

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

INTERCOMMUNITY STUDY AREA

WHELEY TO FORT MOHEGAN, N.W.T.



PEM CAN SERVICES "72"



0001 4005



INTERCOMMUNITY STUDY AREA
WRIGLEY TO FORT NORMAN, N.W.T.
SITE DESCRIPTIONS - BOOK II
BLACKWATER RIVER TO FORT NORMAN

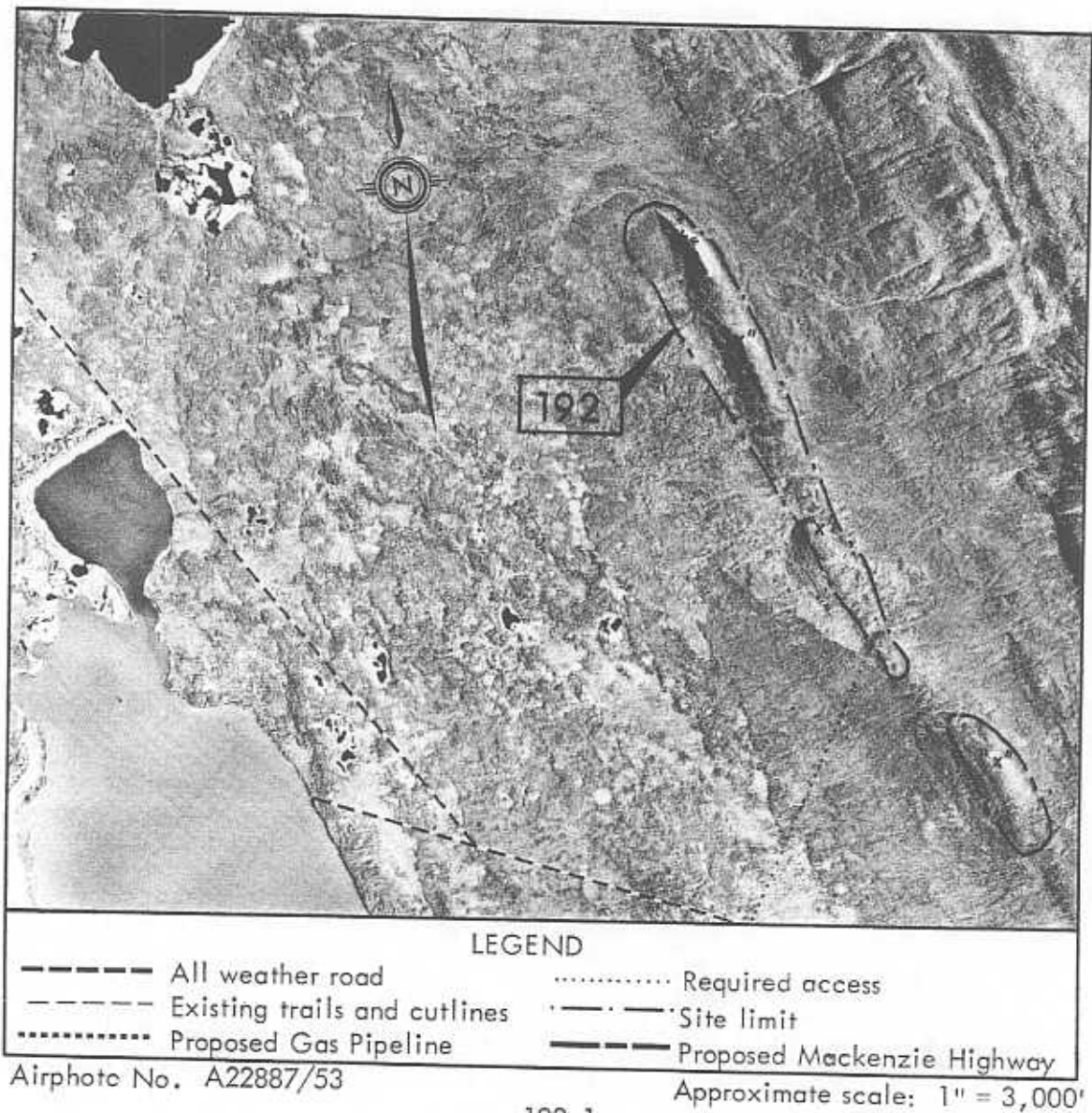
Site Number	Page	Site Number	Page
192	192-1	225	225-1
193	193-1	226	226-1
194	194-1	227	227-1
195	195-1	228	228-1
196	196-1	229	229-1
197	197-1	230	230-1
198X	198-1	231	231-1
199	199-1	232	232-1
200	200-1	233	233-1
201	201-1	234	234-1
202	202-1	235	235-1
203	203-1	236	236-1
204	204-1	237	237-1
205	205-1	238	238-1
206	206-1	239	239-1
207X	207-1	240	240-1
208X	208-1	241	241-1
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211	211-1	244	244-1
212	212-1	245	245-1
213	213-1	246	246-1
214	214-1	247	247-1
215X	215-1	248X	248-1
216	216-1	249	249-1
217	217-1	250X	250-1
218	218-1	251	251-1
219	219-1	252	252-1
220	220-1	253	253-1
221X	221-1	254	254-1
222	222-1	255	255-1
223	223-1	256	256-1
224	224-1	257	257-1
		258X	258-1

SITE NO. 192

LOCATION

Located 4 miles north of the Blackwater River at the western toe of McConnell Range, Site 192 is a shallow, longitudinal bedrock ridge exposing Devonian limestone.

The proposed gas pipeline route runs immediately west of the site area, while the Mackenzie Highway right-of-way is located at Mile 493 approximately 4 miles southwest of the site.



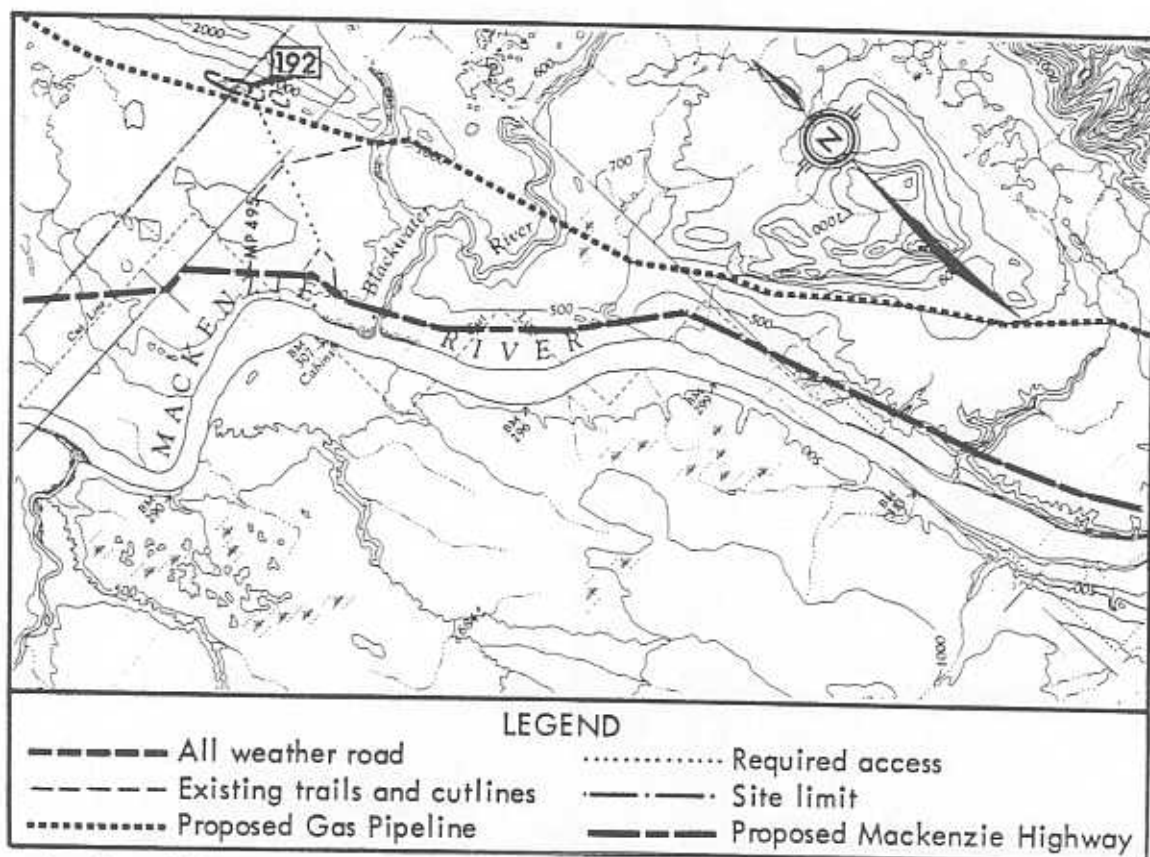


GENERAL

The site area is about 2 miles long and rises some 50 to 100 feet above the flat glaciolacustrine basin which slopes very gently towards the Mackenzie River. Terrain on the east side of the ridge ascends towards the McConnell Range. A relatively thin layer of glaciolacustrine sediments, mainly silts and clays with moderate to high ice content, cover the bedrock east from the ridge. These deposits support moderate to dense growths of spruce and irregular stands of birch and poplar. On the west side of the ridge, stands of tamarack mixed with spruce indicate poorly drained terrain.

Several exposures of fractured to blocky limestone mark the west side of the ridge. Some of them, marked by "x" on the map, form prominent walls which in turn will be suitable for a quarry location. The bedrock is slightly weathered within the surficial zone but it will very likely require blasting to be extracted. Good quality general fill material can be obtained from this location. Aggregates for surface courses can be produced by crushing and screening of fresh limestone.

Site 192 was not investigated during the winter drilling program because of surficial bedrock exposures and difficult access.

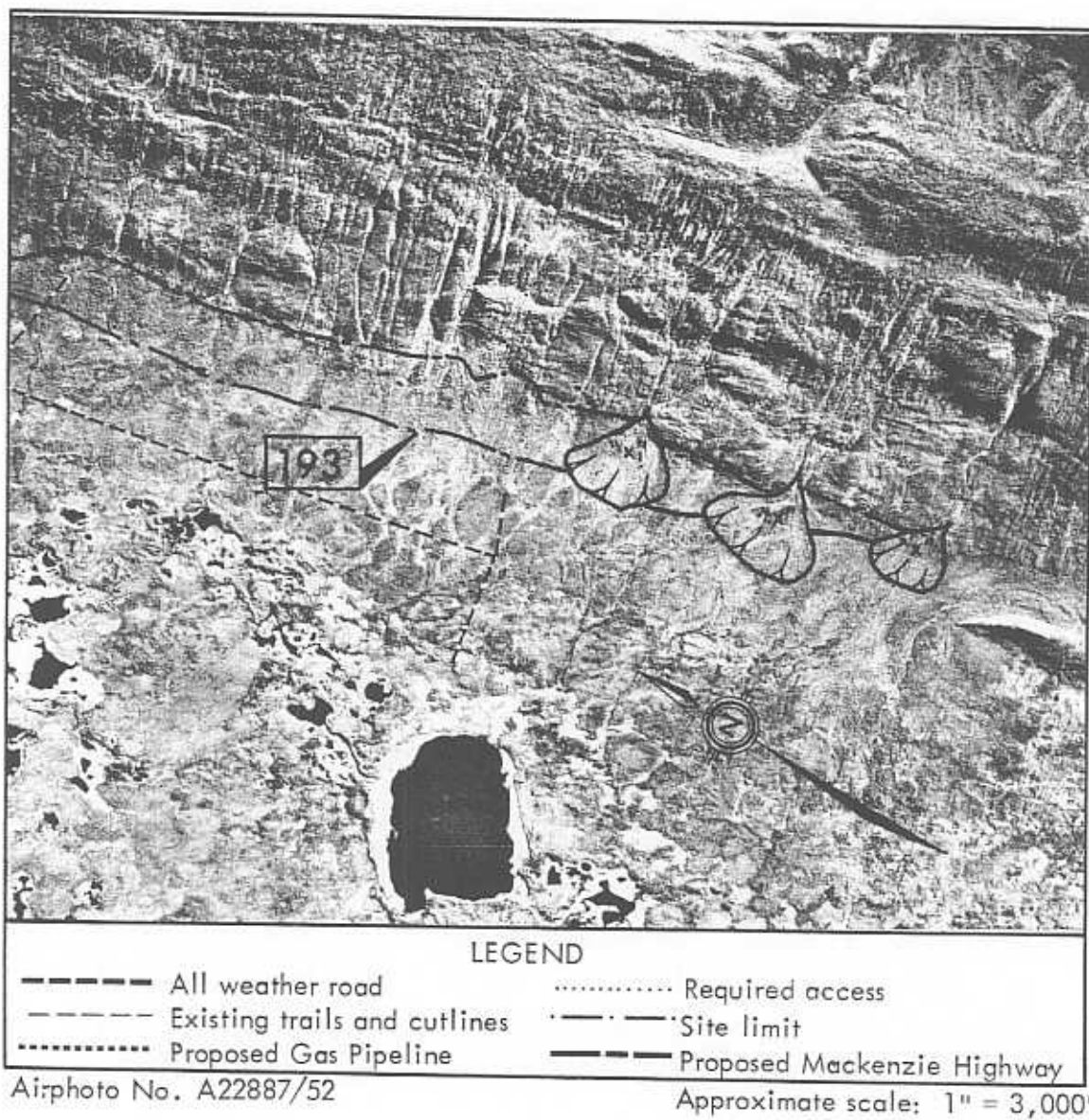


SITE NO. 193

LOCATION

Located approximately 6 miles north from the Blackwater River at the western toe of McConnell Range, Site 193 consists of flat alluvial cones and a narrow belt of slope debris.

The proposed Mackenzie Highway right-of-way at Mile 501 is approximately 6 miles west of Site 193, while the gas pipeline route parallels the site at a distance of one mile.





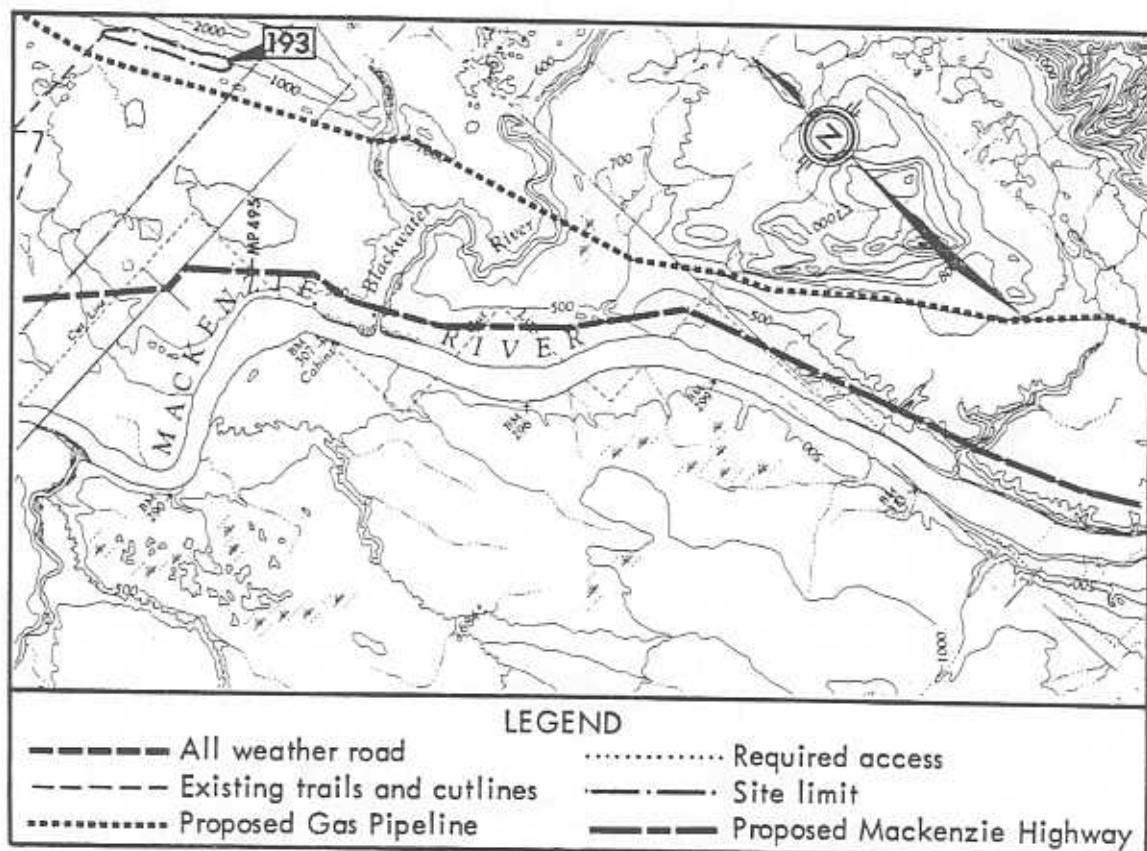
GENERAL

Intermittent discharges of water and material from the hillside resulted in deposition of poorly sorted silts, sands and gravels along the line where the flat terrain of the Mackenzie Plain abruptly ascends the western flank of McConnell Range. Cones were deposited at mouths of ravines and gullies while a relatively narrow and gently sloping band of slope wash and screes mantle other parts of the hillside toe.

Moderate to dense stands of spruce with interspersed birch and poplar covers this site while the poorly drained plain on the east side of the site is vegetated with black spruce, tamarack and willow.

These alluvial cones and slope wash deposits very likely consist of silty and sandy ice-rich material while gravel sized aggregates would be a secondary component. Larger and steeper cones (marked by "x" on the map) may contain more gravel than slope wash mantle and small cones. These materials will be suitable for low quality general fill only.

The site was not drilled because of difficult access, low quantity and doubtful quality of the material.



Section of Map No. 95 N

Scale: 1:250,000

SITE NO. 194

LOCATION

Located approximately 5 miles northwest of the Blackwater River on the northern side of the Mackenzie River channel, Site 194 consists of a large longitudinal segment of a glaciofluvial plain, which is comprised in part of sand and gravel deposits.

The proposed Mackenzie Highway right-of-way at Mile 497 is located less than one mile from the northern tip of Site 194. The haul distance to the proposed gas pipeline along existing seismic cutlines would be in excess of 9 miles.





GENERAL

Site 194 consists of a large segment of a glaciofluvial plain, geologically similar to deposits investigated in Sites 195, 196 and 197 which are located immediately west and north of this site area.

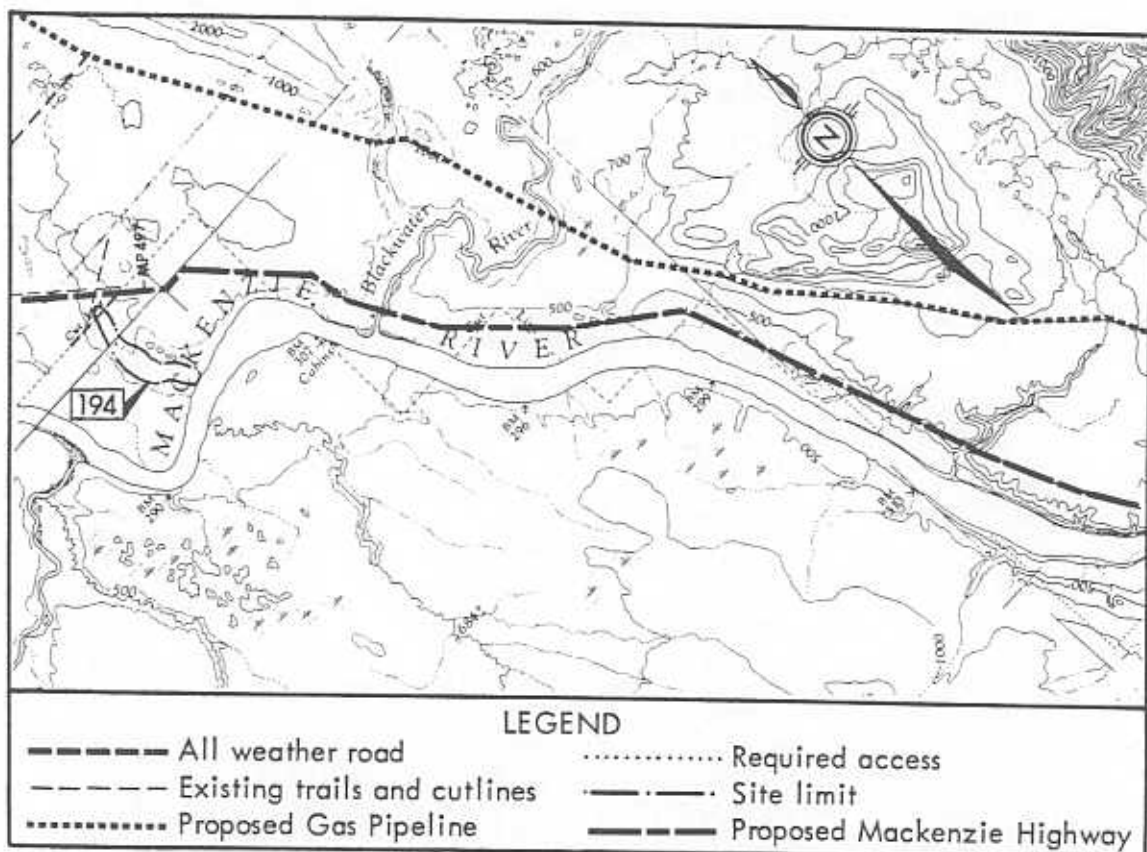
The site area is about $2\frac{1}{2}$ miles in length and ranges from 1000 to 2500 feet in width. The southern perimeter of the site consists of the steep Mackenzie River bank, while a shallow stream channel borders the western periphery of the site. A small tributary stream crosses the northern tip of the deposit and the terrain to the east is slightly depressional, exhibiting thermally sensitive features such as small ponds and muskeg bogs.

Based upon geological inference, the glaciofluvial material likely consists of stratified, well graded sand and gravel. These deposits may be suitable for most construction aggregates.

The organic topsoil layer is relatively shallow and supports moderately dense growths of spruce, poplar and birch.

There are no known critical wildlife areas in the immediate vicinity of Site 194.

Access to the site from the proposed Mackenzie Highway right-of-way consists of existing seismic cutlines.



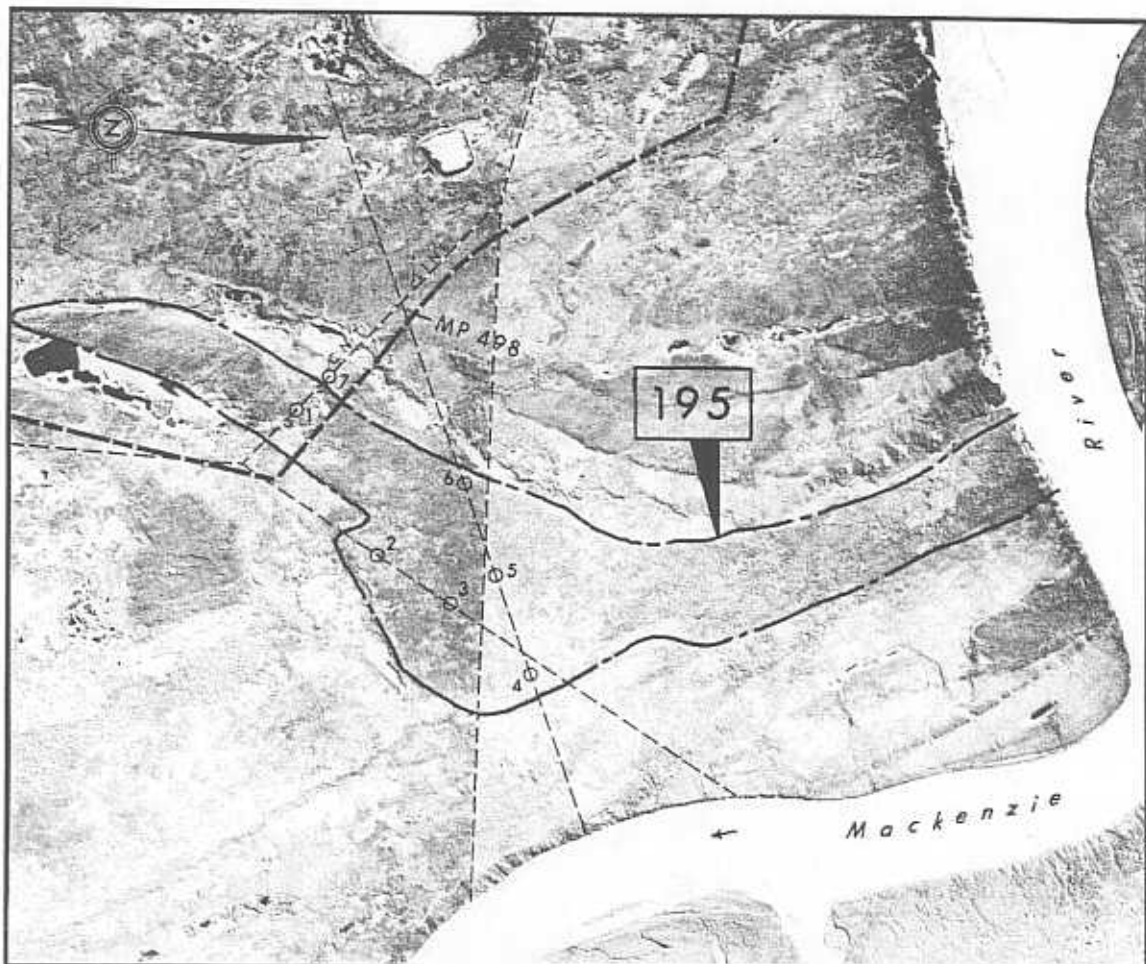
SITE NO. 195

Located approximately 5 miles north of the Blackwater River and adjacent to the proposed Mackenzie Highway at Mile 498, Site 195 consists of a large longitudinal remnant of a glaciofluvial plain.

Type of Material: Gravel and Sand; well graded, stratified, varied size.

Estimated Volume: 10,000,000 cubic yards.

Assessment: Excellent quality granular materials which are suitable for most construction requirements; Site 195 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. A22430/216 and 217

Approximate scale: 1" = 5,000'



ENVIRONMENT

Site 195, located approximately 5 miles north of the Blackwater River, consists of a large, longitudinal remnant of glaciofluvial plain which is orientated generally parallel to the current eastern shoreline of the Mackenzie River at a distance of $\frac{1}{2}$ to 1 mile. The site encompasses an area approximately $3\frac{1}{2}$ miles in length and averages $\frac{1}{4}$ mile in width and is relatively flat but slightly elevated above the adjacent terrain which consists of poorly drained infilled melt-water channels exhibiting thermally sensitive terrain conditions as characterized by numerous lakes and muskeg bog areas. The proposed Mackenzie Highway right-of-way traverses the northern portion of the site at Mile 498.

The material in the glaciofluvial deposit consists of stratified, well graded coarse grained sands and medium to coarse grained gravels. The organic topsoil layer is very shallow, generally less than 1 foot in depth, and supports moderately dense growths of spruce, poplar and birch ranging in height to 30 feet and in trunk diameter to 12 inches. The adjacent poorly drained terrain supports stunted growths of spruce, tamarack and willow.

There are no known critical wildlife areas in the immediate vicinity of Site 195.

Access to potential borrow pit areas is excellent because the existing CNT pole line and proposed Mackenzie Highway right-of-way traverses the northern portion of Site 195 and other existing seismic cutlines traverse various portions of the site.

DEVELOPMENT

The exploratory drill holes indicated the following conditions relative to the quality and quantity of available granular materials:

- Excellent quality granular materials, consisting of stratified, well graded sands and gravels of varying gradation were encountered to depths investigated. These sands and gravels are considered suitable for use in most construction requirements.
- The depth of the granular deposits is in excess of 20 feet although an average depth of 15 feet was used in calculation of volumes.
- The overburden material consisting primarily of topsoil is generally less than 1 foot in depth.
- It is considered that granular materials in excess of 10,000,000 cubic yards are recoverable from Site 195.

Site 195 is recommended as an excellent 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 CNT pole line or proposed Mackenzie Highway right-of-ways 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 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.
- Reseeding of the recontoured pit areas 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. 195

HOLE NO. DH-1

DATE: FEB. 8, 1973 LOGGED BY: ☒ PEMCAN ☐
 DRILLING METHOD: ☒ AIR CONVENTIONAL ☐ AIR REVERSE CIRCULATION ☐ OTHER:

CONVENTIONAL <input type="checkbox"/> CIRCULATION <input type="checkbox"/> OTHER: <input type="checkbox"/>										
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		N	L		0		
1		GW-GP	GRAVEL: little sand, poorly graded, medium grained, frequent boulders, grey							1
2										2
3										3
4										4
5										5
6										6
7		7.0	TOTAL DEPTH 7.0'					7		
				</						

GOVERNMENT OF CANADA
 DEPARTMENT OF INDIAN AFFAIRS
 AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY





PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 195

HOLE NO. DH-2

DATE: FEB. 8, 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:	

				GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	0.4 TOPSOIL: some silt, organic, brown		Vx	L	MC GS P	0
1		GW	GRAVEL: trace sand, coarse grained, well graded, predominantly subrounded and subangular pebbles of quartzite and granite with limestone to 1½ inch size, grey		Nf			1
2					Nf			2
3					Vx			3
4					Nf			4
5					Nf			5
6					Nf			6
7					Nf			7
8			8.0 TOTAL DEPTH 8.0'				8	

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GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 195

HOLE NO. DH-3

DATE: FEB. 8, 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	0.5 TOPSOIL: some silt, little sand brown					0
2								2
4			GRAVEL: trace sand, predominantly rounded and subangular quartzite and limestone pebbles, and cobbles to 4 inch size, grey					4
6		GW						6
8				Vx		L		8
10								10
12								12
14							MC	14
16			15.0 TOTAL DEPTH 15.0'					16
18								18

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GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG





SITE NO. 195

HOLE NO. DH-4

DATE: FEB. 8, 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	0.5 TOPSOIL: little silt, trace sand, organic, dark brown		Vx	M			0
1		ML	1.5 SILT: little sand, frequent rounded or subangular pebbles to 1 inch, grey						1
2		GW	GRAVEL: trace sand, medium grained, well graded, predominantly round and subangular quartzite and granite pebbles and cobbles to 5 inch size, grey		N				2
3									3
4									4
5					Vx	L			5
6								MC	6
7			7.0 TOTAL DEPTH 7.0'		N				7

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PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG



SITE NO. 195

HOLE NO. DH-5

DATE: FEB. 8, 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	0.5 TOPSOIL: some silt and organic roots, greyish brown		Vx	L	I	0
1		GW	GRAVEL: some sand, medium to coarse grained, well graded, predominantly rounded and sub-angular quartzite, granite and limestone pebbles, to 1 1/2 inch size, grey					1
2								2
3								3
4								4
5								5
6			- thin 1/2 foot layer with high ice content at 6.0'				MC	6
7							GS P	7
8								8
9			9.0 TOTAL DEPTH 9.0'				MC	9

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PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG




SITE NO. 195

HOLE NO. DH-6

DATE: FEB.8, 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	0.5 TOPSOIL: some silt and sand, light brown					0
1		GP	GRAVEL AND SAND: well graded, medium grained, predominantly rounded and subangular quartzite pebbles to 3 inch size, few boulders, greyish brown		Vx	L		1
2								2
3								3
4								4
5								5
6								6
7								7
8			8.0 TOTAL DEPTH 8.0'					8

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AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG







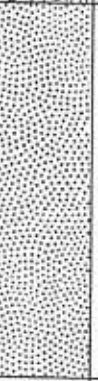
SITE NO. 195

HOLE NO. DH-7

DATE: FEB.8, 1973

LOGGED BY: ☒ PEMCAN ☐

DRILLING METHOD: ☐ CONVENTIONAL ☒ AIR REVERSE CIRCULATION ☐ OTHER:

CONVENTIONAL  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 sand and silt, organic, light brown					0
2		GW-GP	1.5 GRAVEL: little sand, medium grained, well graded, predom- inantly rounded and subangular pebbles to 3 inch size, few boulders, brown		Nf	L		2
4								
6								6
8		SP-GP	8.0 GRAVEL AND SAND: poorly graded, pebbles to 2 inch size, rust brown	UF				8
10								
12								12
14			14.0 TOTAL DEPTH 14.0'					14
16								16

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GRANULAR MATERIALS INVENTORY

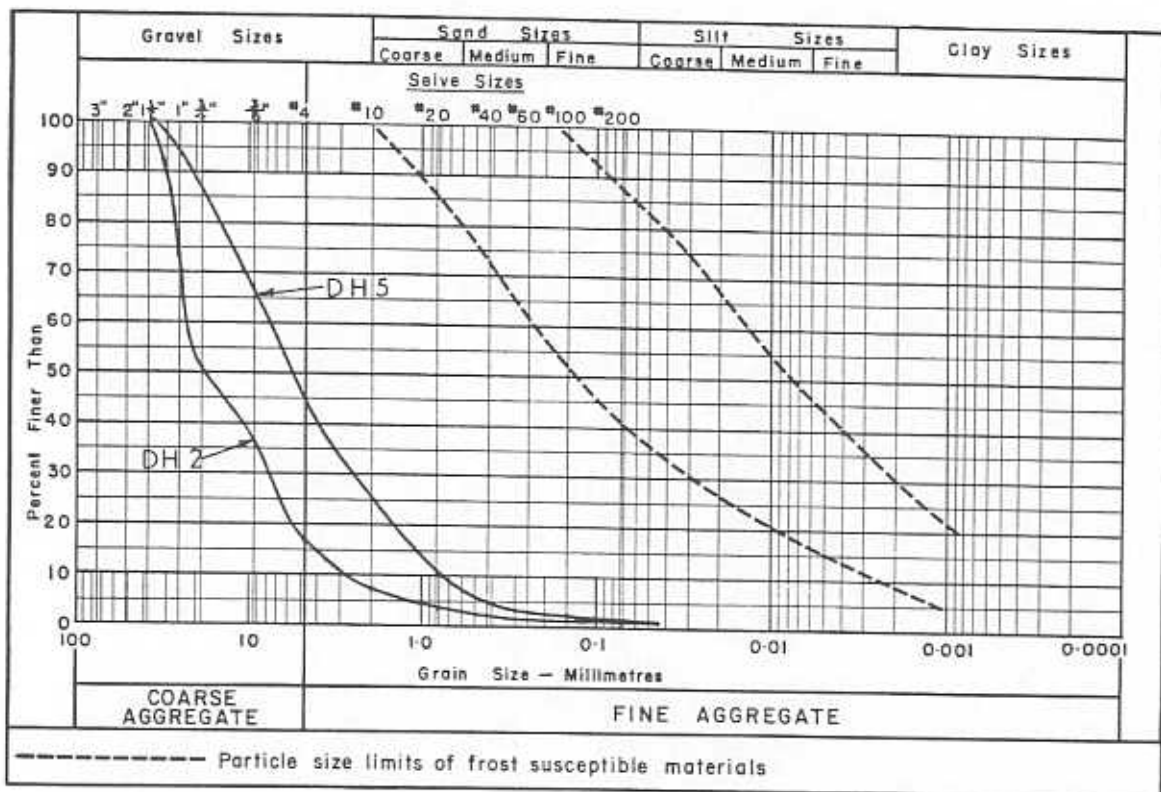


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	195/DH 2	195/DH 5
Sample Depth (Feet):	5	7-9
Moisture Content (%):	1.2	1.7
Ice Content (%):	-	-
Organic Content (%):	-	-

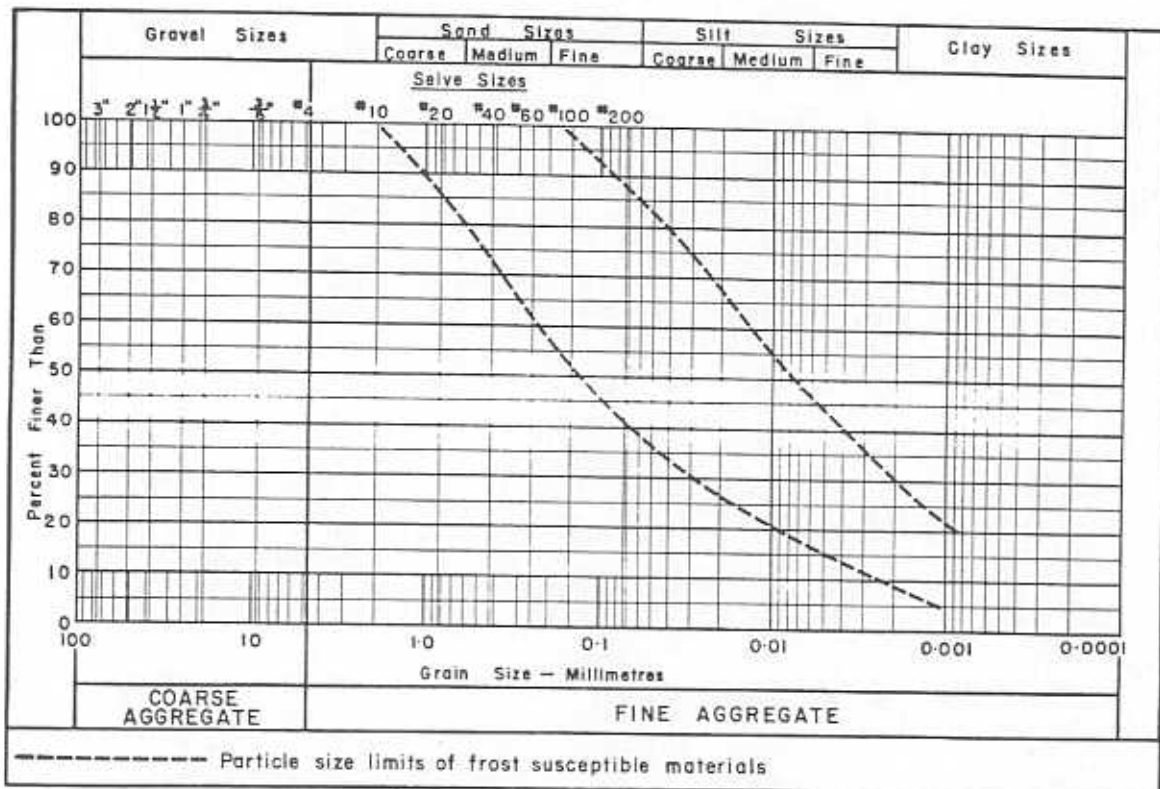
GRAIN SIZE DISTRIBUTION:



SUMMARY OF LABORATORY TEST DATA

Sample Location:	195/DH 3	195/DH 4	195/DH 5
Sample Depth (Feet):	13	6	6
Moisture Content (%):	0.9%	1.4%	9.4%
Ice Content (%):	-	-	-
Organic Content (%):	-	-	-

GRAIN SIZE DISTRIBUTION:



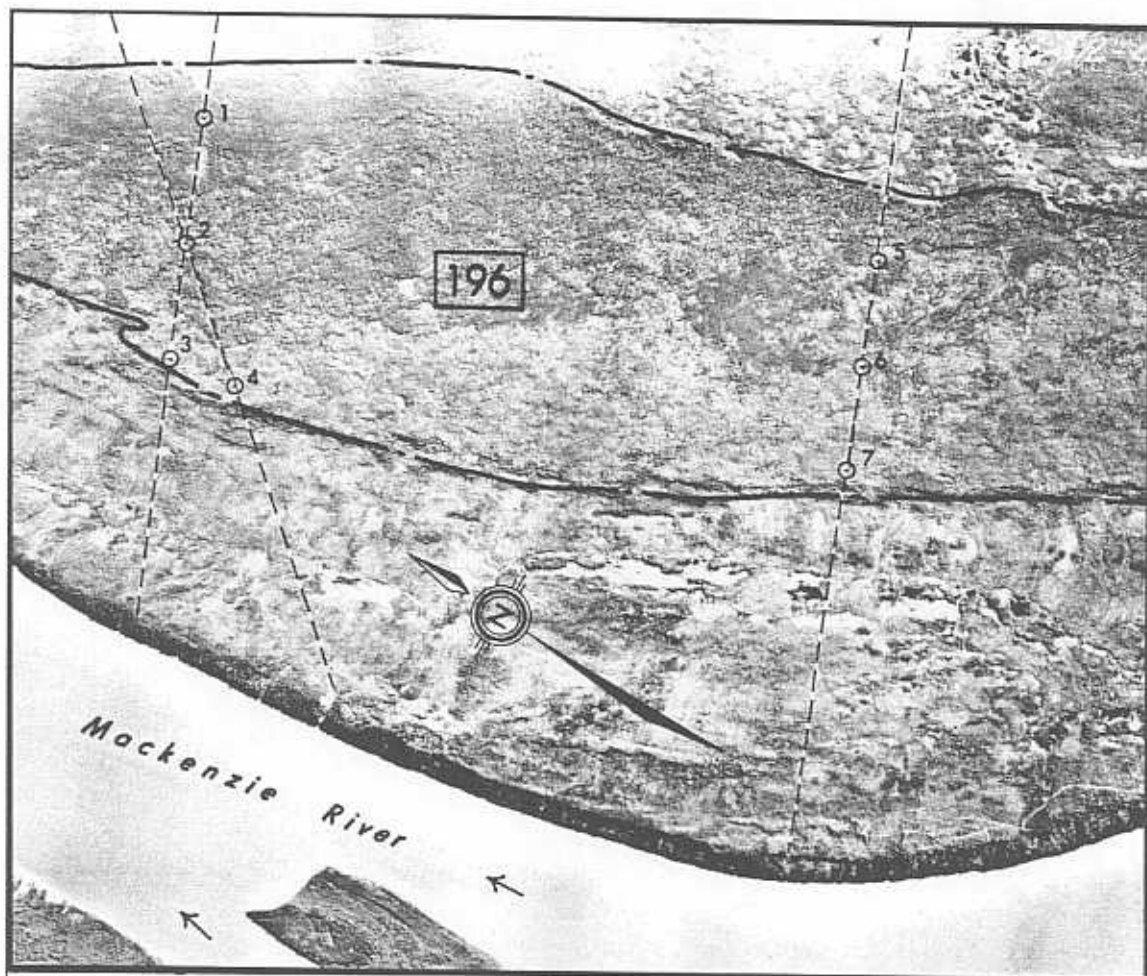
SITE NO. 196

Located approximately 7 miles north of the Blackwater River and 2 miles west of the proposed Mackenzie Highway at Mile 502, Site 196 consists of a large, longitudinal remnant of a glaciofluvial plain.

Type of Material: Gravel and Sand; well graded, varying size, stratified.

Estimated Volume: 40,000,000 cubic yards.

Assessment: Excellent quality granular materials which are suitable for most construction requirements; Site 196 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. A22887/71

Approximate scale: 1" = 3,000'

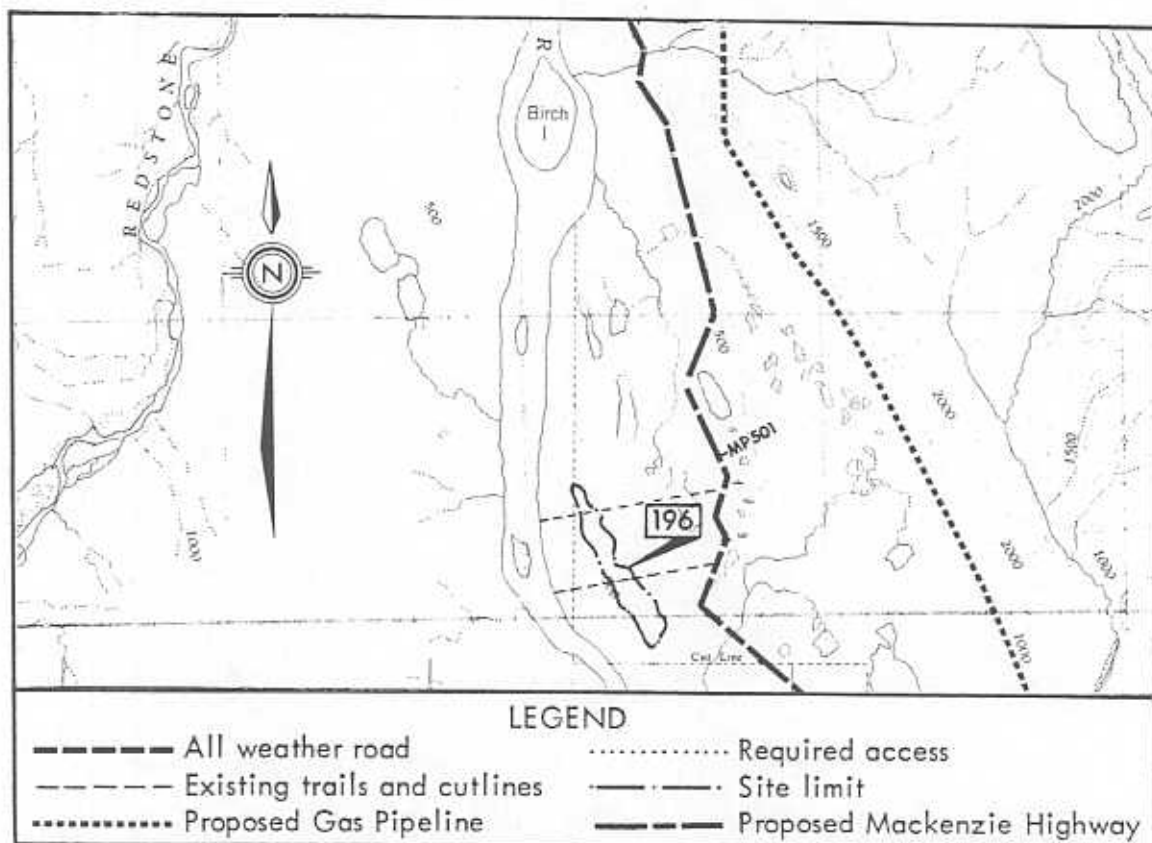


ENVIRONMENT

Site 196 is located approximately 7 miles north of the Blackwater River and 2 miles west of the proposed Mackenzie Highway right-of-way at Mile 502. The site consists of a large, longitudinal remnant of a glaciofluvial plain which is orientated parallel to the current eastern shoreline of the Mackenzie River at a distance of $1\frac{1}{4}$ miles. The site encompasses an area approximately 4 miles in length and 1 mile in width and is relatively flat but slightly elevated above the adjacent terrain which consists of poorly drained in-filled melt-water channels exhibiting thermally sensitive terrain conditions as characterized by numerous lakes and muskeg bog areas.

The material in the glaciofluvial deposit consists of stratified, well graded coarse grained sands and medium to coarse grained gravels. The organic topsoil layer is generally less than 1 foot in depth and supports moderately dense growths of spruce, poplar and birch ranging in height to 30 feet and in trunk diameter to 12 inches. The adjacent poorly drained terrain supports partially stunted growths of spruce, tamarack and willow.

There are no known critical wildlife areas in the immediate vicinity of Site 196.



Section of Map No. 95 N

Scale: 1:250,000



Access to the site from the existing CNT pole line and the proposed Mackenzie Highway right-of-way consists of seismic cutlines which partially traverse thermally sensitive terrain conditions.

DEVELOPMENT

The exploratory drill holes indicated the following conditions relative to the quality and quantity of available granular materials:

- Excellent quality granular materials, consisting of stratified, well graded sands and gravels of varying gradation were encountered to depths investigated. These sands and gravels are considered suitable for use in most construction requirements.
- The depth of the granular deposits is in excess of 20 feet although an average depth of 15 feet was used in calculations of volume.
- The overburden material consisting primarily of topsoil is generally less than 1 foot in depth.
- It is considered that granular materials in excess of 40,000,000 cubic yards are recoverable from Site 196.

Site 196 is recommended as an excellent 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.
- The access road from the proposed Mackenzie Highway right-of-way should be upgraded to an all weather status if borrow pit development is undertaken.
- 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 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.
- 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. 196

HOLE NO. DH-1

DATE: FEB. 7, 1973 LOGGED BY: ☒ PEMCAN ☐
 DRILLING METHOD: ☐ CONVENTIONAL ☒ AIR REVERSE CIRCULATION ☐ OTHER:

CONVENTIONAL  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	0.5	TOPSOIL: some silt and sand, roots, brown					0
2		GW		GRAVEL: little sand, trace silt, coarse grained, well graded, predominantly subrounded and sub-angular pebbles of quartzite and granite to 1½" size, greyish brown		Vx	L		2
4									4
6									6
8									8
10									10
			11.0	TOTAL DEPTH 11.0'				MC GS	
12									12

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PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 196

HOLE NO. DH-2

DATE: FEB. 7, 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:	












CONVENTIONAL 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	0.5' TOPSOIL: some sand, little silt, brown		Vx	L	MC GS LA	0	
1		GW	GRAVEL: little sand, medium to coarse grained, well graded, predominantly subrounded and sub-angular pebbles to 3" size, few cobbles to 5" size, greyish brown					1	
2								2	
3								3	
4								4	
5								5	
6								6	
7								7	
8								8	
9								9	
10		10.0' TOTAL DEPTH 10.0'	10						

DETAILED DRILL HOLE LOG

SITE NO. 196

HOLE NO. DH-3

DATE: FEB. 7, 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		SM-GM	0.5 TOPSOIL: some sand, little gravel and silt, brown		Vx			0
1		GW	GRAVEL: little sand, medium to coarse grained, well graded, predominantly subrounded and subangular pebbles to 3" size, brown		N	L		1
2								2
3								3
4								4
5								5
6								6
7								7
8			8.0 TOTAL DEPTH 8.0'	UF			MC	8

GOVERNMENT OF CANADA
 DEPARTMENT OF INDIAN AFFAIRS
 AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 196

HOLE NO. DH-4

DATE: FEB. 7, 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	0.5 TOPSOIL: some silt and sand, roots, brown		Vx			0
2		GW	GRAVEL: some sand, medium to coarse grained, well graded, pre- dominantly rounded or subangular quartzite pebbles to 2" size, grey		Nf	L		2
4			4.0 - - - - -				MC	4
6			- little sand, few cobbles to 5" size, occasional boulders from 4.0'					6
8							MC	8
10								10
12			11.0 TOTAL DEPTH 11.0'					12
14								14
16								16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 196

HOLE NO. DH-5

DATE: FEB. 8, 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		OL	TOPSOIL: some silt, little sand and organic		Vr			0
2		GW	GRAVEL: little sand, well graded, subrounded and subangular pebbles to 3" in size, greyish brown					2
4		SP-GW	SAND and GRAVEL: medium grained sand, poorly graded, gravel well graded, rounded and subangular pebbles to 1 1/2" size, greyish brown		Vx			4
6						L		6
8							MC GS	8
10								10
12		SP	SAND: fine grained, poorly graded, greyish brown	UF				12
14							MC	14
16								16
18			TOTAL DEPTH 17.0'					18

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG







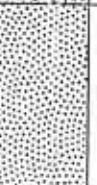

SITE NO. 196

HOLE NO. DH-6

DATE: FEB. 7, 1973

LOGGED BY: ☒ PEMCAN ☐

DRILLING METHOD: ☐ CONVENTIONAL ☒ AIR REVERSE CIRCULATION ☐ OTHER:

CONVENTIONAL  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 and organic, pebbles to 1½" size, dark brown					0	
2		GW	GRAVEL: little sand, trace silt, well graded, subrounded to sub- angular pebbles to 3" size, few boulders, brown		Nf	L		2	
4	4								
6	6								
8	8								
10	10								
12		SW-SP	SAND: occasional pebbles to 1" size, few boulders, brown					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. 196

HOLE NO. DH-7

DATE: FEB. 7, 1973

LOGGED BY: ☒ PEMCAN ☐

DRILLING METHOD: ☐ CONVENTIONAL ☒ AIR REVERSE CIRCULATION ☐ OTHER:

CONVENTIONAL  CIRCULATION  OTHER									
DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS		ICE CONDTIONS		SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.			
0		OL	1.0 TOPSOIL: some silt, organic, dark brown						0
2		GW	GRAVEL: trace sand, coarse grained, well graded, predom- inantly subrounded and subangular pebbles of quartzite, granite and limestone to 2" size, brown		Nf	L		GSP	2
4									4
6									6
8									8
10									10
12			11.0 - becoming high in sand content from 11.0'						12
14									14
15.0			TOTAL DEPTH 15.0'						16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

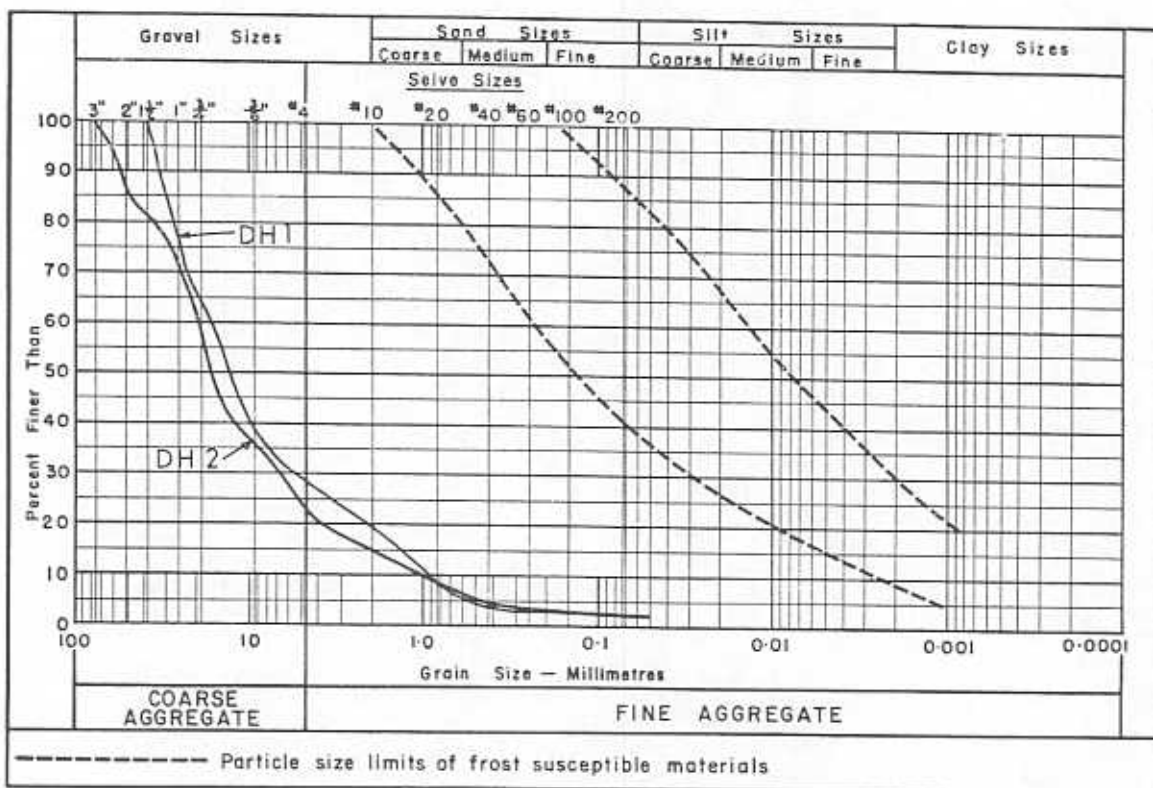


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	196/DH 1	196/DH 2	196/DH 3
Sample Depth (Feet):	6	3	5
Moisture Content (%):	0.3	2.0	1.6
Ice Content (%):	-	-	-
Organic Content (%):	-	-	-

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

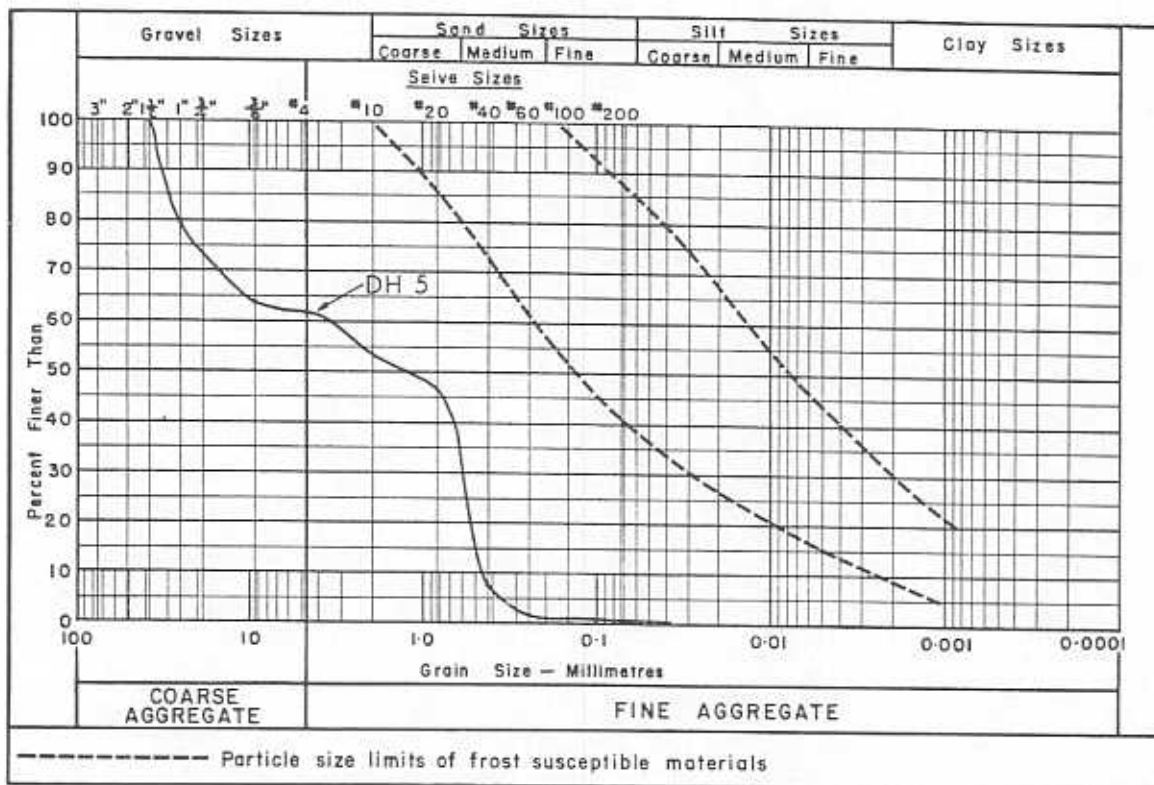
Los Angeles Abrasion Test (196/DH 2 @ 3')

Percent Loss - 17.4

SUMMARY OF LABORATORY TEST DATA

Sample Location:	196/DH 4	196/DH 4	196/DH 5
Sample Depth (Feet):	3.0	7.0	8
Moisture Content (%):	1.2	1.8	1.0
Ice Content (%):	-	-	-
Organic Content (%):	-	-	-

GRAIN SIZE DISTRIBUTION:

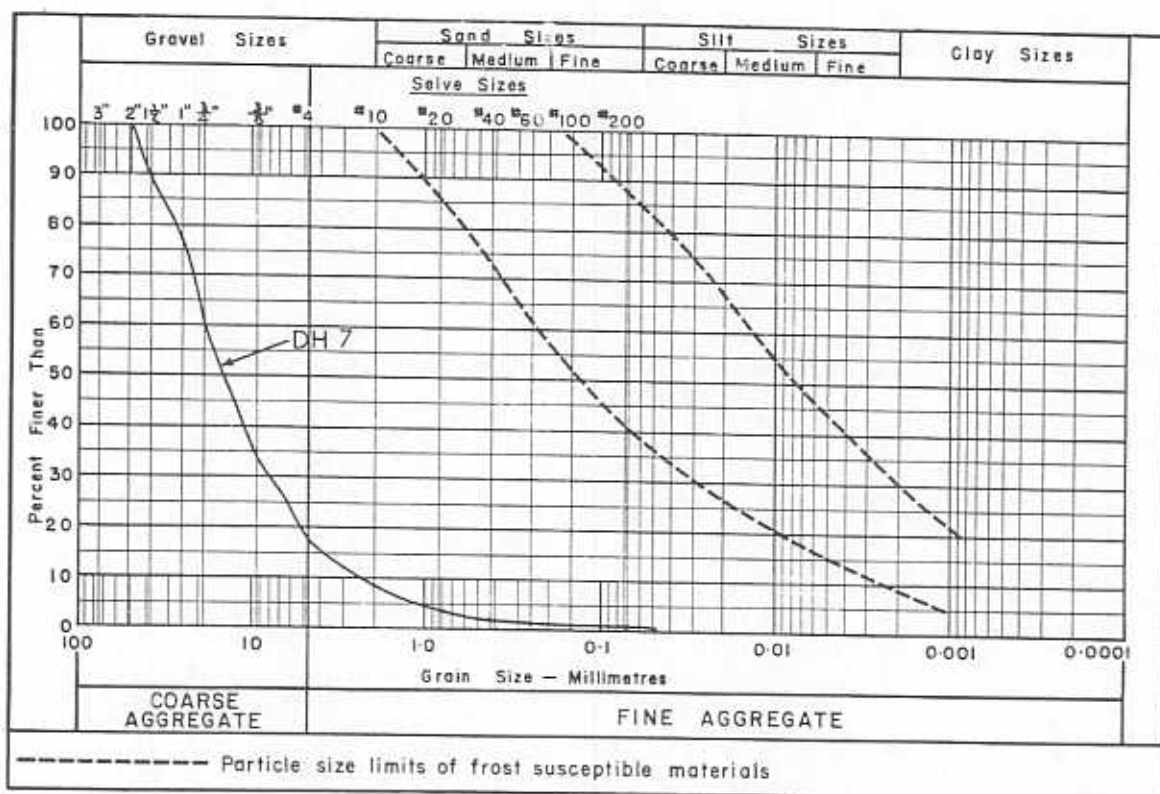


PETROGRAPHIC ANALYSIS:

SUMMARY OF LABORATORY TEST DATA

Sample Location:	196/DH 5	196/DH 6	196/DH 7
Sample Depth (Feet):	14.0	13-15	2-5
Moisture Content (%):	2.4	2.1	-
Ice Content (%):	-	-	-
Organic Content (%):	-	-	-

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS: (196/DH 7 @ 2'-5')

LITHOLOGIC ANALYSIS: (196/DH 7 @ 2'-5')		Hardness
Quartzite	44.3%	6-7
Igneous	36.1%	7-8
Limestone & dolomite (sound)	19.2%	5-6
Chert (stable)	0.5%	5-6

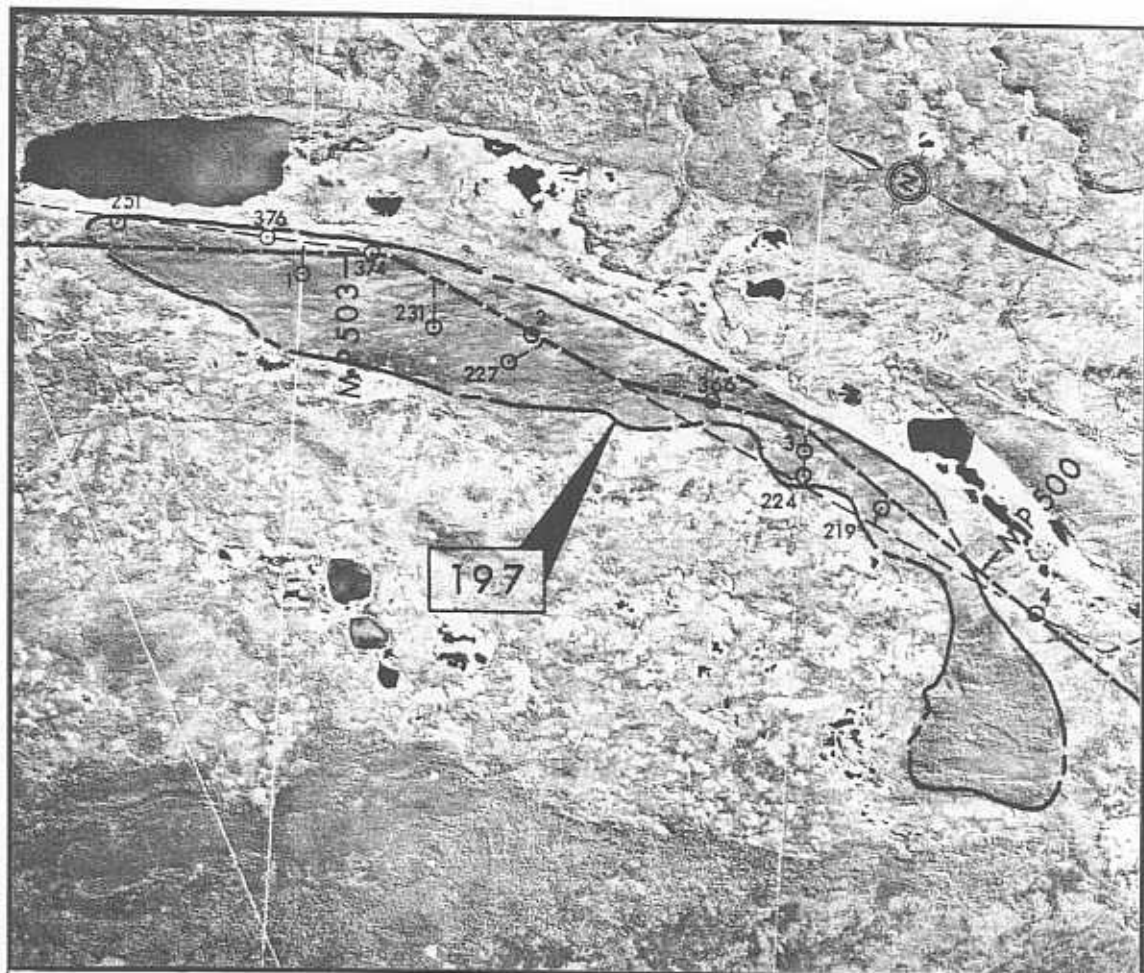
SITE NO. 197

Located approximately 7 miles north of the Blackwater River, Site 197 encompasses the proposed Mackenzie Highway from Mile 500 to Mile 504 and consists of a large, longitudinal remnant of a glaciofluvial plain.

Type of Material: Gravel and Sand; well graded, varying size, stratified.

Estimated Volume: 15,000,000 cubic yards.

Assessment: Excellent quality granular materials which are suitable for most construction requirements; Site 197 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. A22887/17 and 18

Approximate scale: 1" = 4,000'



ENVIRONMENT

Site 197 is located approximately 7 miles north of the Blackwater River and encompasses the Mackenzie Highway right-of-way from Mile 500 to 504. The site consists of a large, longitudinal remnant of a glaciofluvial plain which is orientated parallel to the current eastern shoreline of the Mackenzie River at a distance of $3\frac{1}{2}$ miles. The site area is relatively flat but slightly elevated above the adjacent terrain which consists of poorly drained infilled melt-water channels exhibiting thermally sensitive terrain conditions as characterized by numerous lakes and muskeg bog areas.

The material in the glaciofluvial deposit consists of stratified, well graded coarse grained sands and medium to coarse grained gravels. The organic topsoil layer is generally less than 1 foot in depth and supports moderately dense growths of spruce, poplar and birch ranging in height to 30 feet and in trunk diameter to 12 inches. The adjacent poorly drained terrain supports partially stunted growths of spruce, tamarack and willow.

There are no known critical wildlife areas in the immediate vicinity of Site 197.

Access to potential borrow pit areas is excellent because the existing CNT pole line and the proposed Mackenzie Highway right-of-way traverses the entire length of Site 197.

DEVELOPMENT

The exploratory drill holes indicated the following conditions relative to the quality and quantity of available granular materials:

- Excellent quality granular materials, consisting of stratified, well graded sands and gravels of varying gradation were encountered to depths investigated. These sands and gravels are considered suitable for use in most construction requirements.
- The depth of the granular deposits is in excess of 20 feet, although an average depth of 15 feet was used in calculations of volume.
- The overburden material consisting primarily of topsoil is generally less than 1 foot in depth.
- It is considered that granular materials in excess of 15,000,000 cubic yards are recoverable from Site 197.

Site 197 is recommended as an excellent 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 CNT pole line or proposed Mackenzie Highway right-of-ways 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 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.
- 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. 197

HOLE NO. DH-1

DATE: FEB. 7, 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		GM-GP	GRAVEL: some sand, little silt, rust brown					0
2		SW-SP	SAND: trace gravel, occasional pebbles to 3/4" size, medium brown		Nf	L		2
4								4
6							MC	6
8		GW-SW	GRAVEL: some sand, trace silt, medium to coarse grained, well graded, frequent pebbles to 1 1/4" size, medium brown					8
10								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. 197

HOLE NO. DH-2

DATE: FEB. 7, 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		GW-GP	GRAVEL: little sand, medium brown		Nf	M		0
3								3
4.0								
6		SW-SP	SAND: occasional pebbles to 1 1/2" size, medium brown		Nf	M		6
9								9
9.0								
12		GW-SW	GRAVEL: some sand, trace silt, medium to coarse grained, well graded, frequent pebbles to 1 1/4" size, predominantly subrounded, granite and quartzite with limestone, few cobbles, medium brown	UF				12
15								15
18								18
21								21
21							*LA GS P	21
22.0								
24		CI-ML	SILT: some clay, medium plastic, medium grey					24
24.0								24
			TOTAL DEPTH 24.0'					
27								27

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 197

HOLE NO. DH-3

DATE: FEB. 7, 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			ICE EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS				
0		GW-GP	GRAVEL: some sand, medium brown		Nf	M		0	
2		2.0	2						
4		SP-SW	SAND: frequent pebbles to 1 1/2" size, medium brown					4	
6		6							
8		SW-GW	SAND: some gravel, trace silt, medium to coarse grained, well graded, pebbles to 1 1/2" size, medium brown				MC GS O	8	
10								8.0	10
12								12	
14								14	
15.0			TOTAL DEPTH 15.0'					16	
18								18	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 197

HOLE NO. DH-4

DATE: FEB. 8, 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	PEAT: organic, little silt, fibrous, muskeg, dark brown					0	
1		ML	1.0		Vs	M		1	
2			SILT: trace sand, occasional pebbles to 1" size, grey					2	
3			2.5		- frequent fragments of limestone, rounded quartzite pebbles to 2" size (TILL)			L	3
4			4						
5			5						
6			6.0					6	
6.5	- trace sand	6.5	6						
7								7	
8								8	
9			9.0					UF	
			TOTAL DEPTH 9.0'						

DETAILED DRILL HOLE LOG

SITE NO. 197

HOLE NO. B219 A

DATE: JAN. 29, 1973 LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

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			CLAY: sandy					0
2		GW	GRAVEL:	UF				2
4			- coarse with sand loose and dry					4
6								6
8								8
10			- finer, more sand loose and dry					10
12		GW						12
14								14
16			END OF HOLE 15.0'					16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY





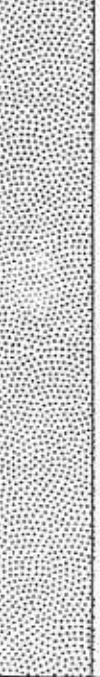
PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 197

HOLE NO. B224 A

DATE: JAN. 29, 1973	LOGGED BY: <input type="checkbox"/> PEMCAN <input checked="" type="checkbox"/> UNDERWOOD
DRILLING METHOD: <input checked="" type="checkbox"/> AIR CONVENTIONAL <input type="checkbox"/> AIR REVERSE CIRCULATION <input type="checkbox"/> 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		GP	GRAVEL: coarse with sand, dry						0
2									2
4									4
4.0		SW	SAND: - coarse with isolated random pebbles and small cobbles, wet	UF					4
6									6
8									8
10									10
12									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"


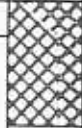
DETAILED DRILL HOLE LOG

SITE NO. 197

HOLE NO. B 227 A

DATE: JAN. 29, 1973 LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

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 — MOSS:					0
2		GW	GRAVEL: - coarse, sand					2
4				UF				4
6								6
8			- fine, pebbles clean sand no cobbles					8
10								10
12			12.0 —					12
14		SW	SAND: - few pebbles					14
16			15.0 —					16
			END OF HOLE 15.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"










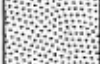
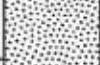
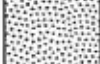
DETAILED DRILL HOLE LOG

SITE NO. 197

HOLE NO. B 231 A

DATE: JAN. 29, 1973 LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

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	MOSS					0
1		GP	GRAVEL:					1
2								2
3				UF				3
4			- coarse, sandy					4
5		SP						5
6								6
7								7
8								8
9								9
10		GW	- cobbles					10
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"


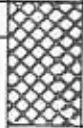
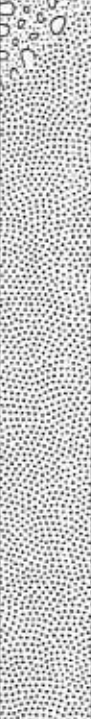

DETAILED DRILL HOLE LOG

SITE NO. 197

HOLE NO. B 251 A

DATE: JAN. 30, 1973 LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

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		GP	0.5 TOPSOIL					0
2			SAND: - fine gravel	UF				2
4		SP						4
6								6
8			- coarse, wet					8
10								10
12		SP	14					14
14			15.0					16
16			END OF HOLE 15.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 197

HOLE NO. C 366 B

DATE: JAN. 30, 1973 LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

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	MUSKEG: granular					0
1			1.0					1
2		SP	SAND: coarse, brown, dry, some pebbles, loose	UF				2
3								3
4								4
5			5.0					5
			END OF HOLE 5.0' Hole sloughing badly, abandoned					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 197

HOLE NO. C 374 B

DATE: JAN. 30, 1973

LOGGED BY: ☐ PEMCAN

☒



UNDERWOOD

DRILLING METHOD:

☒AIR
COMMENT

AIR
ENTONN

☐ AIR REVERSE☐ OTHER: _____

CONVENTIONAL — CIRCULATION —								
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: sand					0
1								
2			- sand			2		
3				UF		3		
4						4		
5			5.0 — END OF HOLE 5.0' Hole sloughing					5

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 197

HOLE NO. C 376 B

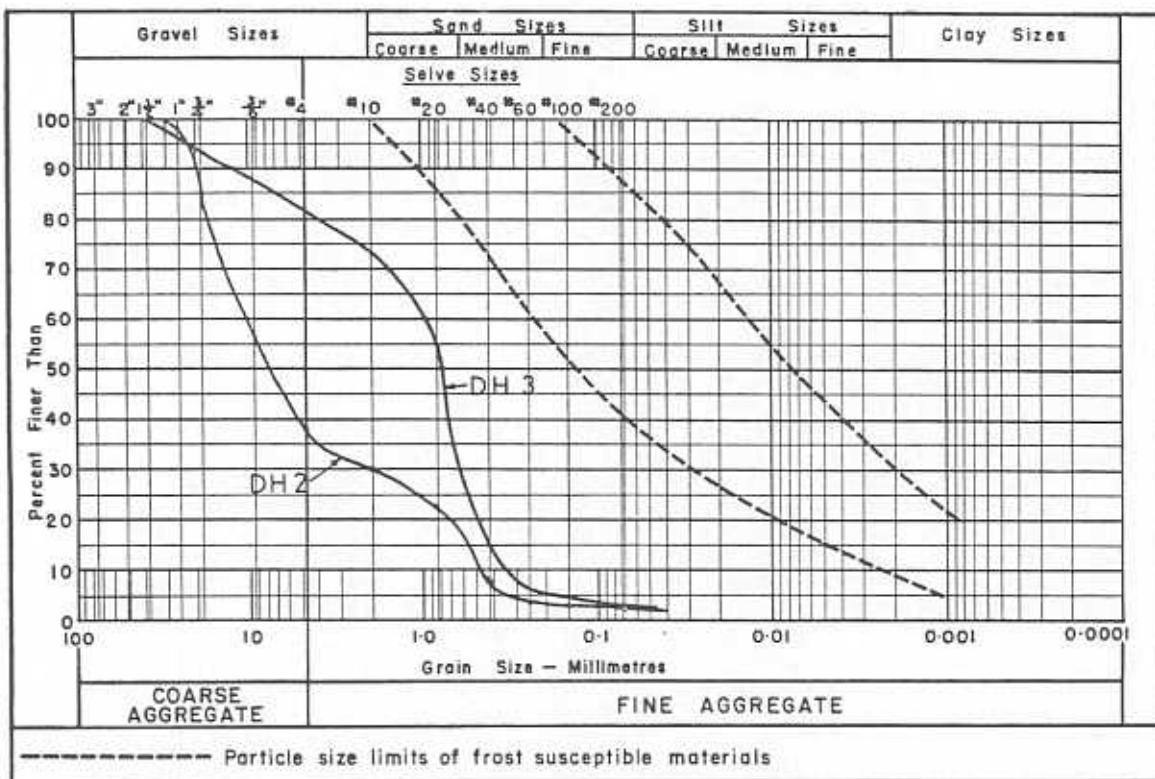
DATE: JAN. 31, 1973	LOGGED BY: <input type="checkbox"/> PEMCAN <input checked="" type="checkbox"/> UNDERWOOD
DRILLING METHOD: <input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> AIR REVERSE CIRCULATION <input type="checkbox"/> OTHER:	

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			MUSKEG: granular, moss					0
1		1.0						1
2			GRAVEL:					2
3								3
4			- sandy	UF				4
5								5
6								6
7								7
8		8.0	END OF HOLE 8.0' Hole sloughing badly, abandoned at 8'					8

SUMMARY OF LABORATORY TEST DATA

Sample Location:	197/DH 1	197/DH 2	197/DH 3
Sample Depth (Feet):	4-7	19-21	8-10
Moisture Content (%):	1.7	-	13.3
Ice Content (%):	-	-	-
Organic Content (%):	-	-	1.2

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

Igneous	40.3%
Quartzite	37.6%
Limestone and dolomite (sound)	18.6%
Chert	2.8%
Deleterious	
Siltstone, shale and sandstone	0.7%
Los Angeles Abrasion Test:	
Percent Loss - 17.9	

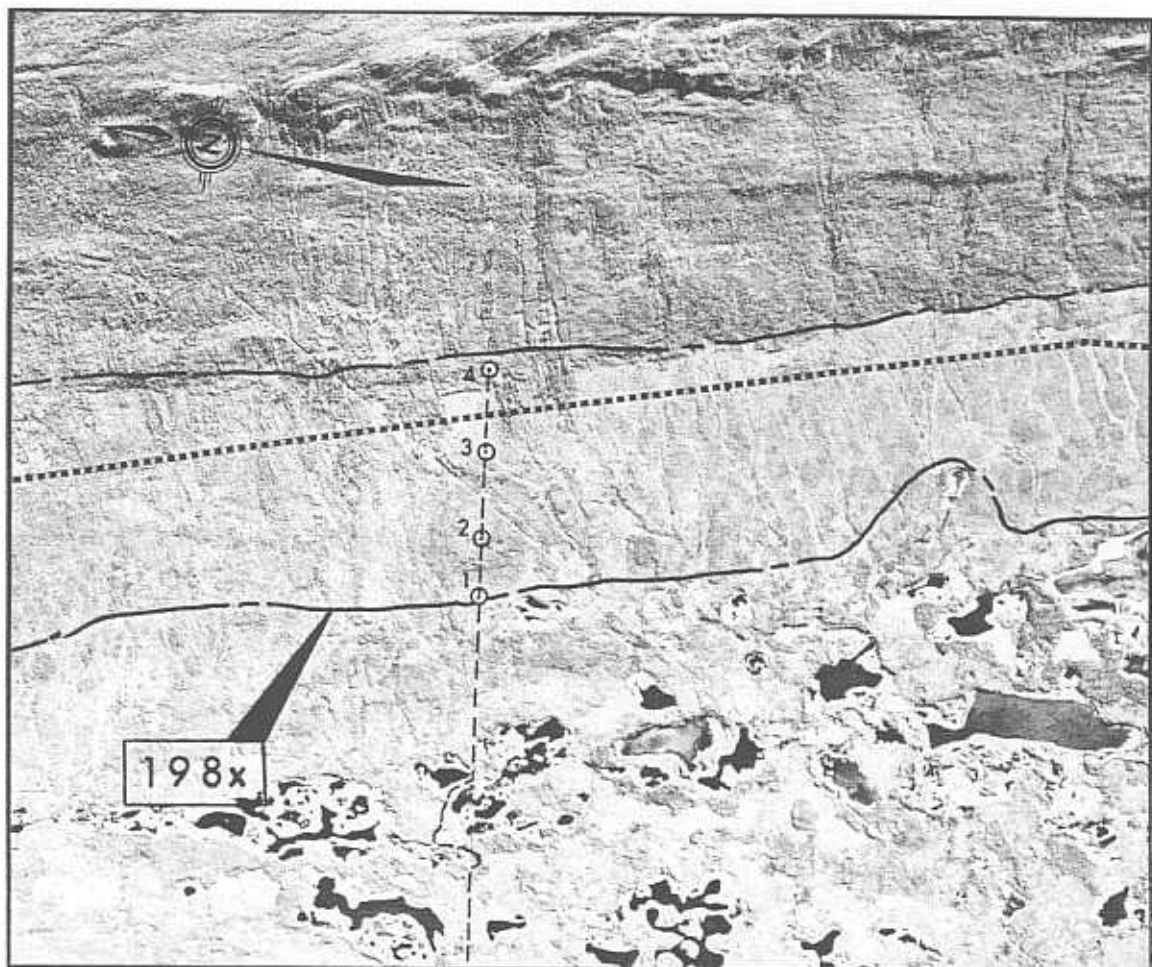
SITE NO. 198X

Located approximately $4\frac{1}{2}$ miles south of Steep Creek and $2\frac{1}{2}$ miles east of the proposed Mackenzie Highway at Mile 505, Site 198X consists of slope wash material intermixed with glaciolacustrine silts along the western slopes of the McConnell Range.

