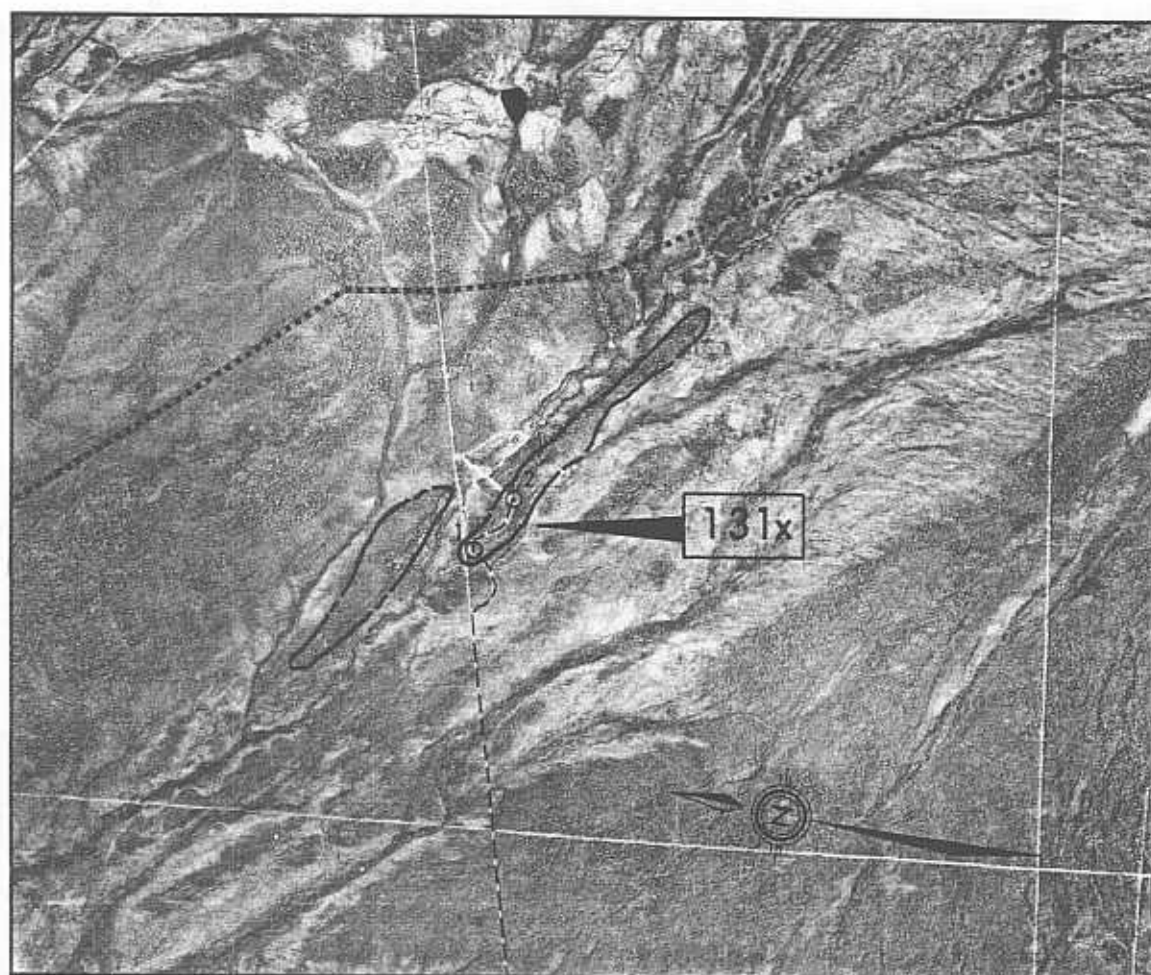
SITE NO. 131X

Located approximately 8 miles south of the Willowlake River and 4 miles east of the proposed Mackenzie Highway at Mile 386, Site 131X consists of two narrow and eroded till ridges which are adjacent to an erosional gully.

Type of Material: Glacial Till; surficially reworked.

Estimated Volume: Not applicable.

Assessment: Site 131X is not recommended for development because materials of granular quality were not encountered during the winter drilling program.



LEGEND

- | | |
|--------------------------------------|----------------------------------|
| ----- All weather road | Required access |
| - - - - Existing trails and cutlines | --- Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |
| ⊙ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A22889/60

Approximate scale: 1" = 3,000'



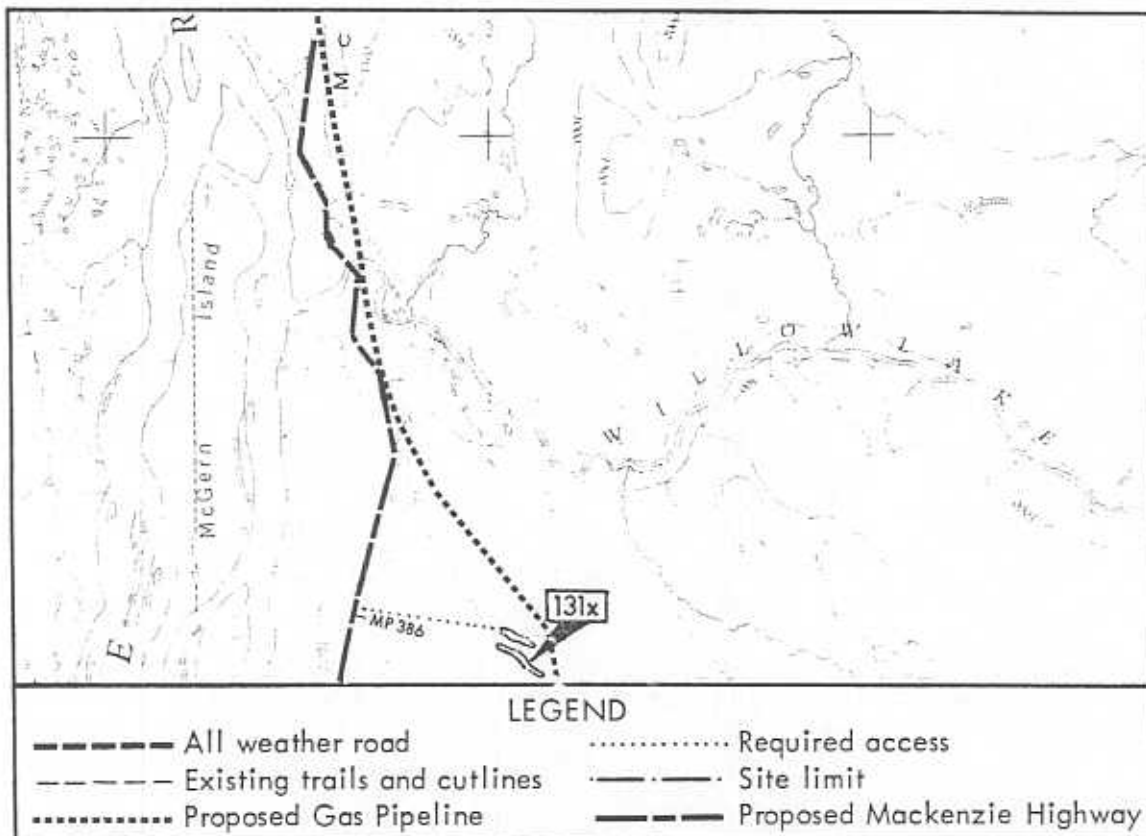
ENVIRONMENT

Site 131X is located approximately 8 miles south of the Willowlake River and 4 miles east of the proposed Mackenzie Highway right-of-way at Mile 386. The site consists of two narrow ridges which are located adjacent to an erosional gully and are approximately 1/2 and 1 mile in length, respectively, and vary from 200 to 500 feet in width. These ridges are well drained and the adjacent terrain, consisting of an eroded glacial till plain, exhibits good drainage to the southwest.

Site 131X consists, primarily, of glacial till overlain by a very shallow layer of reworked till or gravelly outwash. This gravelly surficial layer is poorly graded and high in silt content. A layer of topsoil, less than 1 foot in depth, covers the site area and supports dense growths of spruce attaining heights to 20 feet and trunk diameters to 6 inches.

There are no known critical wildlife areas in the immediate vicinity of Site 131X.

The only access to the site area from the CNT pole line or proposed Mackenzie Highway right-of-way consists of seismic cutlines. The proposed gas pipeline route is located less than 1/4 mile to the east of Site 131X.



Section of Map No. 95 J

Scale: 1:250,000



DEVELOPMENT

Site 131X is not recommended for development because materials of granular quality were not encountered during the winter drilling program. The surficial layer of reworked till could be utilized for very marginal embankment fill material.

DETAILED DRILL HOLE LOG

SITE NO. 131X

HOLE NO. DH-1

DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	1.0 TOPSOIL: organic, dark brown		Nf	L		0
2		GM-GP	GRAVEL: some silt, little sand, frequent pebbles to 1½" size, occasional boulders, medium brown (Reworked Till)		Vs	L-M		2
4							4	
6		ML	7.0 SILT: some clay, trace of rust and coal specks, frequent pebbles to 1" size, occasional boulders, medium brown (TILL)					6
8							8	
10							10	
12			12.0 TOTAL DEPTH 12.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 131X

HOLE NO. DH-2

DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)					
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.							
0		OL	TOPSOIL: organic, black		N			0					
1.0													
2		ML	SILT: some clay, little sand, frequent pebbles to 1" size, medium brown - trace rust and coal specks from 7.0' (TILL)		Vs	L-M		2					
4	4												
6	6												
8	8												
10	10												
12	12												
TOTAL DEPTH 12.0'													

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

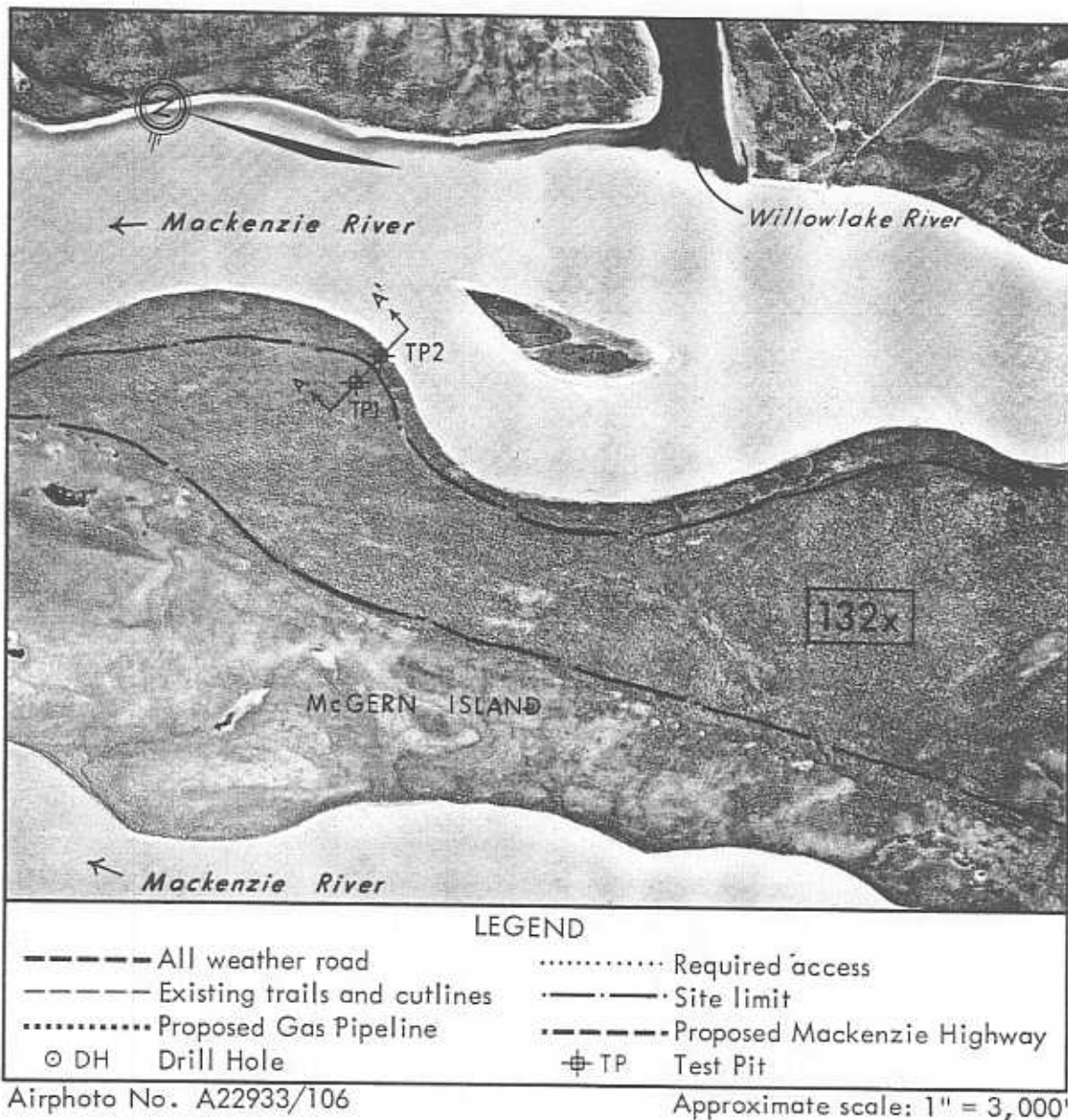
SITE NO. 132X

Located on McGern Island opposite the mouth of Willowlake River at Mile 394 on the proposed Mackenzie Highway, Site 132X consists of a slightly elevated fluvial floodplain.

Type of Material: Sand; varying silt content, fine grained, poorly graded.

Estimated Volume: Not applicable.

Assessment: Site 132X is not recommended for development because granular quality materials were not encountered during the field investigation; also, access to the site area is very difficult.





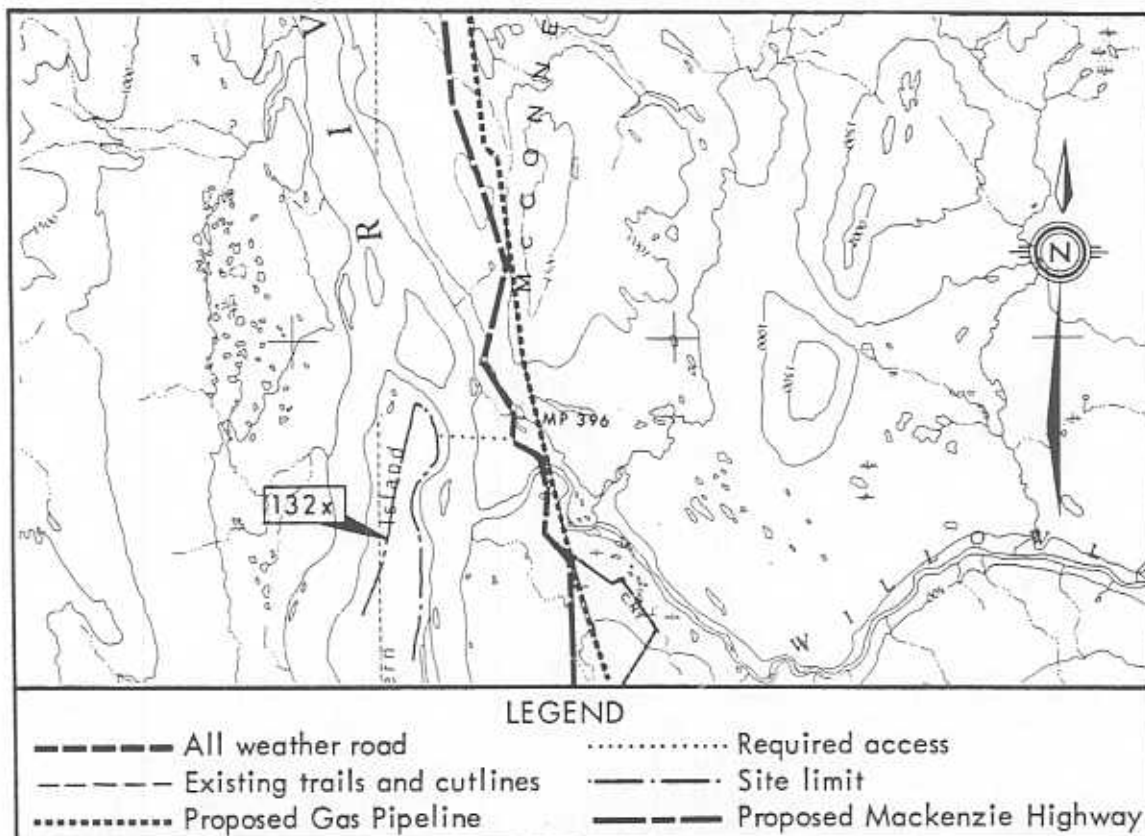
ENVIRONMENT

Site 132X is located on McGern Island in the Mackenzie River Channel and opposite the mouth of the Willowlake River at Mile 394 on the proposed Mackenzie Highway route. Site 132X consists of a slightly elevated and better drained portion of the active floodplain, approximately 2 miles in length and $\frac{1}{4}$ to 1 mile in width, which is comprised of fluvial deposits. The site area exhibits fair surficial drainage into the adjacent river channels.

The material in the fluvial deposits consists primarily of fine grained, poorly graded sand with a highly variable silt content. Thin layers of clay are interspersed within these sand deposits at various depth intervals. The exposed, steep cliff faces along the eastern shore-line of McGern Island have been surficially reworked by wind and water and exhibit slightly coarser graded sand in the initial 1 to 2 feet of the stratum. An organic topsoil layer, less than 1 foot in depth, overlies the site area and supports moderately dense growth of spruce, birch and poplar.

There are no known critical wildlife areas in the immediate vicinity of Site 132X.

The only access to the site area is by water and necessitates the crossing of the east or west channel of the Mackenzie River. Therefore, Site 132X is relatively isolated and difficult to approach.



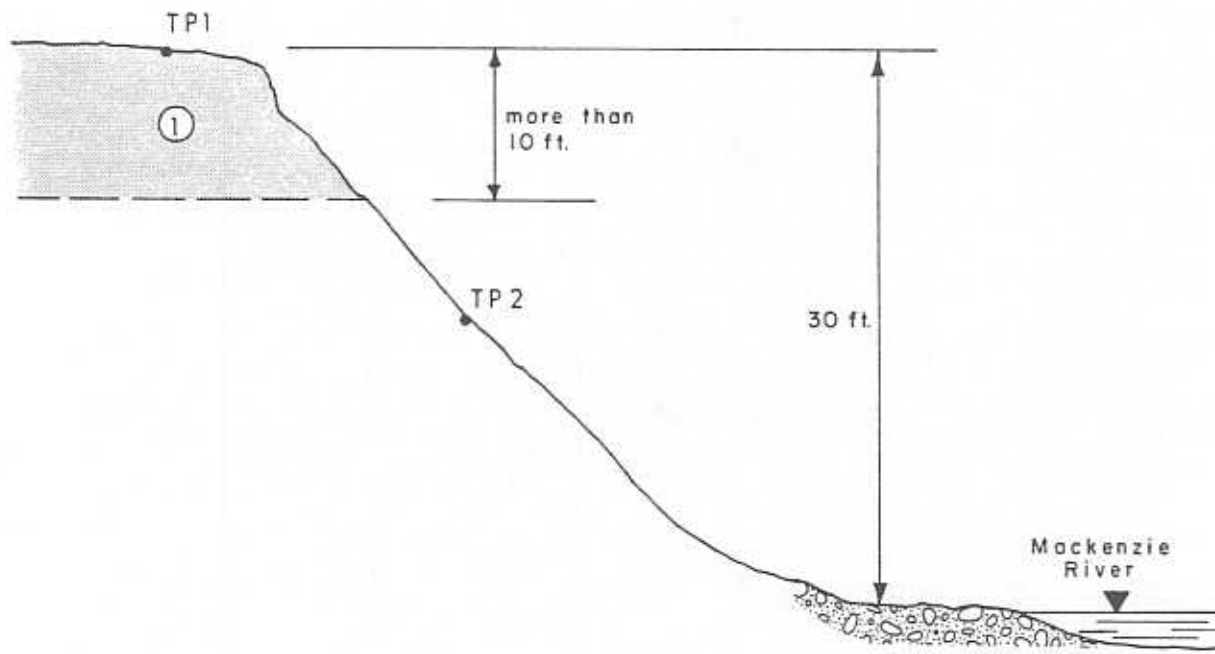
Section of Map No. 95 J

Scale: 1:250,000



DEVELOPMENT

Site 132X is not recommended for development because materials of granular quality were not established during the field investigation and the access to this site is very difficult involving a major crossing of the Mackenzie River.



SECTION A-A'

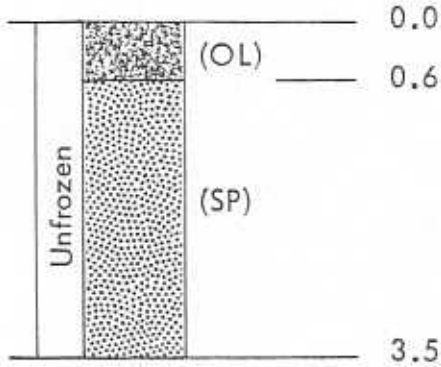
NOT TO SCALE

Soil Type:

1. Sand; some silt few pebbles.

DETAILED TEST PIT LOG

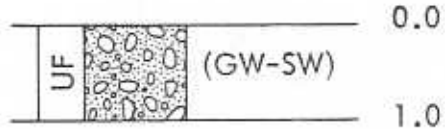
132X/TP 1



Topsoil; organic, roots, black

Sand; trace silt, fine to medium grained, poorly graded, occasional pebbles to $\frac{1}{2}$ " in size, dense, damp, medium brown, silt-clay layers and lenses, grey, 4" - 7" thick at 2.5'

132X/TP 2

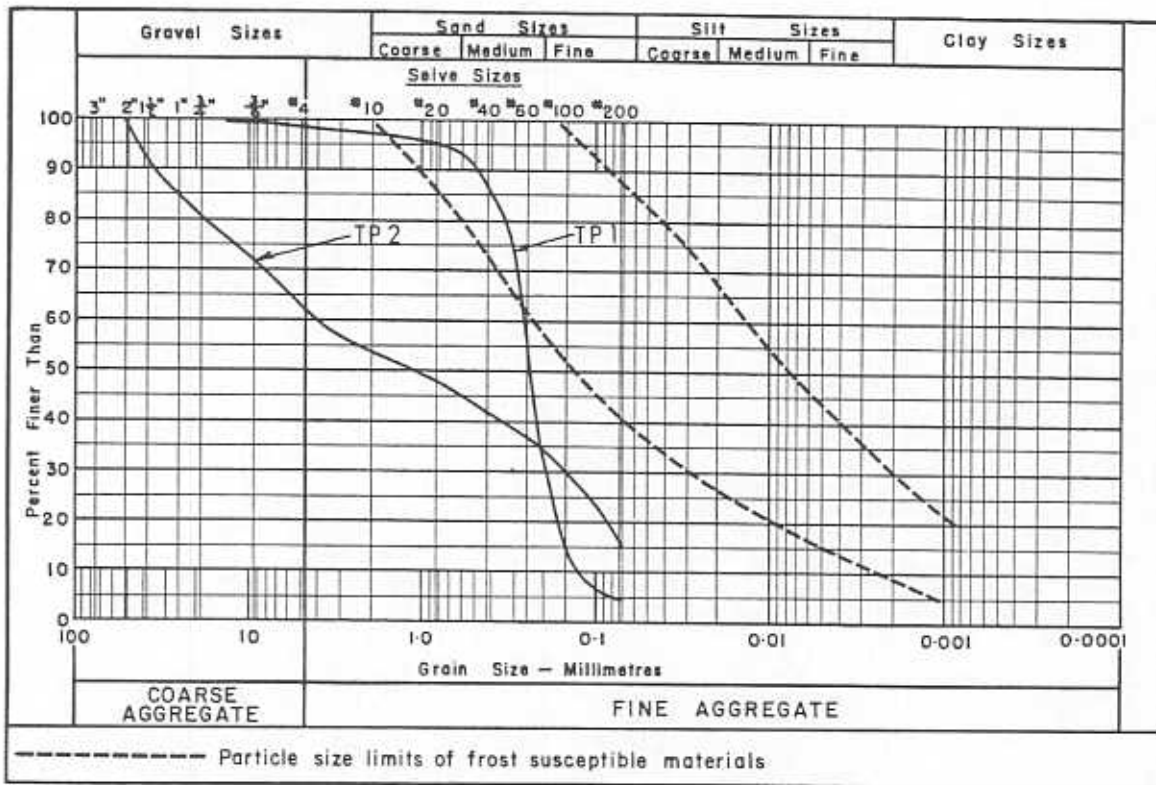


Gravel and Sand; little silt, fine to coarse grained, well graded, very dense, pebbles to 2" in size, occasional cobbles and boulders

SUMMARY OF LABORATORY TEST DATA

Sample Location:	132X/TP 1	132X/TP 2
Sample Depth (Feet):	3.0	1.0
Moisture Content (%):	-	-
Ice Content (%):	-	-
Organic Content (%):	-	-

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS: (132/TP 2 @ 1.0')

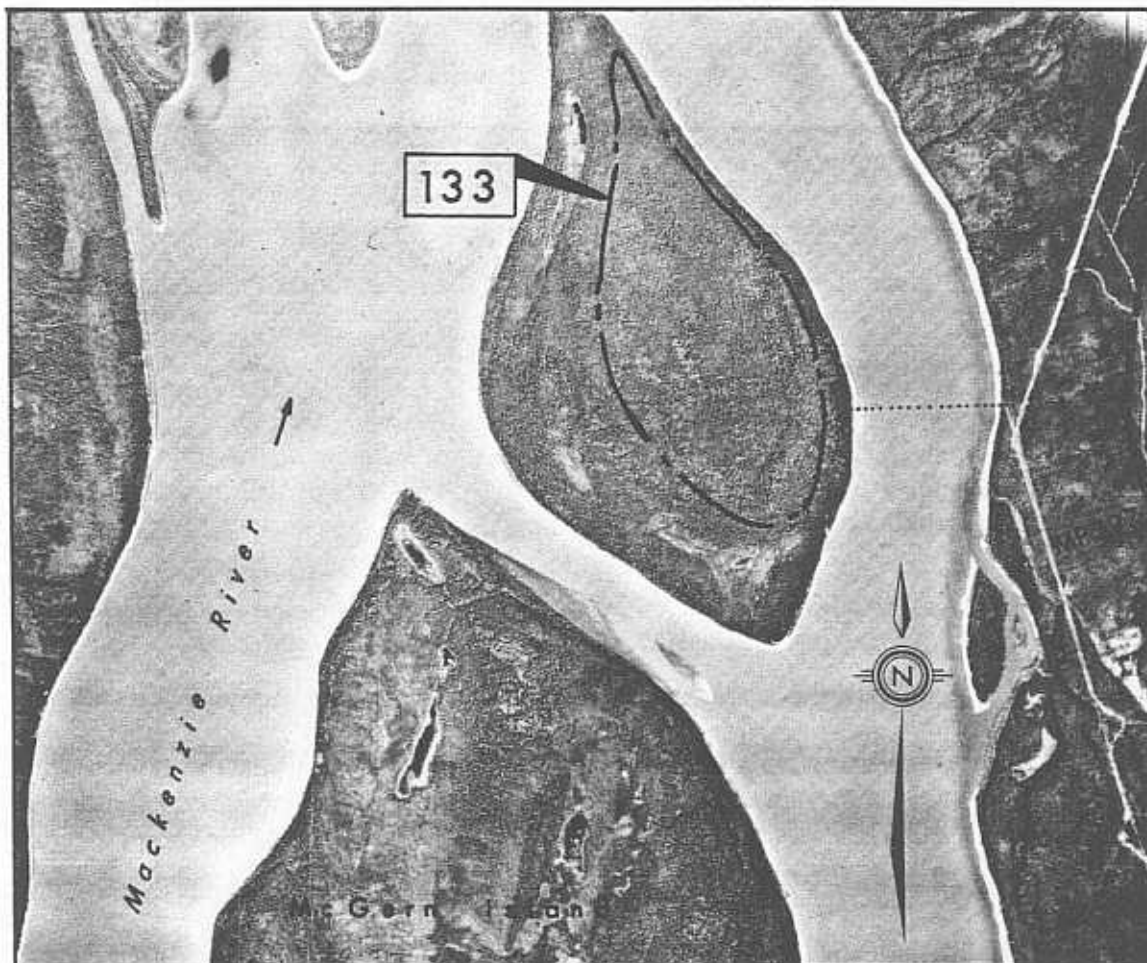
Quartzite	48.7%
Igneous	29.2%
Limestone and dolomite (sound)	19.3%
Chert	1.8%
Deleterious Siltstone and sandstone	0.9%

SITE NO. 133

LOCATION

Located within the broad Mackenzie River channel, approximately 3 miles downstream from the Willowlake River confluence, Site 133 consists of fluvial deposits forming an island. This island is separated from the large McGern Island by a narrow and shallow channel and from the east bank of the Mackenzie River by a channel $\frac{1}{2}$ mile in width.

The proposed Mackenzie Highway right-of-way at Mile 397 is located approximately 1 mile east of Site 133. The proposed gas pipeline route runs approximately 2 miles east of the site area.



LEGEND	
----- All weather road	..... Required access
- - - - - Existing trails and cutlines	- · - · - Site limit
..... Proposed Gas Pipeline	----- Proposed Mackenzie Highway

Airphoto No. A22933/105

Approximate scale: 1" = 3,000'



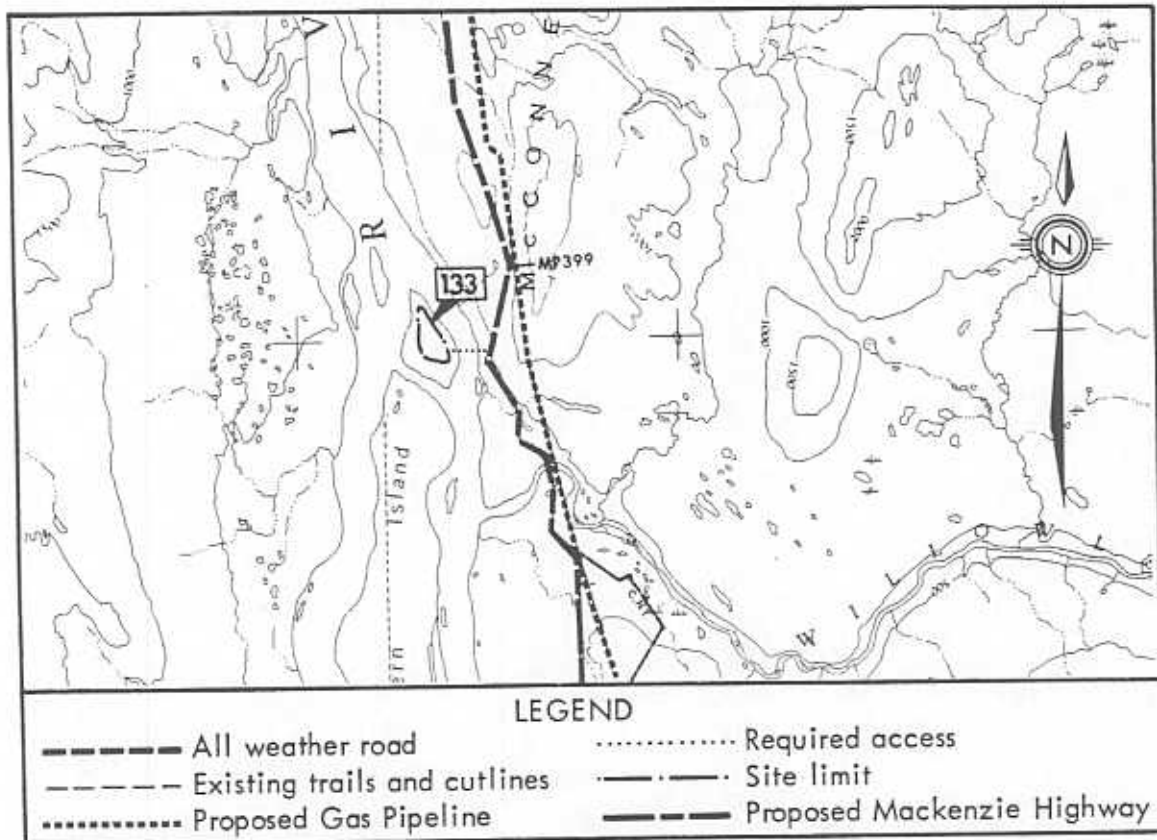
GENERAL

The island, which is approximately 1 square mile in size, is separated from McGern Island by a $\frac{1}{2}$ mile wide river channel. A narrow, gravel paved beach encompasses the island perimeter. The banks of the island, especially on the eastern side, are quite steep.

On the basis of the pits dug on the main portion of McGern Island, a relatively thick layer of stratified alluvial silt forms the upper part of the soil profile which in turn supports good stands of spruce mixed with poplar and birch. Gravel, sand, silt and clay mixtures with thin sand and gravel pockets are indicated at greater depth within an area outlined on the airphoto. These materials would be suitable for marginal quality general fill.

There are no known critical wildlife areas in the immediate vicinity of Site 133.

The exploitation of materials from this site would be, however, curtailed by difficult access and transportation, and excessive siltation resulting from excavation. Therefore, the site is not suggested for development.



SITE NO. 134X

Located immediately adjacent to the south bank of the Willowlake River and encompassing the Mackenzie Highway between Mile 393 and Mile 394, Site 134X consists of a slightly undulating plateau containing deltaic sands.

Type of Material: Sand; little silt, fine grained, poorly graded,

Estimated Volume: Not applicable.

Assessment: Site 134X is not recommended as a source of granular materials; however, these fine silty sands may be considered for use as very marginal fill in the construction of road subgrades.



LEGEND	
----- All weather road	..... Required access
- - - - - Existing trails and cutlines	·-·-·- Site limit
..... Proposed Gas Pipeline	----- Proposed Mackenzie Highway
○ DH Drill Hole	⊕ TP Test Pit

Airphoto No. A22859/94

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 134X is located immediately adjacent to the south bank of the Willowlake River and encompasses the proposed Mackenzie Highway right-of-way from Mile 393 to Mile 394. The site, consisting of a slightly undulating, flat plateau which is bordered on the north by the steep walls of the Willowlake River, encompasses an area approximately 1 mile in length and $\frac{1}{2}$ mile in width. The adjacent terrain to the west is slightly depressional with scattered muskeg bogs and small, shallow ponds indicating terrain conditions which are partially sensitive to thermal erosion. The site area is relatively well drained to the north, east and west into the watershed of the Willowlake River.

The material in the site area consists of poorly graded, fine to medium grained deltaic sand with some silt which is generally unsuitable for most construction requirements. In addition, as indicated by the existing slide to the east of the site area, these sands may be sensitive to sliding if undermined. A layer of topsoil and organic silt and sand, less than 1 foot in depth, overlies the site and supports moderately dense growths of spruce, pine and birch attaining heights to 40 feet. These deltaic sands may extend east from Site 134X along the southern bank of the Willowlake River.

There are no known critical wildlife areas in the immediate vicinity of Site 134X.

The CNT pole line, the proposed gas pipeline route and the proposed Mackenzie Highway right-of-way all traverse the site area, which ensures good existing and future access to the site area.

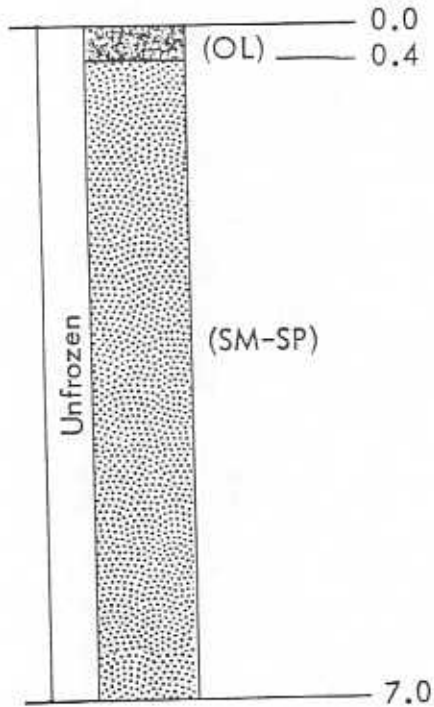
DEVELOPMENT

Site 134X is not recommended as a source of granular materials; however, the fine grained sand with a little silt may be considered for use as a low quality fill material in the construction of subgrades for roads. The following precautions should be noted if the development of borrow pits are undertaken in this site.

- The borrow pit areas should be initiated at locations which are removed as far as possible from the steep banks along the northeastern perimeter of the site.
- In view of the relatively high moisture content of the in place silty sands, the pit walls of the borrow areas should be sloped, not exceeding 3 horizontal to 1 vertical, to ensure stability and prevent localized slides in the pit area.
- The depth of borrow pit excavation will be governed to depths where ground water seepage is encountered.

DETAILED TEST PIT LOG

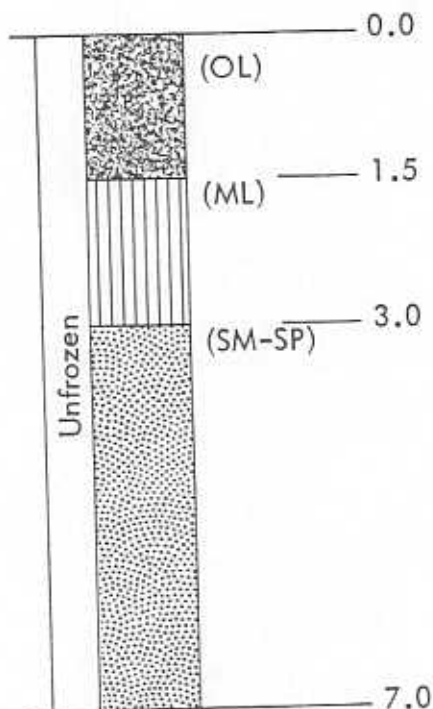
134X/TP 1



Topsoil; organic, roots, black

Sand and Silt; fine grained, poorly graded, layered, light brown

134X/TP 2



Topsoil; organic, roots, black

Silt; little sand, powdery, yellow

Sand and Silt; fine grained, poorly graded, layered, greyish brown

DETAILED DRILL HOLE LOG

SITE NO. 134 X

HOLE NO. B E

DATE: JAN. 30, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	1.0 — 1' of brown top soil		Nf			0
2		SP	Fine brown sand (loose)		Nf			2
4								4
6								6
8		SP	Fine brown sand (with some silt)		Nf			8
10							GS	10
12								12
14								14
16			15.0 — END OF HOLE 15.0'					16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 134X

HOLE NO. C A

DATE: JAN. 31, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)	
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.			
0	[Dotted Pattern]			[Cross-hatch Pattern]				0	
2		SM	Fine silty sand with some clay					2	
4								4	
6								6	
8		SM			Nbn			8	
10								10	
12								12	
14		SM						14	
15.0					END OF HOLE 15.0'				15.0
16									16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 134 X

HOLE NO. S F

DATE: FEB. 3, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		SP	Fine dry brown sand with a trace of silt		Nf		MC GS	0
8		ML	Sandy silt with a trace of clay		Nbn		GS	8
16		SP	Sand with a trace of silt		Nf		GS	16
24		SP	Sand with a trace of silt		Nf			24
32								32
40								40
48								48
56								56
64		SM	Fine sand with some silt and a trace of clay					64
72								72
80			END OF HOLE 80.0'					80

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

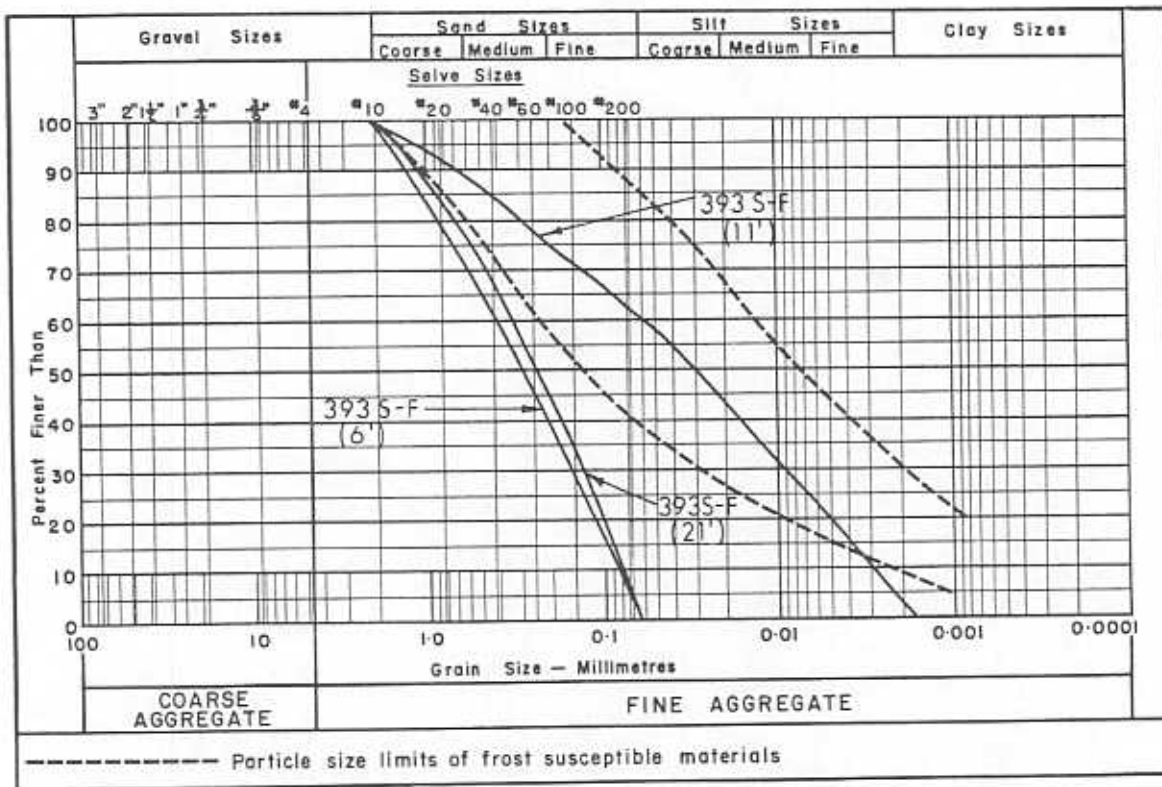


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	134X/393S-F	134X/393S-F	134X/393S-F
Sample Depth (Feet):	6.0	11.0	21.0
Moisture Content (%):	19.5	-	-
Ice Content (%):	-	-	-
Organic Content (%):	-	-	-

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

SITE NO. 135X

Located 1 mile south of the Willowlake River and 1 mile east of the proposed Mackenzie Highway at Mile 392, Site 135X consists of a slightly undulating plateau containing deltaic sands.

Type of Material: Sand; little silt, fine grained, poorly graded.

Estimated Volume: Not applicable.

Assessment: Site 135X is not recommended as a source of granular materials; however, these fine silty sands may be considered for use as very marginal fill in the construction of road subgrades.



LEGEND	
----- All weather road	..... Required access
- - - - Existing trails and cutlines	--- Site limit
..... Proposed Gas Pipeline	----- Proposed Mackenzie Highway
⊙ DH Drill Hole	⊕ TP Test Pit

Airphoto No. A22859/94

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 135X is located 1 mile south of the Willowlake River and 1 mile east of the proposed Mackenzie Highway right-of-way at Mile 392. The site, consisting of a slightly undulating, flat plateau which is bordered on the north by the steep walls of the Willowlake River, encompasses an area approximately $\frac{1}{2}$ mile in length and width. The adjacent terrain to the west is slightly depressional with scattered muskeg bogs and small, shallow ponds indicating terrain conditions which are partially sensitive to thermal erosion. The site area is relatively well drained to the north into the watershed of the Willowlake River.

The material in the site area consists of poorly graded, fine grained deltaic sand with some silt which is generally unsuitable for most construction requirements. In addition, as indicated by the existing slide to the north of the site area, these sands may be sensitive to sliding if undermined. A layer of topsoil and organic silt and sand, less than 1 foot in depth, overlies the site and supports moderately dense growths of spruce, pine and birch attaining heights to 40 feet. These deltaic sands may extend west from Site 135X along the southern bank of the Willowlake River.

There are no known critical wildlife areas in the immediate vicinity of Site 135X.