Type of Material: Silt and Sand; limestone fragments, fine grained.

Estimated Volume: Not applicable.

Assessment: Materials of granular quality were not established during the field drilling program; Site 198X is not 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. A22887/50

Approximate scale: 1" = 3,000'

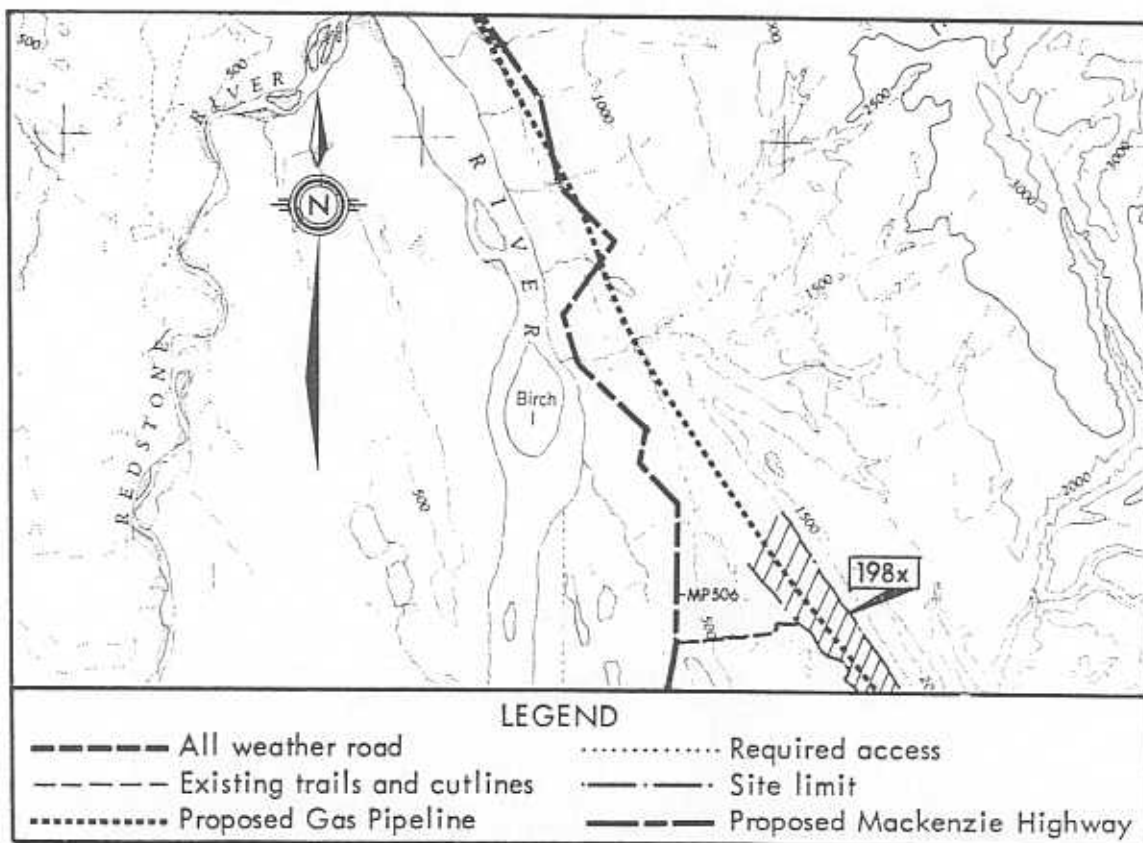


ENVIRONMENT

Site 198X is located approximately $4\frac{1}{2}$ miles south of Steep Creek and less than $2\frac{1}{2}$ miles east of the proposed Mackenzie Highway right-of-way at Mile 505. The site consists of slope wash material intermixed along the western site perimeter with glaciolacustrine silts and sands and encompasses an area $\frac{1}{2}$ mile in width and in excess of 5 miles in length along the western slopes of the McConnell Range of the Franklin Mountains. The terrain immediately east of the site rises steeply and consists of rugged, exposed bedrock ridges whereas the adjacent terrain to the west consists of a glaciolacustrine plain exhibiting thermokarst features characterized by numerous lakes, ponds and muskeg bogs.

The slope wash material consists of limestone fragments intermixed in a silt matrix. The in situ ground ice content of the material is moderately high and generally increases in the downslope direction. The organic topsoil layer is generally less than 1 foot in depth and supports moderately dense growths of spruce and birch which attain heights in excess of 30 feet and trunk diameters to 6 inches.

There are no known critical wildlife areas in the immediate vicinity of Site 198X.



Section of Map No. 96 C

Scale: 1:250,000



The only existing access to Site 198X from the CNT pole line or the proposed Mackenzie Highway right-of-way consists of seismic cutlines which traverse terrain conditions which are highly thermally sensitive if the existing vegetation cover is disturbed. The proposed gas pipeline route traverses the entire length of Site 198X.

DEVELOPMENT

Site 198X is not recommended as a source for granular materials because the exploratory winter drilling has confirmed the material to be non-granular. In addition, the ground ice contents of the frozen soil are relatively high. Access to this site from the proposed Mackenzie Highway is very difficult in view of the highly thermally sensitive terrain which has to be traversed.

DETAILED DRILL HOLE LOG

SITE NO. 198 X

HOLE NO. DH-1

DATE: FEB. 7, 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		OL	TOPSOIL: some silt, organic, roots, dark brown		Vs			0
1								1
2								2
3		ML	SILT: trace clay, dark grey		Vs Vr	M		3
4								4
5							MC	5
6								6
7								7
8			TOTAL DEPTH 8.0'					8
9								9

DETAILED DRILL HOLE LOG

SITE NO. 198X

HOLE NO. DH-2

DATE: FEB. 7, 1973	LOGGED BY: <input checked="" type="checkbox"/> PEMCAN <input type="checkbox"/>
DRILLING METHOD: <input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> AIR <input type="checkbox"/> AIR REVERSE CIRCULATION <input type="checkbox"/> OTHER:	

CONVENTIONAL — CIRCULATION —									
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, organic, roots, dark brown		Vs			0	
1		ML-MH	SILT: some clay, trace sand, fine grained, medium plastic, brown		Vs Vr	M		1	
2									
3									
4									
5									
6									
7									
8									
9			9.0	TOTAL DEPTH 9.0'				9	
10								10	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 198X

HOLE NO. DH-4

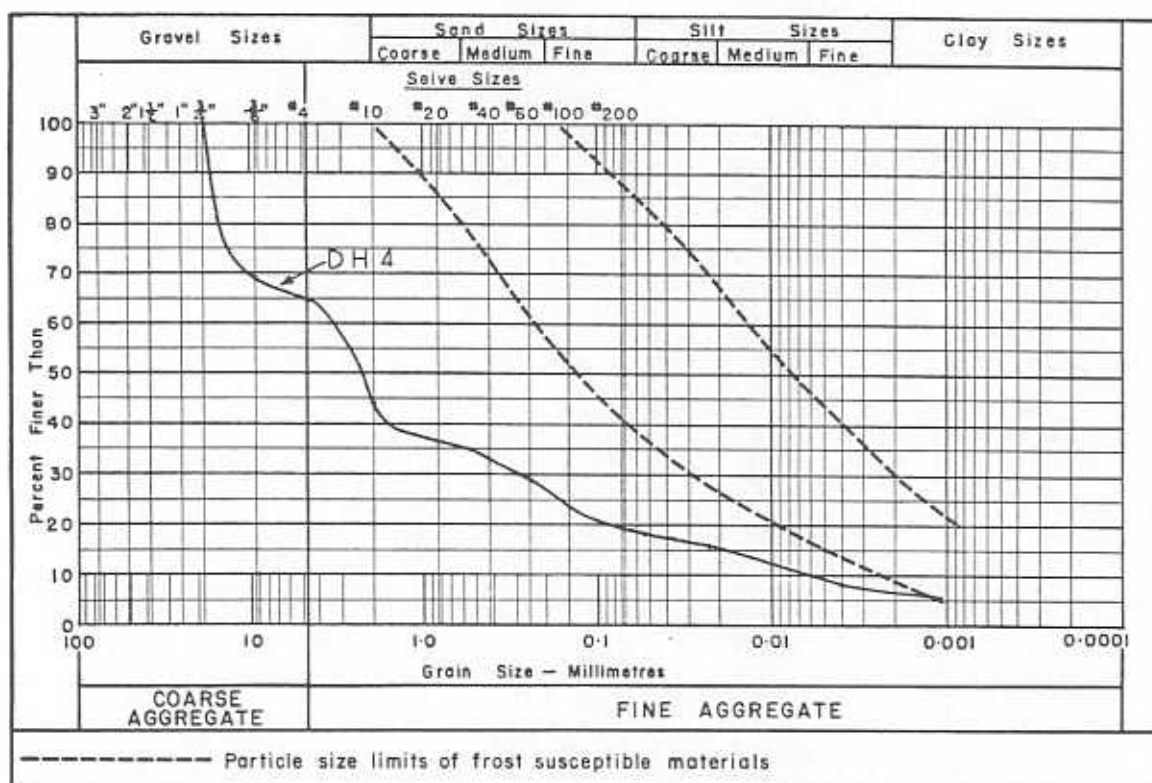
DATE: FEB. 7, 1973		LOGGED BY: <input checked="" type="checkbox"/> PEMCAN <input type="checkbox"/>	
DRILLING METHOD: <input checked="" type="checkbox"/> CONVENTIONAL		<input type="checkbox"/> AIR REVERSE CIRCULATION <input type="checkbox"/> OTHER:	

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	TOPSOIL: some silt, little organic, brown					0
1		GM-GW	GRAVEL, SAND, SILT MIXTURE: trace clay, fine to medium grained, well graded, angular and subangular fragments, pebbles and cobbles of limestone and dolomite to 3/4" size, grey (TILL-LIKE)					
2	2							
3	3							
4	4							
5	5							
6	6							
7	7							
8	8							
9	9							
10			TOTAL DEPTH 10.0'					10

SUMMARY OF LABORATORY TEST DATA

Sample Location:	198X/DH 1	198X/DH 3	198X/DH 4
Sample Depth (Feet):	5.0	8.0	7.0
Moisture Content (%):	19.9	18.4	6.0
Ice Content (%):	-	-	-
Organic Content (%):	-	-	-

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS: (198X/DH 4 @ 7.0')

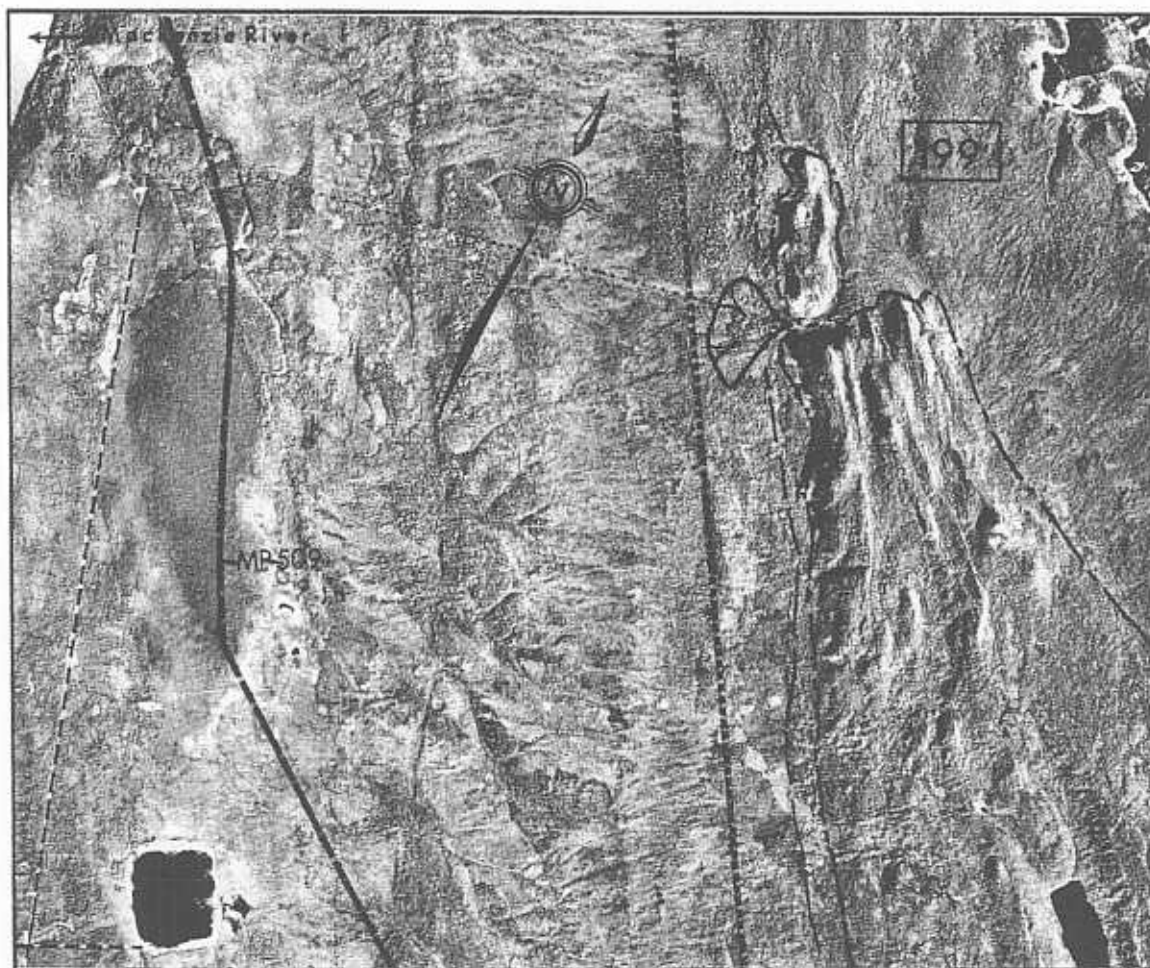
		Hardness
Limestone and dolomite (sound)	79.1%	4-5
Quartzite	18.2%	7-8
Igneous	2.6%	6-7

SITE NO. 199

LOCATION

Located between the Saline and Blackwater Rivers, Site 199 encompasses the northern tip of a western flank of McConnell Range which borders the Mackenzie Plain. Middle Devonian limestones outcrop at numerous locations across the site.

The proposed Mackenzie Highway right-of-way at Mile 510 is located approximately $1\frac{1}{2}$ miles west of Site 199 and the gas pipeline route parallels the site area at a distance of some 1500 feet.



LEGEND

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

Airphoto No. A22887/48

Approximate scale: 1" = 3,000'



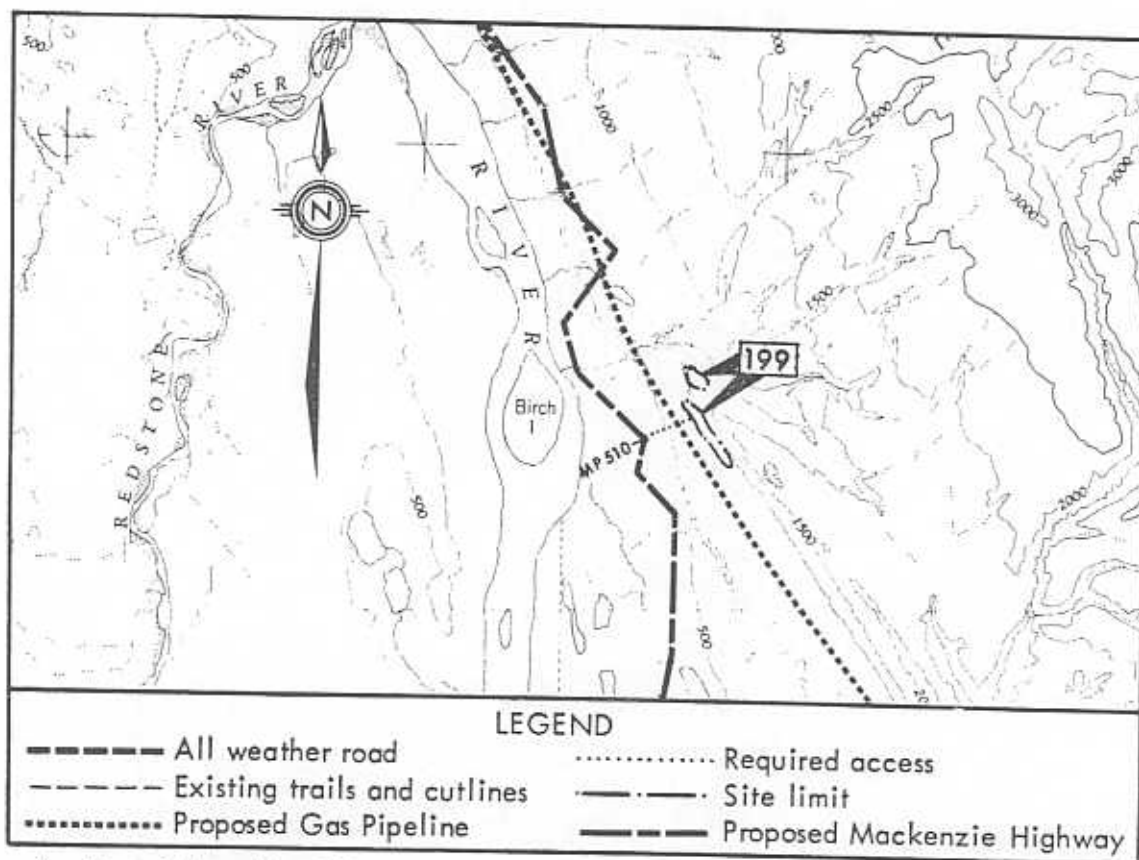
GENERAL

The flat, relatively poorly drained Mackenzie Plain is bordered on its east side with a 200 to 500 feet high ridge which rises gradually from an unnamed stream at the northern portion of the site to an elevation of 2050 feet. Fractured and massive beds of limestone are exposed within the northern tip of the ridge, while bedrock within the southern part of the ridge is mostly covered with overburden. A shallow and narrow talus belt interrupted with a flat alluvial fan has been deposited along the western face of the site.

There are several suitable locations for a quarry. With respect to the heights of a quarry highwall, the northernmost exposures would be the most suitable.

The bedrock is slightly weathered within its surficial zone but it will very likely require blasting to be extracted.

Good quality general fill material can be obtained from fractured and surficial bedrock zones. Aggregates for surface courses can be produced by crushing and screening of fresh and massive limestone.

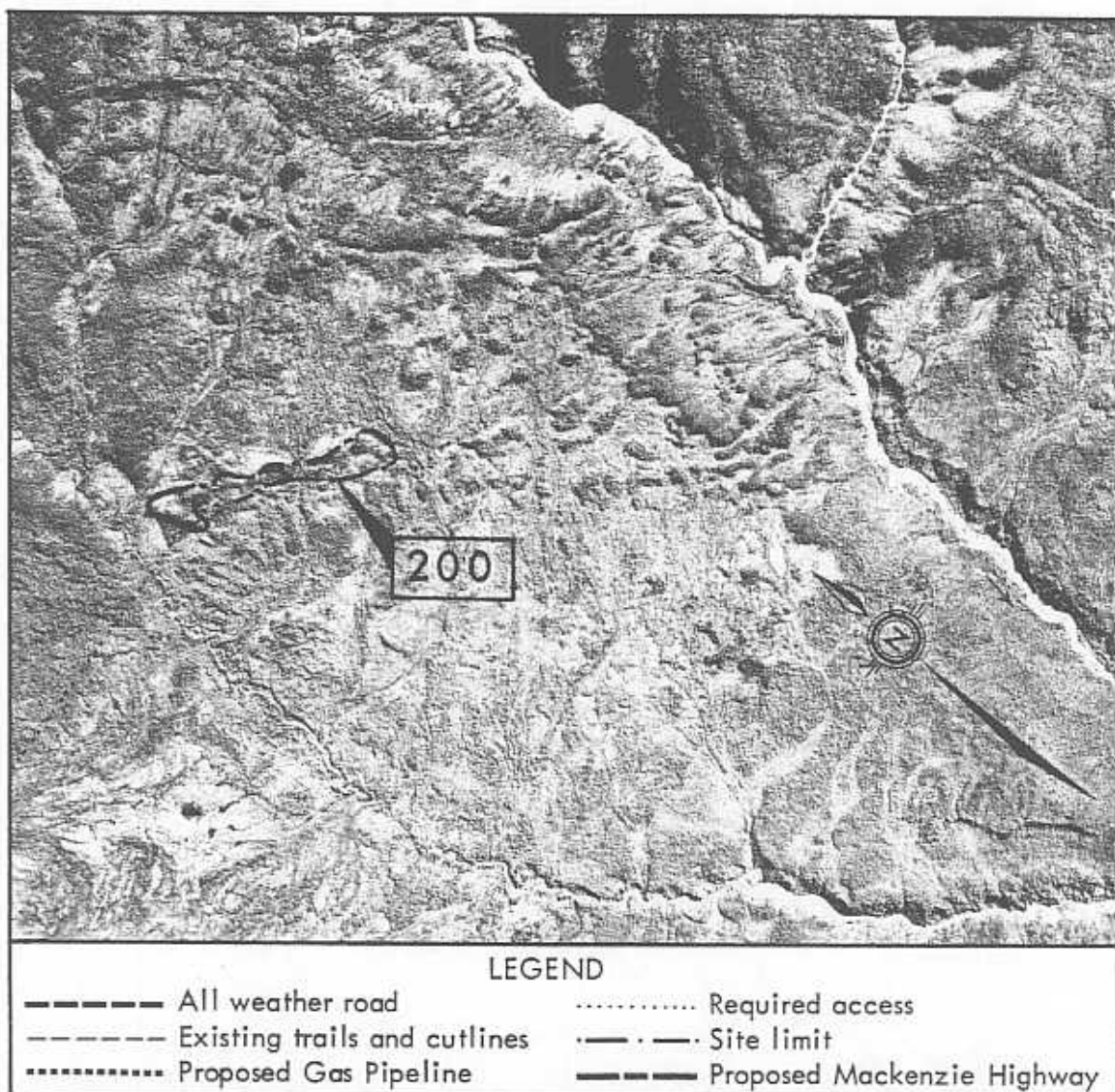


SITE NO. 200

LOCATION

Located on the western slopes adjacent to the McConnell Range and approximately 14 miles north of the Blackwater River, Site 200 consists of a shallow esker-kame ridge.

Both the proposed Mackenzie Highway and gas pipeline routes are separated from Site 200 by a prominent bedrock ridge, resulting in haul distances in excess of 8 miles. Suggested access roads from the site area to the Mackenzie Highway at Mile 511 would be approximately $8\frac{1}{2}$ miles.



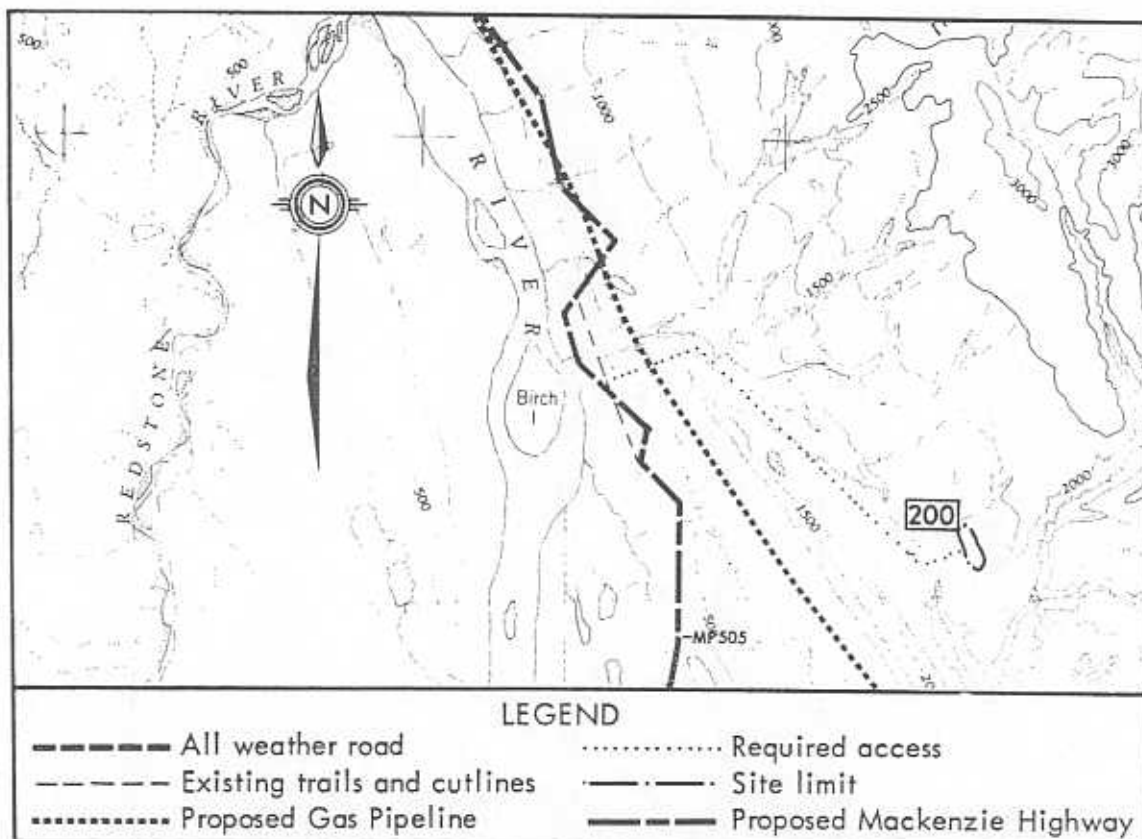


GENERAL

Site 200 encompasses a shallow esker-kame ridge which is approximately 4000 feet long and for the most part, less than 300 feet wide. Irregularly bedded and stratified washed sands with some gravel, silt and till lenses likely comprise the ridge material. Because of sloping ground and erosional gullies surrounding the site area, both the ridge and adjacent terrain are fairly well drained. The vegetation cover consists of stands of spruce and poplar with a relatively dense underbrush.

There are no known critical wildlife areas in the vicinity of Site 200.

A stratified and lensed sequence of sand, gravel and silt is expected from within this site. These deposits should be suitable for marginal quality general fill.



Section of Map No. 96 C

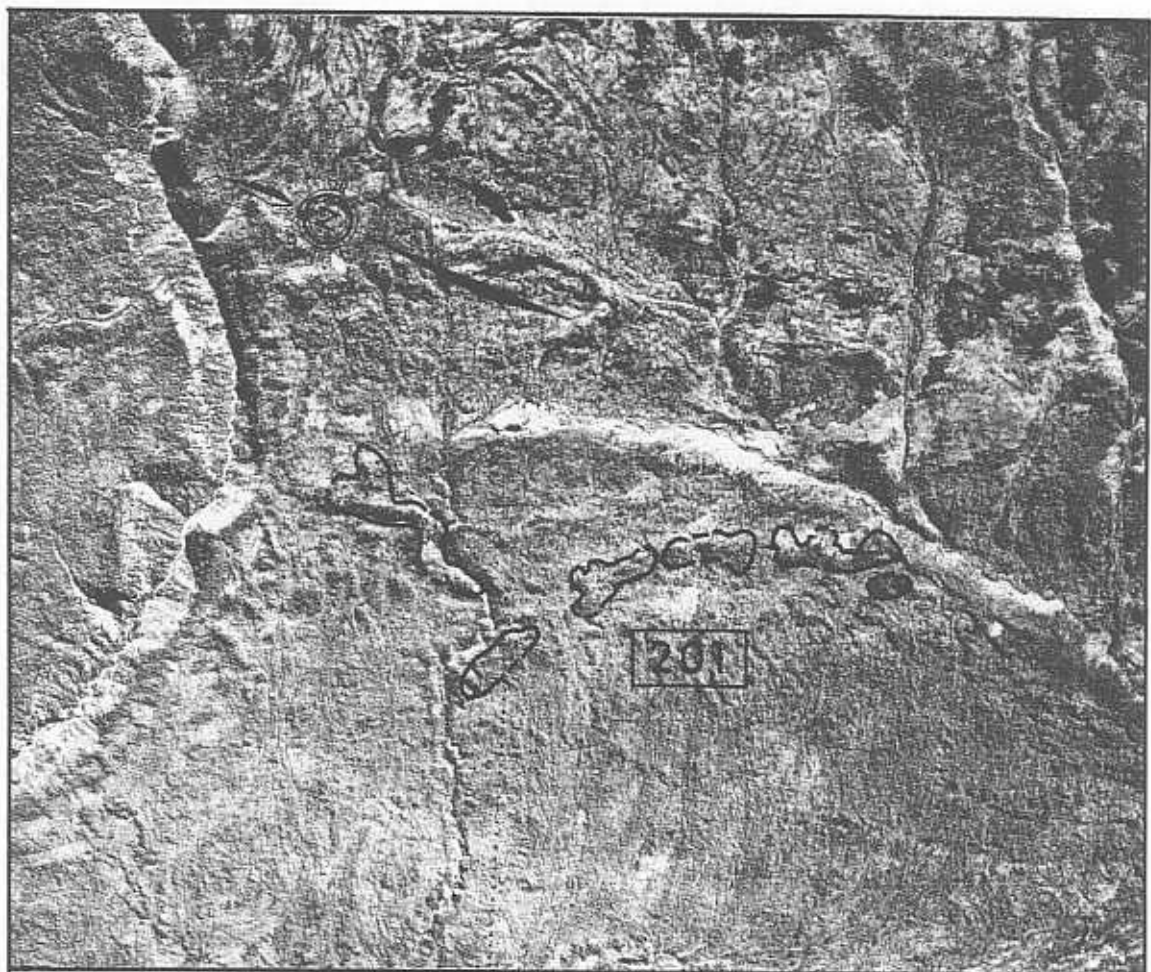
Scale: 1:250,000

SITE NO. 201

LOCATION

Located on the western slopes adjacent to the toe of the McConnell Range and approximately 15 miles north of the Blackwater River, Site 201 consists of a series of small, partly interconnected kame hillocks.

The proposed Mackenzie Highway right-of-way at Mile 511 is located approximately 7 miles northwest of the site area; the haul distance to the proposed gas pipeline would be in excess of 6 miles.



LEGEND

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



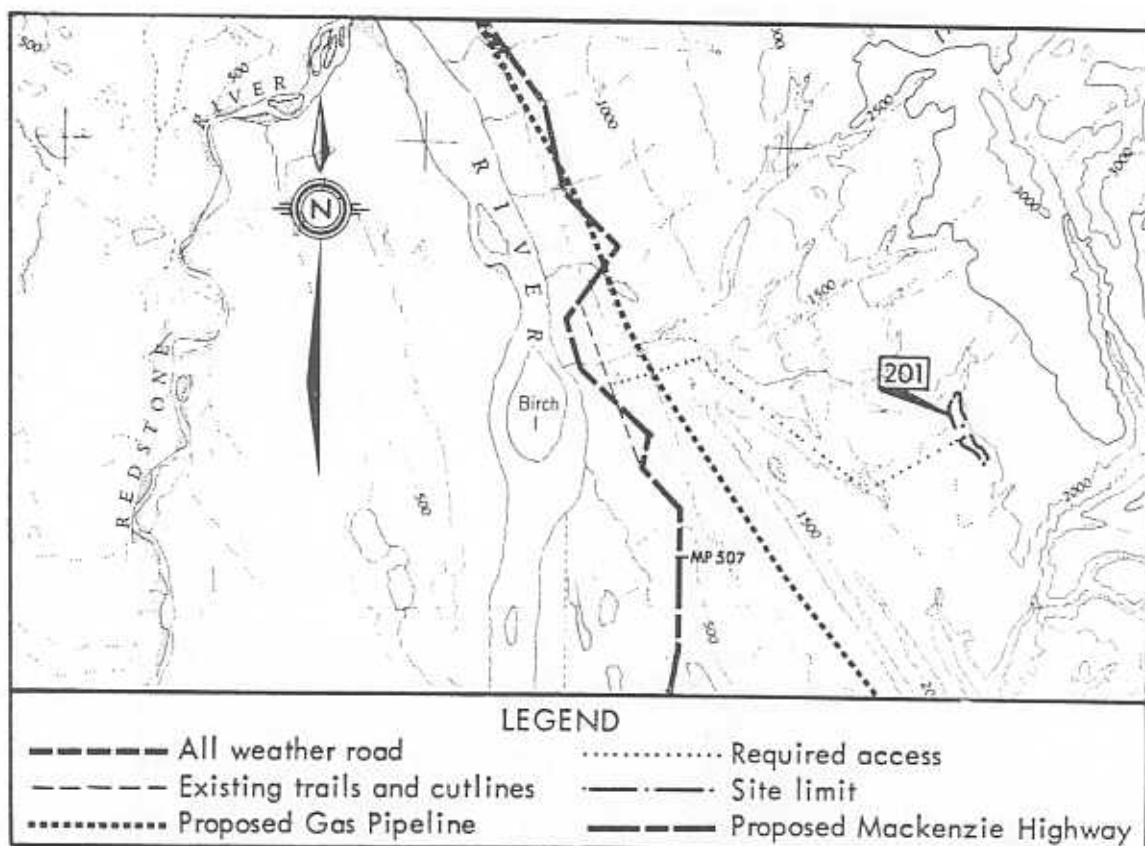
GENERAL

Site 201 is comprised of a series of shallow, partly interconnected hummocky kame hillocks, irregularly spaced across an area more than 1 3/4 miles in length. These kames range in length from 600 to 3000 feet and in width from 300 to 700 feet.

Irregularly bedded, washed sand and gravel are probably the most common constituents of the kame mounds. Silt beds and till lenses may also be common within the main sand and gravel body. The kame field is better drained than adjacent terrain and thus supports well developed stands of spruce and poplar.

There are no known critical wildlife areas in the vicinity of Site 201.

It is anticipated that silty sand and gravel deposits which form the kames, would be suitable for only marginal general fill material. Better quality materials may occur in isolated pockets which would require selective exploitation.



Section of Map No. 96 C

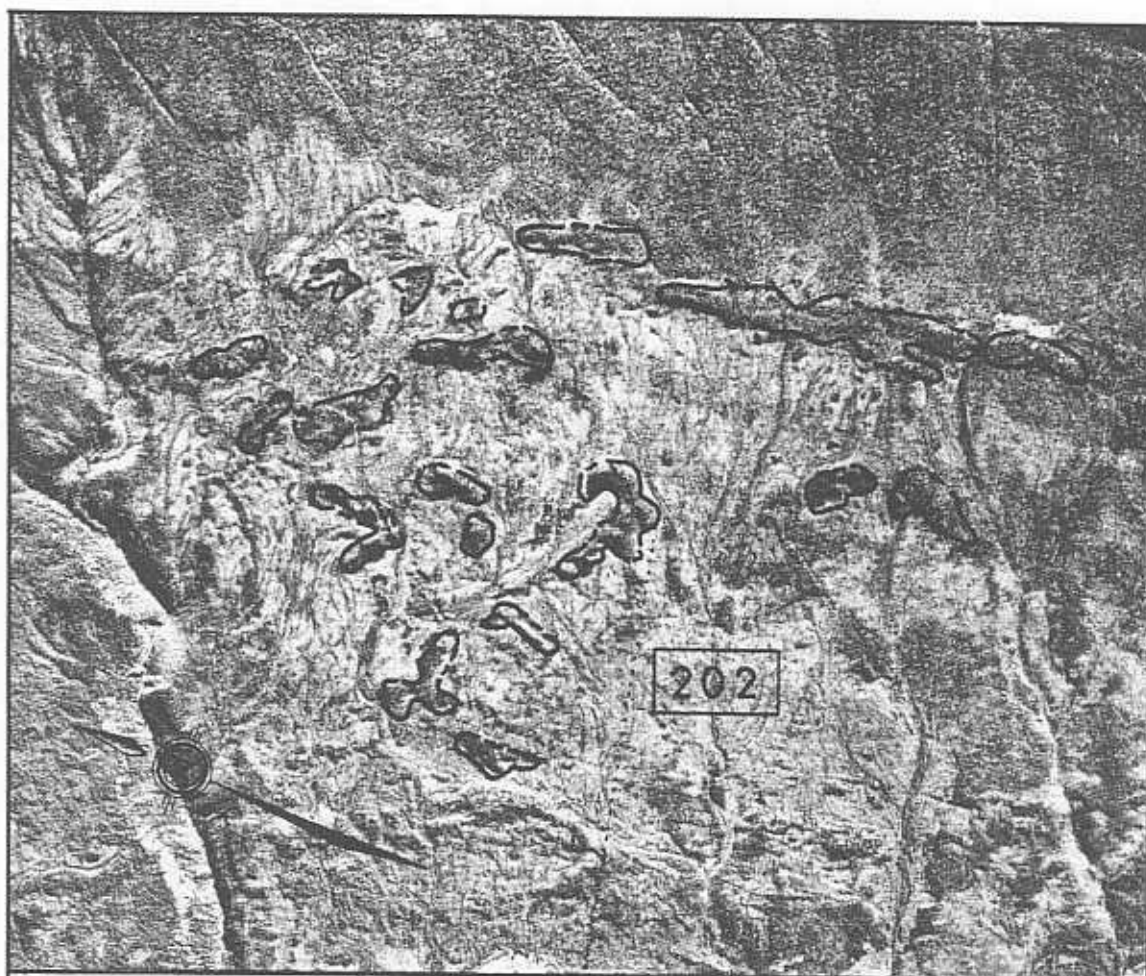
Scale: 1:250,000

SITE NO. 202

LOCATION

Located at the toe of the western flank of the McConnell Range and approximately 18 miles north of the Blackwater River, Site 202 consists of a large series of small kame hillocks.

The proposed Mackenzie Highway right-of-way at Mile 511 is located approximately 8 miles northwest of Site 202; the haul distance to the proposed gas pipeline would be in excess of 7 miles. There is no existing access road from either of the proposed utilities to Site 202.



LEGEND

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

Airphoto No. A22933/129

Approximate scale: 1" = 3,000'

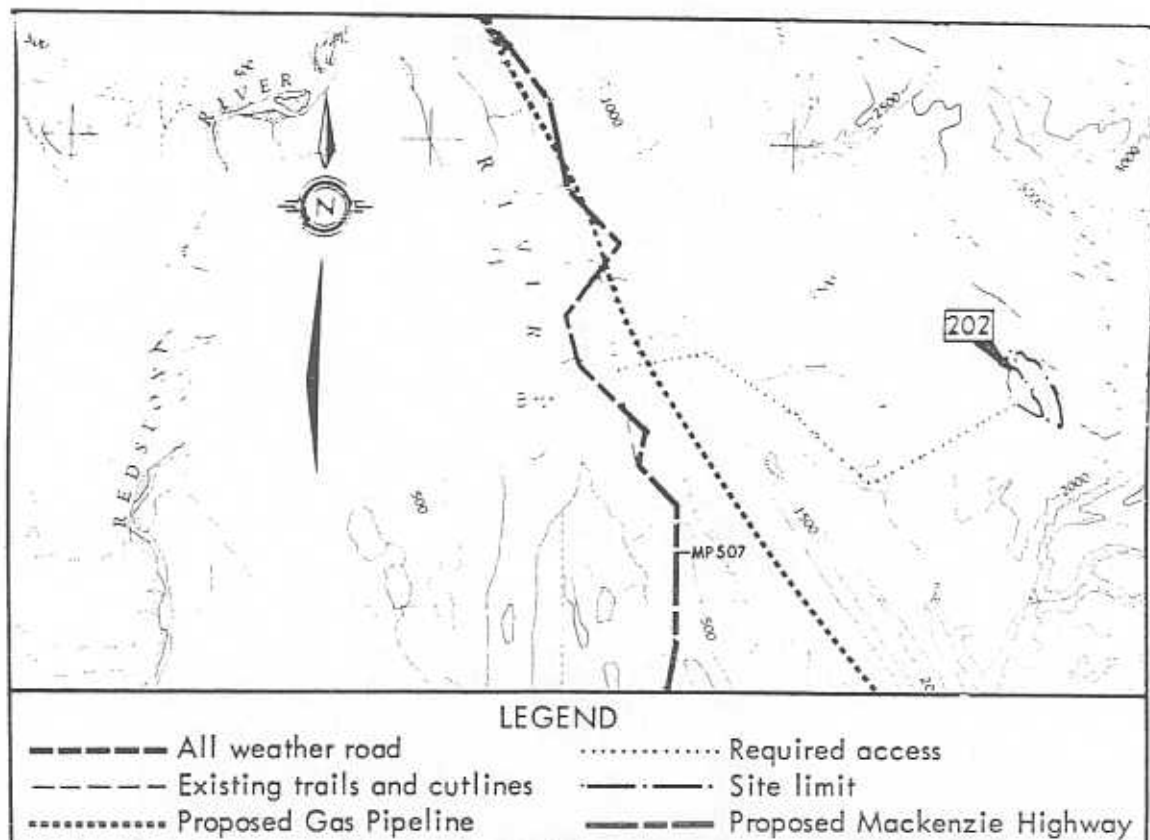
GENERAL

Site 202 is comprised of a large series of shallow, partly interconnected hummocky kame hillocks, irregularly spread across an area in excess of $2\frac{1}{2}$ miles in length and $1\frac{1}{2}$ miles in width. Individual kames range in length from 400 to 1500 feet and in width from 150 to 600 feet. Along the eastern border of the site the kames form three ridges.

Irregularly bedded, washed sands and gravels are probably the most common constituents of the kame mounds. Silt beds and till lenses may be, however, also common within the main sand and gravel body. The kame field is better drained than adjacent terrain and thus supports well developed stands of spruce and poplar.

There are no known critical wildlife areas in the vicinity of Site 202.

It is anticipated that silty sand and gravel deposits which form the kames would be suitable for only marginal general fill material. Better quality materials may occur in isolated pockets which would be difficult for selective exploitation.



Section of Map No. 96 C

Scale: 1:250,000

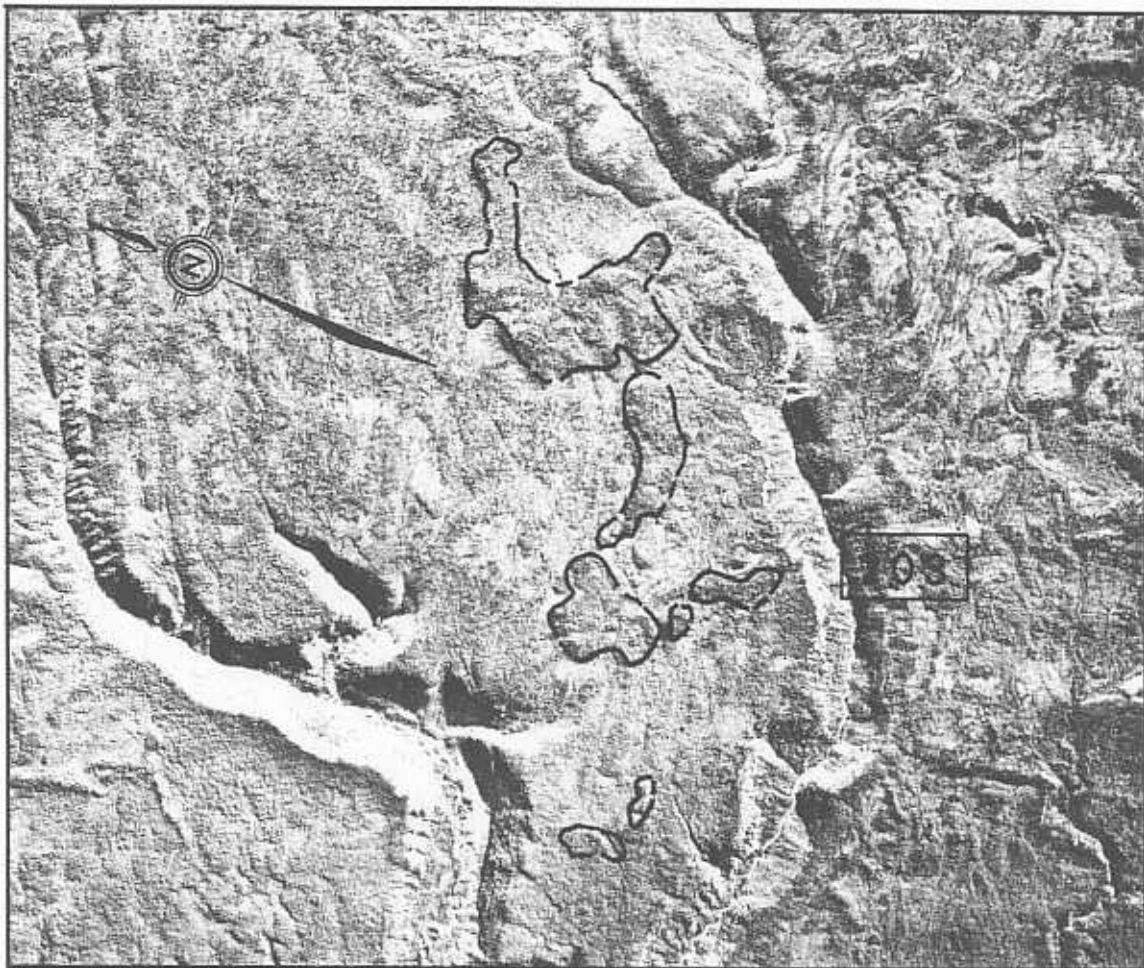
SITE NO. 203

LOCATION

Located approximately 18 miles north of the Blackwater River and 12 miles south of the Saline River on the western slopes adjacent to the McConnell Range, Site 203 consists of a series of relatively small kame fields and individual kame hillocks.

The proposed Mackenzie Highway right-of-way at Mile 511 is located approximately 8 miles northwest of Site 203 and the gas pipeline route is in excess of 7 miles along the same access road.

The access to Site 203 from other proposed utilities is extremely difficult because of deeply incised erosional gullies surrounding the site area.



LEGEND

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

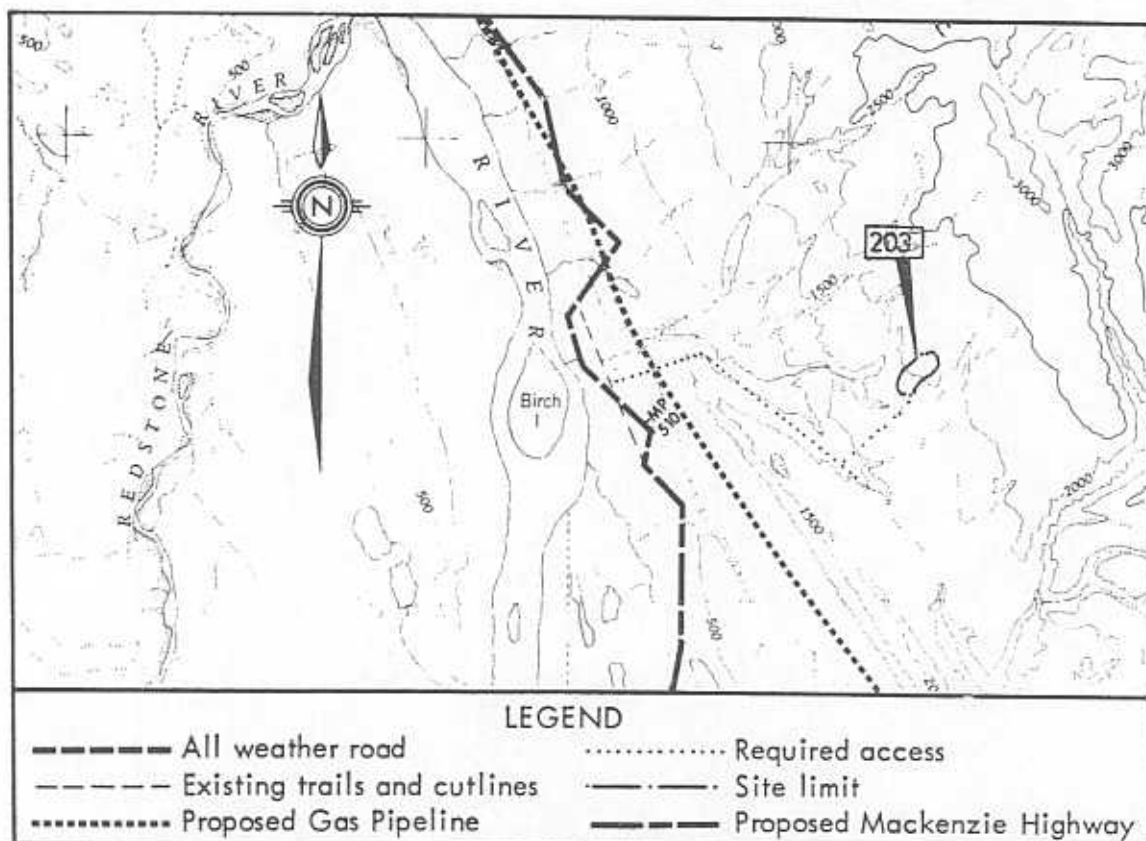


GENERAL

Site 203 encompasses four minor kame fields and four kame mounds deposited over sloping terrain at the toe of the McConnell Range. The site area is separated from the terrain to the west by deeply incised erosional gullies. The kame fields range from 1500 to 3500 feet in length and between 300 and 1300 feet in width. The kame material is probably 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.

There are no known critical wildlife areas in the vicinity of Site 203.

It is anticipated that the sand and gravel deposits within kame fields and kame mounds would have low to medium ice content and thus would be suitable for fair quality general fill material. Better quality materials, such as clean well graded gravel, may occur in isolated pockets which would be difficult for selective exploitation.



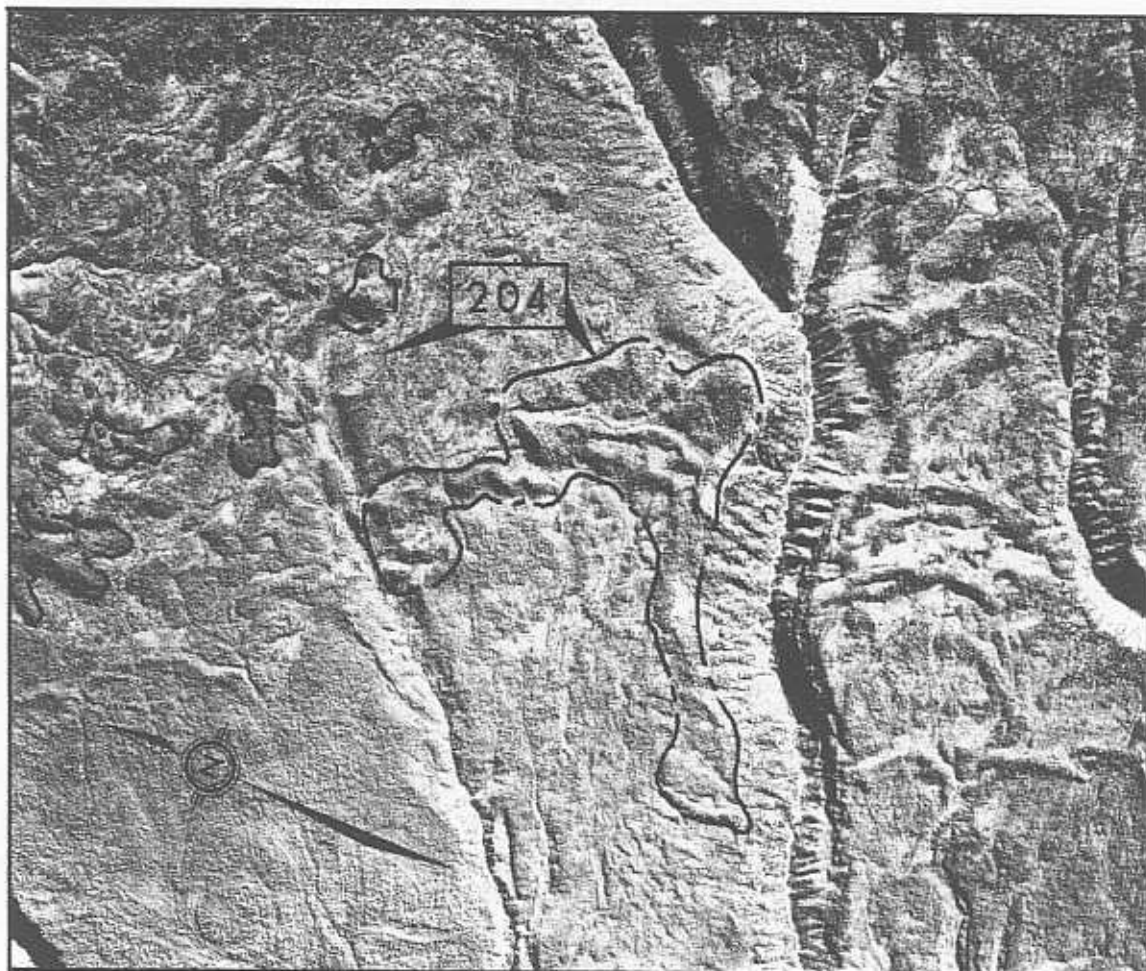
SITE NO. 204

LOCATION

Located immediately north of Steep Creek and approximately 9 miles south of the Saline River on the slopes paralleling the western toe of the McConnell Range, Site 204 consists of one large and a series of minor kame fields.

The proposed Mackenzie Highway right-of-way at Mile 515 and the gas pipeline route are located some 7 miles west of Site 204.

The access to Site 204 from either of the proposed utilities is extremely difficult because of deeply incised stream channels surrounding the site area.



LEGEND

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



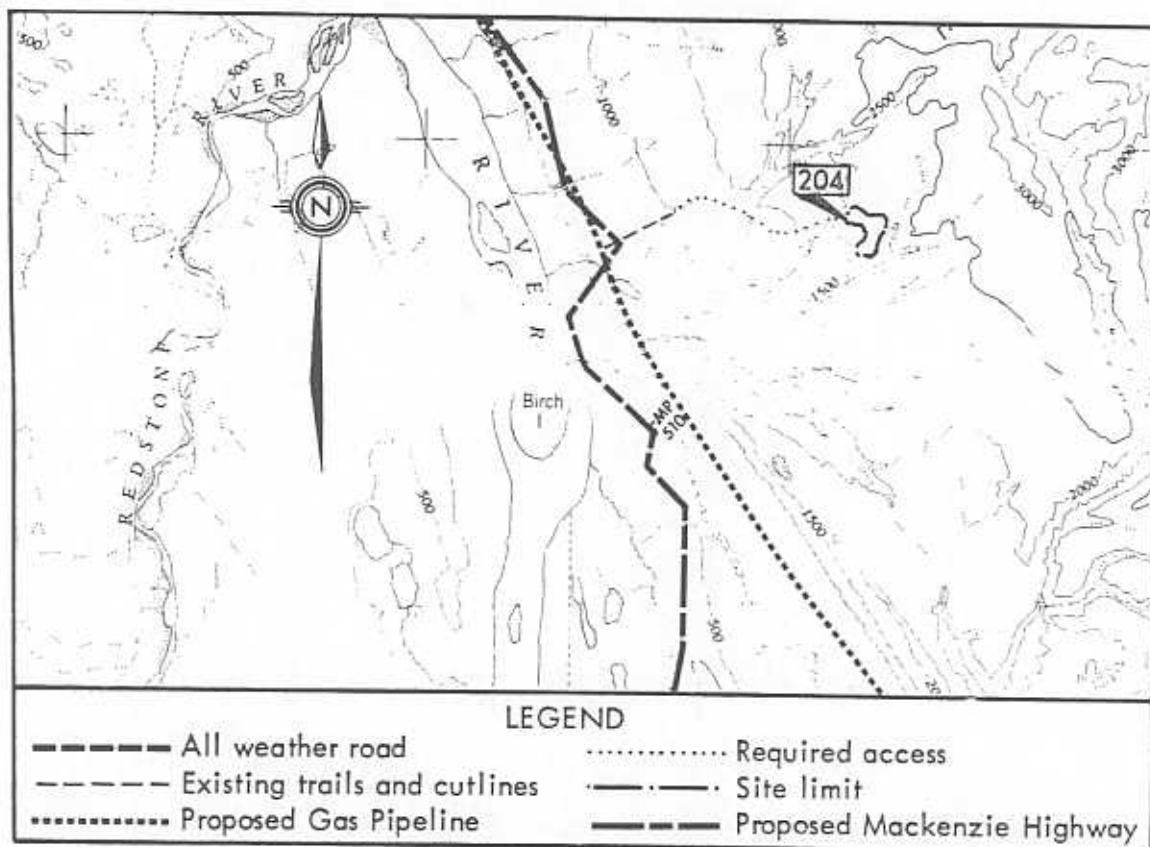
GENERAL

Site 204 consists of one large and five minor kame fields deposited over a sloping and glaciated terrain at the toe of the McConnell Range. The site area is separated from the terrain to the west by deeply incised stream channels of the Steep Creek drainage system. The kame fields range from 1000 to 7500 feet in length and between 400 and 2000 feet in width.

The kame material is probably comprised of variably washed sand and gravel deposits with silt and till pockets. Geomorphic features indicate the possibility of high fine grained material content. The site area is well drained and supports relatively dense growths of spruce and poplar.

There are no known critical wildlife areas in the vicinity of Site 204.

It is anticipated that the sand and gravel deposits within the kame fields would have low to medium ice content. Because of indicated higher silt content, the deposits would be probably suitable for poor quality general fill material. Better quality materials, such as clean well graded gravel, may occur in isolated pockets which would be difficult for selective exploitation.



Section of Map No. 96 C

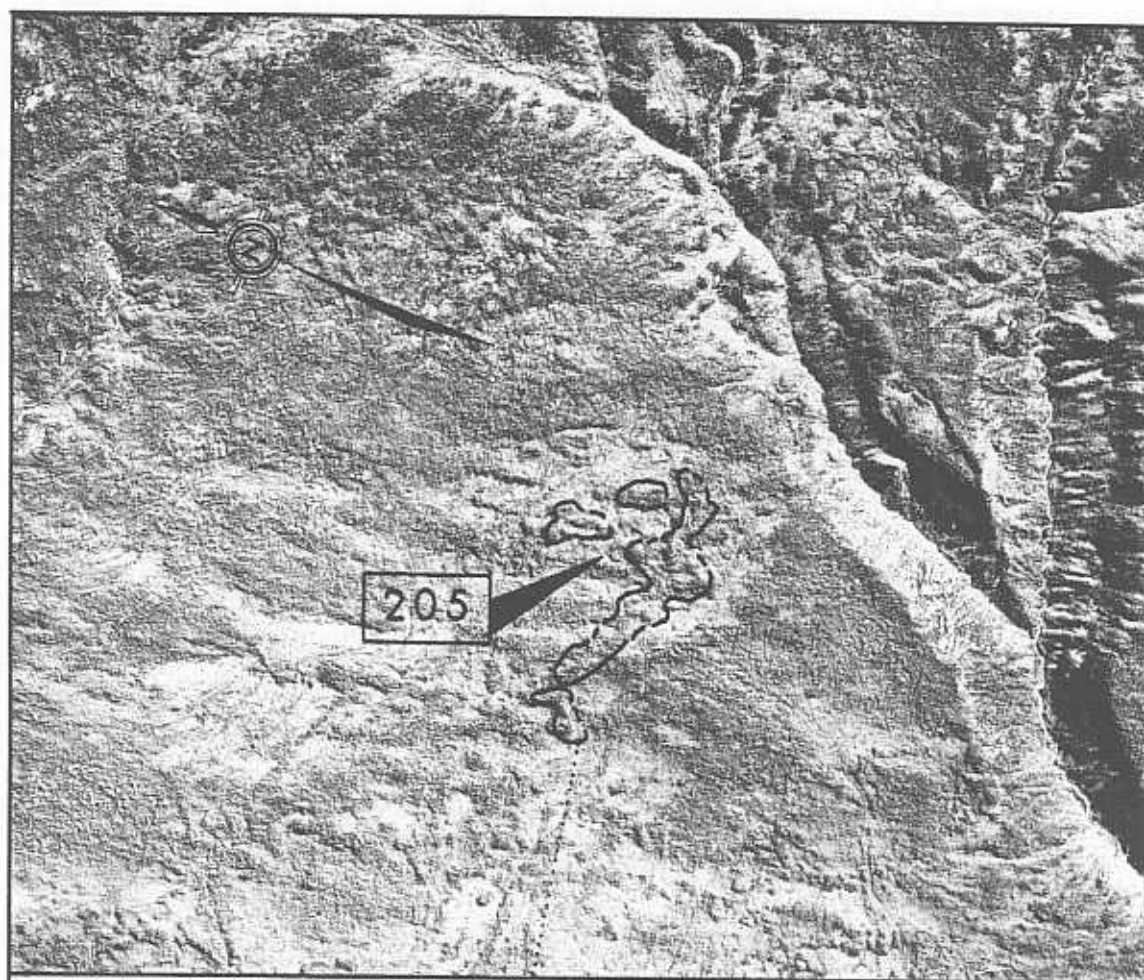
Scale: 1:250,000

SITE NO. 205

LOCATION

Located approximately 7 miles south of the Saline River on slopes forming the western toe of the McConnell Range, Site 205 consists of a series of interconnected and partially segmented small kame hillocks.

The proposed Mackenzie Highway right-of-way and the gas pipeline route are both located some $3\frac{1}{2}$ miles west of Site 205. The access to the site area from the proposed utilities would be difficult because of the rugged terrain conditions.



LEGEND

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



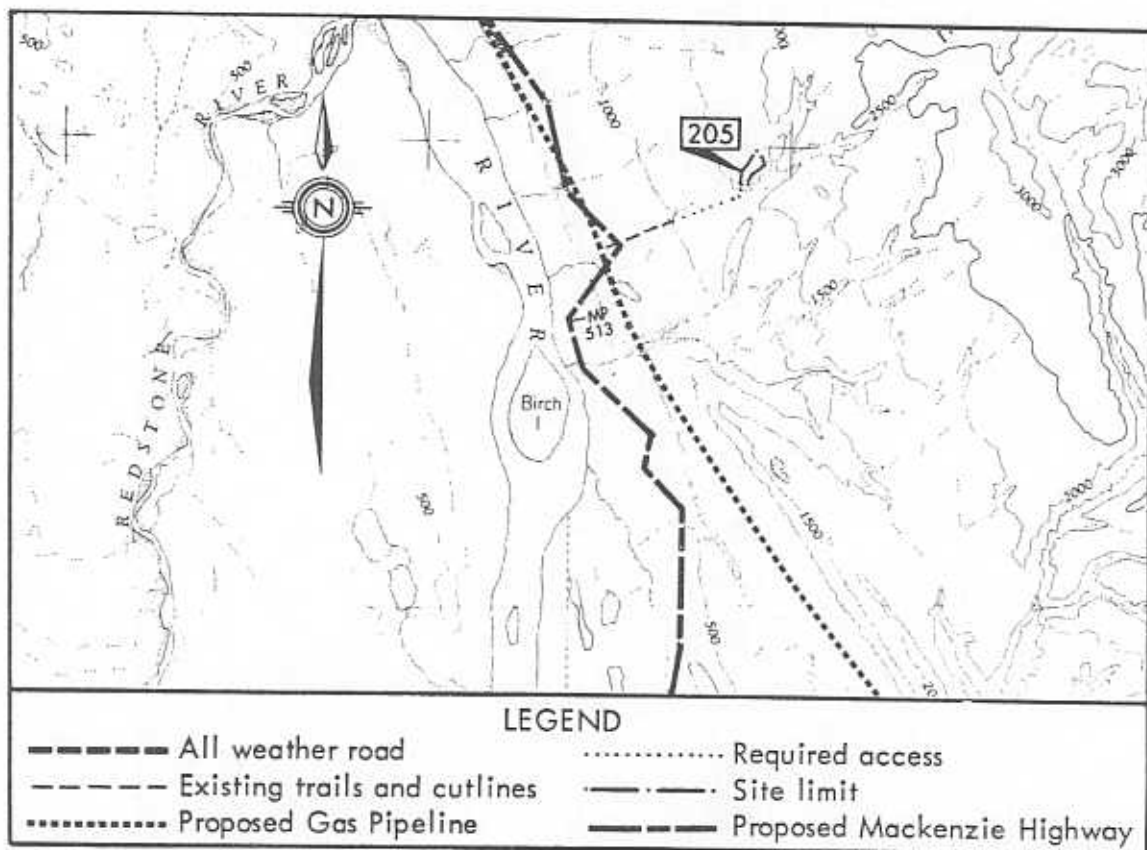
GENERAL

Site 205 is comprised of a small series of shallow, partially interconnected hummocky kame hillocks, irregularly spread across an area in excess of $\frac{3}{4}$ mile in length and $\frac{1}{2}$ mile in width. Individual kame lengths range from 600 to 1300 feet and the width varies from 200 to 500 feet.

Irregularly bedded, washed sands and gravels are probably the most common constituents of the kame mounds. Silt beds and till lenses may also be common within the main sand and gravel body. The kame field is better drained than the adjacent terrain and supports well developed stands of spruce and poplar.

There are no known critical wildlife areas in the vicinity of Site 205.

It is anticipated that silty sand and gravel deposits which form the kames would be suitable for only marginal general fill material. Better quality materials may occur in isolated pockets which would be difficult for selective exploitation.



Section of Map No. 96 C

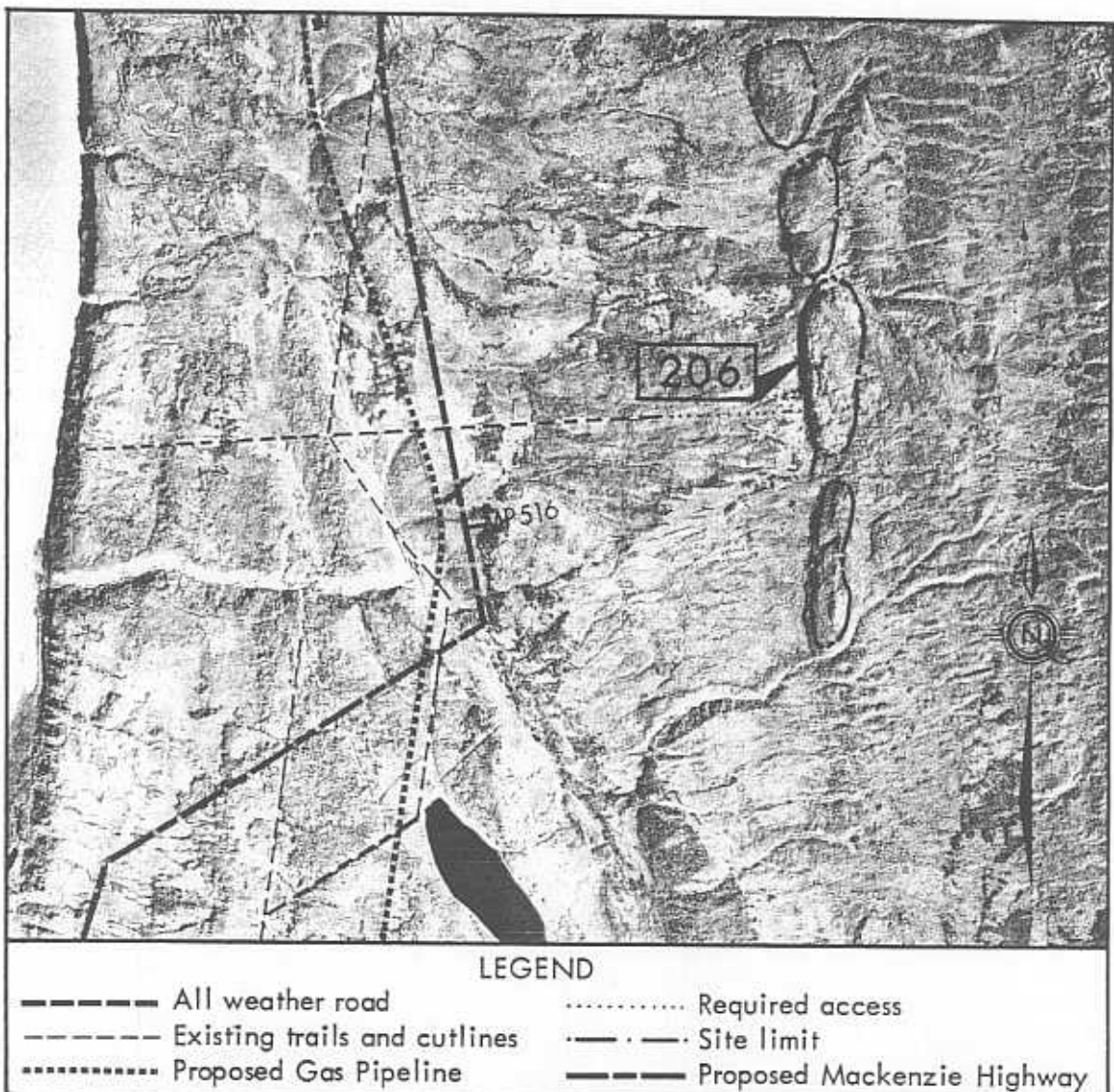
Scale: 1:250,000

SITE NO. 206

LOCATION

Located approximately 3 miles north of the Steep Creek and 7 miles south of the Saline River, Site 206 parallels the western perimeter of the Mackenzie Plain and consists of a series of narrow bedrock ridges with dolomite exposures.

The proposed Mackenzie Highway right-of-way and gas pipeline route are located approximately $1\frac{1}{2}$ miles west of Site 206.



Airphoto No. A22887/45

Approximate scale: 1" = 3,000'



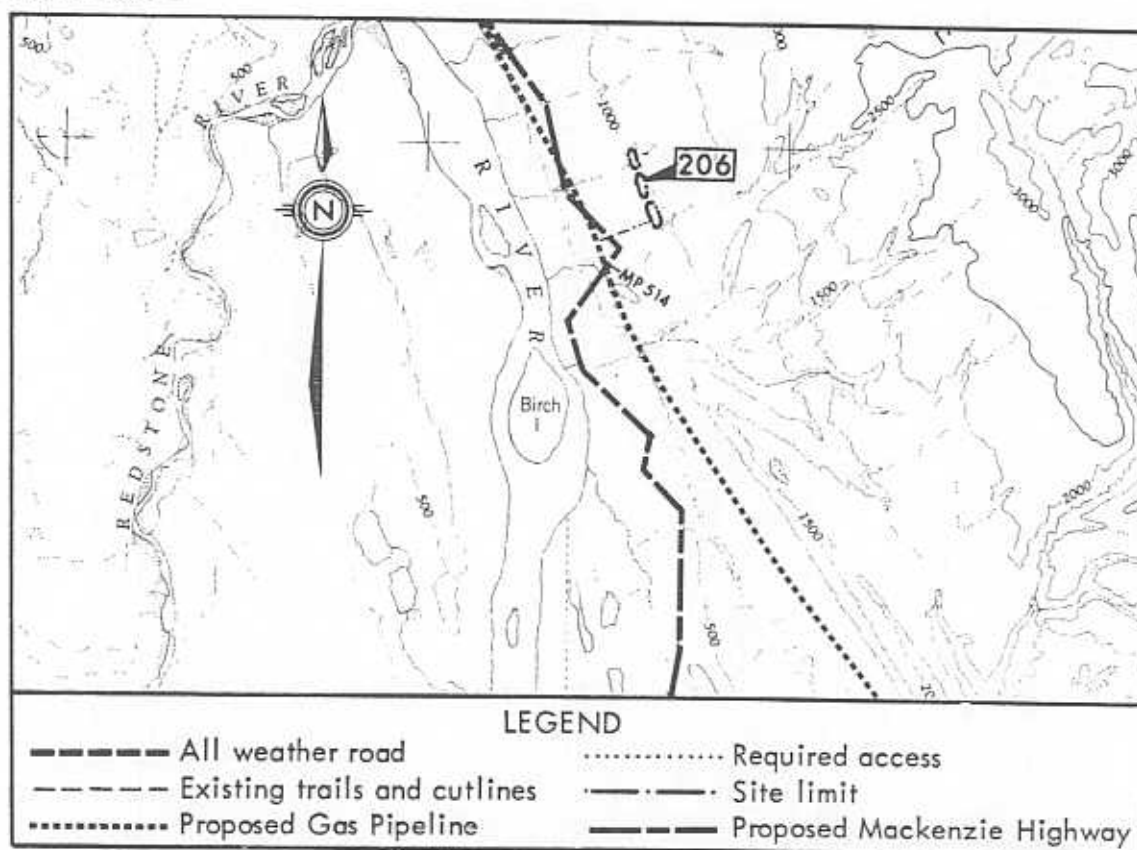
GENERAL

The ridges encompass an area about 1 3/4 miles long and rise some 50 to 150 feet above the relatively steeply sloping terrain before descending onto the flat glaciolacustrine basin paralleling the Mackenzie River. Terrain on the east side of the site ascends towards the McConnell Range. A layer of glaciolacustrine sediment, consisting primarily of silts and clays with moderate to high ice content, covers the terrain westwards from the ridge. These deposits locally exhibit light thermokarst features and support moderate to dense growths of spruce and irregular stands of birch and poplar. Poorly drained terrain is vegetated by stands of tamarack mixed with spruce.

There are no known critical wildlife areas in the vicinity of Site 206.

The bedrock, consisting of Ordovician and Silurian dolomite with minor shale inclusions is mostly covered with glacial drift and slope wash material. A few exposures of fractured to blocky dolomite are, however, noted on the ridges. The bedrock is slightly weathered within the surficial zone but it will very likely require blasting to be extracted. Good quality general fill material can be obtained from this location. Aggregates for base and surface courses can probably be produced by crushing and screening of fresh limestone.

The development of Site 206 would require a quarry operation and stripping of the overburden layer.



Section of Map No. 96 C

Scale: 1:250,000

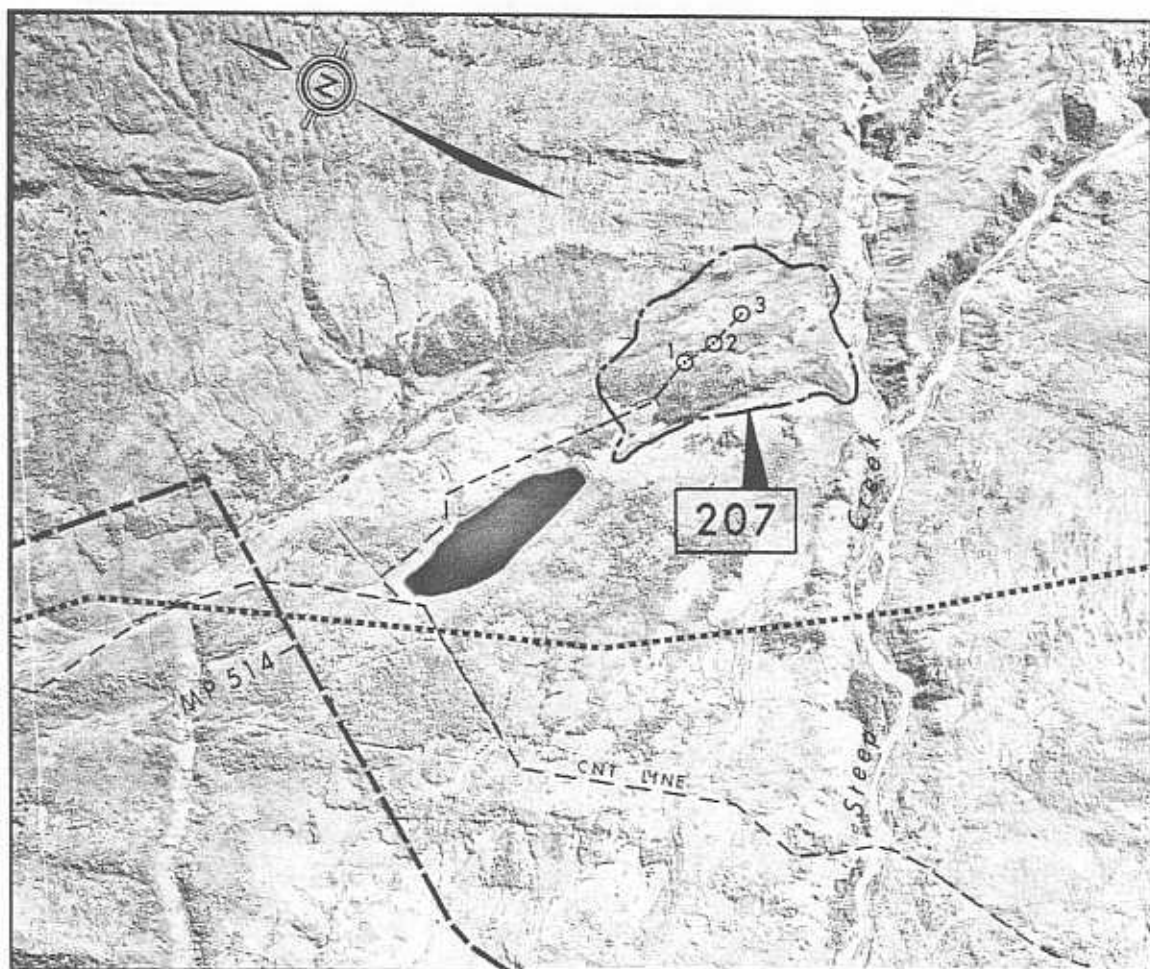
SITE NO. 207X

Located immediately adjacent to the north bank of Steep Creek and $1\frac{1}{4}$ miles southeast of the proposed Mackenzie Highway at Mile 514, Site 207X consists of a partially eroded and rounded knoll of glacial till.

Type of Material: Glacial Till; silt matrix, few pebbles.

Estimated Volume: Not applicable.

Assessment: Materials of granular quality were not established during the field drilling program; Site 207X is not 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. A22887/46

207-1

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 207X is located immediately adjacent to the north bank of Steep Creek and approximately $2\frac{1}{4}$ miles upstream from the mouth of the Creek. The site is located approximately $1\frac{1}{4}$ miles southeast of the proposed Mackenzie Highway right-of-way at Mile 514 and consists of a partially eroded and rounded knoll of glacial till material which rises above the adjacent glaciolacustrine plain to the west. The terrain to the east and north consists of a glacial till sheet overlying bedrock at relatively shallow depths. The site area and the terrain to the east exhibit good surficial drainage whereas the glaciolacustrine plain to the west is relatively flat and poorly drained.

A shallow layer of topsoil and organic silt, generally less than 1 foot in depth, overlies the site area and supports moderate to dense growths of spruce, poplar and birch attaining heights in excess of 30 feet. The adjacent glaciolacustrine plain to the west supports a sparse growth of stunted spruce.

There are no known critical wildlife areas in the immediate vicinity of Site 207X.

The CNT pole line and the proposed Mackenzie Highway and gas pipeline right-of-ways are coincident immediately west of Site 207X; however, the only existing access to the site consists of seismic cutlines and the new access trail which was cleared during the winter drilling program.

DEVELOPMENT

Site 207X is not recommended for development because the winter drilling program proved the absence of granular type materials at this site.




The drill hole log data has been presented in this report for reference.

DETAILED DRILL HOLE LOG

SITE NO. 207X

HOLE NO. DH-1

DATE: FEB. 2, 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 CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		OL	1.0 TOPSOIL: some silt, dark brown		Vx	M		0
2		ML-CL	SILT: some clay, occasional pebbles to 1" size, medium brown (TILL)					2
4								4
6								6
8			- frequent pebbles and cobbles from 8.0'					8
10								10
12			12.0 TOTAL DEPTH 12.0'					12
14								14
16								16

DETAILED DRILL HOLE LOG

SITE NO. 207X

HOLE NO. DH-2

DATE: FEB. 2, 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:			



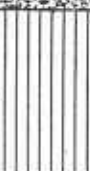



DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	1.5 TOPSOIL: some silt, organic, dark brown					0
3								3
6			SILT: some clay, frequent pebbles to 1½" size, occasional cobbles, medium brown					6
9								9
12		ML-CL	- some gravel, becoming medium grey from 12.0'		Vx	M		12
15								15
18								18
21								21
22.0			TOTAL DEPTH 22.0'					22.0
24								24

DETAILED DRILL HOLE LOG

SITE NO. 207X

HOLE NO. DH-3

DATE: FEB. 6, 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 CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		Pt	1.0 PEAT: organic, fibrous, dark brown		Vs	H		0
3		ML-CL	SILT: some clay, medium brown					3
6		ML	5.0 SILT: trace sand, occasional pebbles to 1/2" size, light brown					6
9		CL-ML	8.0		Vs	M		9
12			SILT: some clay, medium plastic, frequent pebbles to 3/4" size, medium brown (TILL)					12
15								15
18								18
21			21.0 TOTAL DEPTH 21.0'					21
24								24

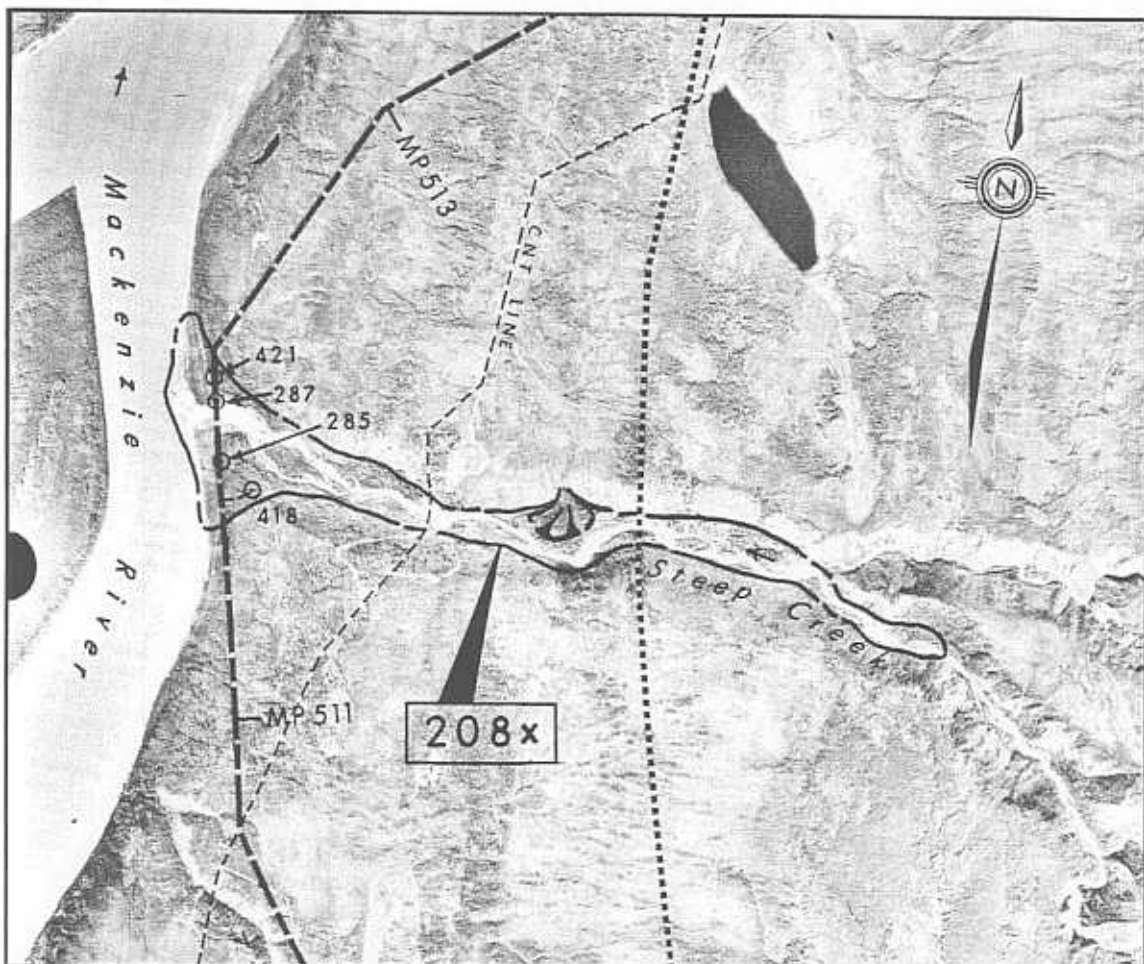
SITE NO. 208X

Located in the downstream portion of Steep Creek at Mile 512 of the proposed Mackenzie Highway, Site 208X consists of sand and gravel bars within the active stream channel.

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

Estimated Volume: Not determined.

Assessment: Site 208X is not recommended for development because the granular material deposits are located within the active stream channel.



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. A22966/93

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 208X is located in the downstream portion of Steep Creek at Mile 502 of the proposed Mackenzie Highway right-of-way. The site extends approximately 2 miles upstream from the mouth of Steep Creek along the deeply incised, narrow stream channel. The stream bed is approximately 50 to 100 feet below the adjacent flat terrain which consists of shallow glaciolacustrine silts and sands overlying a glacial till sheet. The granular deposits consist of sand and gravel bars of variable gradation and some bars are covered with a shallow organic silt which supports growths of small shrubs. The sediment content and gradation of material varies considerably throughout the stream channel, and discontinuous horizontal stratification is common.

The granular deposits in general, lie below the active high water mark of the stream.

There are no known critical wildlife areas in the immediate vicinity of Site 208X.

The existing CNT pole line and the proposed Mackenzie Highway and gas pipeline right-of-way traverse the site area at locations as noted on the preceding site airphoto. (ref. page 208-1).

DEVELOPMENT

Information obtained from the engineering consultant for the Federal Department of Public Works from drill holes conducted along the Mackenzie Highway right-of-way which were located a few hundred yards upstream from the mouth of Steep Creek, confirmed the variability of granular materials and general discontinuity of horizontal stratification. This data has been incorporated into this report.

Site 208X is not recommended for immediate development and exploitation of granular materials for the following reason:

- Much of the available granular materials are found within the active stream channel and below the high water mark of the stream.

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 mater-



ials 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 208X 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 DRILL HOLE LOG

SITE NO. 208X

HOLE NO. C 285A

DATE: FEB. 2, 1973

LOGGED BY: ☐ PEMCAN




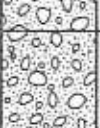

☒ UNDERWOOD

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			ORGANIC					0
2		Pt-ML	SILT					2
4			GRAVEL	UF				4
6		GM						6
8			GRAVEL & SILTY SAND	UF				8
10		GW						10
12			GRAVEL & SAND					12
14		GW						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. 208 X

HOLE NO. C 287A

DATE: FEB. 2, 1973

LOGGED BY: ☐ PEMCAN





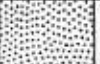
☒ UNDERWOOD

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			ORGANIC					0
1.5								
3			SILT & SAND					3
6								6
7.5								
9			SAND - pebbles					9
12								12
15			SILTY SAND & GRAVEL	UF				15
18								18
21								21
24								24
25.0			END OF HOLE 25.0'					
27			Free water from 18.0'.					27

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 208X

HOLE NO. B 418B

DATE: FEB. 2, 1973 LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

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			3" MOSS ORGANIC					0
2		Pt	ORGANIC & SILT					2
4		GP & Pt	SAND & GRAVEL - organic					4
6			GRAVEL & CLAY					6
8				UF				8
10		GC						10
12			BOULDERS					12
14		CL	CLAY - silty, medium brown					14
			END OF HOLE					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 208 X

HOLE NO. C 421B

DATE: FEB. 2, 1973

LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

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									0
2		Pt	MUSKEG - gran., some roots						2
2.5									
4		CL	SAND - light brown, moist	UF					4
4.0			CLAY - brown, soft, moist						
6									6
6.0			SAND - dark brown, moist						
8									8
8.0			GRAVEL						
10		SW	- cobbles, sand						10
12									12
14				UF					14
14.0									
			ABANDONED @ 14.0'						
			Sloughing below 10.0'.						

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

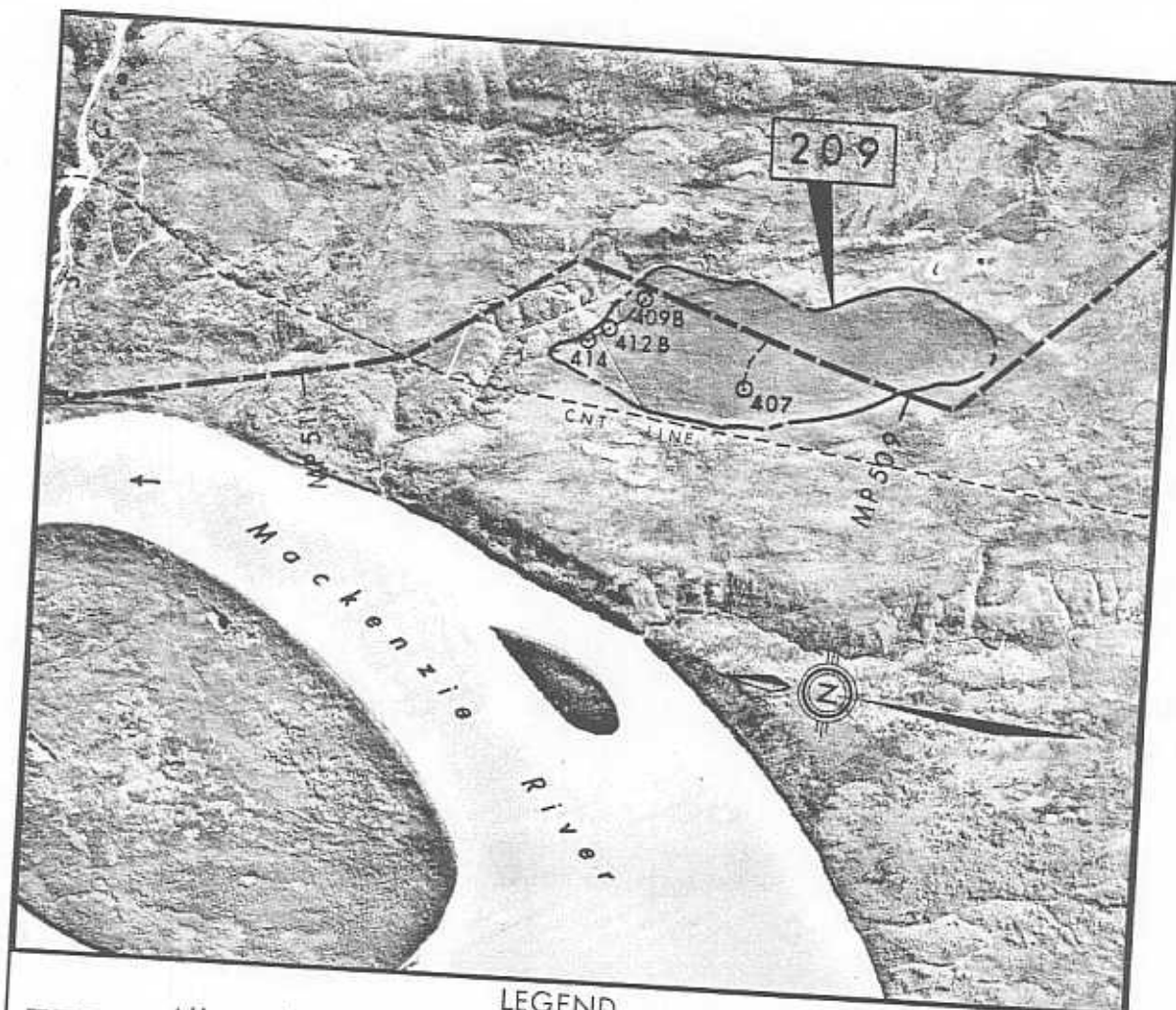
SITE NO. 209

Located approximately $1\frac{1}{2}$ miles south of Steep Creek, Site 209 encompasses the proposed Mackenzie Highway from Mile 509 to Mile 510 and consists of a deltaic deposit within a glaciolacustrine plain.

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

Estimated Volume: 3,000,000 cubic yards.

Assessment: Very poor quality granular material which may be suitable for very marginal embankment fill in the construction of subgrades for roads.



- LEGEND**
- All weather road
 - Existing trails and cutlines
 - Proposed Gas Pipeline
 - ⊙ DH Drill Hole
 - Required access
 - Site limit
 - Proposed Mackenzie Highway
 - ⊕ TP Test Pit
- Airphoto No. A22887/21
- Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 209 is located approximately $1\frac{1}{2}$ miles south of Steep Creek and $\frac{1}{2}$ mile east of the Mackenzie River. The proposed Mackenzie Highway right-of-way traverses the site area from Mile 509 to Mile 510. The site, consisting of a deltaic deposit, encompasses an area approximately 1 mile in length and $\frac{1}{2}$ mile in width and rises slightly above the adjacent flat, glaciolacustrine plain. An unnamed stream channel borders the eastern perimeter of the site area. The site area exhibits fair surficial drainage whereas the adjacent terrain is generally poorly drained.

The material in Site 209 consists of poorly graded, fine grained, deltaic sands with a trace of silt which may be suitable for very marginal fill material in the construction of subgrades for roads. The topsoil layer is generally less than 6 inches and supports moderately dense growths of spruce and birch with the occasional pine.

There are no known critical wildlife areas in the immediate vicinity of Site 209.

The existing CNT pole line and the proposed Mackenzie Highway right-of-way traverse the site area and provide excellent access for the future development of borrow pits.

DEVELOPMENT

The information from the exploratory drill holes, carried out by the engineering consultant for the Federal Department of Public Works, has been assessed and incorporated into this report. The following conditions relative to the quality and quantity of available granular materials are outlined:

- The in situ deltaic material consists of very fine grained, poorly graded sand with a trace of silt. This material is considered suitable only for very low quality, marginal fill material in the construction of subgrades for roads or utility backfill.
- The organic topsoil overburden on the dune slopes is very shallow, generally less than 6 inches in depth.
- The depth of recoverable material is in excess of 10 feet and is very dry to depths investigated. The moisture contents range from 2 to 6 per cent.
- The initial 2 to 6 feet of the dune sand, although frozen during the field drilling, only exhibited very low ground ice content.

Site 209 is not recommended as a source of granular material; however, this fine sand may be used as a low quality fill material in the construction of road subgrades or utility backfill. The following operational guidelines should be considered if this site is developed for marginal fill requirements:

- The on-site tree growth and related vegetation should be cleared and removed in acc-



ordance with current land use guidelines.

- The organic topsoil should be carefully stripped and stockpiled in designated areas for future utilization in the restoration of the borrow pit areas.
- Vegetation buffer zones should be maintained between work areas to minimize erosion and instability of the exposed pit areas.
- Vertical excavation opposed to horizontal excavation should be considered to minimize the erosion of the exposed borrow areas by wind and rain action.
- All access to borrow pit areas from the proposed Mackenzie Highway or CNT pole line should be dog-logged.

ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation guidelines should include the following if Site 209 is developed as a borrow pit:

- Recontouring of borrow pit areas to maintain drainage to the adjacent terrain.
- Replacement and spreading of organic topsoil from pre-production stockpiles on to the recontoured exposed borrow pit area.
- Revegetation of the restored borrow pit areas.

DETAILED DRILL HOLE LOG

SITE NO. 209

HOLE NO. B 407B

DATE: FEB. 2, 1973

LOGGED BY: ☐ PEMCAN

☒ UNDERWOOD

DRILLING METHOD: ☒ CONVENTIONAL

☐ AIR

☐ 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			3" GRAN. MUSKEG						0
1									1
2		SW	SAND						2
3									3
4		SW	- brown, dry						4
5									5
6									6
7									7
8			8.0						8
			ABANDONED @ 8.0'						
			Sloughing.						

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 209

HOLE NO. B 409B

DATE: FEB. 2, 1973

LOGGED BY: ☐ PEMCAN

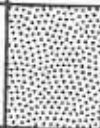

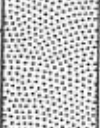
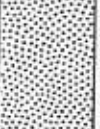
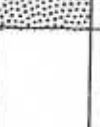
☒ UNDERWOOD

DRILLING METHOD: ☒

AIR
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			3" GRAN. MUSKEG						0
2		SP	SAND: red, pebbles						2
4		SW	SAND - brown, dry	UF					4
6									6
8									8
10		SW							10
12			ABANDONED @ 11.0'						12
			Sloughing.						

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 209

HOLE NO. B 412B

DATE: MAR. 2, 1973

LOGGED BY: ☐ PEMCAN

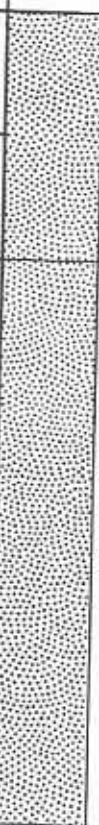

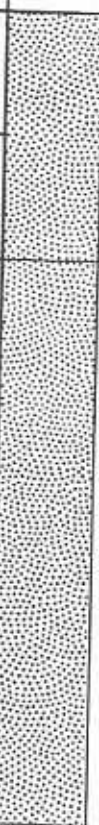
☒ UNDERWOOD

DRILLING METHOD: ☒

AIR
CONVENTIONAL

☐ AIR REVERSE
CIRCULATION

☐ OTHER:

CONVENTIONAL <input type="checkbox"/> CIRCULATION <input type="checkbox"/> OTHER: <input type="checkbox"/>											
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		SW	3" GRAN. MUSKEG					0			
2			SAND					2			
4		SW	- red					4			
4.0			SAND					4			
6		SW	- brown	UF				6			
8								8			
10		SW						10			
12								12			
13.0							13.0				
14			ABANDONED @ 13.0'					14			
			Sloughing below 4.0'.								

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 209

HOLE NO. B 414B

DATE: FEB. 2, 1973

LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

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
1.0			MUSKEG granular					
2		SP	SAND - red, dry, gravel					2
3.0								
4		SP	SAND - brown, dry, gravel					4
6								
6.0			CLAY					6
8		CL	- silty					8
10				UF				10
12								12
14		CL						14
15.0								
16			END OF HOLE 15.0'					16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



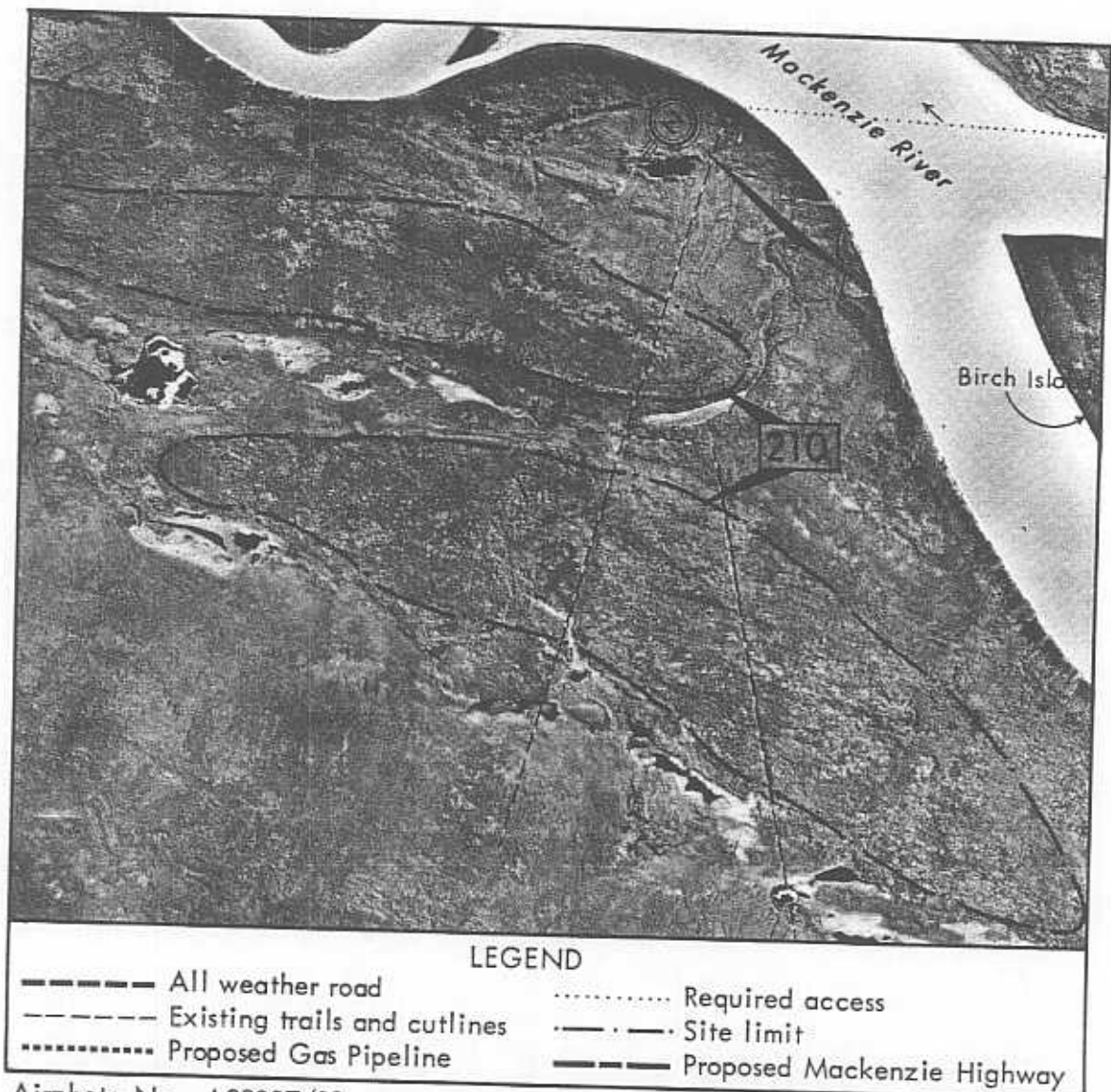
PEMCAN SERVICES "72"

SITE NO. 210

LOCATION

Located on the western side of the Mackenzie River and approximately 6 miles south of the Redstone River, Site 210 consists of alluvial terraces paralleling the Mackenzie River stream channel. The terraces probably consist of silty sand.

The proposed Mackenzie Highway right-of-way parallels the opposite, east river bank and the haul distance from Site 210 to the Mackenzie Highway at Mile 512 would be about 3 miles. The gas pipeline route is located approximately 4 miles from this site area.



Airphoto No. A22887/23

Approximate scale: 1" = 3,000'

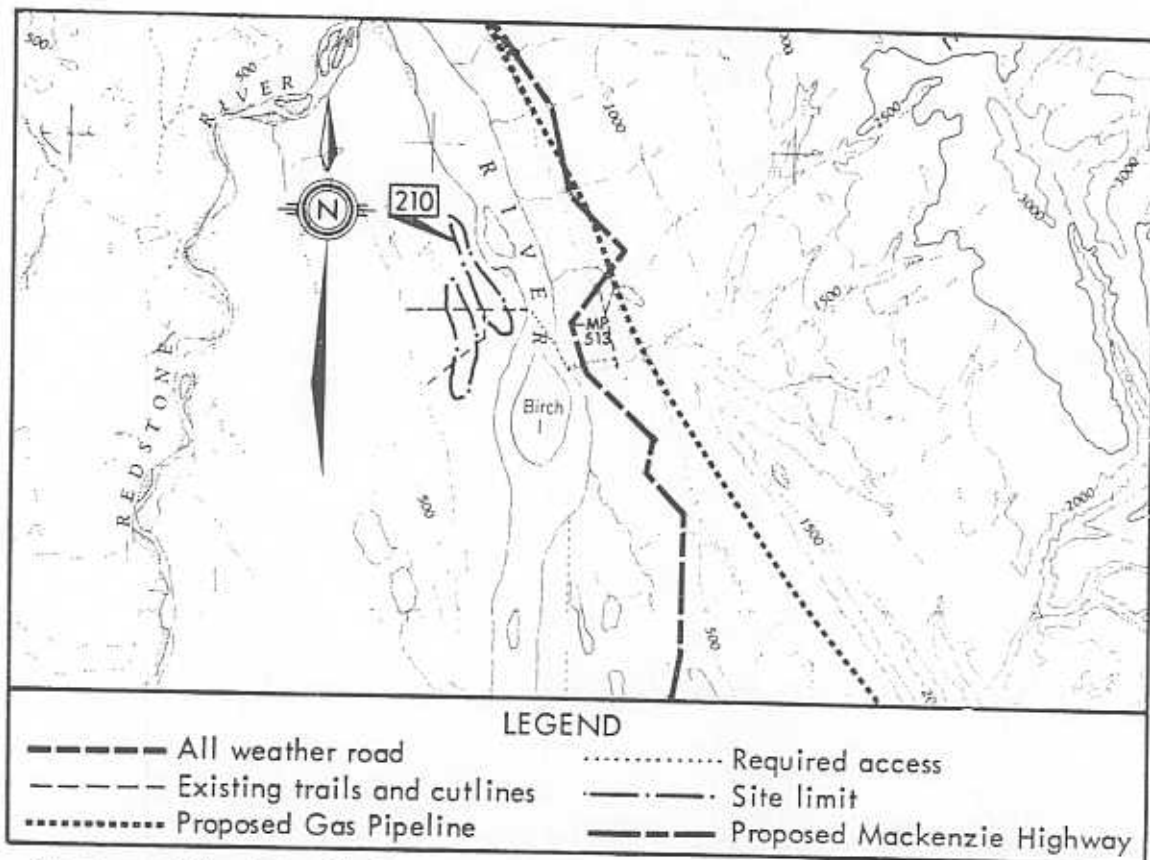


GENERAL

Site 210 consists of two large alluvial terraces paralleling the western Mackenzie River channel. The terraces are approximately 3 miles in length and average about $\frac{1}{2}$ mile in width. The flat surface of these terraces is some 50 feet above the water level of the Mackenzie River. Abandoned river arms exhibiting oxbow lakes and muskeg ground is indicative of the river flood plain which forms the terrain surrounding Site 210. The drainage conditions are only fair and the surficial runoff is directed into the adjacent river channel. The site area is covered with a moderately dense growth of willows, spruce and occasional birch.

There are no known critical wildlife areas in the immediate vicinity of Site 210.

It is anticipated that the subsurface material in Site 210 consists of stratified, fine grained sands with silt topped with variably thick topsoil and silt layers. These terrace deposits would probably be only suitable as very marginal general fill material. Year round access to the site is difficult because of the terrain and the required crossing of the Mackenzie River.



Section of Map No. 96 C

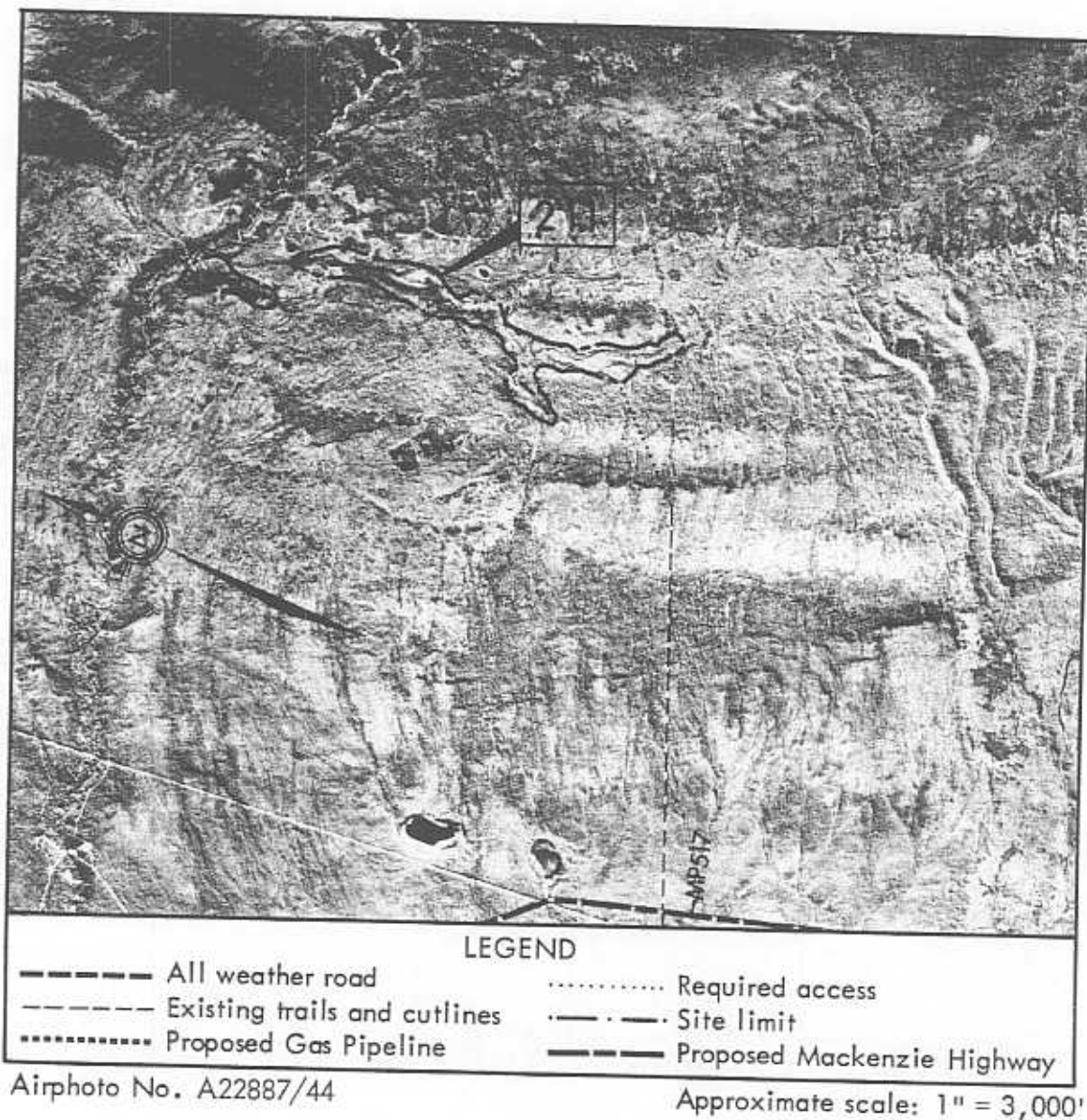
Scale: 1:250,000

SITE NO. 211

LOCATION

Located at the eastern margin of the Mackenzie Plain and approximately $2\frac{1}{2}$ miles southeast of the Saline River, Site 211 encompasses two small and shallow segments of glaciofluvial outwash deposits.

The Mackenzie Highway right-of-way at Mile 517 and the gas pipeline route are both located approximately 2 miles southwest of Site 211.



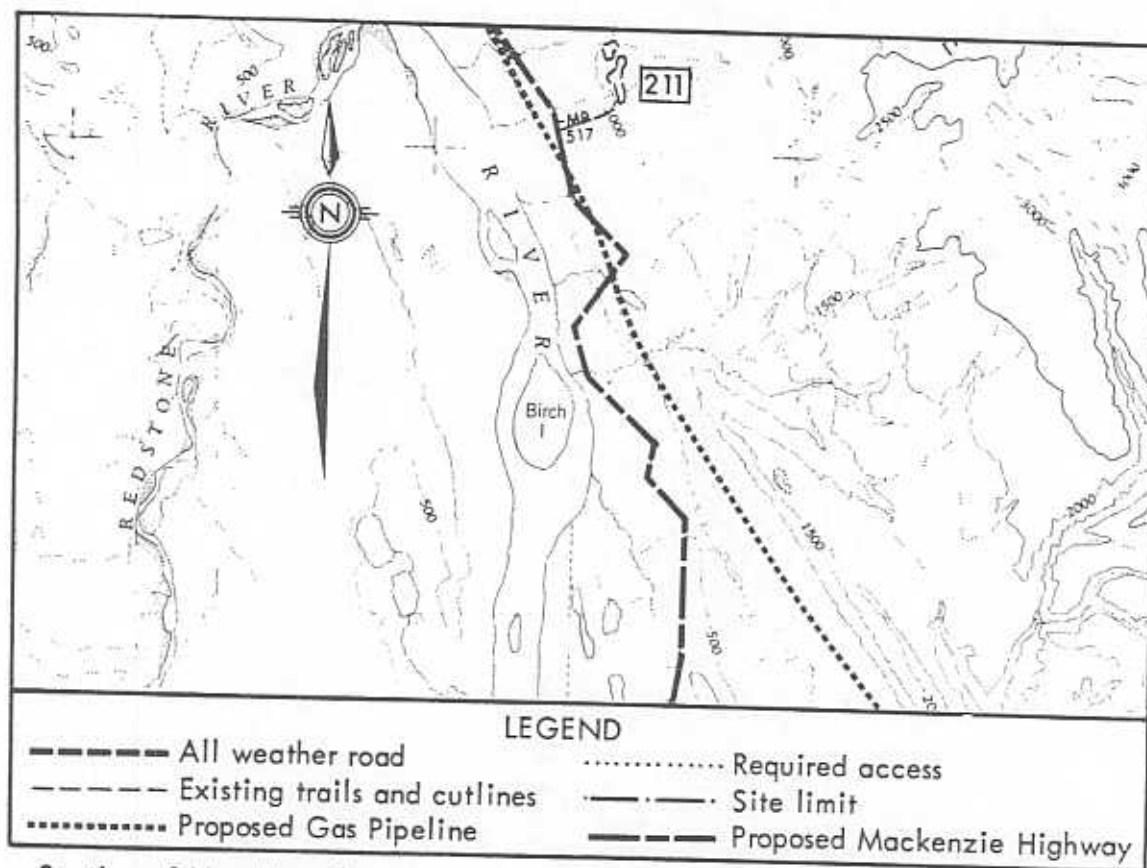


GENERAL

Site 211 is comprised of two small and shallow, ridge like segments of partially eroded and effaced glaciofluvial outwash deposits. The segments are approximately 1500 and 6000 feet in length and average 300 feet in width. The site area parallels the western margin of the Mackenzie Plain, which gently descends towards the Mackenzie River. The terrain adjacent to Site 211 is comprised of glacial drift deposits which exhibit fair drainage conditions. The outwash deposits at the site are better drained and thus support well developed stands of spruce and poplar.

There are no known critical wildlife areas in the vicinity of Site 211.

It is anticipated that the silty sand and gravel deposits which form the shallow outwash ridges would be suitable for only marginal general fill material. Better quality materials may occur in isolated pockets which would be difficult for selective exploitation.

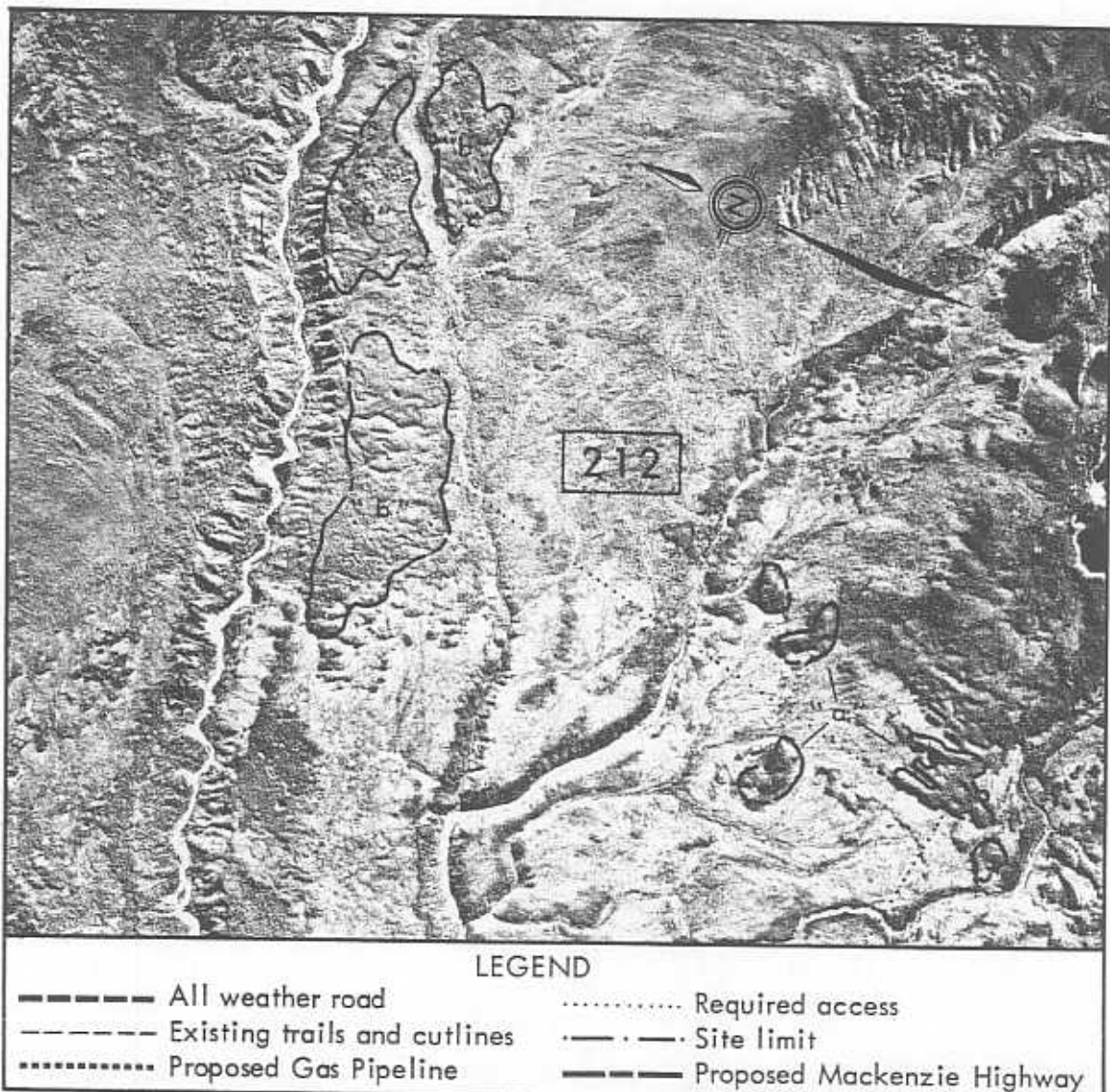


SITE NO. 212

LOCATION

Located immediately south of the Saline River on the western slopes adjacent to the McConnell Range, Site 212 consists of a series of kame fields and individual kame mounds.

The access to Site 212 from both proposed utility routes is difficult because of deeply incised erosional gullies surrounding the larger kame fields. The proposed Mackenzie Highway right-of-way at Mile 519.5 and the gas pipeline route are located approximately 6 miles east of Site 212.



Airphoto No. A22933/123

Approximate scale: 1" = 3,000'



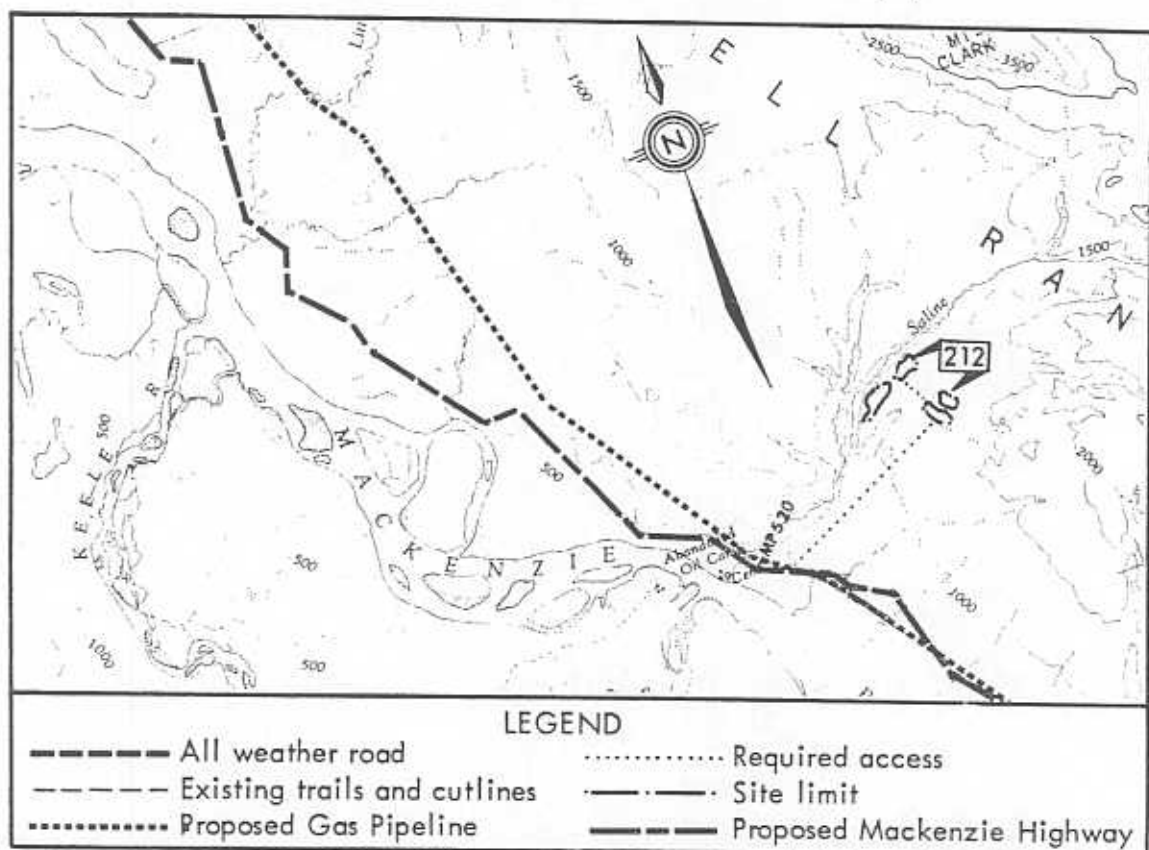
GENERAL

Site 212 encompasses three large kame fields, denoted as "b" on the airphoto, and five kame mounds, denoted as "a"; the kames are deposited over sloping terrain at the toe of the McConnell Range. The site area which contains larger and more prospective deposits is separated from the terrain to the west by deeply incised stream channels of the Saline River and its tributaries. The kame fields range from 2500 to 4500 feet in length and from 800 to 1500 feet in width. The areal extent of individual kames does not exceed several hundred square feet.

The kames are probably comprised of variably washed sands and gravels with silt and till pockets. The site area is well drained and supports relatively dense growths of spruce and poplar.

There are no known critical wildlife areas in the vicinity of Site 212.

It is anticipated that sand and gravel deposits within the kame fields and kame mounds would have low to medium ice content and thus would be suitable for marginal to good quality general fill material. Better quality materials, consisting of clean well graded gravel, may occur in isolated pockets which would be difficult for selective exploitation. Year round access to the site is difficult because of irregular terrain and deeply incised stream channels.



Section of Map No. 96 C

Scale: 1:250,000

DETAILED DRILL HOLE LOG

SITE NO. 198X

HOLE NO. DH-3

DATE: FEB. 7, 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 CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		OL	1.0 TOPSOIL: some silt, organic, dark brown		Vs			0
2		ML	SILT: trace sand, fine grained, brown		Vr Vx	M		2
4				4				
6				6				
8				8				
10				10				
11.0			TOTAL DEPTH 11.0'				MC	11.0
12								12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

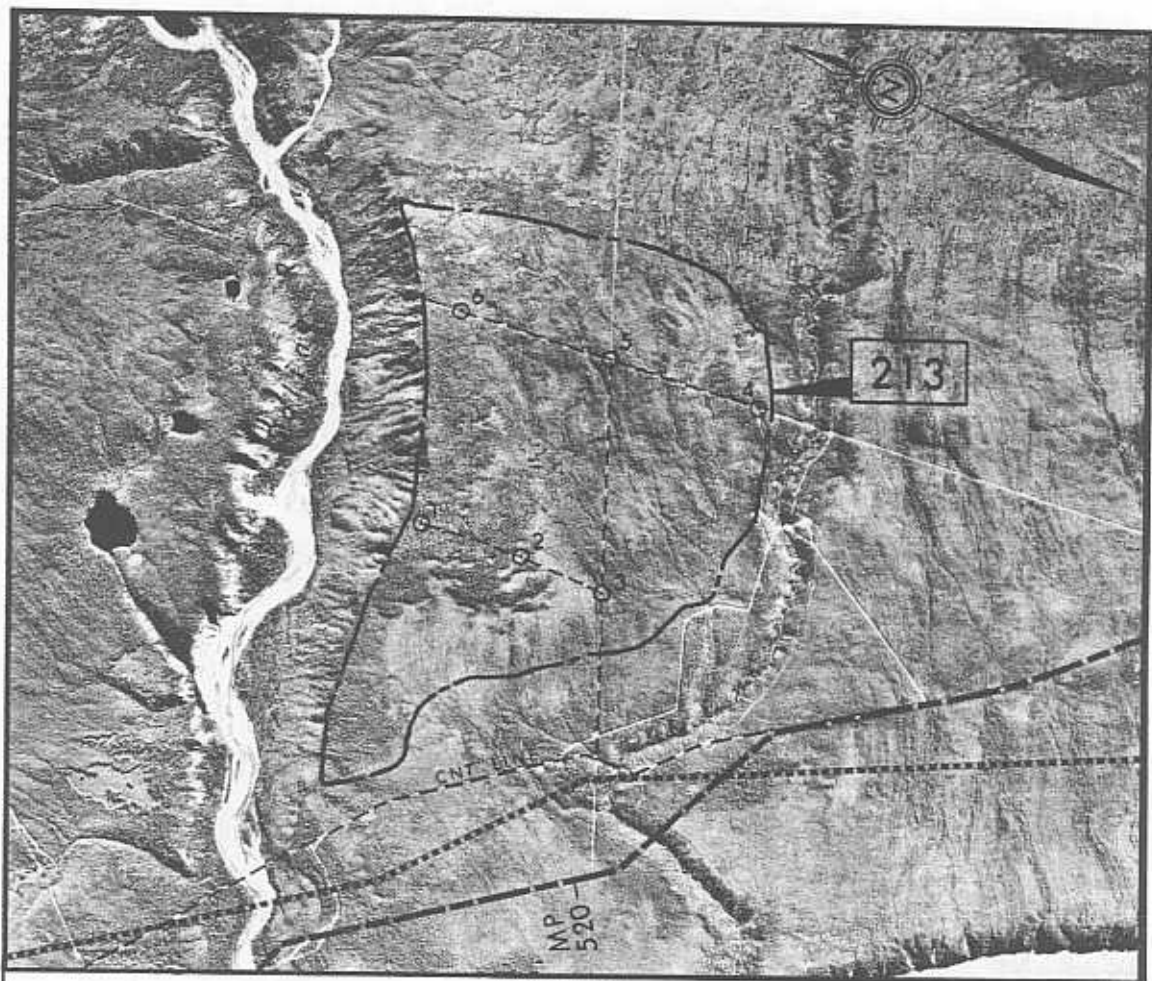
SITE NO. 213

Located immediately adjacent to the south bank of the Saline River and $\frac{1}{2}$ miles east of the proposed Mackenzie Highway at Mile 520, Site 213 consists of a large glaciofluvial plain.

Type of Material: Sand; fine to coarse grained, well graded, variable silt content.

Estimated Volume: 5,000,000 cubic yards.

Assessment: Fair quality granular materials which are suitable in the pit run condition for construction of road subgrades, and general fill; Site 213 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. A22887/43

213-1

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 213 is located immediately adjacent to the south bank of the Saline River and approximately 1 mile upstream from the east bank of the Mackenzie River. The western perimeter of the site area is located approximately $\frac{1}{2}$ mile east of the proposed Mackenzie Highway right-of-way at Mile 520. The site consists of a large glaciofluvial plain which is approximately $1\frac{1}{2}$ miles in length and 1 mile in width. The steep crest of the south bank of the Saline River forms the northern boundary of the site and a small stream channel forms the southern boundary. The site area is fairly well drained and the steep south bank of the Saline River exhibits numerous erosional gullies.

The glaciofluvial plain consists primarily of fine to medium grained sands with a little silt. A few pockets or layers of gravel were encountered at depth. The predominance of finer sands and silts was noted in the southern portion of the site area. A till body was encountered in DH 5. A shallow layer of topsoil, 1 to 2 feet in depth, overlies the granular materials and supports moderate growths of spruce which attain heights to 30 feet and trunk diameters in excess of 6 inches. The understory growth is relatively sparse.

There are no known critical wildlife areas in the immediate vicinity of Site 213, although the general area adjacent to the Saline River is utilized for trapping and hunting by northern residents.

The only existing access to the site consists of several seismic cutlines which extend east and north from the CNT pole line. The proposed Mackenzie Highway and gas pipeline right-of-ways are almost coincident with the existing alignment of the CNT pole line in the immediate vicinity of Site 213. It should be noted that the existing seismic lines have experienced surficial erosion by gullying in the southern portion of the site area adjacent to the small stream channel.

DEVELOPMENT

The exploratory drilling on Site 213 has shown the following conditions relative to the quality and quantity of recoverable granular materials:

- The granular materials consist primarily of fine to coarse grained sands with a highly variable silt content. In general, the predominance of high silt content material was encountered in the southern half of the site area. Scattered pockets or layers of medium grained gravels, with a little silt were encountered at depths in excess of 15 feet below existing ground surface.
- The sands from this site in the pit run condition are considered suitable for lower quality fill material in the construction of road subgrades, berms and utility backfill.
- The overburden material consisting of topsoil and inorganic silts varies from 1 foot to in excess of 6 feet in thickness.



- The ground ice content of the materials is generally low.

Site 213 is recommended for exploitation of low quality granular fill material. The following operational guidelines should be considered for the development of borrow pits in this site area:

- Exploitation of granular materials should be commenced from the northwestern extremities of the site area because of better quality materials being indicated within that portion of Site 213.
- The existing tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil layer should be stripped, removed and stockpiled adjacent to the borrow pit areas in designated locations.
- The inorganic silt overburden material should be stripped and wasted at designated locations adjacent to the borrow pit area.
- Operating procedures during borrow pit development should be maintained whereby surficial waste materials do not drain into the Saline River and adjacent small stream channels.
- Stands of natural growth should be retained between borrow pit areas in order to promote natural regeneration after abandonment.
- A vegetation buffer zone of adequate breadth should be retained between the outer limits of borrow pit areas and the Saline River.
- Generally, dozers, overhead loaders and standard ripping equipment should be adequate for the removal of material from this site. The selection of heavier equipment may be required if higher ground ice contents are encountered at deeper extremities of this ridge.
- The existing seismic cutlines may have to be upgraded to an all weather status unless development of this site is restricted to the winter months.

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 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. 213

HOLE NO. DH-1

DATE: FEB. 6, 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, organic, trace sand, brown					0
3			4.0 SAND: some silt, fine grained, poorly graded, yellowish brown					3
6		SM-SP	- trace silt, greyish brown					6
9								9
12		GW-GM	GRAVEL and SAND: trace silt, fine to coarse grained, well graded, rounded to subangular pebbles to 3/4" size, grey		Vx	M		12
15								15
18							G5	18
21			21.0 TOTAL DEPTH 21.0'					21
24								24

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 213

HOLE NO. DH-2

DATE: FEB. 6, 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, dark brown		Vs			0
2		SM-ML	SAND and SILT: trace clay, light brown		Vr			2
4								4
6		SM	SAND: trace silt, fine grained, poorly graded, greyish brown - few rounded pebbles to 1" size from 9.0'		Vc Vx	M		6
8								8
10								10
12								12
14		SP	SAND: trace gravel, fine grained, poorly graded, rounded and subangular pebbles to 1" size, grey		Vx			14
16								16
18								18
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. 213

HOLE NO. DH-3

DATE: FEB. 5, 1973

LOGGED BY: ☒ PEMCAN ☐

DRILLING METHOD: ☒ AIR 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, organic, dark brown						0
3		ML	SILT: brown						3
6			6.0						6
9			- little sand, frequent pebbles to 1/8" size, sand layer 1.0' thick at 10.0'		N				9
12		GP-GM	GRAVEL and SAND: trace silt, poorly graded, medium brown				M		12
15									15
18					Vx				18
21									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. 213

HOLE NO. DH-4

DATE: FEB. 6, 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		OL	1.0 TOPSOIL: some silt, organic, dark grey		Vs Vr	M		0
2		ML	SILT: occasional pebbles, cobbles and fragments of quartzite and limestone, dark grey					2
4								4
6								6
8								8
10		GW-GM	7.0 GRAVEL: some sand, trace silt, fine to coarse grained, well graded, frequent pebbles to 1" size of quartzite and limestone, grey		Vx	L	GS	10
12								12
14		ML	13.0 SILT: little sand, fine grained, grey					14
16								16
18								18
20								20
			19.0 TOTAL DEPTH 19.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 213

HOLE NO. DH-5

DATE: FEB. 5, 1973		LOGGED BY: <input checked="" type="checkbox"/> PEMCAN <input type="checkbox"/>	
DRILLING METHOD: <input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> AIR <input type="checkbox"/> AIR REVERSE CIRCULATION <input type="checkbox"/> 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, organic, dark grey						0
2									2
4									4
6									6
8		ML-CL	SILT: some clay, rust and coal specks, frequent pebbles to 1/2" size, medium brown (TILL)		Vx	L			8
10									10
12									12
14									14
16									16
18									18
20			TOTAL DEPTH 20.0'						20

DETAILED DRILL HOLE LOG

SITE NO. 213

HOLE NO. DH-6

DATE: FEB. 6, 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, trace sand, roots, dark grey		Vx	M		0
3			3.0					3
6								6
9			SAND and SILT: fine grained, poorly graded, grey	UF				9
12		SP-SM					MC GS O	12
15					Vx	M		15
18								18
21			21.0 TOTAL DEPTH 21.0'					21
24								24

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

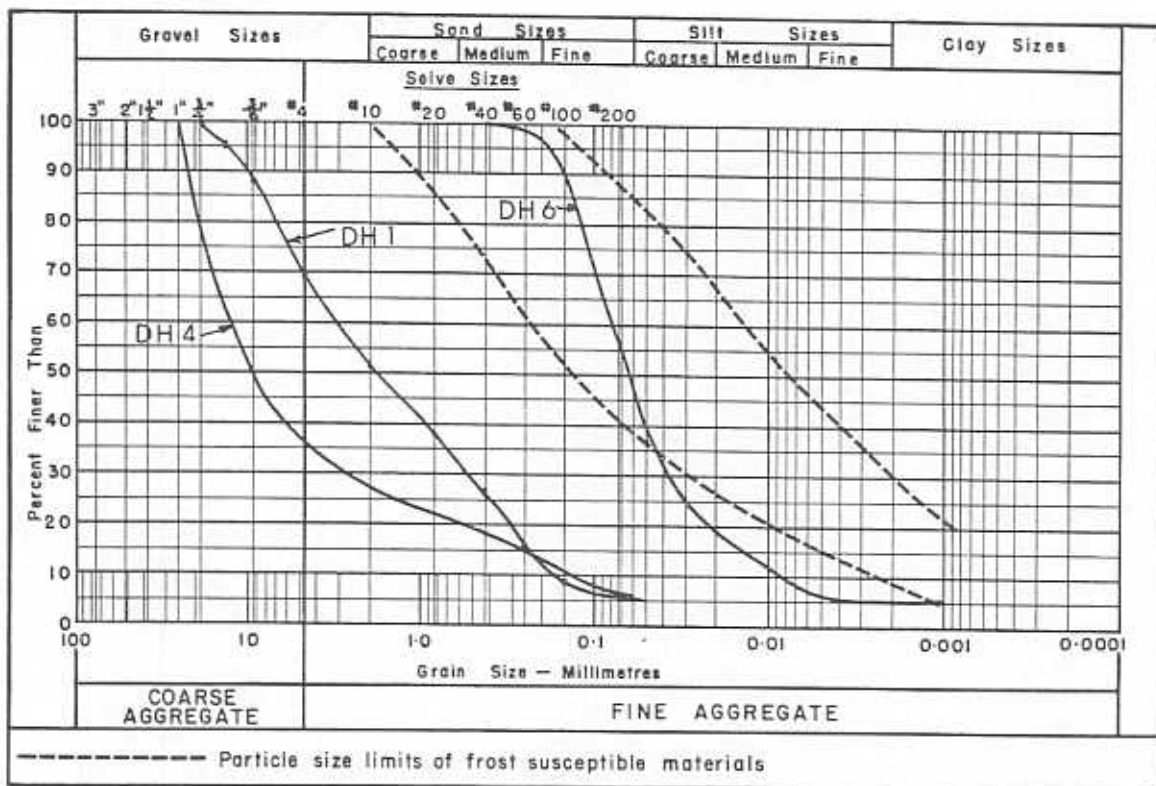


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	213/DH 1	213/DH 4	213/DH 6
Sample Depth (Feet):	16	8	9
Moisture Content (%):	-	-	16.0
Ice Content (%):	-	-	-
Organic Content (%):	-	-	4.4

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS: (213/DH 4 @ 8')

		Hardness
Quartzite	43.9%	7-8
Limestone and dolomite (sound)	21.9%	3-4
Igneous	9.8%	6-7
Deleterious		
Siltstone and sandstone (porous)	9.7%	4-5
Ironstone & mudstone	14.6%	1-2

SITE NO. 214

LOCATION

Located on the east side of the Mackenzie River, Site 214 encompasses the alluvial plain of the braided and meandering Saline River including several shallow terraces bordering the active stream channel, which contain sand, gravel and silt deposits.

The proposed Mackenzie Highway right-of-way crosses the downstream section of the channel between Miles 521 and 521.5, paralleled by the gas pipeline route some 1500 feet upstream.





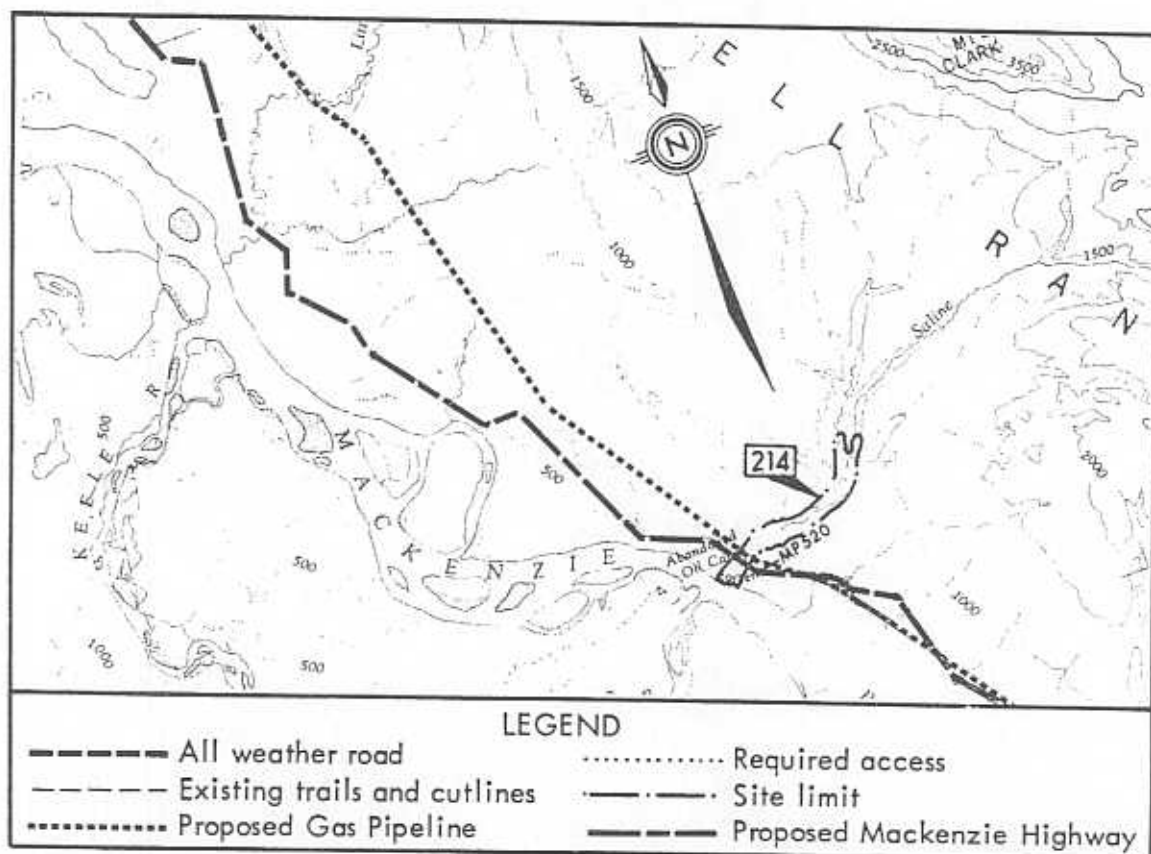
GENERAL

Site 214 encompasses the active stream channel of the Saline River from its mouth for some 3.5 miles upstream, where its gradient becomes steep and the alluvial deposits discontinue. The stream channel in its downstream section is 300 to 1200 feet wide and contains alluvial deposits exposed in the low terraces along the stream bed. These deposits are at or slightly above the high water level of the river. Coarse gravel with cobbles and boulders form gravel bars denoted as "a" on the site airphoto within the braided stream channel. The material becomes finer toward the stream mouth. The terraces, denoted as "t" on the airphoto, apparently contain similar granular deposits covered with organic silt supporting relatively dense growths of spruce, poplar and understory bush.

There are no known critical wildlife areas in the vicinity of Site 214.

Access to this site can be achieved from the existing winter road which traverses the downstream section of the river (Ref. airphoto).

Site 214 is not suggested for development since the granular material is located within or immediately adjacent to the stream channel of the Saline River.