The CNT pole line and the proposed gas pipeline route traverse the site area, whereas existing seismic cutlines provide the only access to the Mackenzie Highway right-of-way which is located $\frac{1}{2}$ mile west of Site 135X.

DEVELOPMENT

Site 135X is not recommended as a source of granular materials; however, the fine grained sand with a little silt may be considered for use as a low quality fill material in the construction of subgrades for roads. The following precautions should be noted if the development of borrow pits is undertaken in this site.

- The borrow pit areas should be initiated at locations which are removed as far as possible from the steep banks along the northeastern perimeter of the site.
- In view of the relatively high moisture content of the in place silty sands, the pit walls of the borrow areas should be sloped, not exceeding 3 horizontal to 1 vertical, to ensure stability and prevent localized slides in the pit area.
- The depth of borrow pit excavation will be governed to depths where ground water seepage is encountered.

DETAILED DRILL HOLE LOG

SITE NO. 135X

HOLE NO. DH-1

DATE: FEB. 14, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)	
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.			
0		ML-OL	1.0' TOPSOIL: some silt and sand, organic, roots, brown		Vx			0	
3		SM-SP	SAND: little silt, fine grained, poorly graded, occasional pebbles to 1/4 inch size, greyish brown		Nf	L		3	
6									6
9									9
12						UF			MC	12
15								15	
18					Vx	L		18	
21			21.0' TOTAL DEPTH 21.0'					21	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 135X

HOLE NO. DH-2

DATE: FEB.14, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		ML-OL	0.5 TOPSOIL: some silt and sand, organic, roots, brown			L		0
3			SAND: trace silt, fine grained, poorly graded, grey					3
6								6
9					Nf	VL		9
12		SM-SP						12
15								15
18								18
21			21.0 TOTAL DEPTH 21.0'				MC GS O	21

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

 **PEMCAN SERVICES "72"**

DETAILED DRILL HOLE LOG

SITE NO. 135X

HOLE NO. DH-3

DATE: FEB. 14, 1973

LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR AIR REVERSE OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		ML-OL	0.5' TOPSOIL: some silt and sand, trace organic, roots, brown		N			0
3			SAND: trace silt, fine grained, poorly graded, brown - becoming grey below 4.0'		Vx	L		3
6								6
9		SM-SP			Nf	VL		9
12								12
15								15
18					Vx	L		18
21		ML	21.0' SILT: little sand, brown					21
			22.0' TOTAL DEPTH 22.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

 **PEMCAN SERVICES "72"**

DETAILED DRILL HOLE LOG

SITE NO. 135X

HOLE NO. DH-4

DATE: FEB. 14, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS				
0		ML-OL	0.5	TOPSOIL: some silt and sand, little organic, roots, brown					0
2		SP		SAND: trace silt, fine grained, poorly graded, greyish brown		Vs	M		2
4									4
6						UF		MC	6
8								MC	8
10						Vx Vs	M		10
11.0		SM-SP	11.0	SAND AND SILT: brown					11.0
11.5			11.5	TOTAL DEPTH 11.5'					11.5
12									12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

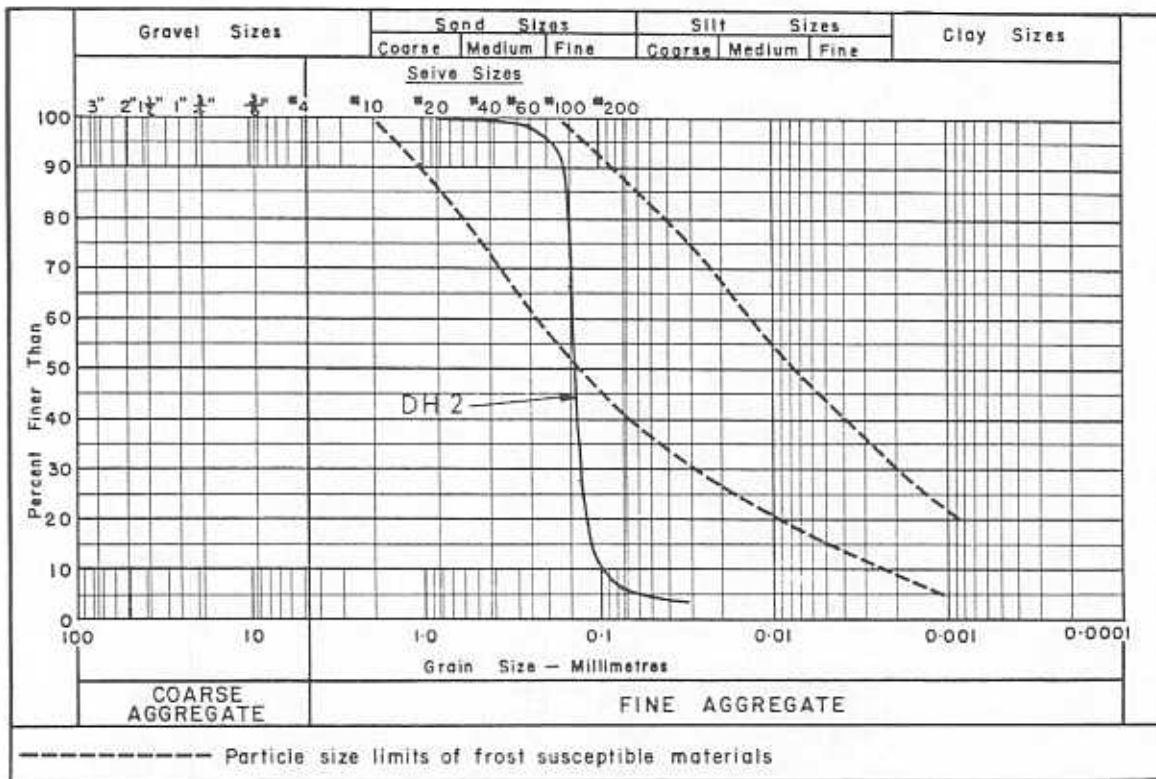
GRANULAR MATERIALS INVENTORY



SUMMARY OF LABORATORY TEST DATA

Sample Location: 135X/DH 2
 Sample Depth (Feet): 18.0
 Moisture Content (%): 3.6
 Ice Content (%): -
 Organic Content (%): 2.6

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

SUMMARY OF MOISTURE CONTENT DETERMINATIONS

<u>Sample Location</u>	<u>Sample Depth (Ft.)</u>	<u>Moisture Content (%)</u>
135X/DH 1	10.0	0.3
135X/DH 4	5.0	14.4
135X/DH 4	7.0	30.4

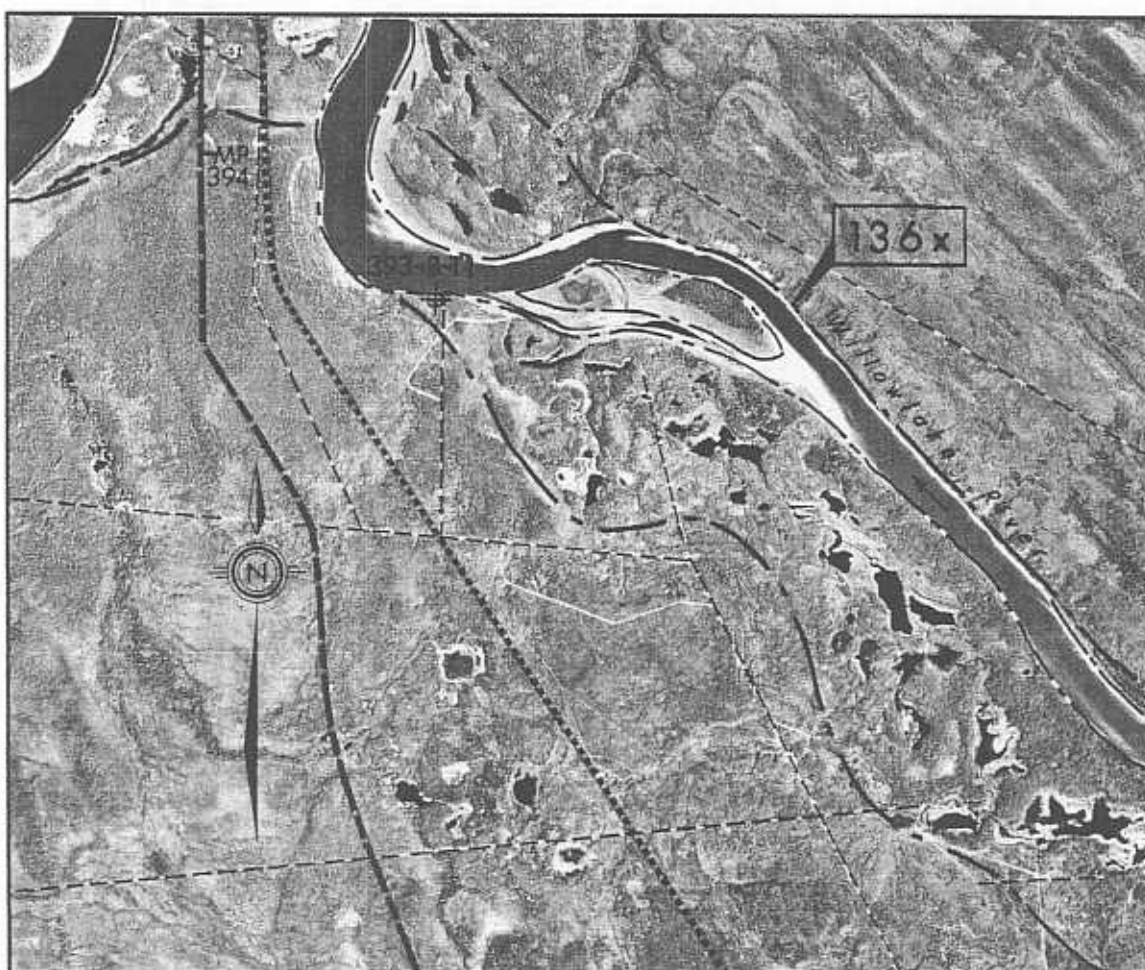
SITE NO. 136X

Located within the active stream channel of Willowlake River and at Mile 394 of the proposed Mackenzie Highway, Site 136X consists of low alluvial terraces and gravel bars.

Type of Material: Silt and Sand; with exposed gravel bars.

Estimated Volume: Not determined.

Assessment: Site 136X is not recommended for development because the potential granular deposits are located within the active stream channel of Willowlake River.



LEGEND

----- All weather road	..... Required access
- - - - Existing trails and cutlines	— · — Site limit
..... Proposed Gas Pipeline	----- Proposed Mackenzie Highway
⊙ DH Drill Hole	⊕ TP Test Pit

Airphoto No. A22859/95

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 136X is located within the wide Willowlake River channel and consists of low alluvial terraces, irregularly bordering the meandering stream channel and gravel bars within the active stream channel. The proposed Mackenzie Highway crosses Willowlake River in the vicinity of Mile 394.

The downstream section of Willowlake River, from its confluence with the Mackenzie River to a point some 5 miles upstream, was evaluated during the summer field program. In this area there exists $\frac{1}{2}$ mile wide terraces adjacent to the river and a major bar within the channel. The terraces rise more than 15 feet above the mean water level and their surfaces are apparently at, or slightly above, the high water level mark. Abandoned river channels are marked by ponded water and by depressions containing thick layers of organic materials. Surficial drainage conditions, in general, are poor on these alluvial terraces.

Cuts in outer banks expose horizontally stratified silt and silty sand, while the shoreline is covered with gravel and cobble pavement. Large boulders are also scattered along the stream channel. Localized layers and pockets of gravel are likely to exist below or within these fine grained alluvial deposits.

There are no known critical wildlife areas in the immediate vicinity of Site 136X.

The CNT pole line, the proposed Mackenzie Highway and the proposed gas pipeline, cross Willowlake River approximately $1\frac{1}{2}$ miles upstream from its confluence with the Mackenzie River. Numerous seismic cutlines were noted on both the south and north banks of Willowlake River.

DEVELOPMENT

Site 136X is not recommended for development because the layers or pockets of exploitable granular materials are located within or immediately adjacent to the active stream channel of Willowlake River. In addition, the surface of the gravel deposits can be expected at about an elevation corresponding to the mean water level of the river and this, together with thickness of silty overburden, imposes both practical and environmental limitations on the exploitation of prospective granular materials.

Site 136X was not drilled during PEMCAN's winter drilling program; however, the results of a test pit placed in this site area by the engineering consultant for The Federal Department of Public Works is attached herewith for reference.


DETAILED DRILL HOLE LOG

SITE NO. 136X

HOLE NO. BT 1

DATE: MAR. 9, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES
 DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER: TRENCH PIT

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	PEAT					0
1		SP	0.8 ————— Brown, medium grained sand with horizontal bedding		Nbn			1
2						Nf		2
3								3
4								4
5								5
6								6
7			7.0 ————— END OF TRENCH AT 7'					7

GOVERNMENT OF CANADA DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT	 PEMCAN SERVICES "72"
GRANULAR MATERIALS INVENTORY	

SUMMARY OF LABORATORY TEST DATA

Sample Location: 136X/393 B-T1

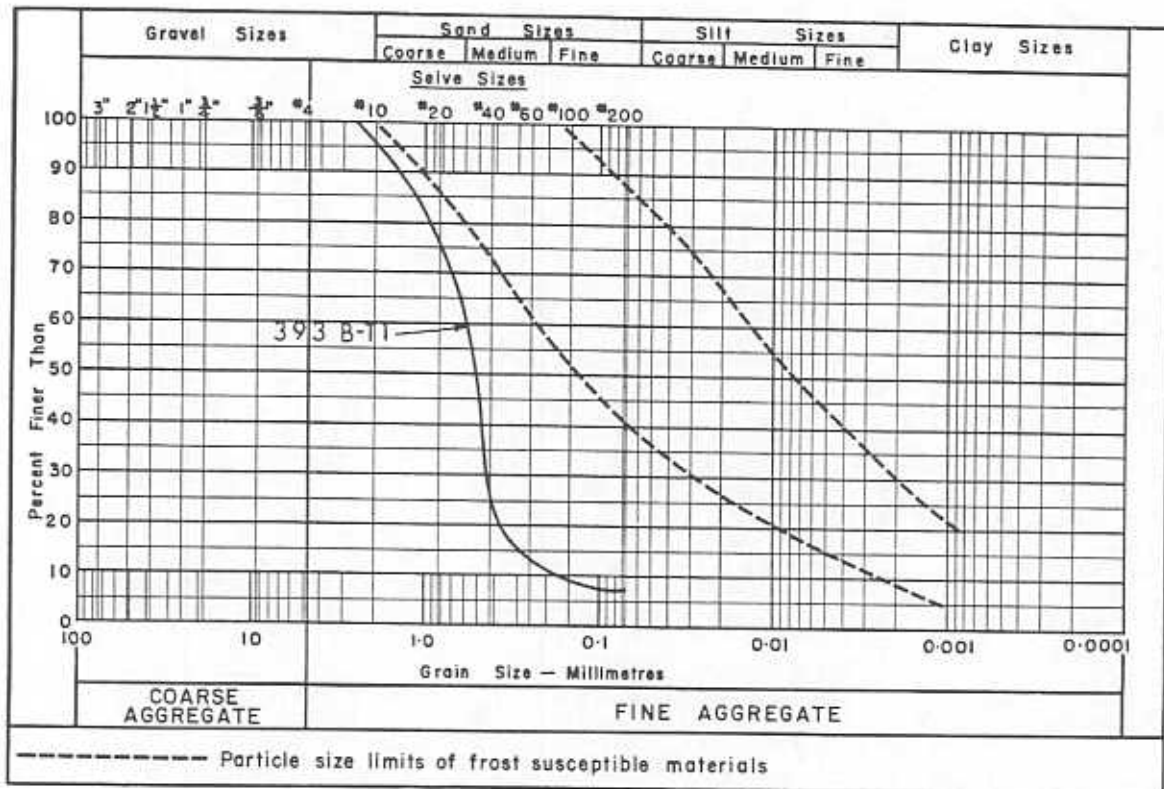
Sample Depth (Feet): -

Moisture Content (%): -

Ice Content (%): -

Organic Content (%): -

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

SITE NO. 137X

Located immediately adjacent to the north bank of Willowlake River and 3 miles east of the proposed Mackenzie Highway at Mile 396, Site 137X consists of drumloid glacial moraine containing pockets of glaciofluvial material.

Type of Material: Glacial Till; pockets of sand and gravel.

Estimated Volume: Not applicable.

Assessment: Site 137X is not recommended because quality granular materials were not established in sufficient volumes during the winter drilling program.



LEGEND

- | | |
|--------------------------------------|------------------------------------|
| ----- All weather road | Required access |
| - - - - Existing trails and cutlines | — · — Site limit |
| Proposed Gas Pipeline | - - - - Proposed Mackenzie Highway |
| ○ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A22889/63

Approximate scale: 1" = 3,000'



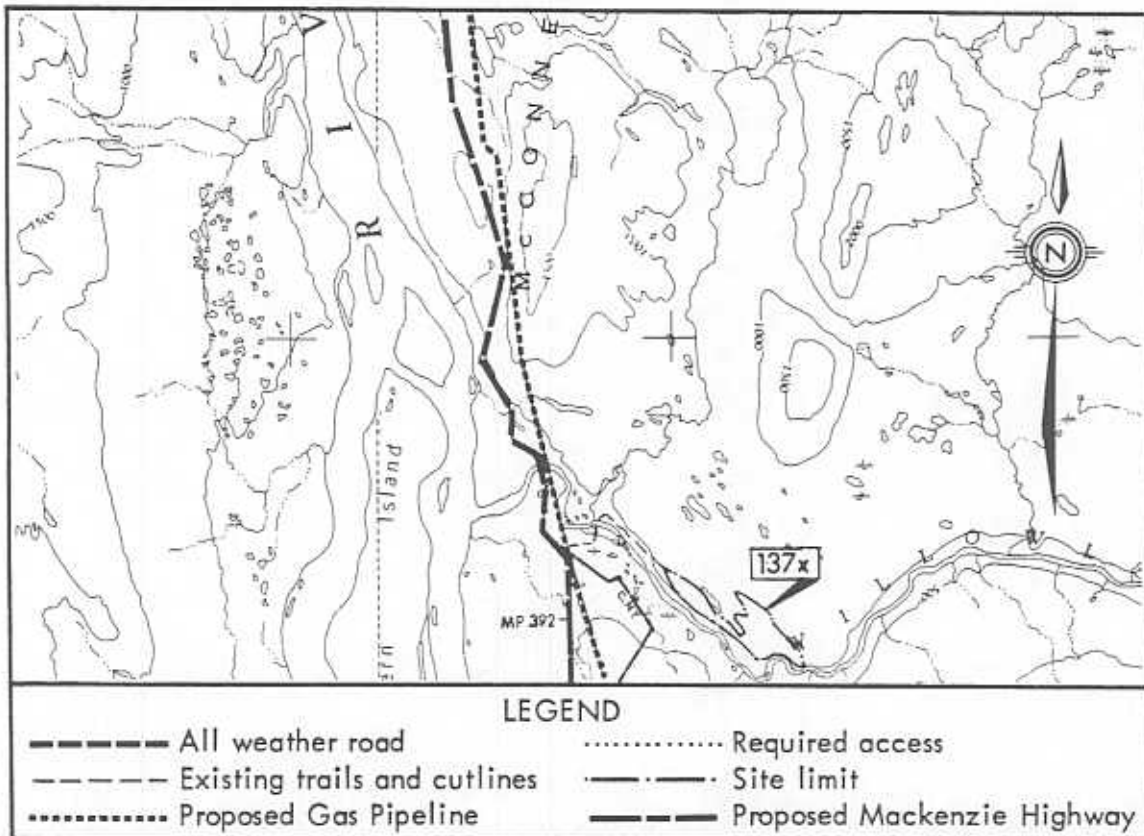
ENVIRONMENT

Site 137X is located immediately adjacent to the north bank of the Willowlake River and consists of a drumloid glacial moraine, similar to the deposits comprising Site 138, with pockets of glaciofluvial material. Mile 396 of the proposed Mackenzie Highway right-of-way is located approximately 3 miles west of Site 137X. The site area, which is approximately 3 miles in length and varies from 1500 to 4000 feet in width, exhibits poor surficial drainage.

The material in Site 137X consists of a glacial moraine till sheet containing scattered sandy and gravelly outwash ridges and inclusions. These sands and gravels, which are very high in silt content and exhibit moderate ground ice content, are not considered suitable for granular material requirements. A surficial overburden layer consisting of peat, muskeg and topsoil covers the site area and supports moderate to dense growths of spruce, pine, poplar and willows.

There are no known critical wildlife areas in the immediate vicinity of Site 137X.

The only existing access to the site area from the CNT pole line or the proposed Mackenzie Highway right-of-way consists of seismic cutlines and the short access trails which were cleared during the winter drilling program.



Section of Map No. 95 J

Scale: 1:250,000



DEVELOPMENT

Although the shallow and isolated pockets of sandy and gravelly outwash materials may be exploited for very marginal embankment fill, the harvesting of material from these pockets could result in extensive surficial damage to the terrain. Therefore, Site 137X is not recommended for development because the drill holes which were conducted on the site did not establish any granular type materials suitable for construction requirements.





DETAILED DRILL HOLE LOG

SITE NO. 137 X

HOLE NO. DH-1

DATE: FEB. 14, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)			
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.					
0		GP-GW	GRAVEL: some sand, little silt, rust brown		Nf	L		0			
2									2		
4									4		
5.0										5.0	
6		ML	SILT: some clay, light brown		Vs	L-M		6			
7.0											7.0
8						from 7.0' trace sand, frequent pebbles to 1 inch size, medium brown		Nf	L		8
10						- fill							10
12			TOTAL DEPTH 12.0'				12				

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

 **PEMCAN SERVICES "72"**

DETAILED DRILL HOLE LOG

SITE NO. 137X

HOLE NO. DH-2

DATE: FEB. 14, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D			
0		Pt	PEAT: organic, fibrous, muskeg, dark brown		Nf	L		0	
2		ML	SILT: some clay, occasional pebbles to 3/8 inch size, light brown		Vs			2	
4			becoming medium grey from 5.0' (TILL)					4	
6						L-M		6	
8					Vx			8	
10								10	
12			TOTAL DEPTH 12.0'					12	
14								14	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

P PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 137X

HOLE NO. DH-3

DATE: FEB. 14, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	PEAT: organic, fibrous, muskeg, dark brown		N	L		0
2		ML	SILT: some clay, light brown		Vs	L- M		2
4			some sand pockets, occasional pebbles, cobbles and boulders, medium brown, from 3.0' (TILL)					
6								6
8								8
10								10
12			TOTAL DEPTH 12.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

 **PEMCAN SERVICES "72"**

DETAILED DRILL HOLE LOG

SITE NO. 137X

HOLE NO. DH-4

DATE: FEB. 14, 1973		LOGGED BY: <input checked="" type="checkbox"/> PEMCAN <input type="checkbox"/>						
DRILLING METHOD: <input type="checkbox"/> AIR CONVENTIONAL <input checked="" type="checkbox"/> AIR REVERSE CIRCULATION <input type="checkbox"/> OTHER:								
DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		Pt	0.5 — PEAT: organic, fibrous, muskeg, dark brown 1.0 — TOPSOIL: some silt, organic, light brown	NF	L		0	
2		OL					2	
4		SM-SP	SAND: little gravel and silt, medium grained, poorly graded, frequent pebbles to 1½ inch size, occasional boulders, medium brown				4	
6							6	
8							8	
10							10	
12							12	
14							14	
16			15.0 — TOTAL DEPTH 15.0'				16	
						MC		

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 137X

HOLE NO. DH-5

DATE: FEB. 14, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0	█	Pt	PEAT: organic, fibrous, muskeg, dark brown	█				0
2								2
3.0								
4	▨	ML	SILT: little sand, frequent pebbles to 3/4 inch size, light brown	▨	Vx			4
6			becoming clay in from 6.0' (TILL)			L- M		6
6	▨	ML-MH		▨	Vr			6
8								8
9.0								
10	▨	GM-GP	GRAVEL; some sand, trace silt, frequent pebbles to 1/2 inch size, medium brown	▨	Nf	L		10
12			TOTAL DEPTH 12.0'				MC	12

GOVERNMENT OF CANADA DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT	PEMCAN SERVICES "72"
GRANULAR MATERIALS INVENTORY	

DETAILED DRILL HOLE LOG

SITE NO. 137X

HOLE NO. DH-6

DATE: FEB. 14, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	1.0 — PEAT: organic, fibrous, muskeg, dark brown					0
2		GM-GP	GRAVEL: some sand, little silt, poorly graded, occasional boulders, medium brown		Nf	L		2
4								4
6								6
8								8
10		ML	9.0 — SILT: some clay, trace sand, frequent pebbles (TILL)					10
12			12.0 — TOTAL DEPTH 12.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

P PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 137X

HOLE NO. DH-7

DATE: FEB. 14, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	1.0 PEAT: organic, fibrous, dark brown					0
2		ML	SILT: some clay, frequent pebbles, occasional boulders, medium brown (TILL)		Nf	L		2
4	4							
6	6							
8	8							
10	10							
12		12.0	TOTAL DEPTH 12.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"









DETAILED DRILL HOLE LOG

SITE NO. 137X

HOLE NO. DH-8

DATE: FEB. 14, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	1.0 PEAT: organic, fibrous, muskeg, dark brown				0	
2		GM-GP	GRAVEL: some silt, poorly graded, frequent pebbles to 1½ inch size, occasional boulders, medium brown		NF	L	2	
4	4							
6	6							
8	8							
10							10	
12			12.0 TOTAL DEPTH 12.0'				12	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 137X

HOLE NO. DH-9

DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		ML-OL	TOPSOIL: some silt, organic, roots, dark brown		Vs			0
1			1.0					1
2			SILT: some sand, frequent pebbles to 1/2 inch size, predominantly limestone and quartzite, greyish brown (TILL)					2
4						L-M		4
5		ML			Vx			5
6								6
7								7
8							MC	8
9								9
10			10.0					10

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

SUMMARY OF MOISTURE CONTENT DETERMINATIONS

<u>Sample Location</u>	<u>Sample Depth (Ft.)</u>	<u>Moisture Content (%)</u>
137X/DH 4	14.0-15.0	6.1
137X/DH 5	11.0-12.0	6.1
137X/DH 9	8.0	6.1

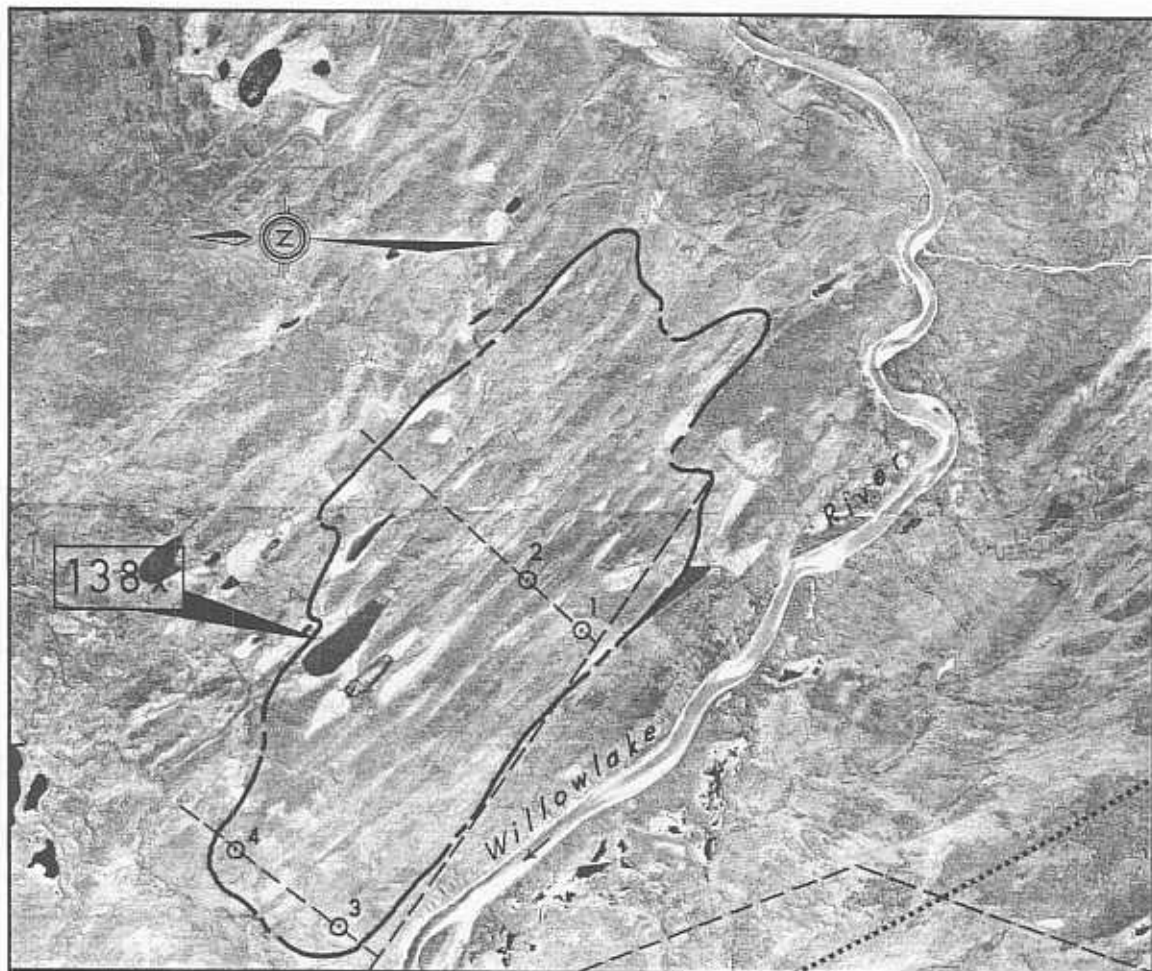
SITE NO. 138X

Located adjacent to the north bank of Willowlake River and 3 miles east of the proposed Mackenzie Highway at Mile 396, Site 138X consists of a drumloid moraine field.

Type of Material: Glacial Till; silt and clay matrix, gravel pockets.

Estimated Volume: Not applicable.

Assessment: Site 138X is not recommended for development because materials of granular quality were not encountered during the winter drilling program.



LEGEND

- | | |
|--------------------------------------|----------------------------------|
| ----- All weather road | Required access |
| - - - - Existing trails and cutlines | --- Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |
| ⊙ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A17430/45

Approximate scale: 1" = 6,000'



ENVIRONMENT

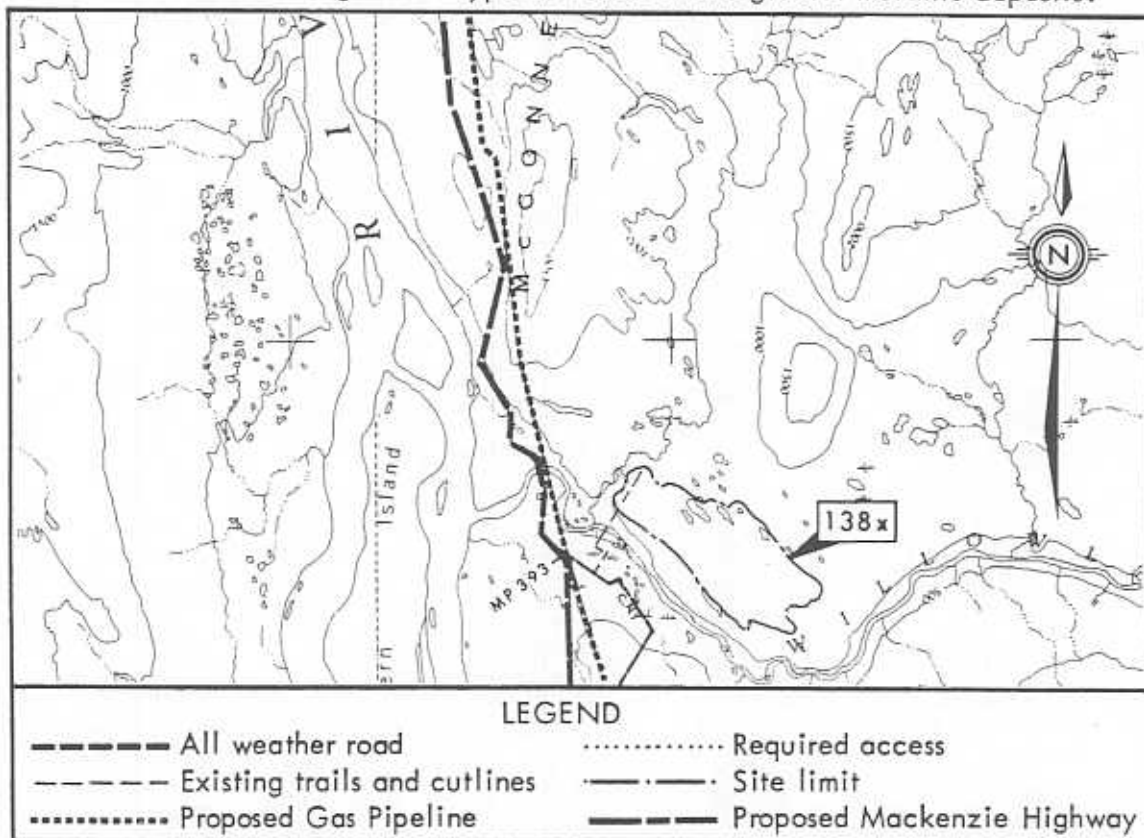
Site 138X is located adjacent to the north bank of Willowlake River and 3 miles east of the proposed Mackenzie Highway right-of-way at Mile 396. Site 138X consists of a large field of drumloid moraine, which encompasses an area approximately 3 miles in length and 1 mile in width. The site area is relatively flat and poorly drained with shallow muskeg bogs and small lakes located in the valleys between the moraine ridges.

The material in the glacial moraine ridges consists primarily of silt and clay till with the occasional small, shallow pockets of silty gravel. The site area is overlain with peat, muskeg and topsoil which varies from less than 1 foot to in excess of 5 feet in depth and supports moderately dense growths of spruce, pine and poplar attaining heights to 40 feet and trunk diameters in excess of 12 inches. There are no known critical wildlife areas in the immediate vicinity of Site 138X.

The only existing access to the site area from the CNT pole line, proposed gas pipeline or proposed Mackenzie Highway right-of-ways consists of existing seismic cutlines and the short access trails which were cleared to the drill hole locations.

DEVELOPMENT

Site 138X is not recommended for development because the information from the drill holes has confirmed the lack of granular type materials in the glacial moraine deposits.



Section of Map No. 95 J

Scale: 1:250,000









DETAILED DRILL HOLE LOG

SITE NO. 138X

HOLE NO. DH-1


DATE: FEB. 14, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	TOPSOIL: some silt, organic, light brown					0
2			2.0					2
4			GRAVEL: some silt, medium grained, poorly graded, pebbles to 1½" size, frequent boulders, medium brown		NF	L		4
6		GM-GP						6
8								8
10								10
12			12.0					12
			TOTAL DEPTH 12.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

 **PEMCAN SERVICES "72"**

DETAILED DRILL HOLE LOG

SITE NO. 138X

HOLE NO. DH-2

DATE: FEB. 14, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L. CLASS	N.R.C. CLASS	EST'D CONT.		
0		SW-SP	SAND: some gravel, rust brown					0
2			2.0					2
4			GRAVEL and SAND: little silt, fine to medium grained, poorly graded, frequent boulders, medium brown					4
6		GM-GP			Nf	L		6
8								8
10								10
12			12.0					12
			TOTAL DEPTH 12.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 138 X

HOLE NO. DH-3

DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0								0
2		Pt	PEAT: organic, fibrous, muskeg, dark brown					2
4					Vs	L-M		4
6								6
8		ML-GM	SILT: some gravel, basically granite cobbles and boulders to 6.5', brown			H		8
10								10
12								12
14		GW-SW	GRAVEL and SAND: little silt, trace clay, fine to coarse grained, well graded, predominantly sub-rounded and subangular quartzite, limestone and dolomite pebbles to 3/4" size, grey		Vx	L		14
16							MC GS P	16
			TOTAL DEPTH 16.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 138X

HOLE NO. DH-4

DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D			
0		OL	0.5 — TOPSOIL: some silt and sand, occasional pebbles, brown		Nf	VI		0	
2		GW	GRAVEL: little sand, medium to coarse grained, well graded, sub-angular to rounded, greyish brown		N	L	MC GS O	2	
4		CH	3.5 — CLAY: some silt, high plastic, light brown		Vs			4	
6		SM	5.0 — SAND: some silt, fine grained, poorly graded, damp, brown, saturated silt pockets at 8.0'	UF				6	
8			8						
10			10						
12								12	
14								14	
16			15.0 — TOTAL DEPTH 15.0'					16	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

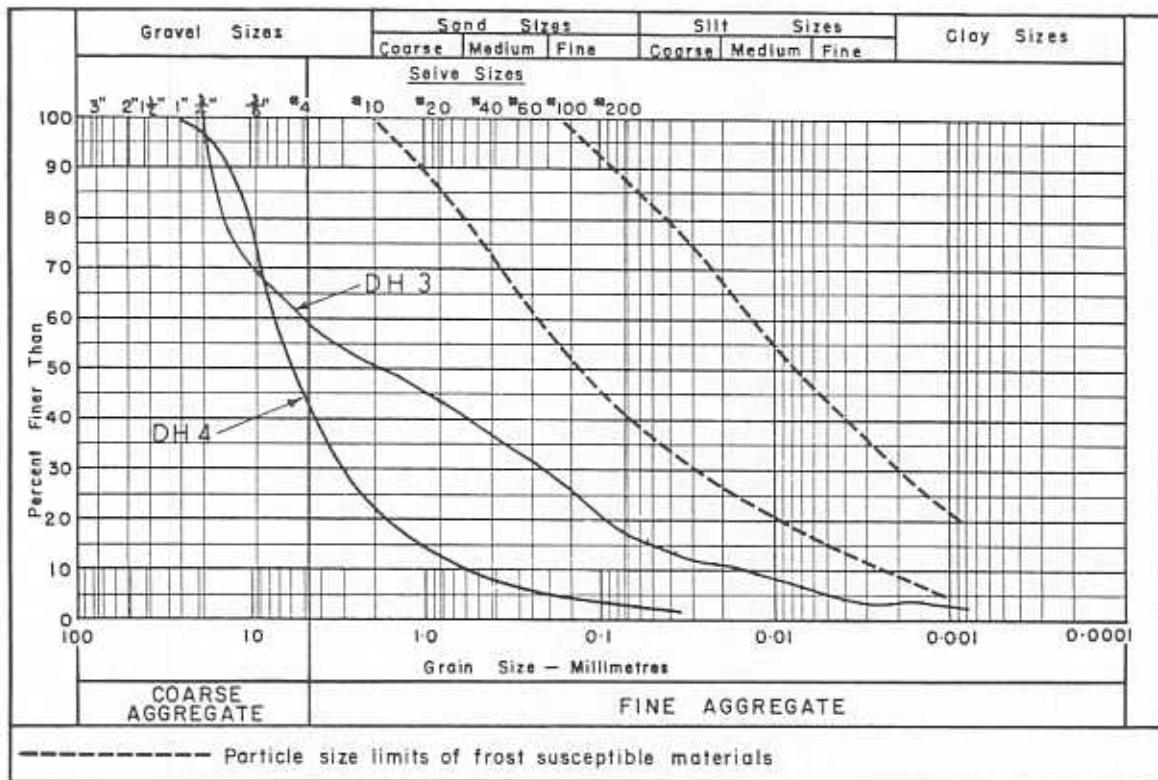


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	138X/DH 3	138X/DH 4
Sample Depth (Feet):	14.0	2.5
Moisture Content (%):	6.7	2.9
Ice Content (%):	-	-
Organic Content (%):	-	4.0

GRAIN SIZE DISTRIBUTION:



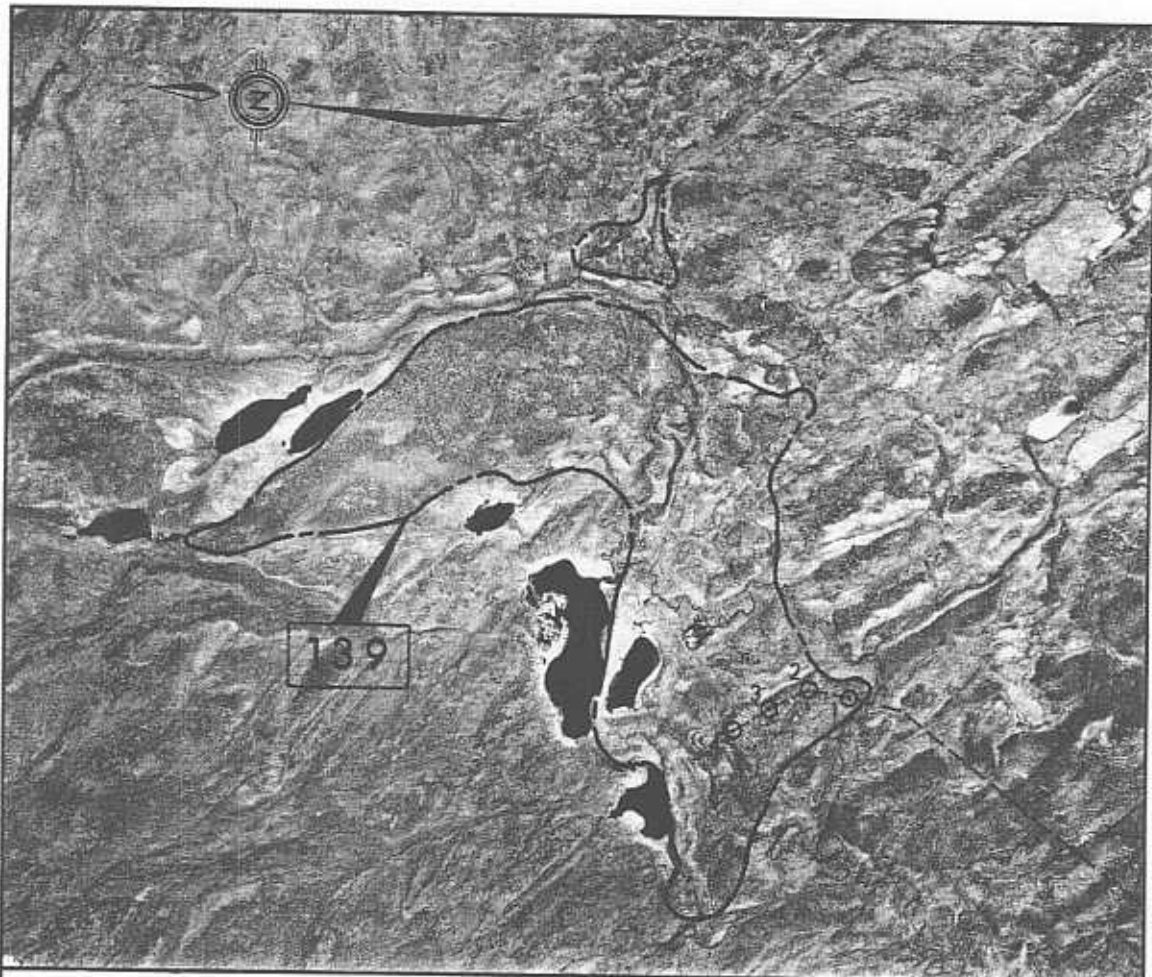
SITE NO. 139

Located approximately 2½ miles north of Willowlake River and 3 miles east of the proposed Mackenzie Highway at Mile 396; Site 139 consists of a series of small esker ridge or kame terrace remnants.

Type of Material: Sand and Gravel; fine to medium grained, well graded.

Estimated Volume: 500,000 cubic yards.

Assessment: Good quality granular materials which are suitable for various construction requirements; Site 139 is recommended for development.



LEGEND

- | | |
|--------------------------------------|----------------------------------|
| ----- All weather road | Required access |
| - - - - Existing trails and cutlines | --- Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |
| ⊙ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A22889/65

Approximate scale: 1" = 3,000'

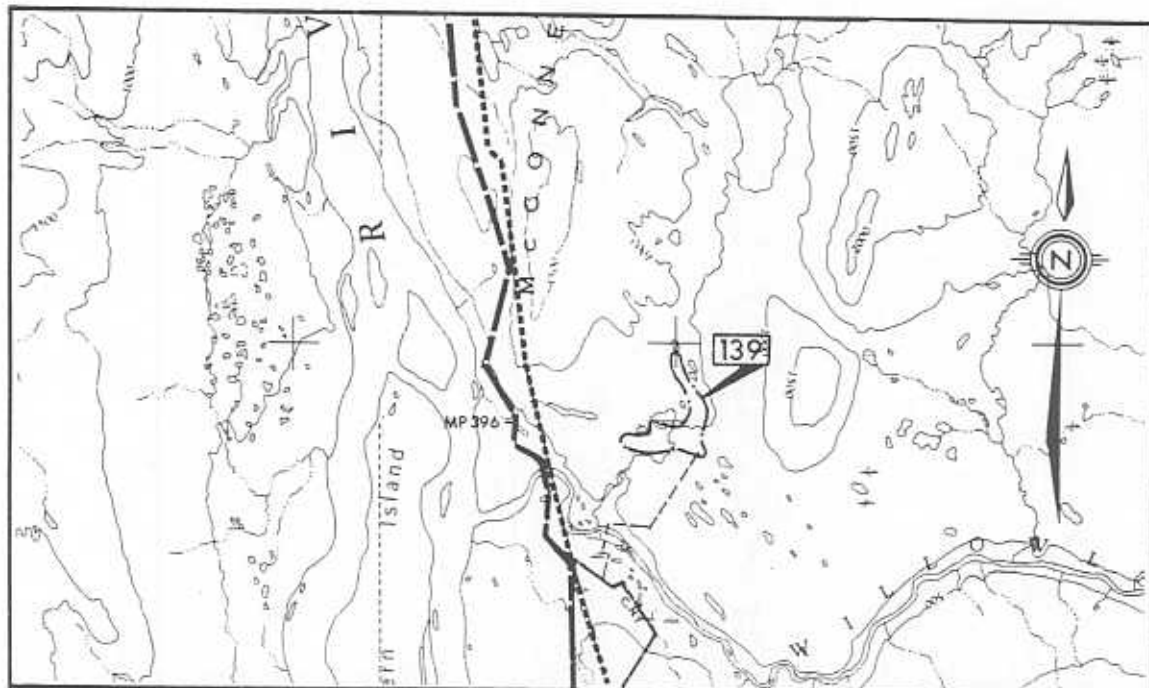


ENVIRONMENT

Site 139 is located approximately 2½ miles north of Willowlake River and 3 miles east of the proposed Mackenzie Highway right-of-way at Mile 396. The site consists of a series of small esker ridge or kame terrace remnants located at the northwest perimeter of a large glacial moraine field. The crescent shaped site area, which is approximately 2 miles in length and ½ mile in width, exhibits fair surficial drainage to the northwest into the adjacent poorly drained muskeg terrain and small lakes. The individual esker ridges rise in excess of 100 feet above the adjacent terrain.

The material in the esker ridges consist of stratified sands and gravels which are generally well graded, medium to coarse grained and contain little silt. These sands and gravels are considered suitable as good quality fill material. A thin veneer of topsoil generally less than 1 foot in thickness, covers the site area and supports moderate growth of poplar, birch, pine and spruce which attain heights to 30 feet and trunk diameters to 12 inches. The sparse understory growth consists primarily of willows and small brush.

There are no known critical wildlife areas in the immediate vicinity of Site 139.



LEGEND	
----- All weather road	..... Required access
- - - - Existing trails and cutlines	— · — Site limit
..... Proposed Gas Pipeline	— — — Proposed Mackenzie Highway

Section of Map No. 95 J

Scale: 1:250,000



The only existing access to the site area from the CNT pole line, proposed Mackenzie Highway or gas pipeline right-of-way consists of seismic cutlines and the access trail which was cleared to the site area during the winter drilling program. The required access, however, includes crossing of the Willowlake River.

DEVELOPMENT

The exploratory drilling which was conducted on Site 139 showed the following conditions relative to quality and quantity of available granular materials.

- Good quality granular materials consisting of irregularly stratified, well graded, clean, coarse grained sands and medium grained gravels which are suitable for various construction requirements are available at Site 139.
- The material in the adjacent terrain consists of shallow silt and sand washed down from individual esker ridges and kame knolls.
- The overburden material consisting of topsoil and organic silt is generally less than 1 foot in thickness.
- The base of the stratified sands and gravels in the esker ridge were not penetrated by the drill holes which were extended to a maximum depth of 25 feet below existing ground surface.
- An estimated quantity in excess of 500,000 cubic yards of sand and gravel are considered available from the single esker ridge remnant which was investigated during the winter drilling program. Therefore, granular materials in extensive quantities may be available from Site 139 by the development and exploitation of similar esker ridges and kames.

Site 139 is recommended for development and exploitation of granular materials and the following development guidelines should be considered.

- The existing tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The topsoil and organic silt overburden should be stripped, removed and stockpiled adjacent to borrow pit areas in designated locations, preferably, along the base of the esker ridges.
- The development of borrow pit areas should be initiated from the eastern extremities of the esker ridge remnants which are the areas furthest removed from the adjacent lakes.
- Procedures should be maintained during the development of borrow pit areas whereby the surficial waste materials do not drain into the adjacent lakes.



- Generally, standard excavation equipment such as dozers, overhead loaders, backhoes and light ripping equipment should be adequate for the removal of material from this site.
- Procedures during the borrow pit development should ensure proper contouring of the pit areas to prevent ponding of water which could result in partial thermokarst subsidence.
- Stands of natural growth should be retained between borrow pit areas in order to promote natural regeneration of vegetation after the borrow pit areas have been exploited and abandoned.

ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation procedures should include:

- Recontouring of the pit areas to provide general drainage compatible with the natural drainage of the adjacent terrain.
- Replacing stockpiled surficial waste material on the abandoned borrow pit areas.
- Reseeding of the recontoured pit areas may be considered in areas that may pose erosional problems. At these locations, the artificial reseeding of annuals and perennials will result in a semi-permanent growth prior to the natural reestablishment of the native species.
- The required access road from the site area to the proposed Mackenzie Highway or gas pipeline right-of-way will traverse relatively rugged terrain.

DETAILED DRILL HOLE LOG

SITE NO. 139

HOLE NO. DH-1


DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	1.0 TOPSOIL: some silt and sand, organic, roots, light brown		Nf	VL		0
2		ML-SM	SILT and SAND: occasional cobbles and boulders, greyish brown - little gravel, predominantly subangular to rounded pebbles to 2" size, occasional larger pebbles		Nbn			2
4								4
6								6
8								8
10							MC	10
12		ML	11.0 SILT: little sand, trace clay, occasional pebbles and cobbles, dark brown 13.0 (TILL)					12
			TOTAL DEPTH 13.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

 **PEMCAN SERVICES "72"**

DETAILED DRILL HOLE LOG

SITE NO. 139

HOLE NO. DH-2

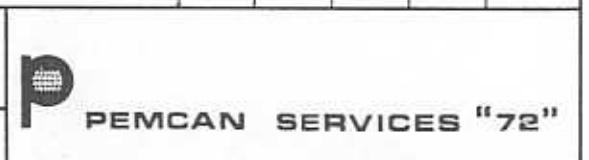
DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)			
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.					
0		OL	1.0 TOPSOIL: some silt, little sand		Nf	VL		0			
2		SM-SP	SAND: some silt, fine grained, poorly graded, greyish brown		Nbn	L		2			
4											4
6											MC	6
8								8			
10				UF				10			
12								12			
14		ML	14.0 SILT: little sand, brown, wet					14			
16			15.0 TOTAL DEPTH 15.0'					16			

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



DETAILED DRILL HOLE LOG

SITE NO. 139

HOLE NO. DH-3

DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)	
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.			
0		OL	1.0 TOPSOIL: some silt and sand, roots, brown		NF	VL	MC	0	
3		SM	4.0 SAND: trace gravel and silt, medium grained, brown		Nbn	L		MC	3
6		GP	GRAVEL and SAND: trace silt, medium to coarse grained, predominantly subangular pebbles to 1 1/2" size, grey						UF			6
9				UF			9		
12							UF			12
15		SM-SP	14.0 SAND: trace silt, fine to medium grained, poorly graded, brown - little gravel from 16.0' to 21.0'	UF						15
18			- fine grained, little silt, trace gravel from 21.0'				UF			18
21				UF						21
24			25.0 TOTAL DEPTH 25.0'				UF			24
27				UF						27

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 139

HOLE NO. DH-4

DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	1.0 TOPSOIL: some silt and sand, trace organic		Nf	VL		0
3								3
6			GRAVEL: some sand, medium to coarse grained, well graded, predominantly angular and subangular limestone and dolomite with quartzite pebbles to 2" size, frequent cobbles, greyish brown					6
9		GW-SW			Nf	L		9
12							MC GS OP	12
15								15
18								18
21				UF				21
24								24
25.0			TOTAL DEPTH 25.0'					
27								27

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

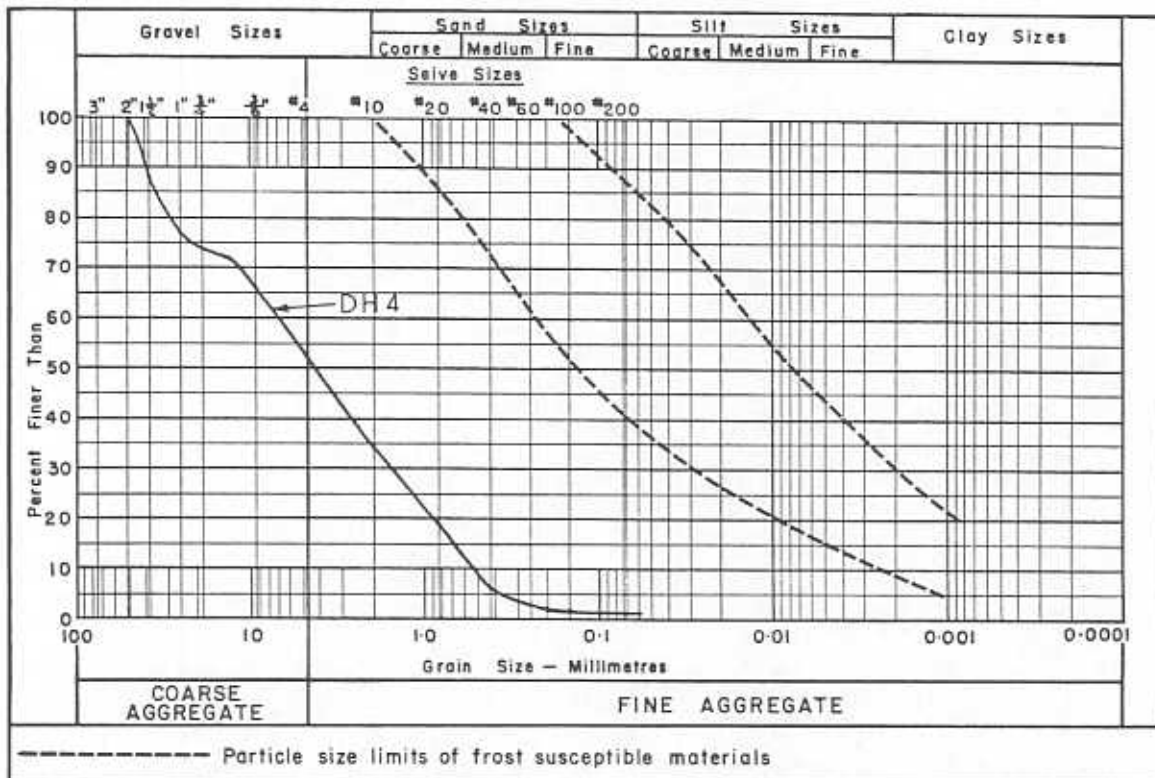


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location: 139/DH 4
 Sample Depth (Feet): 11.0-14.0
 Moisture Content (%): -
 Ice Content (%): -
 Organic Content (%): 2.1

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS: (139/DH 4 @ 11.0'-14.0')

Limestone and dolomite (sound)	49.0%
Quartzite	35.2%
Igneous	11.9%
<u>Deleterious</u>	
Mica, schist and gneiss, brittle pegmatite	2.2%
Siltstone, ironstone and sandstone	1.8%

SUMMARY OF MOISTURE CONTENT DETERMINATIONS

<u>Sample Location</u>	<u>Sample Depth (Ft.)</u>	<u>Moisture Content (%)</u>
139/DH 1	8.0	6.2
139/DH 2	6.0	9.4
139/DH 3	5.0	3.5

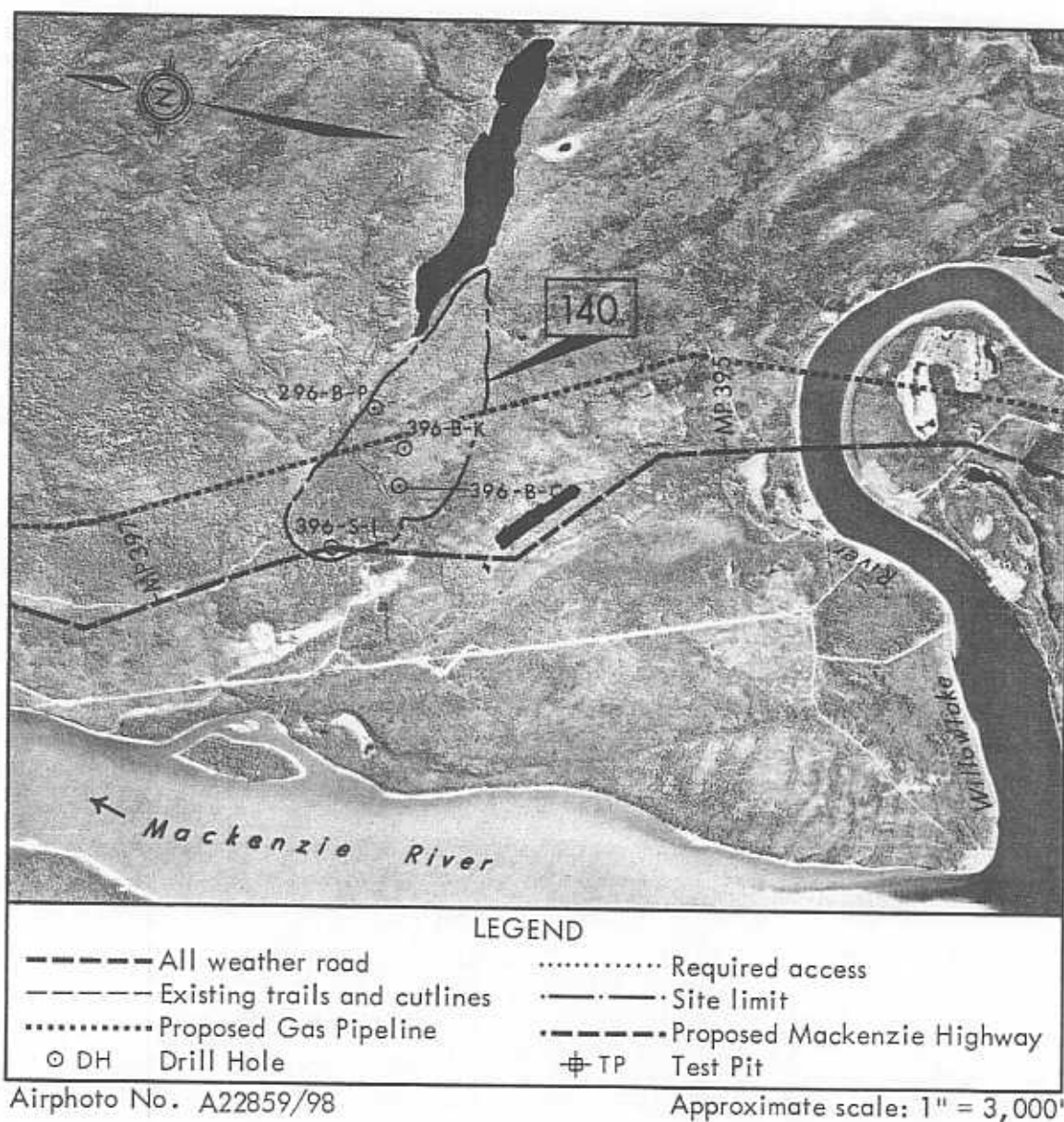
SITE NO. 140

Located approximately $1\frac{1}{2}$ miles north of the Willowlake River and immediately adjacent to the east side of the proposed Mackenzie Highway at Mile 396, Site 140 consists of a glacio-fluvial outwash deposit.

Type of Material: Sand; coarse grained, silty, little gravel.

Estimated Volume: 3,000,000 cubic yards.

Assessment: Fair to poor quality granular materials suitable for general fill in the construction of subgrades for roads and utility backfill; Site 140 is recommended for possible development.





ENVIRONMENT

Site 140 is located approximately $1\frac{1}{4}$ miles north of the Willowlake River and immediately adjacent to the east side of the proposed Mackenzie Highway right-of-way at Mile 396. The site consists of a small glaciofluvial outwash deposit which is approximately 5000 feet in length and 2000 feet in width. The site area exhibits good drainage to the west into the general drainage pattern of the Mackenzie River. The adjacent terrain to the east consists of a rolling glacial till plain which is partially incised with shallow stream channels and exhibits drumlinoid features. A large lake, in excess of 1 mile in length, is located at the east end of the site area and shallow shale outcrops were noted at the extreme western periphery of the site area. The southern tip of the McConnell Range, exposing limestone bedrock, is located immediately north of Site 140.

The material in the glaciofluvial outwash deposit consists of coarse grained sand with a highly variable silt and clay content. The organic topsoil layer is quite shallow and supports moderately dense growths of spruce and birch.

There are no known critical wildlife areas in the immediate vicinity of Site 140.

Current and future access to potential borrow pit locations is excellent because both the CNT pole line and the proposed Mackenzie Highway right-of-way are located immediately adjacent to the west side of Site 140.

DEVELOPMENT

The information from drill holes conducted on Site 140 by the consultant for the Federal Department of Public Works has been assessed and incorporated into this report. The following conditions relate to the quality and quantity of available granular materials from this site:

- Poor to fair quality granular materials, consisting of coarse grained sand with a highly variable clay and silt content were encountered to depths investigated. These coarse sands are considered suitable for use in low quality fill material in the construction of highway grades and utility backfill.
- The depth of the granular deposits is in excess of 20 feet, however, selective excavation of material may be necessary because of the highly variable quality of the in situ sand strata.
- The overburden material consisting primarily of topsoil is generally less than 1 foot in depth.
- It is considered that granular materials in excess of 3,000,000 cubic yards are recoverable from Site 140.

Site 140 is recommended as a possible source of granular materials and the following operational guidelines should be considered during the development of borrow pits at this site:



- The existing tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil should be stripped, removed and stockpiled adjacent to the borrow pit areas in designated locations.
- A natural stand of tree growth and related vegetation should be retained between borrow pit areas to be developed and existing right-of-ways.
- Stands of natural growth should be retained between borrow pit areas in order to facilitate regrowth through natural regeneration.
- The use of dozers, overhead loaders and conventional ripping equipment should adequately remove the material from this site.
- Operating procedures during borrow pit development should be maintained whereby surficial waste materials do not drain into the adjacent lakes or stream channels.

ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation procedures should include:

- Recontouring of the pit areas to provide drainage that is compatible with the natural drainage of the adjacent terrain.
- Replacing stockpiled surficial waste material and organic topsoil on the abandoned recontoured pit areas.

DETAILED DRILL HOLE LOG

SITE NO. 140

HOLE NO. B C

DATE: JAN. 31, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D			
0		GM	Brown silty gravelly till		Nf			0	
2								2	
4								4	
5.0			-----						
6		CL	Grey silty clayey till with gravel (fine)		Nf			6	
8								8	
10								10	
12								12	
14								14	
15.0								15.0	
16			END OF HOLE 15.0'					16	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 140

HOLE NO. B K

DATE: FEB. 8, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0	[Dotted Pattern]	SM	Brown sandy gravelly till	[Cross-hatch Pattern]	Nf			0
3								3
6								6
9								9
12								12
13.0								13.0
15								15
18								18
21								21
24								24
25.0								25.0
27								27
			END OF HOLE 25.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 140

HOLE NO. S I

DATE: FEB. 4, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0								0
1.5			Fine silty sand		Nbn			
4		SM	Sand with some silt and a trace of gravel and clay					4
8								8
12		ML	Silty till, sandy with some clay and gravel		Nbn			12
16								16
20								20
24		ML			Nbn			24
28					Nf			28
32							GS	32
36								36
39.0			END OF HOLE 39.0'					40

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 140

HOLE NO. B P

DATE: FEB. 8, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0	[Stippled Pattern]	SM	Brown silty till with some sand and gravels	[Cross-hatched Pattern]	Nf		GS	0
3								
6								
6	[Stippled Pattern]	SC	Grey silty clayey till	[Cross-hatched Pattern]	Vx		6	
9								
12								
15	[Stippled Pattern]	SW	Grey silty sandy till with some clay and cobbles	[Cross-hatched Pattern]	Vx		15	
18								
21								
24			END OF HOLE 25.0'				24	
27							27	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

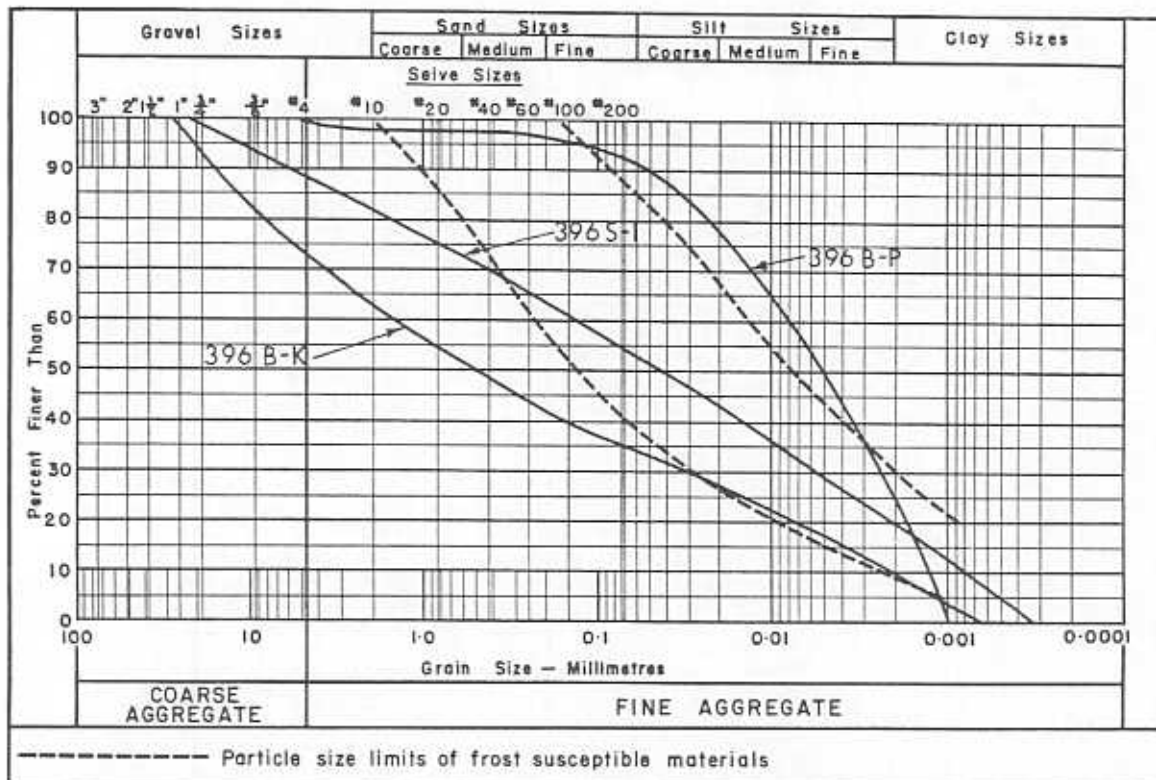


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	140/396B-P	140/396S-I	140/396B-K
Sample Depth (Feet):	2.0	8.0	10.0
Moisture Content (%):	-	-	-
Ice Content (%):	-	-	-
Organic Content (%):	-	-	-

GRAIN SIZE DISTRIBUTION:



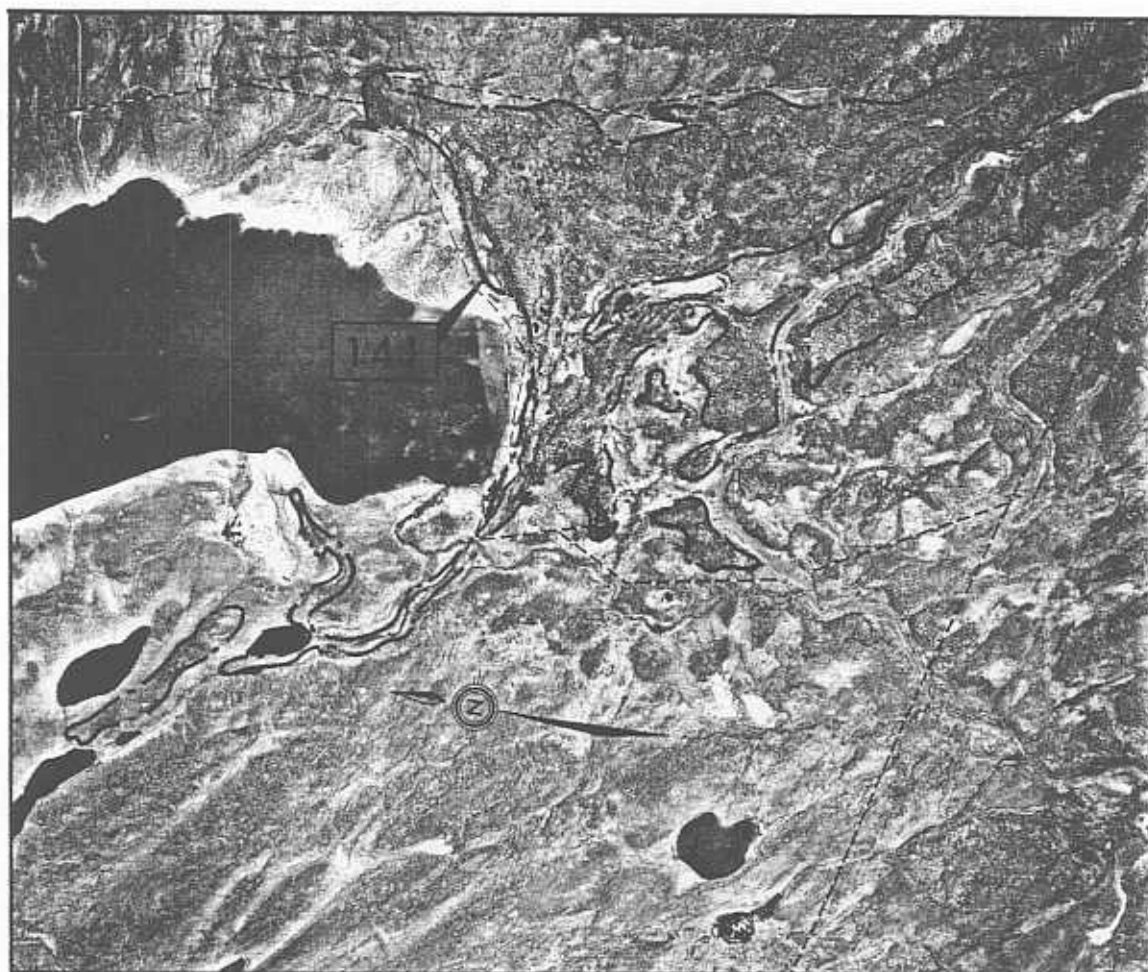
PETROGRAPHIC ANALYSIS:

SITE NO. 141

LOCATION

Located between the McConnell Range and Willow Ridge and approximately half way between the Willowlake River and River Between Two Mountains, Site 141 consists of a large kame-esker complex comprised mainly of sand and gravel.

The site is approximately 5 miles east of the proposed locations of the Mackenzie Highway and gas pipeline. If a new direct access through a valley in the McConnell Range is established, then the haul distance along existing seismic cutlines to the Highway at Mile 412 would be in excess of 9 miles.



LEGEND

- | | |
|--|----------------------------------|
| ————— All weather road | Required access |
| - - - - - Existing trails and cutlines | - · - · - Site limit |
| Proposed Gas Pipeline | ————— Proposed Mackenzie Highway |

Airphoto No. A22889/67

Approximate scale: 1" = 3,000'



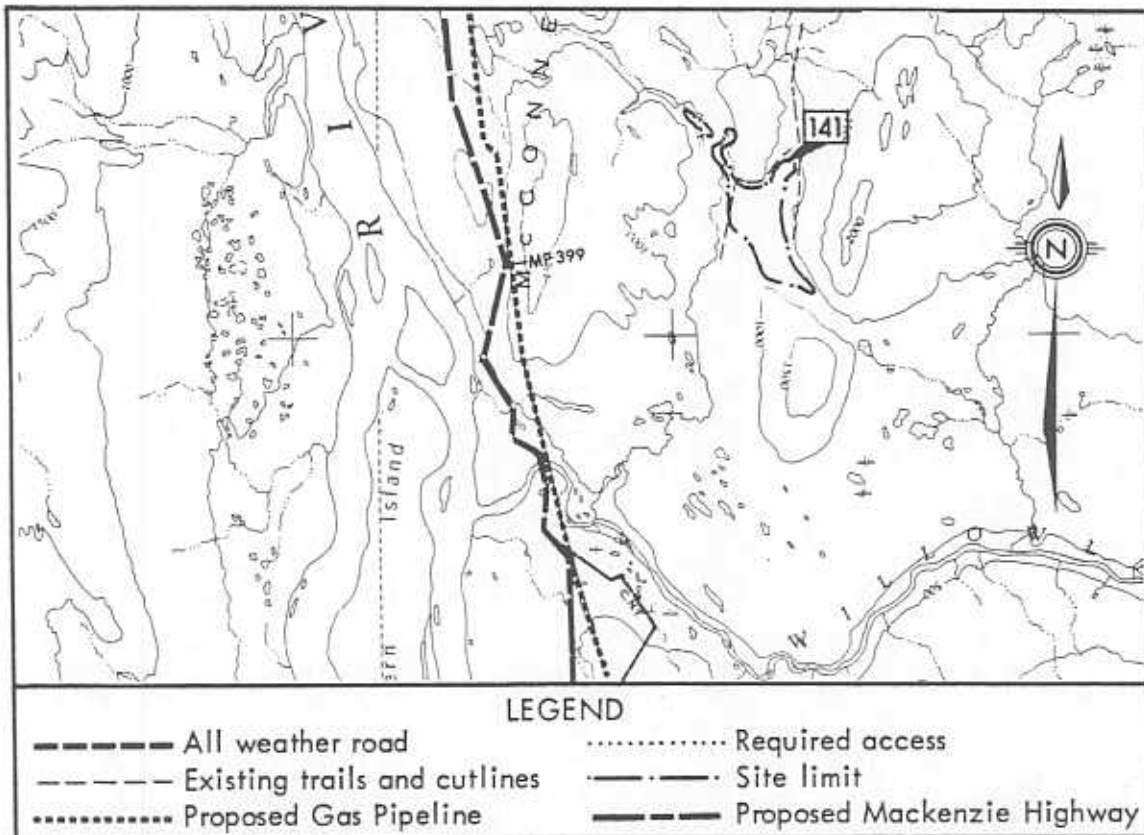
GENERAL

The main part of the kame-esker complex covers approximately three square miles of the terrain at the western toe of Willow Ridge. Esker ridges traverse across the valley towards the eastern face of McConnell Range. There are a few additional esker ridges and small kame fields north and south of this main sector.

The complex consists of segmented and interconnected kame mounds, and esker ridges. Some of the kettle holes collect surficial run-off, thus forming small ponds. In general, the terrain is fairly well drained and supports good stands of spruce. The site is within a region which is periodically hunted and trapped by northern residents. Variable washed gravel and sand are probably the most common materials forming this complex. Localized bodies of glacial till can be, however, expected within the sand and gravel stratum. Estimated thickness in excess of 20 feet is anticipated.

Fair to good quality material for general fill and base courses can be obtained. The site is, however, poorly accessible because of the McConnell Range, which separates the site from the transportation utilities to the west. The only existing access is along River Between Two Mountains and through the cutline which parallels Willow Ridge. Haul distance to the proposed Mackenzie Highway would be in excess of 9 miles.

Site 141 is rated as a good prospect for granular materials.



Section of Map No. 95 J

Scale: 1:250,000

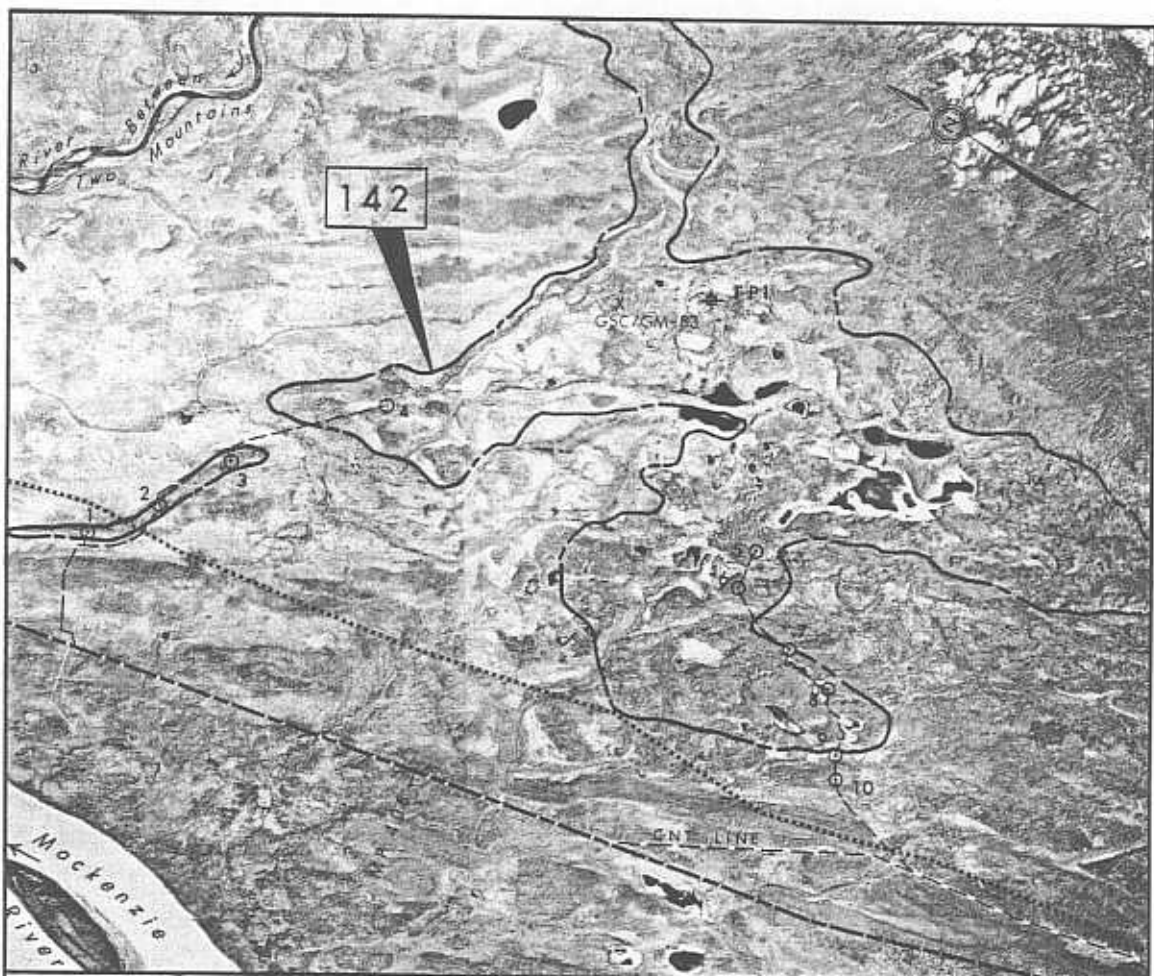
SITE NO. 142

Located approximately 25 miles southeast of Wrigley and less than $\frac{1}{2}$ mile east of the proposed Mackenzie Highway from Mile 405 to Mile 410, Site 142 consists of a large esker and kame terrace field.

Type of Material: Sand and Gravel; variable gradation, fine to medium grained.

Estimated Volume: In excess of several million cubic yards.

Assessment: Good quality granular materials which are suitable for most construction requirements, Site 142 is recommended for development.



LEGEND

- | | |
|------------------------------------|----------------------------------|
| ----- All weather road | Required access |
| ----- Existing trails and cutlines | ----- Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |
| ⊙ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A22889/92

Approximate scale: 1" = 4,500'



ENVIRONMENT

Site 142 is located approximately 25 miles southeast of Wrigley and the western extremity of the site area is less than $\frac{1}{2}$ mile east of the proposed Mackenzie Highway right-of-way between Mile 405 and Mile 410. The site area consists of a large esker and kame terrace field which is interrupted by numerous lakes and meandering gullies. The site, located south of the River Between Two Mountains, is several square miles in areal extent. The ice contact features within the site are well drained, whereas, the adjacent, poorly drained terrain exhibits slight thermokarst conditions.

The material in the ice contact deposits is highly variable and ranges from inorganic silts with some clay to medium grained, well graded gravels with some sand. These varying granular material deposits are, generally, intermixed and moderately scattered throughout the entire site area, although the more well defined esker-like and kame-like features appear to contain pockets or layers of better quality granular materials. A thin veneer of silty organic topsoil supporting growths of moss, small shrubs, spruce and birch covers the site area. The adjacent terrain is relatively flat and poorly drained and consists of numerous wet, boggy muskeg areas.

There are no known critical wildlife areas in the immediate vicinity of Site 142.

The only existing access to the site area from the CNT pole line, proposed gas pipeline or proposed Mackenzie Highway right-of-way consists of the access trails which were cleared during the winter drilling program.

DEVELOPMENT

The detailed findings of the winter drilling program has confirmed the availability of exploitable granular materials at Site 142. On the basis of drill hole data, the following comments relative to material types are outlined as follows:

- The material represented by these ice contact features is extremely variable and ranges from inorganic silts with some clay to relatively well graded gravels.
- The potentially exploitable granular materials of reasonable quality are scattered throughout these ice contact features as pockets and layers.
- The material type within an individual ice contact feature is variable in quality, mode and depth of deposition and recoverable quantities.
- The depth of overburden overlying the granular material deposits varies in depth from a few feet to in excess of several feet.
- An estimated volume in excess of several million cubic yards of fair to good quality granular materials are considered available in the esker ridge deposits.



Site 142 is recommended for development and exploitation of granular materials and the following development guidelines should be considered.

- In view of the highly variable quality and scattered nature of the available granular materials, Site 142 should be considered essentially for pit run aggregates to be utilized in building pads, road and airstrip subbase construction. However, if careful and selective excavating procedures are utilized during the development of borrow pits, then the pockets or layers of high quality gravels could be exploited for use in production of base course and surface course aggregates.
- The individual ice contact features should be further investigated by probing at closer intervals with shallow test pits or drill holes to more specifically delineate and assess the quantity of available granular materials.
- The existing tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The thin veneer of organic topsoil and peat should be stripped, removed and stockpiled adjacent to the borrow pit areas in designated locations.
- Relative to granular deposits immediately adjacent to the small lakes and gullies, the development procedures should be commenced at the source area farthest removed from the water course. A buffer zone of adequate width should be maintained between the stream and the final limits of the borrow pit.
- Operating procedures during borrow pit development should be maintained whereby surficial waste materials do not drain to the adjacent lakes and water courses.

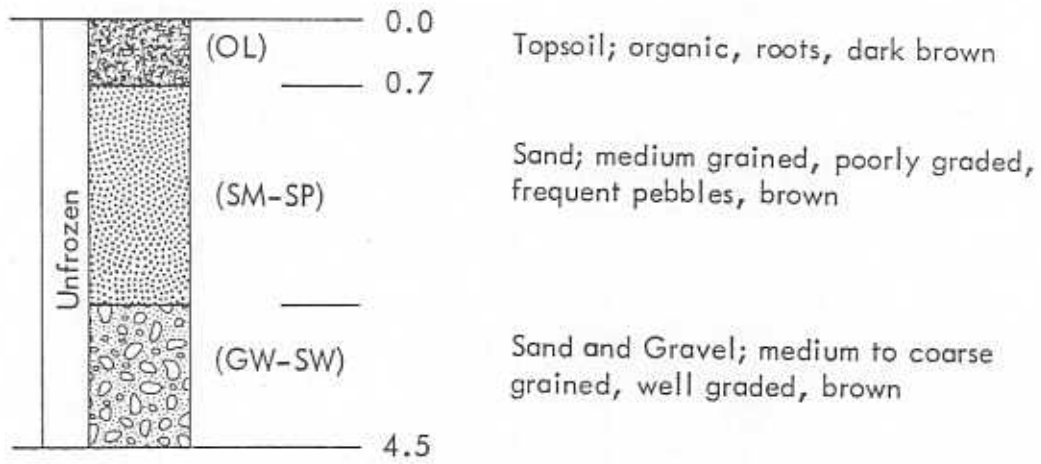
ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation procedures should include:

- Recontouring of the pit area to provide general drainage compatible with the natural drainage of the adjacent terrain.
- Replacing stockpiled surficial waste material on the abandoned borrow pit areas.