Section of Map No. 96 C

Scale: 1:250,000

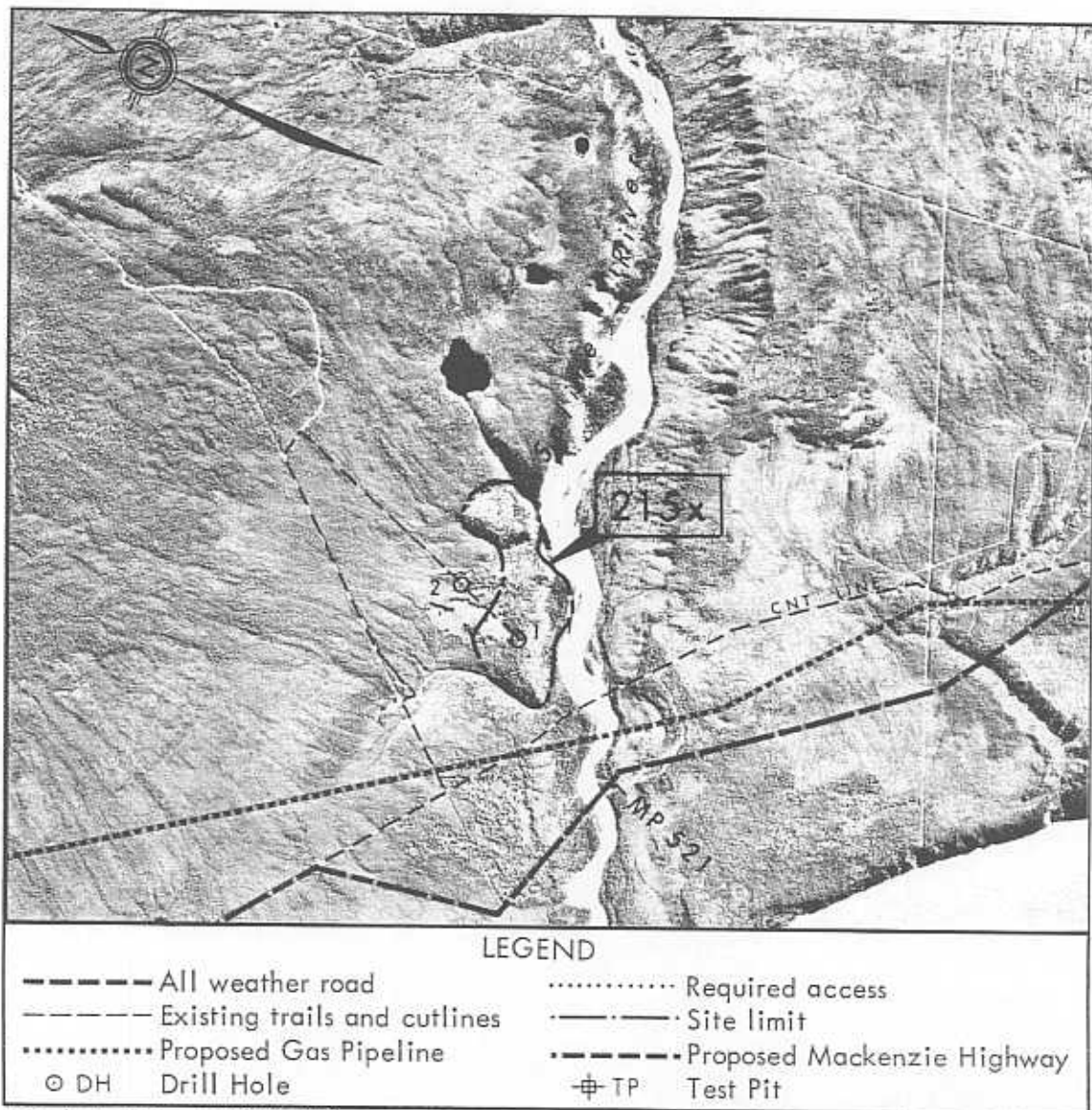
SITE NO. 215X

Located immediately adjacent to the north bank of the Saline River and $\frac{1}{2}$ mile east of the proposed Mackenzie Highway at Mile 521, Site 215X consists of a very small remnant of a glaciofluvial terrace.

Type of Material: Silt and Sand; some clay, fine grained.

Estimated Volume: Not applicable.

Assessment: Materials of granular quality were not established by the field drilling program; therefore, Site 215X is not recommended for development.



Airphoto No. A22887/42

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 215X is located immediately adjacent to the north bank of the Saline River and approximately 1 mile upstream from the east bank of the Mackenzie River. The western extremity of the site area is less than $\frac{1}{2}$ mile east of the proposed Mackenzie Highway at Mile 521. The site consists of a very small remnant of a larger glaciofluvial terrace which has been separated from Site 213 by the Saline River channel. The site is bordered on the south by the steep bank of the Saline River and encompasses an area approximately 3000 feet in length and 1000 feet in width. The site area is well drained to the south and west into the watershed of the Saline River.

The glaciofluvial terrace remnant consists of fine grained sands and silts with very high clay contents which are unsuitable for construction fill requirements. Gravel is expected to form only small localized pockets. One such pocket was noted in the steep northern bank of the Saline River valley. Glacial till underlies the silt stratum at a depth of 8 to 13 feet below existing ground surface. A shallow layer of peat and organic silt, less than 2 feet in depth overlies the site area and supports dense growths of spruce which attain heights in excess of 20 feet and trunk diameters to 6 inches. The understory growth is relatively dense and consists predominantly of willows.

There are no known critical wildlife areas in the immediate vicinity of Site 215X, although the general area adjacent to the Saline River is periodically trapped and hunted by the northern residents.

The only existing access to the site area from the CNT pole line, the proposed Mackenzie Highway and gas pipeline right-of-ways, consists of a seismic cutline.

DEVELOPMENT

Site 215X is not recommended for development because the field drilling program has confirmed that granular materials are not contained in exploitable quantities in this glaciofluvial terrace remnant.

DETAILED DRILL HOLE LOG






SITE NO. 215X

HOLE NO. DH-1

DATE: FEB. 2, 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		Pt	1.0 PEAT: organic, fibrous, muskeg					0
3		OL	3.0 TOPSOIL: some silt, organic medium brown					3
6			SILT: some clay, medium brown					6
9								9
12		ML-CL	13.0 - frequent pebbles to 1" size, medium grey		Nbn	M		12
15								15
18								18
21								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. 215X

HOLE NO. DH-2

DATE: FEB. 5, 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					0
		OL	2.0					
3			TOPSOIL: some silt, organic, dark brown					3
6		ML	SILT: trace sand, light brown		Nbn	M		6
9			8.0					9
12			SILT: some clay, trace rust and coal specks, frequent pebbles to 1" size, medium brown (TILL)					12
15		ML-CL						15
18								18
21			22.0					21
24			TOTAL DEPTH 22.0'					24

GOVERNMENT OF CANADA
 DEPARTMENT OF INDIAN AFFAIRS
 AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



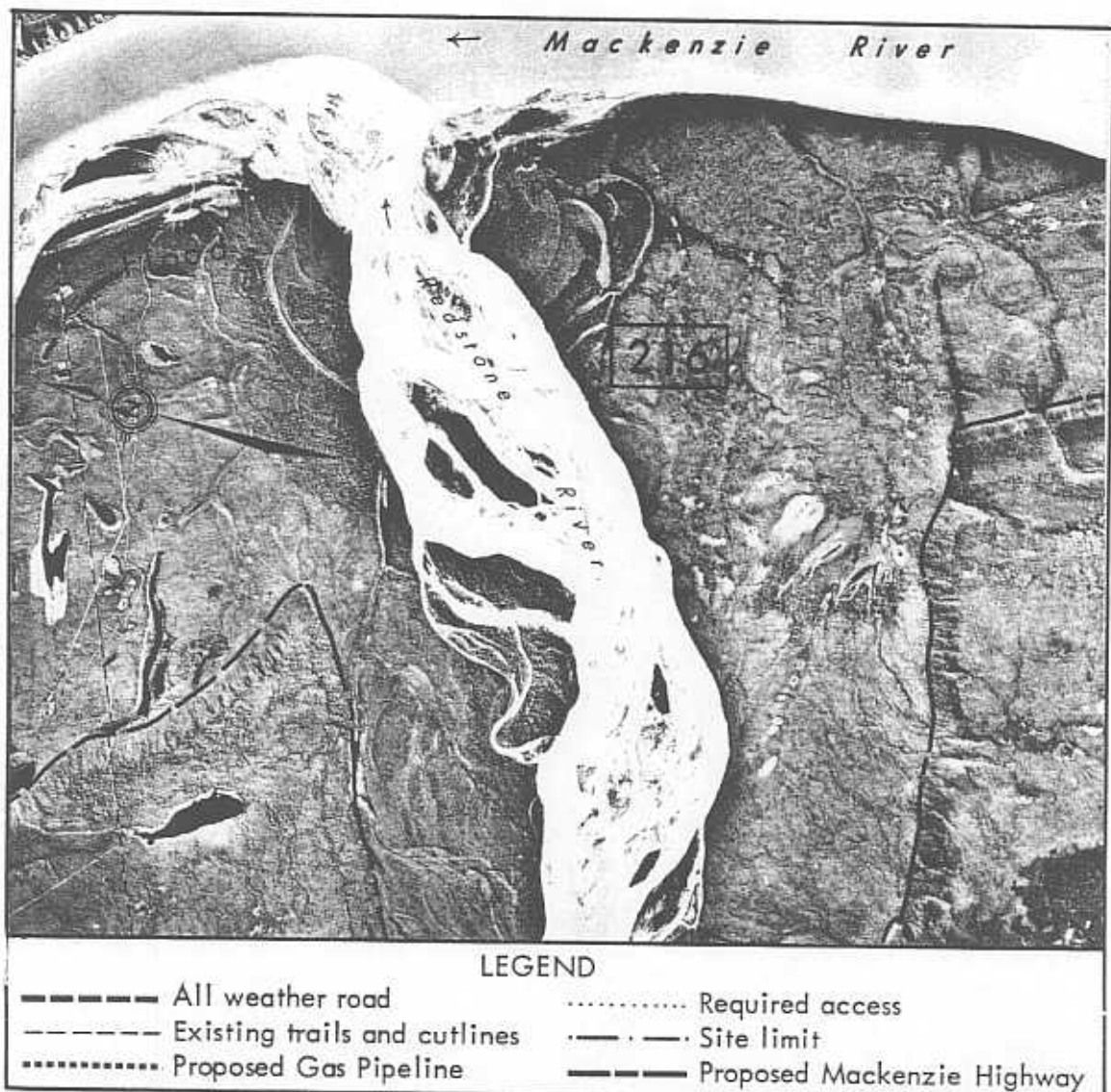
PEMCAN SERVICES "72"

SITE NO. 216

LOCATION

Located on the west side of the Mackenzie River, Site 216 encompasses the downstream segment of the alluvial flood plain of the Redstone River, which consists of low terraces bordering the braided active stream channel.

The proposed Mackenzie Highway right-of-way at Mile 520 is located on the opposite, east Mackenzie River bank at a distance of some 3 miles from the site area while the proposed gas pipeline is located approximately 3 miles further east of the highway alignment.



Airphoto No. A22887/26

Approximate scale: 1" = 3,000'



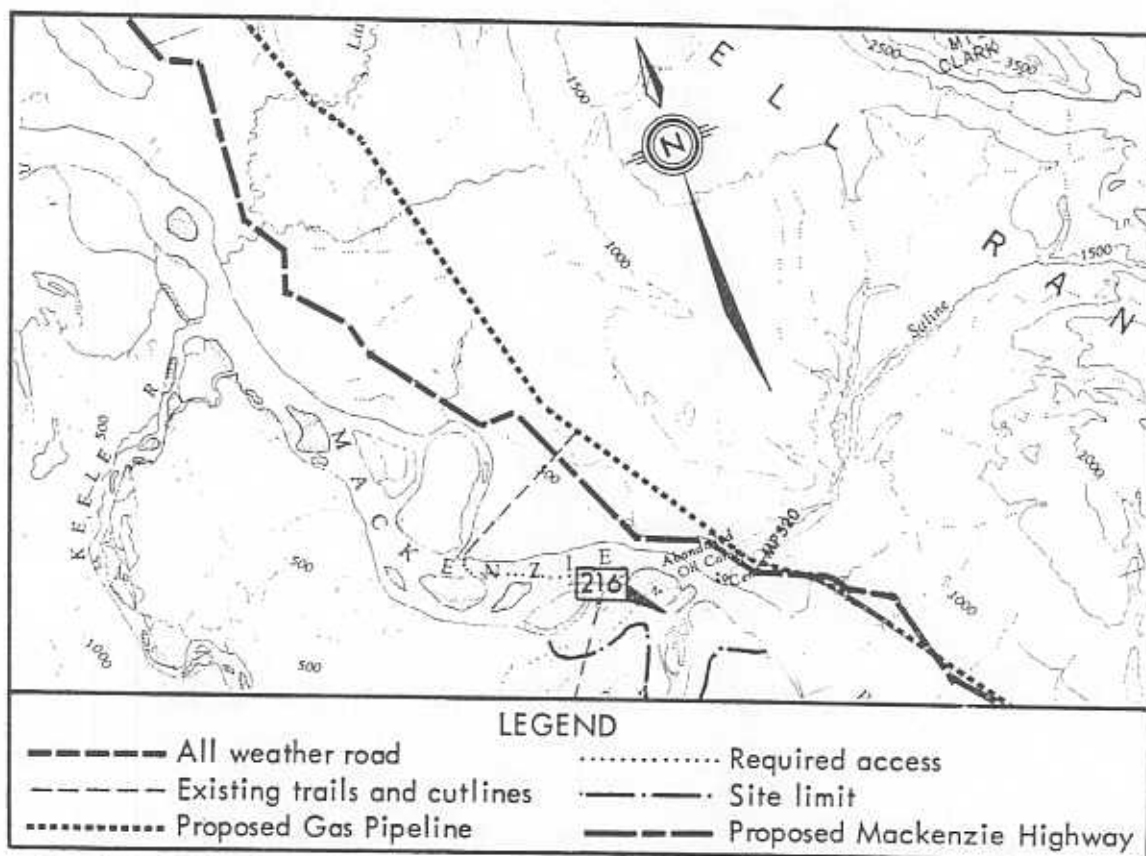
GENERAL

The downstream section of the Redstone River, from its confluence with the Mackenzie River to a point some 6 miles upstream was evaluated during the summer field program. In this area there exists 3/4 mile wide terraces adjacent to the river and frequent bars within the channel. The terraces rise more than 10 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. Drainage conditions, in general, are only fair.

The terraces probably contain stratified silty and sandy sediments. Gravel layers and localized pockets very likely exist below or even locally, within the fine grained alluvial deposits. Since no sizable exposure of this stratum is identifiable at the surface, the site was not drilled.

Coarser granular materials are exposed in bars within the braided stream channel. The bars become gravelly within the upstream segment of the river.

Site 216 is not suggested for development since the granular material is located within an active water course.



Section of Map No. 96 C

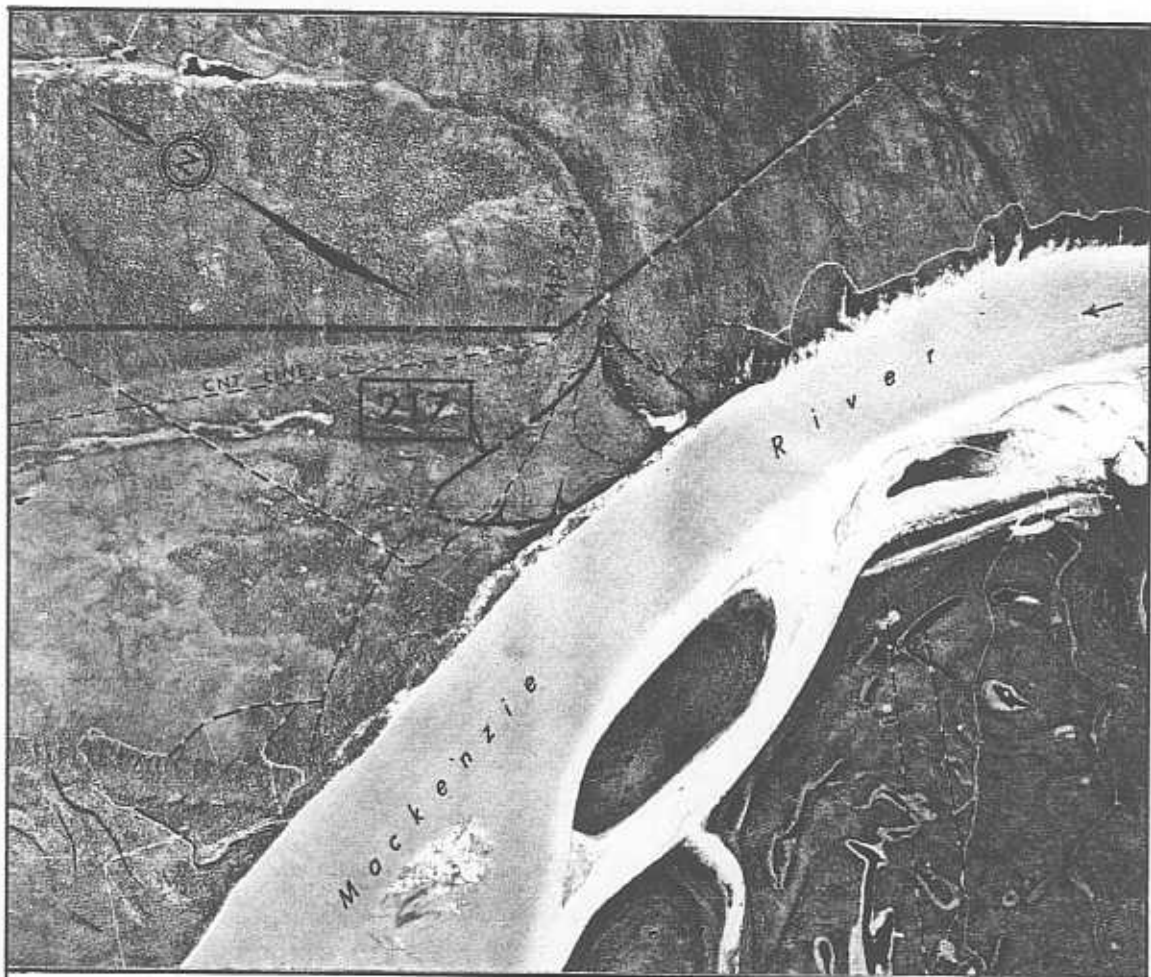
Scale: 1:250,000

SITE NO. 217

LOCATION

Located approximately $2\frac{1}{2}$ miles northwest of the Saline River and immediately adjacent to the east bank of the Mackenzie River, Site 217 encompasses an alluvial fan.

The proposed Mackenzie Highway right-of-way at Mile 524.5 is located less than 1000 feet east from the apex of the fan while the proposed gas pipeline route is located approximately one mile east of Site 217.



LEGEND

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

Airphoto No. A22933/87

Approximate scale: 1" = 3,000'

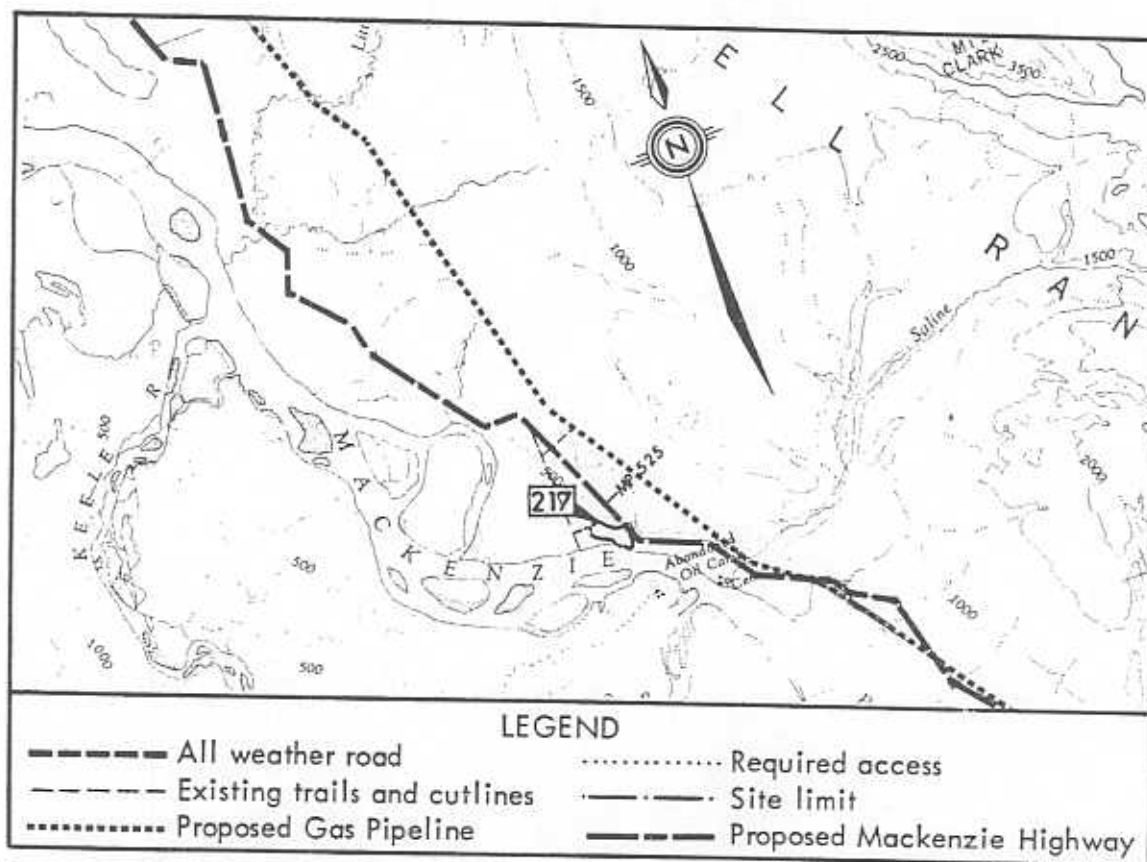


GENERAL

Site 217, consisting of a fossil fan on the east bank of the Mackenzie River, is approximately 1500 feet by 4000 feet in aerial extent. It is anticipated that because of its gently sloping surface, the fan is primarily composed of fine grained materials with lesser coarse aggregates. A few localized exposures in the steep river bank are, however, indicative of gravel layers or pockets. Fair drainage across the site supports well developed stands of black spruce.

There are no known critical wildlife areas in the immediate vicinity of Site 217. Environmental implications relative to the stream channel crossing the southern sector of the site area and the vicinity of the Mackenzie River channel should be taken into consideration if Site 217 is to be developed.

It is expected that predominant materials in the fan likely consist of silt and sand sized materials with secondary gravel aggregates and localized gravel layers. The material may be suitable for low quality general fill.



Section of Map No. 96 C

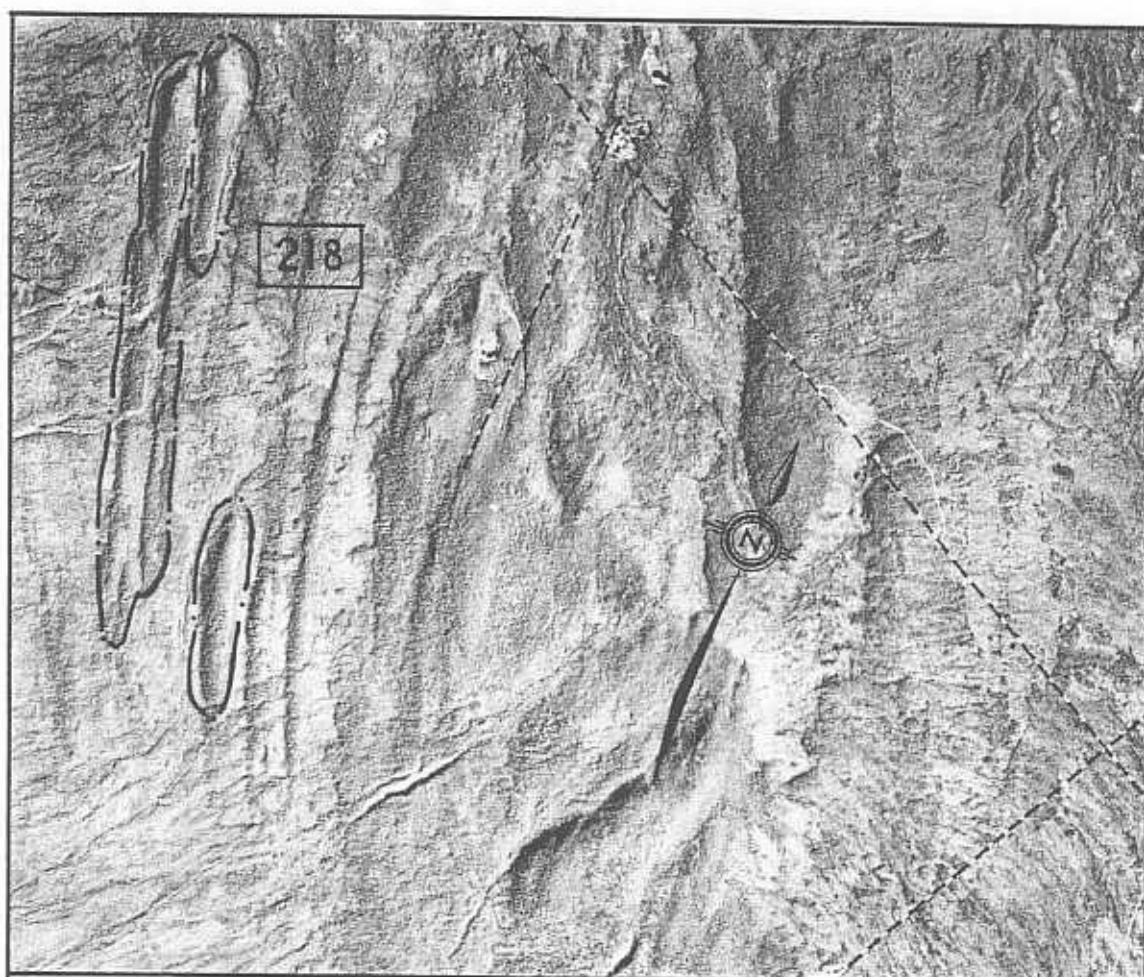
Scale: 1:250,000

SITE NO. 218

LOCATION

Located approximately $3\frac{1}{2}$ miles north of Saline River, Site 218 consists of three narrow, elongated bedrock ridges paralleling a major hill located to the east of the site. Considerable dolomite is indicated in these bedrock ridges.

The proposed gas pipeline parallels the site area at a distance of several thousand feet. The proposed Mackenzie Highway right-of-way at Mile 526.5 is located approximately $1\frac{1}{2}$ miles west of Site 218.



LEGEND

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

Airphoto No. A22887/41

Approximate scale: 1" = 3,000'



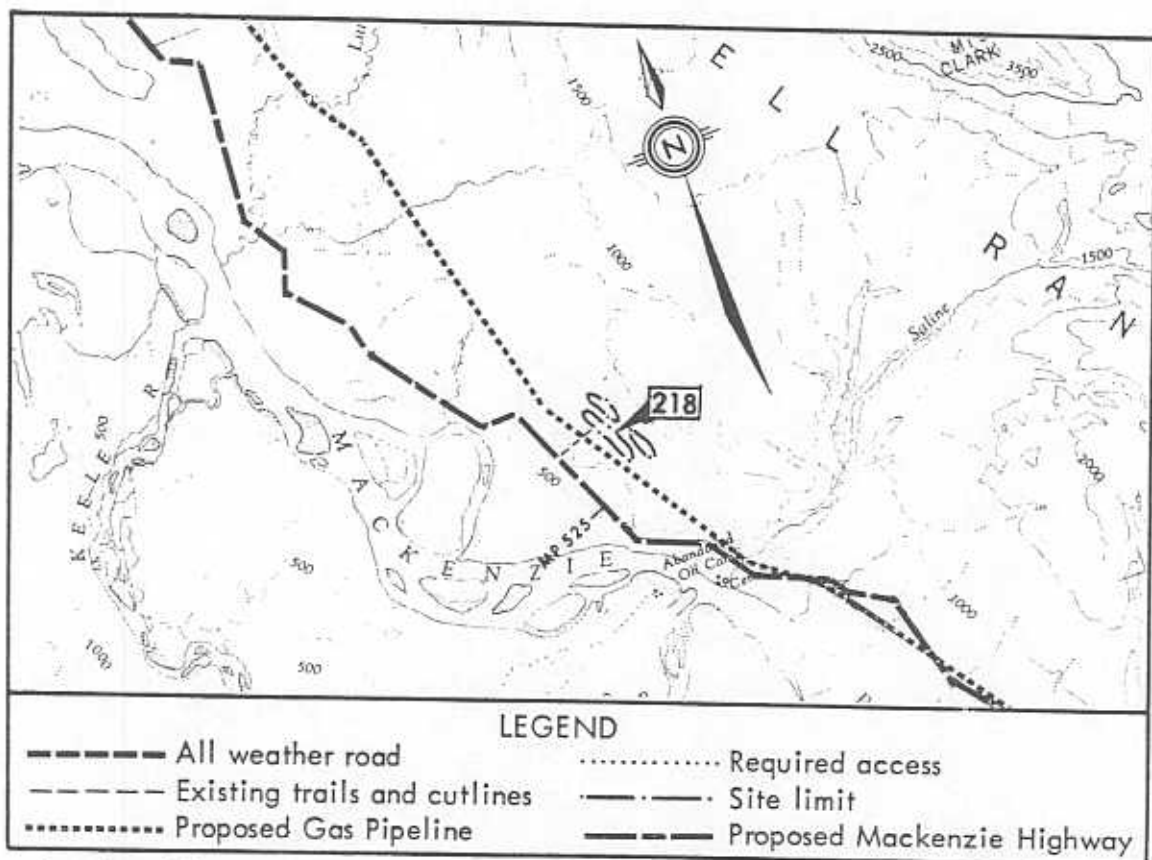
GENERAL

The gently sloping Mackenzie Plain is bordered with narrow and shallow parallel ridges. Small exposures of fractured dolomite were observed along the northern tips of the ridges outlined on the airphoto map. The ridges are apparently indicative of competent dolomite beds of a shale and dolomite formation which forms the hillside located to the east.

The general site area, which is overlain by shallow slope wash and glacial drift, is fairly well drained as indicated by good stands of spruce, poplar and birch. There are no known critical wildlife areas in the immediate vicinity of Site 218.

The ridges represent suitable locations for a quarry; stripping of the overburden and blasting of the bedrock would be required. Height of a quarry highwall may be in excess of 50 feet. Since the depth of the fresh rock is not known, the possibility of producing better quality construction aggregates would be subject to further investigations.

The access to the site area can be achieved through the extension of the existing seismic cutline.



Section of Map No. 96 C

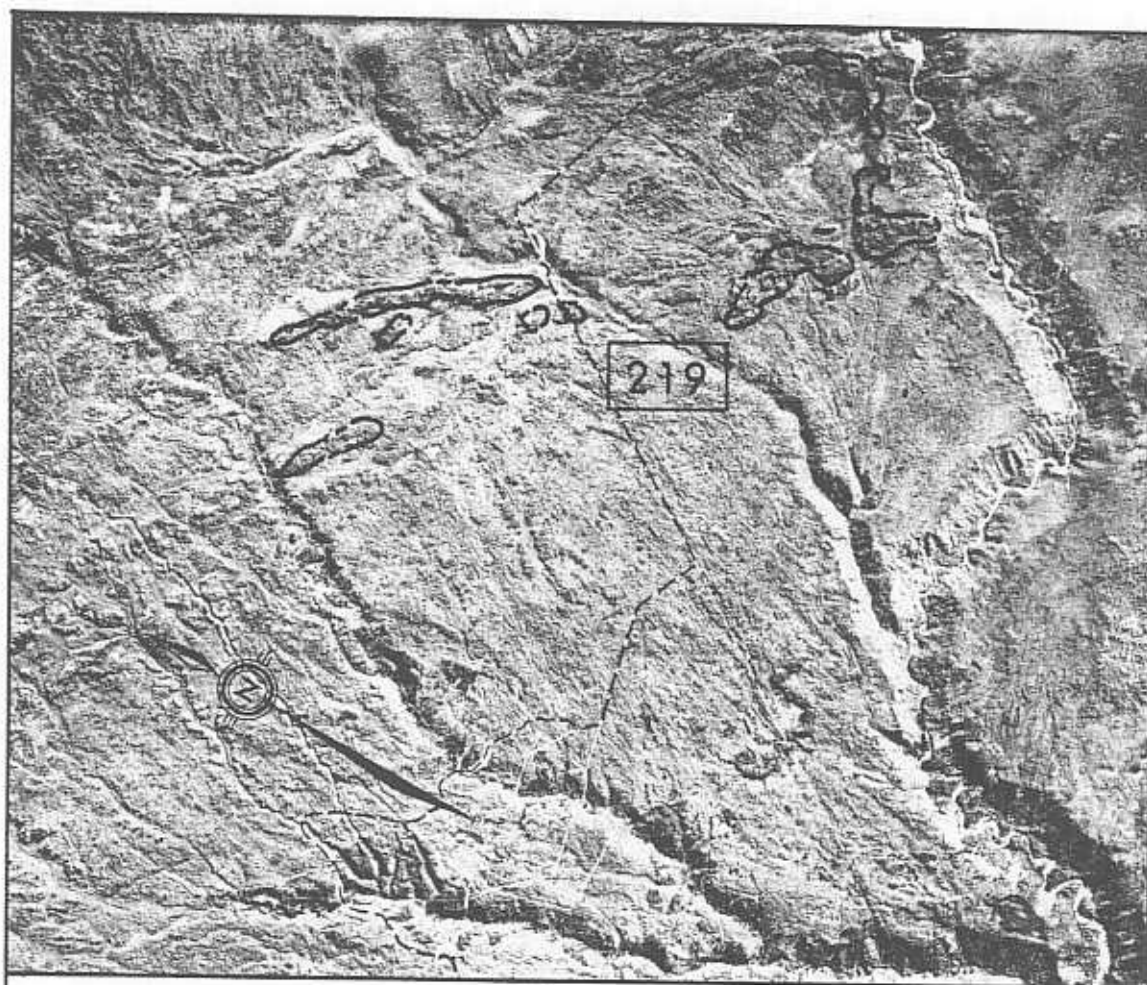
Scale: 1:250,000

SITE NO. 219

LOCATION

Located on the western slopes adjacent to the toe of the McConnell Range and approximately 3 miles north of the Saline River, Site 219 consists of a series of small, partly interconnected kame ridges.

The proposed Mackenzie Highway right-of-way at Mile 523 is located approximately 8 miles southwest of the site area; the haul distance to the proposed gas pipeline would be in excess of 6 miles.



LEGEND

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

Airphoto No. A22933/121

Approximate scale: 1" = 3,000'

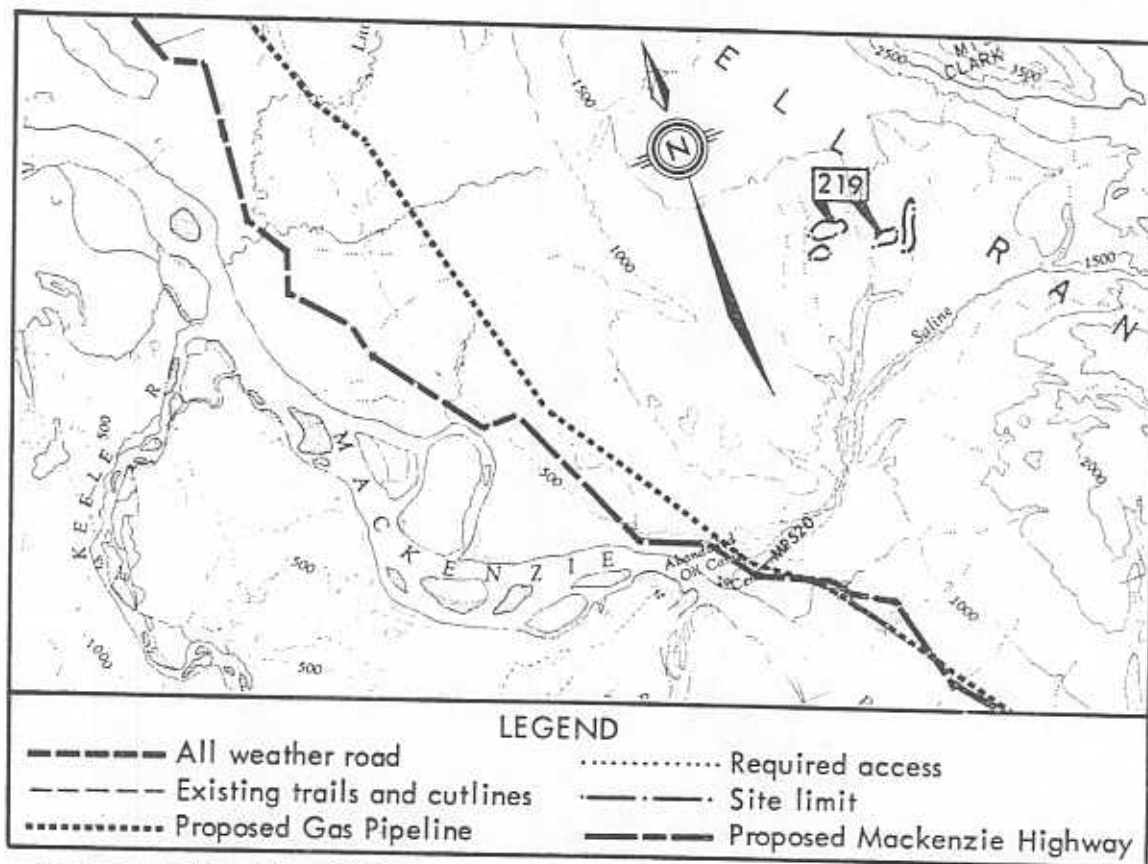


GENERAL

Site 219 is comprised of a series of narrow and shallow kame ridges irregularly spread over an area more than 2 miles in length and 3/4 of a mile in width. These ridges range in length from 300 to 4000 feet and in width from 200 to 500 feet. The site area is fairly well drained to the southwest by a network of tributary streams of the Saline River. Spruce interspersed with poplar stands constitutes the primary vegetation cover on these kame ridges. There are no known critical wildlife areas in the immediate vicinity of Site 219.

Irregularly bedded and variably washed sands and gravels are probably the most common constituents of the kame ridges. Silt beds and till lenses may be, however, also common within the main sand and gravel body. It is expected that these deposits may be suitable as marginal to fair quality general fill material; the site is rated as a poor to fair prospect. The development of Site 219 would, however, entail a comparatively large degree of surficial area being cleared relative to the volume of material available.

The access to the site area from both proposed utility routes can be readily achieved through existing seismic cutlines.



Section of Map No. 96 C

Scale: 1:250,000

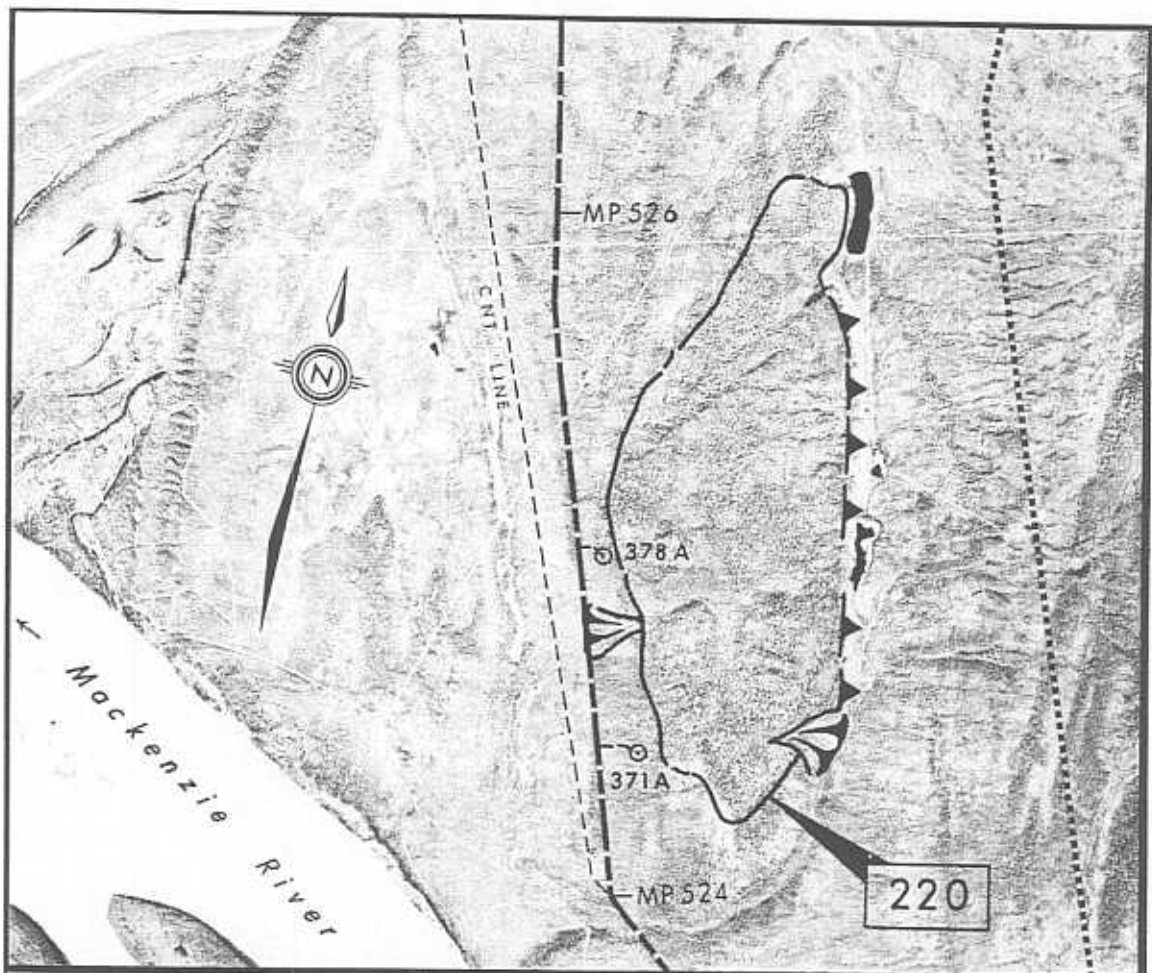
SITE NO. 220

Located approximately 3 miles north of Saline River and adjacent to the east side of the proposed Mackenzie Highway from Mile 524 to Mile 526, Site 220 consists of a prominent bedrock ridge.

Type of Material: Bedrock; limestone

Estimated Volume: Unlimited

Assessment: Site 220 is considered suitable for development because various categories of construction aggregates can be manufactured from the bedrock formation if quarry operations are initiated.



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. A22933/86

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 220 is located approximately 3 miles north of the Saline River and immediately adjacent to the east side of the proposed Mackenzie Highway right-of-way from Mile 524 to Mile 526. The site consists of a prominent bedrock ridge which is approximately 2 miles in length and $\frac{1}{2}$ mile in width. The eastern periphery of the site area consists of a steep escarpment with exposures of fractured to blocky Devonian limestone, whereas the western portion of the site area is overlain by residual soil and a thin veneer of glacial till. The toe of the escarpment is covered with scree, slope wash and two alluvial fans. The site area is well drained to the west onto the relatively flat glaciolacustrine plain. A small lake and a few small ponds are located at the base of the steep eastern escarpment. The site area supports moderately dense growths of spruce, with occasional birch.

There are no known critical wildlife areas in the immediate vicinity of Site 220. The site is located at the periphery of the Saline and Mackenzie River region which is periodically hunted and trapped by northern residents.

The CNT pole line and the proposed Mackenzie Highway are located immediately west of the site area and provide good future access. A seismic cutline traverses the northern tip of Site 220.

DEVELOPMENT

The information from field observations and the drill holes conducted on Site 220 by the engineering consultant for the Federal Department of Public Works has confirmed the presence of competent limestone bedrock at relatively shallow depths below existing ground surface; their drill hole data has been incorporated into this report.

In view of the general shortage of naturally occurring granular materials in this portion of the Study Area, Site 220 is considered suitable for development of quarries for the production of manufactured aggregates for various construction purposes. The following development guidelines should be considered if quarries are initiated at Site 220:

- The best quarry location would be in the site area adjacent to the steep eastern escarpment where the overburden material is relatively shallow.
- The existing tree growth and vegetation in quarry areas should be cleared and removed in accordance with current land use guidelines.
- Quarry operations including blasting and crushing of limestone bedrock will be required for the production of granular materials.
- Selective excavation can be anticipated. The weathered and friable surficial bedrock material may be extracted by standard ripping, dozing and loading techniques and this material should be suitable in its pit run condition for use in general fill requirements. Better quality aggregates can be produced from fresher and more competent limestone beds at greater depths, but extensive blasting and crushing



operations would be necessary.

- Staged development of quarry operations should be considered to allow summer thawing of the frozen bedrock in order to minimize the efforts required for the removal of the limestone bedrock material.
- If staged quarry operations are considered, then the access road to the proposed Mackenzie Highway or gas pipeline routes from the site should be upgraded to all weather standards.
- Access from the site area to the existing CNT pole line and the proposed Mackenzie Highway is excellent, and, in general, does not exceed $\frac{1}{2}$ mile.

ABANDONMENT AND REHABILITATION

In general, if a well organized and controlled quarry operation is maintained during the development and extraction of material, then the problems related to abandonment and rehabilitation would, for the most part, be inherently managed.

DETAILED DRILL HOLE LOG

SITE NO. 220

HOLE NO. B 371 A

DATE: FEB. 7, 1973

LOGGED BY: ☐ PEMCAN







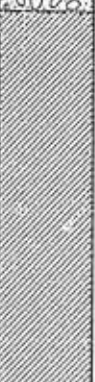

☒ UNDERWOOD

DRILLING METHOD: ☒

AIR
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		Pt	MUSKEG						0
2		GC	1.5 CLAY: light brown with pebbles						2
4			4.0 GRAVEL:						4
6			- sand boulders						6
8									8
10		CL	7.0 CLAY:						10
12			- dark brown, pebbles						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. 220

HOLE NO. B 378 A

DATE: FEB. 8, 1973 LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

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 — MOSS					0
2			CLAY: - light brown, silt					2
4			- cobbles and boulders	UF				4
6								6
8			7.5 —					8
10			SOLID ROCK: - rock fragments					10
12								12
14			14.0 — END OF HOLE 14.0'					14

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

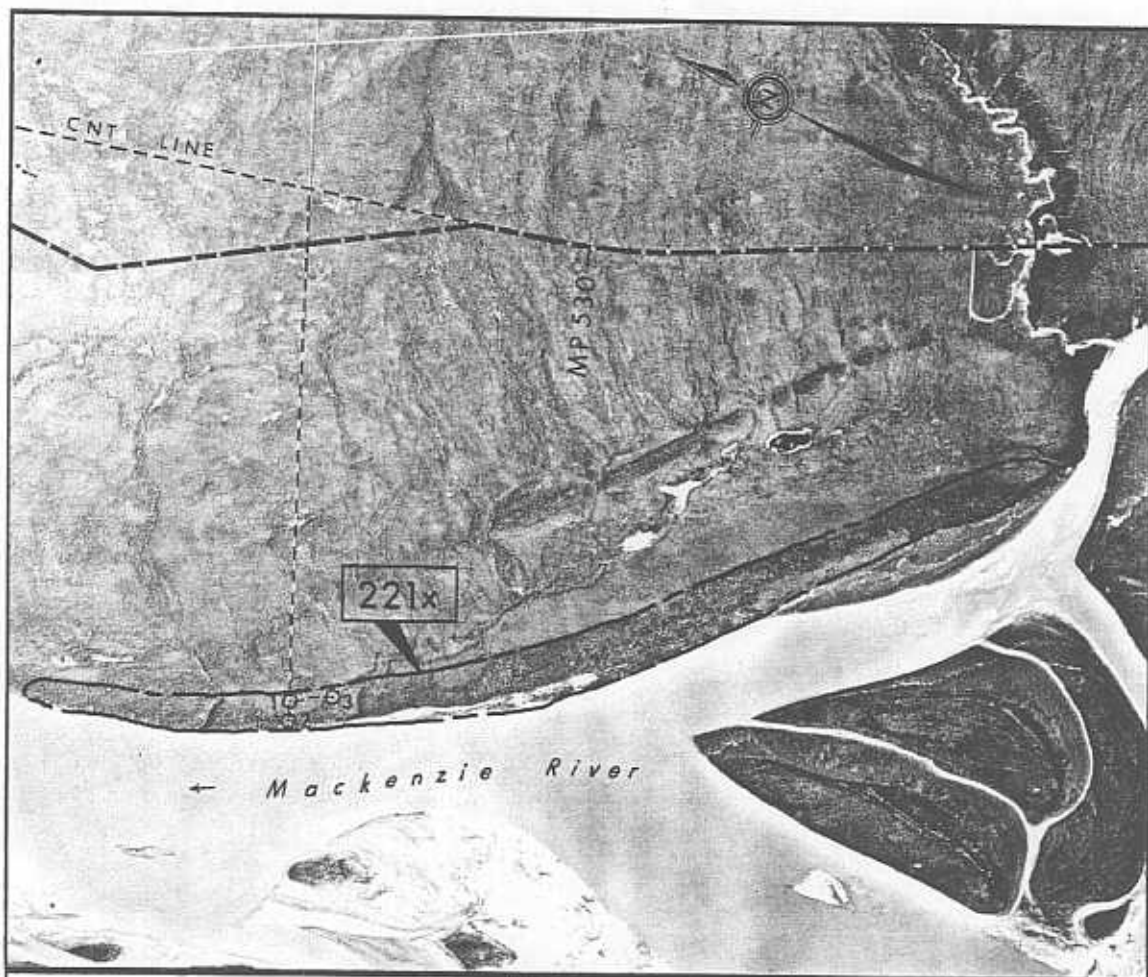
SITE NO. 221X

Located approximately 2 miles south of Little Smith Creek and $1\frac{1}{2}$ miles west of the proposed Mackenzie Highway at Mile 530, Site 221X consists of a narrow, limestone bedrock ridge which is overlain by 6 to 8 feet of high ice content fluvial silt.

Type of Material: Limestone bedrock.

Estimated Volume: Not applicable.

Assessment: The ridge of limestone bedrock is not considered for development because of the significant depth of silt overburden which is high in ground ice content.



LEGEND

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



ENVIRONMENT

Site 221X is located approximately 2 miles south of Little Smith Creek and consists of a narrow bedrock ridge immediately adjacent and parallel to the east bank of the Mackenzie River. The site is located approximately $1\frac{1}{2}$ miles west of the Mackenzie Highway right-of-way at Mile 530. The site area is approximately $3\frac{1}{2}$ miles in length and averages 1000 feet in width. The bedrock ridge is composed of limestone and is overlain by 6 to 8 feet of fluvial silts which are relatively high in ground ice content.

The surficial drainage of the site area is good to the southwest into the Mackenzie River and to the northeast into a buried meltwater channel. A layer of topsoil, peat and organic silts, generally less than 3 feet in depth, overlies the site area and supports light to moderate growths of spruce attaining heights of 20 to 30 feet. The understory growth is relatively sparse.

There are no known critical wildlife areas in the immediate vicinity of Site 221X; however, the site is within a region which is periodically hunted and trapped by northern residents.

The only existing access to the site from the proposed Mackenzie Highway right-of-way or the CNT pole line consists of a seismic cutline and narrow trails.

DEVELOPMENT

Site 221X is not recommended as a potential source for granular materials. Although the preliminary assessment of this site by airphoto interpretation and field reconnaissance indicated that this site may be a fluvial terrace containing granular materials, the exploratory drill holes which were conducted during the winter drilling program, did not prove out any granular materials. The ridge surface is only an erosional terrace.

DETAILED DRILL HOLE LOG

SITE NO. 221X

HOLE NO. DH-1

DATE: FEB. 5, 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	PEAT: organic, fibrous, muskeg					0				
1												
2		OL	TOPSOIL: some silt, little sand and organic, dark brown					2				
3												
4		ML	SILT: some sand, rust brown		Nbn	L		3				
5												
6												
7												
8								8				
9												
10			BEDROCK: siltstone, medium brown			L		9				
			TOTAL DEPTH 10.0'					10				





DETAILED DRILL HOLE LOG

SITE NO. 221X

HOLE NO. DH-2

DATE: FEB. 5, 1973 LOGGED BY: ☒ PEMCAN ☐

DRILLING METHOD: ☒ CONVENTIONAL ☐ AIR REVERSE CIRCULATION ☐ OTHER:

				GROUND ICE CONDITIONS			SAMPLE TYPE	DEPTH (feet)				
DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GEN'L CLASS	N.R.C. CLASS	EST'D CONT.						
0		OL	TOPSOIL: some silt, organic, dark brown		Vx	M		0				
1								1				
2								2				
3		ML	SILT: some sand, medium brown					3				
4								4				
5								5				
6			BEDROCK: siltstone, medium brown		Nbn	L		6				
7								7				
8								8				
9			TOTAL DEPTH 9.0'					9				
10								10				

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY




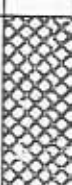




PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 221X

HOLE NO. DH-3

DATE: FEB. 5, 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		OL	TOPSOIL: some silt, organic, dark brown					0
2								2
3.0		ML	SILT: some sand, medium brown		Vx	M		4
4								4
6.0			BEDROCK: siltstone, medium brown		Nbn	L		6
8								8
10								10
12								12
12.0	TOTAL DEPTH 12.0'							12
14								14

SITE NO. 222

Location

Located on the west bank of the Mackenzie River and approximately 6 miles north of the Redstone River, Site 222 encompasses an alluvial terrace paralleling the Mackenzie River stream channel. The terrace material probably consists of silty sand.

The proposed Mackenzie Highway right-of-way parallels the opposite, east river bank and the haul distance from Site 222 to the Mackenzie Highway at Mile 521 would be about 8 miles. The proposed gas pipeline route runs east of the highway alignment.



LEGEND

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

Airphoto No. A22887/83

Approximate scale: 1" = 3,000'



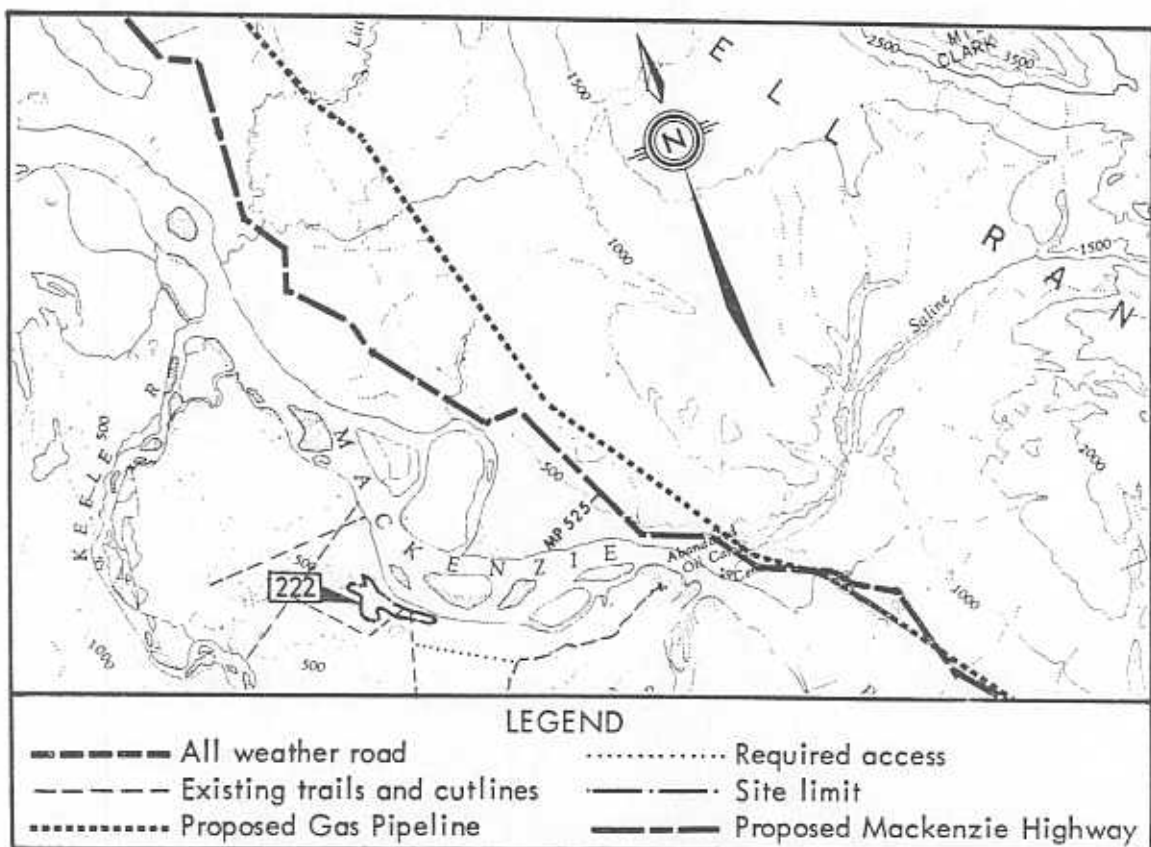
GENERAL

Site 222 consists of an alluvial terrace along the west bank of the Mackenzie River channel. The terrace is approximately 2 miles in length and averages about 1000 feet in width. The flat surface of the terrace is some 150 feet above the water level of the Mackenzie River. The steep river bank, experiencing extensive sloughing, forms the northeast site boundary. The terrain adjacent to the remainder of the terrace perimeter is covered by glaciolacustrine deposits and exhibits frequent thermokarst features, such as lakes and muskeg areas. The drainage conditions are only fair and the surficial runoff is directed into the adjacent river channel. The site area is covered with moderately dense growths of spruce with poplar and birch.

There are no known critical wildlife areas in the immediate vicinity of Site 222.

It is anticipated that the material in Site 222 consists of stratified, fine grained sands with silt topped with variable thicknesses of topsoil and silt. These terrace deposits would likely be suitable only as a very marginal general fill material.

Access to the site area is difficult because of terrain conditions and the required crossing of the Mackenzie River.



Section of Map No. 96 C

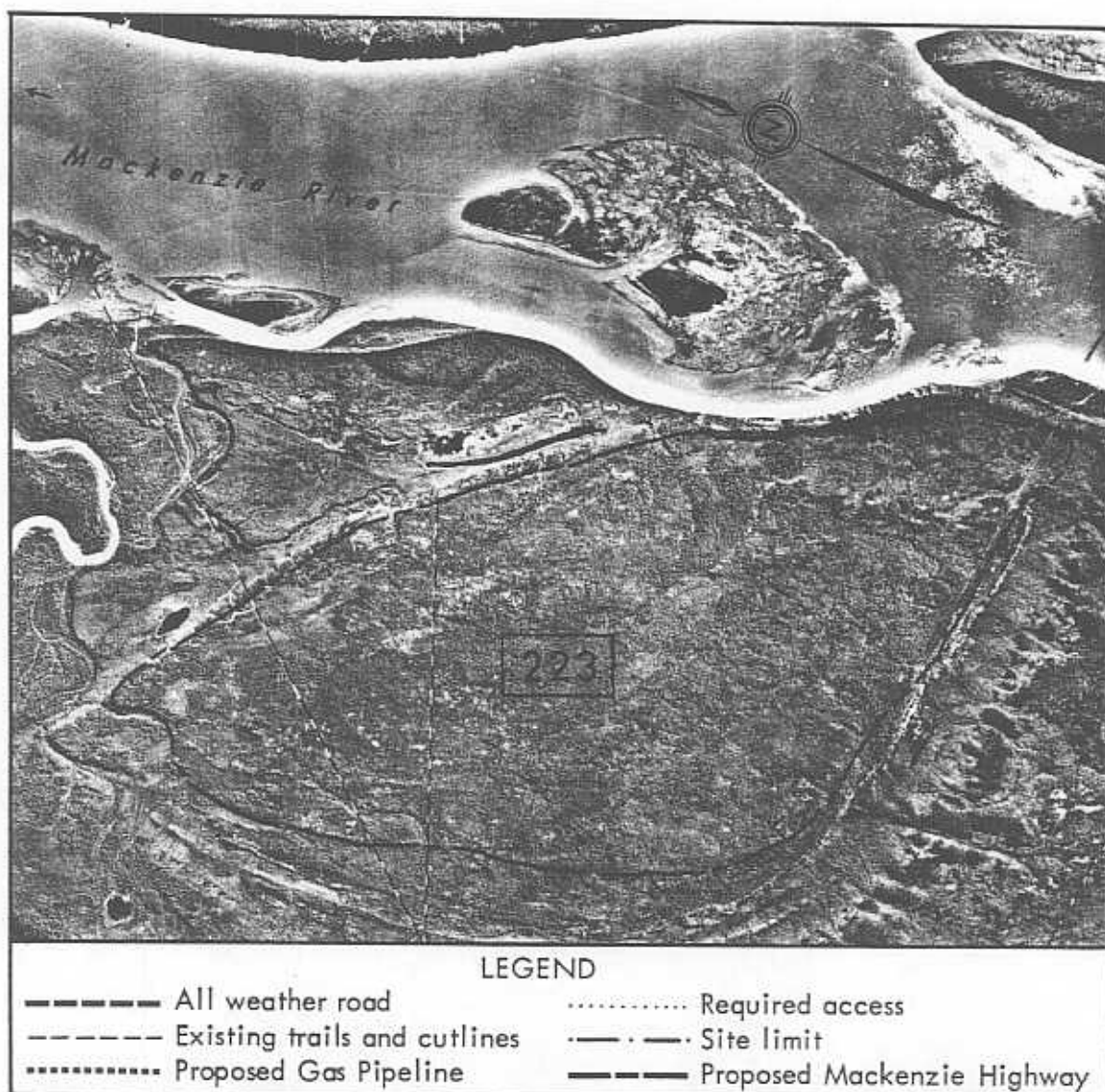
Scale: 1:250,000

SITE NO. 223

LOCATION

Located on the west bank of the Mackenzie River and immediately south of the mouth of the Keele River; Site 223 encompasses a large alluvial terrace which parallels the Mackenzie River stream channel. The terrace material is likely comprised of silty sand.

The proposed Mackenzie Highway right-of-way parallels the opposite, east river bank and the haul distance from Site 223 to the Mackenzie Highway at Mile 533 would be about 4 miles, including the crossing of the Mackenzie River. The gas pipeline route is located approximately 3 miles further east from the Highway right-of-way.



Airphoto No. A22837/35

Approximate scale: 1" = 3,000'



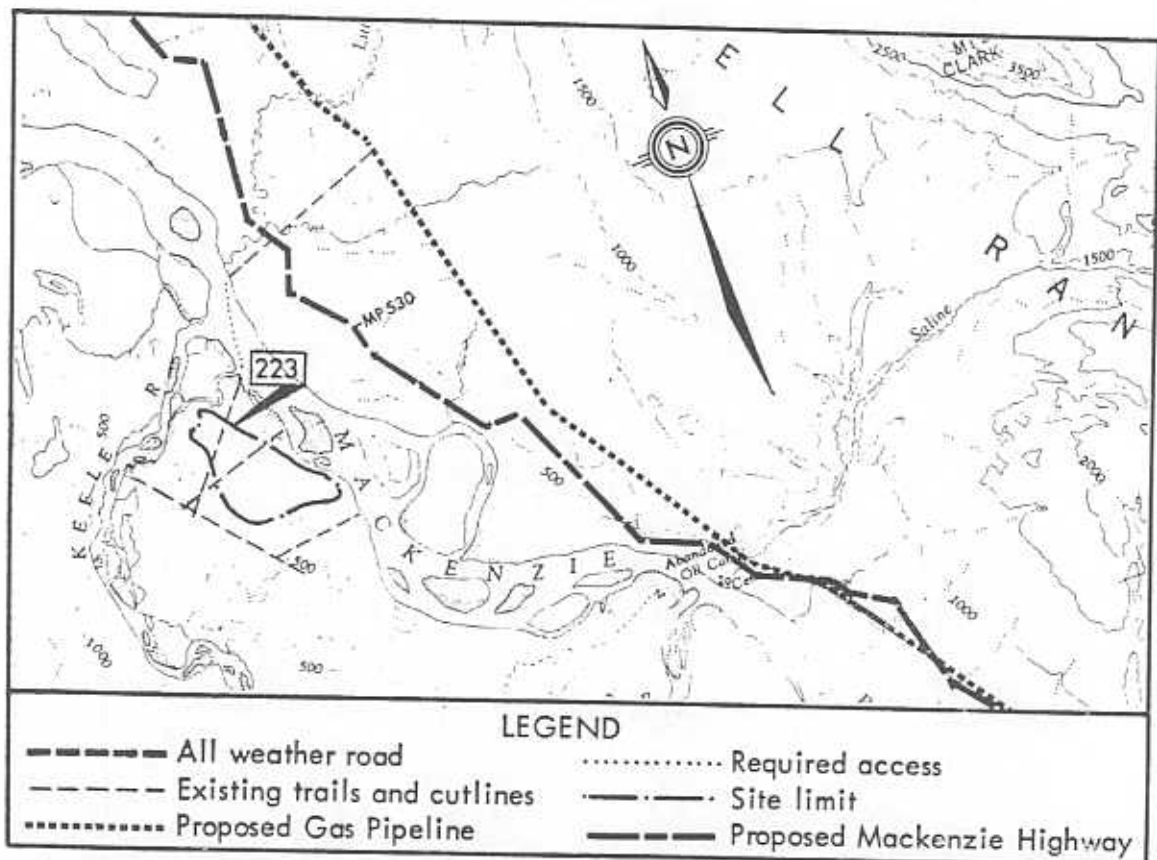
GENERAL

Site 223 encompasses a large alluvial terrace located on the western bank of the Mackenzie River. The terrace is approximately 3 miles in length and about 1 mile in width. The flat terrace surface is about 100 feet above the water level of the Mackenzie River. Abandoned river arms exhibiting oxbow lakes and muskeg terrain characterize the area north and west of the site. Glaciolacustrine sediments cover the terrain south of Site 223 and exhibit thermokarst features, such as small lakes and muskeg areas.

The surficial drainage conditions are only fair and the runoff is directed into the adjacent river channels. The site area is covered with moderately dense growths of spruce, poplar and birch. There are no known critical wildlife areas in the immediate vicinity of Site 223.

It is anticipated that the material in Site 223 consists of stratified, fine grained sands and silt topped with variable thicknesses of topsoil and silt. These terrace deposits would likely be suitable only as a very marginal general fill material.

Access to the site is difficult because of terrain conditions and required crossing of the Mackenzie River.



Section of Map No. 96 C

Scale: 1:250,000

SITE NO. 224

Located approximately $5\frac{1}{2}$ miles south of Little Smith Creek and 5 miles east of the proposed Mackenzie Highway at Mile 529, Site 224 consists of a partially eroded kame-esker complex on the western slopes of the McConnell Range.

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

Estimated Volume: In excess of 2,000,000 cubic yards.

Assessment: Good quality granular materials which are suitable in the pit run condition for quality fill in road bases and general construction requirements. Site 224 is recommended for development; however, access to the site is very difficult.



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. A22887/38

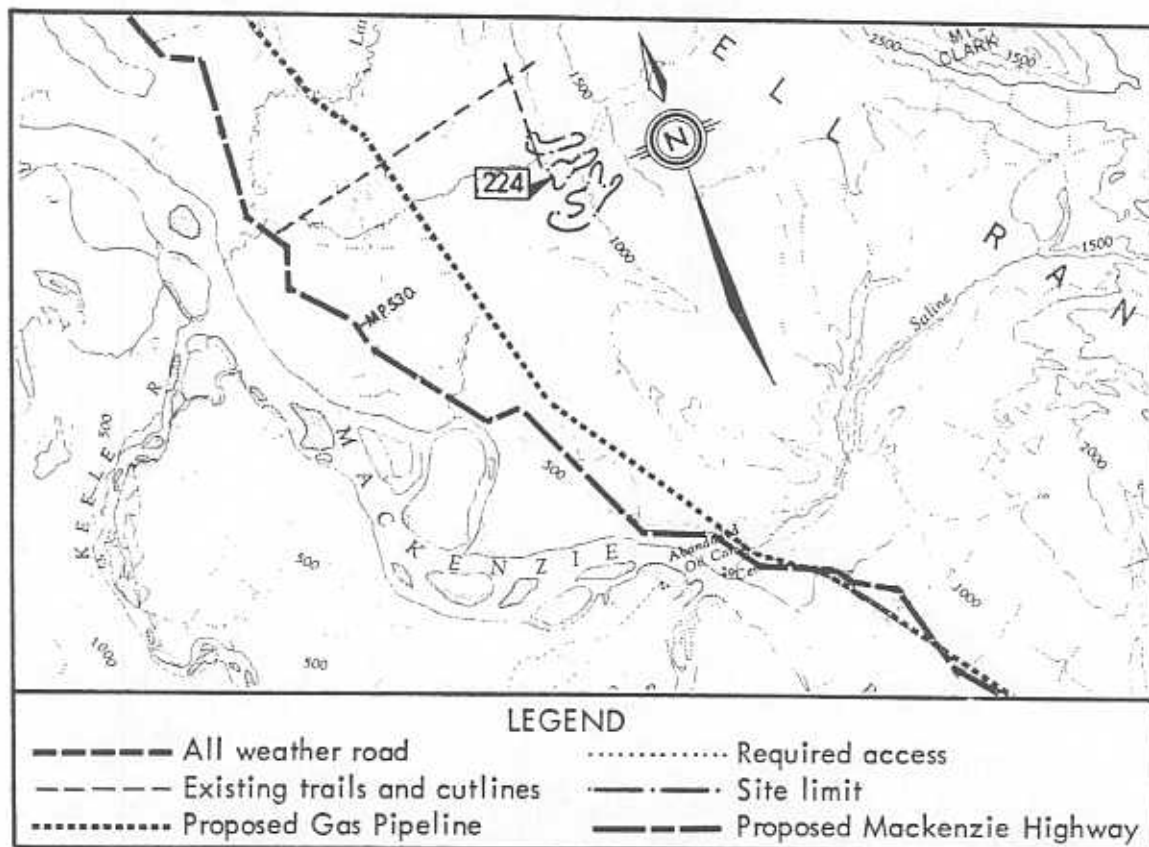
Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 224 is located $5\frac{1}{2}$ miles south of Little Smith Creek and 5 miles east of the proposed Mackenzie Highway right-of-way at Mile 529. The site consists of a partially eroded kame-esker complex located on the gently sloping southwestern flanks of the McConnell Range. The site encompasses a total area approximately $1\frac{1}{2}$ miles in length and 1 mile in width. A major esker ridge rising to heights in excess of 100 feet is located along the southern perimeter of the site area whereas the northern portion of the site consists of numerous partially eroded remnants of esker ridges and kame terraces. A small stream flowing from a deeply incised canyon to the northeast of the site area in the McConnell Range has cut its channel through the northern portion of the site area. The esker ridges and kame terraces which comprise the site area exhibit steep slopes and are well drained. The adjacent terrain exhibits good surficial drainage to the west into several small streams which comprise the general watershed of Little Smith Creek.

The material in the kame-esker deposits is highly variable and ranges from fine to medium sands to coarse grained gravels. A relatively shallow depth of topsoil, varying from $\frac{1}{2}$ to $1\frac{1}{2}$ feet, overlies the granular materials and supports moderate growths of spruce and tam-





arack with interspersed sparse growths of birch and poplar. The understory growth consisting primarily of sedge grass and small bush is relatively sparse. The adjacent terrain consisting of a shallow till plain overlying bedrock supports moderately dense growths of spruce, interspersed with poplar.

There are no known critical wildlife areas in the immediate vicinity of Site 224.

The only existing access to the site from the CNT pole line or the proposed Mackenzie Highway and gas pipeline right-of-way consists only of seismic cutlines. In addition, future access to Site 224 will require the crossing of several deeply incised stream channels and a distance of in excess of 12 miles from the proposed Mackenzie Highway. The overall thermal sensitivity of the terrain over which access roads will have to be routed is considered to be moderately low.

DEVELOPMENT

The exploratory drilling which was carried out on Site 224 showed the following, relative to the quality and quantity of available granular materials:

- The materials represented by the kame-esker complex are variable, and range from fine grained sands to coarse grained gravels. In general, the better quality granular materials are located in the large prominent esker ridge which is located along the southern perimeter of the site area.
- The granular materials are considered suitable in the pit run condition for quality fill in the construction of road bases, building pads and other utility backfill. Pockets and shallow layers of better quality, clean gravels may be selectively recovered for production of concrete, surface and base course aggregates.
- The in situ materials were frozen at the time of the winter drilling program, however, the ground ice content is very low and the in place sands and gravels are in a very friable state.

Site 224 is recommended as a possible source of granular materials because of the general scarcity of naturally occurring granular materials in this portion of the Study Area. A very lengthy access involving the crossing of several deeply incised stream channels is required from the location of proposed utilities to this site. The following operational guidelines should be followed if this site is developed for borrow pits:

- The existing tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil layer should be stripped, removed and stockpiled adjacent to the borrow pit areas in designated locations, preferably along the slopes of the esker ridge.



- Operating procedures during borrow pit development should be maintained whereby surficial waste materials do not drain into the adjacent small stream channels.
- Stands of natural growth should be retained between borrow pit areas in order to promote natural regeneration after abandonment.
- Generally, dozers, overhead loaders and standard ripping equipment should be adequate for the removal of material from this site. The selection of heavier equipment may be required if higher ground ice contents are encountered at deeper extremities in this ridge.
- The existing seismic cutline may have to be upgraded to an all weather status unless development of this site is restricted to the winter months.

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 reseeding of annuals and perennials will result in a semi-permanent cover growth prior to reestablishment of native species.





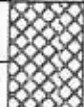
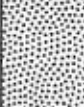
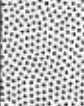
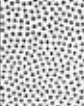
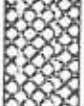





DETAILED DRILL HOLE LOG

SITE NO. 224

HOLE NO. DH-1

DATE: FEB. 24, 1973 LOGGED BY: ☒ PEMCAN ☐

DRILLING METHOD: ☒ CONVENTIONAL ☐ AIR REVERSE CIRCULATION ☐ OTHER:

CONVENTIONAL  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	1.5 TOPSOIL: some silt, organic, dark brown		N	M	MC	0
3		SM-SP						3
6								6
9			12.0 SAND: little silt, fine grained, poorly graded, occasional pebbles to 1/2" size, light brown					9
12								12
15								15
18		GP	GRAVEL: little sand, poorly graded, medium grained, brown					18
21								21
24								24
			TOTAL DEPTH 21.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 224

HOLE NO. DH-2

DATE: FEB. 4, 1973

LOGGED BY: ☒ PEMCAN

DRILLING METHOD: ☐ CONVENTIONAL ☒ AIR REVERSE CIRCULATION ☐ OTHER:

CONVENTIONAL <input checked="" type="checkbox"/> CIRCULATION <input type="checkbox"/> OTHER: <input type="checkbox"/>									
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		GM-GW	GRAVEL: some sand, trace silt, medium to coarse grained, well graded, predominantly subangular igneous and quartzite pebbles to 2" size, frequent cobbles and boulders, medium brown		N	L		GS P LA	0
2									2
4									4
6									6
8									8
10									10
12									12
14									14
15.0									15.0
16									16
TOTAL DEPTH 15.0'									
Note: refusal on boulder									

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

PEMCAN SERVICES "72"

GRANULAR MATERIALS INVENTORY

DETAILED DRILL HOLE LOG

SITE NO. 224

HOLE NO. DH-3

DATE: FEB. 4, 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		GM-OL	GRAVEL: some silt, very organic, medium brown		Nf	L		0
1								1
2			2.0					2
			TOTAL DEPTH 2.0'					
			Note: Refusal on boulder at three locations; discontinued drilling					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY







PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 224


HOLE NO. DH-4

DATE: FEB. 2, 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 CONDITIONS			ICE EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS				
0		OL	1.0 TOPSOIL: some silt, organic, dark brown		Nf	L		0	
3		ML	SILT: trace sand, light brown					3	
6		7.0	GRAVEL and SAND: little silt, medium brown					6	
9	GM	10.0	SILT: little sand, frequent pebbles to 3/4" size, medium brown					9	
12		ML	22.0 TOTAL DEPTH 22.0'					12	
15				15					
18				18					
21				21					
24								24	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY







PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 224

HOLE NO. DH-4A

DATE: FEB. 2, 1973 LOGGED BY: ☒ PEMCAN ☐
 DRILLING METHOD: ☒ AIR CONVENTIONAL ☐ AIR REVERSE CIRCULATION ☐ OTHER:

CONVENTIONAL 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, dark brown		NF	L		0				
3		GW	GRAVEL and SAND: little silt, medium grained, well graded, occasional boulders, rust brown					3				
6								6				
9		ML-CL	9.0 SILT: some clay, occasional sand pockets and pebbles to 1/2" size, few boulders, medium grey					9				
12								12				
15								15				
18								18				
21			22.0 TOTAL DEPTH 22.0'					21				
24								24				

GOVERNMENT OF CANADA
 DEPARTMENT OF INDIAN AFFAIRS
 AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 224

HOLE NO. DH-5

DATE: FEB. 2, 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		GM	GRAVEL; some silt, medium brown		Nf	L	MC	0
3								3
6								6
9		GW-SM	GRAVEL AND SAND: little silt, fine to coarse grained, well graded, medium brown		Nf	L	MC	9
12								12
15								15
18		GW-SM	GRAVEL AND SAND: little silt, fine to coarse grained, well graded, medium brown	UF			MC	18
21								21
24								24
			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. 224

HOLE NO. DH-6

DATE: FEB. 4, 1973	LOGGED BY: <input checked="" type="checkbox"/> PEMCAN <input type="checkbox"/>
DRILLING METHOD: <input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> AIR <input type="checkbox"/> AIR REVERSE CIRCULATION <input type="checkbox"/> OTHER:	

CONVENTIONAL										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			OL	1.5 TOPSOIL: some silt, trace sand and organic, dark brown						NF		L		MC GS O, P	0														
3			GP-GM	GRAVEL: some sand, little silt, poorly graded, medium brown											3														
6		ML	7.0				6																						
9			SILT: little sand, medium brown				9																						
12		GW-SW	12.0				12																						
15			GRAVEL and SAND: little silt, fine to coarse grained, well graded, subangular and sub-rounded, predominantly quartzite with limestone and dolomite pebbles to 3/8" size, rusty brown				15																						
18							18																						
21			22.0											21															
24			TOTAL DEPTH 22.0'											24															

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

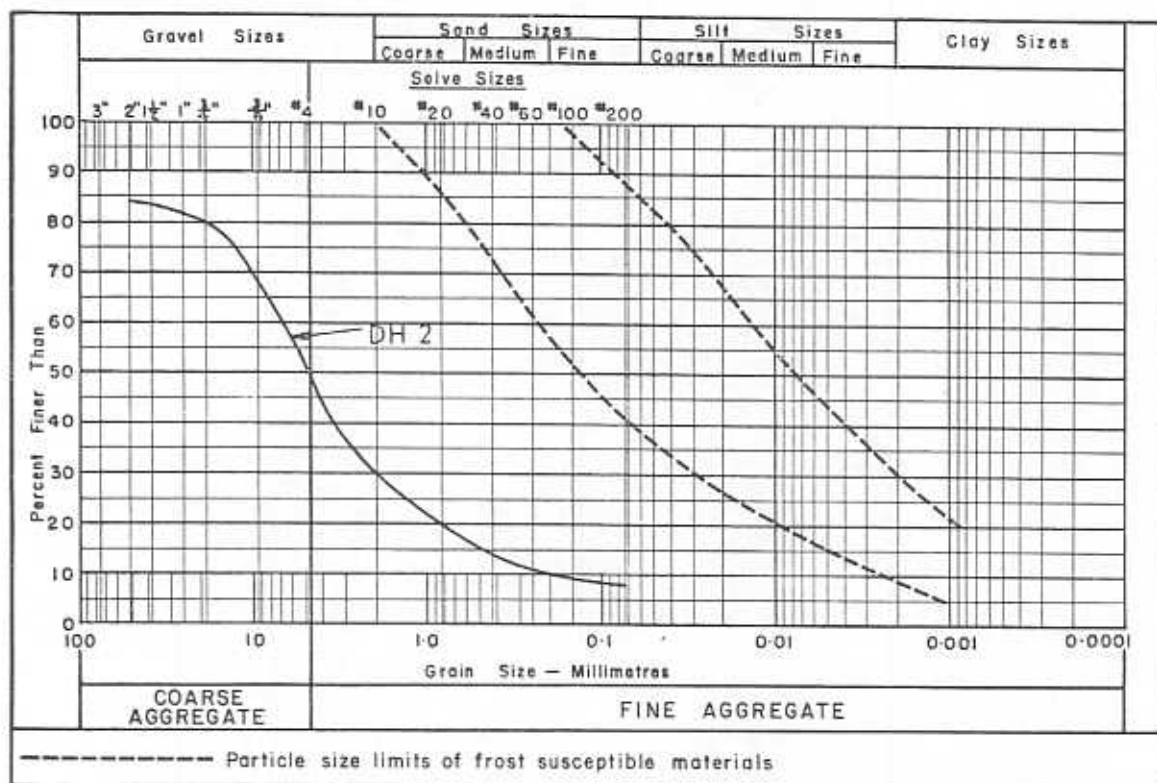


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	224/DH 1	224/DH 2
Sample Depth (Feet):	8-9	2-5
Moisture Content (%):	15.1	-
Ice Content (%):	-	-
Organic Content (%):	-	-

GRAIN SIZE DISTRIBUTION:



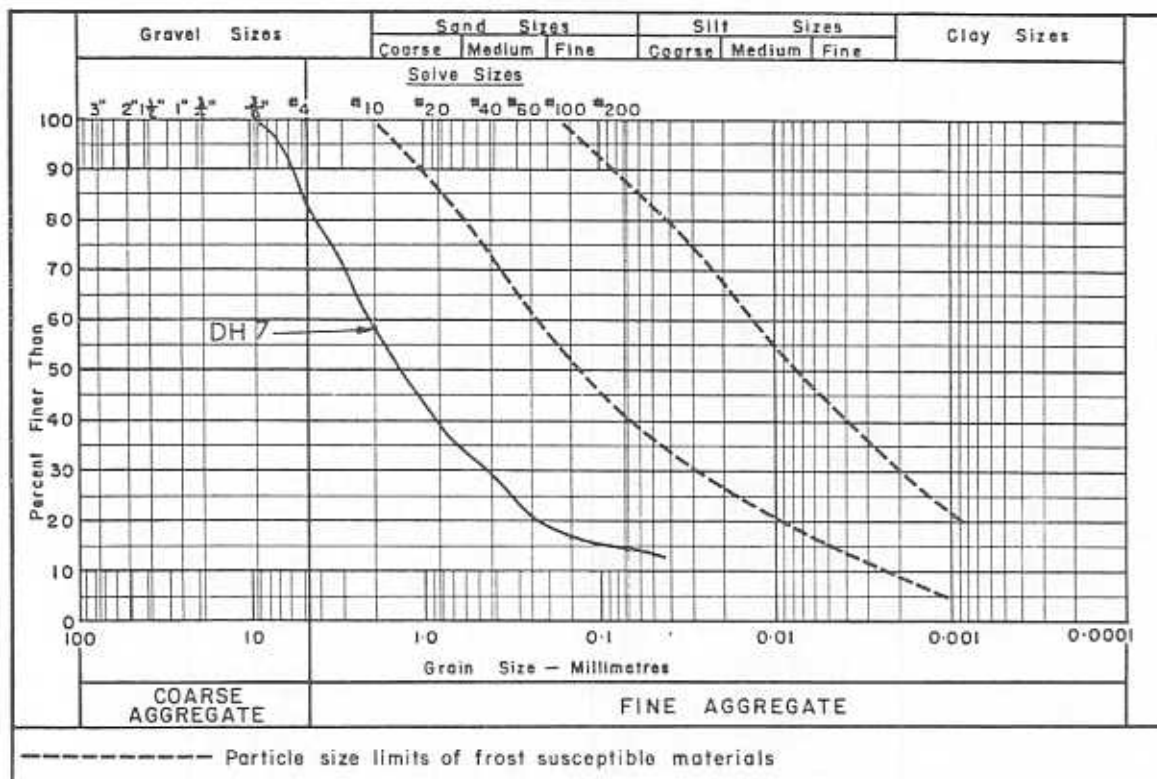
PETROGRAPHIC ANALYSIS: (224/DH 2 @ 2'-5')

Igneous	49.0%
Quartzite	30.3%
Limestone & dolomite (sound)	17.6%
Deleterious	
Siltstone, sandstone and ironstone	3.1%

SUMMARY OF LABORATORY TEST DATA

Sample Location:	224/DH 5	224/DH 5	224/DH 7
Sample Depth (Feet):	7-9	19-21	15-17
Moisture Content (%):	3.6	12.0	5.4
Ice Content (%):	-	-	-
Organic Content (%):	-	-	1.8

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS: (224/DH 7 @ 15'-17')

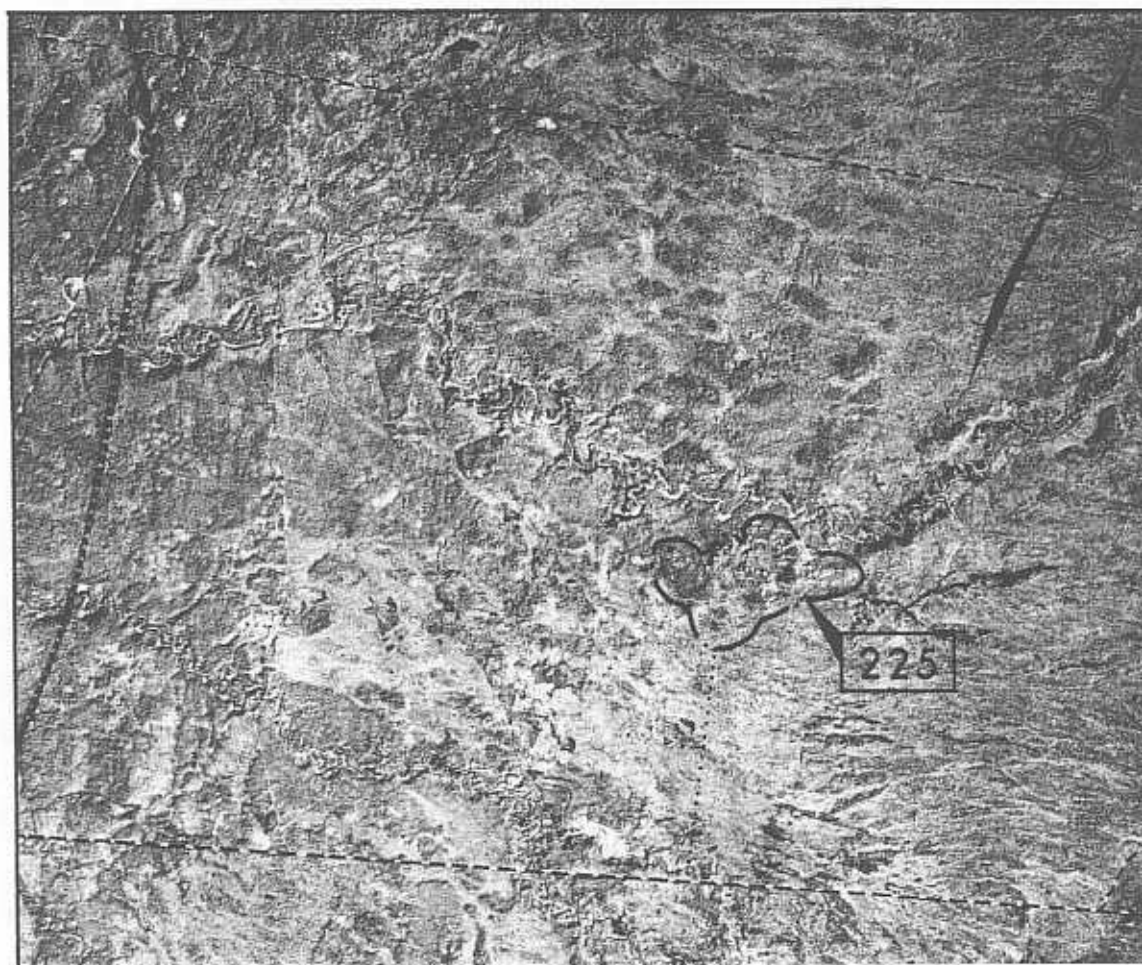
LITHOLOGIC ANALYSIS: (ZZ4/DH 7 @ 15-17')		Hardness
Quartzite	57.7%	6.5-7
Limestone & dolomite (sound)	17.1%	4-5
Igneous	11.8%	6-7
Chert (stable)	2.4%	5-6
Deleterious		
Siltstone, sandstone and mudstone	11.0%	1-2

SITE NO. 225

LOCATION

Located approximately 2 miles southeast of Little Smith Creek at the eastern periphery of the Mackenzie Plain, Site 225 consists of a series of small hummocks formed by glacio-fluvial outwash deposits.

The proposed Mackenzie Highway right-of-way at Mile 534 is located approximately $5\frac{1}{2}$ miles west of Site 225 and the proposed gas pipeline route runs about 3 miles west of the site area.



LEGEND

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

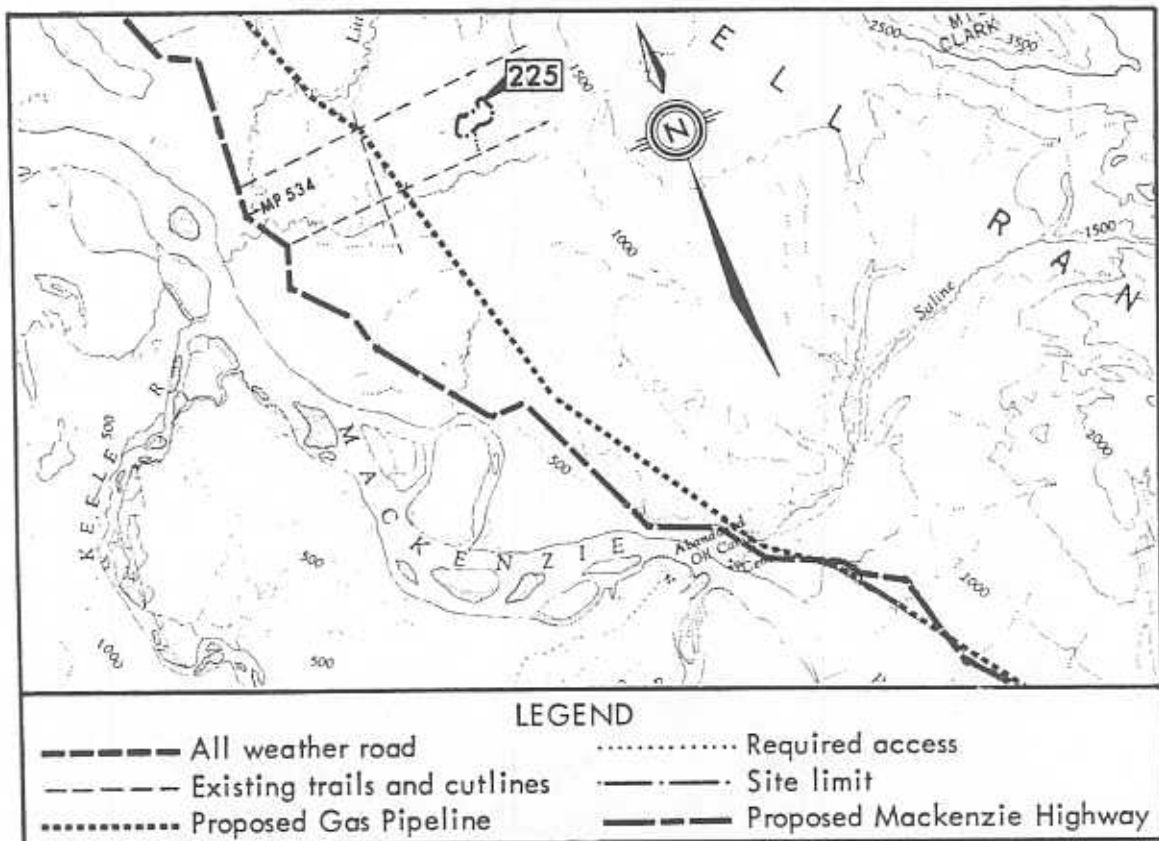


GENERAL

Site 225 is comprised of hummocky knobs approximately 10 to 15 feet high and several hundred square yards in size, which are irregularly spaced over the site area on the south side of an unnamed stream. Adjacent terrain is relatively flat with drainage into the adjacent stream channel. Spruce and poplar are the predominant vegetation growths on the hummocky terrain. There are no known critical wildlife areas in the immediate vicinity of Site 225.

Glaciofluvial outwash deposits may contain any mixture of sand, gravel and silty to clayey till. Geomorphologic features are indicative of rather fine grained material suitable only as low quality general fill. Because of small quantities of doubtful quality material, the site is classified only as a fair prospect.

The access to the site can be achieved through existing seismic cutlines although the crossing of small stream channels is necessary.



Section of Map No. 96 C

Scale: 1:250,000

SITE NO. 226

Located approximately 1 mile southeast of Little Smith Creek and 7 miles northeast of the proposed Mackenzie Highway at Mile 533, Site 226 consists of a prominent bedrock ridge.

Type of Material: Limestone Bedrock; surficially weathered.

Estimated Volume: Unlimited.

Assessment: Good quality general fill material can be produced from the weathered surficial zone and aggregates for base and surface courses can be produced from the fresh and massive limestone beds at depth. Site 226 is recommended as a possible source for quarried granular materials.



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. A22887/36

Approximate scale: 1" = 3,000'

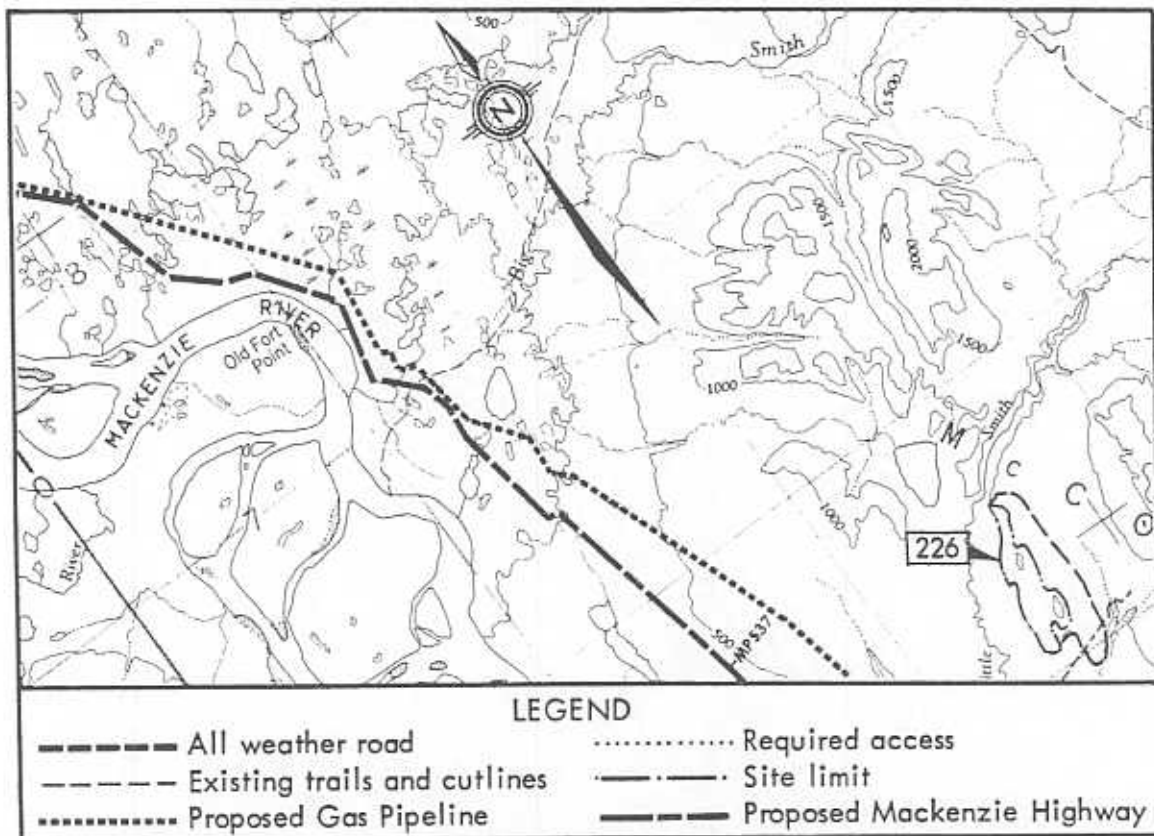


ENVIRONMENT

Site 226 is located approximately 1 mile southeast of Little Smith Creek and 7 miles north-east of the proposed Mackenzie Highway right-of-way at Mile 533. The site encompasses a prominent bedrock ridge which is approximately $\frac{1}{2}$ mile in width and $2\frac{1}{2}$ miles in length. The site rises more than 400 feet above the adjacent terrain and exhibits a predominant slope towards Little Smith Creek. The ridge surface is rugged with several large outcrops and bluffs of exposed dolomite. This area geologically belongs to the Franklin Mountain dolomite and shale formation; therefore, interbedded shale may be encountered. A relatively shallow and narrow belt of slope wash and scree borders the ridge.

The adjacent terrain to the east of Site 226 outlined by dotted lines (ref. Site airphoto, page 226-1) consists of shallow glacial till overlying bedrock. The exposed bedrock is slightly weathered within its surficial zone but is considered to be sound and competent with depth. The site area and adjacent terrain exhibit good drainage to the west and south. A sparse growth of spruce covers the site area except in areas of exposed outcrops. The adjacent terrain supports moderately dense growths of spruce with the occasional poplar attaining heights in excess of 40 feet.

There are no known critical wildlife areas in the immediate vicinity of Site 226.



Section of Map No. 96 C

Scale: 1:250,000



The only access to the site from the proposed Mackenzie Highway or CNT pole line consists of a seismic cutline which passes approximately $\frac{1}{2}$ mile east of the bedrock ridge. The proposed gas pipeline is located approximately 2 miles west of Site 226.

DEVELOPMENT

Site 226 may represent a good prospect for a quarry which can be developed at several locations along the outside perimeter of the ridge. Possible quarry locations are designated with "x's" on the preceding site airphoto, page 226-1. The general remoteness of this site to proposed utilities may restrict development of quarry operations.

A single drill hole was carried out on a prominent knoll within the dotted sector of the site area and showed glacial till material to depths investigated.

It is considered that good quality general fill material can be produced from the fractured surficial bedrock zones. Aggregates for surface courses can be produced from the fresh and massive underlying dolomite and limestone beds. The following operational guidelines should be considered if development of quarries on Site 226 is anticipated at a future date:

- The southern and northwestern perimeters of the site are best suited for quarry locations. These locations are designated with "x's" on the site airphoto.
- Some stripping of overburden material consisting of topsoil, colluvium and glacial till may be required depending upon the actual location of the quarry.
- Although the surficial bedrock zone is slightly weathered, it will very likely require blasting to be extracted.
- The fresh and massive underlying bedrock zone will require blasting for removal.
- Access roads to the site area will require proper upgrading to minimize erosional deterioration.

ABANDONMENT AND REHABILITATION




If Site 226 is developed at a future date, then restoration procedures that are compatible with the development and legislative land use requirements that are current at that time should be developed.

DETAILED DRILL HOLE LOG

SITE NO. 226

HOLE NO. DH-1

DATE: FEB. 5, 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 CONDITIONS		ICE EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS			
0		OL	1.0 TOPSOIL: some silt, organic, roots, dark brown					0
2		ML	SILT: little sand, occasional sub-angular or subrounded pebbles to 1 1/2" size, light brown	Vx	L			2
4			5.0					4
6			- some clay, occasional pebbles and cobbles, dark grey (TILL)	Vx Vr	L-M			6
8			8					
10								10
12								12
13.0			TOTAL DEPTH 13.0'					14

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

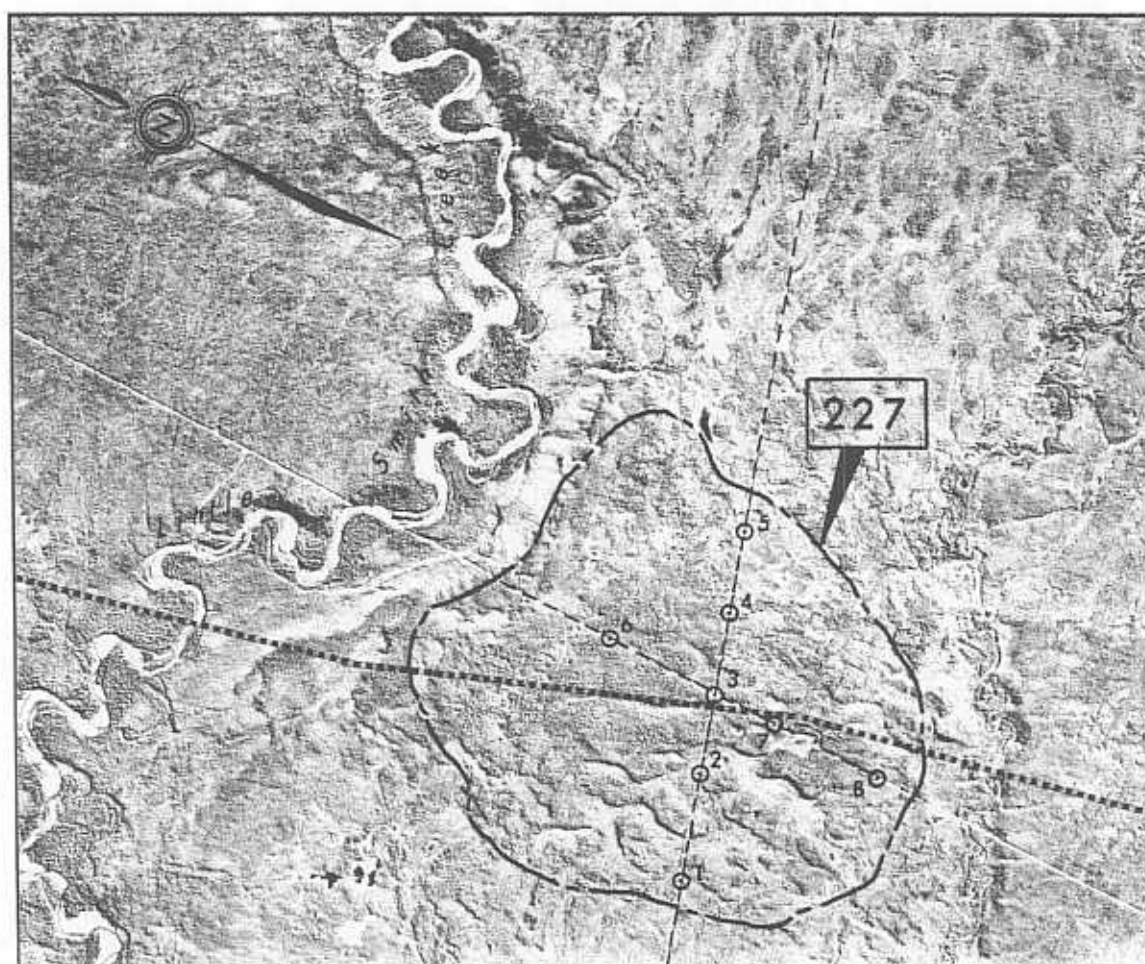
SITE NO. 227

Located immediately adjacent to the south bank of Little Smith Creek and 3 miles east of the Mackenzie Highway at Mile 533, Site 227 consists of a large glaciofluvial outwash plain.

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

Estimated Volume: 25,000,000 cubic yards.

Assessment: Good quality material suitable in the pit run condition as general fill for the construction of road bases, pipeline berms and utility backfill; Site 227 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. A22887/36

Approximate scale: 1" = 3,000'

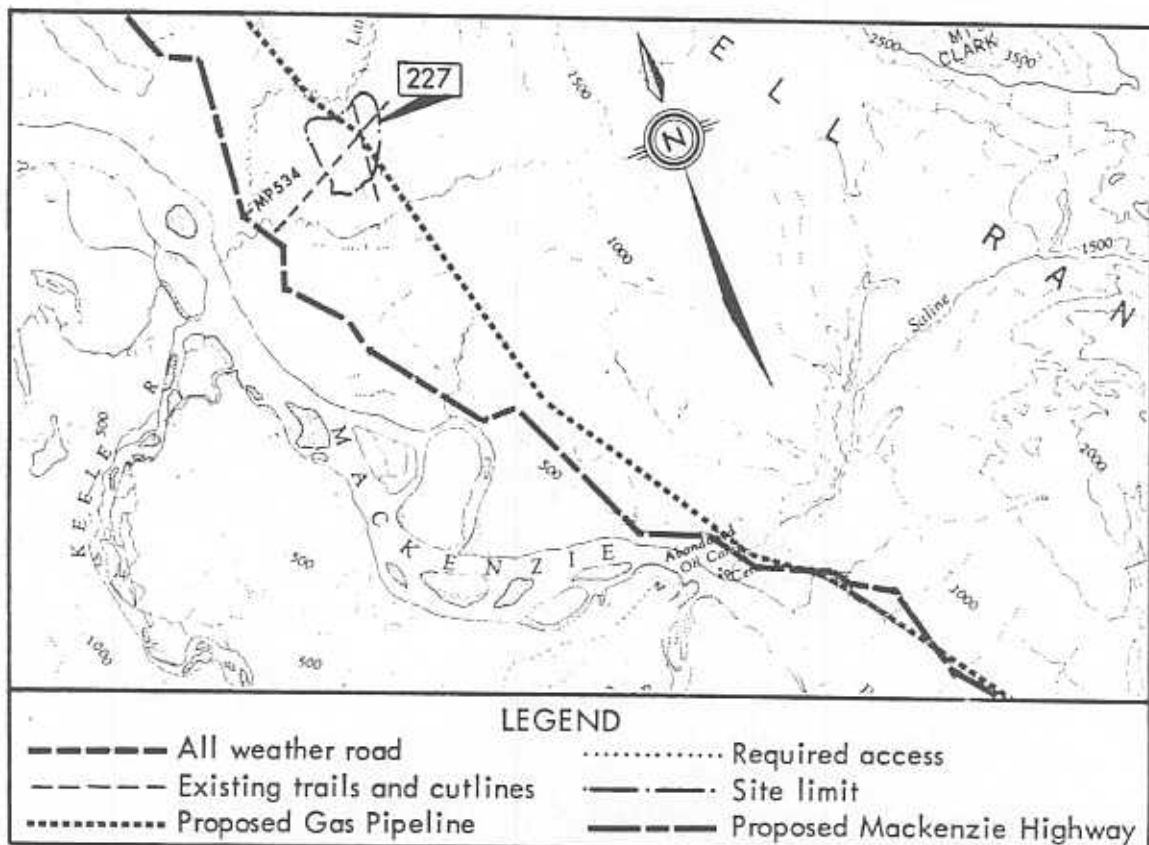


ENVIRONMENT

Site 227 is located immediately adjacent to the south bank of Little Smith Creek and approximately 4 miles upstream from the east bank of the Mackenzie River. The site is located 3 miles east of the Mackenzie Highway right-of-way at Mile 533. The site consists of a large glaciofluvial outwash plain which is approximately $1\frac{1}{2}$ miles in length and $1\frac{1}{2}$ miles in width. The south bank of the meandering Little Smith Creek stream channel forms the northern boundary of the site and an unnamed stream forms the southern boundary. The site area appears to be relatively well drained and the steep south bank of Little Smith Creek exhibits numerous dry erosional gullies. The surface of the plain is pitted.

The glaciofluvial plain consists of stratified fine to medium grained sands and medium grained gravels. In general, the predominance of sands was noted closer to the surface and in the southwestern portion of the site area. A very shallow layer of topsoil, approximately 6 inches in depth, overlies the granular materials and supports dense growths of spruce and birch ranging in height to 40 feet and in trunk diameter to 12 inches. The understory growth is moderately dense and consists primarily of small bushes.

There are no known critical wildlife areas in the vicinity of Site 227, although the area immediately to the west of the site is periodically hunted and trapped by northern residents.



Section of Map No. 96 C

Scale: 1:250,000



The only existing access consists of the seismic cutline which extends eastward from the CNT pole line and the proposed Mackenzie Highway right-of-way. The proposed gas pipeline route is located through the centre of Site 227.

DEVELOPMENT

The exploratory drill holes which were carried out on Site 227 showed the following conditions relative to the quality and quantity of available granular materials:

- Fine to medium grained sands predominate in the initial 5 to 10 feet and also in the southwestern portion of the site area.
- Medium grained gravels with some sand underlie the surficial layer of sand to depths in excess of the drill holes investigated.
- The depths of recoverable granular materials is considered to be in excess of 20 to 30 feet, although an average depth of 15 feet was used in calculations of volume.
- The sands and gravels are suitable for quality granular fill material in the pit run condition in the construction of road bases, pipeline berms and other general embankment construction. The coarse grained gravels can be used in the production of concrete, base and surface course aggregates.
- The overburden material consisting primarily of topsoil is generally less than 1 foot in depth.
- It is considered that granular materials in excess of 25,000,000 cubic yards are potentially recoverable from Site 227.

Site 227 is recommended as a potential source of granular materials and the following operation 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.
- Operating procedures during borrow pit development should be maintained whereby surficial waste materials do not drain into the active Little Smith Creek channel nor into the small unnamed stream channel along the southern perimeter of the site area.
- A vegetation buffer zone of adequate breadth be retained between the outer limits of the borrow pit areas and the southern shoreline of Little Smith Creek.



- 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 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.
- The existing seismic cutline may have to be upgraded to an all weather status unless development of this site is restricted to the winter months.

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 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. 227

HOLE NO. DH-1

DATE: FEB. 5, 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, little organic, roots, brown					0
2		SM	3.0 SAND: some silt, light brown					2
4								4
6			SAND: fine grained, poorly graded, greyish brown		Vx	L		6
8								8
10		SP	- fine to medium grained, occasional rounded and subangular pebbles to 1" size from 11.0'	UF				10
12					Vx	L		12
14								14
16								16
18								18
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. 227

HOLE NO. DH-2

DATE: FEB. 5, 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, trace organic, roots, brown					0
2		SM	3.0 SAND: some silt, fine grained, poorly graded					2
4								4
6			SAND: fine grained, poorly graded, brown					6
8					Vx	L		8
10		SP	- occasional rounded and sub-rounded pebbles to 1" size from 10.0'					10
12								12
14								14
16								16
18								18
20			200 TOTAL DEPTH 20.0'				MC	20

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"





DETAILED DRILL HOLE LOG

SITE NO. 227

HOLE NO. DH-3

DATE: FEB. 5, 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, dark brown		Vx Vr	M		0
2		ML	SILT: some sand, trace clay, brown					2
4								4
6			SAND: fine grained, poorly graded, brown					6
8		SP			Vx	L		8
10								10
12		SW	- little gravel, well graded, predominantly subangular quartzite pebbles to 3/4", greyish brown					12
14								14
16		GW-SW	GRAVEL and SAND: medium to coarse grained, well graded, sub-angular quartzite pebbles and cobbles to 4" size, grey					16
18			TOTAL DEPTH 17.0'					18

DETAILED DRILL HOLE LOG

SITE NO. 227

HOLE NO. DH-4

DATE: _____ 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
		OL	TOPSOIL: some silt, little organic, roots, brown		Vx Vr	M		
2		MH	SILT: some clay, light brown					2
4								4
6								6
8		SP	SAND: fine grained, poorly graded, occasional rounded and subangular pebbles to 1" size, brown		Vx	L		8
10								10
12		SW	- little gravel, well graded, brown					12
14								14
16		GW-SW	GRAVEL and SAND: medium to coarse grained, well graded, predominantly subangular pebbles to 1" size, frequent cobbles and boulders, brown				MC GS	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. 227

HOLE NO. DH - 5

DATE: FEB. 5, 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								0
0.5		OL	TOPSOIL: some silt, organic, roots, drak brown.					0.5
2		SM-SP	SAND: trace silt, fine grained poorly graded, occassional pebbles to 3/4" size, light brown.					2
4.0								4
6		SW-GW	SAND AND GRAVEL: fine to coarse grained, well graded, predominantly subangular quartzite and limestone pebbles 3/4" size, brown.					6
8.0								8
8					Vx	L	MC GS	8
10		GW	GRAVEL: some sand, trace silt, fine to coarse grained, well graded, predominantly subangular quartzite with igneous pebbles to 2" size, occassional cobbles and boulders, brown.				GS P La	10
13.0								12
13.0			TOTAL DEPTH 13.0'					14
14								

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



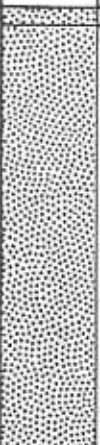



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 227

HOLE NO. DH - 6

DATE: FEB. 5, 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		SM	SAND: some silt, fine grained, poorly graded, light brown.		Vx	L		0
3		SP	SAND: fine to medium grained, poorly graded, brown.					6
6								9
9		GW	GRAVEL: some sand, fine to coarse grained, well graded, predominantly subangular and subrounded quartzite igneous and limestone pebbles to 1" size, few 2" size, occassional cobbles, greyish brown.		Vx	L		11.0
12								15
15								18
18								21
21			TOTAL DEPTH 21.0'					21
24								24

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 227

HOLE NO. DH - 7

DATE: FEB. 5, 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 CONDITIONS		ICE EST'D CONT.	SAMPLE TYPE	DEPTH (feet)	
				GEN'L CLASS	N.R.C. CLASS				
0	[Pattern]	SM	1.0 SAND: little silt, light brown	[Pattern]	Vx	L	MC GS O	0	
2									
4									
6									
8									
10									
8		[Pattern]	SP	SAND: fine grained, poorly graded, occasional subangular and rounded pebbles to 1½" size greyish brown	UF				8
10									
12									
14									
16									
18									
12	[Pattern]	SP-GW	12.0 - some gravel, medium grained, sand poorly graded, gravel well graded, rounded to subangular pebbles to 1" size, greyish brown	Vx	L		12		
14									
16									
18									
20									
22									
18	18.0 TOTAL DEPTH 18.0'						18		
20							20		

DETAILED DRILL HOLE LOG

SITE NO. 227

HOLE NO. DH - 8

DATE: FEB. 5, 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 CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0								0
0.5		OL	TOPSOIL: some silt, little organic, roots, dark brown					
2		ML	SILT: some sand, light-brown					2
4.0								4
4.0		SM-SP	SAND: some silt, very fine grained, poorly graded, greyish brown		Vx	L		4
6								6
8								8
10								10
12				UF			MC	12
14								14
16								16
18					Vx	L		18
20.0			TOTAL DEPTH 20.0'					20

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

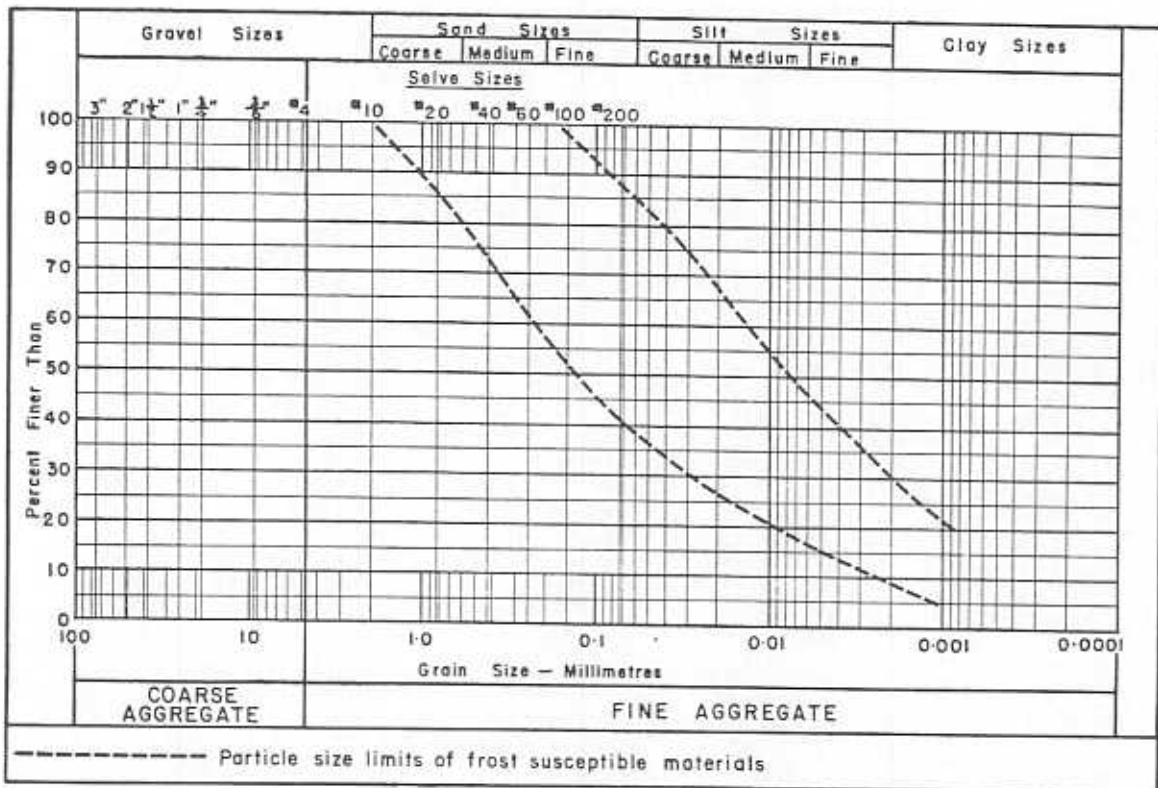


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	227/DH 2	227/DH 4	227/DH 6
Sample Depth (Feet):	19	15	10
Moisture Content (%):	10.9	3.1	8.6
Ice Content (%):	-	-	-
Organic Content (%):	-	-	-

GRAIN SIZE DISTRIBUTION:

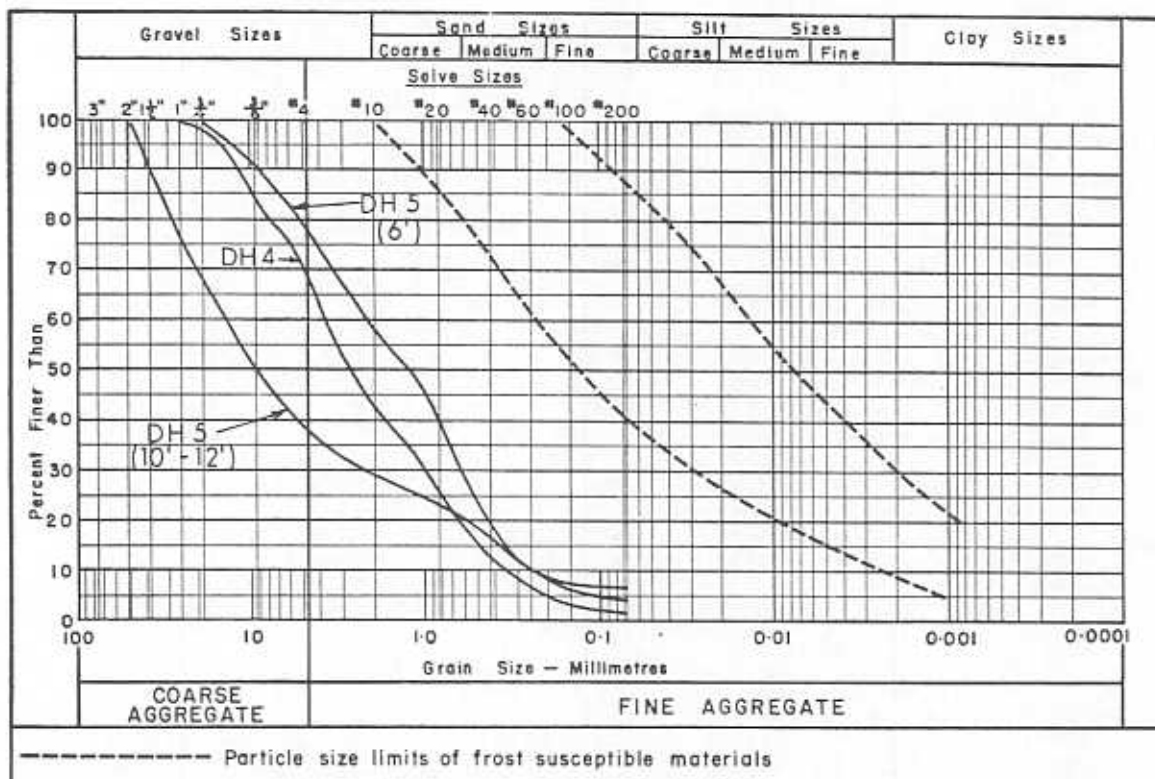


PETROGRAPHIC ANALYSIS:

SUMMARY OF LABORATORY TEST DATA

Sample Location:	227/DH 4	227/DH 5	227/DH 5
Sample Depth (Feet):	15	6	10-13
Moisture Content (%):	-	3.1	-
Ice Content (%):	-	-	-
Organic Content (%):	-	-	-

GRAIN SIZE DISTRIBUTION:



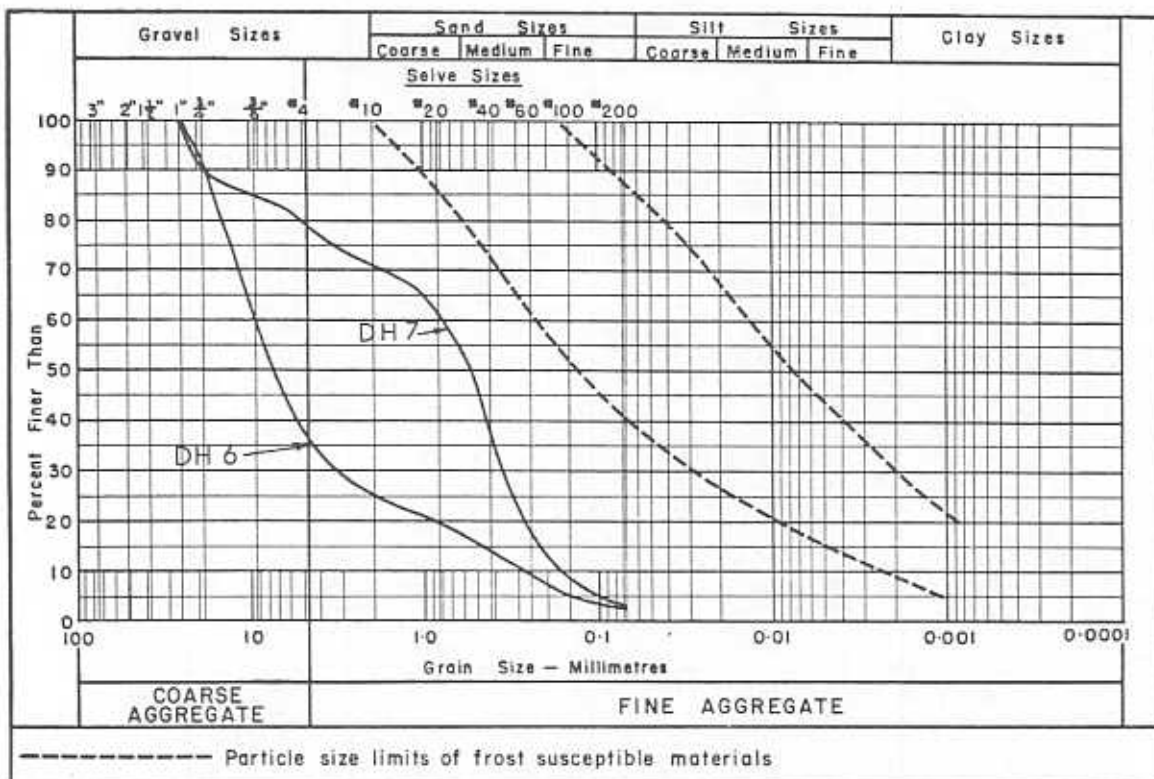
PETROGRAPHIC ANALYSIS: (227/DH 5 @ 10'-13')

Quartzite	50.7%
Igneous	26.4%
Limestone & dolomite	20.9%
Deleterious	
Siltstone, sandstone, shale and ironstone	1.9%

SUMMARY OF LABORATORY TEST DATA

Sample Location:	227/DH 6	227/DH 7	227/DH 8
Sample Depth (Feet):	15	14	12
Moisture Content (%):	6.4	3.5	15.4
Ice Content (%):	-	-	-
Organic Content (%):	-	1.9	-

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

SITE NO. 228

Located adjacent to the southeast bank of Little Smith Creek, Site 228 consists of a large glaciofluvial outwash plain which encompasses the proposed Mackenzie Highway from Mile 532 to Mile 534.

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

Estimated Volume: 8,000,000 cubic yards.

Assessment: Good quality material suitable in the pit run condition as general fill for the construction of road bases and utility backfill. Site 228 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. A22933/83

228-1

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 228 is located adjacent to the southeast bank of Little Smith Creek approximately 1 mile upstream from the east bank of the Mackenzie River. The southern portion of the site encompasses the proposed Mackenzie Highway right-of-way at Mile 532 to Mile 534. The site consists of a large glaciofluvial outwash plain which in total is approximately 3 miles in length and slightly less than $\frac{1}{2}$ mile in width. The site area is separated into two segments by a small stream; the east bank of the meandering Little Smith Creek stream channel forms the western boundary. The site area appears to be relatively well drained and the steep south bank of Little Smith Creek exhibits numerous dry erosional gullies.

The glaciofluvial plain consists of stratified fine to medium grained sands and medium grained gravels. In general, the predominance of gravel was noted nearer to the surface within the outlined site area. A very shallow layer of topsoil approximately 6 inches in depth overlies the granular materials and supports dense growths of spruce and birch ranging in height to 40 feet and in trunk diameter to 12 inches. The understory growth is moderately dense and consists primarily of small bushes.

There are no known critical wildlife areas in the vicinity of Site 228. However, the site is within a region which is periodically hunted and trapped by northern residents.

The CNT pole line and the proposed Mackenzie Highway both traverse the width of the southern segment of the site area thus ensuring good access to future borrow pit areas. The proposed gas pipeline route is located approximately $1\frac{1}{2}$ miles northeast of Site 228.

DEVELOPMENT

The exploratory drill holes which were carried out on Site 228 by the engineering consultant for the Federal Department of Public Works showed the following conditions relative to the quality and quantity of available granular materials:

- Fine to medium grained gravels predominate in the initial 5 to 10 feet of the glaciofluvial deposit.
- Medium grained sand underlies the surficial layer of gravel to depths in excess of the drill holes.
- The depth of recoverable granular materials is considered to be in excess of 20 to 30 feet, although an average depth of 15 feet was used in calculation of volume.
- The sand and gravel deposits are suitable for quality granular fill material in the pit run condition in the construction of road bases, pipeline berms and other general embankment construction. The coarse grained gravels can be used in the production of concrete, base and surface course aggregates.
- The overburden material consisting primarily of topsoil is generally less than 1 foot in depth.



- It is considered that granular materials in excess of 8,000,000 cubic yards are potentially recoverable from Site 228.

Site 228 is recommended as a potential source 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 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 active Little Smith Creek channel nor into the small unnamed stream channel.
- A vegetation buffer zone of adequate breadth should be retained between the outer limits of the borrow pit areas and the eastern shoreline of Little Smith Creek as well as in the areas adjacent to the small unnamed 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 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.
- Reseeding of the recontoured pit areas should be considered in areas that may pose



PEMCAN SERVICES

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. 228

HOLE NO. C 393A

DATE: FEB. 9, 1973

LOGGED BY: ☐ PEMCAN



UNDERWOOD

DRILLING METHOD: ☒ CONVENTIONAL

☐ AIR
CIRCULATION

☐ AIR REVERSE
CIRCULATION

☐ OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS			ICE CONDT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D			
0		Pt	0.5 TOPSOIL:						0
2		GW	GRAVEL: - sand and cobbles						2
4			5.0					MC GS	4
6			SAND:						6
8									8
10		SP	- pebbles and cobbles						10
12									12
14									14
15.0			END OF HOLE 15.0'						
16			Insulated hole						16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 228

HOLE NO. C 396A

DATE: FEB. 10, 1973

LOGGED BY: ☐ PEMCAN



UNDERWOOD

DRILLING METHOD: ☒

AIR
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		GW	GRAVEL:						0
2									2
4									4
6									6
8		SP	SAND & PEBBLES:						8
10									10
12									12
14									14
15.0		SW	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. 228

HOLE NO. C 398F

DATE:	LOGGED BY: <input type="checkbox"/> PEMCAN <input checked="" type="checkbox"/> UNDERWOOD
DRILLING METHOD: <input checked="" type="checkbox"/> AIR CONVENTIONAL	<input type="checkbox"/> AIR REVERSE CIRCULATION <input type="checkbox"/> OTHER:

CONVENTIONAL 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		GW	GRAVEL:						0
3									3
4.0		CL	SILTY CLAY:						6
6									9
9				UF					12
12									15
15		CL							18
18									21
21		CL		UF					24
24									27
25.0			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. 228

HOLE NO. TP 1

DATE: FEB. 10, 1973

LOGGED BY: ☐ PEMCAN

☒ UNDERWOOD

DRILLING METHOD:

☒ AIR CONVENTIONAL ☐ AIR REVERSE CIRCULATION

☒ OTHER:

DISPOSAL PIT

[illegible]

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 228

HOLE NO. C 554B

DATE: FEB. 12, 1973

LOGGED BY: ☐ PEMCAN





UNDERWOOD

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		GW	GRAVEL: - sandy, dry						0
1				UF					1
2									2
3									3
4									4
5									5
6									6
7			7.0 END OF HOLE 7.0' Hole caved in						7

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 228

HOLE NO. B 556B

DATE: FEB. 13, 1973

LOGGED BY: ☐ PEMCAN

☐

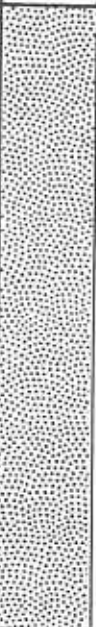

UNDERWOOD

DRILLING METHOD:

☒

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 CONT.		
0		SP	SAND: - gravel, cobbles, boulders				MC GS	0
1								1
2								2
3								3
4								4
5			5.0					5
			END OF HOLE 5.0' Hole sloughing Very dry					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 228

HOLE NO. B 560B

DATE: FEB. 13, 1973

LOGGED BY: ☐ PEMCAN

☒

UNDERWOOD

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
1			SAND:					1
2			- pebbles, gravel and cobbles					2
3								3
4								4
5			5.0					5
			END OF HOLE 5.0'					
			Hole sloughing					
			Very dry					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 228

HOLE NO. B 563B

DATE: FEB. 13, 1973

LOGGED BY: ☐ PEMCAN



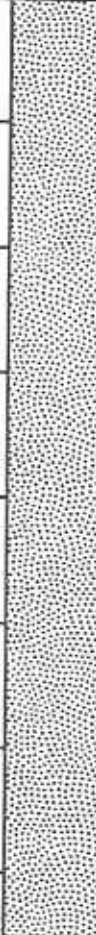
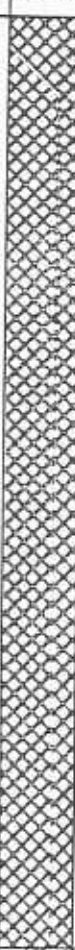
UNDERWOOD

DRILLING METHOD: ☒ CONVENTIONAL

☐ AIR

☐ AIR REVERSE CIRCULATION

☐ OTHER:

CONVENTIONAL										CIRCULATION										OTHER:									
DEPTH (feet)		GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION		GROUND CONDITIONS		ICE CONDITIONS		SAMPLE TYPE	DEPTH (feet)																		
						GEN'L CLASS	N.R.C. CLASS	EST'D CONT.																					
0			SW	SAND:						MC	0																		
2											GS	2																	
4											4																		
6			SP	- silt, gravel pebbles, wet											6														
8															8														
10															10														
12															12														
14															14														
15.0			SW	- very wet											15.0														
16			END OF HOLE 15.0'																	16									

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

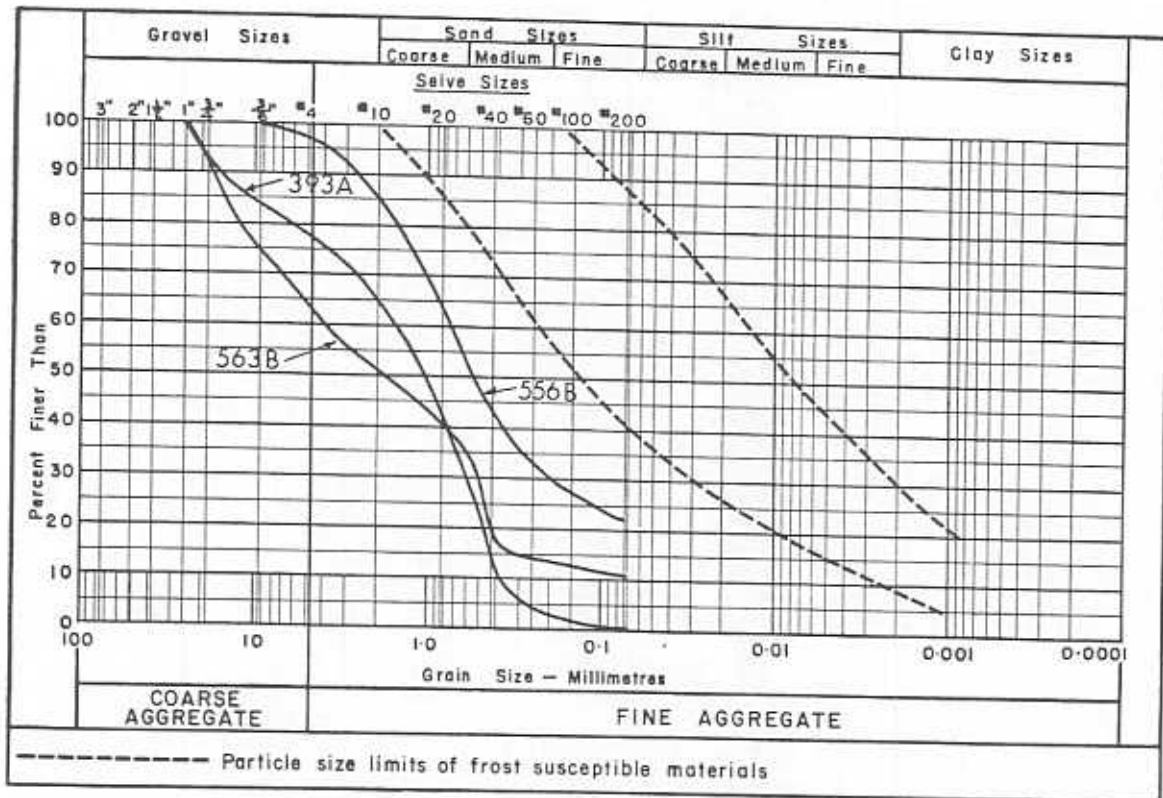


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	228/556B	228/563B	228/393A
Sample Depth (Feet):	3.0-4.0	1.0-2.0	4.0-5.0
Moisture Content (%):	3.0	4.0	2.0
Ice Content (%):	-	-	-
Organic Content (%):	-	-	-

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

SUMMARY OF LABORATORY TEST DATA

Sample Location: 228/(sampled by Underwood from Disposal Pit)

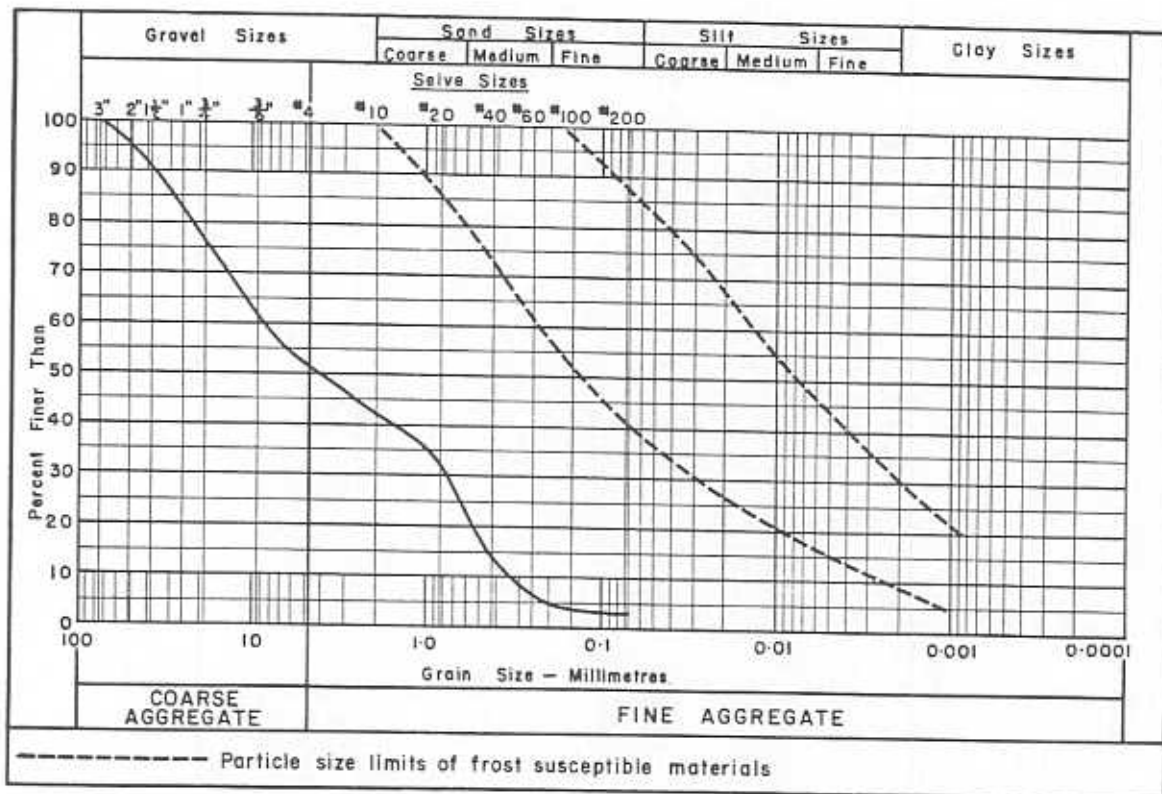
Sample Depth (Feet): -

Moisture Content (%): -

Ice Content (%): -

Organic Content (%): -

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

Limestone	46.5%
Granitic	39.2%
Volcanic	10.5%
Chert	1.4%
Deleterious	
Schist	1.4%
Silicious sandstone	1.0%

Los Angeles Abrasion Test: Per cent Loss - 21.6

SUMMARY OF LABORATORY TEST DATA

Sample Location: 228/(sampled by Underwood from Disposal Pit)

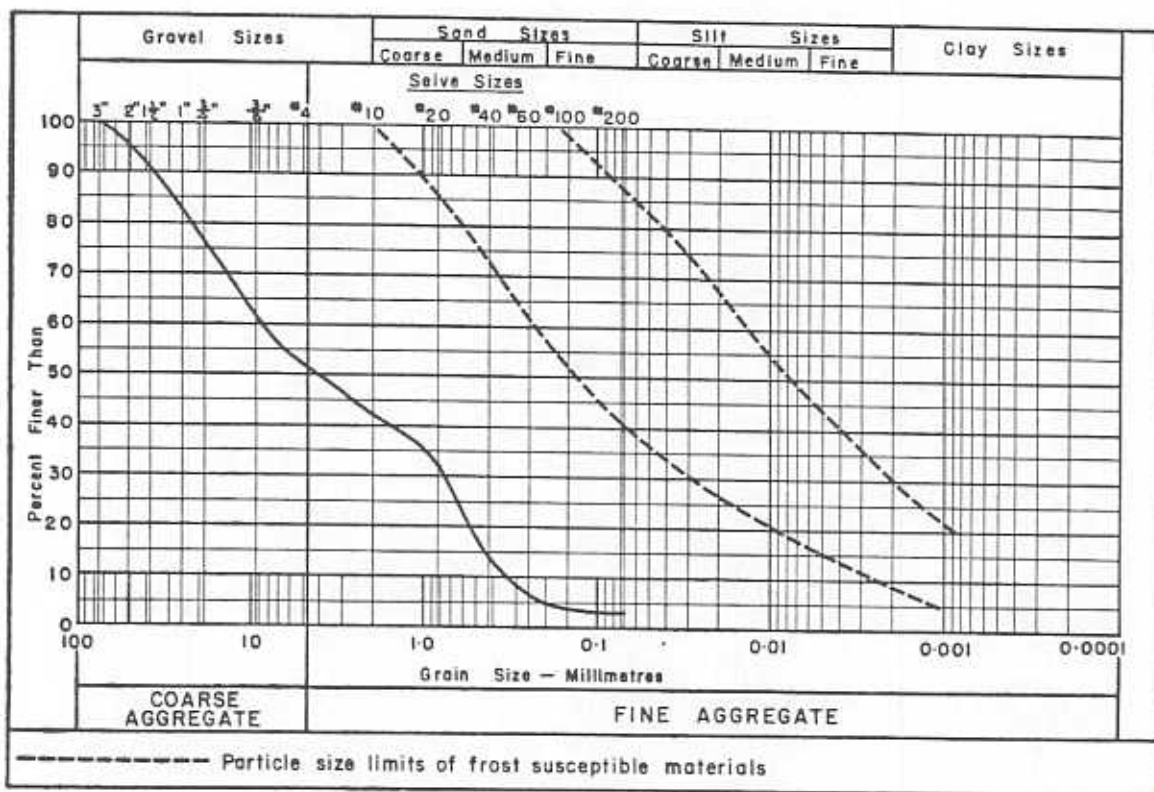
Sample Depth (Feet): -

Moisture Content (%): -

Ice Content (%): -

Organic Content (%): -

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

Limestone	46.5%
Granitic	39.2%
Volcanic	10.5%
Chert	1.4%
Deleterious	
Schist	1.4%
Silicious sandstone	1.0%

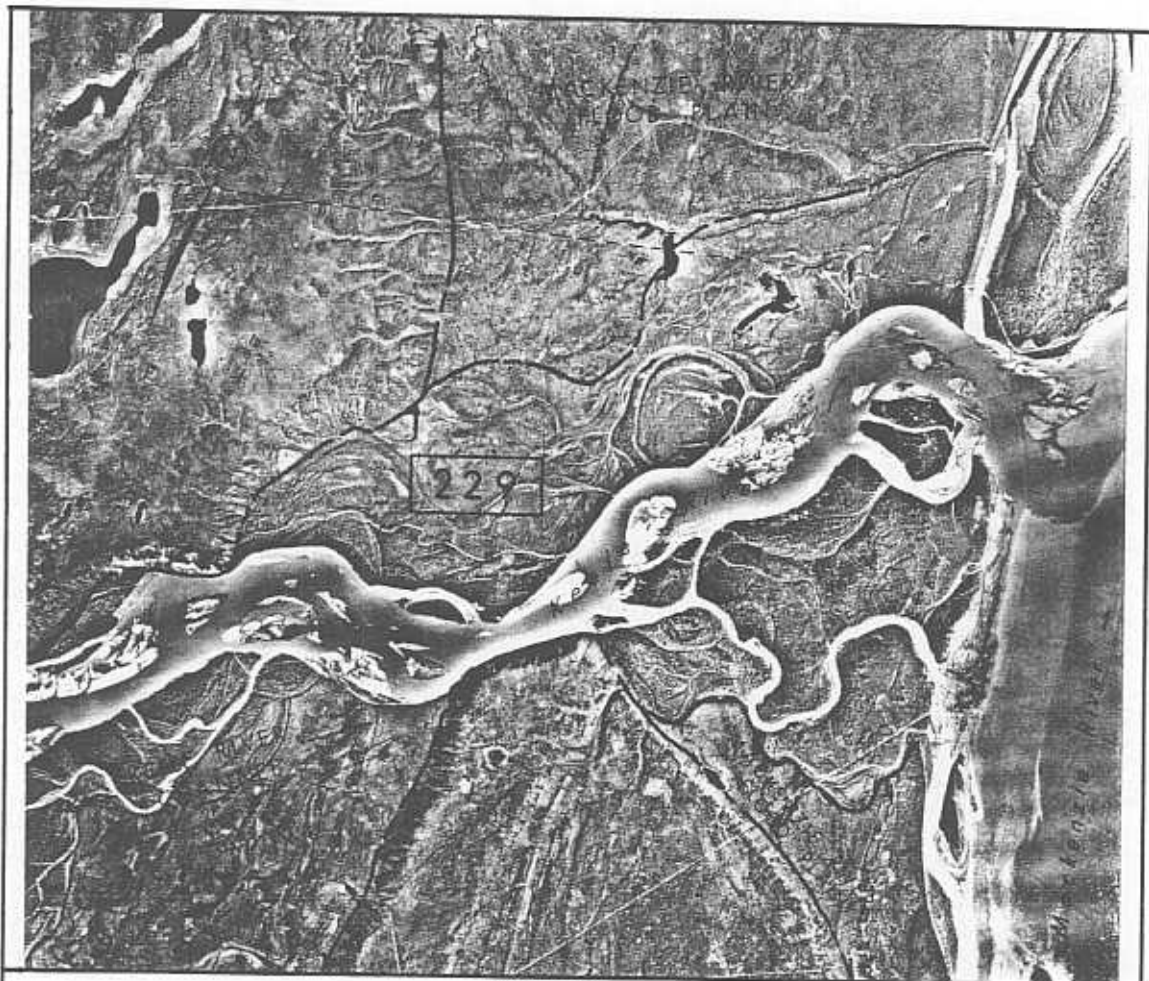
Los Angeles Abrasion Test: Per cent Loss - 21.6

SITE NO. 229

LOCATION

Located on the west side of the Mackenzie River, Site 229 encompasses the downstream segment of the alluvial flood plain of the Keele River. The alluvial plain consists of low terraces bordering the braided active stream channel.

The proposed Mackenzie Highway right-of-way at Mile 534 is located on the opposite, east Mackenzie River bank at a distance of some 5 miles from the site area, while the proposed gas pipeline is located approximately 3 miles further east of the highway alignment.



LEGEND

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

Airphoto No. A22887/86

Approximate scale: 1" = 3,000'

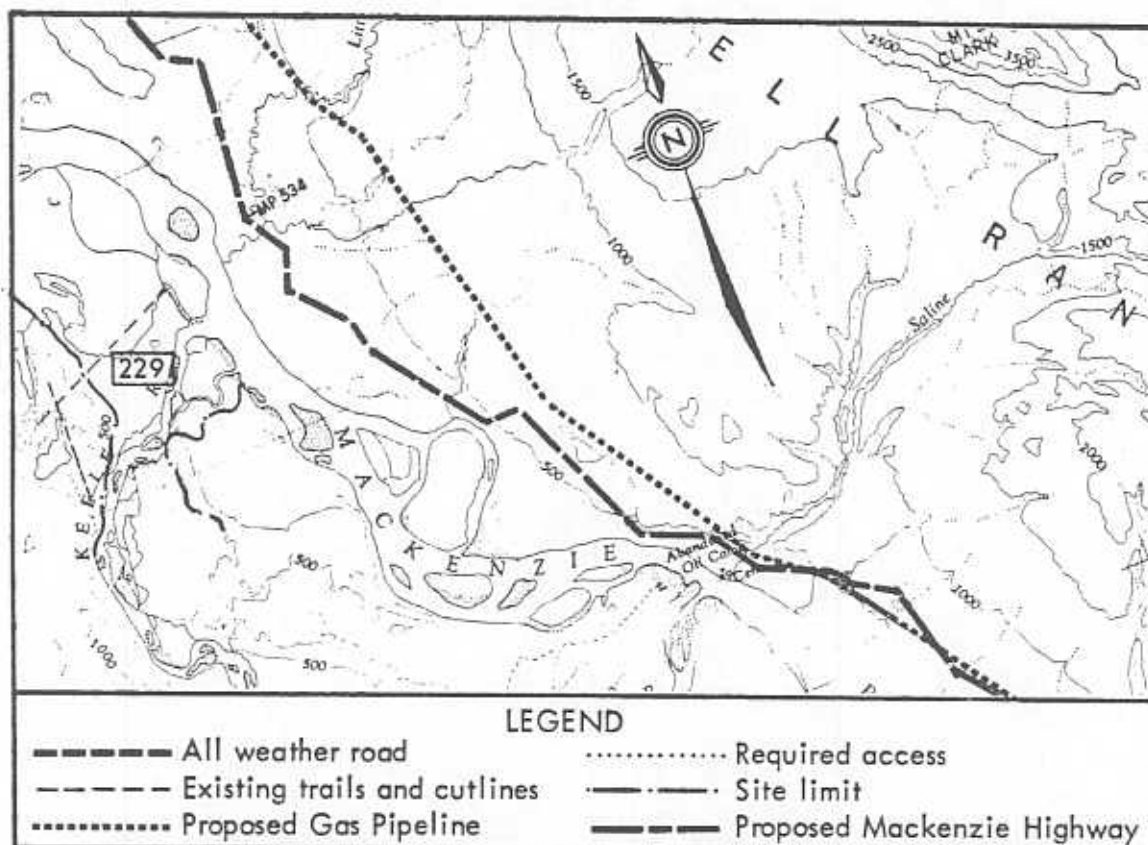


GENERAL

The downstream section of the Keele River alluvial flood plain is nearly two miles wide and the river mouth is slightly incised into the Mackenzie River flood plain. The site area consists of alluvial terraces in excess of 1 mile in width which border the active stream channel; frequent sand and silt bars are located within the braided river bed. The bars become coarser west of the river mouth and contain gravel in the upstream section. Abandoned river channels and depressions containing organic materials mark the terrace surfaces. Drainage conditions of the flood plain, in general, are only fair.

The terrace materials likely contain stratified silt and sand sediments. Gravel stratum and localized gravel pockets very likely exist below or even locally within the fine grained alluvial deposits, although no sizable exposures of this stratum are identifiable at the surface.

Site 229 is not suggested for development since the granular materials are located within the upstream segment of an active water course.