142/TP 1

DETAILED TEST PIT LOG



DETAILED DRILL HOLE LOG

SITE NO. 142

HOLE NO. DH-1

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	PEAT: organic, fibrous, muskeg, dark brown					0
2		GP-GW	GRAVEL: some sand, rust brown					2
4		SP	SAND: trace silt, fine to medium grained, poorly graded, few pebbles to 3/8 inch size, rust brown		Nf	L		4
6	6							
8	8							
10	10							
12			TOTAL DEPTH 12.0'				MC GS	12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 142

HOLE NO. DH-2

DATE: FEB.13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		GP	GRAVEL: some sand, rust brown	[Cross-hatch pattern]	Nf	L		0
3		SP	SAND: fine grained, poorly graded, light brown					2.0	3
6	[Dotted pattern]	SW	SAND: some gravel, medium to coarse grained, well graded, wet, rust brown	UF				6
9			9					
12			12					
15	[Dotted pattern]	SP	- little silt, fine to medium grained, poorly graded, occasional pebbles to 1/2 inch size, medium brown					15
18			18					
21			TOTAL DEPTH 22.0'					21
24								24

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY





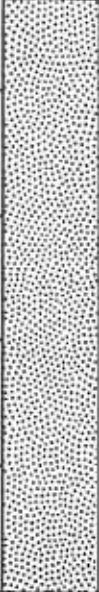

DETAILED DRILL HOLE LOG

SITE NO. 142

HOLE NO. DH-3

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)			
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.					
0		Pt	0.5 PEAT: organic, fibrous, muskeg, dark brown		Nf	L	MC GS O	0			
2		SW-GW	SAND AND GRAVEL: medium to coarse grained, well graded, pebbles to 3/4 inch size, few boulders, rust brown					2			
4								4			
6								6			
8								8			
10								10			
12								12			
14								14			
10									ML	10.0 SILT: low plastic, light grey	10
12										12.0 TOTAL DEPTH 12.0'	12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 142

HOLE NO. DH-4

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		GW-GP	GRAVEL: some sand, few boulders, medium brown					0
3								3.0
6		SP	SAND: trace silt, fine grained, poorly graded, few pebbles to 3/8 inch size, light brown		Nf	L		6
9								9
12								12
15								15
18								18
21								21
22.0		22.0	TOTAL DEPTH 22.0'					22
24								24

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 142

HOLE NO. DH-5

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	0.5 PEAT: organic, fibrous, muskeg, dark brown					0
2		GW	GRAVEL: little sand, trace silt, medium to coarse grained, well graded, subangular and subrounded limestone, dolomite and granite pebbles to 2" size, rust brown				GS P	2
4								4
6		SM-SP	5.0 SAND: some clay, little silt, light brown					6
8			8.0		Nf	L		8
10		GP-GW	GRAVEL: some sand, rust brown					10
12			12.0					12
14		SM-SP	SAND: little silt, fine grained, poorly graded, light brown				MC	14
16			15.0 TOTAL DEPTH 15.0'					16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 142

HOLE NO. DH-6

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE CON- DIT- IONS	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.			
0		Pt	0.5 PEAT: organic, fibrous, muskeg					0	
2		GP-GW	GRAVEL: some sand, little silt, medium brown					2	
4		SM-SP	SAND: little silt, fine grained, poorly graded, rust brown					4	
6		SP-GM	SAND and GRAVEL: coarse grained, poorly graded, pebbles to 3" size, rust brown					6	
8	8								
10	10								
12								12	
14							MC	14	
16			15.0 TOTAL DEPTH 15.0'					16	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"



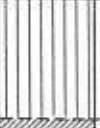

DETAILED DRILL HOLE LOG

SITE NO. 142

HOLE NO. DH-7

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS		ICE	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	PEAT: organic, fibrous, muskeg, dark brown		Nf	L		0
2		ML-CL	SILT: some clay, trace sand, pebbles to 1" size, medium brown		Vx			2
4		CI	- frequent pebbles to 1½" size and occasional boulders from 3.0' (TILL)					4
6							L-M	6
8								8
10					Vx			10
12					Vr			12
14								14
15.0			TOTAL DEPTH 15.0'					15.0
16								16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 142

HOLE NO. DH-8

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	0.5 PEAT: organic, fibrous, muskeg, dark brown					0
2		SW	SAND: well graded, frequent pebbles to 3/4" size, rust brown					2
4			4.0					4
6		GP-GW	GRAVEL: some sand, occasional boulders, medium brown		Nf	L		6
8								8
10								10
11.0			11.0 TOTAL DEPTH 11.0'					11.0
12								12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT






GRANULAR MATERIALS INVENTORY

P PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 142

HOLE NO. DH-9

DATE: FEB. 13, 1973		LOGGED BY: <input checked="" type="checkbox"/> PEMCAN <input type="checkbox"/>							
DRILLING METHOD: <input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> AIR REVERSE CIRCULATION <input type="checkbox"/> OTHER:									
DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)	
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.			
0		Pt	1.0 PEAT: organic, fibrous, muskeg, dark brown		Vs	M		0	
2		ML	SILT: some clay, frequent pebbles to 1" size, medium brown					2	
4					4				
5.0									5.0
6		GM-SP	GRAVEL: some sand, trace silt, poorly graded, medium brown		Nf	L			6
8					8				
10		ML-CL	10.0 SILT: some clay, pebbles to 1/2" size, medium brown		10				
12			12.0 TOTAL DEPTH 12.0'		12				

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"



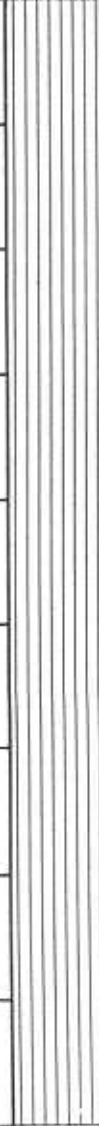

DETAILED DRILL HOLE LOG

SITE NO. 142

HOLE NO. DH-10

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	PEAT: organic, fibrous, muskeg, dark brown					0
1		1.0	SILT: some clay, frequent pebbles to 1" size, occasional boulders, medium brown (TILL)		Nbn	L-M		1
2								2
3								3
4		ML-CL						4
5								5
6								6
7								7
8								8
9								9
10			10.0 TOTAL DEPTH 10.0'					10

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

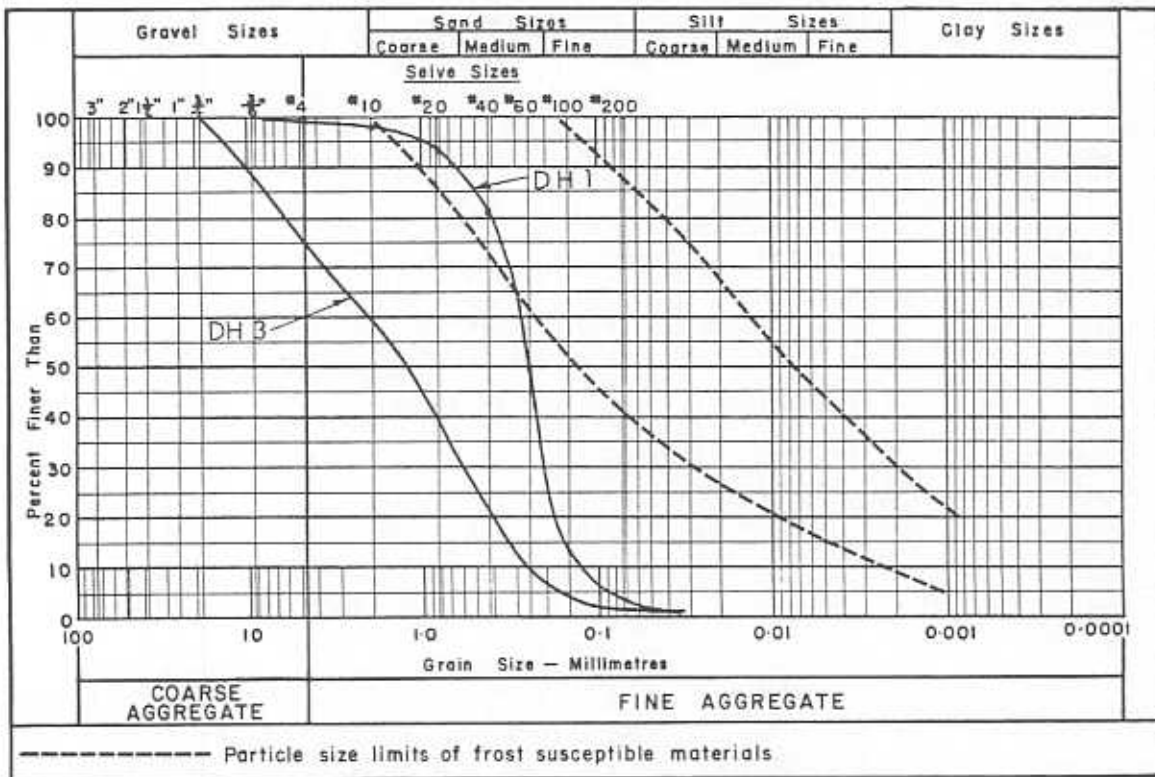


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	142/DH 1	142/DH 3
Sample Depth (Feet):	10.0-12.0	6.0-7.0
Moisture Content (%):	-	2.3
Ice Content (%):	-	-
Organic Content (%):	-	3.0

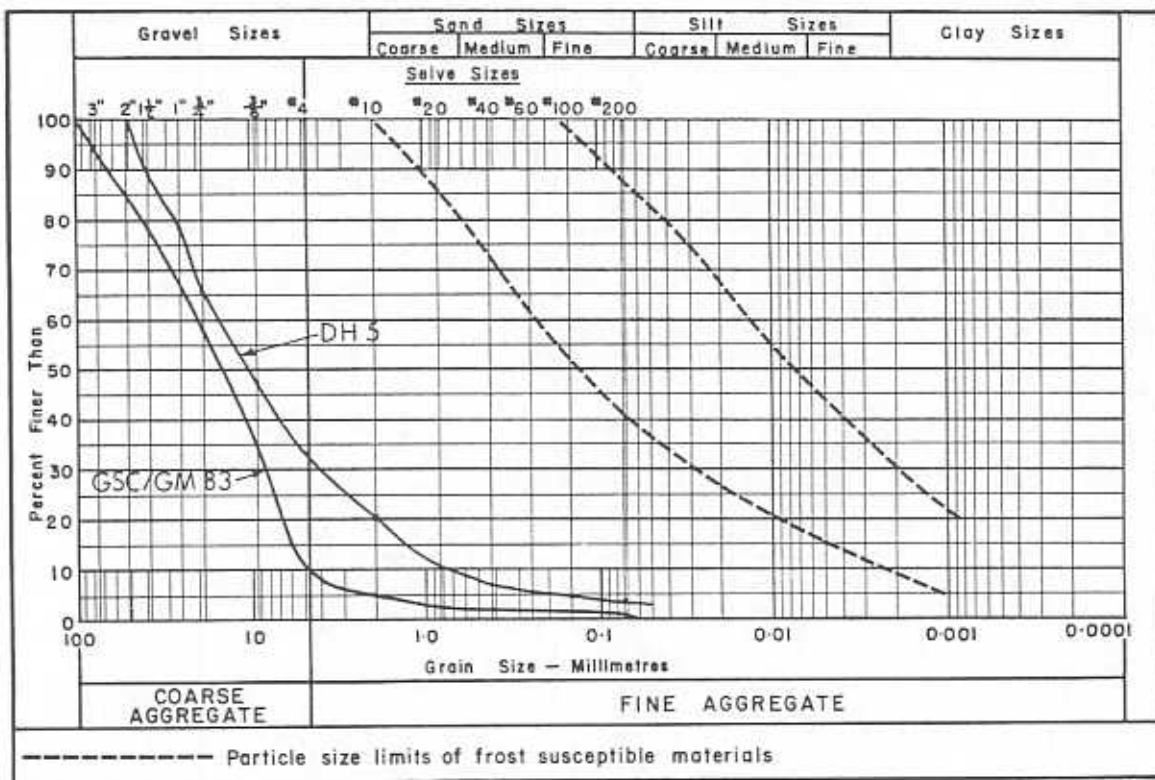
GRAIN SIZE DISTRIBUTION:



SUMMARY OF LABORATORY TEST DATA

Sample Location:	142/DH 5	GSC/GM-83
Sample Depth (Feet):	2.0-5.0	-
Moisture Content (%):	-	-
Ice Content (%):	-	-
Organic Content (%):	-	-

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS: (142/DH 5 @ 2.0' - 5.0')

Limestone and dolomite	36.8%
Igneous	31.1%
Quartzite	20.7%
Chert	2.2%
<u>Deleterious</u>	
Sandstone, siltstone, shale and mudstone	9.1%

SUMMARY OF MOISTURE CONTENT DETERMINATIONS

<u>Sample Location</u>	<u>Sample Depth (Ft.)</u>	<u>Moisture Content (%)</u>
142/DH 5	12.0-15.0	1.6
142/DH 6	13.0-14.0	4.0

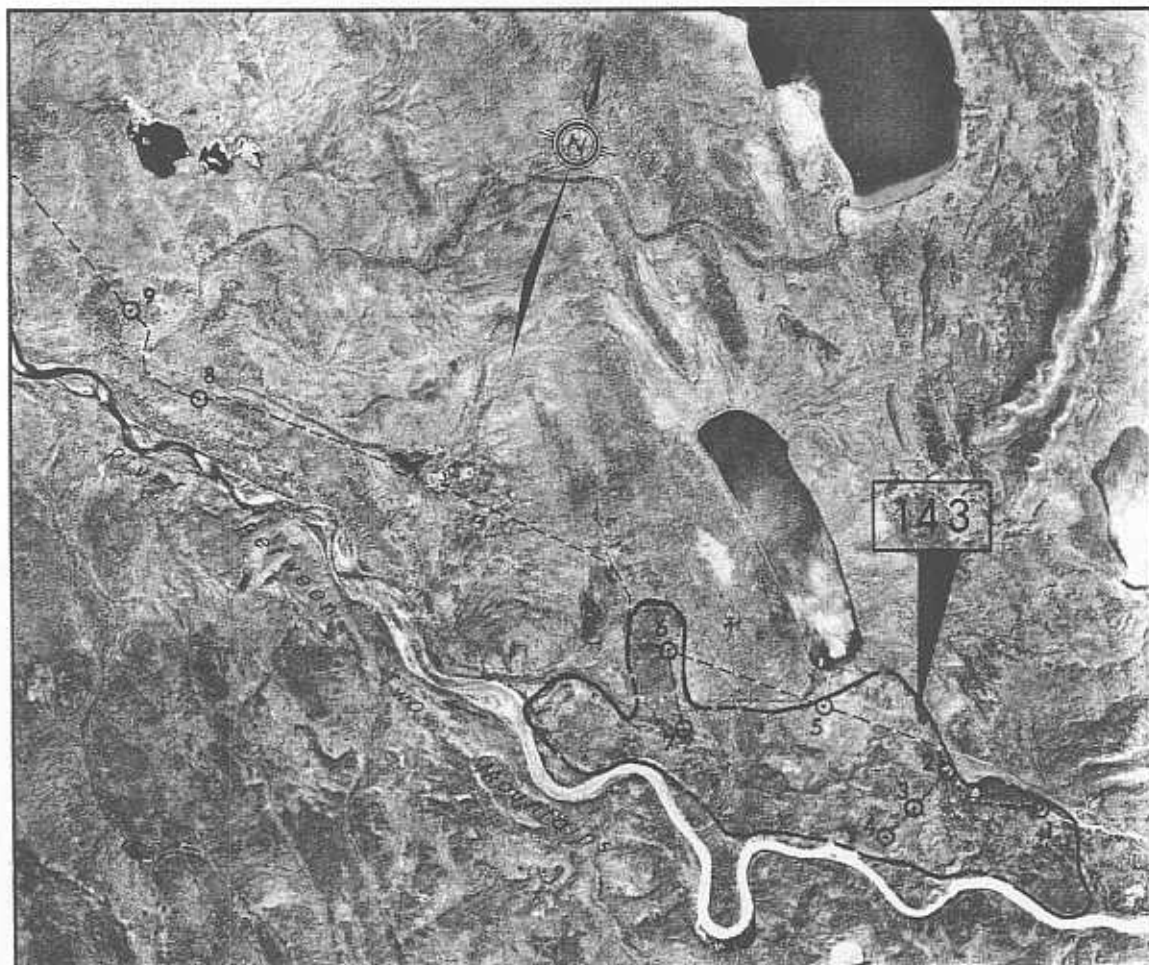
SITE NO. 143

Located approximately 23 miles southeast of Wrigley and 3½ miles east of the proposed Mackenzie Highway at Mile 408, Site 143 consists of glacial outwash deposits with the occasional small esker ridge remnant.

Type of Material: Gravel; some sand, variable grading, medium grained.

Estimated Volume: 1,000,000 cubic yards.

Assessment: Good quality granular materials suitable for most construction requirements were encountered in the esker ridge deposits. Site 143 is recommended for development.



LEGEND

- | | |
|--------------------------------------|----------------------------------|
| ----- All weather road | Required access |
| - - - - Existing trails and cutlines | — · — Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |
| ⊙ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A22859/85

Approximate scale: 1" = 3,600'

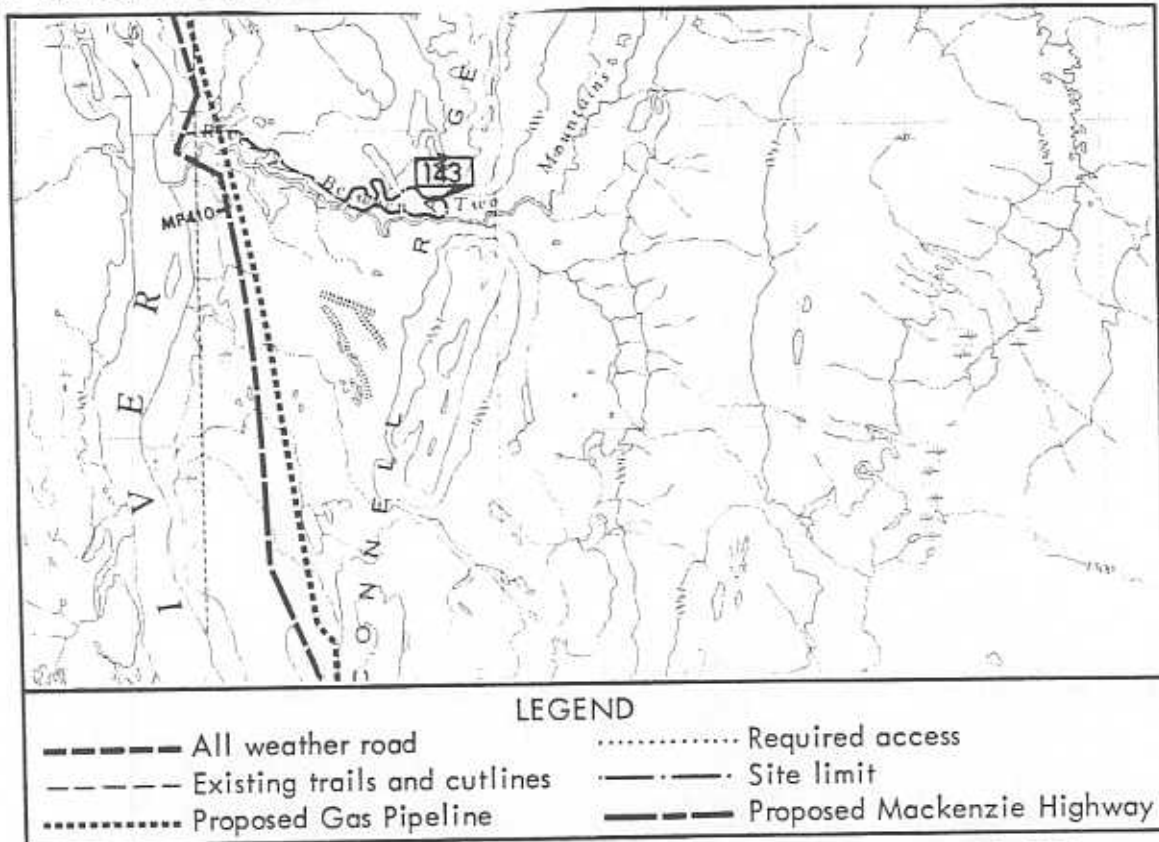


ENVIRONMENT

Site 143 is located approximately 23 miles southeast of Wrigley and 3 1/2 miles east of the proposed Mackenzie Highway right-of-way at Mile 408. The site, consisting primarily of glacial outwash deposits with the occasional small esker ridge, is located immediately adjacent to the north bank of the River Between Two Mountains. The adjacent terrain to the west, as confirmed by drill holes DH-8 and DH-9, consist of fine grained deltaic sand and silt. The site area is gently rolling and exhibits fair to good surficial drainage to the north and south into the watershed of adjacent lakes, streams and rivers.

The material in the glacial outwash deposits is highly variable and ranges from inorganic silts with some clay to medium grained, well graded gravels with some sand. These varying granular material deposits are generally intermixed and moderately scattered throughout the entire site area, although the more well defined esker-like features appear to contain pockets or layers of better quality granular materials. A thin veneer of silty organic topsoil supporting growths of moss, small shrubs, spruce and birch covers the site area. The adjacent terrain is relatively flat and contains a few localized areas with muskeg bogs.

There are no known critical wildlife areas in the immediate vicinity of Site 143. However, River Between Two Mountains contains several areas of existing and potential spawning gravels



Section of Map No. 95 J

Scale: 1:250,000



along its course.

The only existing access to the site area from the CNT pole line or the proposed Mackenzie Highway right-of-way consists of seismic cutlines and the access trails which were cleared during the winter drilling program.

DEVELOPMENT

The detailed findings of the winter drilling program has confirmed the availability of exploitable granular materials at Site 143. On the basis of the drill hole data, the following comments relative to material types are outlined as follows:

- The material represented by these glacial outwash features is extremely variable and ranges from inorganic silts with some clay to relatively well graded gravels.
- The potentially exploitable granular materials of reasonable quality are scattered throughout the site area as pockets and layers.
- The material type within an individual deposit is variable in quality, mode and depth of deposition and recoverable quantities.
- In general, the better quality granular materials appear to be located within the narrow esker ridges.
- The depth of overburden overlying the granular material deposits varies in depth from a few feet to in excess of several feet.
- The better quality granular materials, consisting of medium grained, well graded gravels of varying silt content were noted at drill hole locations 1, 2, 3, 4 and 7. (Ref. Airphoto Site Description, Page 143-1).
- An estimated volume in excess of 1,000,000 cubic yards of granular materials are considered available from Site 143.

Site 143 is recommended for development and exploitation of granular materials and the following development guidelines should be considered.

- In view of the highly variable quality and scattered nature of the available granular materials, Site 143 should be considered essentially for pit run aggregates to be utilized in building pads, road and airstrip subbase construction. However, if careful and selective excavating procedures are utilized during the development of borrow pits, then the pockets or layers of high quality gravels could be exploited for use in production of base course and surface course aggregates.
- The development of borrow pits for Site 143 should be initiated at locations represented by drill holes 1, 2, 3, 4 and 7 which have proven depths of fair quality gravels.



- The glacial outwash features should be further investigated by probing at closer intervals with shallow test pits or drill holes to more specifically delineate and assess the quantity of available granular materials.
- The existing tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The thin veneer of organic topsoil and peat should be stripped, removed and stockpiled adjacent to the borrow pit areas in designated locations.
- Relative to granular deposits immediately adjacent to the north sides of the River Between Two Mountains, the development procedures should be commenced at the source area farthest removed from the water course. A buffer zone of adequate width should be maintained between the stream and the final limits of the borrow pit.
- Procedures during borrow pit development should be maintained whereby surficial waste materials do not drain to the active stream channel of the River Between Two Mountains or into adjacent lakes.

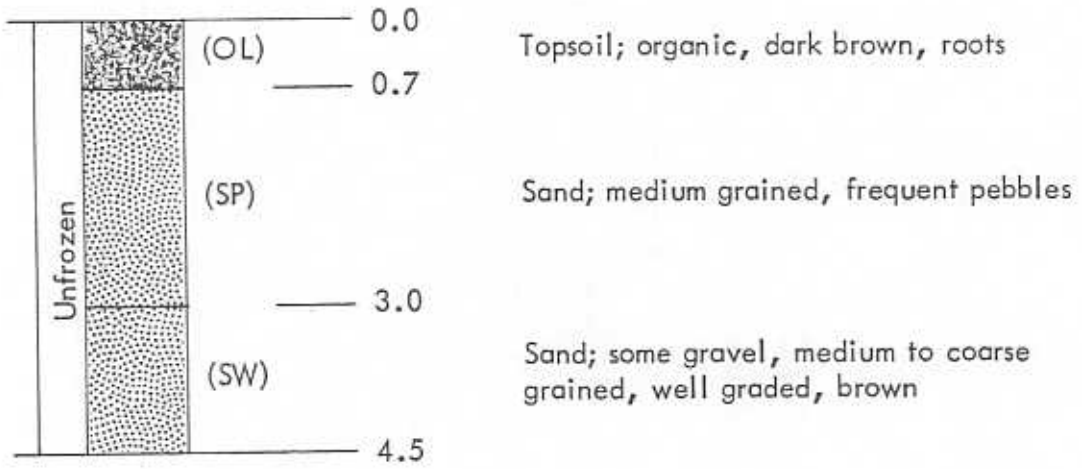
ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation procedures should include:

- Recontouring of the pit area to provide general drainage compatible with the natural drainage of the adjacent terrain.
- Replacing stockpiled surficial waste material on the abandoned borrow pit areas.

DETAILED TEST PIT LOG

143/TP 1



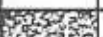




DETAILED DRILL HOLE LOG

SITE NO. 143

HOLE NO. DH-1

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	0.5 PEAT: organic, trace silt, fibrous, muskeg, brown		Vx	L-M	0	
2		ML	2.0 SILT: trace sand, frequent pebbles to 1/4" size, brown				2	
4		GP-GC	GRAVEL: little sand and silt, trace clay, poorly graded, rounded and subrounded pebbles to 2" size, frequent cobbles, greyish brown				4	
6							6	
8							8	
10		ML	9.0 SILT: some clay, little sand, frequent pebbles to 2" size, dark brown (TILL)				10	
12							12	
14							14	
15.0	TOTAL DEPTH 15.0'						15.0	
16							16	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 143

HOLE NO. DH-2

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	PEAT: organic, fibrous, muskeg, dark brown					0
1			1.0					1
2		GW-GP	GRAVEL: little sand, fine grained, medium brown		Nf	L		2
3								3
4			4.0					4
5		ML	SILT: some clay, occasional subangular pebbles to 1" size, dark brown		Vs Vx	M		5
6								6
7								7
8								8
9								9
10			10.0	TOTAL DEPTH 10.0'				10

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 143

HOLE NO. DH-3

DATE: FEB. 12, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	PEAT: organic, fibrous, muskeg, dark brown		Nf			0
3		ML-CL	SILT: some clay, frequent pebbles to 1" size, medium brown		Vx			3
6								6
9			GRAVEL: some sand, little silt, fine grained, frequent boulders			L		9
12								12
15		GM-GP			Nf			15
18								18
21			- occasional boulders from 19.0'					21
22.0			TOTAL DEPTH 22.0'					22.0
24								24

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 143

HOLE NO. DH-4

DATE: FEB. 12, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		Pt	1.0 — PEAT: organic, fibrous, muskeg, dark brown		Nbn	M		0
2		GM-GP	GRAVEL: some sand, trace silt, poorly graded, medium brown				2	
4							4	
6			6.0 — SILT: some clay, frequent pebbles to 1" size, medium brown (TILL)				6	
8		ML-CL					8	
10							10	
12			12.0 — TOTAL DEPTH 12.0'				12	
14							14	

GOVERNMENT OF CANADA DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT	PEMCAN SERVICES "72"
GRANULAR MATERIALS INVENTORY	

DETAILED DRILL HOLE LOG

SITE NO. 143

HOLE NO. DH-5

DATE: FEB. 12, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0								0
2								2
4		Pt	PEAT: organic, fibrous, muskeg, dark brown		Vr			4
6								6
7.0						L-M		
8								8
10		ML	SILT: some sand and gravel, few occasional boulders, light grey		Vx			10
12			TOTAL DEPTH 12.0'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

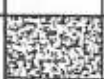



DETAILED DRILL HOLE LOG

SITE NO. 143

HOLE NO. DH-6

DATE: FEB. 12, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	1.0 — PEAT: organic, fibrous, dark brown		NF	M	0	
2		GM-GP	GRAVEL: some silt, few boulders, medium brown				2	
4			4					
6							6	
8		ML	8.0 — SILT: frequent pebbles to 3/4" size, medium brown				8	
10			10					
12			12.0 — TOTAL DEPTH 12.0'				12	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 143

HOLE NO. DH-7

DATE: FEB. 12, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	0.5 — PEAT: organic, fibrous, muskeg, dark brown					0
1		GM-GP	GRAVEL: some sand, little silt, occasional boulders, rust brown		N	M		1
2				2				
3				3				
4				4				
5				5				
6				6				
7				7				
8				8				
9				9				
10				10.0 — TOTAL DEPTH 10.0'				

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 143

HOLE NO. DH-8


DATE: FEB. 12, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS				
0		OL	1.0' TOPSOIL: some silt, little organic, roots, greyish brown		Vs			0	
3		ML	SILT: some clay, medium plastic, greyish brown		Vs	L-M		3	
6					Vx			6	
9					UF			9	
12								12	
15					Vx	L-M		15	
18								18	
21			21.0' TOTAL DEPTH 21.0'					21	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

 **PEMCAN SERVICES "72"**

DETAILED DRILL HOLE LOG

SITE NO. 143

HOLE NO. DH-9

DATE: FEB. 12, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR CIRCULATION AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	1.0 — TOPSOIL: some silt, trace sand, light brown					0
2		ML	SILT: some clay, medium plastic, greyish brown		Vs Vx	L-M		2
4	4							
6	6							
8	8							
10	10							
12	12							
14								14
			12.0 — TOTAL DEPTH 12.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



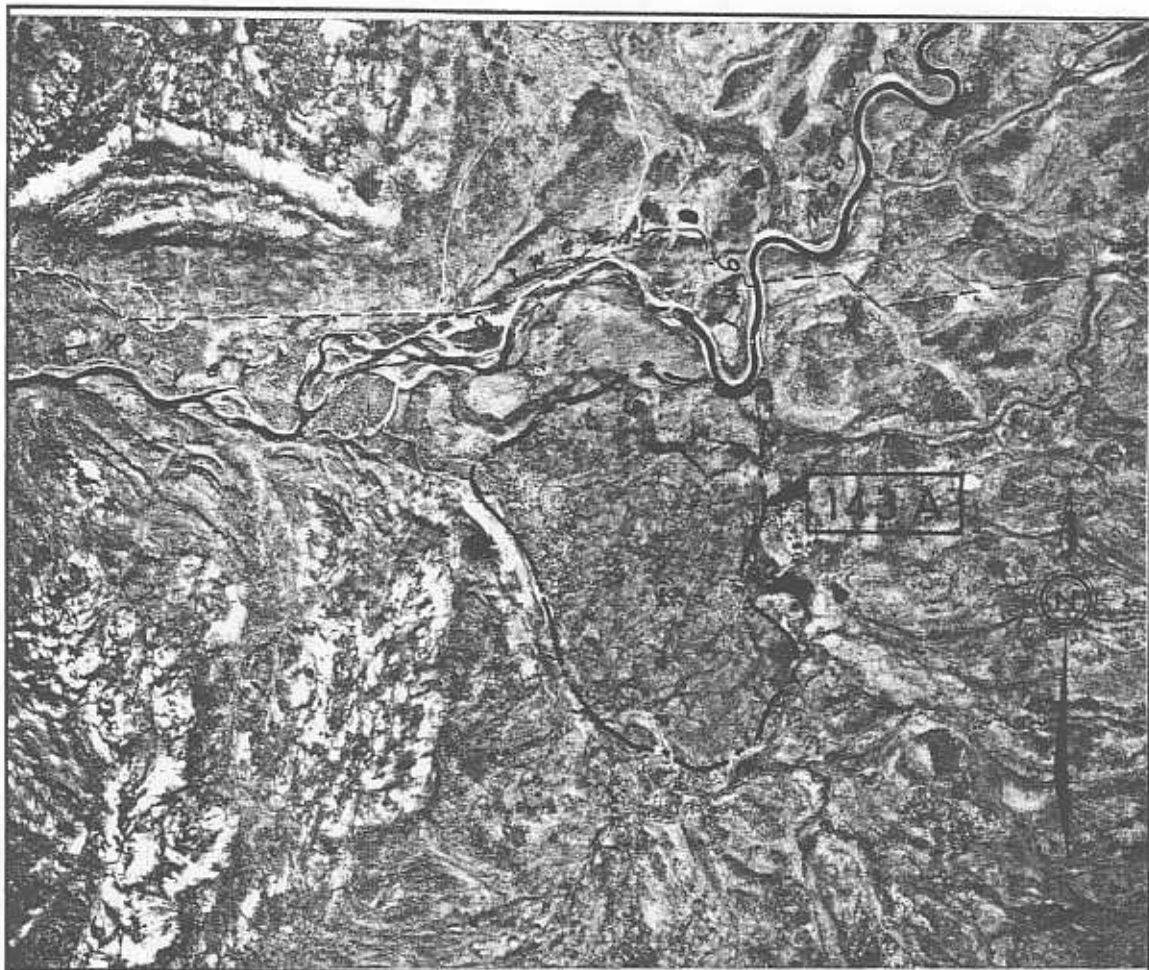
PEMCAN SERVICES "72"

SITE NO. 143 A

LOCATION

Located south of the alluvial flood plain of the River Between Two Mountains at the eastern toe of the McConnell Range, Site 143 A consists of a glaciofluvial outwash plain. This site represents an eastern segment of glaciofluvial and ice contact deposits which form Site 143 on the other side of the mountain range.

Site 143 A is approximately 8 and 7 miles east of the proposed locations of the Mackenzie Highway and gas pipeline respectively.



LEGEND

- | | | | |
|-------|------------------------------|---------|----------------------------|
| ----- | All weather road | ..... | Required access |
| ----- | Existing trails and cutlines | ---\|--- | Site limit |
| ..... | Proposed Gas Pipeline | ----- | Proposed Mackenzie Highway |

Airphoto No. A22889/71

Approximate scale: 1" = 3,000'

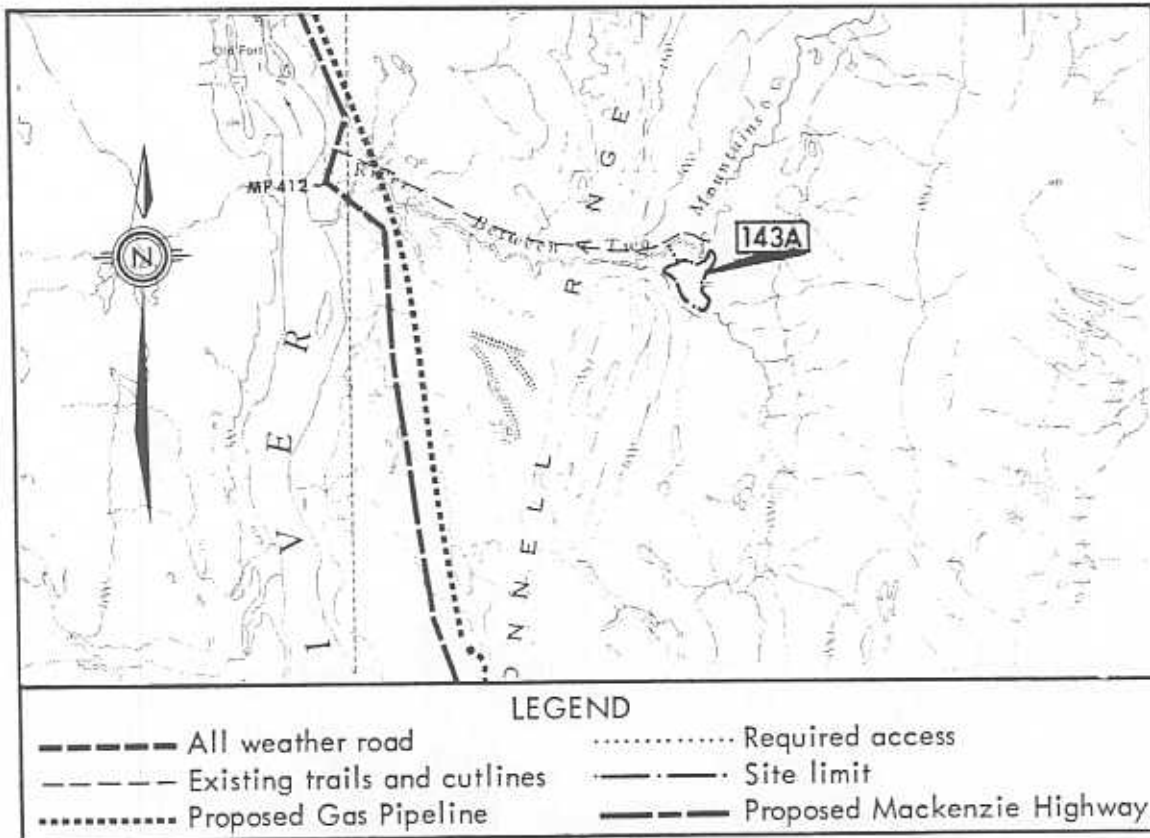


GENERAL

The broad, generally flat but pitted outwash plain covers an area in excess of 3/4 of a square mile. The northern boundary coincides with the River Between Two Mountains flood plain, indicating that the former connection with outwash sediments forming Site 142 has been eroded. The plain rises more than 15 feet above the alluvial flood plain and above the unnamed tributary, limiting the site to the southwest. On the east side the plain surface matches the adjacent flatly rolling terrain. The plain is well drained into adjacent stream channels along its northern and western perimeter, while drainage conditions in the remainder of the site are fair to poor. Spruce, poplar and birch, with relatively dense understory growth, form the vegetation cover across the site.

The plain probably consists of alternating sand and gravel deposits with localized silt or till-like pockets. These deposits are very likely suitable for good quality gravel fill materials. They may also suit requirements for base and surface courses.

The site was not drilled because the access to the site involves the crossing of the River Between Two Mountains, lack of existing cutlines to the site and its relative remoteness. Site 143A is rated as a good prospect for granular materials.



Section of Map No. 95 J

Scale: 1:250,000

SITE NO. 144

LOCATION

Located immediately south of the River Between Two Mountains and about $1\frac{1}{2}$ miles east of the proposed Mackenzie Highway right-of-way, Site 144 is a small esker ridge paralleling the river channel.

The proposed Mackenzie Highway right-of-way at Mile 411 is located approximately $1\frac{1}{2}$ miles west of Site 144. The proposed gas pipeline route runs approximately $1\frac{1}{4}$ miles west of the site area.



LEGEND

- | | |
|--|----------------------------------|
| ----- All weather road | Required access |
| - - - - - Existing trails and cutlines | - · - · - Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |

Airphoto No. A22859/86

Approximate scale: 1" = 3,000'



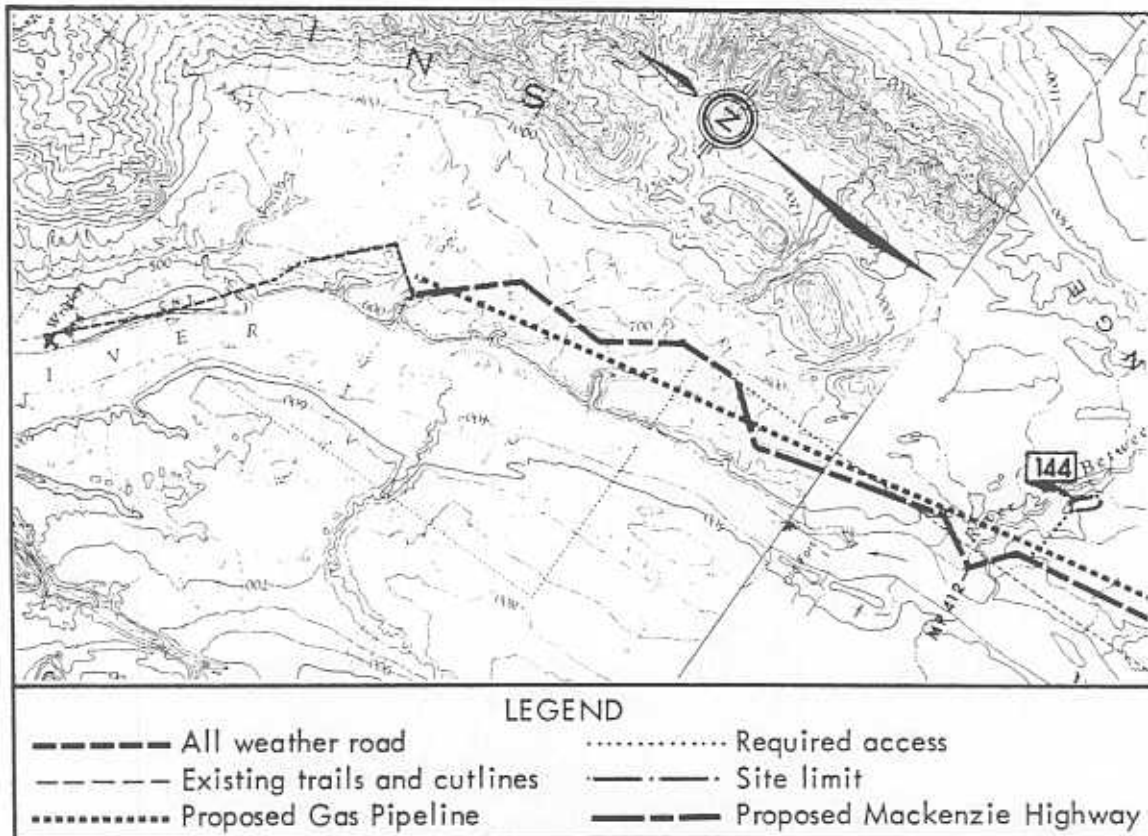
GENERAL

Some 1500 feet long and about 150 feet wide, Site 144 consists of a sinuous ridge which rises 10 to 30 feet above the adjacent relatively flat glaciated plain. The terrain slopes north towards the river channel, thus favourably affecting surficial run-off. A relatively well drained esker ridge supports stands of spruce, poplar, birch and pine. The site does not traverse any known critical wildlife areas.

This esker is likely composed of washed and stratified drift and till - chiefly sand and gravel with minor silt and till inclusions, thus providing fair quality material for general fill only.

The site was not investigated because of the small size of the prospect, non-existent access, and better sources located in the near vicinity.

Site 144 is rated as a poor prospect because its development would entail the stripping of large tracts of land relative to the quantity of materials available.



SITE NO. 145X

Located approximately 22 miles southeast of Wrigley between Miles 411 and 412 on the proposed Mackenzie Highway, Site 145X consists of an alluvial fan and terrace which is located at the mouth of the River Between Two Mountains.

Type of Material: Silt, Sand and Clay; stratified.

Estimated Volume: Not applicable.

Assessment: Site 145X is not recommended for development because materials of granular quality were not established during the field drilling program.



LEGEND

- | | |
|--|--------------------------------------|
| ----- All weather road | Required access |
| - - - - - Existing trails and cutlines | - · - · - Site limit |
| Proposed Gas Pipeline | - - - - - Proposed Mackenzie Highway |
| ⊙ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A22889/91

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 145X is located approximately 22 miles southeast of Wrigley and encompasses the proposed Mackenzie Highway right-of-way from Mile 411 to Mile 412. The site, consisting of an alluvial fan and terrace located at the mouth of the River Between Two Mountains, is approximately 2 miles in length and $\frac{1}{2}$ mile in width. The site area is relatively flat with some shallow depressions indicating former flow channels.

The material in the alluvial fan and terrace deposit consists of stratified and pocketed silts, sands and clays which are saturated or high in ground ice content if frozen. The organic topsoil and peat layer which covers the site area supports moderately dense growths of spruce and tamarack.

There are no known critical wildlife areas in the immediate vicinity of Site 145X. A domestic fishing locale is located at the mouth of the River Between Two Mountains and existing or potential spawning areas are located at several points along the length of the River.

The access to Site 145X is good because the CNT pole line and the proposed Mackenzie Highway right-of-way both traverse the eastern portion of the site area. The proposed gas pipeline right-of-way is located approximately $\frac{1}{2}$ mile east of the site.

DEVELOPMENT

Site 145X is not recommended for development because the data from the drill holes has confirmed the absence of granular type materials in the alluvial fan and terrace deposits.



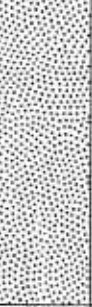
DETAILED DRILL HOLE LOG

SITE NO. 145X

HOLE NO. DH-1

DATE: FEB. 12, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)						
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.								
0		ML	SILT: little clay, thin clay laminations, greyish brown		Vs	L-M		0						
2														
4														
6														
8														
9.0														
10									SM	SAND: some silt, fine grained, poorly graded, frequent silt pockets, damp, brown	UF			10
12														
12														MC
14														
14.0	TOTAL DEPTH 14.0'						14							

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



DETAILED DRILL HOLE LOG

SITE NO. 145X

HOLE NO. DH-2

DATE: FEB. 12, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	0.5 PEAT: organic, fibrous, muskeg, dark brown					0
2		ML	SILT: little clay, thin clay laminations		Vs	L-M		2
4								4
6						UF			6
8								8
10					Vs	L-M		10
12								12
13.0	TOTAL DEPTH 13.0'							13.0
14								14

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

P PEMCAN SERVICES "72"

SUMMARY OF MOISTURE CONTENT DETERMINATIONS

<u>Sample Location</u>	<u>Sample Depth (Ft.)</u>	<u>Moisture Content (%)</u>
145X/DH 1	12.0	15.3

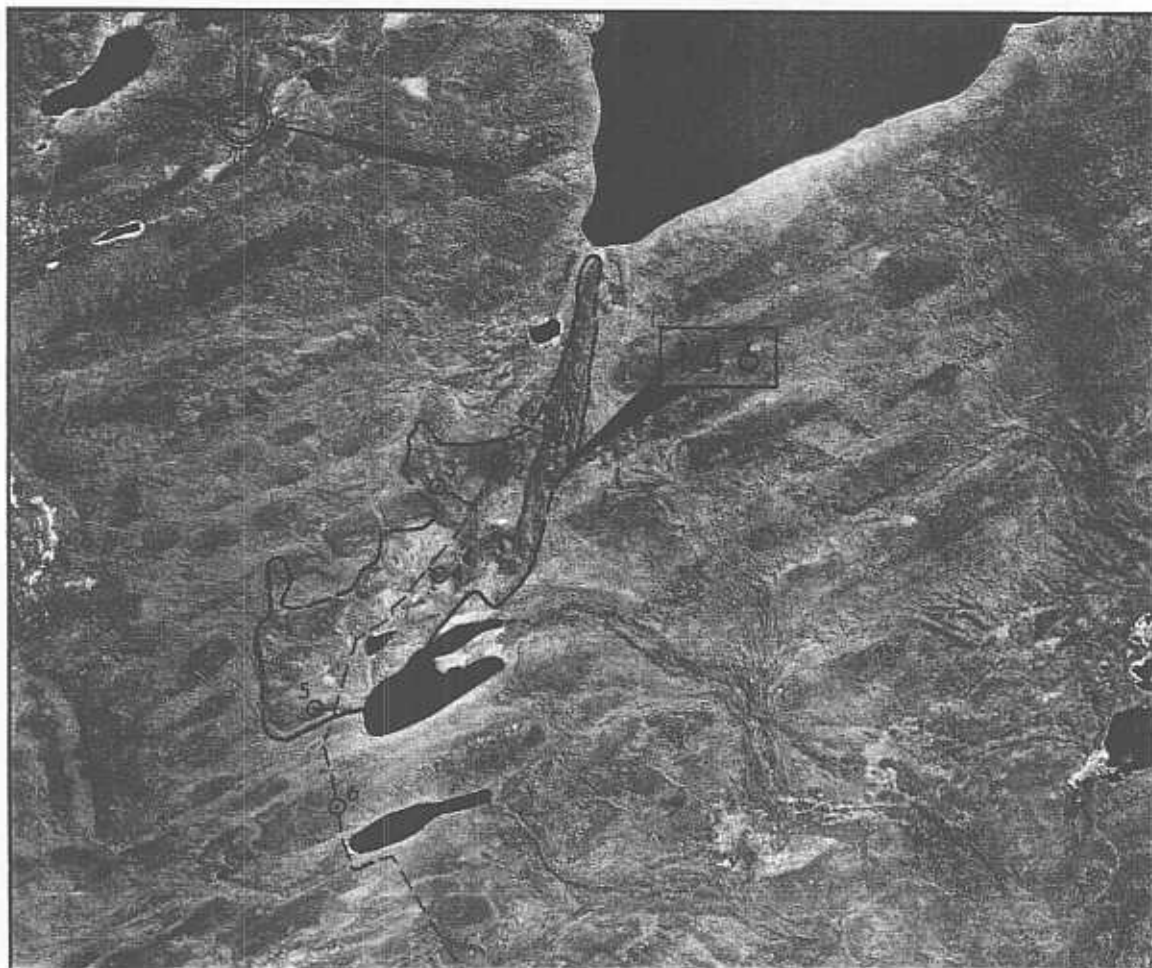
SITE NO. 146

Located approximately 20 miles southeast of Wrigley and 2½ miles east of the proposed Mackenzie Highway at Mile 414, Site 146 consists of a discontinuous esker ridge complex.