Section of Map No. 96 C

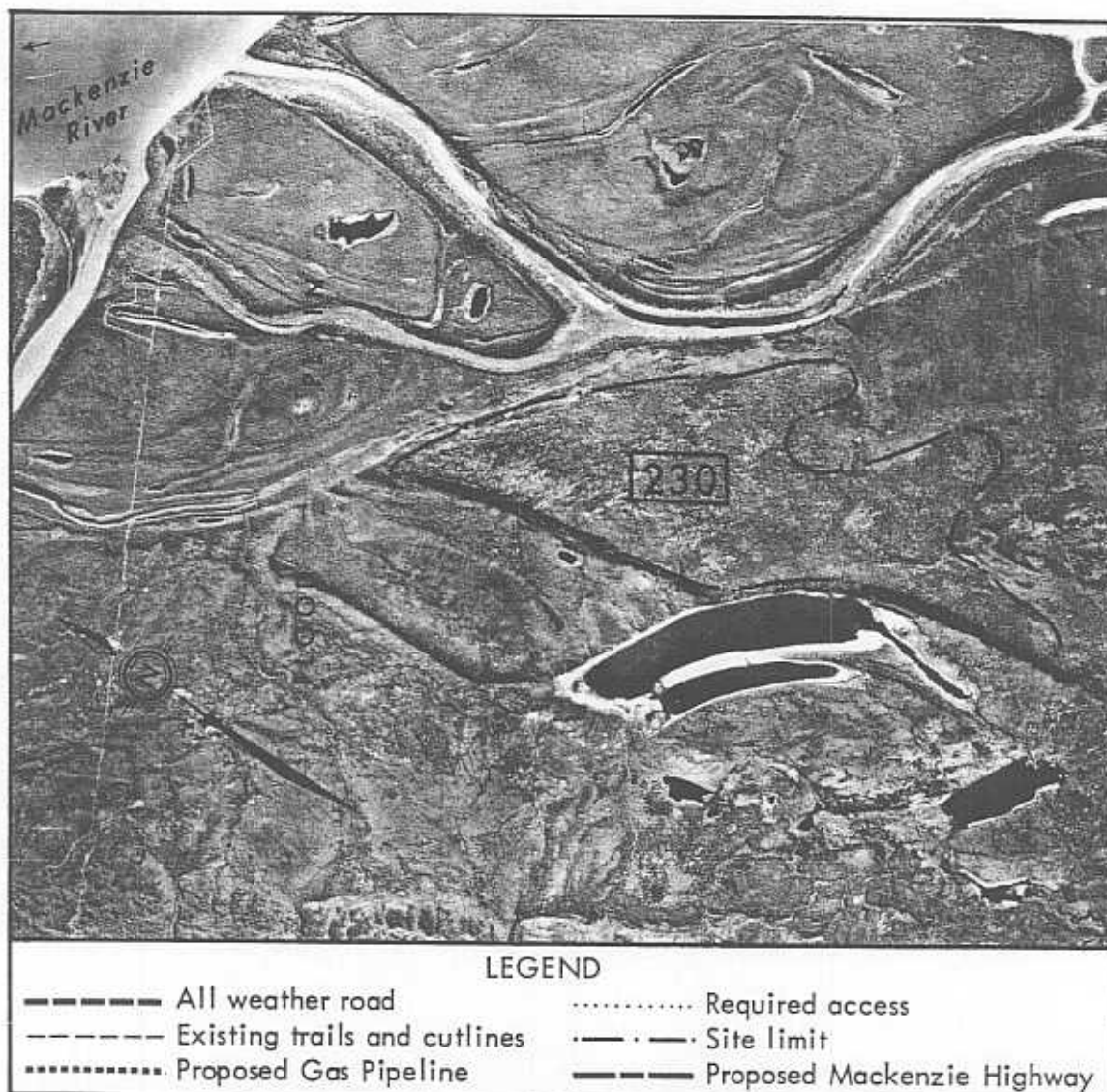
Scale: 1:250,000

SITE NO. 230

LOCATION

Located within the broad flood plain on the western side of the Mackenzie River and approximately 2 miles north of the Keele River; Site 230 consists of an alluvial terrace. The terrace materials likely consist in part of silt and silty sand.

The proposed Mackenzie Highway right-of-way parallels the opposite, east river bank and the haul distance from Site 230 to the Mackenzie Highway at Mile 533 would be approximately 3 miles. The gas pipeline route is located approximately 4 miles from this site area.



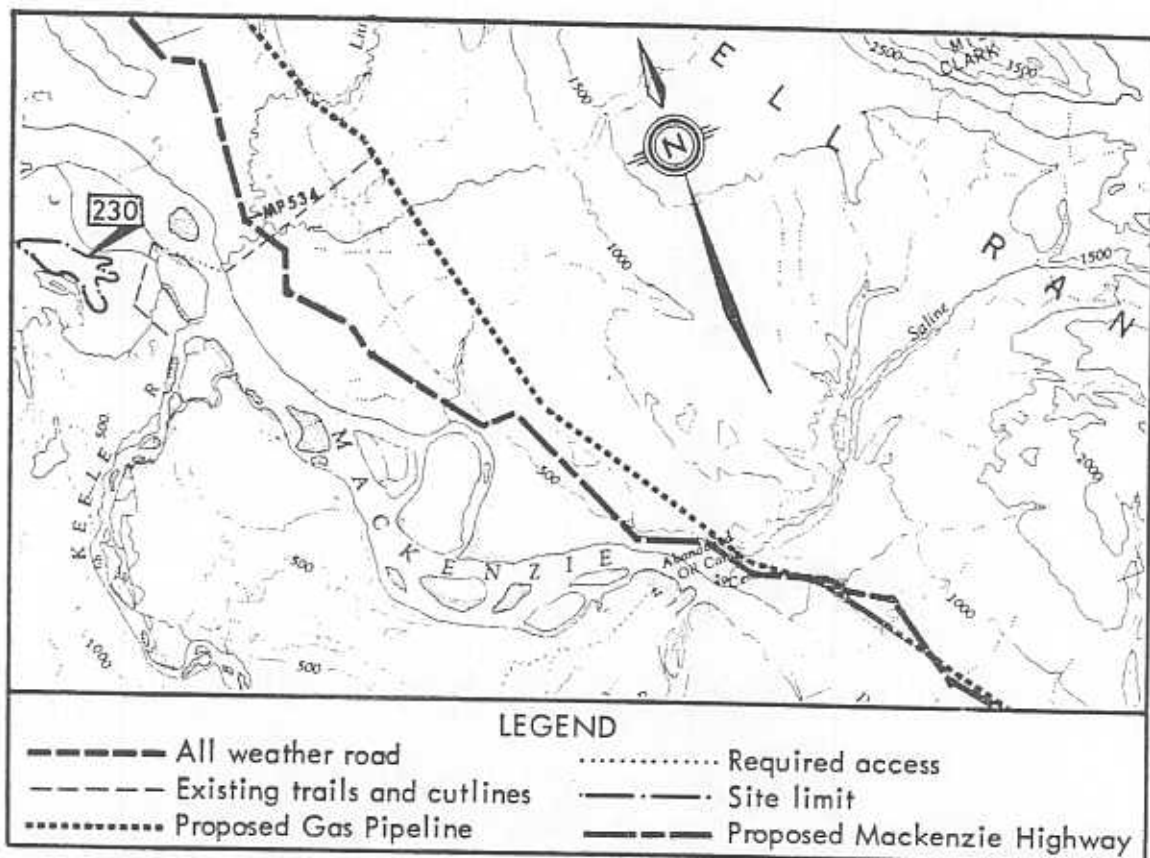


GENERAL

Site 230 consists of a low alluvial terrace located within the broad Mackenzie River flood plain, west of its active stream channel. The terrace is approximately $1\frac{1}{2}$ miles in length and averages about $\frac{1}{2}$ mile in width. The flat surface of the terrace is less than 50 feet above the water level of the Mackenzie River. Abandoned river arms exhibiting large oxbow lakes and muskeg bogs mark the river flood plain which forms the terrain surrounding Site 230. The drainage conditions are only fair and the surficial runoff is directed into the adjacent terrain and river arms. The site area is covered with a moderately dense growth of spruce, willow, poplar and birch. There are no known critical wildlife areas in the immediate vicinity of Site 230.

It is anticipated that the material in Site 230 consists of stratified, fine grained silty sands and silts topped with variable thicknesses of topsoil and silt. The terrace deposits, considered as a very poor prospect, would likely be suitable only as a very marginal general fill material.

Access to the site is difficult because of terrain conditions and the required crossing of the Mackenzie River.



Section of Map No. 96 C

Scale: 1:250,000

SITE NO. 231

LOCATION

Located on the east side of the Mackenzie River, Site 231 encompasses the meandering alluvial flood plain of the Little Smith Creek which contains shallow terraces probably comprised of silt, sand and gravel deposits.

The proposed Mackenzie Highway right-of-way at Mile 534 crosses the downstream creek section of Little Smith Creek. The proposed gas pipeline route crosses the stream channel approximately 5 miles upstream from the creek mouth.



Airphoto No. A22933/82

Approximate scale: 1" = 3,000'

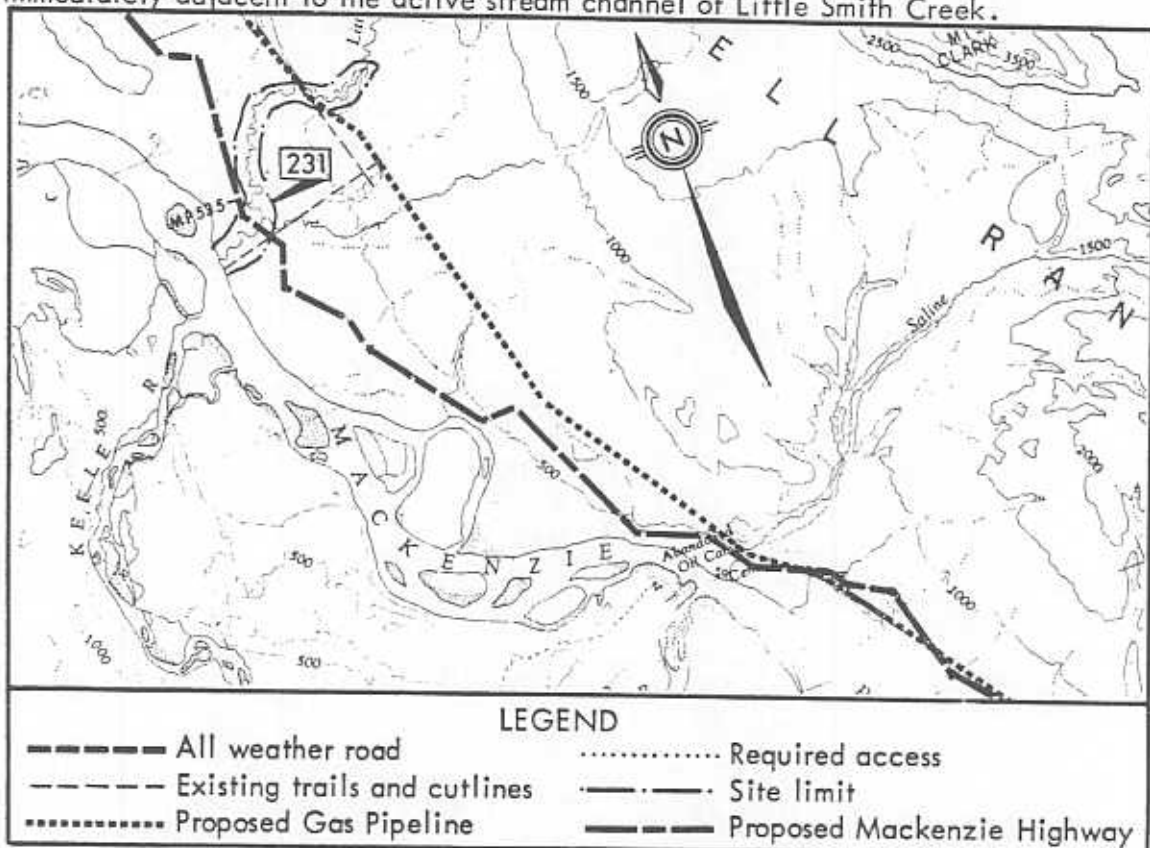


GENERAL

Site 231 encompasses the meandering stream channel of the Little Smith Creek from its mouth for some 6 miles upstream. The stream channel is relatively deeply incised below the flat Mackenzie Plain which is covered with glaciolacustrine deposits. The drainage area of Little Smith Creek is some 30 miles long. The stream channel in its downstream section is 2000 to 2500 feet wide and contains alluvial deposits locally exposed in the low terraces along the stream bed. These deposits are at or slightly above the high water level of the river and apparently consist of stratified sand with gravel and silt layers or pockets. The material becomes finer toward the stream mouth and mostly fine grained silts and sandy deposits with some clay can be expected to prevail along the downstream creek segment. In turn, coarser deposits with higher gravel content are indicated in areas in excess of 5 miles upstream from the creek mouth.

The terraces, representing the fossil flood plain intercepted by the meandering stream, are covered with organic silt supporting relatively dense growths of spruce, poplar and willow. There are no known critical wildlife areas in the vicinity of Site 231.

Access to this site can be achieved from the existing winter road which traverses the downstream section of the river or from a seismic line paralleling the proposed gas pipeline route. Site 231 is not suggested for development since the granular materials are located within or immediately adjacent to the active stream channel of Little Smith Creek.



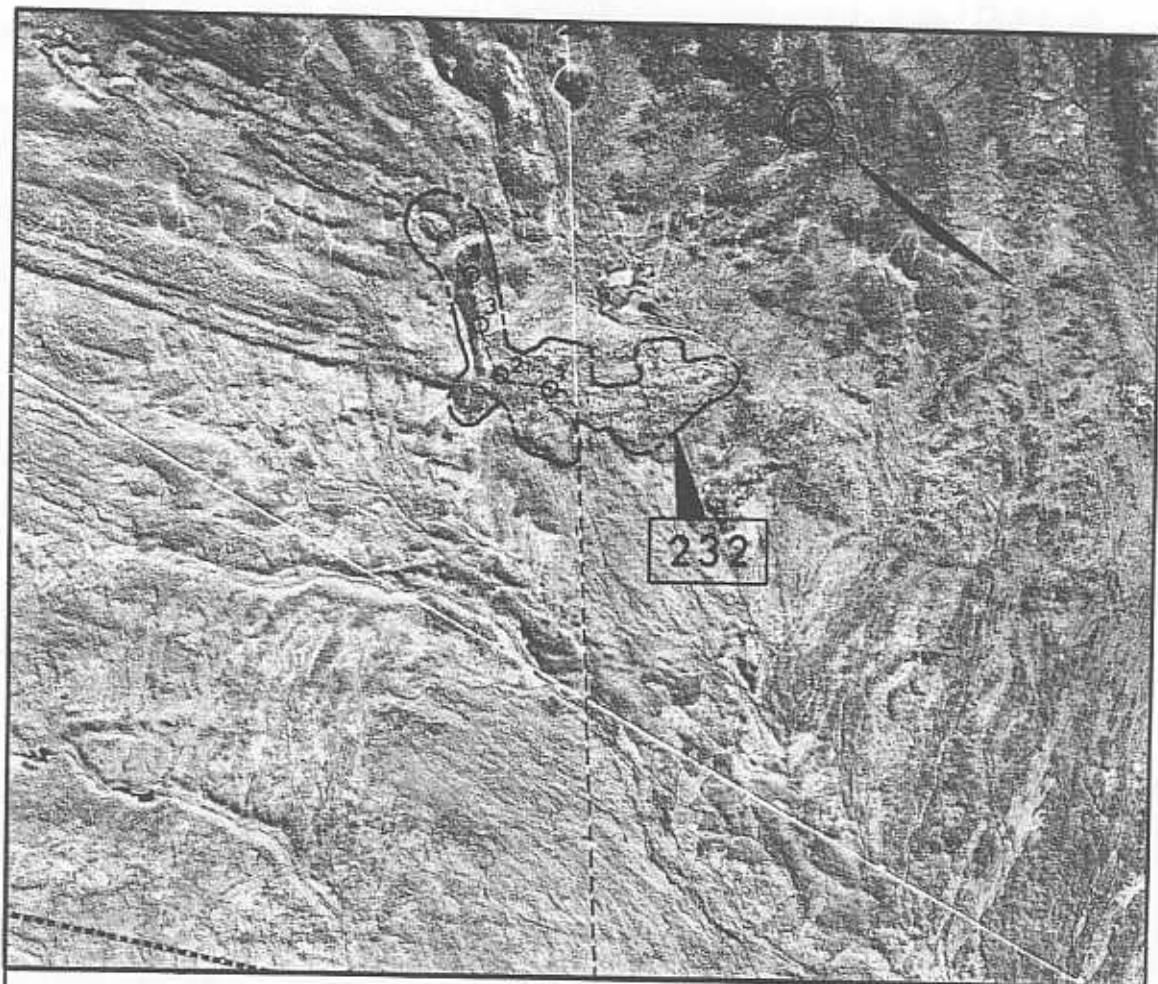
SITE NO. 232

Located approximately $2\frac{1}{2}$ miles north of Little Smith Creek and 4 miles northeast of the proposed Mackenzie Highway at Mile 537, Site 232 consists of a partially effaced, sinuous esker ridge.

Type of Material: Sand and Gravel; coarse grained, well graded.

Estimated Volume: 500,000 cubic yards.

Assessment: Good quality granular materials which are suitable for general fill in the pit run condition; Site 232 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. A22887/34

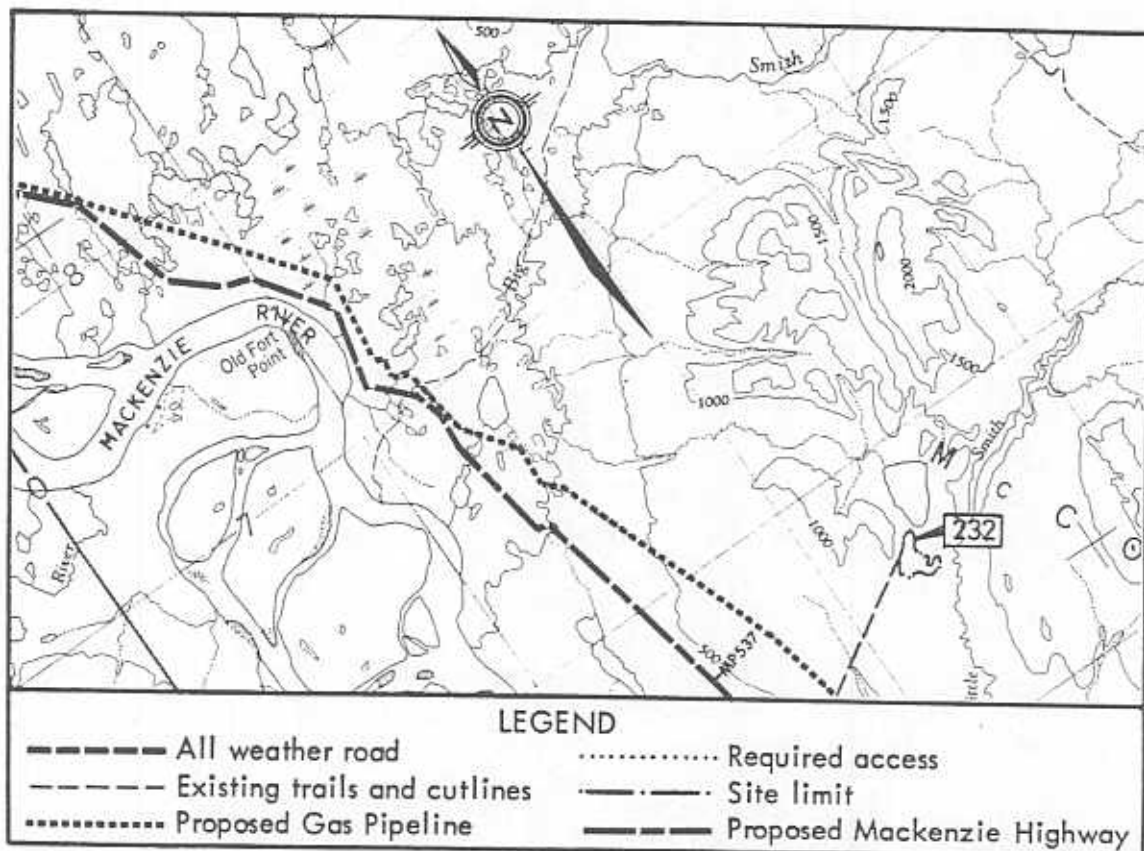
Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 232 is located $2\frac{1}{2}$ miles northwest of Little Smith Creek and 6 miles northeast of the eastern bank of the Mackenzie River. The site area is approximately 4 miles northeast of the existing CNT pole line and the proposed Mackenzie Highway right-of-way at Mile 537. Site 232, consisting of a sinuous esker ridge, which is $1\frac{1}{4}$ miles in length and varying in width from 400 to 700 feet, is located on the southwestern flanks of the McConnell Range. The esker ridge, which is approximately 30 to 40 feet in height, exhibits relatively steep slopes and is well drained. Numerous rock outcrops are evident to the north and east of the site area. The adjacent terrain, characterized by numerous small, dry creek beds, exhibits good surficial drainage to the southwest into the watershed of Little Smith Creek.

The esker ridge consists of medium to coarse grained sands and fine grained gravels with a trace of silt in the northern portion of the site where the ridge is more pronounced. The southeastern portion of the site area exhibits fine grained sands intermixed with silt. Gravel is probably evident as smaller pockets and layers in this southern portion of the site. The organic topsoil layer, varying in depth from $\frac{1}{2}$ to $1\frac{1}{2}$ feet in thickness, supports dense growths of spruce and poplar with occasional clusters of birch and willow. The understory growth consisting primarily of sedge grass is relatively sparse. The adjacent terrain consisting of a thin glacial till plain supports moderately dense growths of spruce with the occasional clusters of poplar.



Section of Map No. 96 C

Scale: 1:250,000



There are no known critical wildlife areas in the immediate vicinity of Site 232.

The only existing access to the site from the CNT pole line or the proposed Mackenzie Highway and gas pipeline right-of-way consists of the seismic cutline and the new access trail which was cleared across the top of the esker ridge during the winter drilling program. Although the access to the site area entails the crossing of one small, dry stream bed, the overall sensitivity to thermal disturbance appears to be quite low.

DEVELOPMENT

The exploratory drill holes which were carried out on Site 232 indicated the following conditions relative to the quality and quantity of available granular materials:

- The northwestern portion of the esker ridge, represented by drill holes DH 3 and DH 4, showed coarse grained sands to depths of approximately 10 feet underlain by fine to medium grained, clean gravel to depths in excess of 20 feet. These sands and gravels are considered suitable for quality granular fill requirements in the pit run condition in the construction of road bases, pipeline berms and other utility backfill.
- The southeastern portion of the site as represented by drill holes DH 1 and DH 2 exhibit finer grained soils consisting primarily of silty sands with isolated pockets and layers of gravel.
- The ground ice content in the initial 10 feet of the esker ridge is very low; however, the ice content increases substantially with increasing depth below 10 feet.
- The organic topsoil overburden material ranges in depth from $\frac{1}{2}$ to $1\frac{1}{2}$ feet.

Due to the general scarcity of natural occurring granular materials in this portion of the Study Area, Site 232 is recommended as a possible source of granular materials although a relatively lengthy access to proposed utility locations is required. The following operational guidelines should be followed in the development of borrow pits in this area.

- Exploitation of granular materials should be commenced from the northwestern extremities of the site area because of better quality materials in that segment.
- The existing tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil layer should be stripped, removed and stockpiled adjacent to the borrow pit areas in designated locations, preferably along the slopes of the esker ridge.
- Operating procedures during borrow pit development should be maintained whereby surficial waste materials do not drain into the adjacent small stream channels.



- Stands of natural growth should be retained between borrow pit areas in order to promote natural regeneration after abandonment.
- Generally, dozers, overhead loaders and standard ripping equipment should be adequate for the removal of material from this site. The selection of heavier equipment may be required when higher ground ice contents are encountered at deeper extremities of this ridge.
- The existing seismic cutline may have to be upgraded to an all weather status unless development of this site is restricted to the winter months.

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 to 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. 232

HOLE NO. DH-1

DATE: FEB. 4, 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 CONDITIONS			ICE EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS				
0		OL	1.5 TOPSOIL: some organic, little silt, roots, dark brown						0
2		ML	SILT: little sand, light brown						2
4			- some clay, trace sand, occasional pebbles and cobbles, fragments of limestone and quartzite, greyish brown (TILL)						4
6		ML-CI			Vx	L			6
8									8
10									10
12									12
14									14
15.0			TOTAL DEPTH 15.0'						15.0
16									16

DETAILED DRILL HOLE LOG



SITE NO. 232

DATE: FEB. 4, 1973

LOGGED BY: ☒ PEMCAN ☐

HOLE NO. DH-2

DRILLING METHOD: ☒ CONVENTIONAL ☐ AIR CIRCULATION ☐ 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, organic, dark brown						0
2									2
4									4
6		ML-SM	SILT AND SAND: fine grained, poorly graded, yellowish brown						6
8									8
10									10
12									12
14									14
16		MH	14.0 SILT: some clay, few angular limestone and quartzite fragments to 1½" size, medium plastic, greyish brown (TILL)						16
18			17.0 TOTAL DEPTH 17.0'						18

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 232

HOLE NO. DH-3

DATE: FEB. 4, 1973

LOGGED BY: ☒ PEMCAN ☐

DRILLING METHOD: ☒ AIR 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, organic, roots, dark						0
2		SM	SAND AND SILT: fine grained, poorly graded, light brown		Vx		L		2
4			4.5						4
6		GW-SM	SAND AND GRAVEL: medium to coarse grained, well graded, pebbles to 1" size, greyish brown		Vx Vs				6
8			9.0					MC GS	8
10		GW-GM	GRAVEL: some sand, trace silt, fine to coarse grained, well graded, predominantly subangular and subrounded quartzite and limestone pebbles to 1" size, greyish brown				M	MC GS P	10
12					Vs				12
14									14
16									16
18								MC	18
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. 232

HOLE NO. DH-4

DATE: FEB. 4, 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									0
2		OL	TOPSOIL: some silt, little organic, dark brown						2
4		SP	SAND: medium grained, poorly graded, occasional pebbles to 1" size						4
6					Vx		L		6
8									8
10								MC GS O	10
12				UF					12
14					Vx		L		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

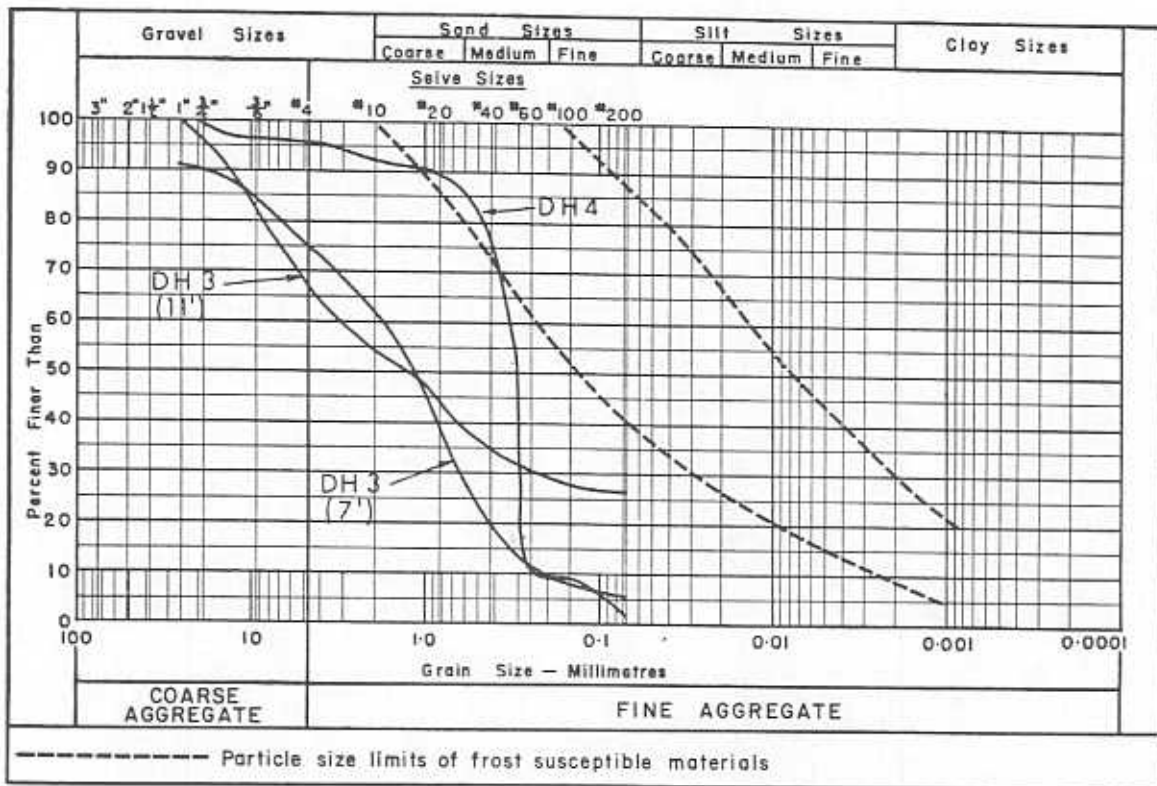


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	232/DH 3	232/DH 3	232/DH 3	232/DH 4
Sample Depth (Feet):	7	11	17	9
Moisture Content (%):	-	11.3	12.4	3.6
Ice Content (%):	-	-	-	-
Organic Content (%):	-	-	-	2.7

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS: (232/DH 3 @ 11')

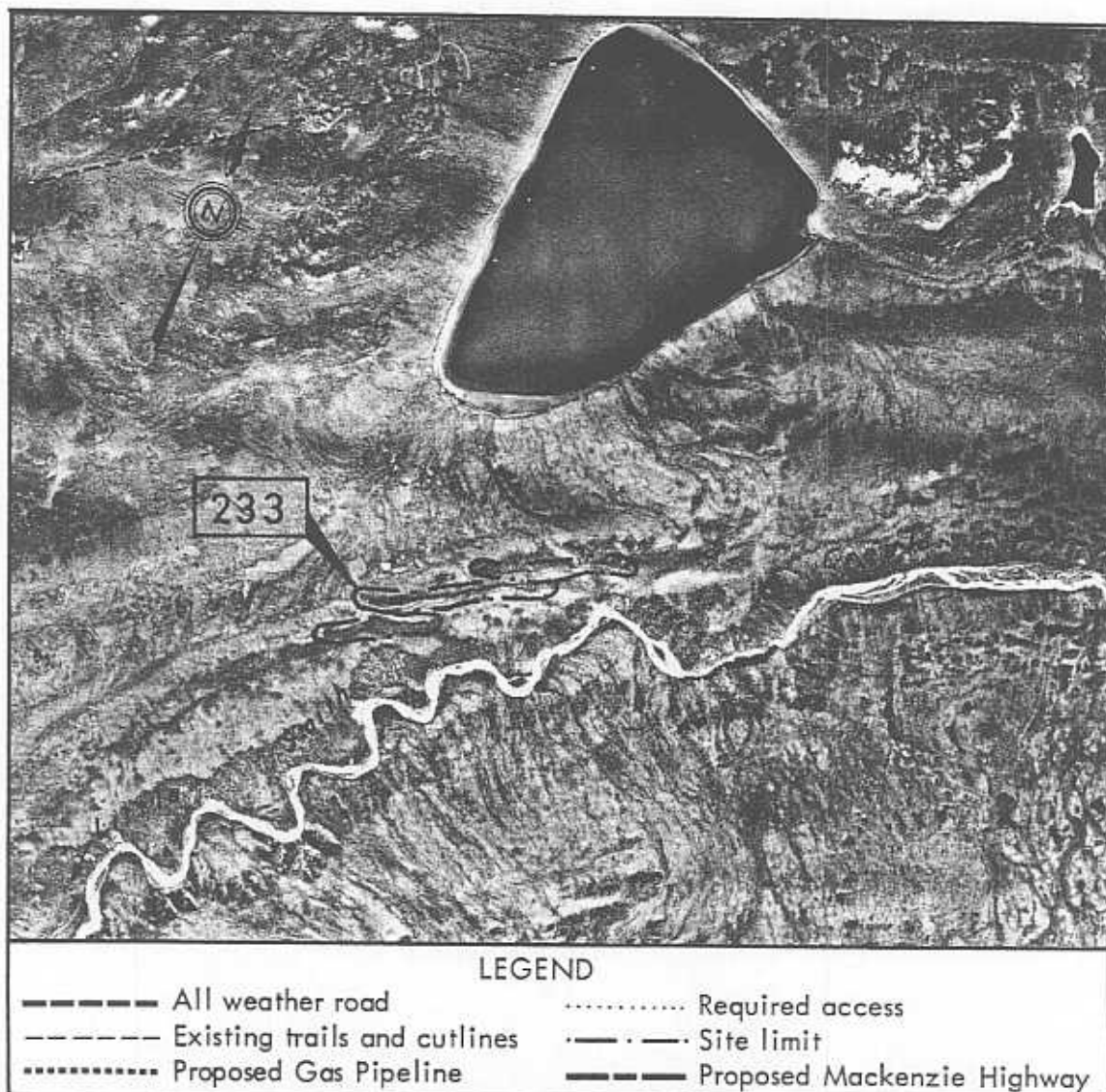
Quartzite	60.1%
Limestone and dolomite (sound)	26.7%
Igneous	12.2%
Deleterious	
a) Shale and ironstone	1.0%

SITE NO. 233

LOCATION

Located on the north side of Little Smith Creek, Site 233 encompasses a group of narrow esker ridges which rise 30 to 50 feet above the adjacent rolling terrain. The ridge material likely consists of sandy and silty gravel.

Site 233 is approximately 7 and 4 miles east of the proposed locations of the Mackenzie Highway and gas pipeline respectively. The haul distance from the site area to the Mackenzie Highway at Mile 536.5 along existing and required new access is approximately 6 miles.



Airphoto No. A22886/11

Approximate scale: 1" = 3,000'



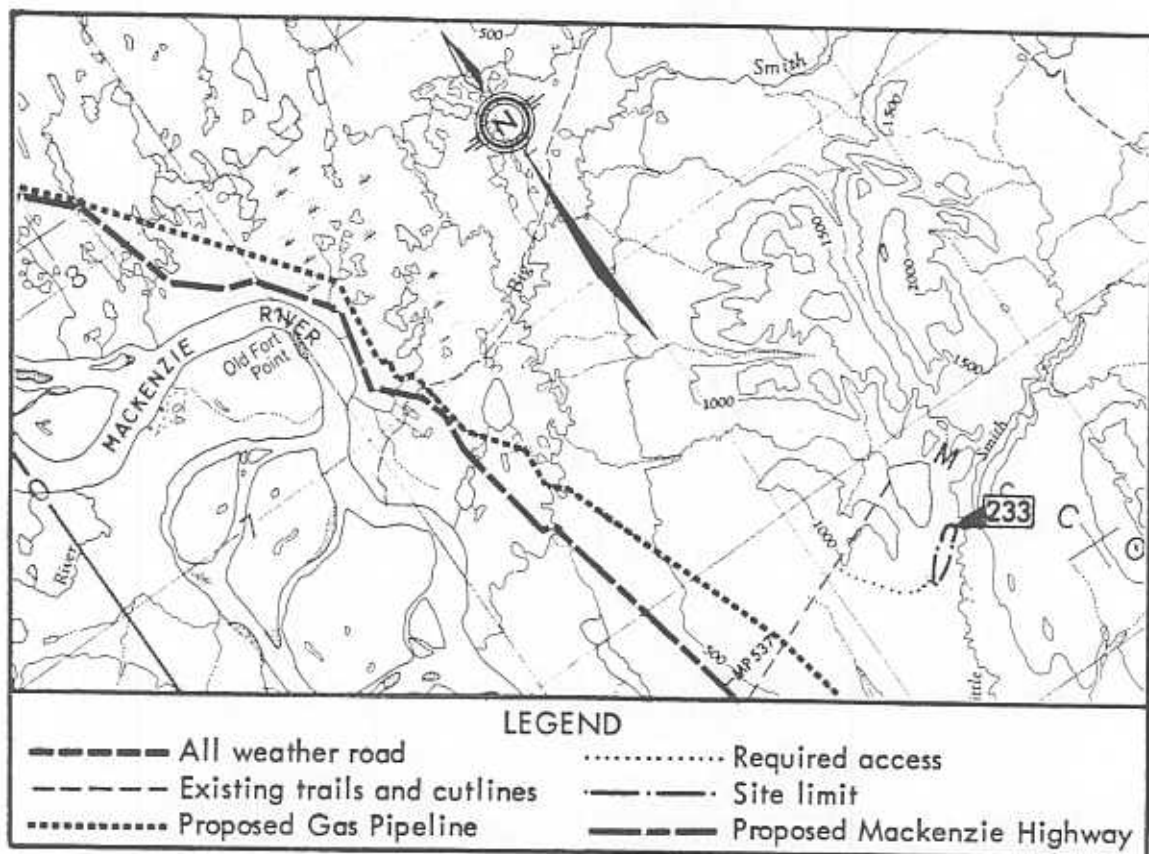
GENERAL

Site 233 consists of three esker ridges which total about one mile in length and average 300 feet in width. The adjacent terrain descends in both north and south directions from the ridges which favourably affects surficial runoff. Vegetation cover consists of good stands of spruce, birch and poplar.

There are no known critical wildlife areas in the immediate vicinity of Site 233.

It is anticipated that the eskers are composed of glacial outwash material, consisting primarily of silty sand and gravel with minor silt and till inclusions. These deposits may be suitable for the requirements of fair quality material for general fill.

The access to Site 233 can be achieved along existing seismic cutlines and a new access requirement approximately $1\frac{1}{2}$ miles in length.



Section of Map No. 96 C

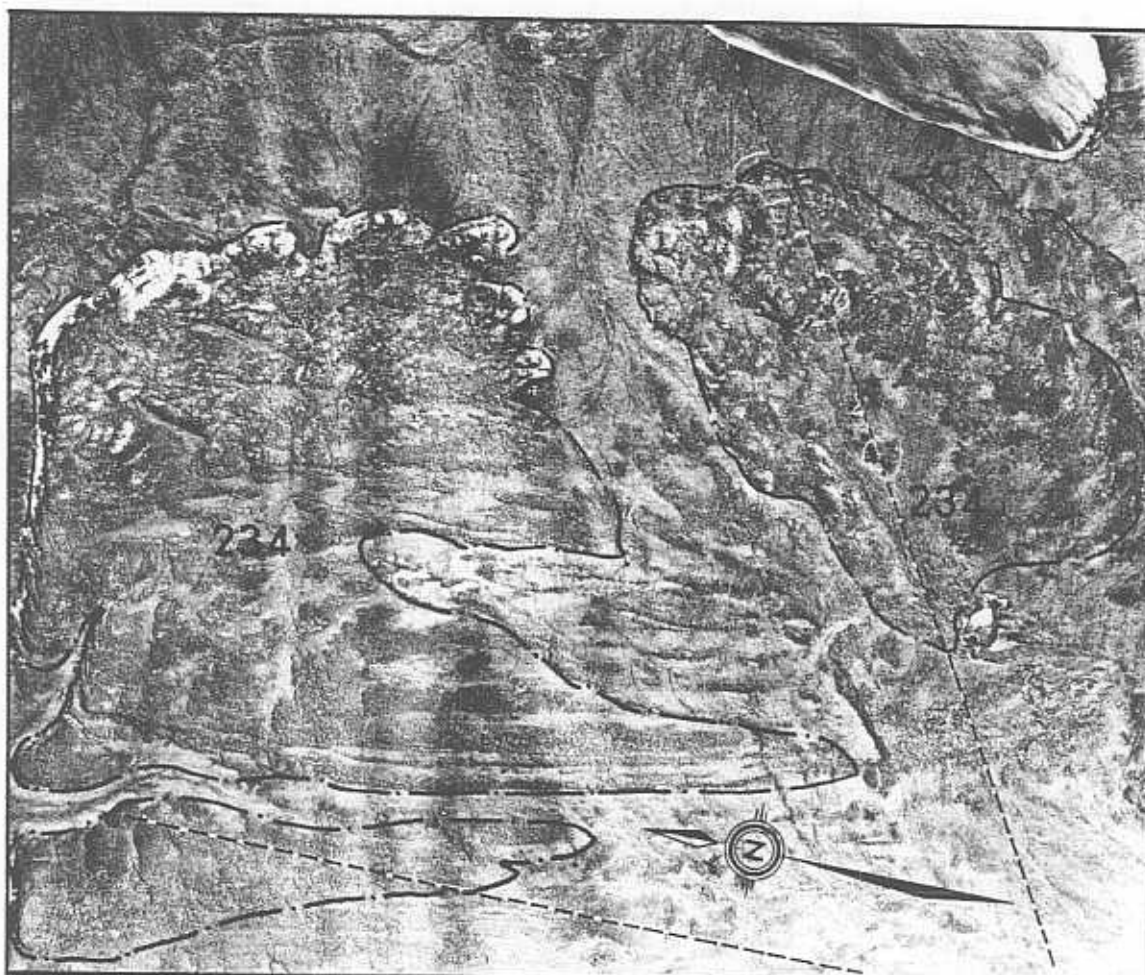
Scale: 1:250,000

SITE NO. 234

LOCATION

Located within the western margin of McConnell Range, some 6 miles east of the Mackenzie River and about 3 miles north of Little Smith Creek, Site 234 encompasses bedrock bluffs, ridges and hills comprised of dolomite and shale of the Franklin Mountain formation.

The proposed Mackenzie Highway right-of-way at Mile 536 is located approximately $3\frac{1}{2}$ miles west of Site 234 while the proposed gas pipeline parallels the western site margin at a distance of $\frac{1}{2}$ mile.



LEGEND

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

Airphoto No. A22886/10

Approximate scale: 1" = 3,000'

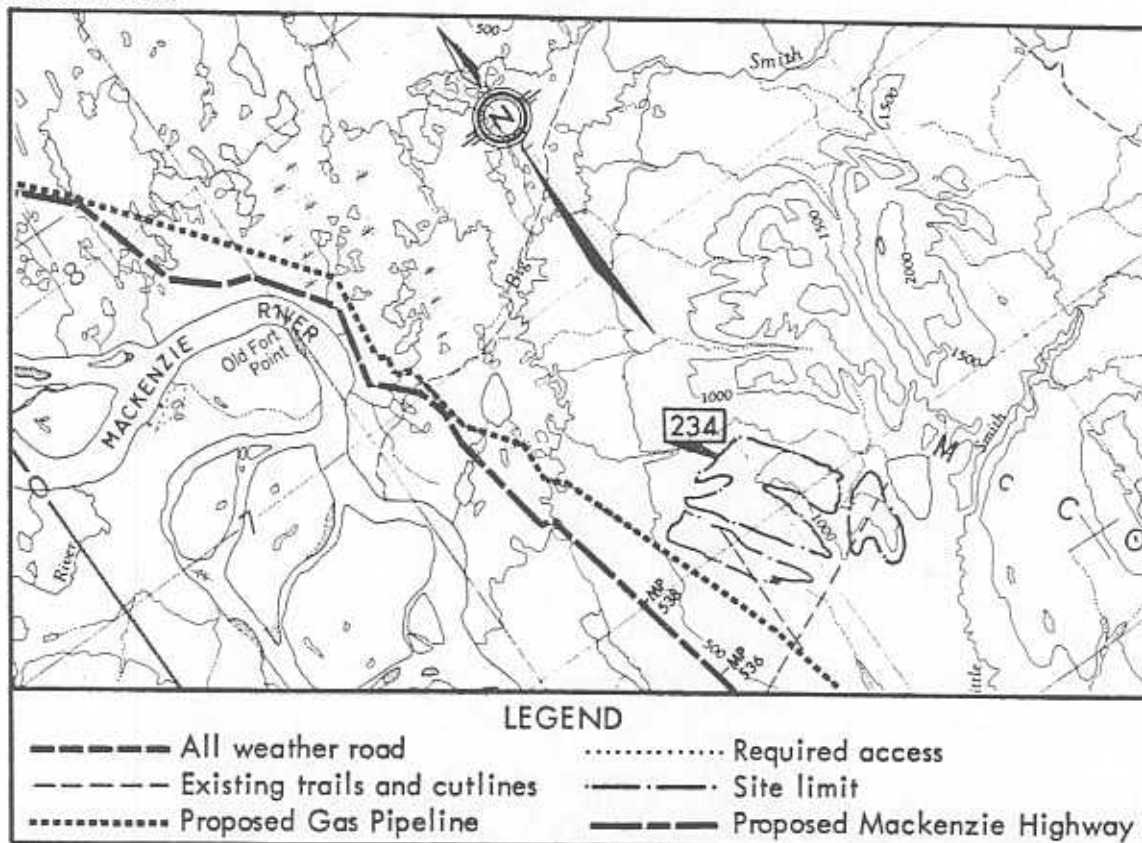


GENERAL

The terrain within the site area is rugged, especially along the eastern and northern perimeter of the rocky hills where dolomite is exposed in numerous bluffs. Frequent erosional gullies contribute to the irregularities in the bedrock surface and several sinkholes are scattered throughout the site. A relatively shallow belt of scree and slope wash deposits borders the bedrock area. These deposits, together with patches of glacial drift preserved in depressions of the bedrock surface, support growths of spruce with minor stands of poplar. There are no known critical wildlife areas in the immediate vicinity of Site 234.

Site 234 represents a good prospect for a quarry. There are numerous locations at individual ridges or bluffs which offer suitable conditions for a quarry operation. Bluffs along the northern perimeter and ridges within the eastern portion would be the most suitable, since these locales would minimize required stripping and would provide for sufficient high wall.

Good quality general fill can likely be produced by ripping and blasting the fractured surficial bedrock zones. Fresh and massive beds of dolomite can be expected at greater depths below the bedrock surface, which if blasted, crushed and screened, may be used for production of good quality aggregates for surface courses. Existing seismic cutlines can be used as access roads.



Section of Map No. 96 C

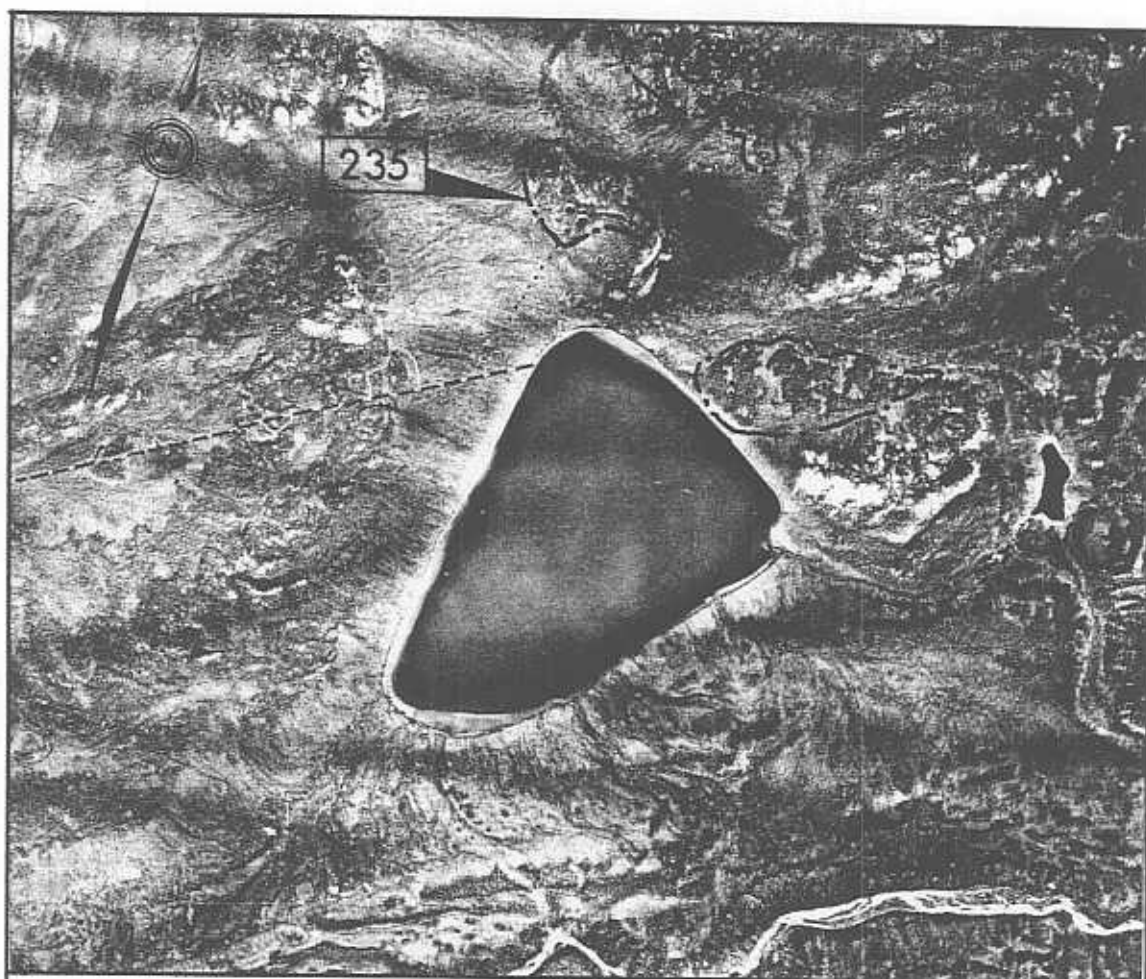
Scale: 1:250,000

SITE NO. 235

LOCATION

Located approximately 2 miles north of Little Smith Creek and 10 miles east of the Mackenzie River, Site 235 consists of four kame fields scattered at the toe of the McConnell Range. The kames probably contain silty sand and gravel materials.

The proposed Mackenzie Highway right-of-way at Mile 536 is located approximately 6 miles southwest of Site 235. The proposed gas pipeline route runs approximately $4\frac{1}{2}$ 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. A22886/11

Approximate scale: 1" = 3,000'



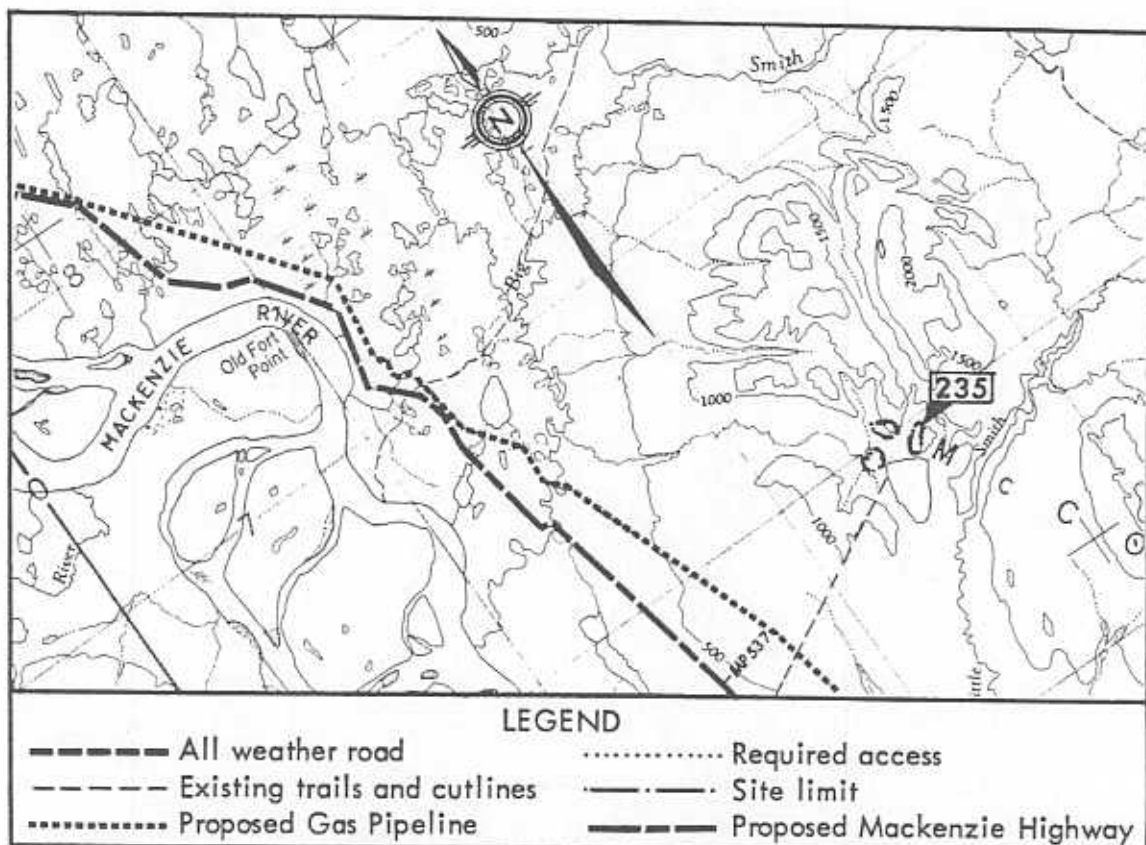
GENERAL

Site 235 consists of two small and two larger kame fields which include kettles and short eskers. These deposits rise above the adjacent flat to gently sloping, relatively poorly drained terrain. Variably washed gravels and sands are probably the most common constituents of the kame field, although silt and till pockets and boulders may occur locally. Better drained, granular deposits support good stands of spruce while poorly drained adjacent grounds are covered with black spruce and tamarack.

There are no known critical wildlife areas in the immediate vicinity of Site 235, although the area is within a region which is periodically hunted and trapped by northern residents.

Geological conditions and morphologic features are indicative of predominantly gravel and sand deposits which, in turn, will be suitable for fair to good quality general fill materials. It is doubtful that better quality aggregates for surface courses or for concrete can be obtained, unless the material is screened, washed and blended.

The access to Site 235 from both the proposed utility routes can be achieved through relatively short extensions of the existing seismic cutline. This cutline, however, crosses the rocky hill which can make the exploitation of materials difficult.



Section of Map No. 96 C

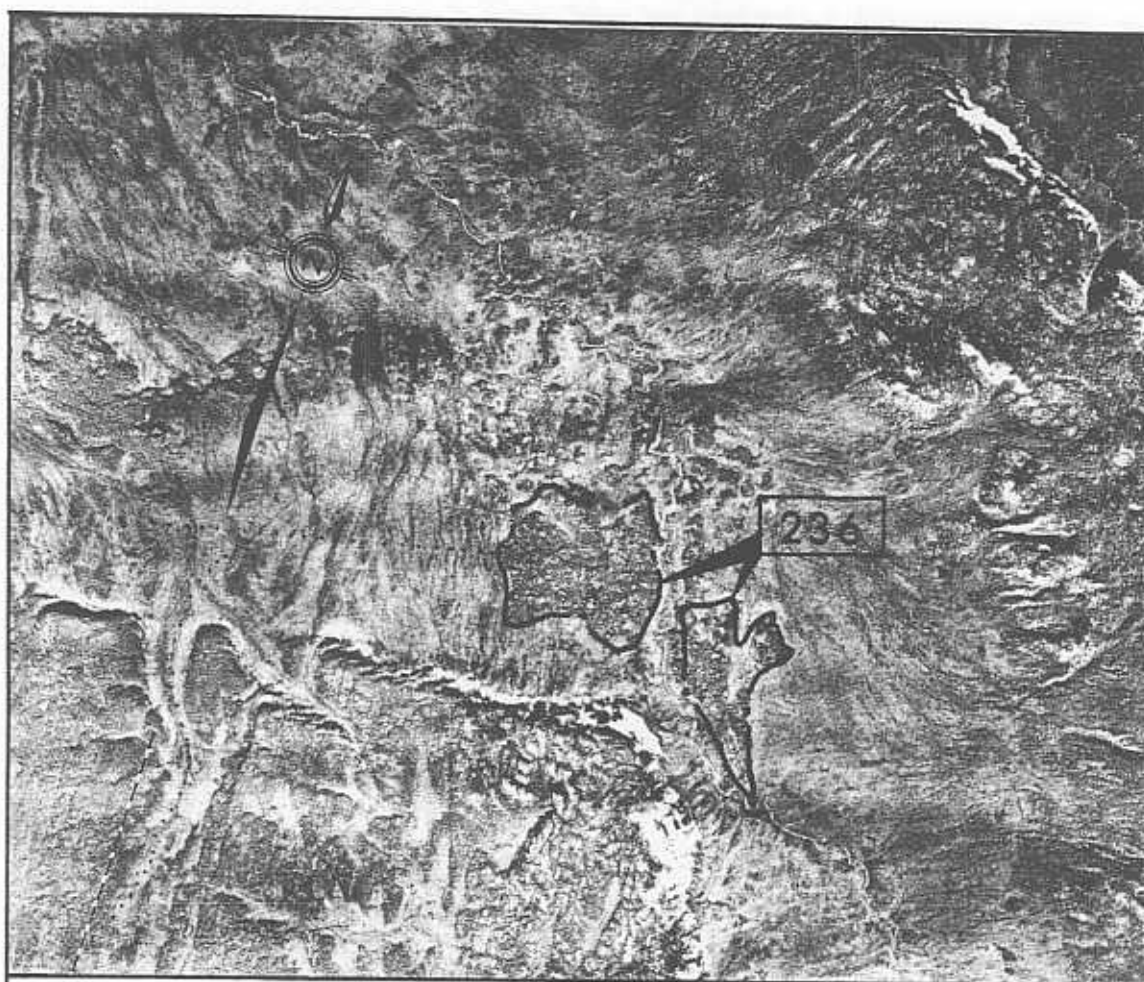
Scale: 1:250,000

SITE NO. 236

LOCATION

Located approximately 8 miles east of the Mackenzie River, between Big Smith and Little Smith Creeks, Site 236 consists of a kame terrace along the toe of the McConnell Range. Sand and gravel deposits are expected in this site area.

The proposed Mackenzie Highway right-of-way at Mile 543 is located approximately 4 miles southwest of Site 236 if a new access road is established. The haul distance from the site area to the Mackenzie Highway at Mile 538, along existing seismic cutlines would be approximately 6 miles. The proposed gas pipeline route runs $3\frac{1}{2}$ miles west of Site 236.



LEGEND

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

Airphoto No. A22886/9

Approximate scale: 1" = 3,000'

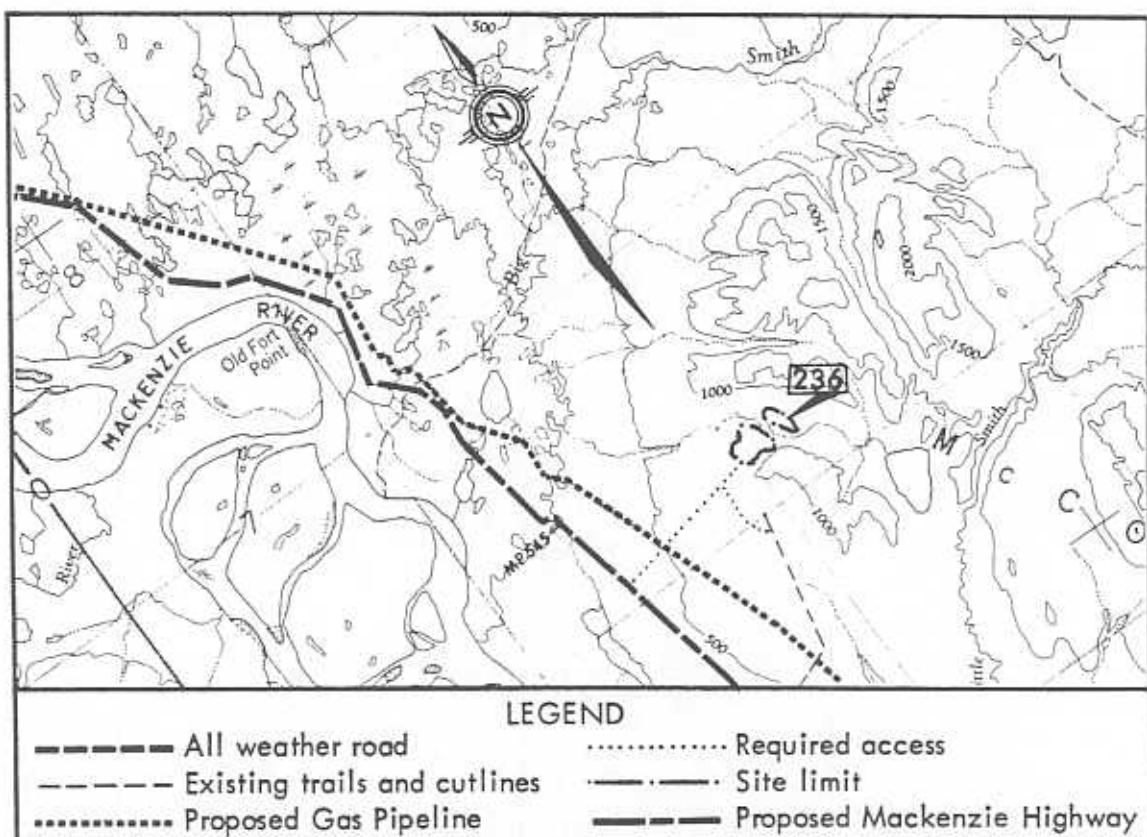


GENERAL

Site 236 consists of a kame terrace approximately 1.5 acres in size. The terrace is divided by an unnamed tributary of the Big Smith Creek into two separate fields. The stream drains the site terrain in a southerly direction towards the dolomite bluffs which are catalogued as Site 234. Black spruce forms the predominant vegetation cover across the site area. There are no known critical wildlife areas in the immediate vicinity of Site 236.

The terrace consists of a series of pitted and interconnected kame hummocks. It is anticipated the kames contain variably washed and irregularly stratified silty sand and gravel with pockets of ablation till and silt. These deposits may be suitable materials for fair to good quality general fill.

The access to Site 236 is approximately 4 miles in length if new access is developed. Access can be also attained by extending existing seismic cutlines. This will, however, increase the haul distance and involves the crossing of rocky hills and irregular terrain.

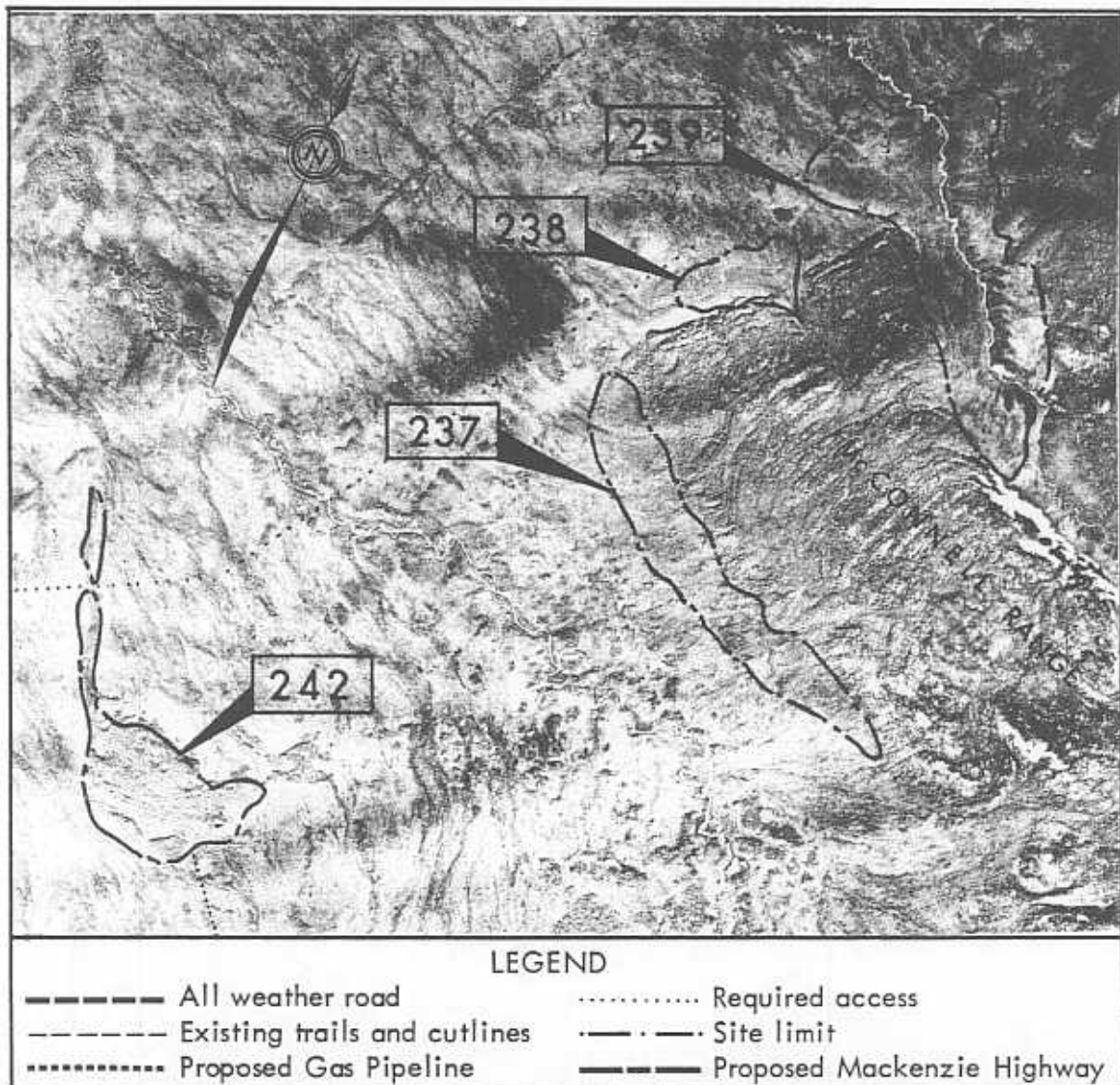


SITE NO. 237

LOCATION

Located approximately 3 miles east of Big Smith Creek along the southwestern toe of the McConnell Range, Site 237 consists of scree and other slope wash deposits.

The proposed Mackenzie Highway right-of-way at Mile 544 is located approximately 4 miles southwest of Site 237. The proposed gas pipeline route runs approximately 3 miles west of the site area.





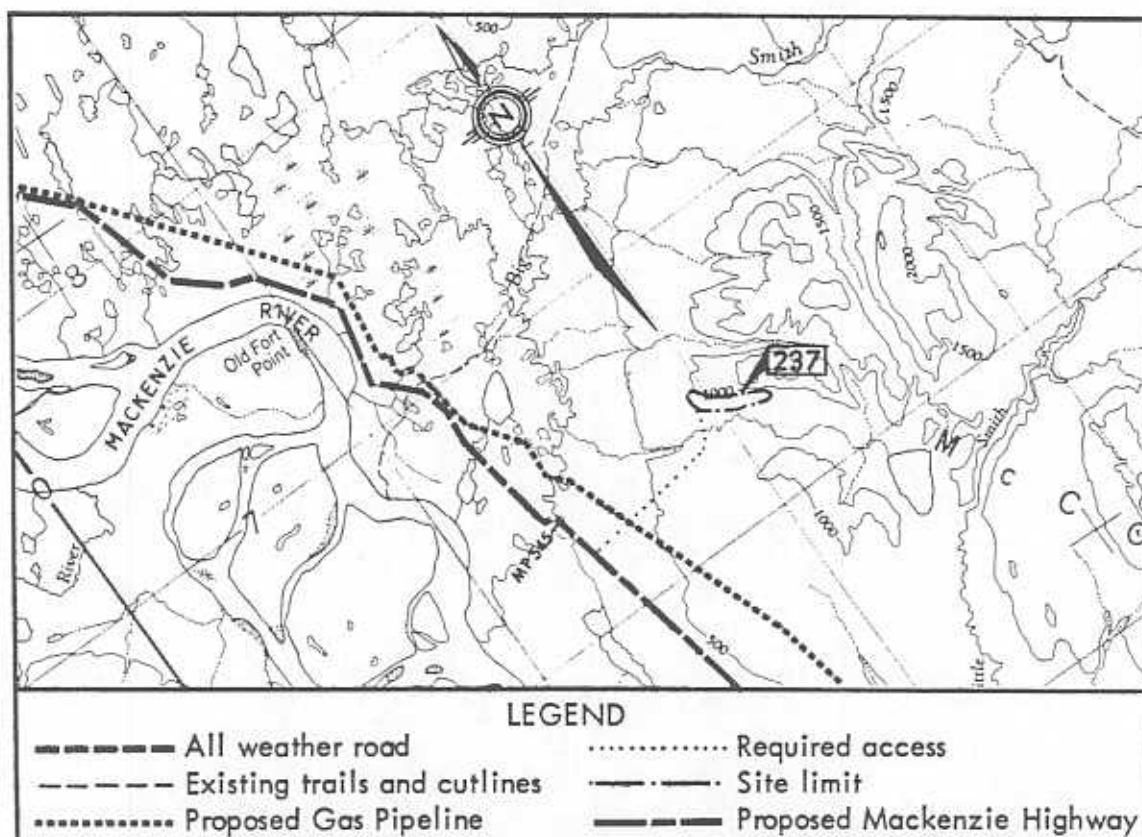
GENERAL

Water and material discharges from the hillside have resulted in deposition of poorly sorted silts and sands with some rock fragments along the line where the relatively flat margin of the Mackenzie Plain abruptly ascends the slopes of the McConnell Range. These sediments form a long, narrow band some 500 to 1000 feet wide and about 1 mile in length along the hillside toe. Moderate to dense stands of black spruce with minor groups of poplar cover this terrain.

There are no known critical wildlife areas in the immediate vicinity of Site 237.

The slope wash deposits, in general, likely consist of silty and sandy deposits while gravel sized particles would be a subordinate component. Moderate ice content is anticipated because of the southern orientation of the site.

Site 237 is remotely located from proposed utilities and is currently inaccessible.



Section of Map No. 96 C

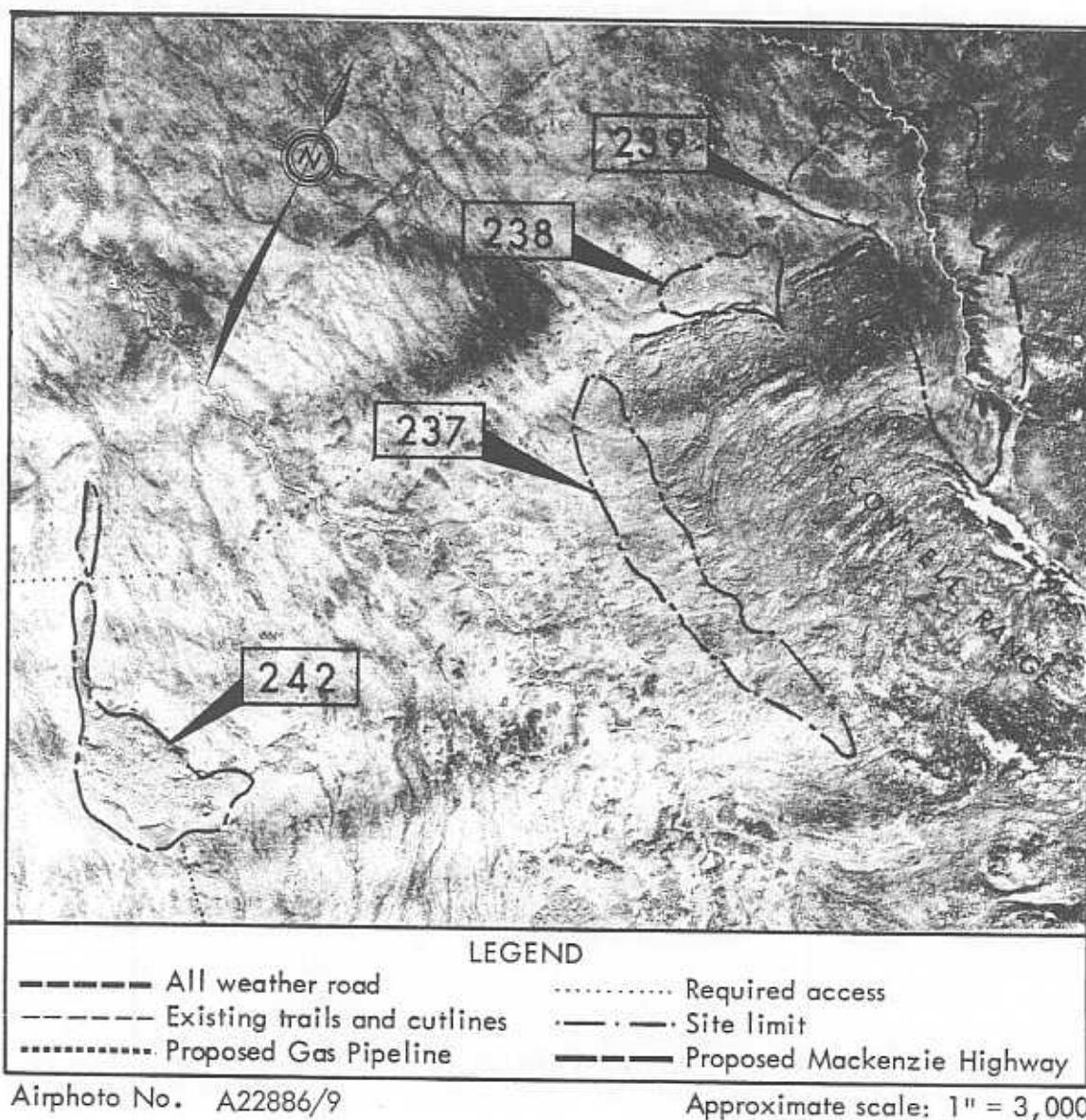
Scale: 1:250,000

SITE NO. 238

LOCATION

Located approximately $2\frac{1}{2}$ miles east of Big Smith Creek along the western face of the McConnell Range, Site 238 consists of a large alluvial fan. Fine grained silt and sand deposits probably prevail within the site area.

The proposed Mackenzie Highway right-of-way at Mile 544 is located approximately 5 miles southwest of Site 238. The proposed gas pipeline route runs approximately 4 miles southwest of the site area.





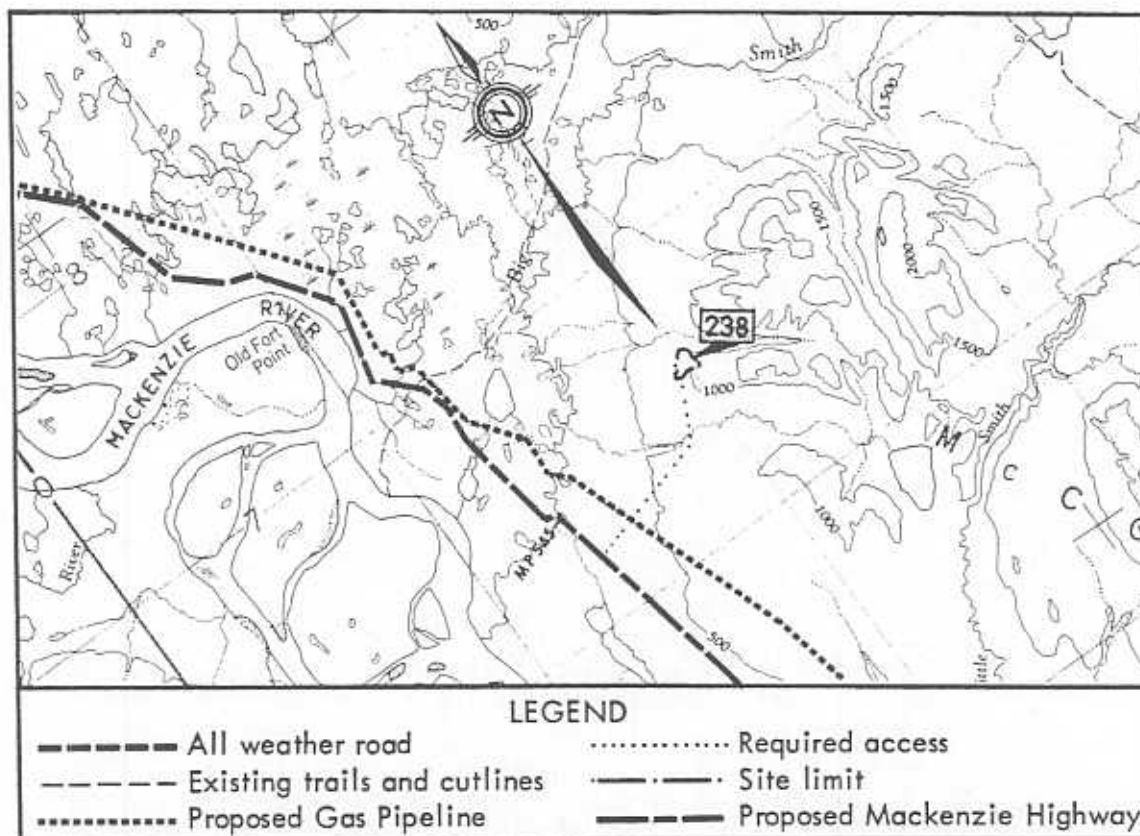
GENERAL

Site 238 encompasses an alluvial fan which has been formed by intermittent stream drainage along the western slope of the McConnell Range. The aerial extent of the fan deposit is approximately 500 feet by 1000 feet. The fan is probably composed of fine grained materials with lesser coarse aggregates which forms a very gently sloping cone at the mouth of an erosional gully. Fair drainage across the site supports well developed stands of black spruce.