Type of Material: Sand and Gravel; trace silt, well graded, medium to coarse grained.

Estimated Volume: 600,000 cubic yards.

Assessment: Good quality granular materials which are suitable for most construction requirements, Site 146 is recommended for development.



LEGEND	
----- All weather road	..... Required access
- - - - - Existing trails and cutlines	———— Site limit
..... Proposed Gas Pipeline	———— Proposed Mackenzie Highway
⊙ DH Drill Hole	⊕ TP Test Pit

Airphoto No. A22859/84

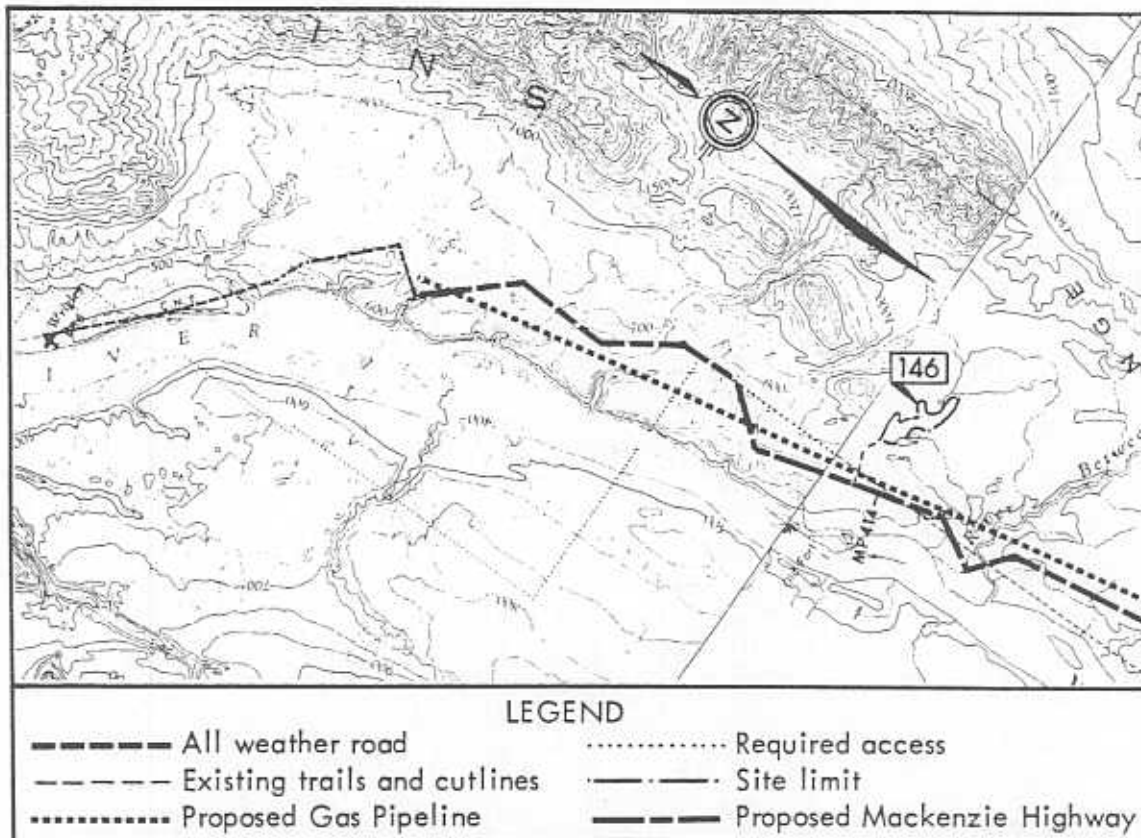
Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 146 is located approximately 20 miles southeast of Wrigley and $2\frac{1}{2}$ miles east of the proposed Mackenzie Highway right-of-way at Mile 414. The site consists of a complex of discontinuous esker ridges which encompass an area approximately $1\frac{1}{2}$ miles in length and $\frac{1}{4}$ mile in width. The individual esker ridge features are generally 200 to 400 feet wide at the base and rise from 30 to 60 feet above the gently rolling terrain which consists of effaced, drumloid ground moraine. A large lake is located at the eastern end of the esker ridge complex and some smaller ponds are located in the valleys between individual esker ridges. The site area and adjacent terrain generally exhibits fair surficial drainage to the west; the rugged McConnell Range rises to the east of the site.

The material in the esker ridges consists of well graded, clean, coarse grained sands and medium grained gravels which are suitable for most construction requirements. A layer of topsoil and organic silt generally less than 2 feet in thickness, covers the surface of the individual esker ridges and supports moderate growths of spruce. The ground water table apparently lies deep within the esker ridges, possibly at depths corresponding to the elevation of the adjacent lakes and ponds.



Section of Map No. 95 O & 95 J

Scale: 1:250,000



There are no known critical wildlife areas in the immediate vicinity of Site 146. The site is within a region which is periodically hunted and trapped by northern residents.

The only existing access to the site area from the CNT pole line, proposed gas pipeline or proposed Mackenzie Highway right-of-way consists of the access trail which was cleared to and onto the site area during the winter drilling program.

DEVELOPMENT

The information compiled from the drill holes conducted on Site 146 showed the following conditions relative to the quality and quantity of available granular materials from these esker ridge deposits.

- Good quality granular materials varying from well graded, coarse grained, clean sands to medium grained gravels which are suitable for most construction requirements are recoverable from these esker deposits.
- The overburden material consisting of topsoil and organic silt is generally less than 2 feet in thickness.
- The depth of sands and gravels in esker deposits vary from several feet to in excess of 15 feet. Therefore, an average depth of 10 feet was utilized for estimating the quantities of available granular materials.
- The in situ granular materials which were frozen during the winter drilling program exhibited very low ground ice contents.
- An estimated volume of approximately 600,000 cubic yards of good quality granular materials are considered available from these esker deposits.

Site 146 is recommended for the development and exploitation of granular materials and the following guidelines should be considered in the development of borrow pits.

- The existing tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil and silt overburden should be stripped, removed and stockpiled adjacent to borrow pit areas in designated locations near the base of the esker ridges.
- The development of borrow pit areas should be initiated in the ridges or their sections removed from existing lakes and ponds.
- Vertical excavation opposed to horizontal excavation should be considered to minimize the effects of erosional agents on the exposed borrow pit areas.



- Operating procedures should be maintained during borrow pit development whereby surficial waste materials do not drain into the adjacent lakes.
- Generally, standard excavation equipment such as dozers, overhead loaders, backhoes and light ripping equipment should be adequate for the removal of material from this site.
- Operating procedures during the borrow pit development should ensure proper contouring of the pit areas to maintain the final level of the borrow pit areas above the level of adjacent lakes.
- Stands of natural growth should be retained between borrow pit areas in order to promote natural regeneration of vegetation after the borrow pit areas have been exploited and abandoned.

ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation procedures should include:

- Recontouring of the pit areas to provide general drainage compatible with the natural drainage of the adjacent terrain.
- Replacing stockpiled surficial waste material on the abandoned borrow pit areas.
- Reseeding of the recontoured pit areas may be considered in areas that may pose erosional problems. At these locations, the artificial reseeding of annuals and perennials will result in a semi-permanent growth prior to the natural reestablishment of the native species.

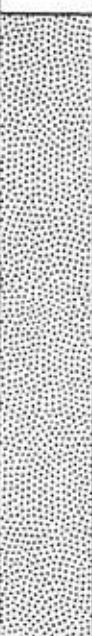



DETAILED DRILL HOLE LOG

SITE NO. 146

HOLE NO. DH-1

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D			
0		SP	SAND: some silt, fine grained, poorly graded, very loose, frequent cobbles and boulders, dry, light brown		Nf	VL			0
1									1
2		GM-GP	GRAVEL: little sand, trace silt and organics, poorly graded, predominantly subround to sub- angular limestone, quartzite and granite pebbles, greyish brown		Nf	L			2.5
3									3
4									4
5	5.0 TOTAL DEPTH 5.0'								5

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY







PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 146

HOLE NO. DH-2

DATE: FEB. 13, 1973		LOGGED BY: <input checked="" type="checkbox"/> PEMCAN <input type="checkbox"/>						
DRILLING METHOD: <input type="checkbox"/> CONVENTIONAL <input checked="" type="checkbox"/> AIR REVERSE CIRCULATION <input type="checkbox"/> OTHER:								
DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		SM	TOPSOIL: some silt, little sand, trace clay, light brown		Vs			0
2			SAND: little gravel and silt, medium to coarse grained, brown					Vs Vx	2
4		ML	SILT: some clay, trace sand, medium grained, frequent sub- angular to angular quartzite and granite pebbles to 3" size, brown		Vs	L-M		4
6								6
8			- layer of cobbles and boulder concentration at 9.0' (TILL)					8
10								10
14			TOTAL DEPTH 14.0'					14

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 146

HOLE NO. DH-3

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	TOPSOIL: some silt, little sand and gravel, brown		Vx			0
2		GW	GRAVEL: little sand, trace silt, medium to coarse grained, well graded, predominantly sub-rounded and subangular pebbles to 1½" size, grey		Nf	L	M C G S O P	2
4								
6								
8								
10								
12		ML	SILT: some clay, trace sand, brown (TILL)	UF				12
14								14
16			TOTAL DEPTH 15.0'					16

GOVERNMENT OF CANADA
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AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 146

HOLE NO. DH-3a

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0	[Pattern]	OL-ML	TOPSOIL: some silt and sand, trace clay, roots, few cobbles and boulders, brown	[Pattern]	Nf	VL		0
1								1
2	[Pattern]	GW-GM	GRAVEL: little silt and sand, medium to coarse grained, frequent pebbles and cobbles to 5" size	[Pattern]	Nf	L		2
3								3
			TOTAL DEPTH 3.0' Note: Refusal on boulders at 3.0'; moved to DH 3.					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 146

HOLE NO. DH-4

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	TOPSOIL: some silt, little sand, few cobbles and boulders, brown		Nf	VL		0
2		GW	GRAVEL: trace sand and silt, well graded, predominantly sub-angular and subrounded pebbles to 1½" size, few cobbles from 3" to 5" size, limestone and quartzite dominate, grey		Vx	L		2
4								4
6								6
8								8
10						MC GS P	10	
12							12	
14			TOTAL DEPTH 14.0'				14	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 146

HOLE NO. DH-5

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	TOPSOIL: some silt, little sand, trace clay, light brown		Vs	M		0
2		SW	SAND: trace gravel, medium to coarse grained, well graded, pebbles to 3/4" size, medium brown		Vx	L		2
4								4
6								6
8							MC GS O	8
10		GW	GRAVEL: little sand, trace silt, well graded, predominantly rounded and subrounded pebbles to 3" size, greyish brown		Nbn	L		10
12								12
14								14
16							MC	16
17.0			TOTAL DEPTH 17.0'					17.0
18								18

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

 **PEMCAN SERVICES "72"**



DETAILED DRILL HOLE LOG

SITE NO. 146

HOLE NO. DH-6

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		ML	SILT: little sand, occasional subangular and angular fragments, pebbles to 2" size - becoming Till-like from 10.0' TOTAL DEPTH 15.0'		Vs	L-M		0
2								2
4								4
6								6
8								8
10								10
12								12
14								14
16								16
15.0								15.0
15.0								15.0
15.0								15.0
15.0								15.0
15.0								15.0
15.0								15.0

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

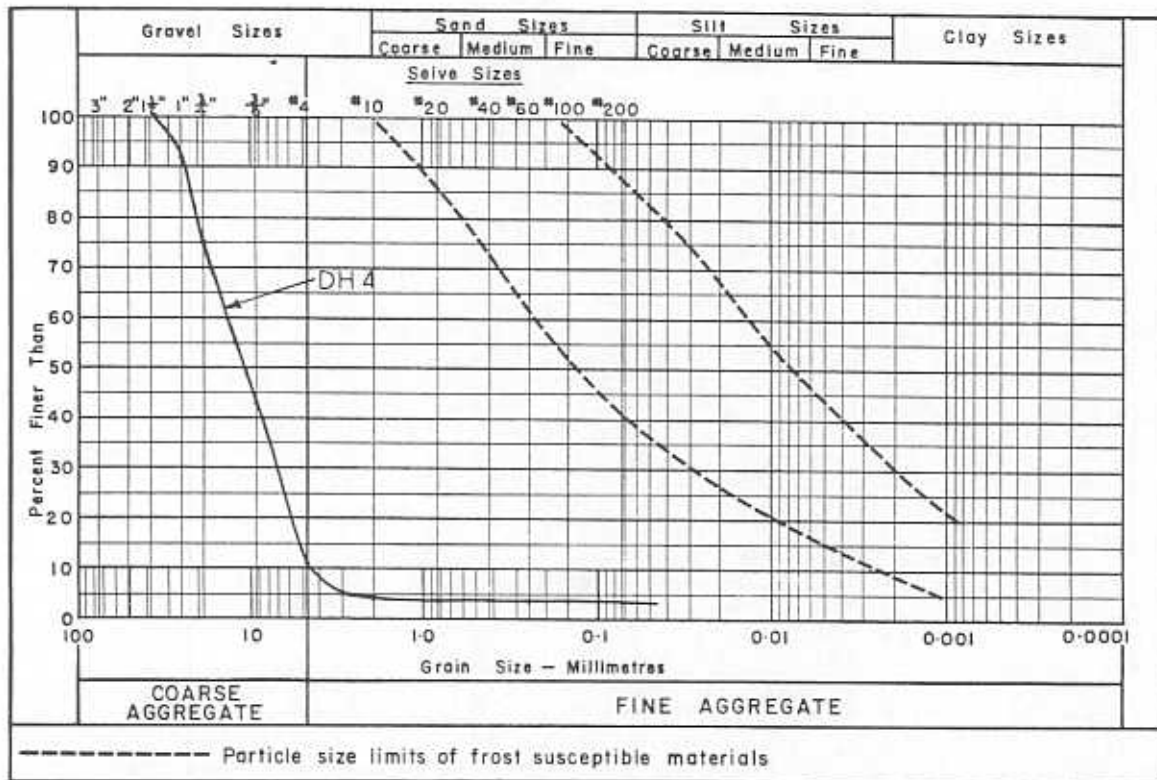


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location: 146/DH 4
 Sample Depth (Feet): 10.0
 Moisture Content (%): 1.3
 Ice Content (%): -
 Organic Content (%): -

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

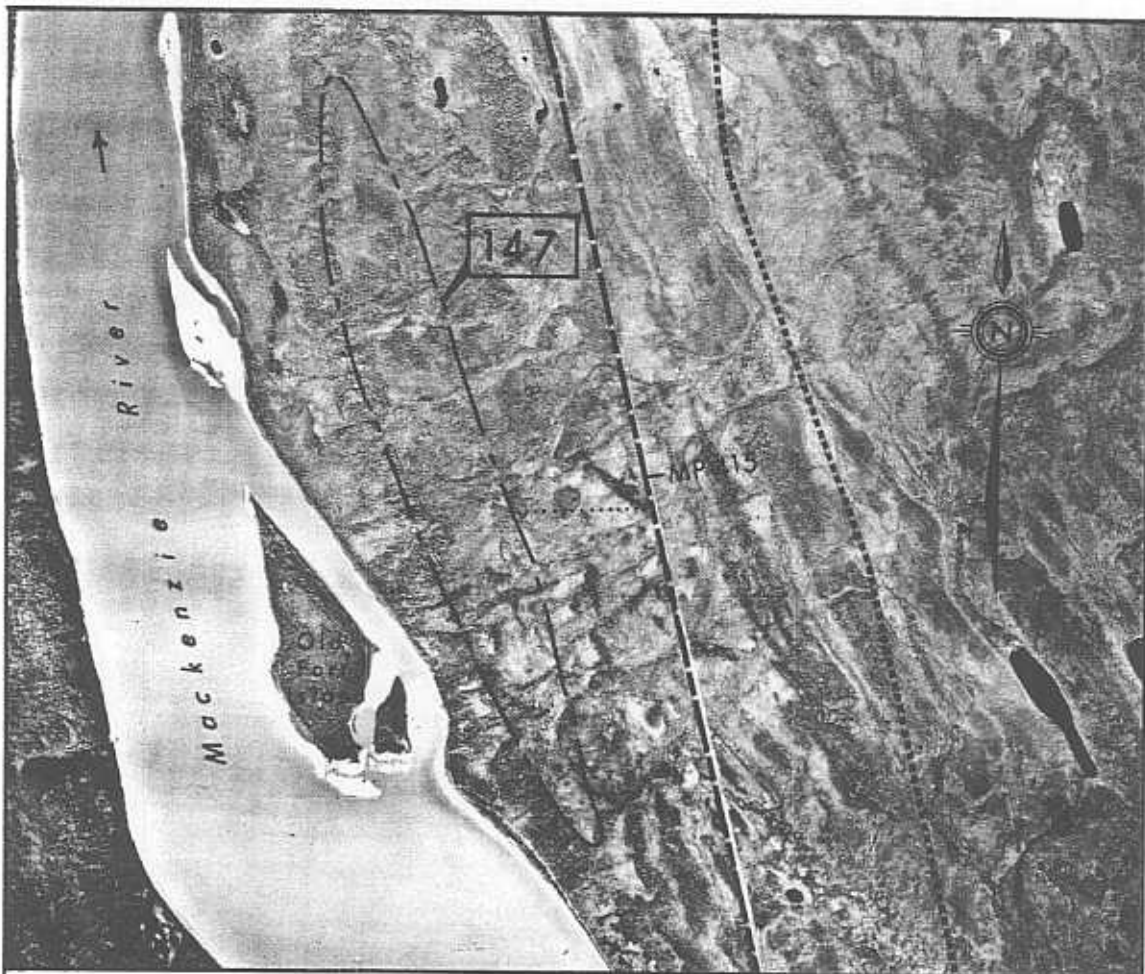
		<u>Hardness</u>
Limestone and dolomite (sound)	44.5%	4-5
Quartzite	36.3%	7-8
Igneous rock	16.5%	6-7
Deleterious ironstone, siltstone, shale and sandstone	1.8%	3-4

SITE NO. 147

LOCATION

Paralleling the eastern side of the Mackenzie River opposite Old Fort Island and approximately 3 miles north of the River Between Two Mountains, Site 147 encompasses a high fluvial terrace.

The proposed Mackenzie Highway right-of-way at Mile 415 is located approximately $\frac{1}{2}$ mile east of Site 147. The proposed gas pipeline route runs approximately 1 mile east of the site area.



LEGEND	
————— All weather road	..... Required access
- - - - - Existing trails and cutlines	- · - · - Site limit
..... Proposed Gas Pipeline	————— Proposed Mackenzie Highway

Airphoto No. A22933/96

Approximate scale: 1" = 3,000'

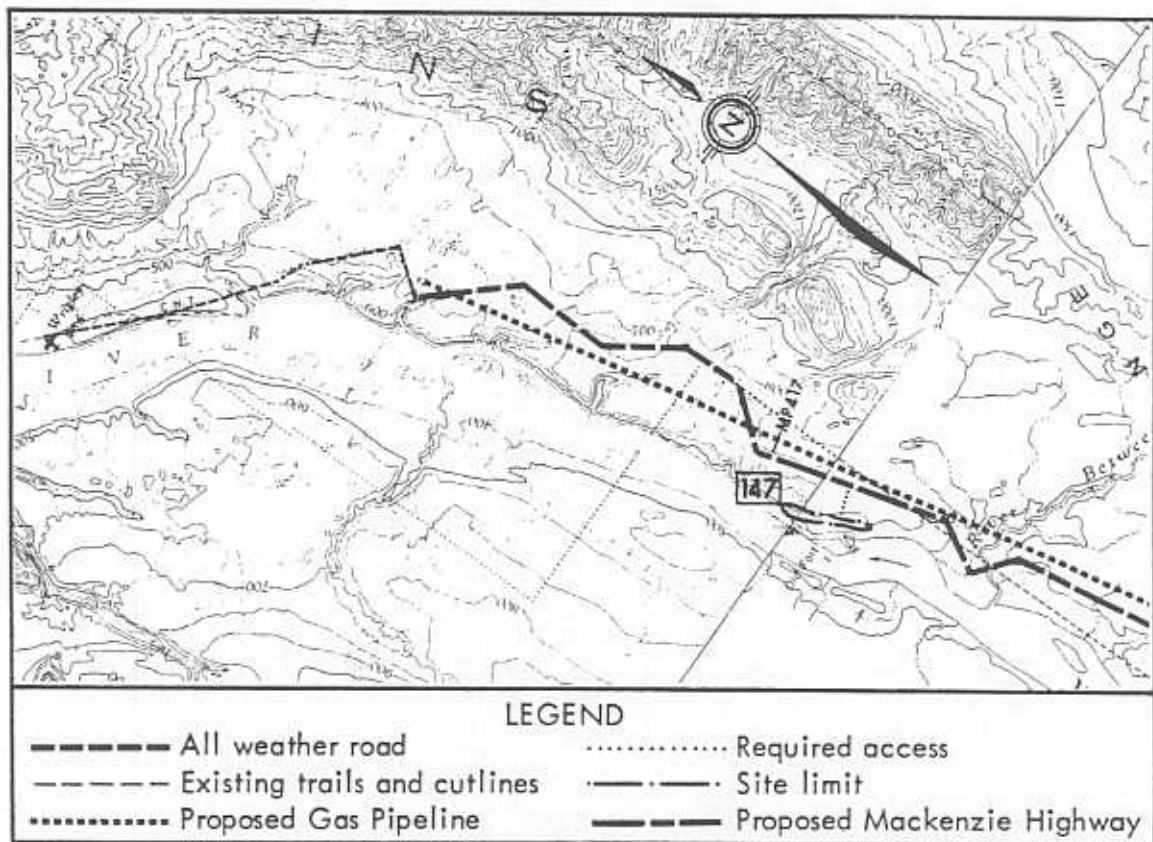


GENERAL

The high fluvial terrace parallels the eastern Mackenzie River valley wall for about 2½ miles; over most of its length the site averages more than 1000 feet in width. The terrace surface is flat while its outer rim and the valley wall are gullied. The terrain east of the terrace gently ascends towards the distant McConnell Range.

Gravel and sand with silt, overlain by a silt and topsoil layer, is exposed in cut slopes in some of the gullies incising the outer terrace perimeter. These deposits can provide for fair to good quality general fill material. Materials within the terrace can, however, vary from spot to spot; thus, coarse granular deposits may form isolated pockets within the fine grained fluvial sediments. The thickness of overburden may also increase towards the eastern site limit. There are no known critical wildlife areas in the immediate vicinity of Site 147; however, this region is periodically trapped and hunted by northern residents.

It is anticipated that deposits within the terrace are of variable quality and that the exploitation of Site 147 would entail selective operations if quality general fill material is required. Therefore, Site 147 is rated as a fair prospect.



Section of Map No. 95 O & 95 J

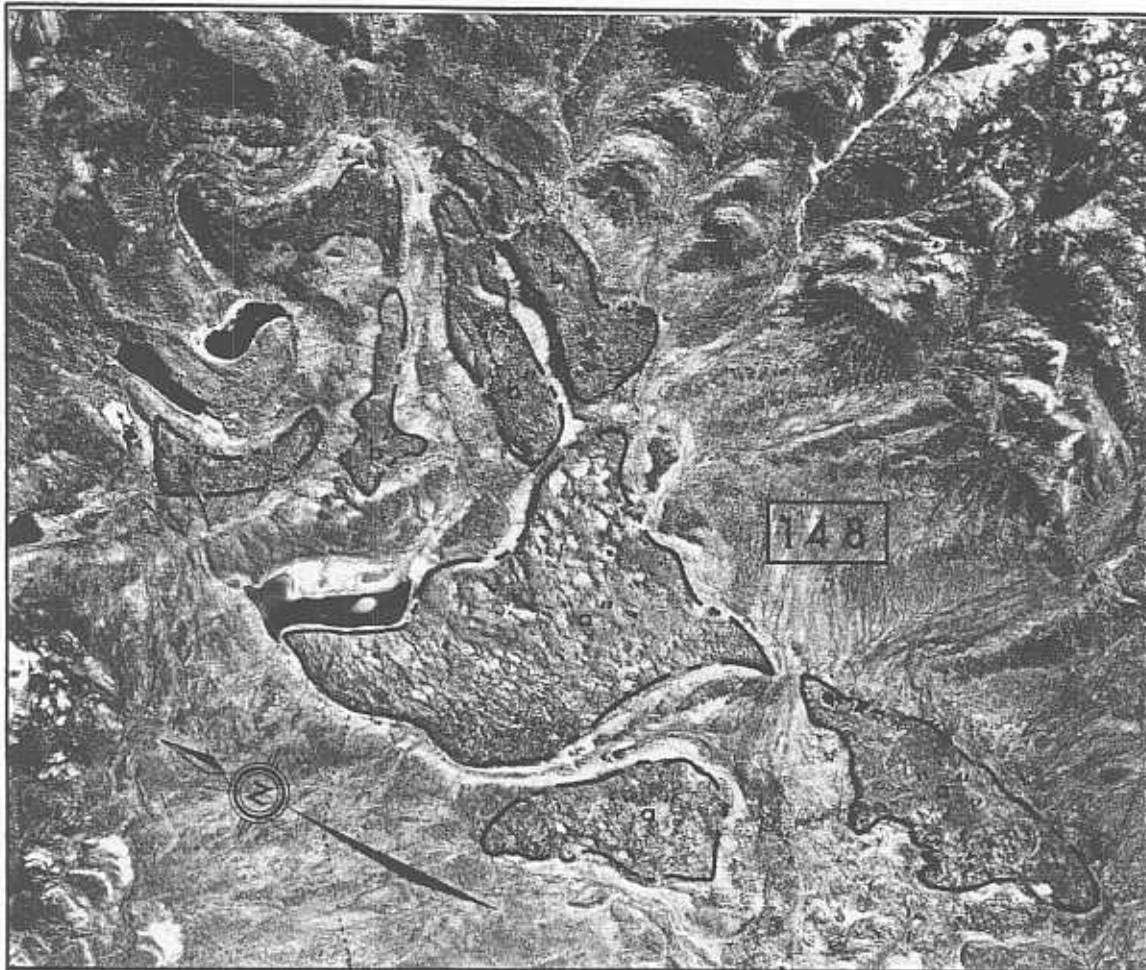
Scale: 1:250,000

SITE NO. 148

LOCATION

Paralleling the western toe of the McConnell Range, approximately 4 miles north of the River Between Two Mountains, Site 148 consists of several kame terraces and kame fields which are spread across an area in excess of one mile in width and 3 miles in length.

Site 148 is approximately 4 miles east of the proposed locations of the Mackenzie Highway and gas pipeline right-of-ways.



LEGEND

- | | |
|--|----------------------------------|
| ————— All weather road | Required access |
| - - - - - Existing trails and cutlines | · · · · · Site limit |
| Proposed Gas Pipeline | ————— Proposed Mackenzie Highway |

Airphoto No. A22859/69

Approximate scale: 1" = 3,000'

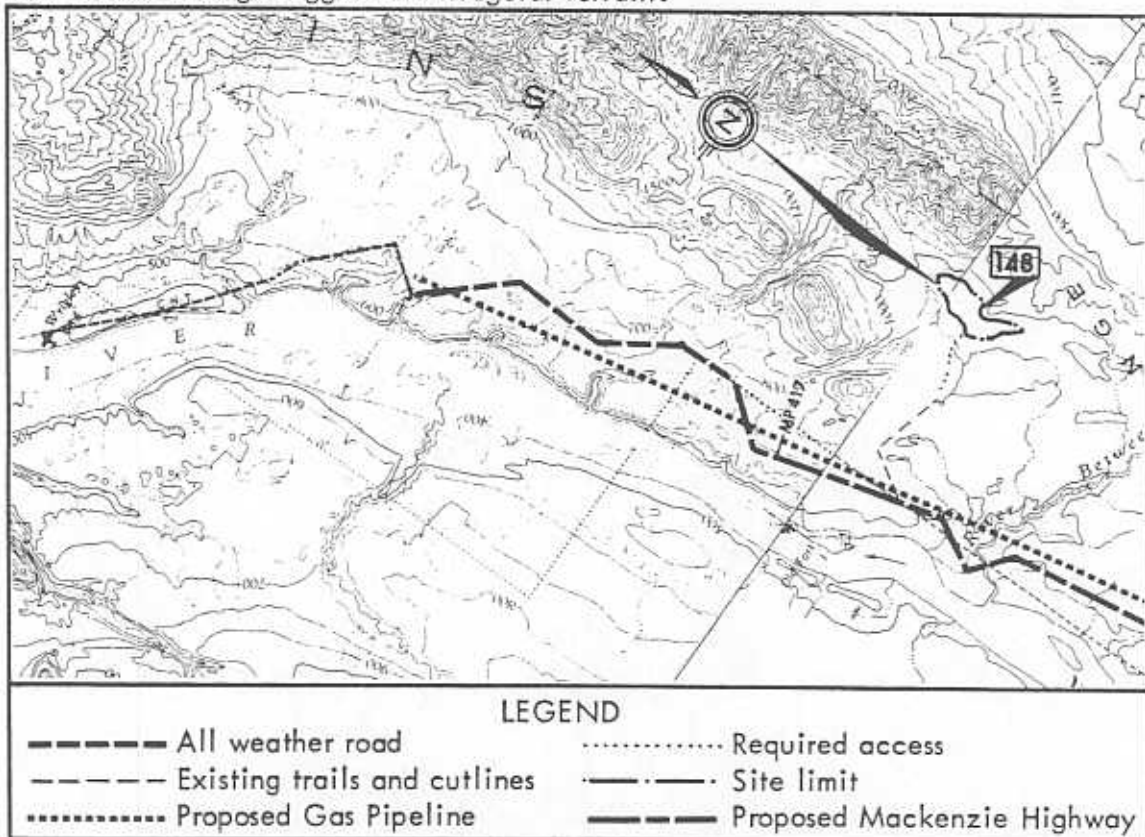


GENERAL

Site 148 consists of three separate kame fields, ranging from 0.1 to 0.5 square miles each in size within the southwestern part of the site; four longitudinal kame terraces, 500 to 1000 feet wide and 2000 to 4000 feet long, are located north of the kame fields. As noted, the kame fields are denoted as "a" and the terraces as "b" on the airphoto. Variably washed and irregularly stratified gravel and sand are apparently the most common constituents of these ice contact landforms. Silt beds, till bodies and boulders may be, however, occasionally encountered within the gravel and sand deposits.

The kame fields are pitted and some of the kettle holes collect the surficial runoff which, in turn, forms numerous small ponds. The terraces are flat topped. Adjacent terrain is rugged as noted on the eastern side, which ascends the steep slopes of the mountain ranges. Gullies and depressions separate both the terraces and kame fields. Fair to good drainage conditions contribute to relatively dense growths of spruce, poplar and birch across the individual site segments. The area is within a region which is periodically hunted and trapped by northern residents.

It is anticipated the deposits will suit the requirements for general fill materials and possibly for both base and surface courses. Therefore, Site 148 is rated as a good prospect. The site is, however, currently inaccessible; exploitation would require cutting approximately 4 miles of new access through rugged and irregular terrain.



Section of Map No. 95 O & 95 J

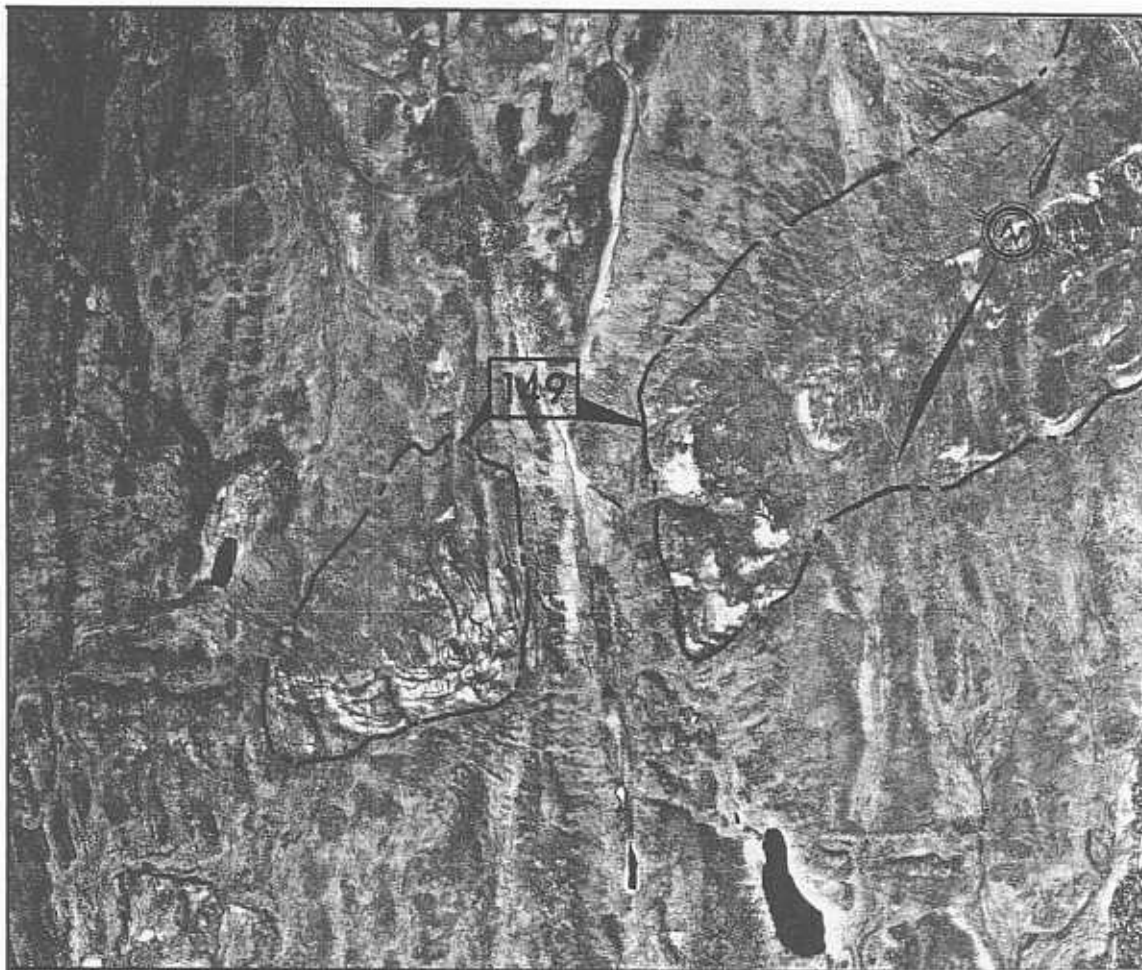
Scale: 1:250,000

SITE NO. 149

LOCATION

Located approximately 3 miles east of the Mackenzie River channel, Site 149 encompasses the southern tip of Franklin Mountains. The bedrock massif forms a prominent ridge which is dissected by an erosion gully into two segments.

Both proposed utilities, the Mackenzie Highway right-of-way at Mile 415 and the gas pipeline route are located west of the site area at a distance of approximately 2 miles.



LEGEND

- | | |
|--|-------------------------------|
| ———— All weather road | Required access |
| - - - - - Existing trails and cutlines | — · — Site limit |
| Proposed Gas Pipeline | —— Proposed Mackenzie Highway |

Airphoto No. A22889/105

Approximate scale: 1" = 3,000'



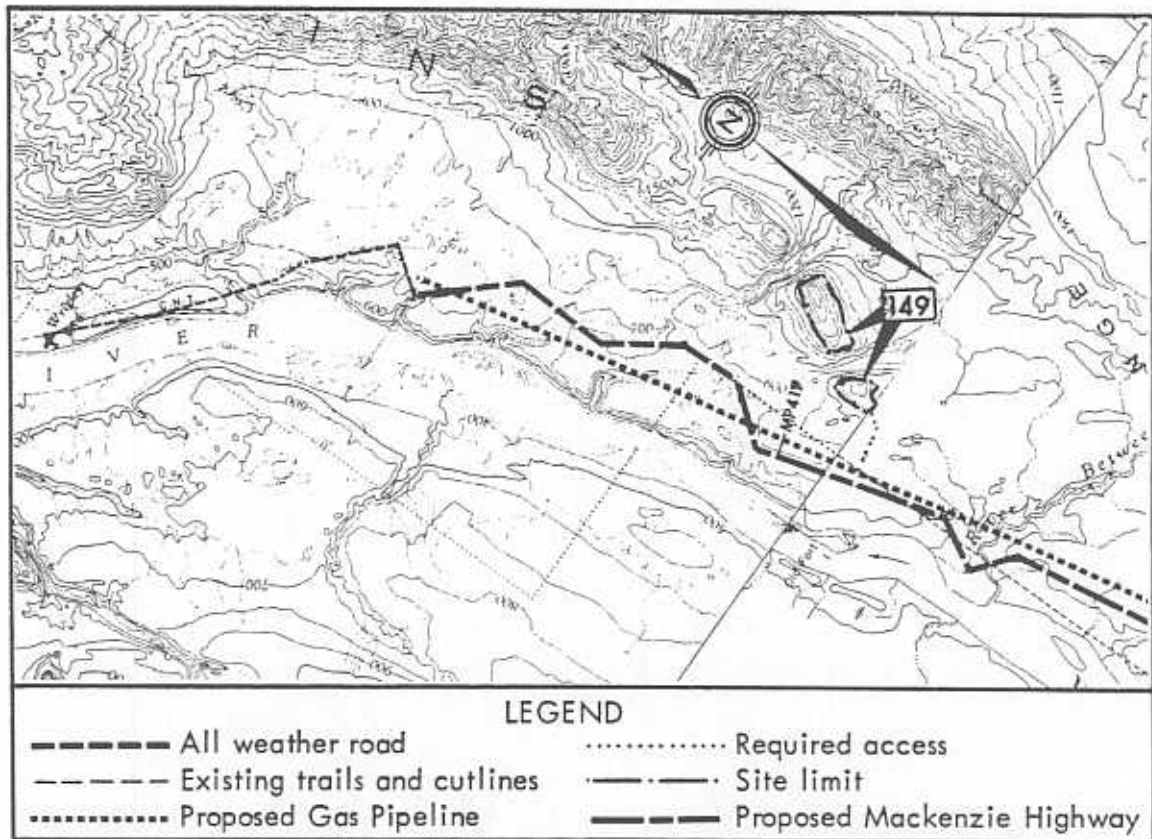
GENERAL

The southern segment of the ridge is about 1/2 mile wide and 1 mile long. The northern part is less than 1 mile wide and is some 3 miles long. The ridge rises several hundred feet above the adjacent rolling terrain and its surface is rugged. Thick bedded Devonian limestones, exposed in numerous rock walls, form ledges and cliffs. Several larger sinkholes exist along the northern face of the southern ridge segment.

The bedrock is covered with discontinuous drift and colluvial materials. A relatively thick layer of slope wash and debris mantles the northwestern slopes of the ridge, and supports medium to dense growths of poplar and birch.

Quarries can be located at several points along the southern and southeastern faces of the ridge. Although the southern segment of the ridge is more accessible, new access however, will still be required. The bedrock will require blasting to be extracted. Good quality general fill can be obtained from this location and aggregates for base and surface courses can be produced by crushing and screening of fresh limestone.

Site 149 is rated as a good prospect for manufacturing granular materials.



Section of Map No. 95 O & 95 J

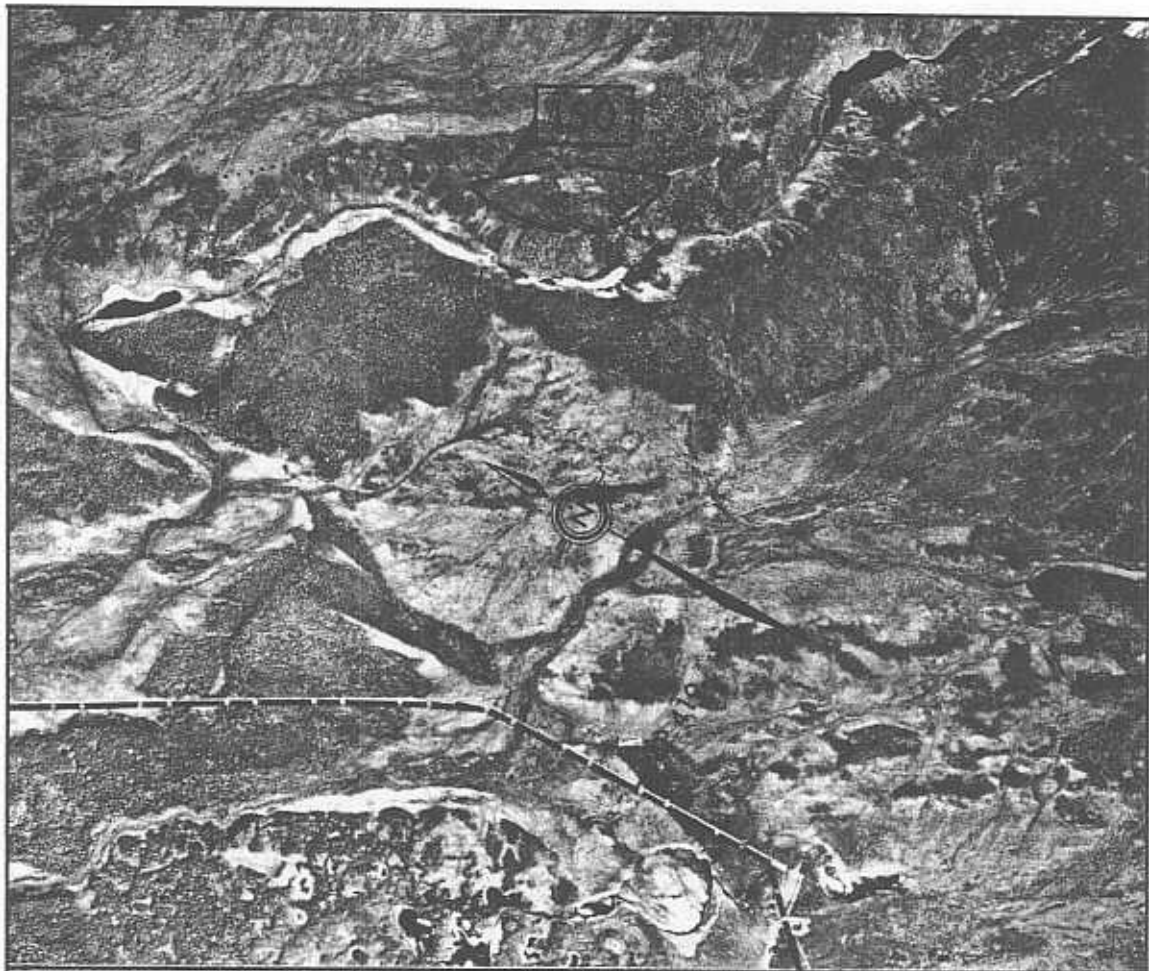
Scale: 1:250,000

SITE NO. 150

LOCATION

Located approximately 15 miles southeast of Wrigley at the western toe of the McConnell Range, Site 150 consists of a kame terrace.

The proposed Mackenzie Highway right-of-way at Mile 421 is located approximately 3 miles west of Site 150. The proposed gas pipeline route is approximately $3\frac{1}{2}$ miles west of the site area.



LEGEND

-----	All weather road	.....	Required access
- - - - -	Existing trails and cutlines	- · - · -	Site limit
.....	Proposed Gas Pipeline	-----	Proposed Mackenzie Highway

Airphoto No. A22889/107

Approximate scale: 1" = 3,000'

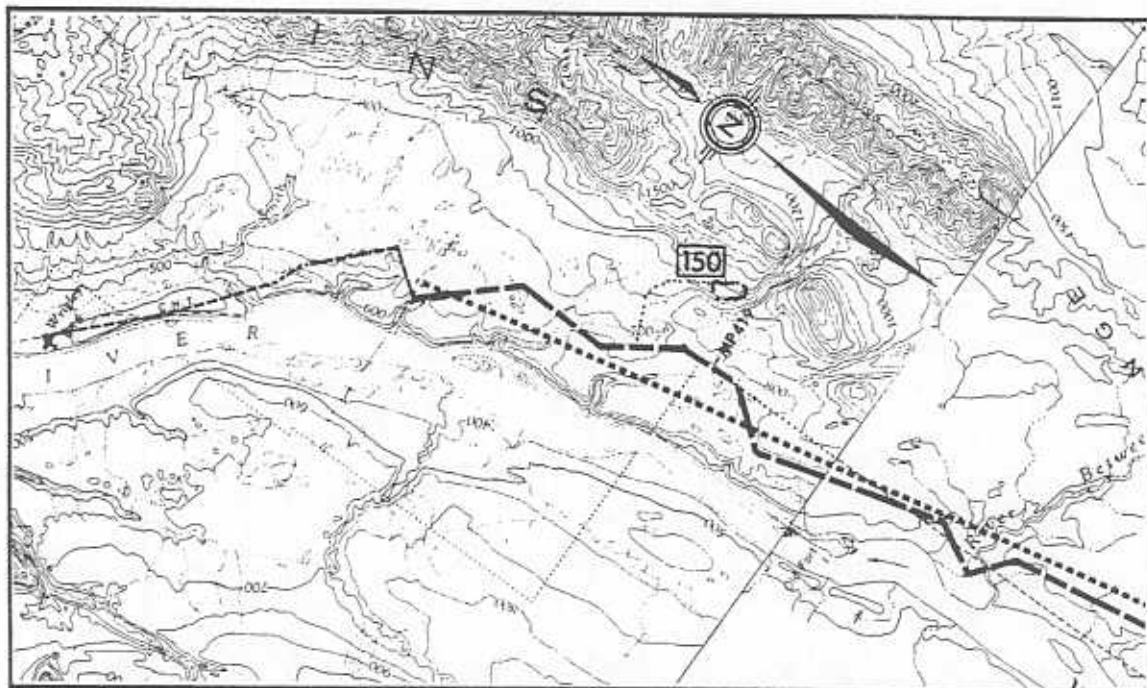


GENERAL

Site 150 encompasses a kame terrace located on sloping grounds adjacent to the western toe of the McConnell Range. The site area is separated from the terrain to the west by a deeply incised erosional gully. The kame terrace is approximately 3000 feet in length with a maximum width of 1000 feet.

The kame material is likely comprised of variably washed sand and gravel deposits with silt and till pockets. The site area is well drained and supports relatively dense growths of spruce and poplar. Surficial drainage is directed west into the erosional gully. There are no known critical wildlife areas in the vicinity of Site 150.

It is anticipated that the sand and gravel deposits within the kame terrace will contain low to medium ice content and thus would be suitable for fair quality fill material. Better quality materials, such as clean, well graded gravel, may occur in isolated pockets, which would be difficult for selective exploitation. There is no existing cutline connecting the site area with the proposed utility routes. Rugged terrain makes the access to the site difficult. Therefore, Site 150 is rated only as a fair prospect.



LEGEND	
----- All weather road	..... Required access
- - - - Existing trails and cutlines	--- Site limit
..... Proposed Gas Pipeline	--- Proposed Mackenzie Highway

Section of Map No. 95 O & 95 J

Scale: 1:250,000

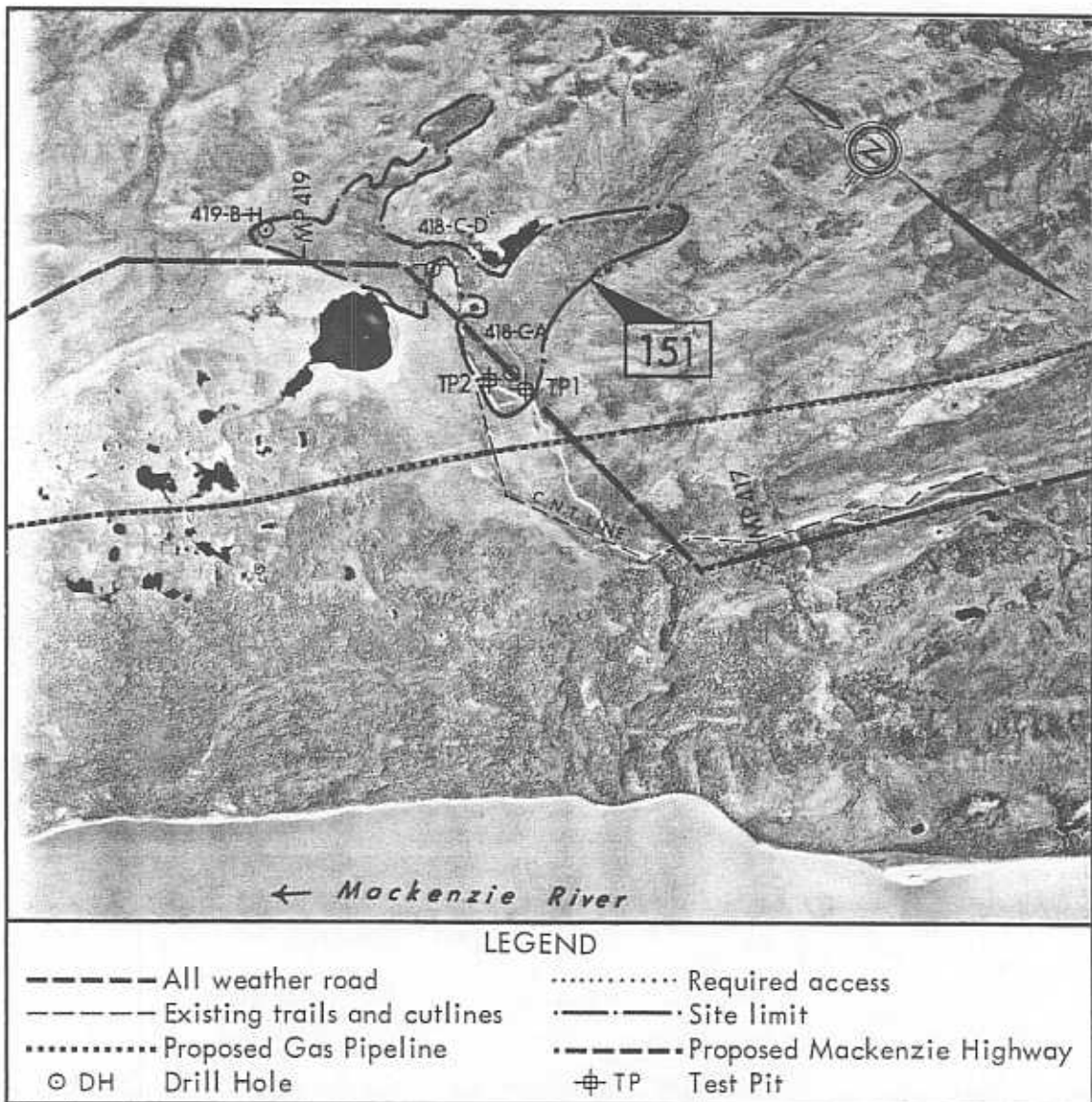
SITE NO. 151

Located approximately 17 miles south of Wrigley; Site 151 consists of a glaciofluvial outwash deposit which encompasses the proposed Mackenzie Highway from Mile 418 to Mile 419.

Type of Material: Gravel and Sand; variable silt content, stratified.

Estimated Volume: 1,500,000 cubic yards.

Assessment: Fair quality granular materials, suitable for general fill in the construction of road subgrades, pipeline berms and utility backfill; Site 151 is recommended for development.



Airphoto No. A22933/95

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 151 is located approximately 17 miles south of Wrigley and consists of a glaciofluvial outwash deposit which encompasses the proposed Mackenzie Highway right-of-way from Mile 418 to Mile 419. The site area is approximately 1 mile in length and averages $\frac{1}{2}$ mile in width. The site area exhibits good surficial drainage to the west into the Mackenzie River, whereas the adjacent terrain to the east consists of shallow lacustrine silt and sand overlying glacial till, and exhibits slight thermokarst features.

The material in the outwash plain consists of medium to coarse grained, sandy gravels with a highly variable silt content. The organic topsoil layer is quite shallow and supports moderately dense growths of spruce and birch.

There are no known critical wildlife areas in the immediate vicinity of Site 151.

Current and future access to potential borrow pit locations is excellent because both the CNT pole line and the proposed Mackenzie Highway right-of-way traverse the entire length of Site 151.

DEVELOPMENT

The information from the field investigation conducted on Site 151 by PEMCAN and the consultant for the Federal Department of Public Works showed the following conditions relative to the quality and quantity of available granular materials:

- Fair quality granular materials, consisting of medium grained, sandy gravels with a highly variable silt content were encountered to depths investigated. These sandy gravels are interspersed with numerous cobbles and are considered suitable for use in fair quality fill material in the construction of highway grades and utility backfill.
- The depth of the granular deposits is in excess of 20 feet, however, selective excavation of material may be necessary because of the highly variable quality of the in situ gravel strata.
- The overburden material consisting of topsoil and silt is generally less than 1 foot in depth. The moisture content of the gravel stratum is quite low, ranging from 5 to 8 per cent.
- It is considered that granular materials in excess of 1,500,000 cubic yards are recoverable from Site 151.

Site 151 is recommended as a source of granular materials and the following operational guidelines should be considered during the development of borrow pits at this site:

- The existing tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.



- The organic topsoil should be stripped, removed and stockpiled adjacent to the borrow pit areas in designated locations.
- A natural stand of tree growth and related vegetation should be retained between borrow pit areas to be developed and existing or proposed right-of-ways.
- Stands of natural growth should be retained between borrow pit areas in order to facilitate regrowth through natural regeneration. A buffer zone of adequate width should be maintained between the Mackenzie River and the final limits of the borrow pit areas.
- The use of dozers, overhead loaders and conventional ripping equipment should adequately remove the material from this site.
- The production of quality surface course and concrete aggregate material may be possible by exercising selective excavation procedures during the development of borrow pits. The production of higher quality aggregates will dictate the need of screening, crushing and washing plants to ensure satisfactory properties for specified construction requirements.
- Additional laboratory tests to evaluate specific physical and chemical properties of the granular materials will be required, if the material is to be considered for the production of concrete aggregates.

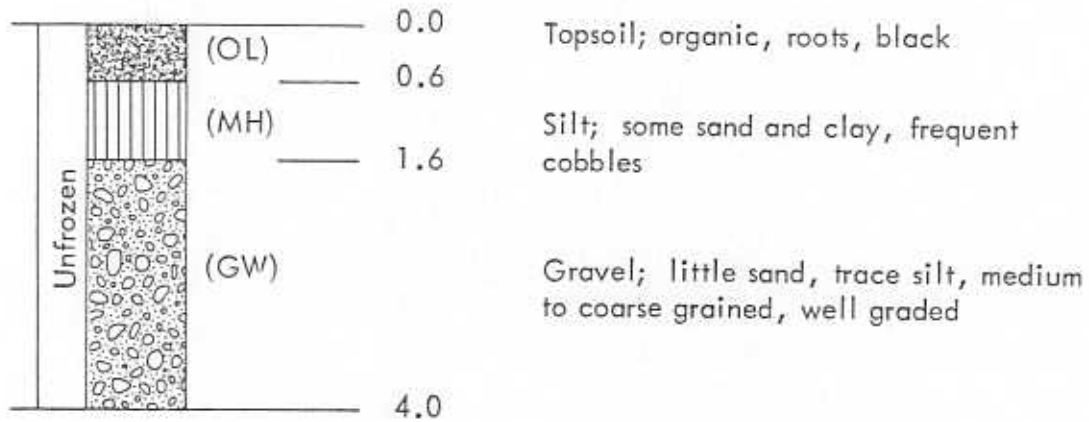
ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation procedures should include:

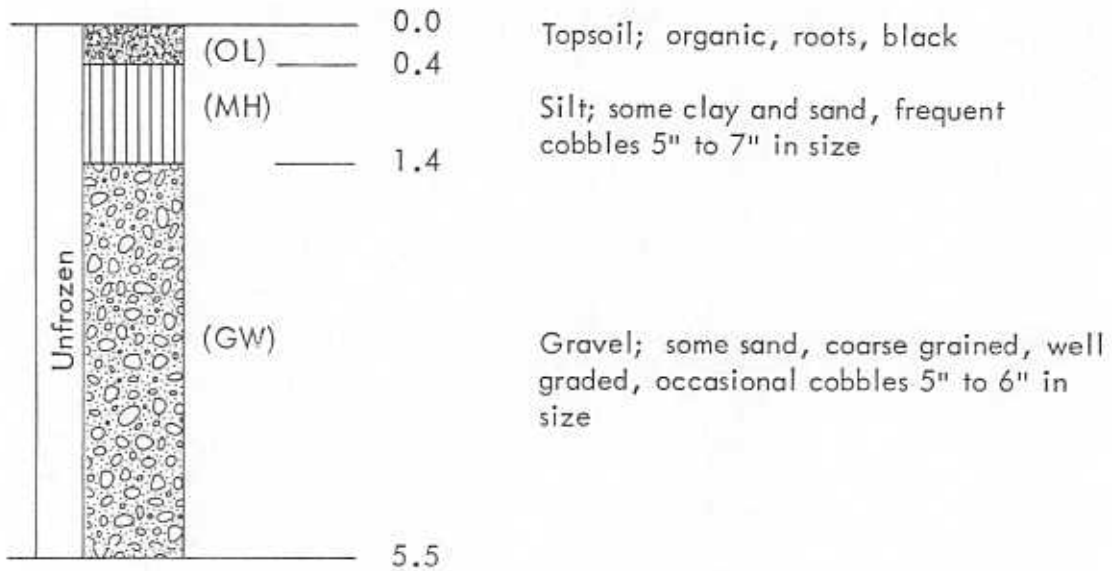
- Recontouring of the pit areas to provide general drainage that is compatible with the natural drainage of the adjacent terrain.
- Replacing stockpiled surficial waste material and organic topsoil on the abandoned recontoured pit areas.

151/TP 1

DETAILED TEST PIT LOG



151/TP 2



DETAILED DRILL HOLE LOG

SITE NO. 151

HOLE NO. B H

DATE: FEB. 12, 1973

LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		Pt	Peat with ice lenses		Vs			0
3			4.0					3
6		SW	Sandy till with some peat		Nf			6
9								9
12								12
15		SW	Sandy till with fine gravel		Nf			15
18								18
21							GS	21
24			25.0					24
27			END OF HOLE 25.0'					27

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 151

DATE: FEB. 14, 1973

LOGGED BY: PEMCAN

HOLE NO. C A

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

ACRES CONSULTING SERVICES

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)			
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.					
0		GP	Brown sand with fine gravel		Nf			0			
2								2			
4		4									
6		6									
6.5		6.5									
8		GS									
8		GW	Grey fine to coarse gravel and sand								8
10											10
10		GS									
12		12									
12		GW									12
14											14
14		14									
15.0		15.0									
16		16									
16	16										

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 151

HOLE NO. C D

DATE: FEB. 14, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE			SAMPLE TYPE	DEPTH (feet)
				COND.	COND.	CONT.		
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		Pt	PEAT		Vx		0	
2		SM	Brown silty gravelly sand with a trace of clay		Nbn		GS	
4	4							
6		GW	Fine to coarse gravel and sand		NF			
8	8							
10	10							
12							GS	
14	14							
15.0			END OF HOLE 15.0'					
16								

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

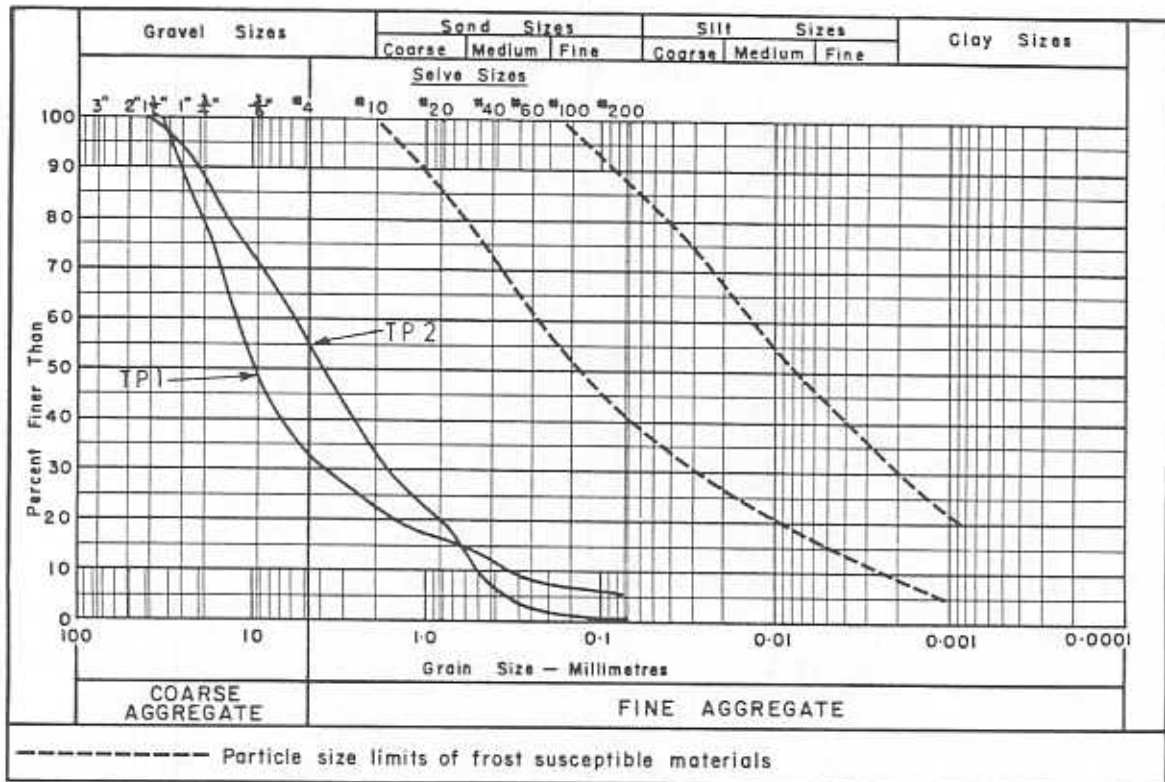


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	151/TP 1	151/TP 2
Sample Depth (Feet):	2.0	3.0
Moisture Content (%):	-	-
Ice Content (%):	-	-
Organic Content (%):	-	-

GRAIN SIZE DISTRIBUTION:

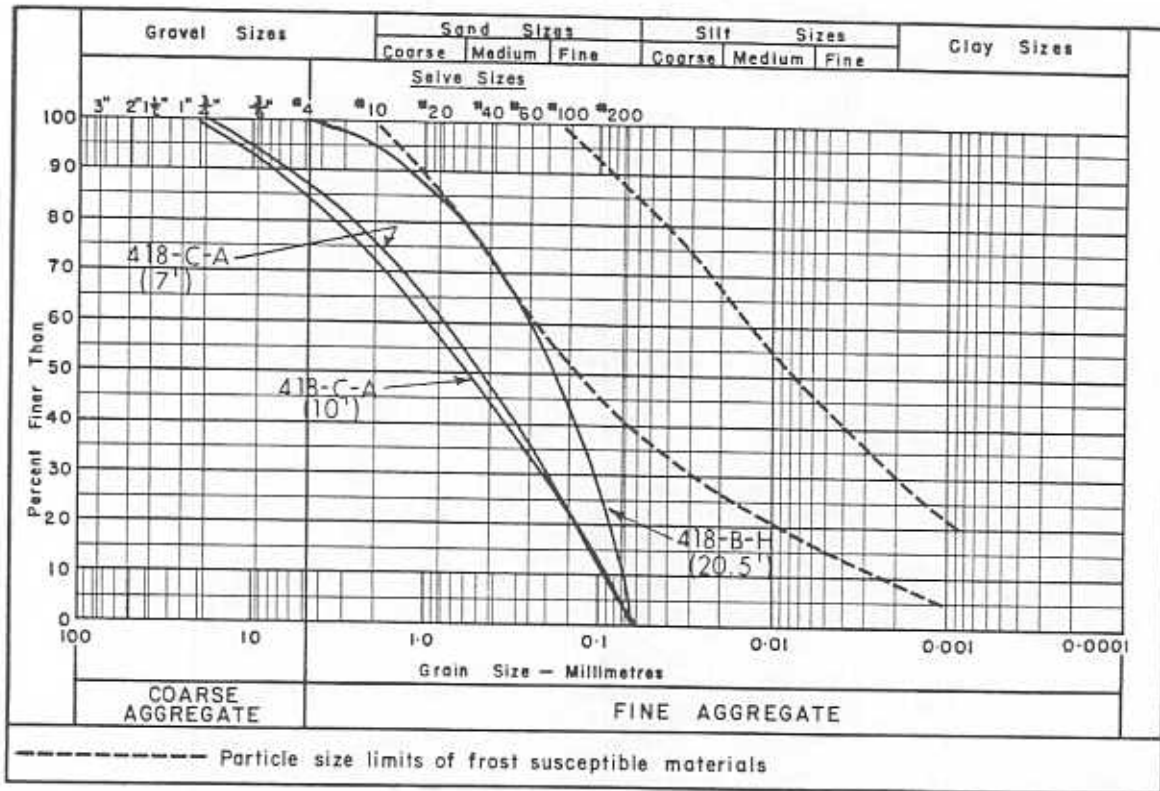


PETROGRAPHIC ANALYSIS:

SUMMARY OF LABORATORY TEST DATA

Sample Location:	151/418-C-A	151/418-C-A	151/418-B-H
Sample Depth (Feet):	7.0	10.0	20.5
Moisture Content (%):	-	-	-
Ice Content (%):	-	-	-
Organic Content (%):	-	-	-

GRAIN SIZE DISTRIBUTION:

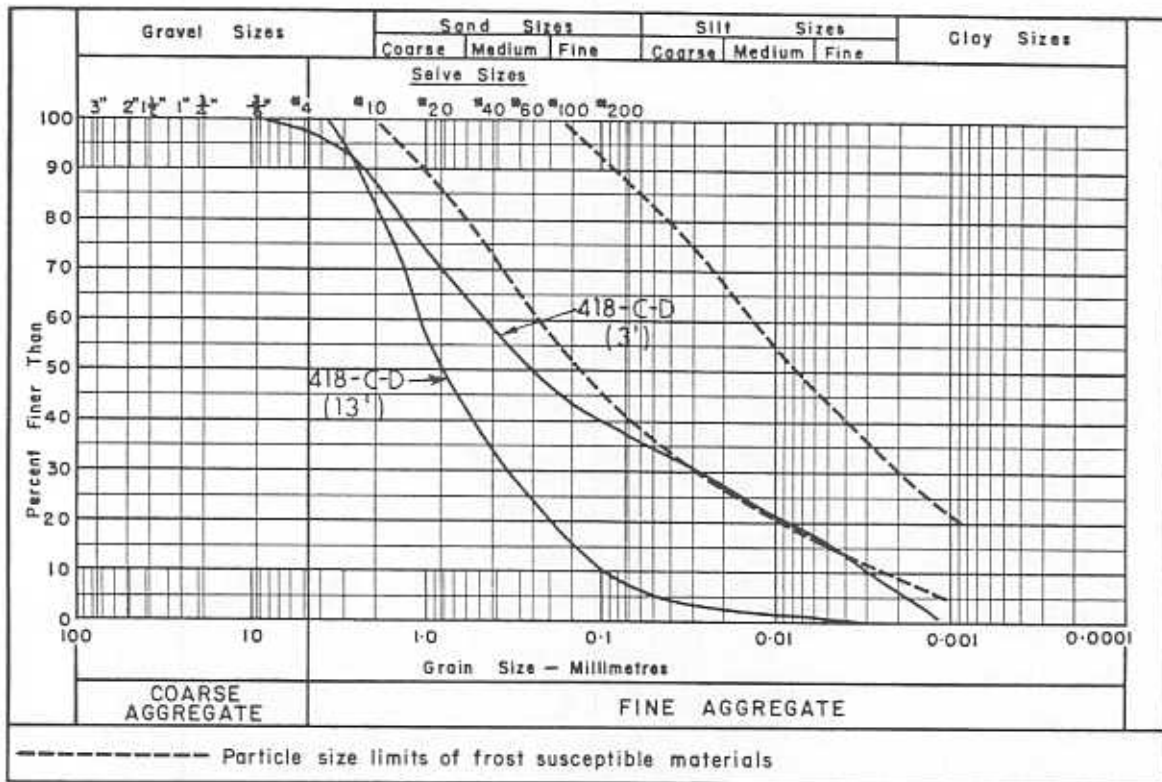


PETROGRAPHIC ANALYSIS:

SUMMARY OF LABORATORY TEST DATA

Sample Location:	151/418-C-D	151/418-C-D
Sample Depth (Feet):	3.0	13.0
Moisture Content (%):	-	-
Ice Content (%):	-	-
Organic Content (%):	-	-

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

SITE NO. 152

LOCATION

Located approximately 14 miles southeast of Wrigley and immediately east of the Mackenzie River channel, Site 152 consists of an outwash plain. Sandy and gravelly materials are anticipated within the site area.

The proposed Mackenzie Highway right-of-way at Mile 420 is located less than $\frac{1}{2}$ mile north-east of Site 152, while the proposed gas pipeline route traverses the site area.



LEGEND

- | | |
|--|----------------------------------|
| ----- All weather road | Required access |
| - - - - - Existing trails and cutlines | --- Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |

Airphoto No. A22933/94

Approximate scale: 1" = 3,000'

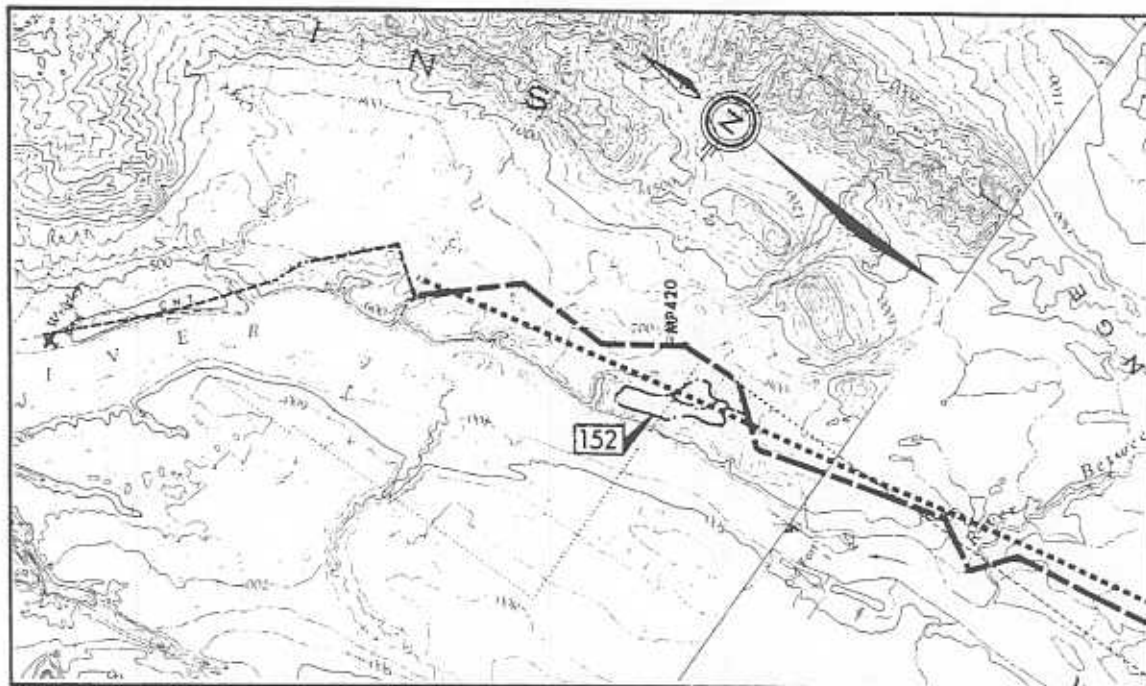


GENERAL

Site 152 encompasses a large glaciofluvial outwash plain which covers an area approximately 2½ miles long and 1 mile wide. The steep, partly eroded Mackenzie River bank borders the site to the southeast. The bank exhibits a fossil slide in the section marked by "c" on the air-photo. An erosional gully limits the plain to the north and northwest. The terrain to the east is slightly rolling to flat. Drainage conditions are fair. Vegetation cover consists of moderately dense to dense growths of spruce, birch and poplar.

There are no known critical wildlife areas in the vicinity of Site 152; however, this general region is periodically hunted and trapped by local residents. The outwash plain exhibits a kettled surface; relatively poor drainage within its eastern segment, marked by "a" on the air-photo, and which is likely indicative of silty gravel material. The plain surface in zone "b" is relatively flat which together with river bank sloughing indicates fine grained materials, probably similar to deltaic sands. It is anticipated that these deposits would suit requirements for marginal and very marginal general fill materials.

The development of Site 152 is questionable because of better quality materials available in the immediate vicinity (Ref. Sites 151 and 154). Therefore Site 152 is rated only as a fair prospect.



LEGEND	
————— All weather road	..... Required access
- - - - Existing trails and cutlines	— · — Site limit
..... Proposed Gas Pipeline	———— Proposed Mackenzie Highway

Section of Map No. 95 O & 95 J

Scale: 1:250,000

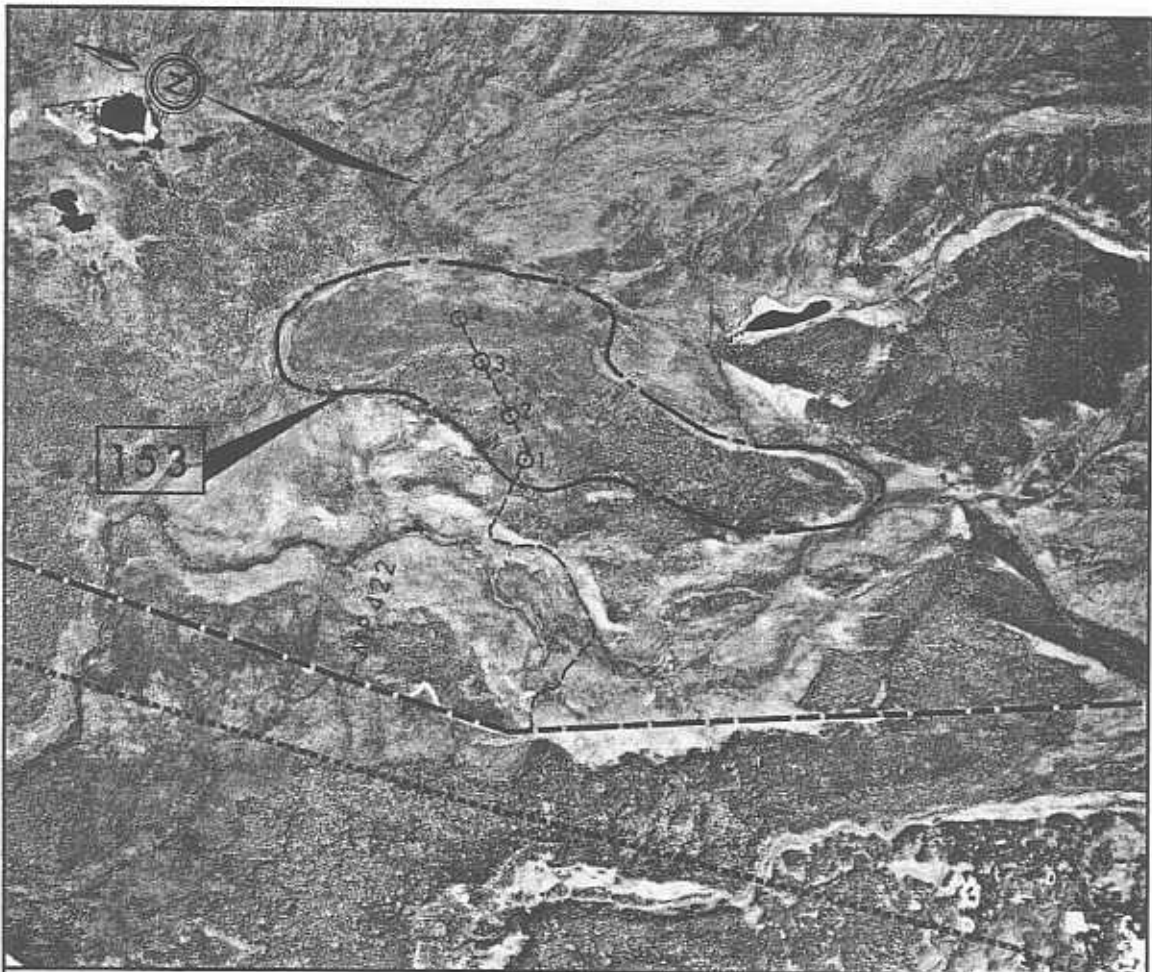
SITE NO. 153

Located approximately 13 miles southeast of Wrigley and $1\frac{1}{4}$ miles east of the proposed Mackenzie Highway at Mile 422, Site 153 consists of a glaciofluvial outwash plain.

Type of Material: Gravel; medium grained, poor to well graded.

Estimated Volume: 3,000,000 cubic yards.

Assessment: Good quality granular materials which are suitable for most construction requirements, Site 153 is recommended for development.



LEGEND

- | | |
|--------------------------------------|----------------------------------|
| ----- All weather road | Required access |
| - - - - Existing trails and cutlines | — · — Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |
| ⊙ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A22889/108

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 153 is located approximately 13 miles southeast of Wrigley and $1\frac{1}{4}$ mile east of the proposed Mackenzie Highway right-of-way at Mile 422. The site, consisting of a glacio-fluvial outwash plain, encompasses an area approximately $1\frac{1}{2}$ miles in length with an average width of $\frac{1}{4}$ mile. A small meandering stream channel forms the east, south and western boundaries of the site area. The site area exhibits fair drainage and rises approximately 100 feet above the adjacent flat glaciated terrain which exhibits slight thermokarst features and is poorly drained. The steep McConnell Range rises immediately to the north-east of the site area.

The material in the terrace deposit consists of poor to well graded, medium grained and variably washed gravels which are suitable for most construction requirements. A layer of topsoil and organic silty sand, generally less than $1\frac{1}{2}$ feet in thickness, overlies the site area and supports dense growths of pine, spruce and poplar attaining heights to 40 feet and trunk diameters to 12 inches. The understory growth consisting of willows, small bushes and grass is light to moderate.

There are no known critical wildlife areas in the immediate vicinity of Site 153. The site is within a region which is periodically hunted and trapped by northern residents.

The only existing access from the site area to the CNT pole line or proposed Mackenzie Highway right-of-way consists of the access trail which was cleared during the winter drilling program. The trail, however, crosses a depressional, muskeg terrain. Any access to the site area will have to cross the small stream channel and a major portion of the lacustrine plain which exhibits thermally sensitive subsurface soil conditions.

DEVELOPMENT

The information compiled from the drill holes conducted on Site 153 showed the following conditions relative to the quality and quantity of available granular materials.

- Good quality granular materials consisting of poor to well graded, medium grained, clean gravels which are suitable for use in most construction requirements can be recovered. Scattered cobbles and boulders were noted at the surface near the drill hole locations.
- The overburden material, consisting of topsoil and organic silty sands, is generally less than $1\frac{1}{2}$ feet in thickness.
- The ground ice content of the in situ gravels is very low.
- The drill holes which were extended to a maximum depth of 14 feet below existing ground surface did not penetrate the gravel stratum. Therefore, an average depth of 15 feet was utilized in estimating the available volume of granular materials.



- An estimated volume of 3,000,000 cubic yards of granular materials is considered available from Site 153.

Site 153 is recommended for the development and exploitation of granular materials and the following operational guidelines should be considered in the development of borrow pit areas.

- The existing tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil should be stripped, removed and stockpiled adjacent to the borrow pit areas in designated locations.
- Operating procedures during borrow pit development should be maintained whereby surficial waste materials do not drain into the adjacent small stream channel.
- Stands of natural growth should be retained between borrow pit areas in order to facilitate regrowth through natural regeneration.
- The use of dozers, overhead loaders and conventional ripping equipment should adequately remove the material from this site.
- The production of quality surface course and concrete aggregate material may be possible by exercising selective excavation procedures during the development of borrow pits. The production of higher quality aggregates will dictate the need of screening, crushing and washing plants to ensure aggregate properties for specified construction requirements.
- Additional laboratory tests to evaluate specific physical and chemical properties of the granular materials will be required, if the material is to be considered for the production of concrete aggregates.
- Future access roads to the site area from the proposed Mackenzie Highway or gas pipeline right-of-ways will have to be upgraded to an all weather status if extensive quantities of granular materials are to be developed and exploited.

ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation procedures should include:

- Recontouring of the pit areas to provide general drainage that is compatible with the natural drainage of the adjacent terrain.
- Replacing stockpiled surficial waste material and organic topsoil on the abandoned recontoured pit areas.



- Reseeding of the recontoured pit areas should be considered in areas that may pose erosional problems. At these locations, the artificial reseeded of annuals and perennials will result in a semi-permanent cover growth prior to reestablishment of native species.

DETAILED DRILL HOLE LOG

SITE NO. 153

HOLE NO. DH-1

DATE: FEB. 12, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D			
0		GM	GRAVEL: little sand and silt, predominantly boulders and cobbles to 1.5'		Vx			0	
1									
2		GP	- medium grained from 1.5', poorly graded, predominantly rounded to subangular limestone and quartzite pebbles and cobbles to 5" size, few boulders, greyish brown		Nf			L	2
3									
4									MC
5									
6									
7	7.0	TOTAL DEPTH 7.0'	7						
8							8		

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"





DETAILED DRILL HOLE LOG

SITE NO. 153

HOLE NO. DH-2

DATE: FEB. 12, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	TOPSOIL: some sand, little silt, frequent pebbles to 2" size		Vx			0
1								
1.5								
2		GW	GRAVEL: little sand, coarse grained, well graded, predomi- nantly rounded to subangula- r limestone and dolomite pebbles and cobbles to 5" size, greyish brown		Nf	L	P G S O	2
3								
4								
5								
6								
7			TOTAL DEPTH 7.0'					7

GOVERNMENT OF CANADA
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AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

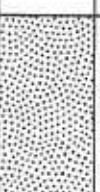



DETAILED DRILL HOLE LOG

SITE NO. 153

HOLE NO. DH-3

DATE: FEB. 12, 1973 LOGGED BY: PEMCAN


DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		SM-GM	SAND and GRAVEL: little silt, roots, light brown		Vx			0
1								1
2		GW	GRAVEL: some sand, fine to medium grained, predominantly rounded to subangular limestone and quartzite pebbles and cobbles to 4" size, occasional boulders, brown		NF	L		2
3								3
4								4
5								5
6								6
7								7
8								8
9								9
10								10

10.0 TOTAL DEPTH 10.0'

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

 **PEMCAN SERVICES "72"**

DETAILED DRILL HOLE LOG

SITE NO. 153

HOLE NO. DH-4

DATE: FEB. 12, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D			
0		OL	1.0 TOPSOIL: some silt, little sand and organic, roots, brown		Vr	L-M		0	
2		SM			2.0 SAND: little silt, few pebbles to 1" size, brown		Vx		2
4		GW	GRAVEL: little sand, well graded, predominantly rounded to sub-angular limestone and quartzite pebbles and cobbles to 4" size, greyish brown		Nf	L		4	
6							6		
8							8		
10							10		
12								12	
14			14.0 TOTAL DEPTH 14.0'					14	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

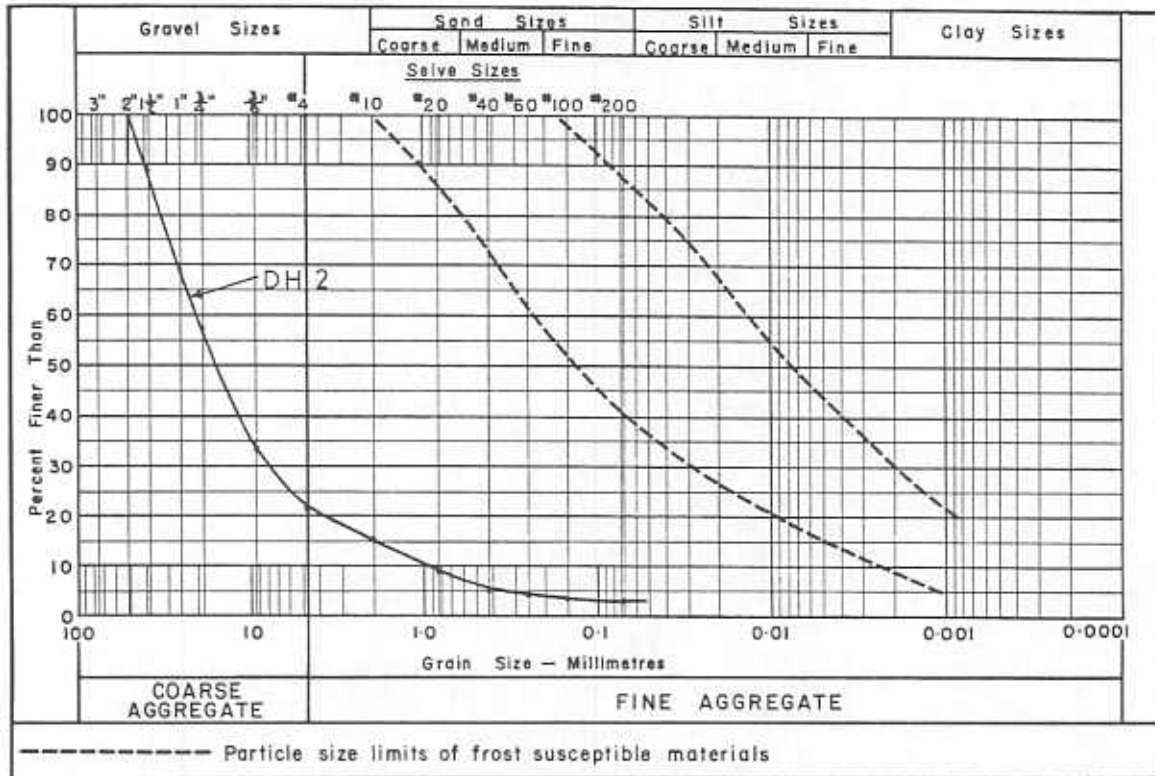


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location: 153/DH 2
 Sample Depth (Feet): 4.0-7.0
 Moisture Content (%): -
 Ice Content (%): -
 Organic Content (%): 1.8

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

Limestone & dolomite (sound)	66.9%
Igneous	19.0%
Quartzite	10.0%
Chert	0.2%
Deleterious	
Siltstone, shale and ironstone	0.8%
Limestone and dolomite (porous)	3.2%

SUMMARY OF MOISTURE CONTENT DETERMINATIONS

<u>Sample Location</u>	<u>Sample Depth (Ft.)</u>	<u>Moisture Content (%)</u>
153/DH 1	4.0	1.8
153/DH 3	8.0	2.4
153/DH 4	12.0	0.7

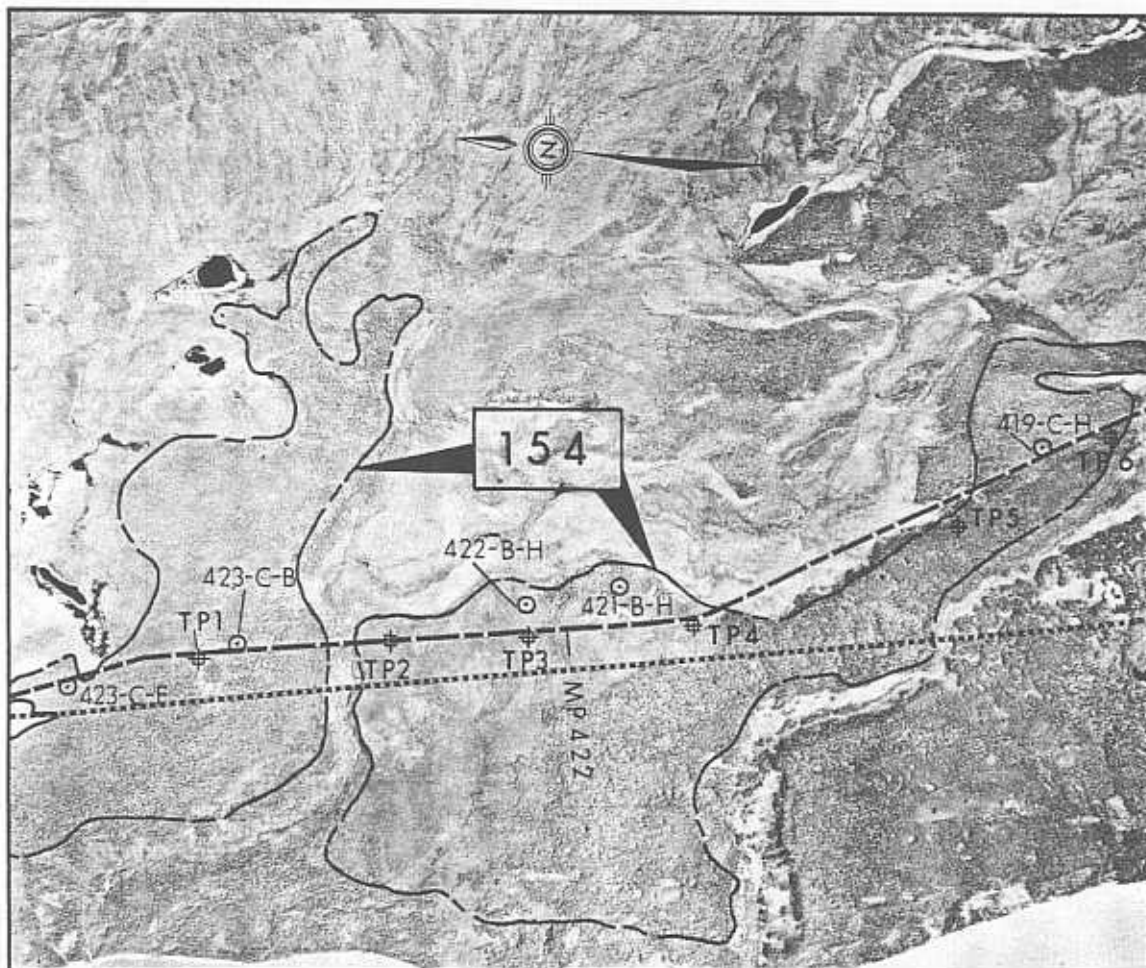
SITE NO. 154

Located approximately 11 miles south of Wrigley; Site 154 consists of a large glaciofluvial outwash plain along the east bank of the Mackenzie River and encompasses the proposed Mackenzie Highway from Mile 420 to Mile 424.