There are no known critical wildlife areas in the immediate vicinity of Site 238.

Predominant material in the fan likely consists of silt and sand sized deposits with secondary angular to subangular gravel fragments. Relatively high ice content can be anticipated. The material would be suitable only for low quality general fill if the in place moisture content is acceptable. Site 238 is currently inaccessible and new access in excess of 5 miles would be required.

Site 238 is considered as a very poor prospect for granular materials.



Section of Map No. 96 C

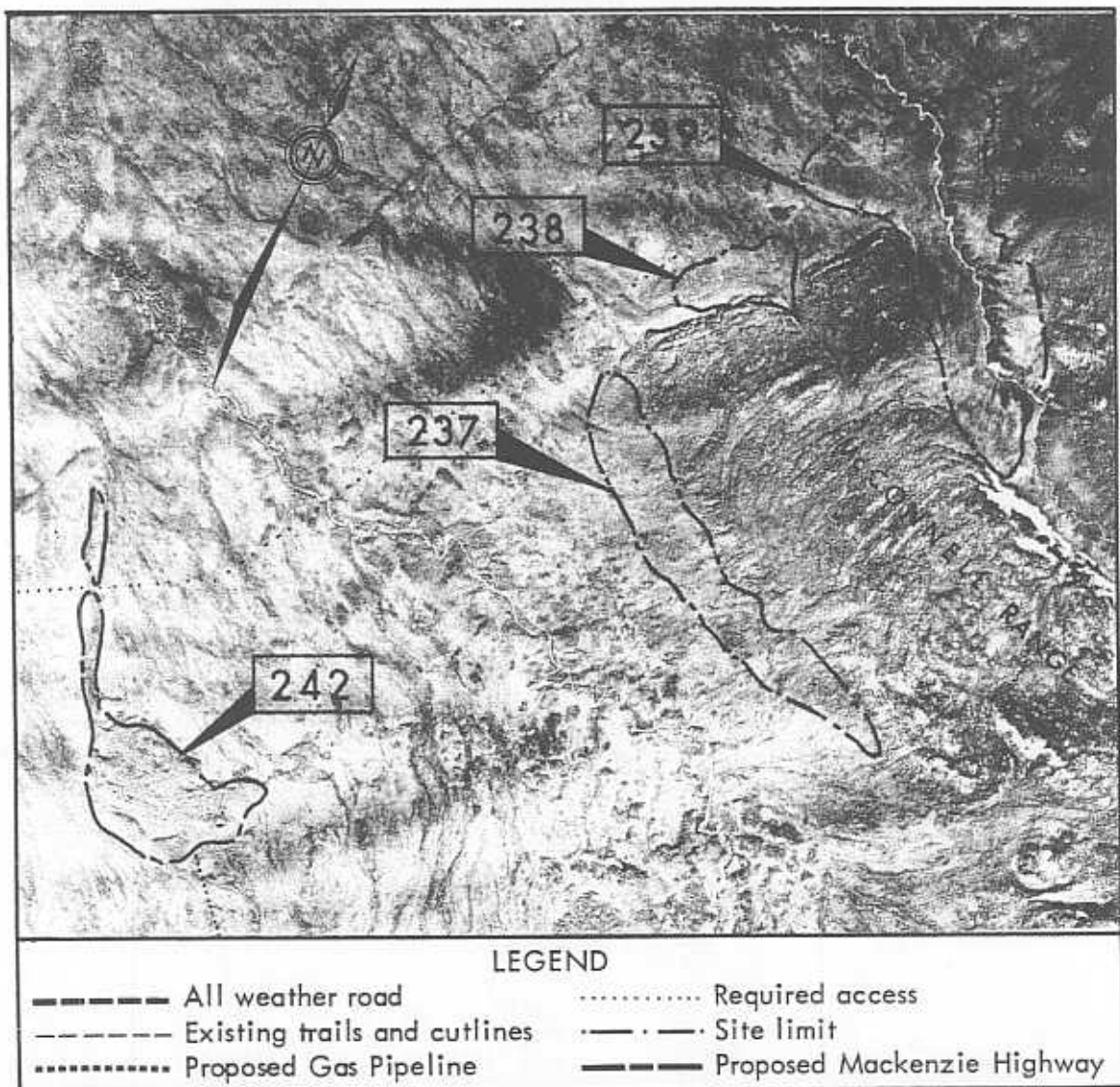
Scale: 1:250,000

SITE NO. 239

LOCATION

Located approximately $2\frac{1}{2}$ miles east of Big Smith Creek along the western face of the McConnell Range, Site 239 consists of predominantly fine grained alluvial sediments deposited at the mouth of a major gully. The deposits contained in the site area are probably unsuitable for construction purposes.

The proposed Mackenzie Highway right-of-way at Mile 544 is located approximately 5 miles southwest of Site 239. The proposed gas pipeline route is located at a distance of some 4 miles west of the site area.



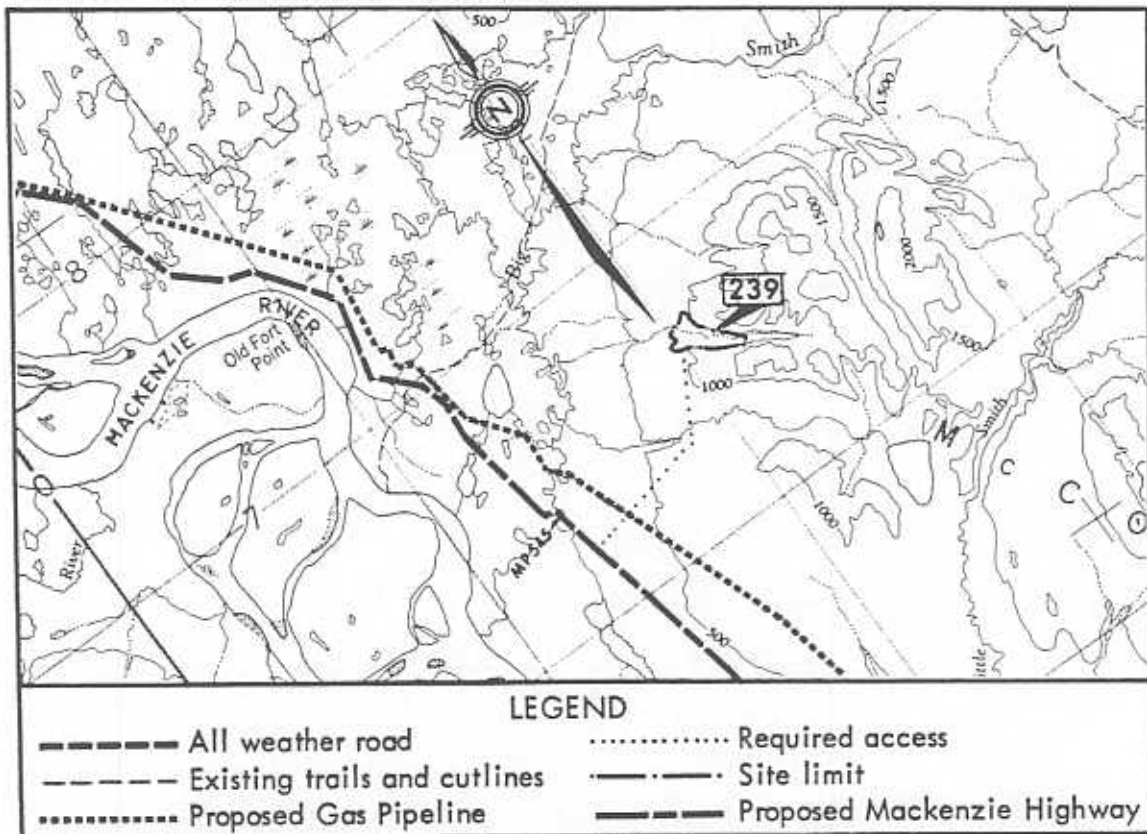


GENERAL

Site 239 consists of alluvial sediments deposited in and at the mouth of a gully cut into the northwestern tip of McConnell Range by an unnamed tributary stream of the Big Smith Creek. The gully at its mouth is approximately 1000 feet wide and narrows considerably about a mile upstream from the mouth. Banks on both sides of the stream are covered with scree and slope wash materials eroded from adjacent rock walls. These deposits are apparently mixed with fluvial sediments brought in by the stream from the eastern sections of the gully. A flat fan, formed by fluvial sediments is located at the gully mouth. Drainage conditions across the site are fair. Vegetation cover consists predominantly of black spruce with relatively dense underbrush. There are no known critical wildlife areas in the immediate vicinity of Site 239.

Poorly sorted, locally stratified, predominantly fine grained materials including sandy silts and silty sands with subordinate angular to subangular gravel sized rock fragments are anticipated from within this site. These materials would be of low quality and variable ice content which are probably unsuitable as granular material for construction purposes. Moreover, a stream channel, which dissects the site into two narrow strips would make development difficult.

Site 239 is not suggested for development.



Section of Map No. 96 C

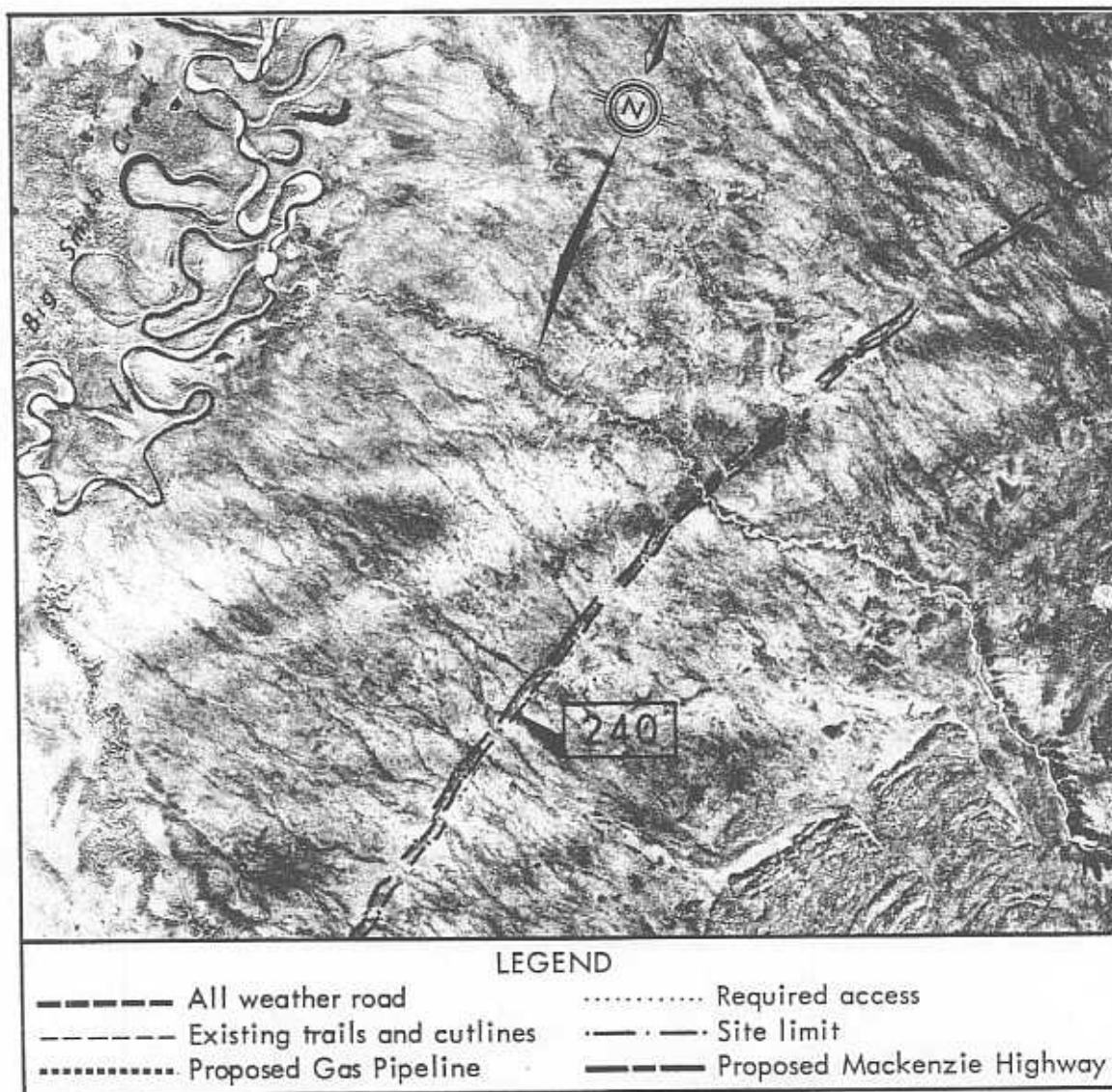
Scale: 1:250,000

SITE NO. 240

LOCATION

Located about $1\frac{1}{2}$ miles east of Big Smith Creek at the eastern margin of the Mackenzie Plain, Site 240 encompasses an abandoned strand line.

The proposed Mackenzie Highway right-of-way at Mile 545.5 is located approximately 3 miles southwest of Site 240. The proposed gas pipeline route runs approximately 2 miles west of the southwestern tip of the site area.



Airphoto No. A22886/8

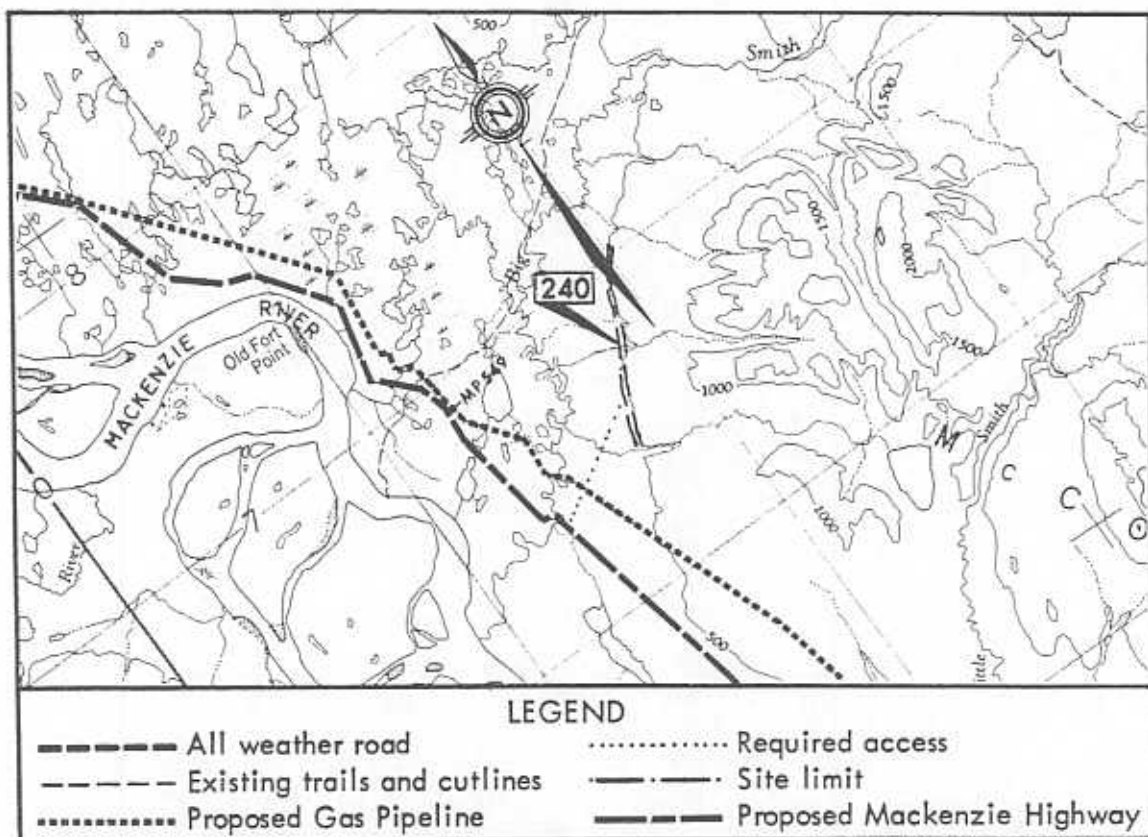
Approximate scale: 1" = 3,000'



GENERAL

Site 240 consists of an abandoned strand line paralleling the terrain contour around the northwestern tip of the McConnell Range at an elevation of 500 feet. Although the site does not form a major ridge or step, the strand line is distinguished from adjacent terrain by a vegetation cover consisting of better stands of mixed black spruce and poplar. The strand line marks the position of a proglacial lake basin and lake sediments should exist west of the line while morainal deposits should be encountered to the east. Shallow and narrow wave-washed sediment features contour the site terrain. There are no known critical wildlife areas in the immediate vicinity of Site 240. The area, however, lies within the region along Big Smith Creek which is trapped by natives of Fort Norman.

The flat slope of the beach and its narrow width are indicative of fine to medium grained silty sand material. This material is probably unsuitable or of low quality for construction purposes. Moreover, the extraction of prospective deposits would require clearing of large tracts of land in order to recover relatively small volumes of material. Therefore, Site 240 is not suggested for development.



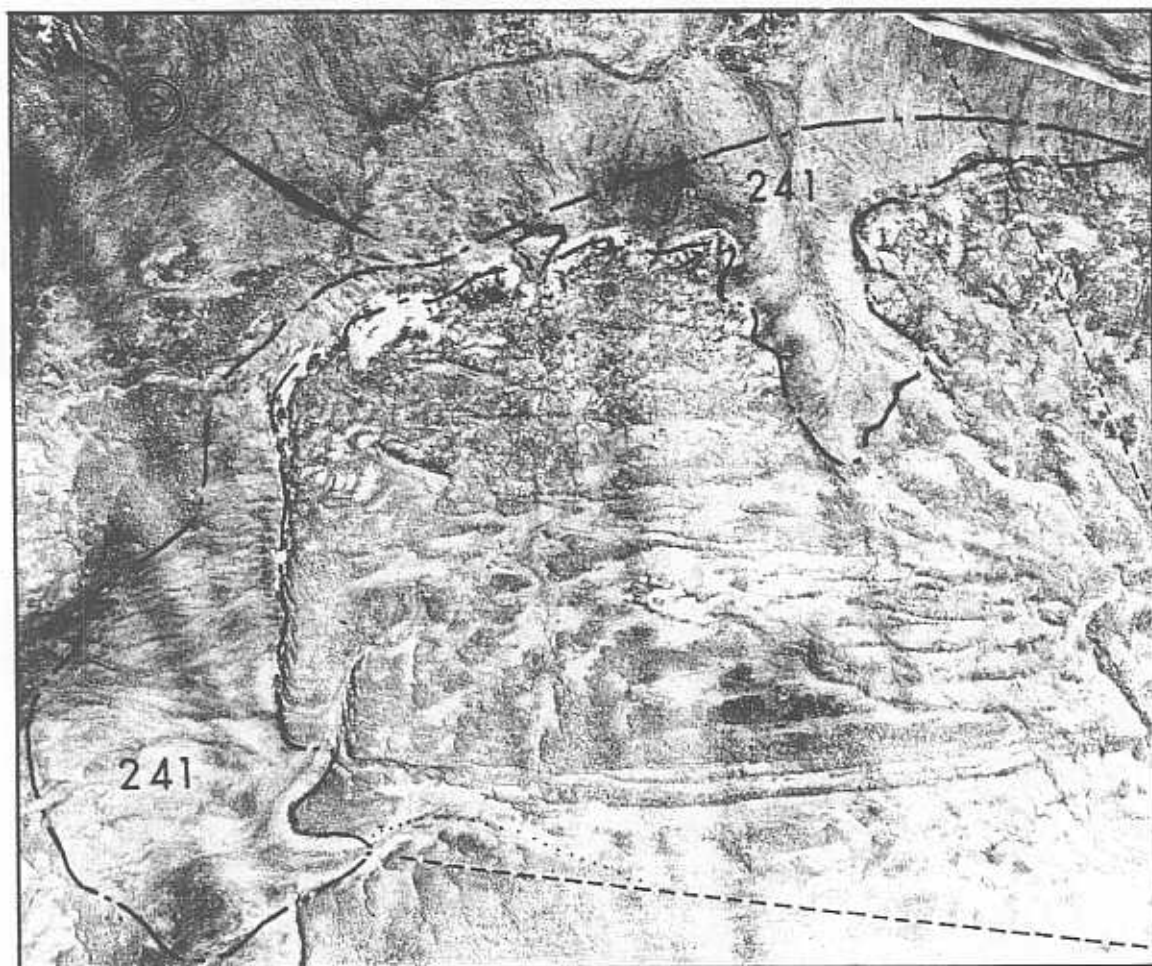
SITE NO. 241

LOCATION

Located approximately 4 miles south of Big Smith Creek, Site 241 consists of slope wash deposits and scree which mantle the northern face of a rocky hill.

The proposed Mackenzie Highway right-of-way at Mile 542.5 is located approximately $3\frac{1}{2}$ miles west of Site 241 if new access is cut. The haul distance from the site area to the Highway at Mile 538 along existing seismic cutlines would be $5\frac{1}{2}$ miles.

The proposed gas pipeline route lies approximately 2 miles west of the western margin of the site area.



LEGEND

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

Airphoto No. A22886/10

Approximate scale: 1" = 3,000'



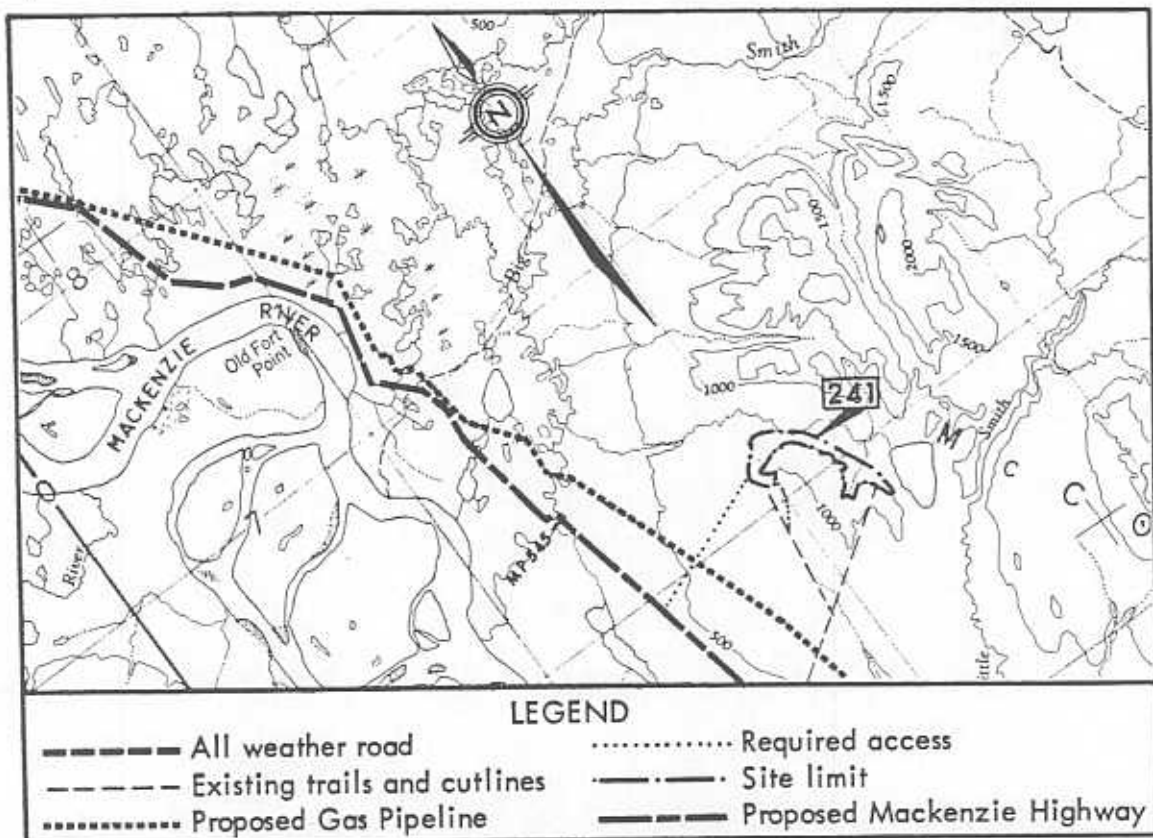
GENERAL

Site 241 parallels the toe of the western flank of the McConnell Range. Soil and rock materials have moved down the hillside to form irregular scree, fans and slope wash debris. The ground surface slopes very gently toward the flat areas away from the site. The drainage pattern is not well developed and the terrain is marked with numerous, very shallow rills indicating surficial run-off patterns. This in turn has facilitated the development of peat and organic soil layers which support stands of black spruce.

There are no known critical wildlife areas in the vicinity of Site 241. The site area is, however, included within the region along Big Smith Creek which is trapped by natives of Fort Norman.

The slope wash deposits very likely consist of silty and sandy aggregates with secondary gravel sized subangular rock fragments. Because of poor drainage conditions and northern exposure, moderate to high ice content is expected. The site is currently inaccessible and was not therefore drilled. Material from the site is of low to very low quality, and conceivably could be used as general fill for embankment construction if acceptable ice content is proved by field testing.

The prospect for granular materials at Site 241 is considered to be poor. The access along the existing seismic cutlines is difficult because of rugged terrain in the area encompassed by rocky hills.



Section of Map No. 96 C

Scale: 1:250,000

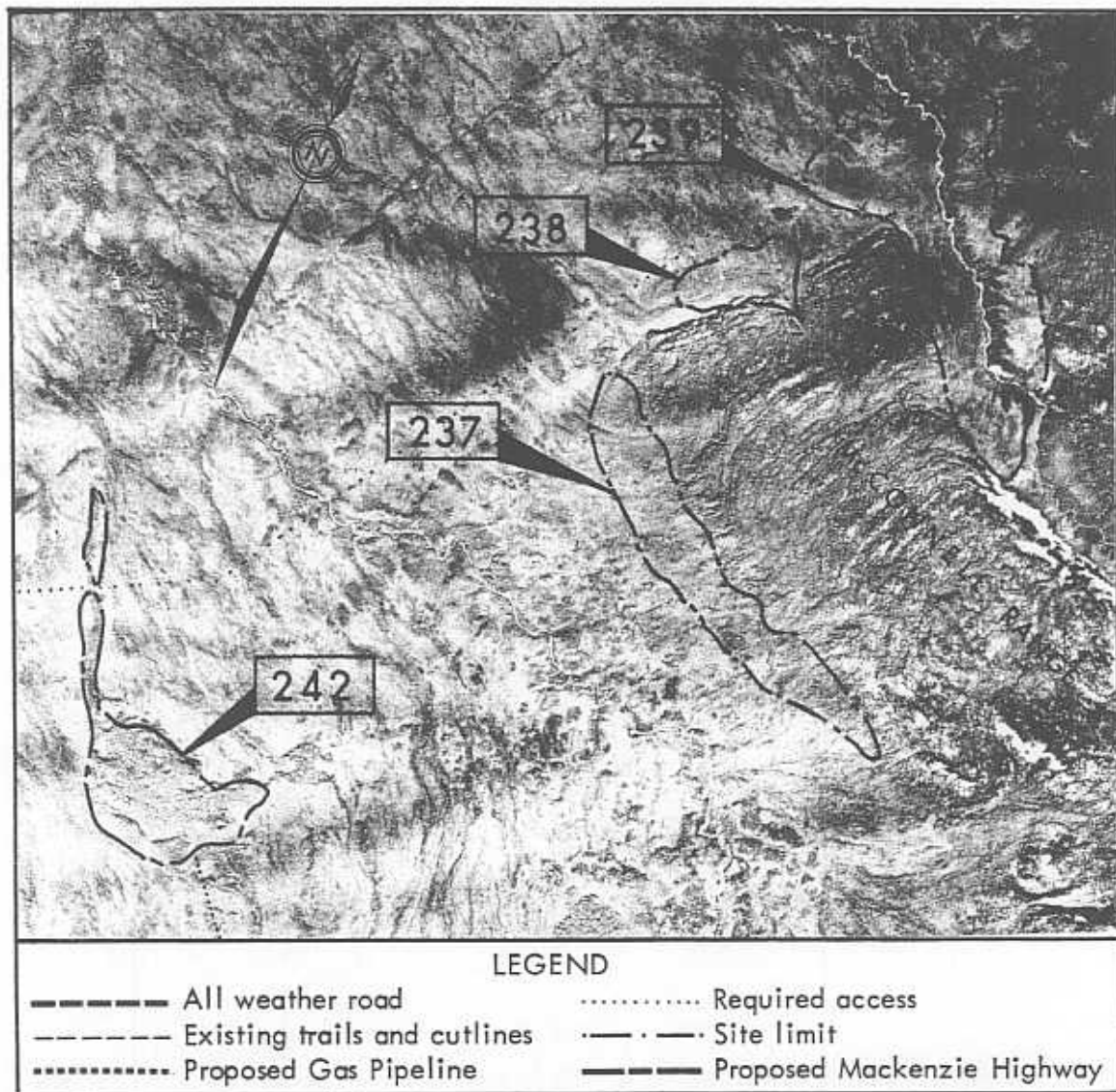
SITE NO. 242

LOCATION

Located approximately $2\frac{1}{2}$ miles southeast of Big Smith Creek, Site 242 consists of a hummocky kame field. The kames are anticipated to be comprised of silty sand and gravel materials.

The proposed Mackenzie Highway right-of-way at Mile 544 is located approximately $2\frac{1}{2}$ miles west of Site 242. The haul distance from the site area along existing seismic cutlines to the proposed Mackenzie Highway at Mile 539 is in excess of 5 miles.

The proposed gas pipeline route runs west of the kame field at a distance of $1\frac{1}{2}$ miles.



Airphoto No. A22886/9

Approximate scale: 1" = 3,000'

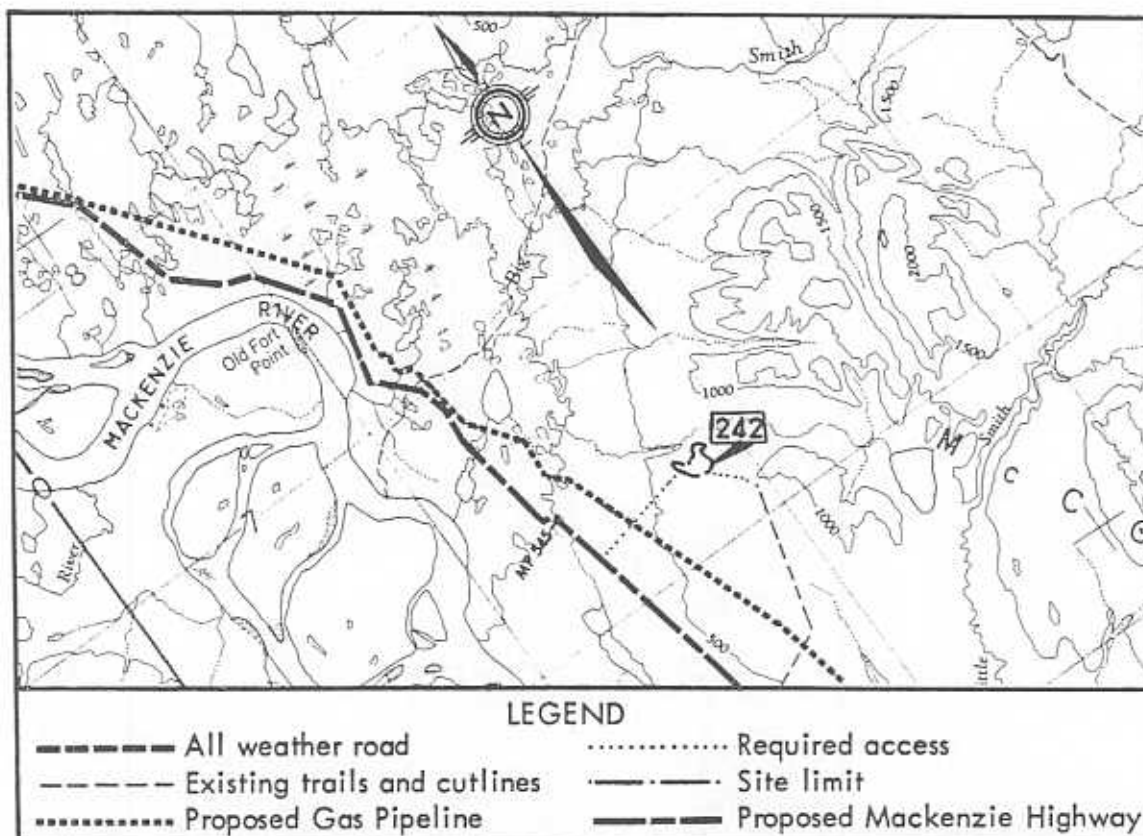
GENERAL

Site 242 consists of a kame field and a shallow and narrow discontinuous esker ridge which extends to the northwest about 3/4 of a mile beyond the field. The kame field measures approximately 2500 feet in length and 1500 feet in width. The adjacent terrain slopes gently to the west, exhibiting fair to poor surficial drainage. Irregularly bedded and variably washed sands and gravels are probably the most common constituents of this kame field. Silt beds and till lenses may also be common within the main sand and gravel body. The kame field is better drained than the adjacent terrain and supports well developed stands of spruce and poplar.

There are no known critical wildlife areas in the vicinity of Site 242; however, the region along Big Smith Creek is trapped by natives of Fort Norman.

It is anticipated that sand and gravel deposits within the kame field would have low to medium ice content and thus would be suitable for fair to good quality general fill material. Better quality materials, such as clean well graded gravel, may occur in isolated pockets which would be difficult for selective exploitation. The kame field is considered to be a fair to good prospect for granular materials.

The relatively minimal volume of material available from the shallow esker ridge would entail a comparatively large degree of surficial area being cleared relative to the volume of material available.



Section of Map No. 96 C

Scale: 1:250,000

SITE NO. 243

LOCATION

Located approximately $4\frac{1}{2}$ miles east of the Mackenzie River and 4 miles south of Big Smith Creek, Site 243 encompasses a drumloid till plain.

The proposed Mackenzie Highway right-of-way at Mile 537 is located approximately 3½ miles southwest of Site 243.

The proposed gas pipeline route parallels the site area at a distance of $\frac{1}{2}$ mile to the west.



LEGEND

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

Airphoto No. A22966/106

Approximate scale: 1" = 3,000'



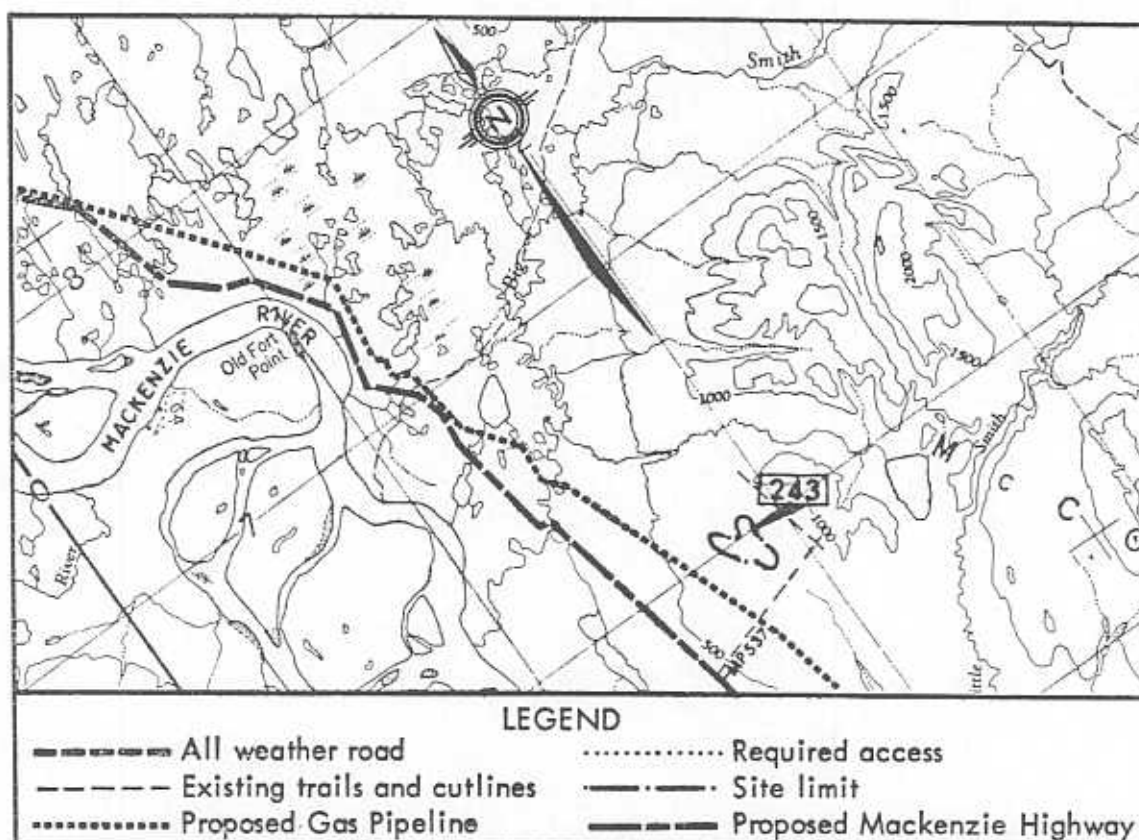
GENERAL

Site 243 encompasses a better drained segment of a drumloid till plain. The site lies above the general level of the former lake bottom and the terrain beyond the eastern site boundary abruptly ascends the western flank of McConnell Range.

The till plain surface is rolling and streamlined, elongated mounds mark the direction of ice movement. Drumlins vary in height from 10 to 40 feet being steeper in the northern section of the site. The thickness of the till sheet which overlies bedrock is probably less than 15 feet. Drainage conditions across the site area are fair. Vegetation cover consists mainly of good stands of black spruce mixed irregularly with groups of poplar.

There are no known critical wildlife areas in the vicinity of Site 243; however, the region along Big Smith Creek is trapped by natives of Fort Norman.

The till sheet is primarily comprised of a nonsorted and nonstratified mixed-grained sediment, suitable only for very marginal quality material for general fill. Site 243 is not suggested for development.



Section of Map No. 96 C

Scale: 1:250,000

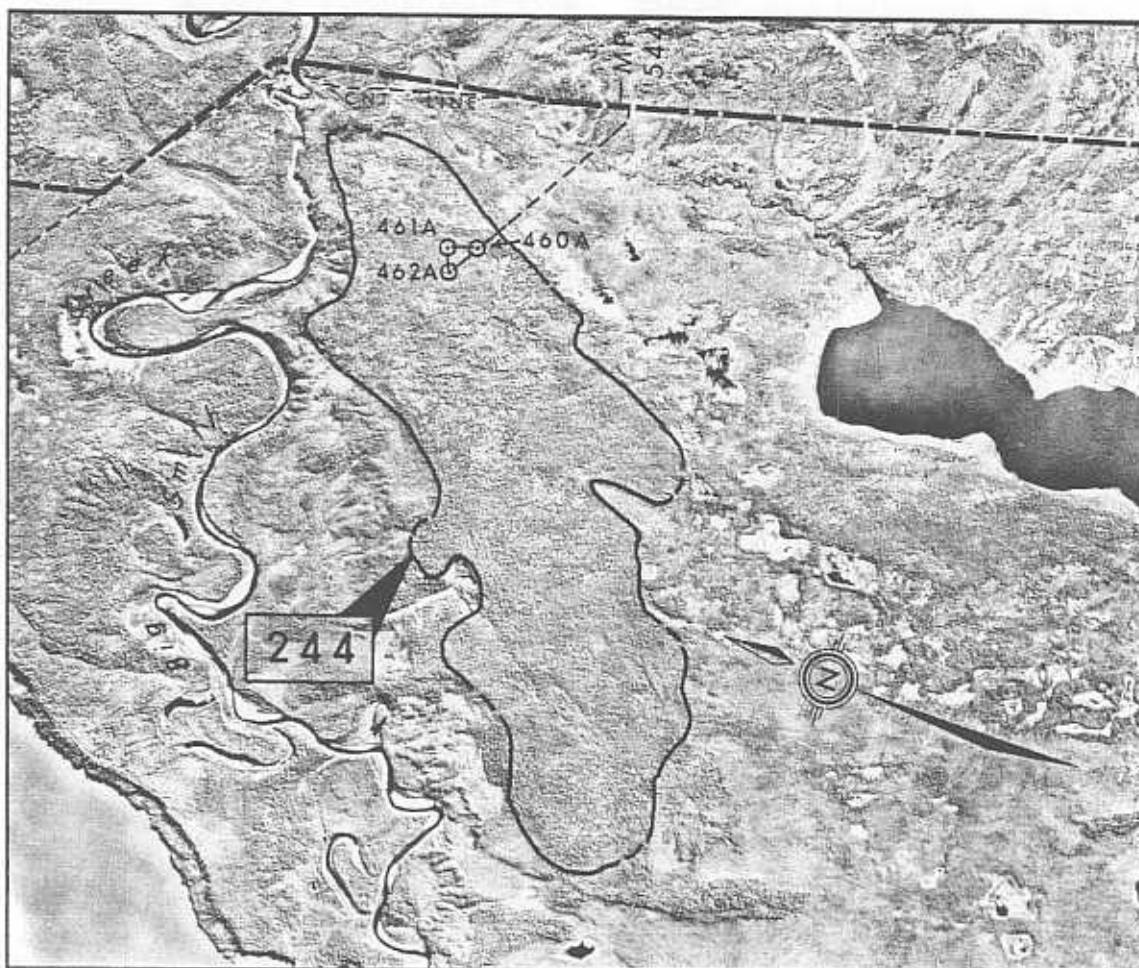
SITE NO. 244

Located immediately adjacent to the southern crest line of Big Smith Creek and less than $\frac{1}{4}$ mile from the proposed Mackenzie Highway at Mile 544, Site 244 consists of a deltaic deposit rising slightly above the adjacent, flat glaciolacustrine plain.

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

Estimated Volume: Not determined.

Assessment: Site 244 is not considered as a source of granular materials; however, this fine sand may be utilized as very marginal embankment fill material in the construction of road subgrades.



LEGEND

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

Airphoto No. A22933/15

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 244 is located immediately adjacent to the southern crest line of Big Smith Creek and the eastern perimeter of the site area is less than $\frac{1}{4}$ mile from the proposed Mackenzie Highway right-of-way at Mile 544. The site, consisting of a deltaic deposit, encompasses an area approximately 2 miles in length and $\frac{1}{2}$ mile in width and rises slightly above the adjacent flat, glaciolacustrine plain. Cleaver Lake is located $\frac{1}{2}$ mile south of the site area and the east bank of the Mackenzie River is approximately $\frac{1}{2}$ mile west. The northern perimeter of the site is incised with numerous shallow, dry, erosional gullies. The site area exhibits fair drainage to the north and south whereas the adjacent terrain to the south is poorly drained and exhibits thermokarst features characterized by small ponds and muskeg bogs.

The material in Site 244 consists of poorly graded, fine grained deltaic sands with a trace of silt which may be suitable for very marginal fill material in the construction of subgrades for roads. The topsoil layer is generally less than 1 foot in thickness and supports moderately dense growths of spruce and poplar attaining heights to 50 feet.

There are no known critical wildlife areas in the immediate vicinity of Site 244; however, the site is within a region which is periodically hunted and trapped by northern residents.

The only existing access to the site from the proposed Mackenzie Highway right-of-way or CNT pole line which are coincident in the immediate vicinity of Site 244, consists of the access trail cleared to the eastern portion of the site during the winter drilling program. The short access trail traverses terrain conditions which are sensitive to thermal erosion if the organic vegetation cover is removed or excessively disturbed.

DEVELOPMENT

The information from the exploratory drill holes which were carried out on Site 244 by the engineering consultant for the Federal Department of Public Works, has been received and incorporated into this report. The following conditions relative to the quality and quantity of available materials are outlined:

- The in situ deltaic material consists of very fine grained, poorly graded sand with a trace of silt. This material is considered suitable only for very low quality, marginal fill material in the construction of subgrades for roads or utility backfill.
- The organic topsoil overburden on the dune slopes is generally less than 1 foot in depth.
- The depth of recoverable material is in excess of 15 feet and is very dry to depths investigated. The moisture contents range from 3 to 7 per cent.
- The initial 3 to 4 feet of the sand, although frozen during the field drilling, only exhibited very low ground ice content.



Site 244 is not recommended as a source of granular material; however, this fine deltaic sand may be used as a low quality fill material in the construction of road subgrades or utility backfill. The following operational guidelines should be followed if this site is developed for marginal fill requirements.

- The on-site tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil should be carefully stripped and stockpiled in designated areas for future utilization in the restoration of the borrow pit areas.
- Vegetation buffer zones should be maintained between work areas to minimize erosion and instability of the exposed pit areas.
- Vertical excavation opposed to horizontal excavation should be considered to minimize the erosion of the exposed borrow areas by wind and rain action.
- The access from the Mackenzie Highway or CNT pole line right-of-ways entails the traversing of thermally sensitive silts and sands; therefore, borrow pit development may be restricted to the winter months unless an all weather access road is constructed.

ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation guidelines should include the following if Site 244 is developed as a borrow pit:

- Recontouring of borrow pit areas to maintain drainage to the adjacent terrain.
- Replacement and spreading of organic topsoil from pre-production stockpiles on to the recontoured exposed borrow pit areas.
- Revegetation of the restored borrow pit areas.

DETAILED DRILL HOLE LOG

SITE NO. 244

HOLE NO. B 460A

DATE: FEB. 19, 1973		LOGGED BY: <input type="checkbox"/> PEMCAN <input checked="" type="checkbox"/> UNDERWOOD			
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		SP	SILT - 4" organic					0	
2							2		
3.0									
4		SP	SAND		UF			4	
6							6		
8							8		
10							10		
12							12		
14							14		
16							16		
18		SP					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. 244

HOLE NO. B 461A

DATE: FEB. 19, 1973	LOGGED BY: <input type="checkbox"/> PEMCAN <input checked="" type="checkbox"/> UNDERWOOD		
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		SM	SILT - 3" organic - some pebbles					0
2								2
3.0								
4		SP	SAND	UF				4
6								6
8								8
10								10
12								12
14								14
16								16
18								18
20								20
20.0								20.0
20.0								20.0
20.0								20.0
20.0								20.0
20.0								20.0
20.0								20.0
20.0								20.0

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. 244

HOLE NO. B 462A

DATE: FEB. 19, 1973		LOGGED BY: <input type="checkbox"/> PEMCAN <input checked="" type="checkbox"/> UNDERWOOD	
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 CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.		
0		SM	SILT - 5" organic					0
2						2		
3.0		SP	SAND	UF				4
4								6
6								8
8								10
10								12
12								14
14								16
16								18
18			SP					20
20								
20.0				END OF HOLE 20.0'				

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



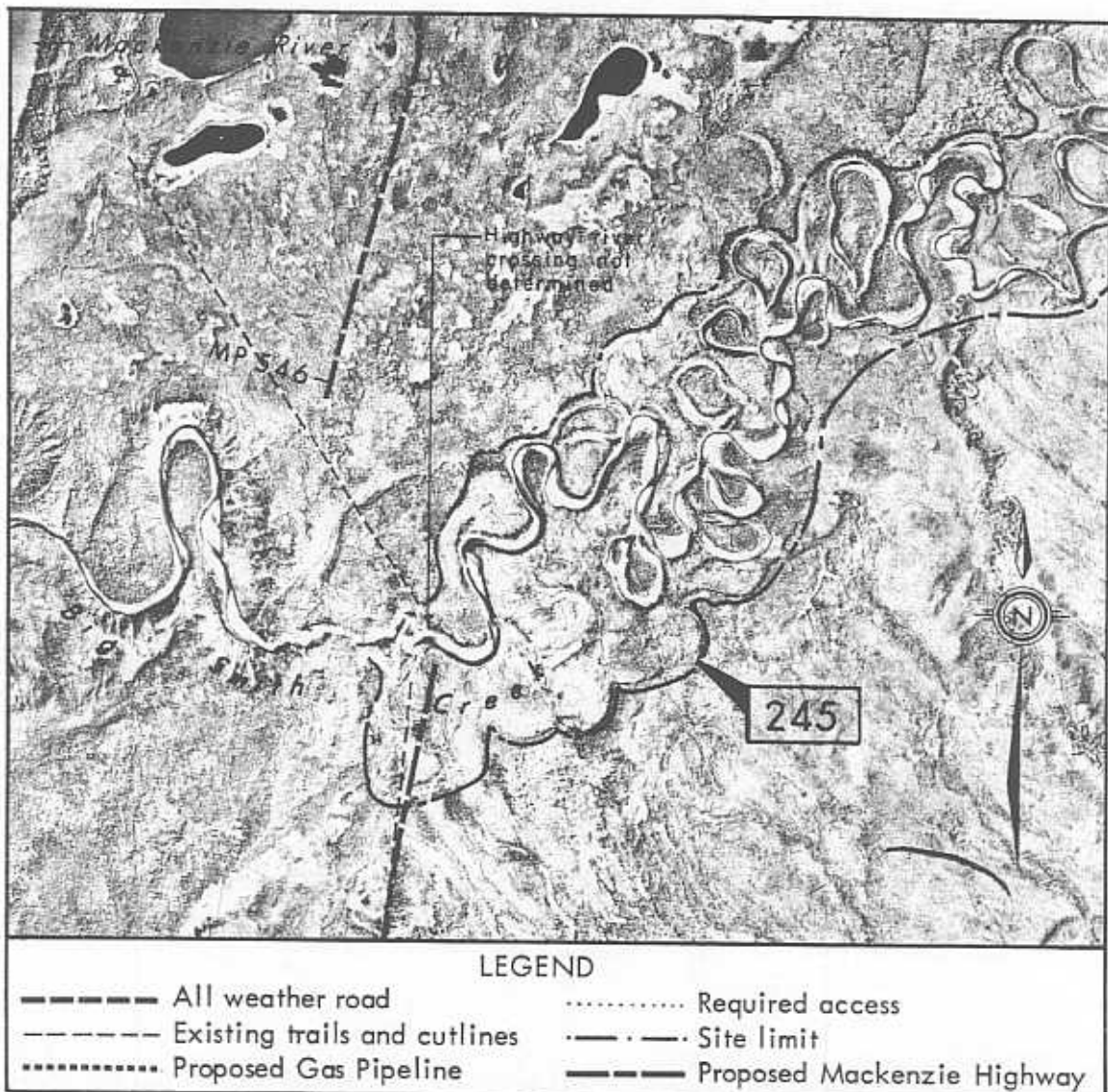
PEMCAN SERVICES "72"

SITE NO. 245

LOCATION

Located on the east side of the Mackenzie River, Site 245 encompasses the wide alluvial flood plain of the meandering Big Smith Creek. Sandy deposits are indicated in the site area.

Both the proposed Mackenzie Highway right-of-way at Mile 545 and gas pipeline route cross the site area within its southern segment.



Airphoto No. A22933/16

Approximate scale: 1" = 3,000'



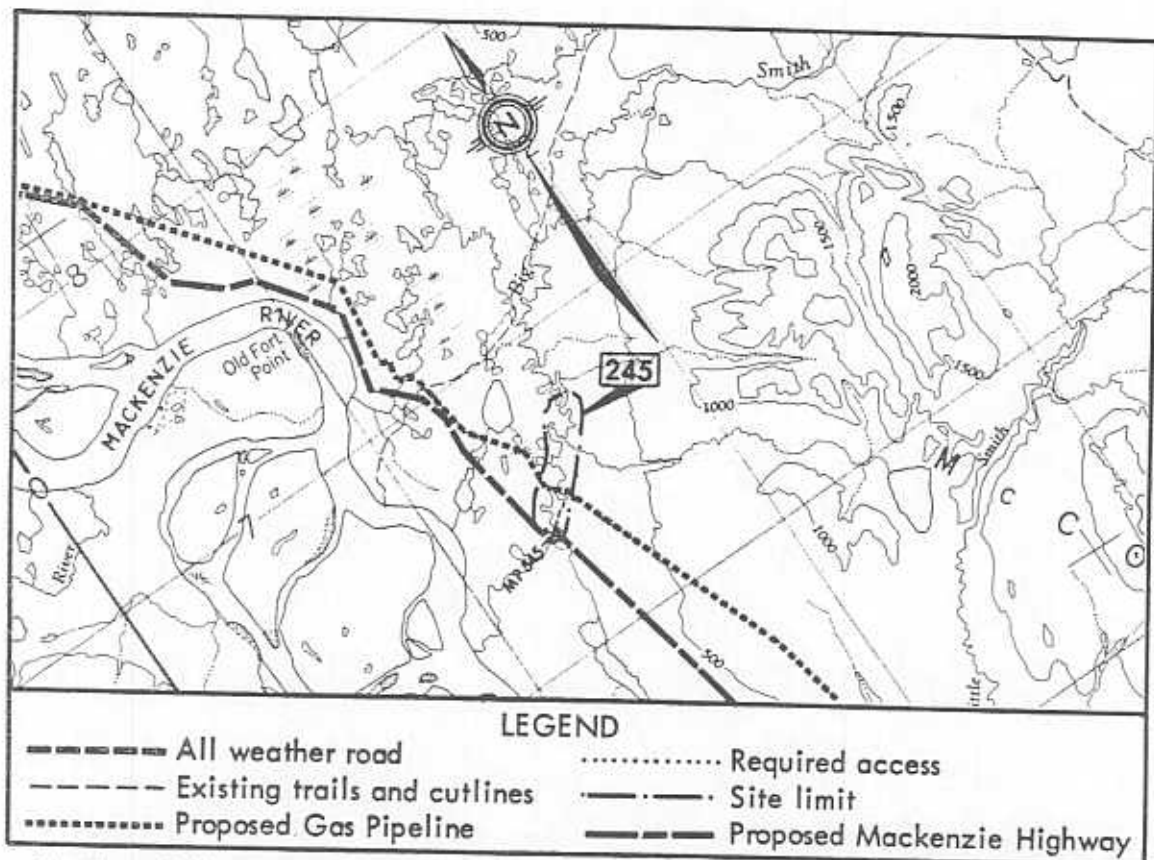
GENERAL

Site 245 encompasses a wide alluvial flood plain of Big Smith Creek which begins approximately 3 miles upstream from the confluence of the creek with the Mackenzie River and continues along the meandering stream for several miles.

The downstream portion of Big Smith Creek is deeply incised below the flat surface of the Mackenzie Plain. Retrogressive erosion has resulted in rapids being cut into the bedrock west of the site area as outlined on the airphoto. The creek channel above the rapids is only slightly incised into the surrounding terrain. The flood plain in this section is 3000 to 4000 feet wide with numerous active and abandoned meanders. Poorly graded to well graded, fine to coarse grained, stratified sands are anticipated in the exposed banks of the meanders. Sandy deposits are topped with several inches to several feet of peat and organic soil which supports relatively dense growths of spruce, willow and underbrush.

There are no known critical wildlife areas in the immediate vicinity of Site 245. This region is periodically hunted and trapped by natives of Fort Norman.

Prospective construction materials are located within the active flood plain and mostly below the high water level of the creek. Sandy deposits would probably suit the requirements for marginal to very marginal fill only.



Scale: 1:250,000



PEMCAN SERVICES

The site is not suggested for development because the granular materials are located within or adjacent to the active stream channel of Big Smith Creek.

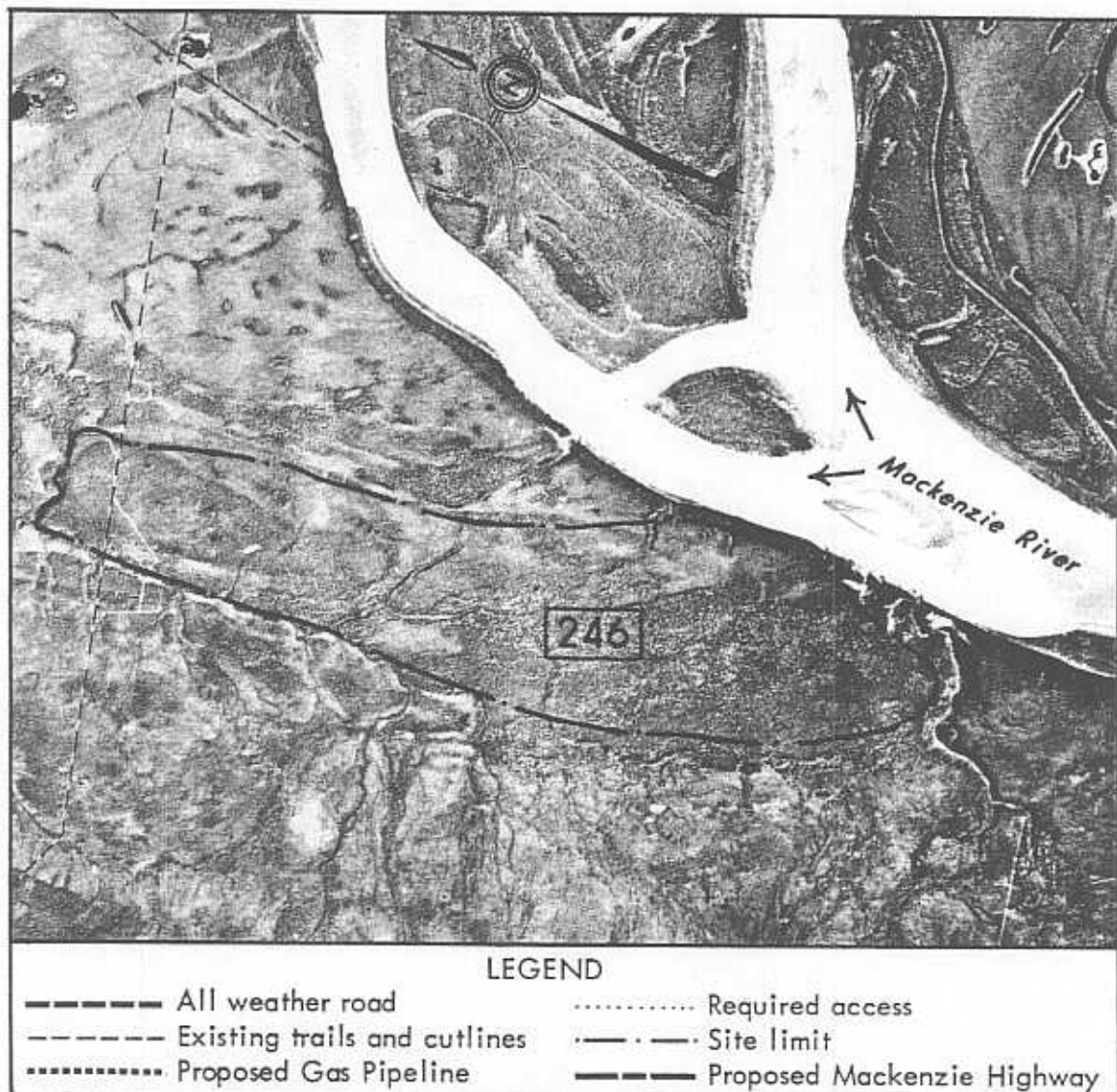
SITE NO. 246

LOCATION

Located within the broad flood plain on the western side of the Mackenzie River, approximately 6 miles west of Old Fort Point; Site 246 encompasses an alluvial terrace consisting, in part, of silt and sand deposits.

The proposed Mackenzie Highway right-of-way at Mile 557 is located approximately 6 miles northeast of Site 246 on the opposite, east river bank.

The proposed gas pipeline route parallels the highway right-of-way approximately one mile further east.



Airphoto No. A22933/74

Approximate scale: 1" = 3,000'

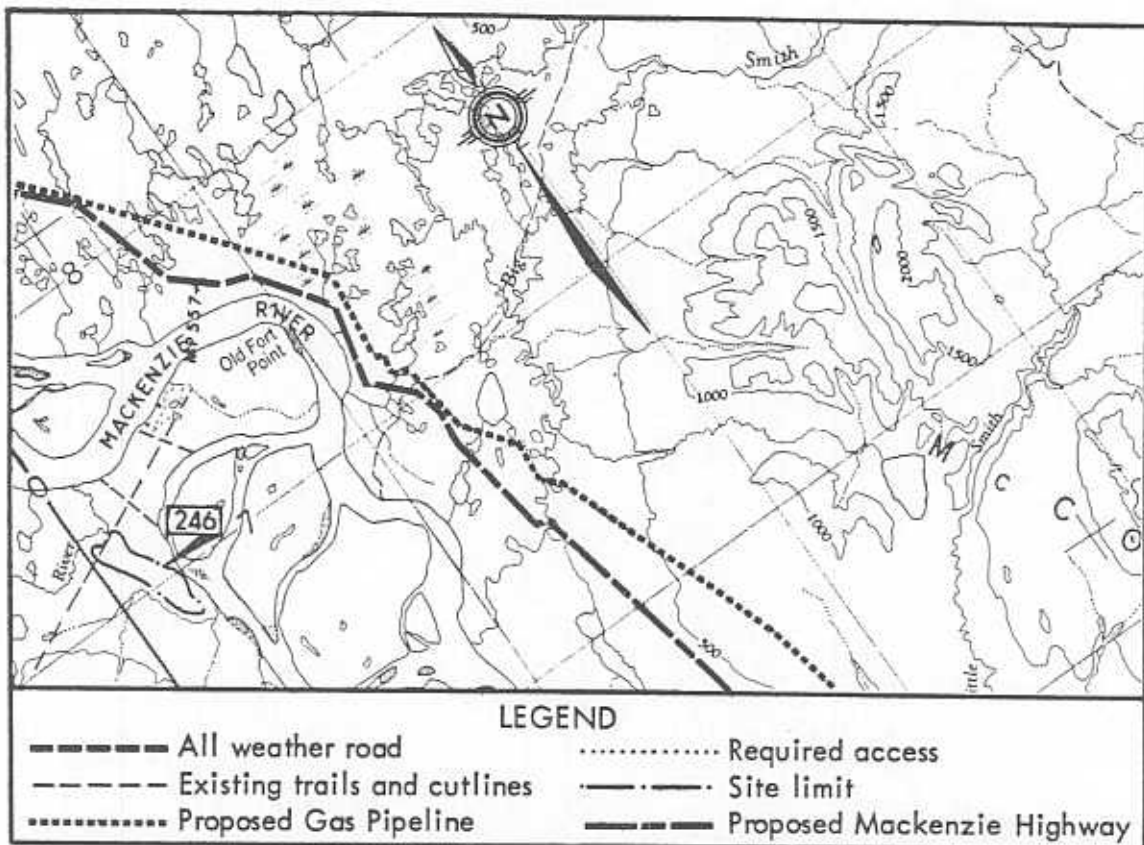


GENERAL

Site 246 consists of a shallow alluvial terrace paralleling the Mackenzie River channel on the west side. The terrace is approximately 3 miles in length and averages about $\frac{1}{2}$ mile in width. The flat surface of the terrace is 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 which forms the terrain surrounding Site 246. The drainage conditions are only fair and the surficial runoff is directed into the adjacent river channel. The site area is covered with moderately dense growths of willows, poplar, birch and spruce.

There are no known critical wildlife areas in the immediate vicinity of Site 246.

It is anticipated that the material in Site 246 consists of stratified, fine grained silty sands with silt layers topped with variable thicknesses of topsoil and organic silt. Depending upon the actual silt and moisture content, the deposits may be suitable for very marginal fill material. Access to the site is difficult because of irregular terrain and the required crossing of the Mackenzie River. Site 246 is considered to be a very poor prospect for granular materials.



Section of Map No. 96 C

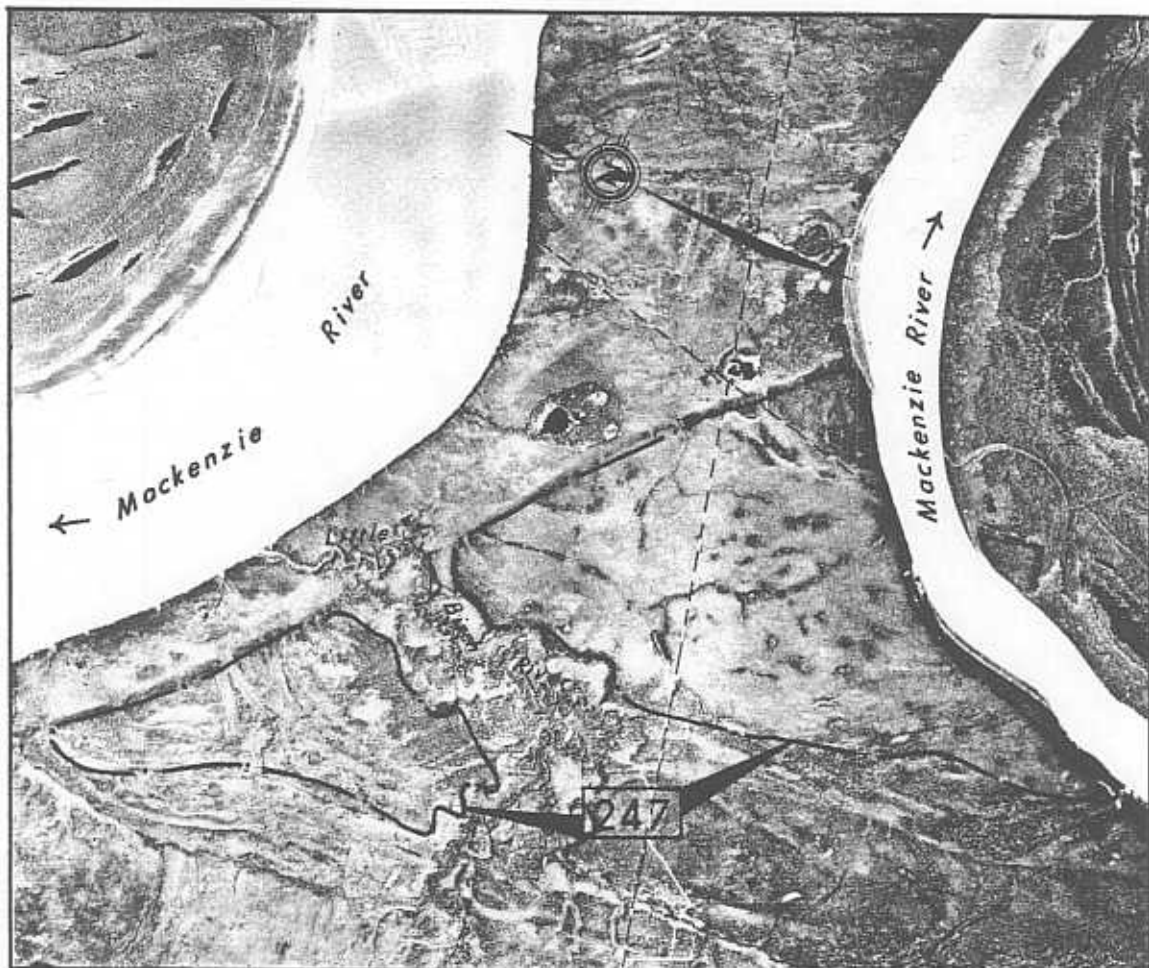
Scale: 1:250,000

SITE NO. 247

LOCATION

Located on the west side of the Mackenzie River within its broad flood plain and dissected by Little Birch River, Site 247 consists of a shallow alluvial terrace, paralleling the active Mackenzie River stream channel. The terrace material probably consists of silt and silty sand.

The proposed Mackenzie Highway right-of-way parallels the opposite, east river bank; the haul distance from Site 247 to the Mackenzie Highway at Mile 557 would be about 6 miles. The gas pipeline route is located approximately 7 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. A22933/73

Approximate scale: 1" = 3,000'



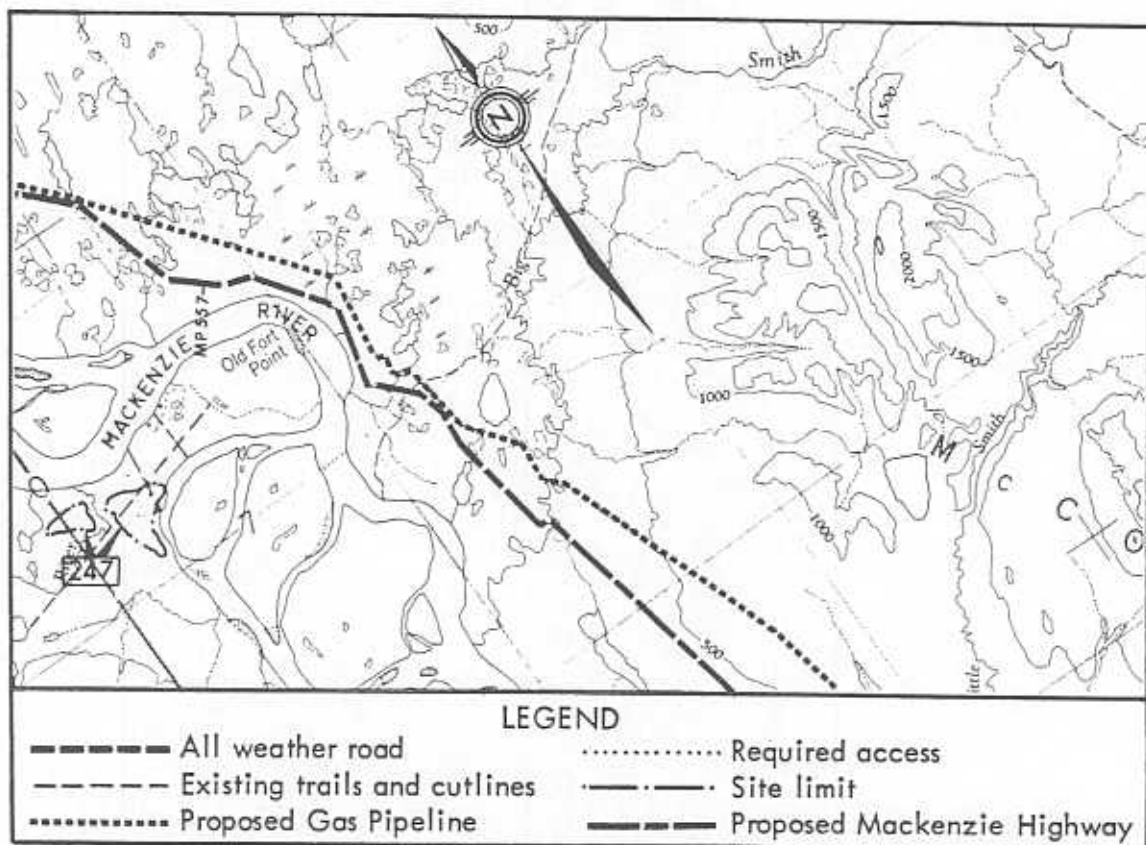
GENERAL

Site 247 consists of a large alluvial terrace which is dissected into two segments by the active stream channel of Little Birch River. The terrace segments are approximately $2\frac{1}{2}$ miles in length and averages about $\frac{3}{4}$ of a mile in width. The flat surfaces of these terraces 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 which forms the terrain surrounding Site 247. The drainage conditions are only fair and the surficial runoff is directed into adjacent river channels. The site area is covered with moderately dense growths of willow, poplar, birch and spruce.

There are no known critical wildlife areas in the immediate vicinity of Site 247.

It is anticipated that the material in Site 247 consists of stratified, fine grained silty sands and sandy silts, topped with variable thicknesses of topsoil and organic silt. The terrace deposits may be suitable only as a very marginal general fill material.

Access to the site area is difficult because of irregular terrain and the required crossing of the Mackenzie River.



Section of Map No. 96 C

Scale: 1:250,000

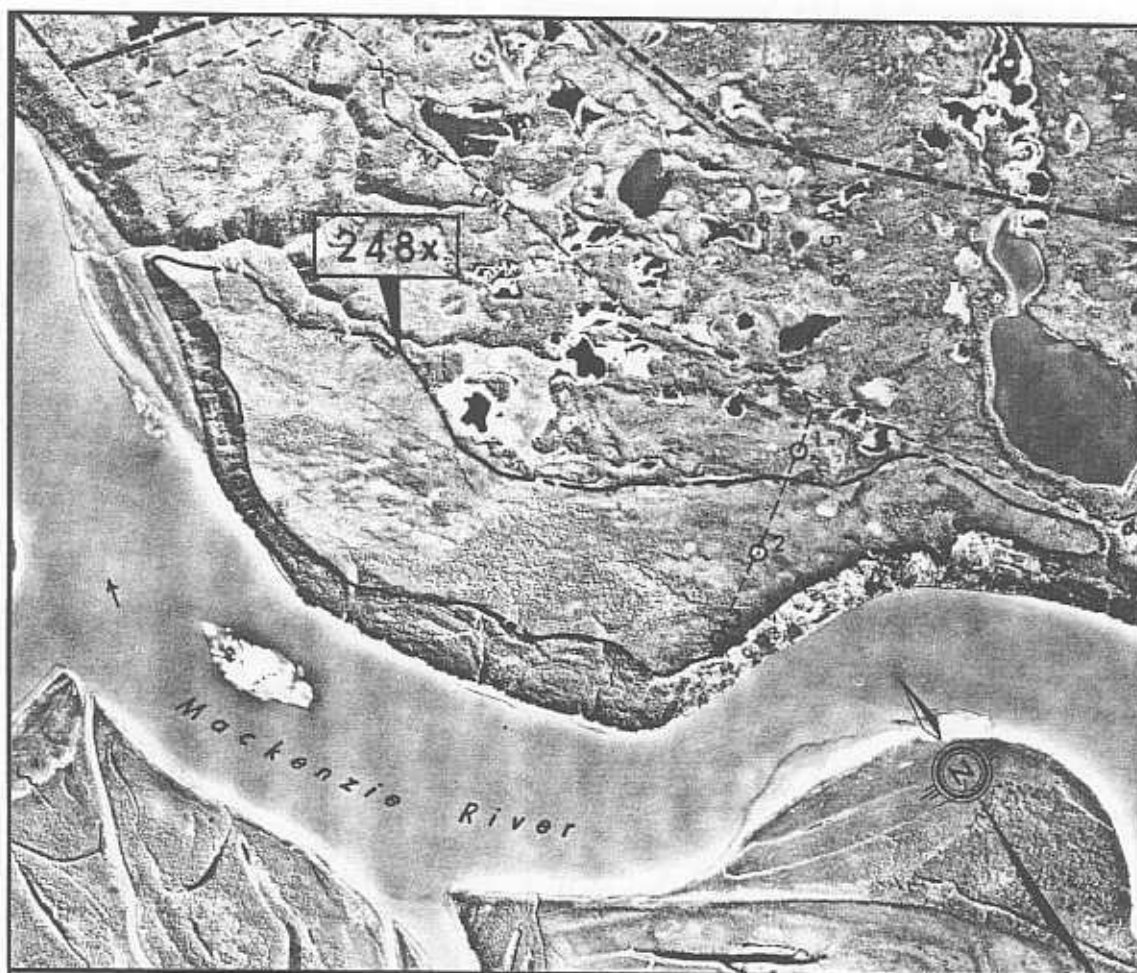
SITE NO. 248X

Located approximately 1 mile north of Big Smith Creek and $1\frac{1}{4}$ miles west of the proposed Mackenzie Highway at Mile 548, Site 248X consists of deltaic sands and silt deposits in a broad lacustrine plain.