Type of Material: Gravel and Sand; variable silt content, stratified.

Estimated Volume: 10,000,000 cubic yards.

Assessment: Fair to good quality granular materials, suitable for general fill, base and surface course aggregates, are available; Site 154 is recommended for development.



LEGEND

- | | |
|--------------------------------------|----------------------------------|
| ----- All weather road | Required access |
| - - - - Existing trails and cutlines | ----- Site limit |
| Proposed Gas Pipeline | ----- Proposed Mackenzie Highway |
| ⊙ DH Drill Hole | ⊕ TP Test Pit |

Airphoto No. A22933/93

Approximate scale: 1" = 3,600'



ENVIRONMENT

Site 154 is located approximately 11 miles south of Wrigley and consists of a large glacio-fluvial outwash plain which encompasses the proposed Mackenzie Highway right-of-way from Mile 420 to Mile 424. The site area which is approximately 4 miles in length and ranges from $\frac{1}{4}$ to $\frac{1}{2}$ mile in width is located immediately adjacent and generally parallel to the east bank of the Mackenzie River. The site area exhibits good surficial drainage to the west into the Mackenzie River whereas the adjacent terrain to the east consists of shallow lacustrine silt and sand overlying glacial till and exhibits slight thermokarst features. The plain has been dissected into two segments by an erosional gully.

The material in the outwash plain consists of medium to coarse grained, sandy gravels with a highly variable silt content. The surficial topsoil and organic silt layer is quite shallow and supports moderately dense growths of spruce and birch.

There are no known critical wildlife areas in the immediate vicinity of Site 154.

Current and future access to potential borrow pit locations is excellent because both the CNT pole line and the proposed Mackenzie Highway right-of-way traverse the entire length of Site 154.

DEVELOPMENT

The information from the investigation program conducted on Site 154 by PEMCAN and the consultant for the Federal Department of Public Works showed the following conditions relative to the quality and quantity of available granular materials:

- Fair quality granular materials, consisting of medium grained, sandy gravels with a highly variable silt content were encountered to depths investigated. These sandy gravels are interspersed with numerous cobbles and are considered suitable for use in fair quality fill material in the construction of highway grades and utility backfill.
- The depth of the granular deposits is in excess of 10 feet, however, selective excavation of material may be necessary because of the highly variable quality of the in situ gravel strata.
- The overburden material consisting of topsoil and organic silt is generally less than 1 foot in depth. The moisture content of the gravel stratum is quite low, ranging from 5 to 8 per cent.
- It is considered that granular materials in excess of 10,000,000 cubic yards are recoverable from Site 154.

Site 154 is recommended as a source of granular materials and the following operational guidelines should be considered during the development of borrow pits at this site:

- The existing tree growth and related vegetation should be cleared and removed in



accordance with current land use guidelines.

- The organic topsoil should be stripped, removed and stockpiled adjacent to the borrow pit areas in designated locations.
- A natural stand of tree growth and related vegetation should be retained between borrow pit areas to be developed and existing or proposed right-of-ways.
- Stands of natural growth should be retained between borrow pit areas in order to facilitate regrowth through natural regeneration. A buffer zone of adequate width should be maintained between the Mackenzie River and the final limits of the borrow pit areas.
- The use of dozers, overhead loaders and conventional ripping equipment should adequately remove the material from this site.
- Operating procedures during borrow pit development should be maintained whereby surficial waste materials do not drain into the active Mackenzie River channel.
- The production of quality surface course and concrete aggregate material may be possible by exercising selective excavation procedures during the development of borrow pits. The production of higher quality aggregates will dictate the need of screening, crushing and washing plants to ensure satisfactory properties for specified construction requirements.
- Additional laboratory tests to evaluate specific physical and chemical properties of the granular materials will be required, if the material is to be considered for the production of concrete aggregates.

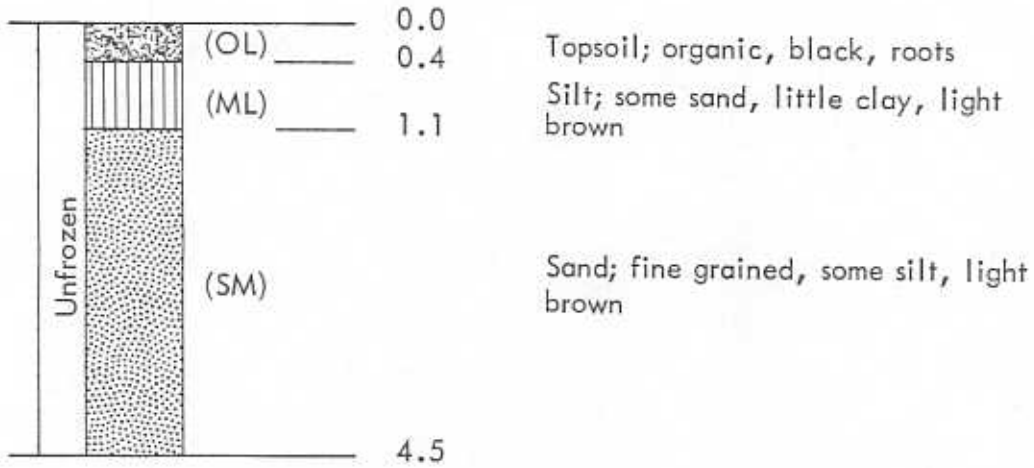
ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation procedures should include:

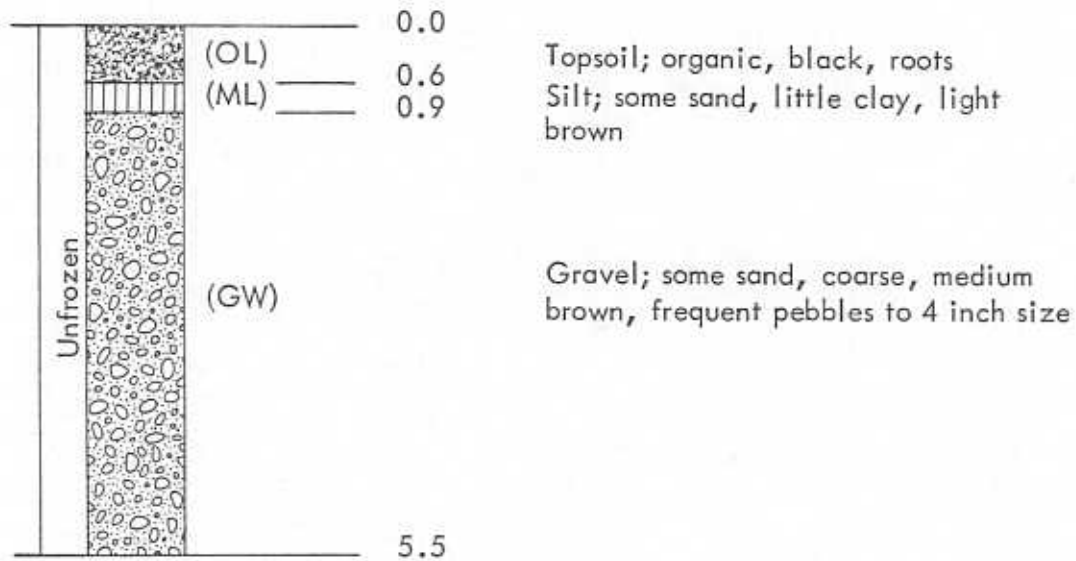
- Recontouring of the pit areas to provide general drainage that is compatible with the natural drainage of the adjacent terrain.
- Replacing stockpiled surficial waste material and organic topsoil on the abandoned recontoured pit areas.

DETAILED TEST PIT LOG

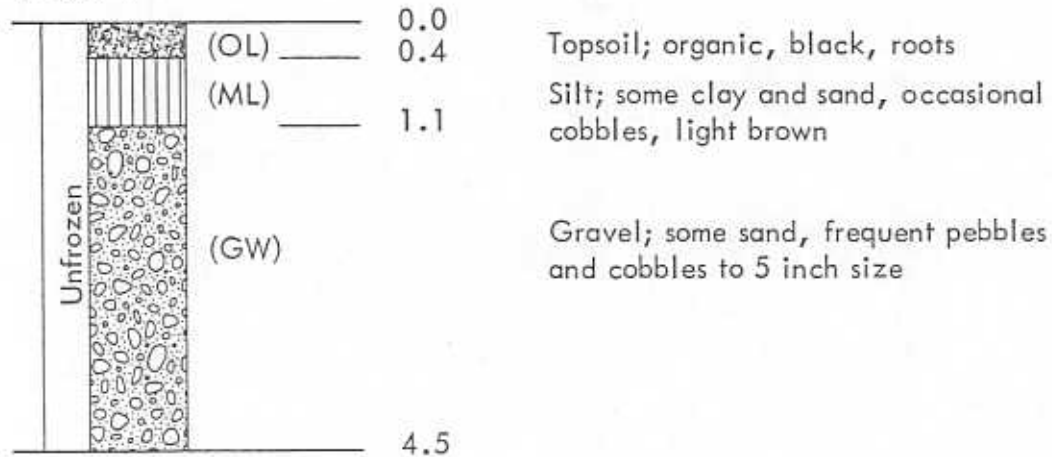
154/TP 1



154/TP 2

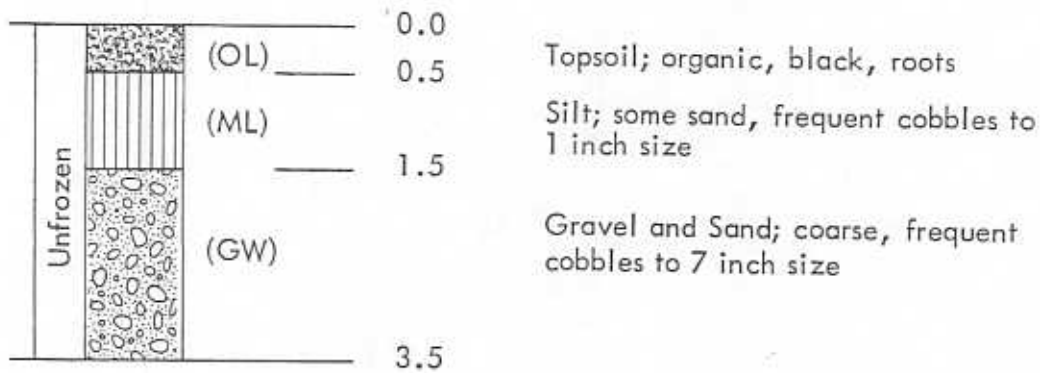


154/TP 3

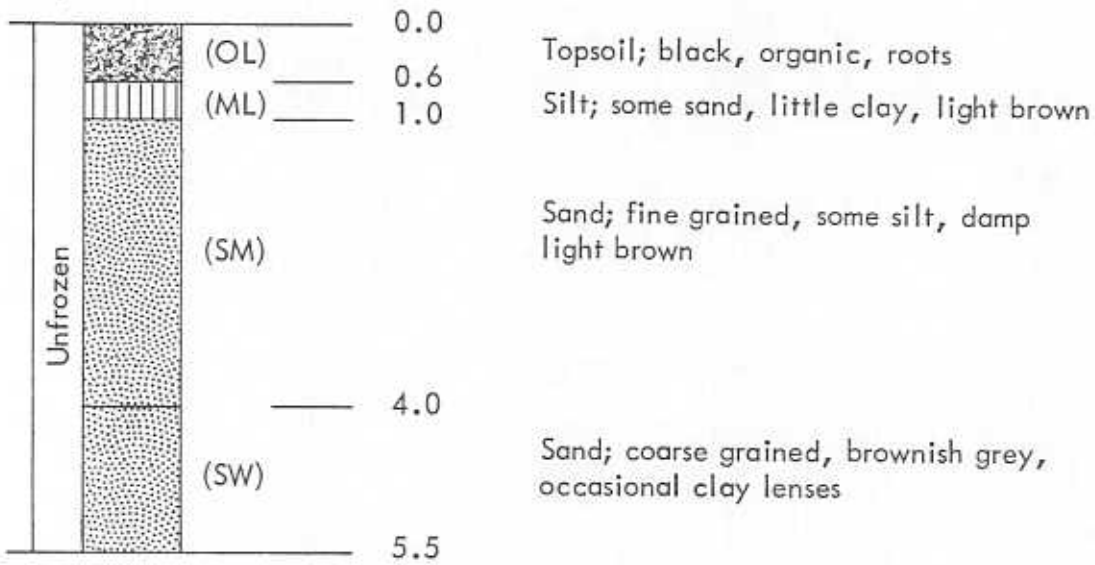


DETAILED TEST PIT LOG

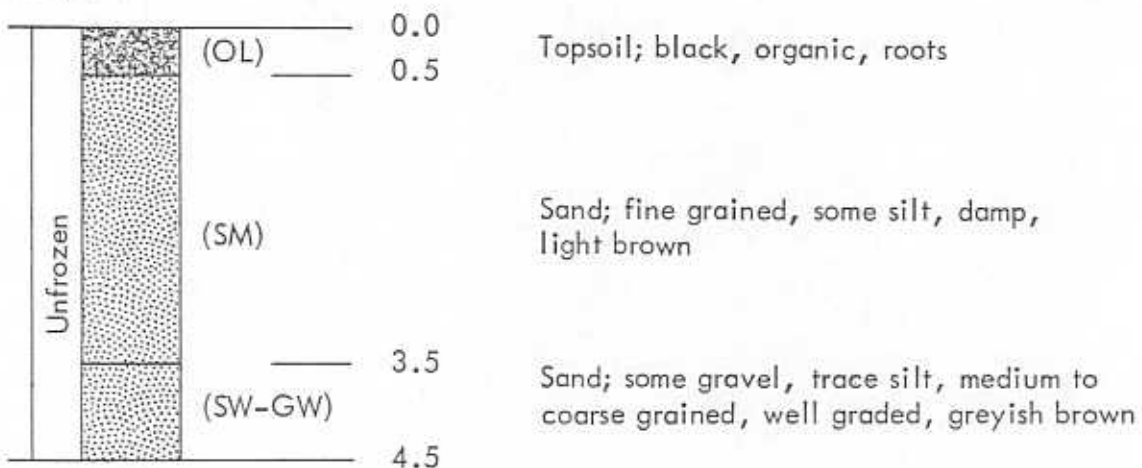
154/TP 4



154/TP 5



154/TP 6



DETAILED DRILL HOLE LOG

SITE NO. 154

HOLE NO. 421-B-H

DATE: FEB. 14, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS				
0		OL	1' sandy top soil		Nf			0	
1		GW	Brown fine to coarse gravel		Nf			1	
2								GS	
3									
4									
5		GP	Fine gravel		Nf			5	
6								GS	
7									
8									
9									
10									
			END OF HOLE 10.0' (Caving in)					10	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 154

HOLE NO. 422-B-H

DATE: FEB. 14, 1973

LOGGED BY: PEMCAN

ACRES CONSULTING SERVICES

DRILLING METHOD: CONVENTIONAL

AIR

AIR REVERSE CIRCULATION

OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		GP	Brown fine to coarse gravel (pea gravel)		Nf			0
2							GS	2
4								4
6			6.0					6
8		GW	Fine to coarse gravel with stones (3/8')		Nf		GS	8
10								10
12			11.0					12
			END OF HOLE 11.0' (Caving in)					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 154

HOLE NO. C B

DATE: FEB. 14, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)	
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.			
0								0	
2			Brown silty sand					2	
4		SM						4	
6								6	
8		SM						8	
10						Nbn			10
12									12
14		SM							14
15.0					15.0				15.0
					END OF HOLE 15.0'				
16									16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 154

HOLE NO. C F

DATE: FEB. 14, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE CONT.		
0								0
2		ML	Brown silty sand with a trace of gravel					2
4								4
6								6
8		SM			Nbn			8
10								10
12		SM		UF				12
14								14
15.0			15.0 END OF HOLE 15.0'					15.0
16								16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 154

HOLE NO. C H

DATE: FEB. 13, 1973 LOGGED BY: PEMCAN ACRES CONSULTING SERVICES

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		GW	Sand and gravel		Nf			0
1								1
2								2
3								3
4								4
5								5
6								6
7								7
8								8
9								9
10			10.0 — END OF HOLE 10.0'					10

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

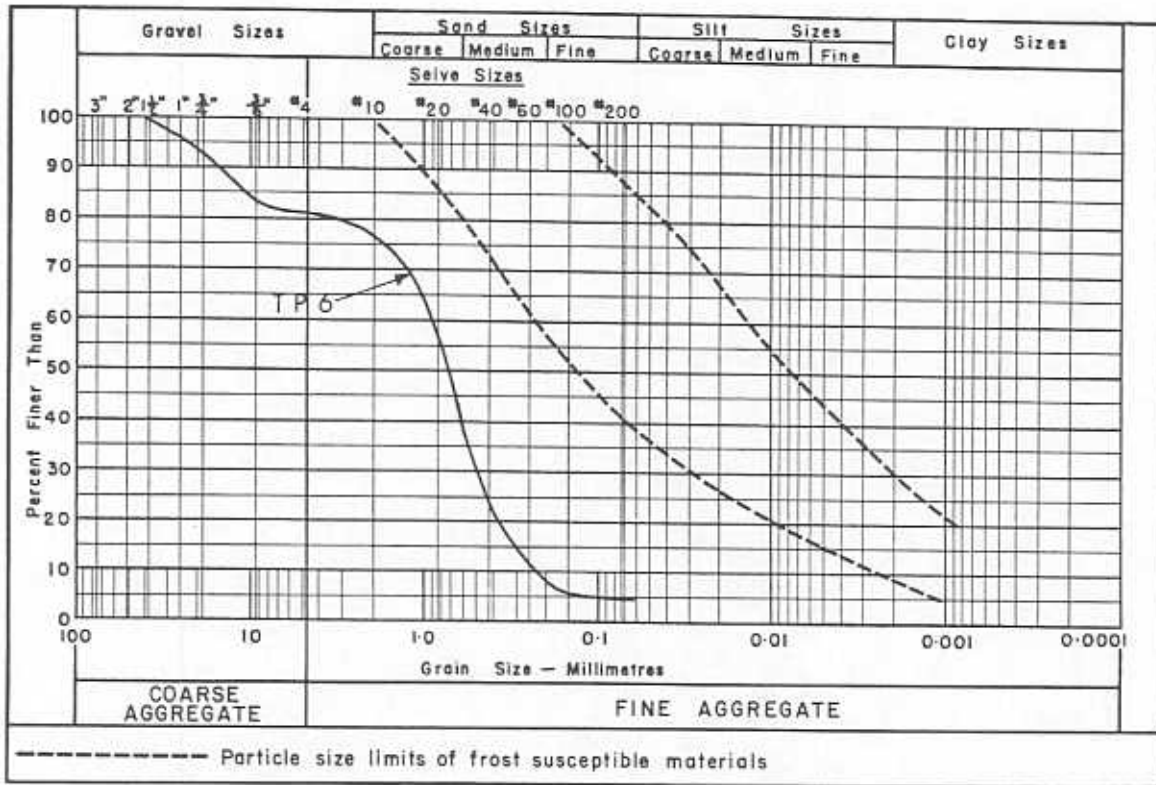


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	154/TP 1	154/TP 5	154/TP 6
Sample Depth (Feet):	3.0	5.0	3.5-4.0
Moisture Content (%):	4.9	7.9	-
Ice Content (%):	-	-	-
Organic Content (%):	-	-	-

GRAIN SIZE DISTRIBUTION:



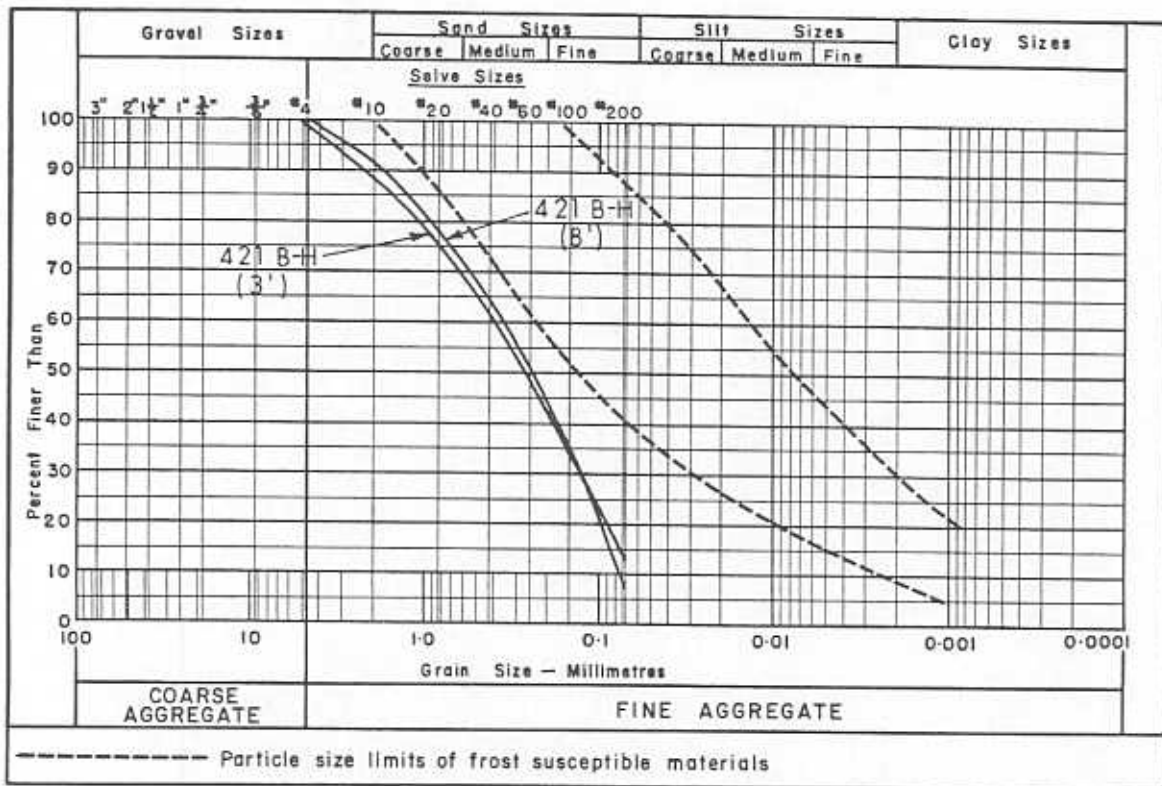
PETROGRAPHIC ANALYSIS: (154/TP 6 @ 3.5'-4.0')

Limestone and dolomite (sound)	32.7%
Igneous	58.1%
Chert	4.6%
Quartzite	4.6%

SUMMARY OF LABORATORY TEST DATA

Sample Location:	154/421B-H	154/421B-H
Sample Depth (Feet):	3.0	8.0
Moisture Content (%):	12.5	-
Ice Content (%):	-	-
Organic Content (%):	-	-

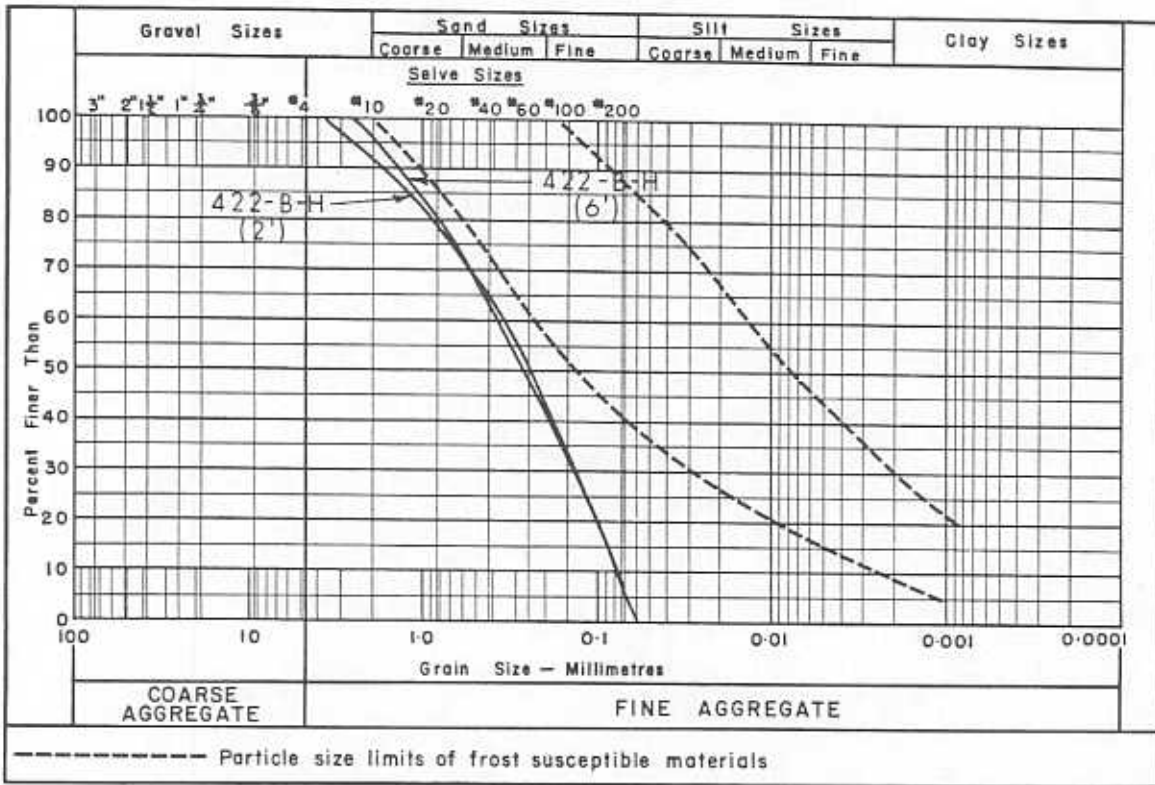
GRAIN SIZE DISTRIBUTION:



SUMMARY OF LABORATORY TEST DATA

Sample Location:	154/422-B-H	154/422-B-H
Sample Depth (Feet):	2.0	6.0
Moisture Content (%):	-	..
Ice Content (%):	-	-
Organic Content (%):	-	..

GRAIN SIZE DISTRIBUTION:



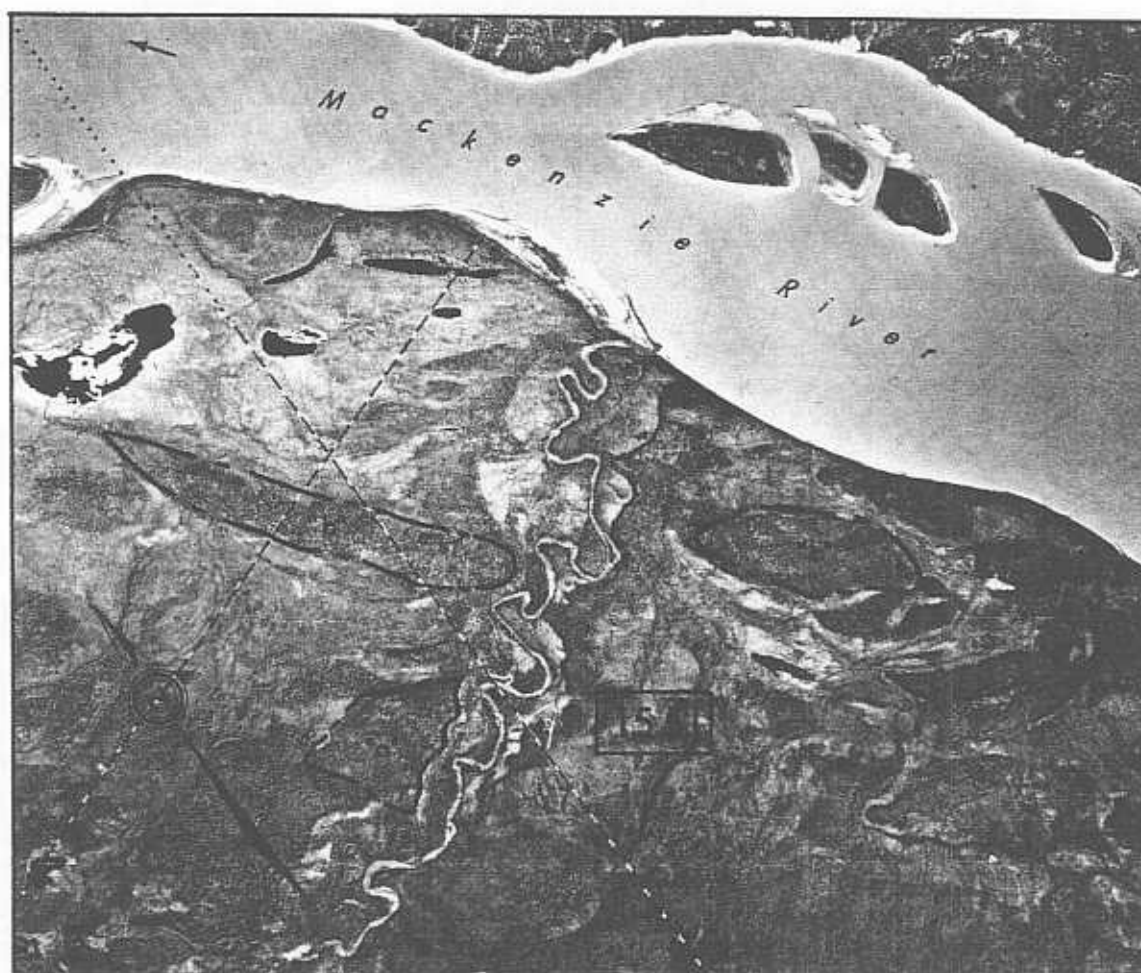
PETROGRAPHIC ANALYSIS:

SITE NO. 155

LOCATION

Located approximately 11 miles south of Wrigley on the west bank of the Mackenzie River adjacent to both sides of a tributary stream, Site 155 consists of a group of alluvial river terraces.

The proposed Mackenzie Highway right-of-way at Mile 425 and the proposed gas pipeline route are both located on the opposite, east side of the Mackenzie River. Direct distance from the site to the Mackenzie Highway at Mile 425 is approximately 3 miles; however, because of the steep eastern river bank, the Highway right-of-way can be better approached at Mile 431 resulting in a haul distance in excess of 4 miles.



LEGEND

- | | |
|------------------------------------|-------------------------------|
| ———— All weather road | Required access |
| ----- Existing trails and cutlines | - · - Site limit |
| Proposed Gas Pipeline | —— Proposed Mackenzie Highway |

Airphoto No. A22889/85

Approximate scale: 1" = 3,000'



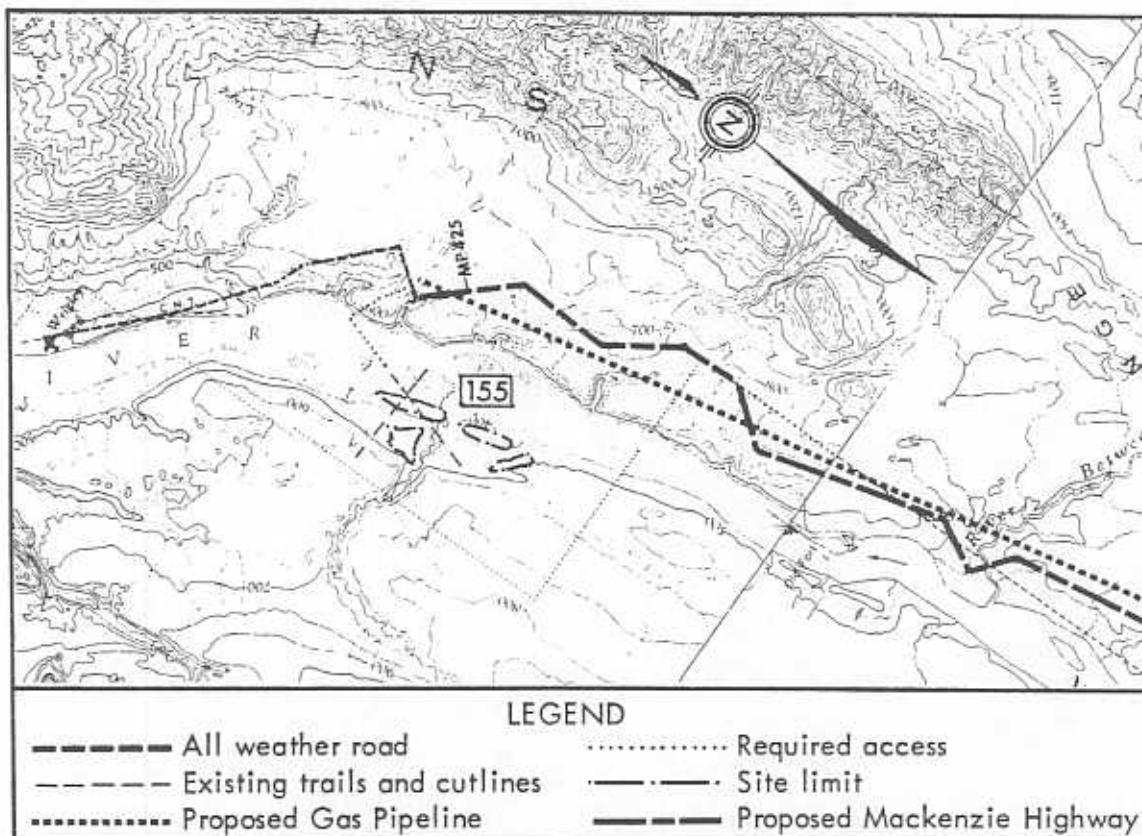
GENERAL

Site 155 consists of four alluvial terraces located within the broad western flood plain of the Mackenzie River. An unnamed tributary stream dissects the site area. The terraces range from 200 to 6500 feet in length and from 400 to 1500 feet in width. The flat terrace surfaces are less than 50 feet above the water level of the Mackenzie River. Abandoned river arms exhibiting oxbow lakes and muskeg bogs mark the river flood plain.

The higher elevated terrace, designated as "a" on the site airphoto contains few exposures of sandy gravels, and appears to be well drained. This terrace is vegetated by a moderately dense growth of spruce, willows, poplar and birch. The low terraces, designated as "b", exhibit gentler slopes, and are poorly wooded, which may be indicative of finer grained soils.

There are no known critical wildlife areas in the immediate vicinity of the site.

The terrace designated as "a" may contain granular materials suitable for marginal general fill for construction purposes while the terraces designated as "b" probably contain fine grained, sandy silt deposits of very marginal quality. Therefore, Site 155 is rated as a poor to fair prospect.



Section of Map No. 95 O & 95 J

Scale: 1:250,000

SITE NO. 156

LOCATION

Located approximately 12 miles southeast of Wrigley on the sloping terrain adjacent to the western toe of the McConnell Range, Site 156 consists of two shallow esker ridges.

The proposed Mackenzie Highway right-of-way at Mile 422 is located approximately 2 miles southwest of Site 156. The proposed gas pipeline route also runs approximately 2 miles west of the site area.



LEGEND

- | | |
|--|---------------------------------|
| ———— All weather road | Required access |
| - - - - - Existing trails and cutlines | — · — Site limit |
| Proposed Gas Pipeline | ———— Proposed Mackenzie Highway |

Airphoto No. A22933/92

Approximate scale: 1" = 3,000'

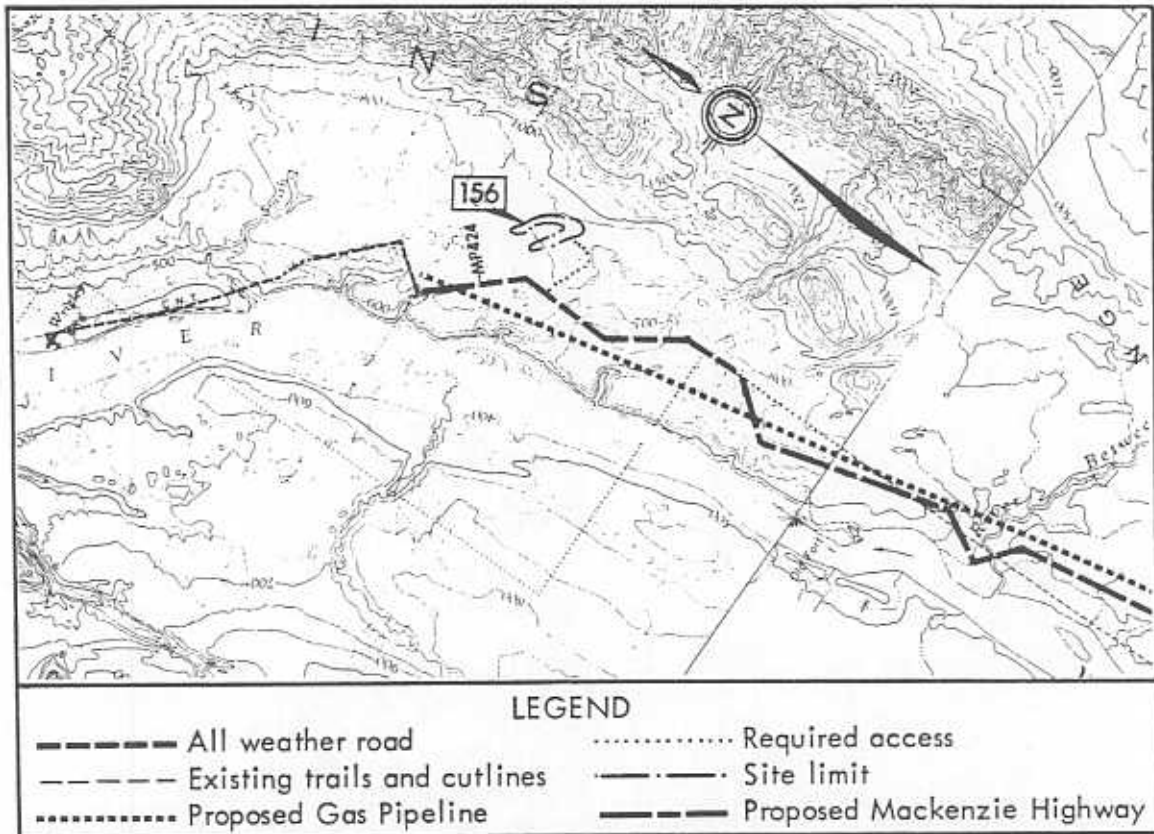


GENERAL

Site 156 is comprised of two shallow and narrow esker ridges, which are approximately $\frac{1}{2}$ mile in length. The site which is located on the western slopes adjacent to the toe of the McConnell Range, exhibits good surficial drainage and supports moderately dense stands of spruce, poplar and birch. The terrain between the site area and the proposed highway right-of-way is depressional which is characterized with numerous lakes and muskeg bogs and supports sparse growths of spruce and tamarack.

There are no known critical wildlife areas in the vicinity of this site.

The material in the esker ridges is anticipated to be silty sand and gravel deposits suitable for general fill. However, the exploitation of this site would entail the stripping of large tracts of land relative to volumes of materials available. Moreover, a new and relatively long access road would be required; therefore, Site 156 is rated as a poor prospect.



Section of Map No. 95 O & 95 J

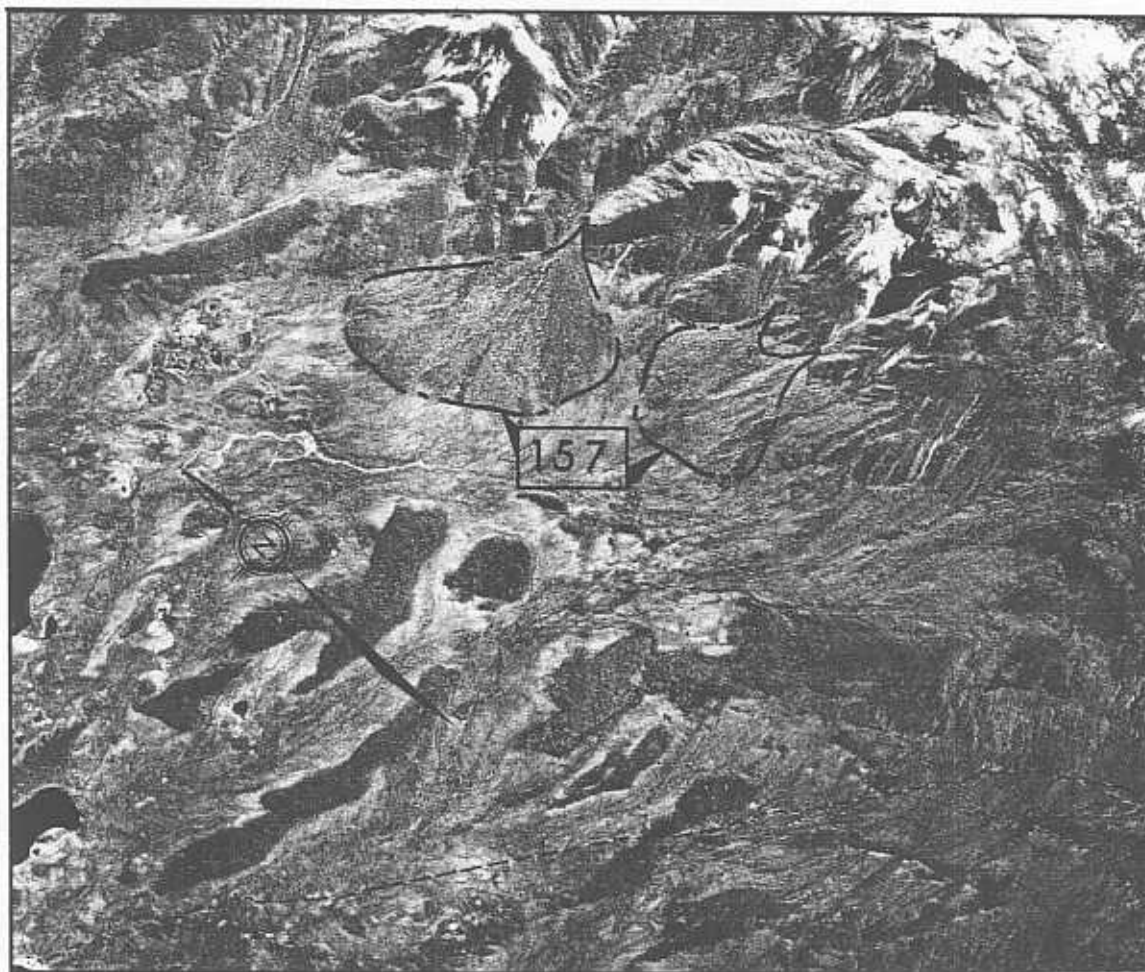
Scale: 1:250,000

SITE NO. 157

LOCATION

Located approximately 12 miles southeast of Wrigley at the western toe of McConnell Range, Site 157 consists of two large alluvial cones.

The proposed Mackenzie Highway right-of-way and gas pipeline route are located approximately 3 miles southwest of the site; however, the actual haul distance along existing and required cutlines to the Highway at Mile 425 would be in excess of 4 miles.



LEGEND

- | | |
|------------------------------------|-------------------------------|
| ———— All weather road | Required access |
| ----- Existing trails and cutlines | — · — Site limit |
| Proposed Gas Pipeline | —— Proposed Mackenzie Highway |

Airphoto No. A22859/65

Approximate scale: 1" = 3,000'

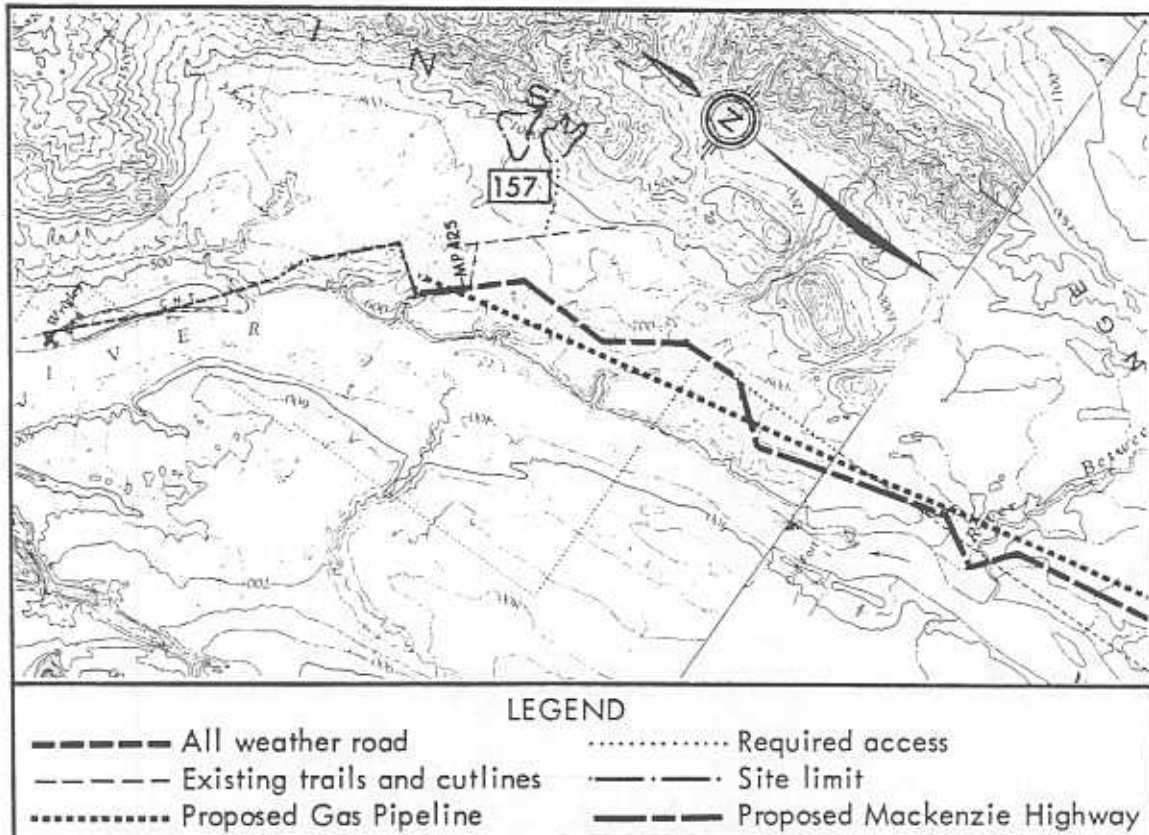


GENERAL

Site 157 consists of two large alluvial fans located at the mouths of erosional gullies incised into the western hillside of the McConnell Range. The cones are approximately 2500 by 2000 feet and 4000 by 2000 feet in size. The mountain slopes are rugged and the adjacent terrain to the west is undulating.

The cone surfaces do not exhibit disturbances nor fresh deposits thus indicating very low discharges from the gullies. The site area is well drained to the west and supports moderately dense growths of spruce, poplar and birch. There are no known critical wildlife areas in the vicinity of Site 157.

It is anticipated that the cones contain variably washed and randomly stratified silty and sandy gravel with angular and subangular rock fragments. These deposits may be suitable for general fill material. Site 157 is rated as a good prospect for granular materials; however, the access to the site area along existing and new cutlines would require traversing of depression- and thermally sensitive terrain adjacent to the McConnell Range.



Section of Map No. 95 O & 95 J

Scale: 1:250,000

SITE NO. 158

LOCATION

Located along the western toe of the McConnell Range and approximately 9 miles southeast of Wrigley, Site 158 consists of a group of alluvial cones and one relatively small kame field. These landforms contain variably washed granular materials.

The proposed Mackenzie Highway right-of-way and gas pipeline route are located approximately 3 miles southwest of the site, whereas the actual haul distance along suggested new access roads to the Highway at Mile 424 would be approximately 5 miles.



LEGEND

----- All weather road	..... Required access
- - - - - Existing trails and cutlines	· - · - · Site limit
..... Proposed Gas Pipeline	----- Proposed Mackenzie Highway

Airphoto No. A22859/64

Approximate scale: 1" = 3,000'



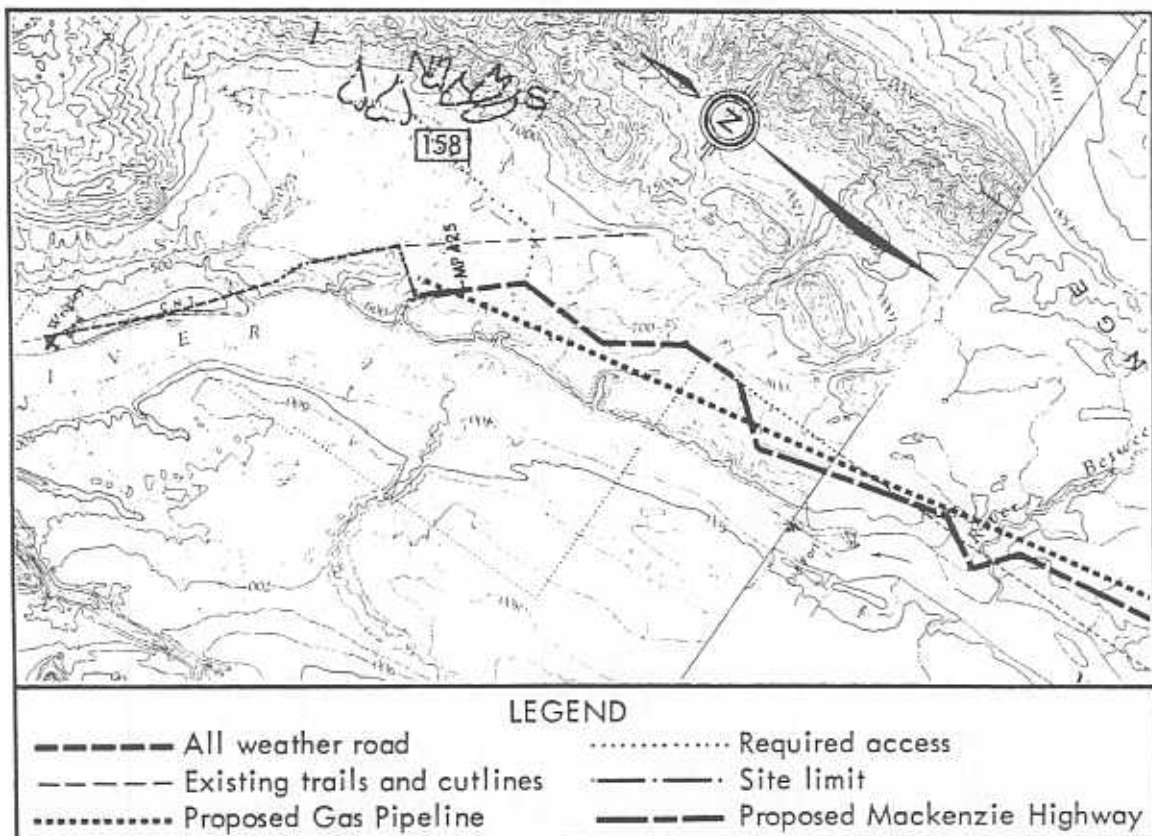
GENERAL

Site 158 consists of 5 large alluvial fans located at mouths of erosional gullies incised into the western hillside of the McConnell Range. A relatively small kame field (denoted as "k" on the airphoto) is noted within the site area. The mountain slopes are rugged and the terrain southwest of individual prospects is undulating and becomes depressional within the Mackenzie Plain.

Narrow and braided stream channels mark the cone surfaces indicating good surficial drainage. During spring run-off the cones would be wet and locally unstable. Drainage conditions within the kame field are good. Vegetation growth on the cones varies from sparse to relatively dense, while good stands of spruce, poplar and birch are noted on the kame field. There are no known critical wildlife areas in the vicinity of the site.

Variably washed and irregularly stratified sandy and silty gravel is anticipated in the cones. Also, till bodies may be incorporated in granular deposits forming the kame field. These deposits may be suitable for general fill material.

The site was not investigated in detail because of its remote location and difficult access; therefore this site is suggested for development.



Section of Map No. 95 O & 95 J

Scale: 1:250,000



GLOSSARY



GLOSSARY

Alluvium	Stream deposits of comparatively recent time, does not include subaqueous deposits of seas and lakes.
Anhydrite	A mineral, anhydrous calcium sulfate, CaSO_4 . Orthorhombic, commonly massive in evaporite beds.
Annuals	A plant that lives only one year or season.
Autoclave Expansion	Laboratory test procedure as designated by ASTM-C151-63 for determination of expansive qualities for all types of Portland Cement and aggregate reactions.
Berm	A horizontal portion of an earth embankment to ensure greater stability of a long slope.
Biotic	Of or pertaining to life or mode of living.
Boreal	Pertaining to the North.
Boulder	A rock fragment larger than 8" in diameter.
Cartographic	Pertaining to a map. In geology a cartographic unit is a rock or group of rocks that is shown on a geologic map by a single color or pattern.
Clay	Soil particles smaller than 0.002 mm. in diameter.
Cobble	A rock fragment between 3" and 8" in diameter.
Colluvium	A general term applied to loose and incoherent deposits, usually at the foot of a slope or cliff and brought there chiefly by gravity.
Conglomerate	Rounded water-worn fragments of rocks or pebbles, cemented together by another mineral substance which may be of a siliceous or argillaceous nature.
Cretaceous	The third and latest of the periods included in the Mesozoic era; also the system of strata deposited in the Cretaceous period.
Crystalline	Of or pertaining to the nature of a crystal; having regular molecular structure.
Delta Deposits	An alluvial deposit, usually triangular, at the mouth of a river.



Devonian	In the ordinarily accepted classification, the fourth in order of age of periods, comprised in the Paleozoic era, following the Silurian and succeeded by the Mississippian. Also the system of strata deposited at that time.
Dolomite	A mineral, $\text{CaMg}(\text{CO}_3)_2$, commonly with some iron replacing magnesium; a common rock-forming mineral.
Ecology	The study of the mutual relationships between organisms and their environments.
Eolian	Deposits which are due to the transporting action of the wind.
Escarpment	The steep face of a ridge of high land.
Esker	A narrow ridge of gravelly or sandy drift, deposited by a stream in association with glacier ice.
Excess Ice	Ice in excess of the fraction that would be retained as water in the soil voids upon thawing.
Fauna	The animals collectively of any given age or region.
Flood Plain	That portion of a river valley, adjacent to the river channel, which is built of sediments during the present regime of the stream and which is covered with water when the river overflows its banks at flood stages.
Flora	The plants collectively of any given formation, age or region.
Fossiliferous	Containing organic remains.
Geomorphology	The study of landscape and of the geologic forces that produce it. It is the dynamic geology of the face of the earth. It concerns that branch of physical geography dealing with the origin and development of the earth's surface; features (landforms) and the history of geologic changes through the interpretation of topographic forms.
Glacial Till	Non sorted, non stratified sediment carried or deposited by a glacier.
Glaciofluvial	Fluvioglacial. Pertaining to streams flowing from glaciers or to the deposits made by such streams.



Glaciolacustrine	Pertaining to glacial-lake conditions, as in glaciolacustrine deposits.
Gravel	Soil particles smaller than 3" in diameter and larger than 2.0 mm in diameter.
Ground Moraine	A moraine with low relief, devoid of transverse linear elements.
Gypsum	Alabaster. Selenite. Satin Spar. A mineral, $\text{CaSO}_4, 2\text{H}_2\text{O}$. Monoclinic. A common mineral of evaporites.
Heterogeneous	Differing in kind; having unlike qualities; possessed of different characteristics; opposed to homogeneous.
Hummock	A mound or knoll.
Icing	Mass of surface ice formed during winter by successive freezing of sheets of water seeping from the ground, a river or spring.
Kames	A mound composed chiefly of gravel or sand, whose form is the result of original deposition modified by settling during the melting of glacier ice against or upon which the sediment is accumulated.
Karst	A limestone plateau marked by sinkholes and underlain by cavernous carbonate rocks having subterranean drainage channelways that largely follow solution-widened joints, faults, and bedding planes.
Lacustrine	Produced or belonging to lakes.
Lichen	Any of a group of low growing plant formations composed of a certain fungi growing close together with certain algae.
Massif	A French term adopted in geology and physical geography for a mountainous mass or group of connected heights, whether isolated or forming a part of a larger mountain system.
Meandering	Condition of river that follows a winding path owing to natural physical causes not imposed by external restraint. Characterized by alternating shoals and bank erosion.
Moraine	Drift, deposited chiefly by direct glacial action, and having constructional topography independent of control by the surface on which the drift lies.



Morphological	The scientific study of form. Used in various connections, e.g. landforms (geomorphology).
Muskeg	The term designating organic terrain, the physical condition of which is governed by the structure of peat it contains and its related mineral sublayer, considered in relation to topographic features and the surface vegetation with which the peat co-exists.
Ordovician	The second of the periods comprised in the Paleozoic era, in the geological classification now generally used. Also the system of strata deposited during that period.
Perennial	Lasting through the year.
Permafrost	The thermal condition under which earth materials exist at a temperature below 32°F continuously for a number of years.
Petrography	The branch of science treating of the systematic description and classification of rocks.
Proglacial	Pertaining to features of glacial origin beyond the limits of the glacier itself, as...streams, ...deposits, ...sand.
Sand	Soil particles smaller than 2.0 mm. in diameter and larger than 0.06 mm. in diameter.
Screens	A heap of rock waste at the base of a cliff or a sheet of coarse debris mantling a mountain slope.
Silurian	The third in order of age of the geologic periods comprised in the Paleozoic era, in the nomenclature in general use. Also the system of strata deposited during that period.
Sinuuous	Winding or curving in and out.
Slope Wash	Soil and rock material that is being or has moved down a slope predominantly by the action of gravity assisted by running water that is not concentrated into channels.
Taiga	A Russian word applied to the old, swampy, forested region of the north...that region between the Tundra in the north and the Boreal in the south.



Talus	Coarse angular fragments of rock and subordinate soil material dislodged by weathering (temperature and moisture changes) and collected at the foot of cliffs and other steep slopes and moved downslope primarily by the pull of gravity.
Terrace	A relatively flat elongate stairstepped surface bounded by a steeper ascending slope on one side and a steep descending slope on the other.
Tertiary	The earlier of the two geologic periods comprised in the Cenozoic era, in the classification generally used. Also the system of strata deposited during that period.
Thermal Regression	The thawing of frozen ground due to surface disturbance, increasing temperature, etc.
Thermokarst Lake	(Cave-in Lake), lakes which occupy depressions resulting from subsidence caused by thawing of ground ice.
Tundra	Any of the vast, nearly level, treeless plains of the Arctic Regions.
Turbid.	Having the sediment stirred up hence muddy, impure.



PEMCAN SERVICES

EXPLANATION OF TERMS AND SYMBOLS



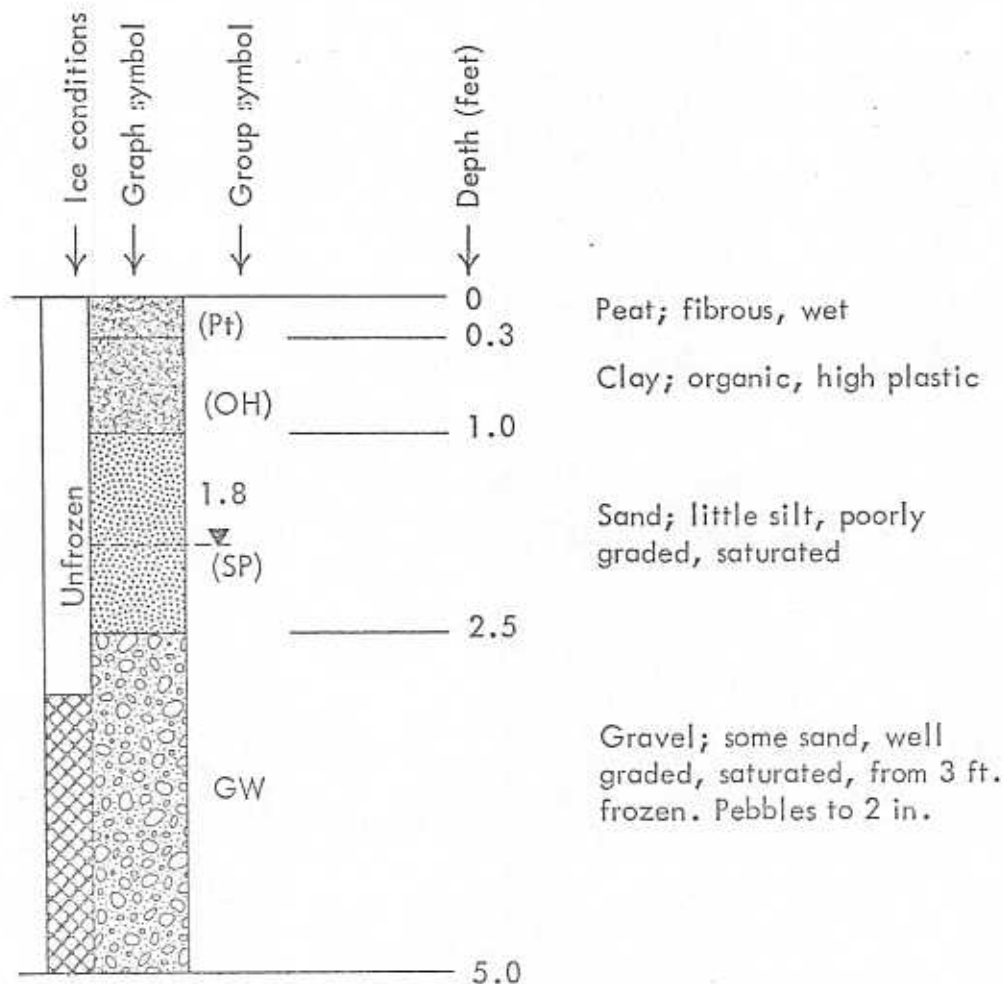
EXPLANATION OF TERMS AND SYMBOLS

DRILL HOLES AND TEST PITS

These pages present an explanation of the terms and symbols used in summarizing the results of field investigations as presented under Site Descriptions. Specifically, the explanations refer to the sheets entitled "Log Description and Laboratory Test Data". The materials, boundaries, and conditions have been established only at the test locations and could differ elsewhere on the site.

TEST PIT LOG DESCRIPTION

Soils of different engineering classification are commonly grouped generically for ease of reference. Seepage and the water level are indicated beside the graphical representation. They are followed by group symbols (according to the Unified Soil Classification System) and depths at individual soil type boundaries. Frost penetration is indicated to the left of the graph symbol as illustrated below:





DRILL HOLE LOG DESCRIPTION

The general information, indicating Site No., Hole No., Date drilled, Drilling Method and the firm responsible for the acquisition of the drill hole data designated under "Logged By", is noted in the upper portion of the standard "Detailed Drill Hole Log" form.

The detailed sub-surface information at each drill hole location has been presented in a columnar form as noted on the "exhibit" drill hole log data sheet on the following page. A description of each column used is outlined herewith:

- Column 1 and 9: Depth scale outlining increasing depth of drill hole below existing ground surface.
- Column 2: Graph Symbol to pictorially illustrate major soil divisions encountered in the drill hole. A detailed definition of each graph symbol is explained in the Materials Classification section of the Terms and Symbols.
- Column 3: Unified Group Symbol indicating the abbreviated material classification in accordance with the Unified Soil Classification system. A detailed definition of each Unified Group Symbol is explained under the Materials Classification heading in the Terms and Symbols section of the glossary.
- Column 4: Materials Description contains the engineering classification of each soil strata encountered in accordance with the criteria outlined in the Materials Classification heading in the Terms and Symbols section of the Glossary.
- The depths of ground water level and the interface between different soil strata are indicated on the extreme left of this column.
- Column 5: General Classification of Ground Ice Conditions indicates whether the material was frozen or unfrozen at the time of drilling.
- Column 6: N.R.C. Classification of Ground Ice Conditions contains abbreviated symbols for ground ice in accordance with the National Research Council of Canada's "Guide to a Field Description of Permafrost for Engineering Purposes", Technical Memorandum 79. A detailed outline of the N.R.C. classification is contained in the "Ground Ice Classification" heading in the Terms and Symbols Section of the Glossary.
- Column 7: Estimated Content of Ground Ice Conditions refers, generally, to the visual estimate of ice content in the soil formations encountered during the drilling program. The following abbreviations have been utilized for estimated ice content:



"L":- indicates Low ice content with generally less than 10% ice.

"M":- indicates Medium ice content with generally 10% to 50% ice.

"H":- indicates High ice content with generally in excess of 50% ice.

Column 8:

Sample Type indicates the depth intervals where field samples were secured during the drilling program and the subsequent types of laboratory tests conducted on each respective sample. The following abbreviations have been utilized for the various types of laboratory tests conducted:

MC:- designates moisture content determinations.

GS:- designates grain size analyses including hydrometer tests.

P:- designates Petrographic analyses.

H:- designates Hardness Tests in accordance with the standard "Morr" classification for rocks and minerals.

O:- designates Organic Content determinations.

DETAILED DRILL HOLE LOG

SITE NO. 131

HOLE NO. DH-1

DATE: FEB. 15, 1973 LOGGED BY: PEMCAN

DRILLING METHOD: AIR CONVENTIONAL AIR REVERSE CIRCULATION OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D			
0		OL	1.0 TOPSOIL: organic, dark brown		Nf	L		0	
2		GM-GP	GRAVEL: some silt, little sand, frequent pebbles to 1/2" size, occasional boulders, medium brown		Vs	L-M		2	
4	4								
6		ML	SILT: some clay, trace of rust and coal specks, frequent pebbles to 1" size, occasional boulders, medium brown					6	
8	8								
10	10								
12			TOTAL DEPTH 12.0'					12	
	①	②	③	④	⑤	⑥	⑦	⑧	⑨

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"



MATERIAL CLASSIFICATION

Soil types are designated by a modified version of the Unified Soil Classification System ("The Unified Soil Classification System", Technical Memorandum No. 3-357, Vol.1, 1953, the Waterways Research Station, U.S.A.). The following page defines these terms and symbols. Letters appearing in parentheses denote visual identification which have not been verified in the laboratory. If the soil falls close to the boundaries established between the various groups a double symbol (for example GW-GP) is used.

Since the Unified Soil Classification System does not contain detailed subdivisions of granular soils according to percentage proportions of secondary components, the ASTM suggested method for identification of granular soils ("Suggested Methods of Test for Identification of Soils", ASTM Procedures for Testing of Soils, 4th edition, December, 1964) is adopted for soil description as defined below:

Composite Sand-Gravel Soils		Composite Sand-Silt Soils	
Percentages	Identification	Percentages	Identification
90 to 10	Gravel; trace Sand	95 to 5	Sand; trace - Silt
80 to 20	Gravel; little Sand	90 to 10	Sand; trace + Silt
65 to 35	Gravel; some Sand	80 to 20	Sand; little Silt
50 to 50	Gravel and Sand	65 to 35	Sand; some Silt
35 to 65	Sand and Gravel	50 to 50	Sand and Silt
20 to 80	Sand; some Gravel	35 to 65	Silt and Sand
10 to 90	Sand; little Gravel	20 to 80	Silt; some Sand
	Sand; trace Gravel	10 to 90	Silt; little Sand
			Silt; trace Sand

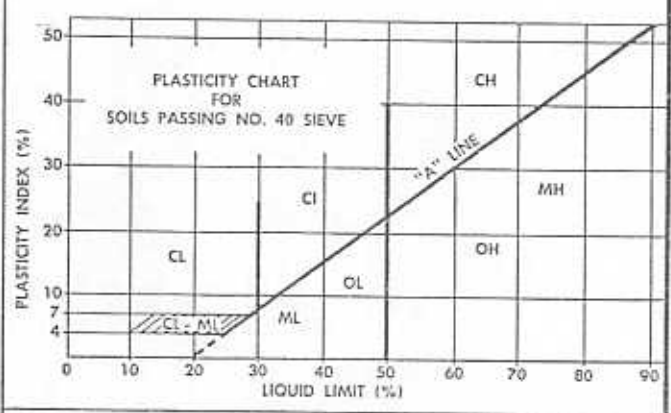
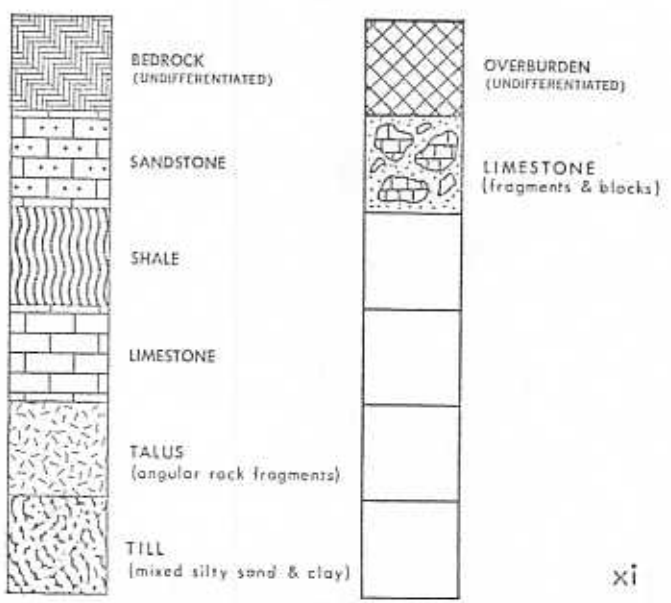
MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION		GROUP SYMBOL	GRAPH SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA			
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 200 SIEVE)	GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		WELL GRADED GRAVELS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 6$	$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$		
		DIRTY GRAVELS (WITH SOME FINES)		POORLY GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES			NOT MEETING ABOVE REQUIREMENTS	
		SANDS MORE THAN HALF FINE GRAINS SMALLER THAN NO. 4 SIEVE		CLEAN SANDS (LITTLE OR NO FINES)		WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 4$	$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$
				DIRTY SANDS (WITH SOME FINES)		POORLY GRADED SANDS, LITTLE OR NO FINES			NOT MEETING ABOVE REQUIREMENTS
	SILTS BELOW "A" LINE NEGLECTIBLE ORGANIC CONTENT	$W_L < 50\%$	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY		CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE P.I. LESS THAN 4	
		$W_L > 50\%$	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS			ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7	
	CLAYS ABOVE "A" LINE ON PLASTICITY CHART NEGLECTIBLE ORGANIC CONTENT	$W_L < 30\%$	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS	CONTENT OF FINES EXCEEDS 12%		ATTERBERG LIMITS BELOW "A" LINE P.I. LESS THAN 4	
		$30\% < W_L < 50\%$	CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS			ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7	
ORGANIC SILTS & CLAYS BELOW "A" LINE ON CHART	$W_L < 50\%$	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE P.I. LESS THAN 4			
	$W_L > 50\%$	OH	ORGANIC CLAYS OF HIGH PLASTICITY		ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7			
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE			

CLASSIFICATION IS BASED UPON PLASTICITY CHART
(see below)

WHENEVER THE NATURE OF THE FINE CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "F", E.G. SF IS A MIXTURE OF SAND WITH SILT OR CLAY

SPECIAL SYMBOLS



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



GROUND ICE CLASSIFICATION

TABLE I
ICE DESCRIPTIONS
A. ICE NOT VISIBLE^(a)

Group Symbol	Subgroup		Field Identification
	Description	Symbol	
N	Poorly bonded or friable	Nf	Identify by visual examination. To determine presence of excess ice, use procedure under note ^(b) and hand magnifying lens as necessary. For soils not fully saturated, estimate degree of ice saturation: medium, low. Note presence of crystals or of ice coatings around larger particles.
	No excess ice Well-bonded Excess ice	Nb	
		Nbn Nbe	

^(a) Frozen soils in the N group may, on close examination, indicate presence of ice within the voids of the material by crystalline reflections or by a sheen on fractured or trimmed surfaces. The impression received by the unaided eye, however, is that none of the frozen water occupies space in excess of the original voids in the soil. The opposite is true of frozen soils in the V group (see p. 14).

^(b) When visual methods may be inadequate, a simple field test to aid evaluation of volume of excess ice can be made by placing some frozen soil in a small jar, allowing it to melt, and observing the quantity of supernatant water as a percentage of total volume.

FIG A. ICE NOT VISIBLE

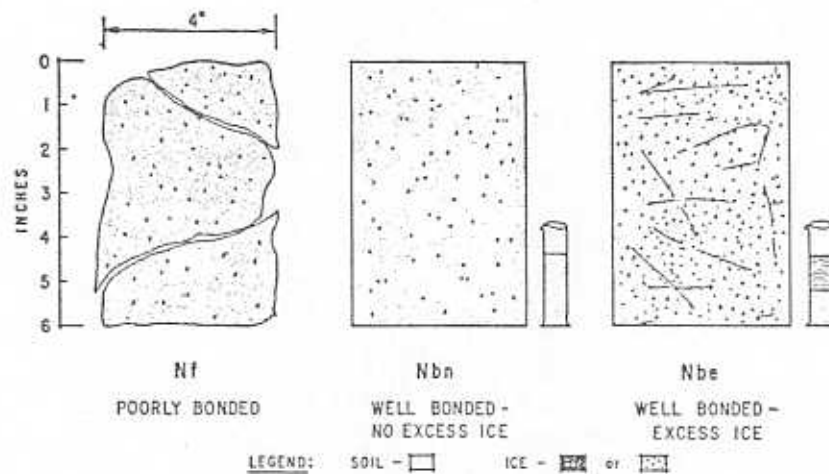


TABLE I (cont'd)
ICE DESCRIPTIONS
B. VISIBLE ICE—LESS THAN 1 INCH THICK^(*)

Group Symbol	Subgroup		Field Identification
	Description	Symbol	
V	Individual ice crystal or inclusions	Vx	For ice phase, record the following when applicable: Location Size Orientation Shape Thickness Pattern of arrangement Length Spacing Hardness Structure } per Group C (see p. 16) Colour Estimate volume of visible segregated ice present as percentage of total sample volume.
	Ice coatings on particles	Vc	
	Random or irregularly oriented ice formations	Vr	
	Stratified or distinctly oriented ice formations	Vs	

^(*) Frozen soils in the N group may, on close examination, indicate presence of ice within the voids of the material by crystalline reflections or by a sheen on fractured or trimmed surfaces. The impression received by the unaided eye, however, is that none of the frozen water occupies space in excess of the original voids in the soil. The opposite is true of frozen soils in the V group.

FIG B. VISIBLE ICE LESS THAN ONE INCH THICK

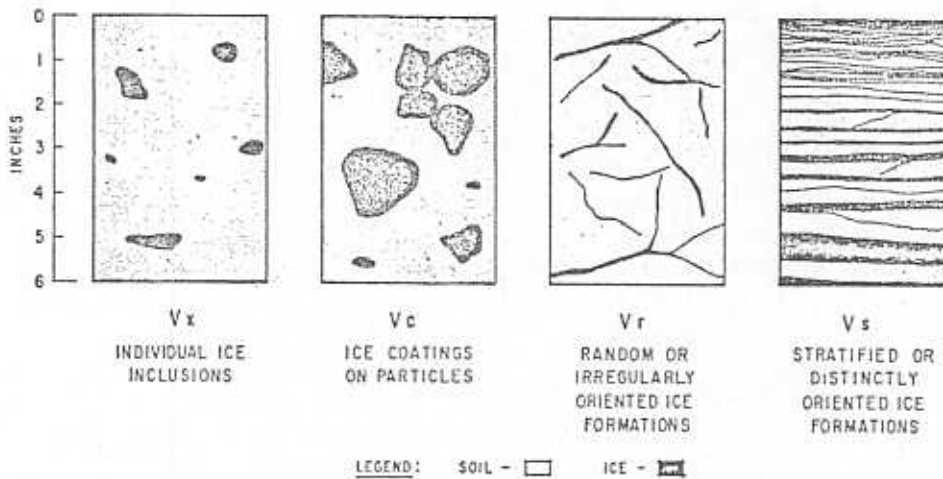


TABLE I (cont'd)
ICE DESCRIPTIONS
C. VISIBLE ICE—GREATER THAN 1 INCH THICK

Group Symbol	Subgroup		Field Identification
	Description	Symbol	
ICE	Ice with soil inclusions	ICE + soil type	Designate material as ICE ^(a) and use descriptive terms as follows, usually one item from each group, when applicable: <u>Hardness</u> HARD SOFT (of mass, not individual crystals) <u>Colour</u> (Examples): COLOURLESS GRAY BLUE <u>Structure^(b)</u> CLEAR CLOUDY POROUS CANDLED GRANULAR STRATIFIED <u>Admixtures</u> (Examples): CONTAINS FEW THIN SILT INCLUSIONS
	Ice without soil inclusions	ICE	

^(a) Where special forms of ice such as hoarfrost can be distinguished, more explicit description should be given.

^(b) Observer should be careful to avoid being misled by surface scratches or frost coating on the ice.

FIG C. VISIBLE ICE GREATER THAN ONE INCH THICK

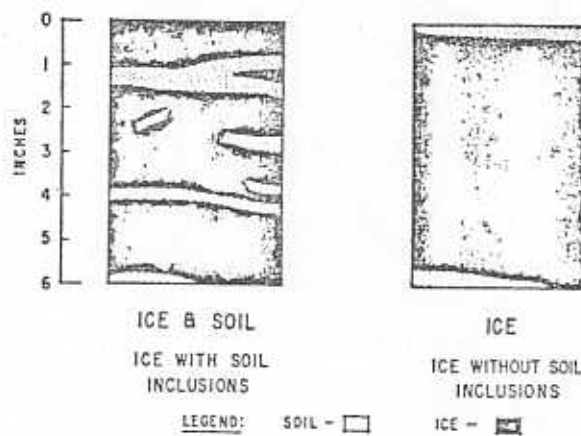




TABLE II

TERMINOLOGY

Ice Coatings on Particles are discernible layers of ice found on or below the larger soil particles in a frozen soil mass. They are sometimes associated with hoarfrost crystals, which have grown into voids produced by the freezing action.

Ice Crystal is a very small individual ice particle visible in the face of a soil mass. Crystals may be present alone or in combination with other ice formations.

Clear Ice is transparent and contains only a moderate number of air bubbles.

Cloudy Ice is relatively opaque due to entrained air bubbles or other reasons, but which is essentially sound and non-pervious.

Porous Ice contains numerous voids, usually interconnected and usually resulting from melting at air bubbles or along crystal interfaces from presence of salt or other materials in the water, or from the freezing of saturated snow. Though porous, the mass retains its structural unity.

Candied Ice is ice that has rotted or otherwise formed into long columnar crystals, very loosely bonded together.

Granular Ice is composed of coarse, more or less equidimensional, ice crystals weakly bonded together.

Ice Lenses are lenticular ice formations in soil occurring essentially parallel to each other, generally normal to the direction of heat loss and commonly in repeated layers.

Ice Segregation is the growth of ice as distinct lenses, layers, veins, and masses in soils commonly but not always, oriented normal to direction of heat loss.

Well-bonded signifies that the soil particles are strongly held together by the ice and that the frozen soil possesses relatively high resistance to chipping or breaking.

Poorly-bonded signifies that the soil particles are weakly held together by the ice and that the frozen soil consequently has poor resistance to chipping or breaking.

Friable denotes extremely weak bond between soil particles. Material is easily broken up.

Excess Ice signifies ice in excess of the fraction that would be retained as water in the soil voids upon thawing.

For a more complete list of terms generally accepted and used in current literature on Frost and Permafrost see Hennion, F. "FROST AND PERMAFROST DEFINITIONS", Highway Research Board, Bulletin 111, 1955.



EXPLANATION OF TERMS AND SYMBOLS

WILDLIFE AREAS

Wildlife boundaries and information presented in the Community and Intercommunity reports has been extracted for the most part from publications prepared by the Canadian Wildlife Service, Government of Canada.

The terms "critical" and "important" as used to designate certain wildlife areas can be generally defined as habitat areas which are critical and/or important to the subsistence and survival of various wildlife species.

COMMUNITY REPORTS

In each Community Study Area, known "critical" and "important" wildlife, waterfowl and fishery resource areas are outlined on the respective map presentations. Any wildlife, waterfowl or fishery resource area which is acknowledged as being "critical" is outlined in red and is noted with the word "critical" within the boundary of the respective area. Non-critical areas are outlined as follows:

- Wildlife areas are outlined in red.
- Waterfowl areas and, in the case of Fort Simpson, hunting locales, are outlined in yellow.
- Fishery resource areas are outlined in blue.

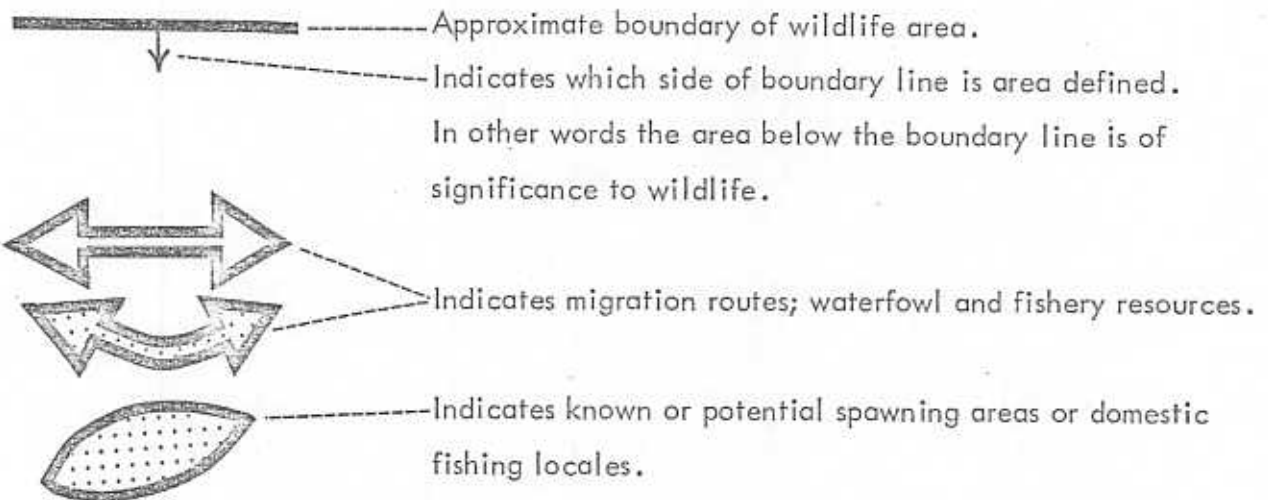
Outlined wildlife areas include both regions of known wildlife habitation and regions which have been historically trapped by northern residents.

Waterfowl areas include migration, staging, molting and nesting locales which are of significance in the respective Study Areas.



Fishery resource areas include migration, spawning and domestic fishing locales which are of significance in the respective Study Areas.

Symbols used on the maps are illustrated and explained as follows:

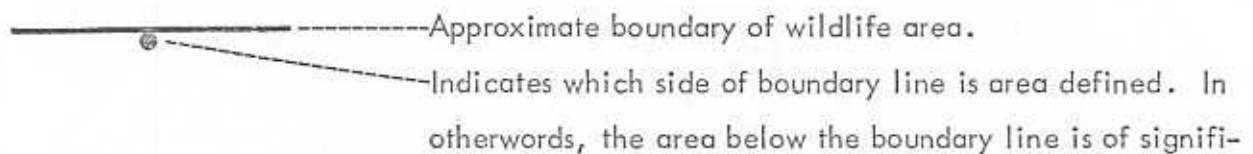


Pertinent wildlife areas are discussed in the Methodology-Evaluation section of the text in each community report. Similar documentation is also presented for sites which occur in significant wildlife areas in the Site Description section of the report.

INTERCOMMUNITY REPORTS

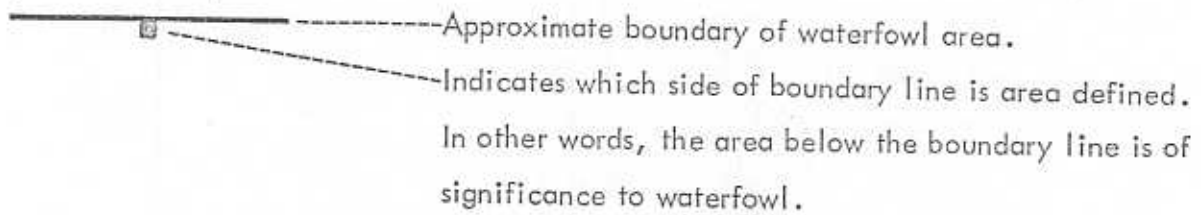
In each Intercommunity Study Area, known "critical" and "important" wildlife, waterfowl and fishery resource areas are outlined on the respective map presentations. A brief description relating to the significance of each area is included within the outlined boundary. Areas that are classified as "critical" are so noted on the maps.

Symbols used on the maps are illustrated and explained as follows:





cance to wildlife.



Significant fishery resource information such as migration routes and potential spawning areas is noted directly on the maps.

Pertinent wildlife areas are discussed in the Methodology-Evaluation section of the text in each Intercommunity report. Similar documentation is also presented for sites which occur in significant wildlife areas in the Site Description section of the report.



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