Type of Material: Sand and Silt; fine grained.

Estimated Volume: Not applicable.

Assessment: Very poor quality material exhibiting high ground ice content, Site 248X is not 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. A22933/18

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 248X is located approximately 1 mile north of Big Smith Creek and $1\frac{1}{4}$ miles west of the Mackenzie Highway right-of-way at Mile 548. The site consists of deltaic sands and silts in a broad lacustrine plain and is situated immediately adjacent and parallel to the northeast bank of the Mackenzie River. The site area is approximately 3 miles in length, averages $\frac{1}{2}$ mile in width and rises 100 to 150 feet above the water level of the Mackenzie River. The southern steep banks exhibit slumping and some minor erosional gullying whereas the terrain adjacent to the northern perimeter of the site area is flat, poorly drained and exhibits thermokarst features characterized by numerous lakes, ponds and muskeg bogs.

The material in Site 248X consists of fine grained silts and sands with a relatively high ground ice content. The organic topsoil layer is generally less than 1 foot in thickness, although localized depressions containing thicker depths of peat were noted. The site area is covered with a light to moderate growth of spruce and birch attaining heights in excess of 30 feet and trunk diameters to 6 inches.

There are no known critical wildlife areas in the immediate vicinity of Site 248X; however, the site is within a region which is periodically trapped and hunted by northern residents.

The only existing access to Site 248X consists of the access trail which was cleared from the CNT pole line during the winter drilling program. The proposed Mackenzie Highway is located approximately $1\frac{1}{4}$ miles east of the site area. Future access to this site from either the proposed Mackenzie Highway right-of-way or the existing CNT pole line will have to traverse terrain conditions which are highly sensitive to thermal erosion.

DEVELOPMENT

Site 248X is not recommended as a source for granular materials because the fine grained, deltaic silts and sands which exhibit a relatively high ground ice condition would not be suitable for use as construction materials. In addition, access to the site area is very difficult because of the adjacent thermally sensitive terrain conditions.

Although the preliminary assessment of Site 248X by airphoto interpretation and field reconnaissance indicated possible granular materials, the drill holes carried out during the winter drilling program did not prove out any granular type materials. The results of the field drilling program are attached herewith for reference.

DETAILED DRILL HOLE LOG

SITE NO. 248X

HOLE NO. DH - 1

DATE: FEB. 3, 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								0
3		ML	SILT: medium brown.		Vs Vx	H		3
6			- some clay, occasional sand pockets, medium brown, from 6.0'					6
9		ML-CL						9
12					Vs	M		12
15								15
18			- little sand medium grey, from 18.0'		Vs			18
21		ML			Vc			21
22.0			TOTAL DEPTH 22.0'					
24								24

DETAILED DRILL HOLE LOG

SITE NO. 248 X

HOLE NO. DH-2

DATE: FEB. 3, 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 CONDITIONS			ICE EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS				
0		Pt	PEAT: organic, fibrous		Vr				0
3		SP	SAND: trace silt, medium grained, poorly graded, occasional pebbles to 3/8" size, medium brown						3
6									6
9				Vc	M	MC	GS	O	9
12				Vr					12
15									15
18							MC		18
21			TOTAL DEPTH 21.0'						21
24									24

DETAILED DRILL HOLE LOG

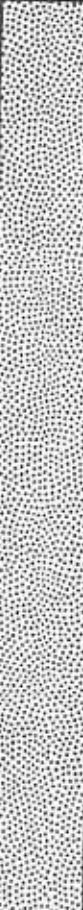

SITE NO. 248 X

HOLE NO. DH-3

DATE: FEB. 3, 1973

LOGGED BY: ☒ PEMCAN ☐

DRILLING METHOD: ☒ CONVENTIONAL ☐ AIR REVERSE CIRCULATION ☐ OTHER:

CONVENTIONAL									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		SM-SP	SAND: trace gravel and silt, medium grained, poorly graded, occasional pebbles to 3/8" size, medium brown		Vx	M	MC	0					
3								3					
6								6					
9								9					
12								12					
15								15					
18								18					
21					Vx Vr		MC GS	21					
22.0					TOTAL DEPTH 22.0'								
24													24

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

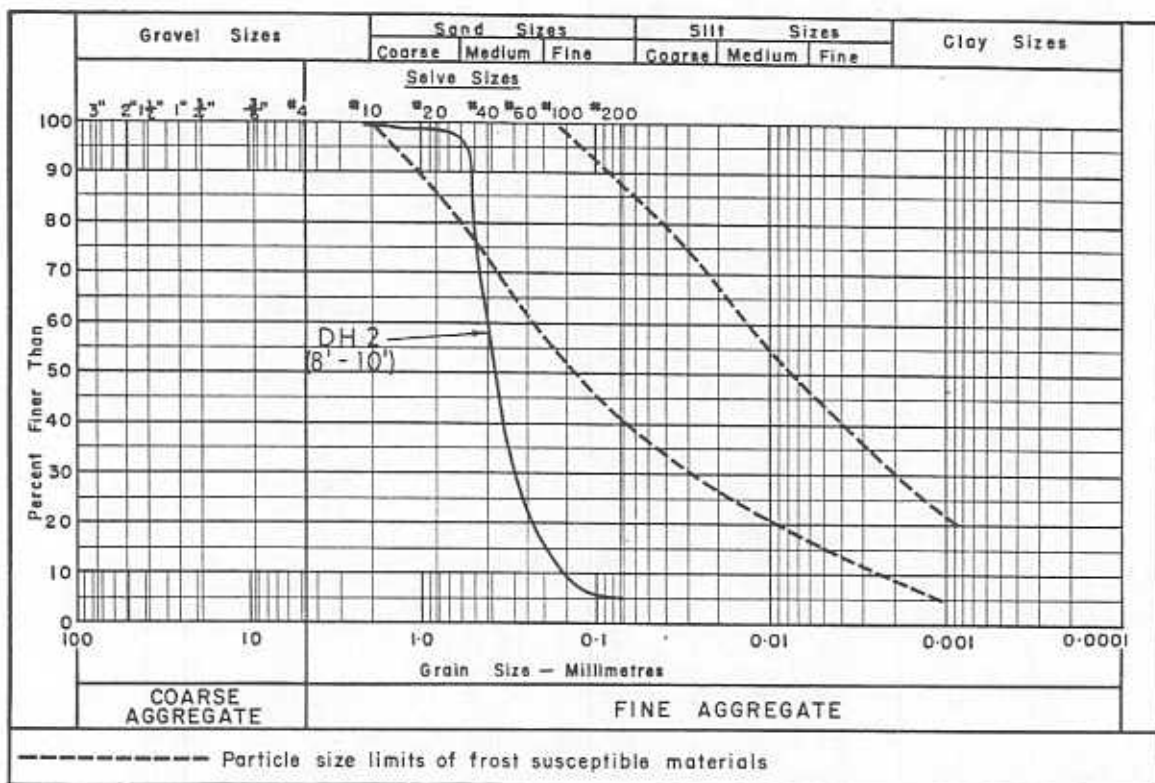


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	248X/DH 2	248X/DH 2
Sample Depth (Feet):	8-10	17-18
Moisture Content (%):	23.5	22.4
Ice Content (%):	-	-
Organic Content (%):	3.4	-

GRAIN SIZE DISTRIBUTION:

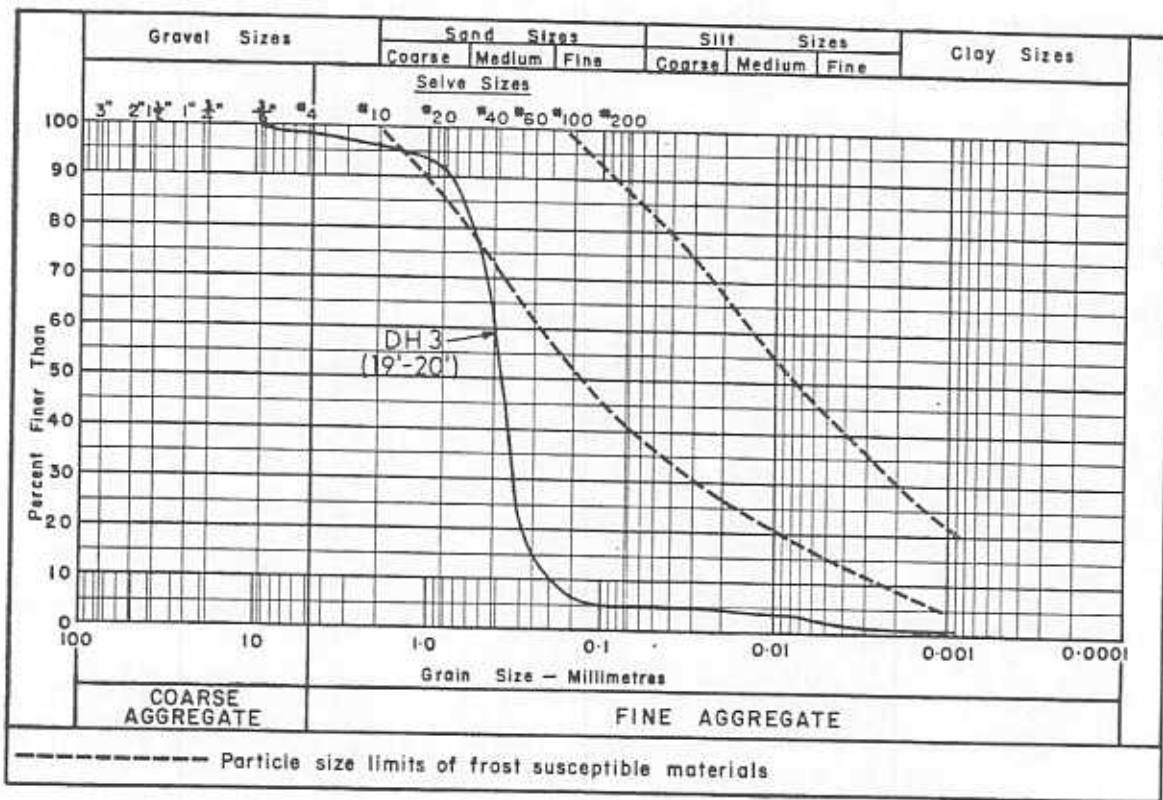


PETROGRAPHIC ANALYSIS:

SUMMARY OF LABORATORY TEST DATA

Sample Location:	248X/DH 3	248X/DH 3
Sample Depth (Feet):	9-11	19-20
Moisture Content (%):	17.0	16.7
Ice Content (%):	-	-
Organic Content (%):	-	-

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

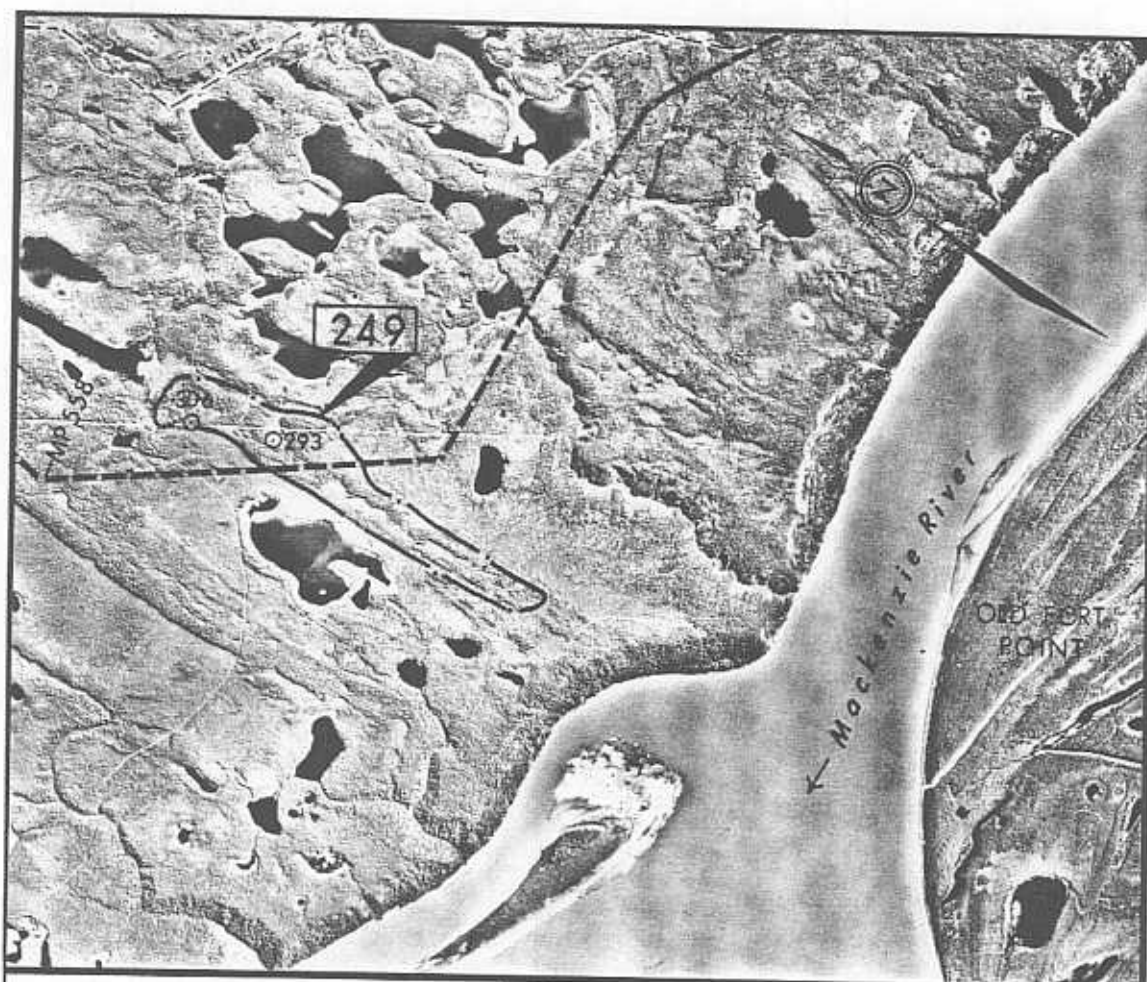
SITE NO. 249

Located approximately 25 miles southeast of Fort Norman, Site 249 consists of a small sand dune across which the Mackenzie Highway traverses at Mile 557.

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

Estimated Volume: 700,000 cubic yards.

Assessment: Site 249 is not considered as a source of granular materials; however, the fine sand may be used as very low quality 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. A22933/21

249-1

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 249 is located approximately 25 miles southeast of Fort Norman and the proposed Mackenzie Highway right-of-way crosses the dune at Mile 557. This site consists of a small sand dune which comprises a portion of a major sand dune complex located on an ancient glacial lake bed. The dune is approximately $1\frac{1}{4}$ miles in length and averages 200 to 500 feet in width. The sand dunes exhibit a relatively flat profile ranging in height to 15 feet above the adjacent flat terrain, which is poorly drained and is characterized with numerous lakes and muskeg bogs. The surface of this large glaciolacustrine plain has been reworked by wind action. The north bank of the Mackenzie River is located less than $\frac{1}{4}$ mile from the southern extremity of the site area.

The sand dunes contain very fine, eolian sand which are very dry to depths investigated. The dune slopes are covered with a shallow layer of organic topsoil which supports a dense growth of spruce, poplar and tamarack ranging in height to 40 feet and in trunk diameter to 12 inches. The understory growth consisting of sedge grass and small shrubs is quite dense. Wet areas in the flat muskeg terrain supports growths of spruce and tamarack.

There are no known critical wildlife areas in the immediate vicinity of this site; however, the site is within a region which is periodically hunted and trapped by northern residents.

The only existing access to Site 249 consists of the seismic cutline from the CNT pole line which is located approximately $1\frac{1}{2}$ miles northeast of the site. The proposed Mackenzie Highway right-of-way traverses the site area.

DEVELOPMENT

The exploratory drilling which was conducted on Site 249 by the engineering consultant for The Federal Department of Public Works, showed the following conditions relative to the quantity and quality of available materials.

- The in situ sand dune material consists of very fine grained, poorly graded, eolian sand with a trace of silt. This material is considered suitable only for very low quality, marginal fill material in the construction of subgrades for roads or utility backfill.
- The organic topsoil overburden on the dune slopes is very shallow, generally, less than 6 inches in depth.
- The depth of recoverable material is in excess of 15 feet and is very dry to depths investigated.
- The initial 0 to 10 feet of the dune sand, although frozen during the field drilling, only exhibited very low ground ice content.

Site 249 is not recommended as a source of granular material; however, this fine eolian sand may be used as a low quality fill material in the construction of road subgrades or utility



backfill. The following operational guidelines should be followed if this site is developed for marginal fill requirements.

- The on-site tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil should be carefully stripped and stockpiled along the lower slopes of the dune for future utilization in the restoration of the borrow pit areas.
- Vegetation buffer zones should be maintained between work areas to minimize erosion and instability of the dune area.
- Vertical excavation opposed to horizontal excavation should be considered to minimize the erosion of the exposed borrow areas by wind and rain action.
- The access from the CNT pole line or proposed utility right-of-ways entails the traversing of thermal sensitive lacustrine silts and sands; therefore, borrow pit development may be restricted to the winter months unless an all weather access road is constructed.

ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation guidelines should include the following if Site 249 is developed as a borrow pit.

- Recontouring of borrow pit areas to maintain drainage to the adjacent terrain.
- Replacement and spreading of organic topsoil from pre-production stockpiles on to the recontoured exposed borrow pit area.
- Revegetation of the restored borrow pit areas.

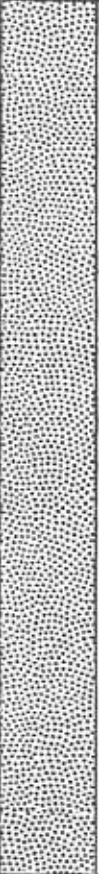

DETAILED DRILL HOLE LOG

SITE NO. 249

HOLE NO. C 293

DATE: JAN. 18, 1973 LOGGED BY: ☐ PEMCAN ☒ R.M. HARDY & ASSOCIATES

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		SM	SAND: silty, fine grained, non plastic, grey brown		Nbn			0
2								2
4								4
6								6
8								8
10								10
12								12
14			14.0 END OF HOLE 14.0'					14

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"



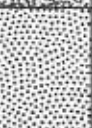

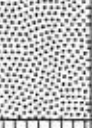


DETAILED DRILL HOLE LOG

SITE NO. 249

HOLE NO. B26 306

DATE: JAN. 19, 1973 LOGGED BY: ☐ PEMCAN ☒ R.M. HARDY & ASSOCIATES

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:					0
2		SM	2.0 — SAND: silty, fine grained, uniform, non plastic, brown		Nbn	M		2
4				UF				4
6					Nbn	M		6
8		ML	7.5 — SILT: sandy, low plastic, grey brown			M		8
10					Nbn	M		10
12			12.5 — END OF HOLE 12.5'					12

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

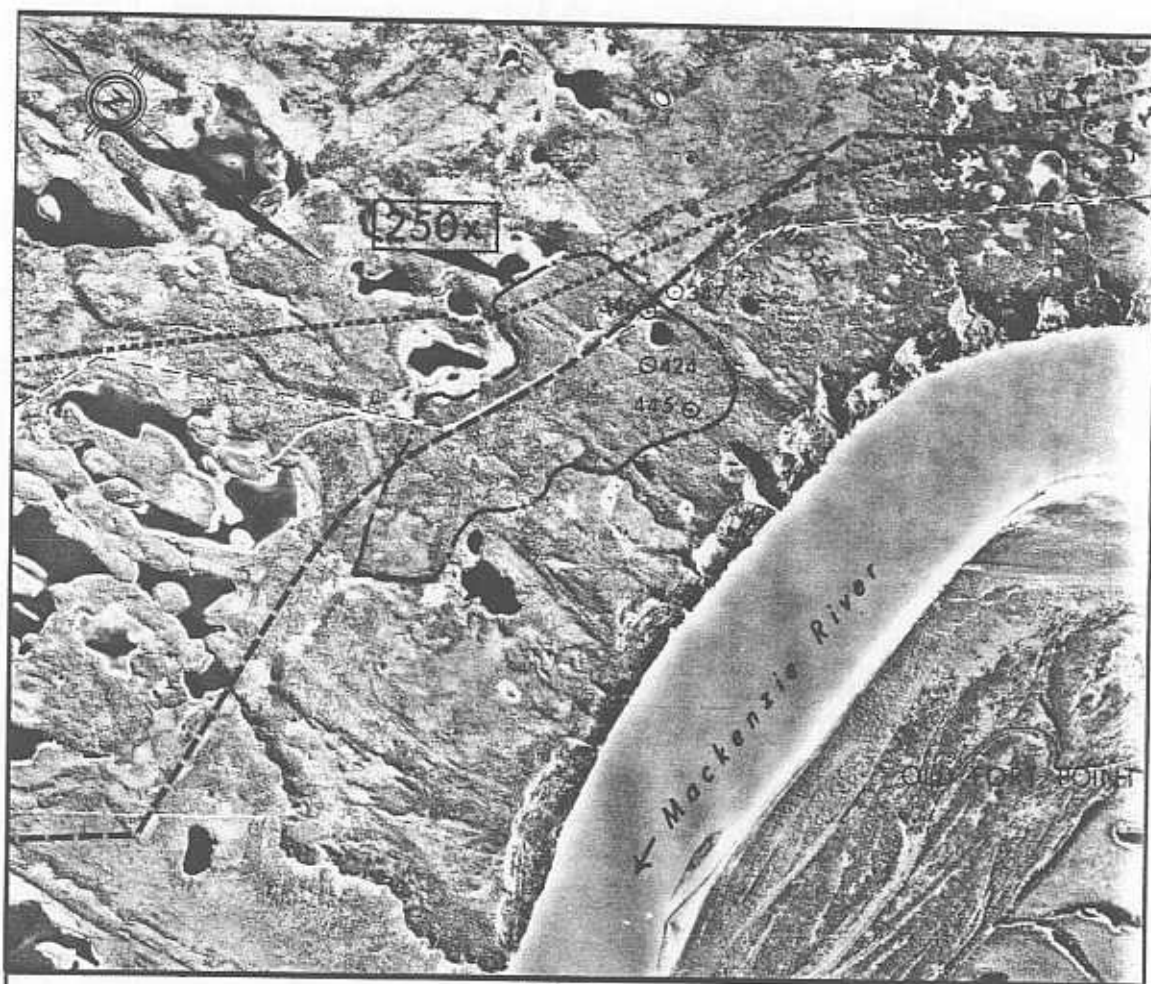
SITE NO. 250X

Located approximately 26 miles southeast of Fort Norman, Site 250X consists of a better drained segment of the glaciolacustrine plain which encompasses the proposed Mackenzie Highway from Mile 554 to Mile 556.

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

Estimated Volume: Not applicable.

Assessment: Materials of granular quality were not established during the winter drilling program; therefore, Site 250X is not recommended for development.



----- All weather road
----- Existing trails and cutlines
..... Proposed Gas Pipeline
⊙ DH Drill Hole

LEGEND

..... Required access
----- Site limit
----- Proposed Mackenzie Highway
⊕ TP Test Pit

Airphoto No. A22933/21

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 250X is located approximately 26 miles southeast of Fort Norman and encompasses the proposed Mackenzie Highway right-of-way from Mile 554 to Mile 556. The site consists of a better drained segment of the glaciolacustrine plain and encompasses an area $1\frac{1}{2}$ miles in length and averages $\frac{1}{2}$ mile in width. The southern perimeter of Site 250X is located parallel to the north bank of the Mackenzie River at a distance of less than $\frac{1}{4}$ mile. The adjacent terrain to the northeast is poorly drained and exhibits thermokarst features as characterized by numerous shallow lakes, ponds and muskeg bogs.

The site area consists of deltaic sands which are poorly graded, high in silt content and relatively high ground ice content. A layer of peat and organic topsoil, generally less than 1 foot in depth, overlies the site area and supports moderately dense growths of spruce, poplar and tamarack.

There are no known critical wildlife areas in the immediate vicinity of Site 250X; however, the site is within a region which is periodically hunted and trapped by the northern residents.

The CNT pole line, proposed gas pipeline and the proposed Mackenzie Highway right-of-ways, all traverse the entire length of this site area.

DEVELOPMENT

The exploratory drilling which was conducted on Site 250X by the engineering consultant for The Federal Department of Public Works showed that materials of granular quality are not available at this site. In addition, the relatively high ground ice content of the in situ silty, deltaic sands further restrict the use of this material for construction purposes.

DETAILED DRILL HOLE LOG

SITE NO. 250X

HOLE NO. C 347

DATE: JAN. 25, 1973		LOGGED BY: <input type="checkbox"/> PEMCAN <input checked="" type="checkbox"/> R.M. HARDY & ASSOCIATES			
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	[Pattern]	SM	SAND: silty, slightly organic, fine grained, non plastic, light brown	[Pattern]	Nbn	M		0
3			3.0 —					3
6			- inorganic - grey brown					6
9								9
12								12
15								15
18			UF				18	
21						MC GS	21	
24							24	
27			26.0 — END OF HOLE 26.0'					27

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 250X

HOLE NO. B28 424

DATE: JAN. 29, 1973

LOGGED BY: ☐ PEMCAN

☒ R.M. HARDY & ASSOCIATES

DRILLING METHOD: ☒

AIR
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		Pt	0.3 PEAT: Category #9		Nbn				0
3		SM	SAND: silty, non plastic, fine grained, light brown						3
6			6.0 - brown with coal specks						6
9									9
12									12
15									15
18									18
21									21
24									24
27		SM			Nbn				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. 250X

HOLE NO. C 445

DATE: FEB. 2, 1973		LOGGED BY: <input type="checkbox"/> PEMCAN <input checked="" type="checkbox"/> R.M. HARDY & ASSOCIATES	
DRILLING METHOD: <input checked="" type="checkbox"/> AIR CONVENTIONAL <input type="checkbox"/> AIR REVERSE CIRCULATION <input type="checkbox"/> 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		Pt	PEAT: Category #4		Nbn				0
5		SM	SAND: silty, fine grained, non plastic						5
10		MH	SILT: clayey, low plastic, grey brown						10
15		CI	CLAY: medium plastic, slightly silty, dark brown						15
20									20
25									25
30		CI			Nbn				30
35									35
40									40
45			END OF HOLE 45.0'						45

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

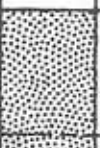

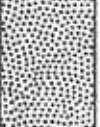
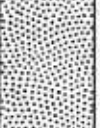
DETAILED DRILL HOLE LOG

SITE NO. 250X

HOLE NO. C 346

DATE: JAN. 25, 1973 LOGGED BY: ☐ PEMCAN ☒ R.M. HARDY & ASSOCIATES

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		SM-OL	SAND: silty, organic inclusions, fine grained, non plastic, light brown		Nbn			0
3		SM	- inorganic - grey brown		Nbn Nf			3
6							MC GS	6
9		SM		UF				9
12							MC GS	12
15								15
18							MC GS	18
21								21
24		SM		UF				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

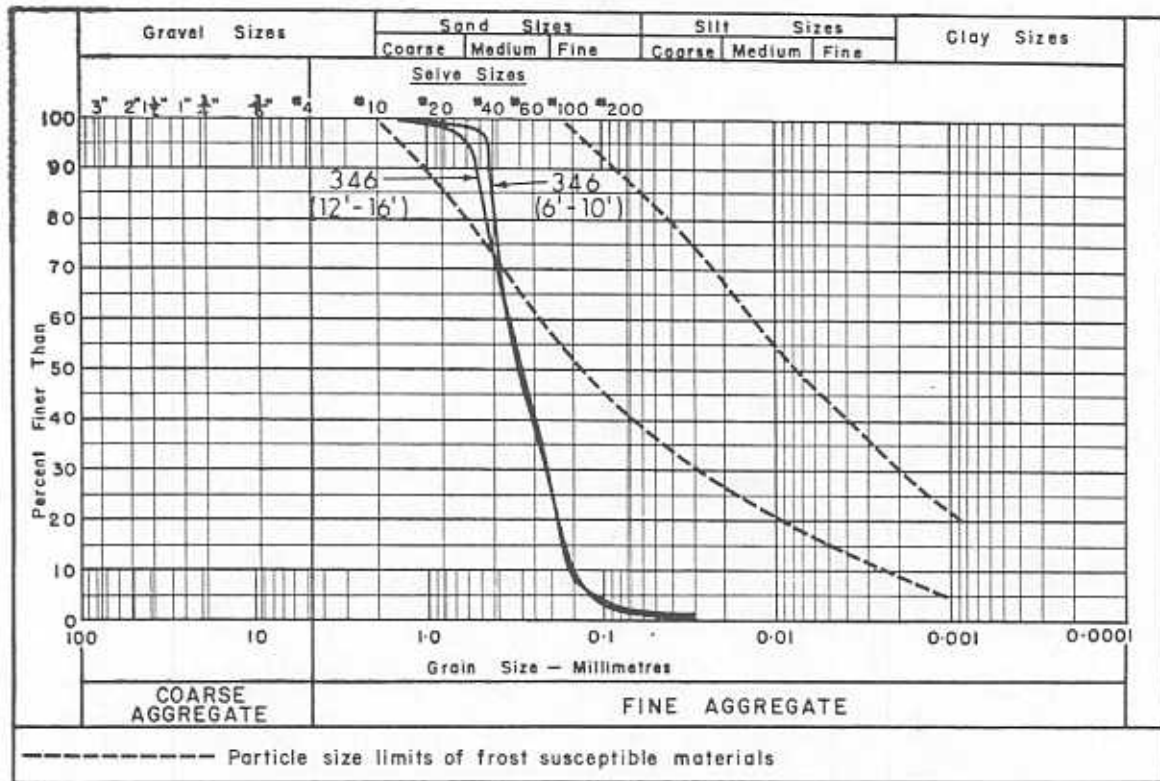


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	250X/346	250X/346
Sample Depth (Feet):	6-10	12-16
Moisture Content (%):	4.0	16.0
Ice Content (%):	-	-
Organic Content (%):	-	-

GRAIN SIZE DISTRIBUTION:

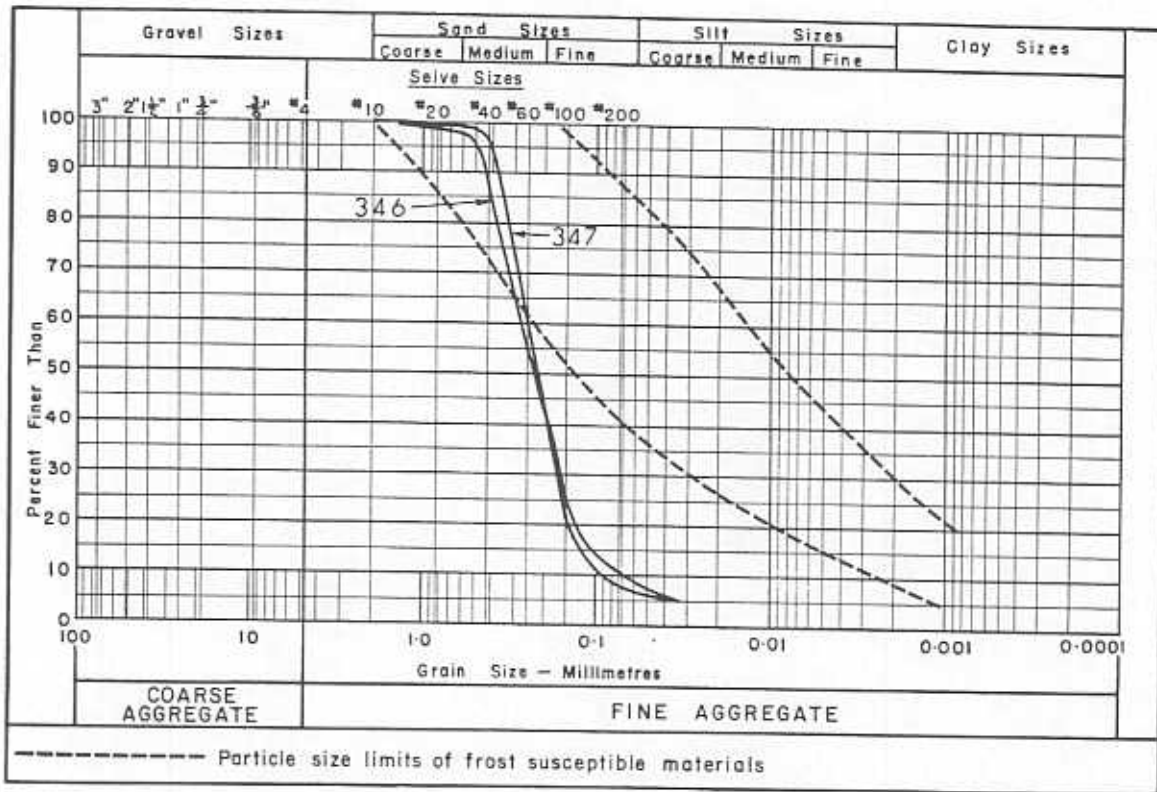


PETROGRAPHIC ANALYSIS:

SUMMARY OF LABORATORY TEST DATA

Sample Location:	250X/346	250X/347
Sample Depth (Feet):	18-24	20-26
Moisture Content (%):	28.0	32.0
Ice Content (%):	-	-
Organic Content (%):	-	-

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

SITE NO. 251

Located approximately 23 miles southeast of Fort Norman and 4 miles east of the proposed Mackenzie Highway at Mile 564, Site 251 consists of 4 large sand dune deposits.

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

Estimated Volume: In excess of 5,000,000 cubic yards.

Assessment: Site 251 is not considered as a source of granular materials; however, this fine eolian sand may be used as a low quality fill material 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. A21527/31

Approximate scale: 1" = 3,000'

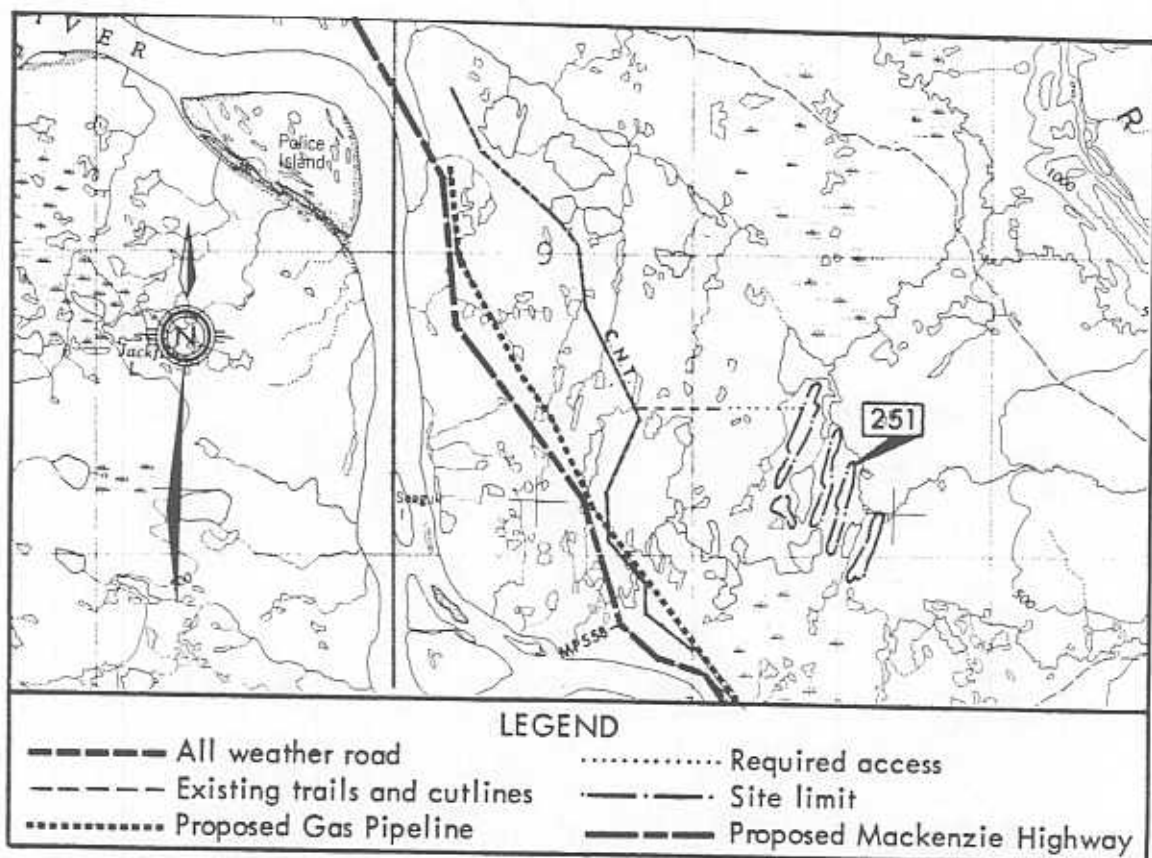


ENVIRONMENT

Site 251 is located approximately 23 miles southeast of Fort Norman and 4 miles east of the proposed Mackenzie Highway right-of-way at Mile 564. This site consists of 4 large sand dunes located immediately east of Site 252 and comprises a portion of a major sand dune complex located on an ancient glacial lake bed. The dunes range in size from $1\frac{1}{2}$ to 4 miles in length and 100 to 300 feet in width. The sand dunes exhibit a relatively flat profile ranging in height to 30 feet above the adjacent flat terrain, which is poorly drained and is characterized with numerous lakes and muskeg bogs. The surface of this large glaciolacustrine plain has been reworked by wind action.

The dunes contain very fine, eolian sands which are very dry to depths investigated. The dune slopes are covered with a shallow layer of organic topsoil which supports a dense growth of spruce, poplar and tamarack ranging in height to 40 feet and in trunk diameter to 12 inches. The understory growth consisting of sedge grass and small shrubs is relatively dense. Wet areas in the flat muskeg terrain support growths of spruce and tamarack.

There are no known critical wildlife areas in the immediate vicinity of this site.



Section of Map No. 96 C

Scale: 1:250,000



The only existing access to Site 251 consists of the seismic cutline from the CNT pole line which is located approximately 2 miles west of the site. The proposed Mackenzie Highway right-of-way is located approximately 4 miles west of the site area whereas the proposed gas pipeline route is located immediately adjacent to the southern periphery of the site.

DEVELOPMENT

No exploratory drilling was conducted on Site 251; therefore the following conditions relative to the quality and quantity of available materials have been based on the drill hole information from Sites 252, 253 and 254.

- The in situ sand dune material consists of very fine grained, poorly graded, eolian sand with a trace of silt. This material is considered suitable only for very low quality, marginal fill in the construction of subgrades for roads or utility backfill.
- The organic topsoil overburden on the dune slopes is generally less than 6 inches in depth.
- The depth of recoverable material is in excess of 15 feet and is very dry to depths investigated.
- The initial 0 to 10 feet of the dune sand, although frozen during the field drilling, only exhibited very low ground ice content.

Site 251 is not recommended as a source of granular material; however, this fine eolian sand may be used as a low quality fill material in the construction of road subgrades or utility backfill. The following operational guidelines should be followed if this site is developed for marginal fill requirements.

- The on-site tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil should be carefully stripped and stockpiled along the lower slopes of the dune for future utilization in the restoration of the borrow pit areas.
- Vegetation buffer zones should be maintained between work areas to minimize erosion and instability of the dune area.
- Vertical excavation opposed to horizontal excavation should be considered to minimize the erosion of the exposed borrow areas by wind and rain action.
- The access from the CNT pole line or proposed utility right-of-ways entails the traversing of thermal sensitive lacustrine silts and sands; therefore, borrow pit development may be restricted to the winter months unless an all weather access road is constructed.



ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation guidelines should include the following if Site 251 is developed as a borrow pit.

- Recontouring of borrow pit areas to maintain drainage to the adjacent terrain.
- Replacement and spreading of organic topsoil from pre-production stockpiles on to the recontoured exposed borrow pit area.
- Revegetation of the restored borrow pit areas.

SITE NO. 252

Located approximately 23 miles southeast of Fort Norman and 4 miles east of the proposed Mackenzie Highway at Mile 564, Site 252 consists of a large, longitudinal sand dune.

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

Estimated Volume: 1,000,000 cubic yards.

Assessment: Site 252 is not considered as a source of granular material; however, this eolian sand may be used as a low quality fill material 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. A21527/80

Approximate scale: 1" = 3,000'

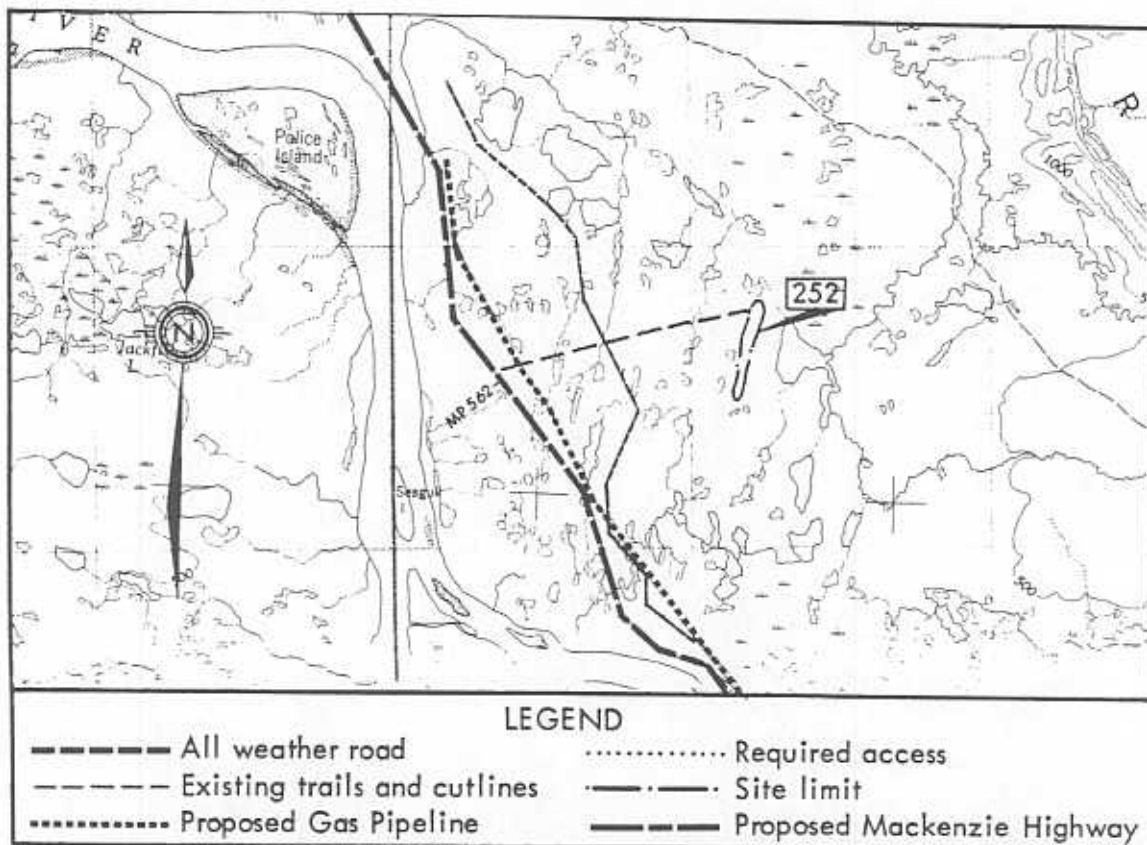


ENVIRONMENT

Site 252 is located approximately 23 miles southeast of Fort Norman and 4 miles east of the proposed Mackenzie Highway right-of-way at Mile 564. This site consists of a large longitudinal sand dune comprising a portion of a major sand dune complex located on an ancient glacial lake bed. The dunes range in size from 1 to 3 miles in length and 200 to 300 feet in width. The sand dune exhibits a relatively flat profile ranging in height to 30 feet above the adjacent flat terrain, which is poorly drained and is characterized with numerous lakes and muskeg bogs. The surface of this large glaciolacustrine plain has been reworked by wind action.

The sand dune contains very fine, eolian sand which is very dry to depths investigated. The dune slopes are covered with a shallow layer of organic topsoil which supports a dense growth of spruce, birch and poplar ranging in height to 40 feet and in trunk diameter to 12 inches. The understory growth consisting of sedge grass and small shrubs is moderately dense. Wet areas in the flat muskeg terrain supports growths of spruce and tamarack.

There are no known critical wildlife areas in the immediate vicinity of this site.



Section of Map No. 96 C

Scale: 1:250,000



The only existing access to Site 252 consists of the seismic cutline from the CNT pole line which is located approximately 2 miles west of the site. The proposed Mackenzie Highway right-of-way is located approximately 4 miles west of the site area and has no direct existing access. The proposed gas pipeline route is located immediately adjacent to the southwest periphery of the site area.

DEVELOPMENT

The exploratory drilling which was conducted on Site 252 showed the following conditions relative to the quantity and quality of available materials.

- The in situ sand dune material consists of very fine grained, poorly graded, eolian sand with a trace of silt. This material is considered suitable only for very low quality, marginal fill material in the construction of subgrades for roads or utility backfill.
- The organic topsoil overburden on the dune slopes is generally less than 6 inches in depth.
- The depth of recoverable material is in excess of 15 feet and is very dry to depths investigated.
- The initial 0 to 10 feet of the dune sand, although frozen during the field drilling, only exhibited very low ground ice content.

Site 252 is not recommended as a source of granular material; however, this fine eolian sand may be used as a low quality fill material in the construction of road subgrades or utility backfill. The following operational guidelines should be followed if this site is developed for marginal fill requirements.

- The on-site tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil should be carefully stripped and stockpiled along the lower slopes of the dune for future utilization in the restoration of the borrow pit areas.
- Vegetation buffer zones should be maintained between work areas to minimize erosion and instability of the dune area.
- Vertical excavation opposed to horizontal excavation should be considered to minimize the erosion of the exposed borrow areas by wind and rain action.
- The access from the CNT pole line or proposed utility right-of-ways entails the traversing of thermal sensitive lacustrine silts and sands; therefore, borrow pit development may be restricted to the winter months unless an all weather access road is constructed.



ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation guidelines should include the following if Site 252 is developed as a borrow pit.

- Recontouring of borrow pit areas to maintain drainage to the adjacent terrain.
- Replacement and spreading of organic topsoil from pre-production stockpiles on to the recontoured exposed borrow pit area.
- Revegetation of the restored borrow pit areas.

DETAILED DRILL HOLE LOG

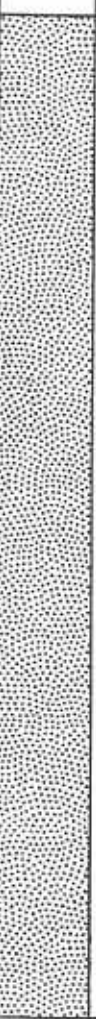


SITE NO. 252

HOLE NO. DH - 1

DATE: FEB. 3, 1973

LOGGED BY: ☒ PEMCAN

DRILLING METHOD: ☒ AIR CONVENTIONAL ☐ AIR REVERSE CIRCULATION ☐ OTHER:

CONVENTIONAL 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		SP	SAND: fine to medium grained, poorly graded, brown		Vx	L-M	MC GS O	0		
2								2		
4								4		
6								6		
8								8		
10								10		
12								12		
14								14		
16				16.0	TOTAL DEPTH 16.0'			Vx	M	16
18				18						

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 252

HOLE NO. DH - 2

DATE: FEB. 3, 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 CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0								0
2		OL	TOPSOIL: some silt, little organic roots, dark brown					2
4		SP	SAND: trace silt, fine grained, poorly graded, medium brown.		Vx	L		4
6								6
8								8
10				UF				10
12					Vx	M		12
14								14
16								16
18			TOTAL DEPTH 17.0'					18

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location: 252/DH 1

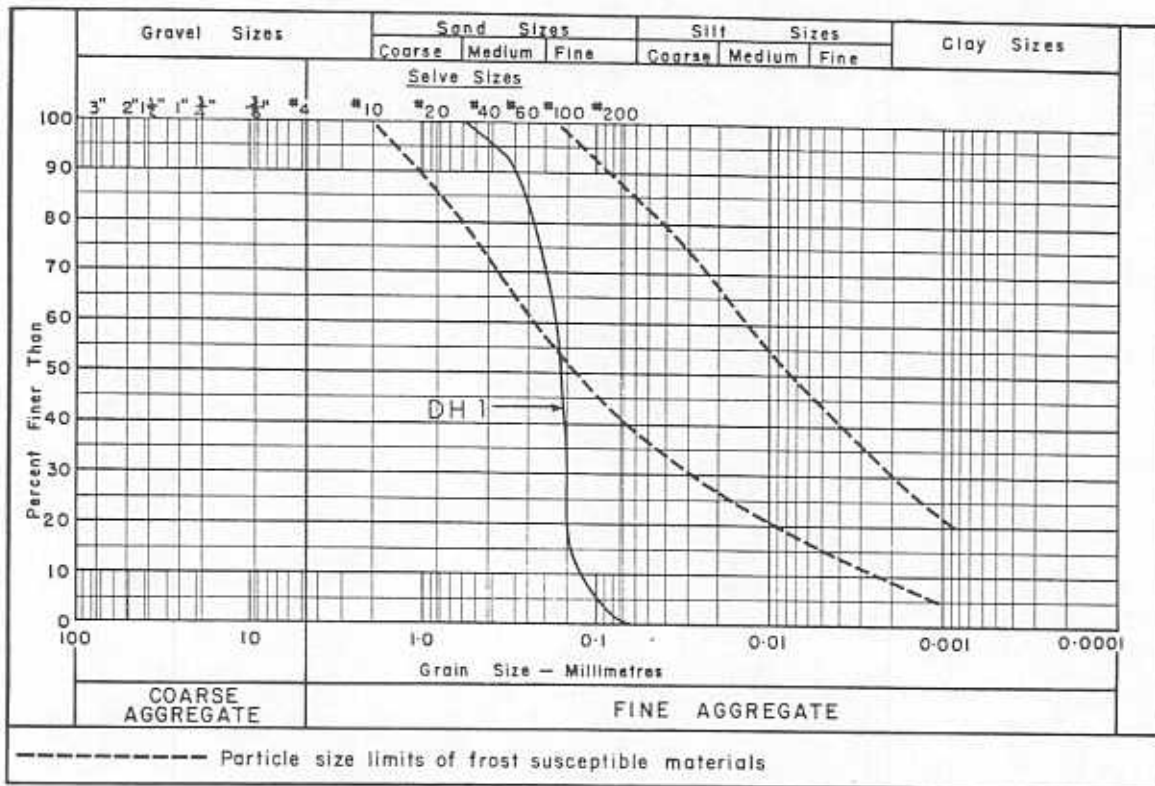
Sample Depth (Feet): 13

Moisture Content (%): 20.1

Ice Content (%): -

Organic Content (%): -

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

SITE NO. 253

Located approximately 22 miles southeast of Fort Norman and 4 miles east of the proposed Mackenzie Highway at Mile 564, Site 253 consists of 2 large sand dunes which comprise a portion of a major sand dune complex.

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

Estimated Volume: 2,000,000 cubic yards.

Assessment: Site 253 is not considered as a source of granular materials; however, the fine eolian sand may be used as a low quality fill 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. A21527/80

Approximate scale: 1" = 3,000'

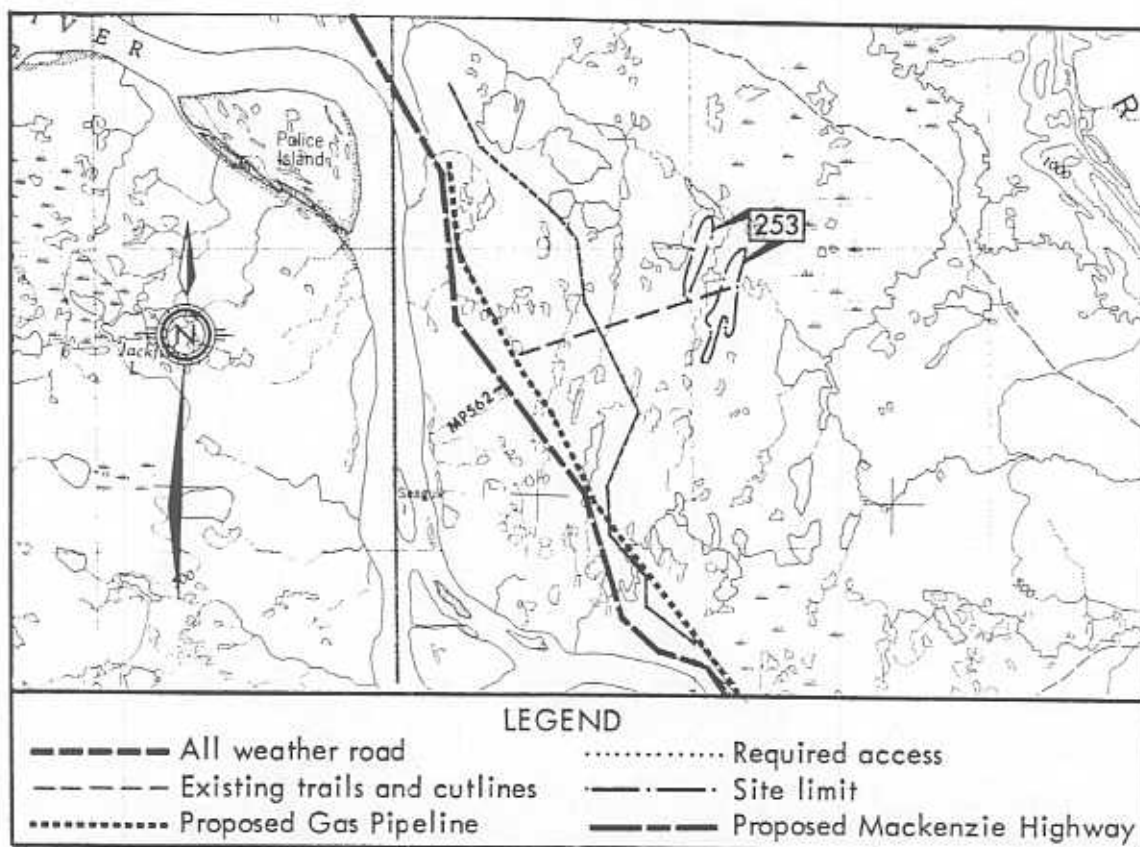


ENVIRONMENT

Site 253 is located approximately 22 miles southeast of Fort Norman and 4 miles east of the proposed Mackenzie Highway right-of-way at Mile 564. This site consists of 2 large sand dunes located immediately west of Site 252 and comprises a portion of a major sand dune complex located on an ancient glacial lake bed. The dunes range in size from $1\frac{1}{2}$ to 3 miles in length and 100 to 200 feet in width. The sand dunes exhibit a relatively flat profile ranging in height to 30 feet above the adjacent flat terrain, which is poorly drained and is characterized with numerous lakes and muskeg bogs. The surface of this large glacio-lacustrine plain has been reworked by wind action.

The sand dunes contain very fine, eolian sand which are very dry to depths investigated. The dune slopes are covered with a shallow layer of organic topsoil which supports a dense growth of spruce, poplar and tamarack ranging in height to 40 feet and in trunk diameter to 12 inches. The understory growth consisting of sedge grass and small shrubs is quite dense. Wet areas in the flat muskeg terrain supports growths of spruce and tamarack.

There are no known critical wildlife areas in the immediate vicinity of this site; however, the site is within a region which is periodically hunted and trapped by northern residents.





The only existing access to Site 253 consists of the seismic cutline from the CNT pole line which is located approximately 2 miles west of the site. The proposed Mackenzie Highway right-of-way is located approximately 4 miles west of the site area. The proposed gas pipeline route is located immediately adjacent to the southwest periphery of the site area.

DEVELOPMENT

The exploratory drilling which was conducted on Site 253 showed the following conditions relative to the quantity and quality of available materials.

- The in situ sand dune material consists of very fine grained, poorly graded, eolian sand with a trace of silt. This material is considered suitable only for very low quality, marginal fill material in the construction of subgrades for roads or utility backfill.
- The organic topsoil overburden on the dune slopes is very shallow, generally, less than 6 inches in depth.
- The depth of recoverable material is in excess of 15 feet and is very dry to depths investigated.
- The initial 0 to 10 feet of the dune sand, although frozen during the field drilling, only exhibited very low ground ice content.

Site 253 is not recommended as a source of granular material; however, this fine eolian sand may be used as a low quality fill material in the construction of road subgrades or utility backfill. The following operational guidelines should be followed if this site is developed for marginal fill requirements.

- The on-site tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil should be carefully stripped and stockpiled along the lower slopes of the dune for future utilization in the restoration of the borrow pit areas.
- Vegetation buffer zones should be maintained between work areas to minimize erosion and instability of the dune area.
- Vertical excavation opposed to horizontal excavation should be considered to minimize the erosion of the exposed borrow areas by wind and rain action.
- The access from the CNT pole line or proposed utility right-of-ways entails the traversing of thermal sensitive lacustrine silts and sands; therefore, borrow pit development may be restricted to the winter months unless an all weather access road is constructed.



Site 244 is not recommended as a source of granular material; however, this fine deltaic sand may be used as a low quality fill material in the construction of road subgrades or utility backfill. The following operational guidelines should be followed if this site is developed for marginal fill requirements.

- The on-site tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil should be carefully stripped and stockpiled in designated areas for future utilization in the restoration of the borrow pit areas.
- Vegetation buffer zones should be maintained between work areas to minimize erosion and instability of the exposed pit areas.
- Vertical excavation opposed to horizontal excavation should be considered to minimize the erosion of the exposed borrow areas by wind and rain action.
- The access from the Mackenzie Highway or CNT pole line right-of-ways entails the traversing of thermally sensitive silts and sands; therefore, borrow pit development may be restricted to the winter months unless an all weather access road is constructed.

ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation guidelines should include the following if Site 244 is developed as a borrow pit:

- Recontouring of borrow pit areas to maintain drainage to the adjacent terrain.
- Replacement and spreading of organic topsoil from pre-production stockpiles on to the recontoured exposed borrow pit areas.
- Revegetation of the restored borrow pit areas.



ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation guidelines should include the following if Site 253 is developed as a borrow pit:

- Recontouring of borrow pit areas to maintain drainage to the adjacent terrain.
- Replacement and spreading of organic topsoil from pre-production stockpiles on to the recontoured exposed borrow pit area.
- Revegetation of the restored borrow pit areas.

DETAILED DRILL HOLE LOG

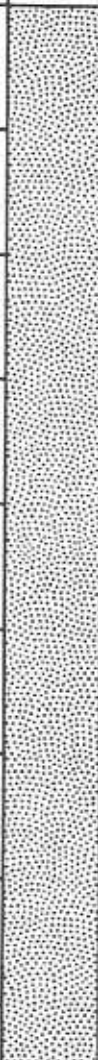
SITE NO. 253

HOLE NO. DH - 1

DATE: FEB. 3, 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		SP-SM	SAND: trace silt, fine to medium grained, poorly graded, medium brown. at 9.0' damp <					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location: 253/DH 1

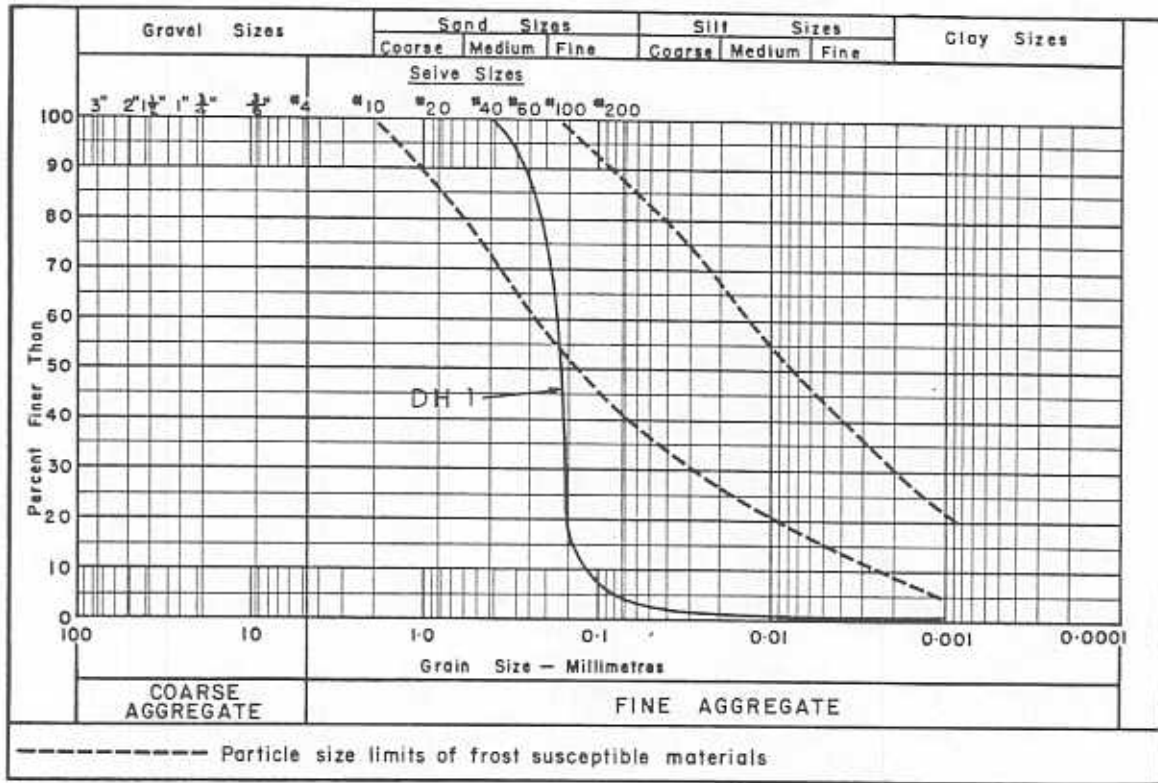
Sample Depth (Feet): 12

Moisture Content (%): 4.3

Ice Content (%): -

Organic Content (%): 2.9

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

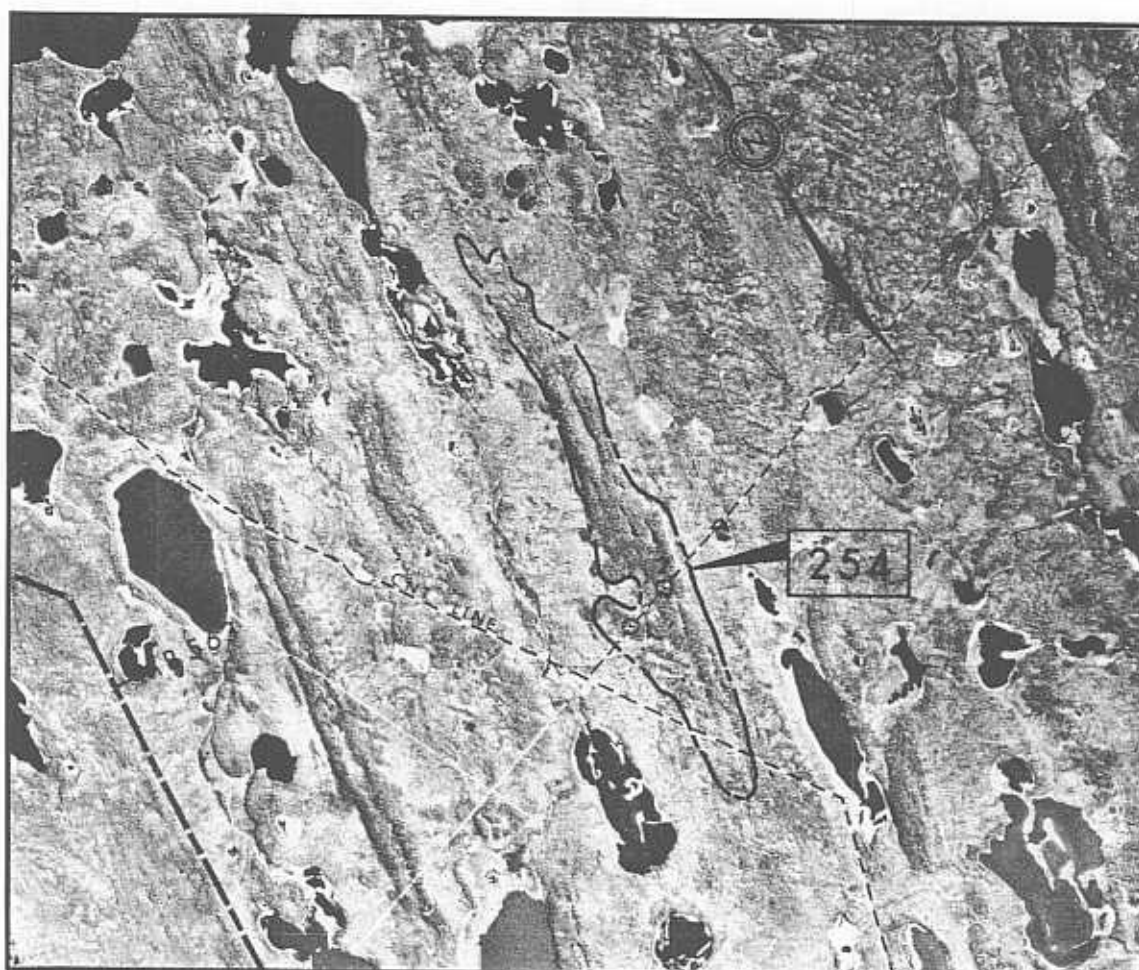
SITE NO. 254

Located approximately 21 miles southeast of Fort Norman and $1\frac{1}{2}$ miles east of the proposed Mackenzie Highway at Mile 563, Site 254 consists of a large sand dune.

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

Estimated Volume: 1,000,000 cubic yards.

Assessment: Site 254 is not considered as a source of granular materials; however, the fine eolian sand may be used as a 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. A22862/55

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 254 is located approximately 21 miles southeast of Fort Norman and $1\frac{1}{2}$ miles east of the proposed Mackenzie Highway right-of-way at Mile 563. This site consists of a large sand dune located immediately west of Site 252 and comprises a portion of a major sand dune complex located on an ancient glacial lake bed. The sand dune is approximately $1\frac{1}{2}$ miles in length and 500 to 700 feet in width. The sand dune exhibits a relatively flat profile rising in height to 30 feet above the adjacent flat terrain, which is poorly drained and is characterized with numerous lakes and muskeg bogs. The surface of this large glacio-lacustrine plain has been reworked by wind action.

The sand dune contains very fine, eolian sand which is very dry to depths investigated. The dune slopes are covered with a shallow layer of organic topsoil which supports a dense growth of spruce, poplar and tamarack ranging in height to 40 feet and in trunk diameter to 12 inches. The understory growth consisting of sedge grass and small shrubs is quite dense. Wet areas in the adjacent flat muskeg terrain supports growths of spruce and tamarack.

There are no known critical wildlife areas in the immediate vicinity of this site; however, the site is within a region which is periodically hunted and trapped by northern residents.

The only existing access to Site 254 consists of a seismic cutline and the CNT pole line which traverses the southern portion of the site. The proposed Mackenzie Highway right-of-way is located approximately $1\frac{1}{2}$ miles west of the site area. The proposed gas pipeline route is located approximately 3 miles east of Site 254.

DEVELOPMENT

The exploratory drilling which was conducted on Site 254 showed the following conditions relative to the quantity and quality of available materials.

- The in situ sand dune material consists of very fine grained, poorly graded, eolian sand with a trace of silt. This material is considered suitable only for very low quality, marginal fill material in the construction of subgrades for roads or utility backfill.
- The organic topsoil overburden on the dune slopes is very shallow, generally, less than 6 inches in depth.
- The depth of recoverable material is in excess of 15 feet and is very dry to depths investigated.
- The initial 0 to 10 feet of the dune sand, although frozen during the field drilling, only exhibited very low ground ice content.

Site 254 is not recommended as a source of granular material; however, this fine eolian sand may be used as a low quality fill material in the construction of road subgrades or utility backfill. The following operational guidelines should be followed if this site is developed for marginal-fill requirements.



- The on-site tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil should be carefully stripped and stockpiled along the lower slopes of the dune for future utilization in the restoration of the borrow pit areas.
- Vegetation buffer zones should be maintained between work areas to minimize erosion and instability of the dune area.
- Vertical excavation opposed to horizontal excavation should be considered to minimize the erosion of the exposed borrow areas by wind and rain action.
- The access from the Mackenzie Highway or gas pipeline right-of-way entails the traversing of thermal sensitive lacustrine silts and sands; therefore, borrow pit development may be restricted to the winter months unless an all weather access road is constructed.

ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation guidelines should include the following if Site 254 is developed as a borrow pit:

- Recontouring of borrow pit areas to maintain drainage to the adjacent terrain.
- Replacement and spreading of organic topsoil from pre-production stockpiles on to the recontoured exposed borrow pit area.
- Revegetation of the restored borrow pit areas.

DETAILED DRILL HOLE LOG

SITE NO. 254

HOLE NO. DH - 1

DATE: FEB. 3, 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			TOPSOIL: some silt, little organic, brown.					0
2		OL						
		SM	SAND: some silt, brown.					2
4			- trace silt, fine to medium grained, poorly graded, brown		Vx	L		4
6		SP					MC	6
8				UF				8
10								10
12					Vx	L		12
14								14
16			TOTAL DEPTH 16.0'				MC GS	16
18								18

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

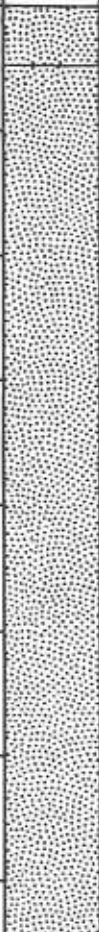


SITE NO. 254

HOLE NO. DH - 2

DATE: FEB. 3, 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		SM	1.0 SAND: little silt, light brown		Vx	L	MC O	0		
2		SP-SM	- trace silt, fine to medium grained, poorly graded, brown.					2		
4			4							
6			6							
8			8							
10			UF			10				
12				Vx	L			12		
14								14		
15.0			TOTAL DEPTH 15.0'							16
16										

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

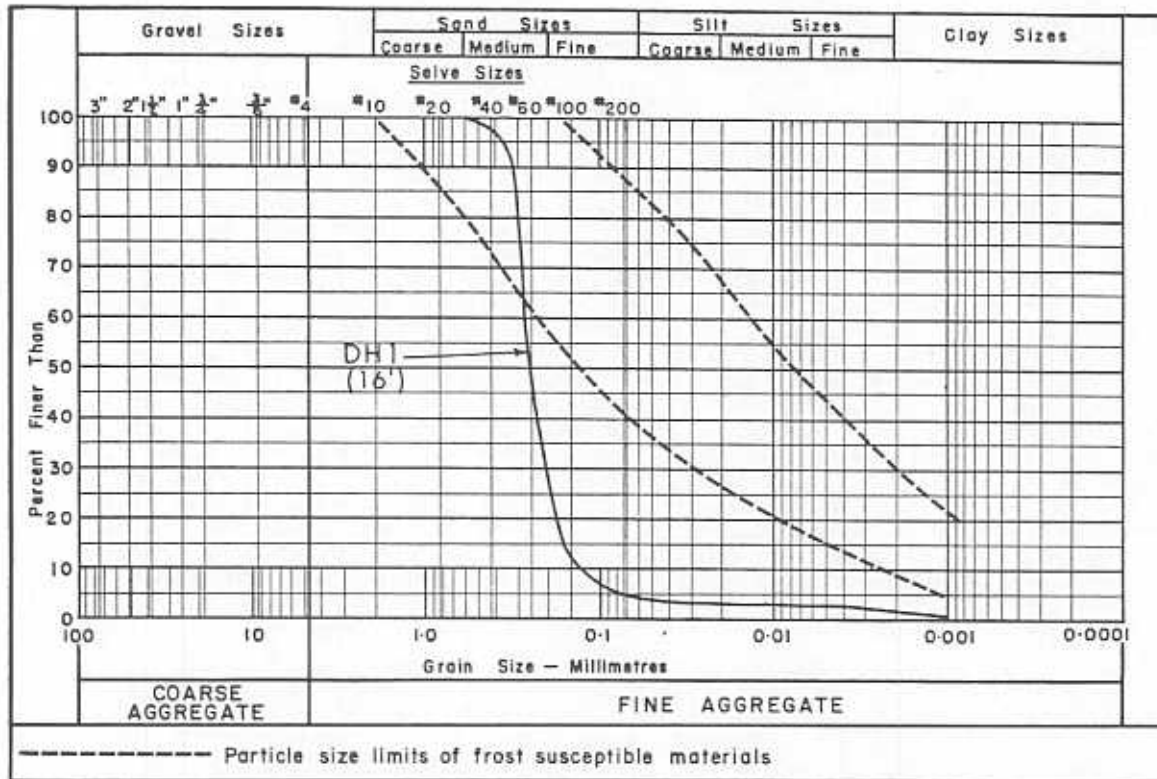


PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	254/DH 1	254/DH 1	254/DH 2
Sample Depth (Feet):	5.0	16	8.0
Moisture Content (%):	7.5	-	4.7
Ice Content (%):	-	-	-
Organic Content (%):	-	-	2.9

GRAIN SIZE DISTRIBUTION:



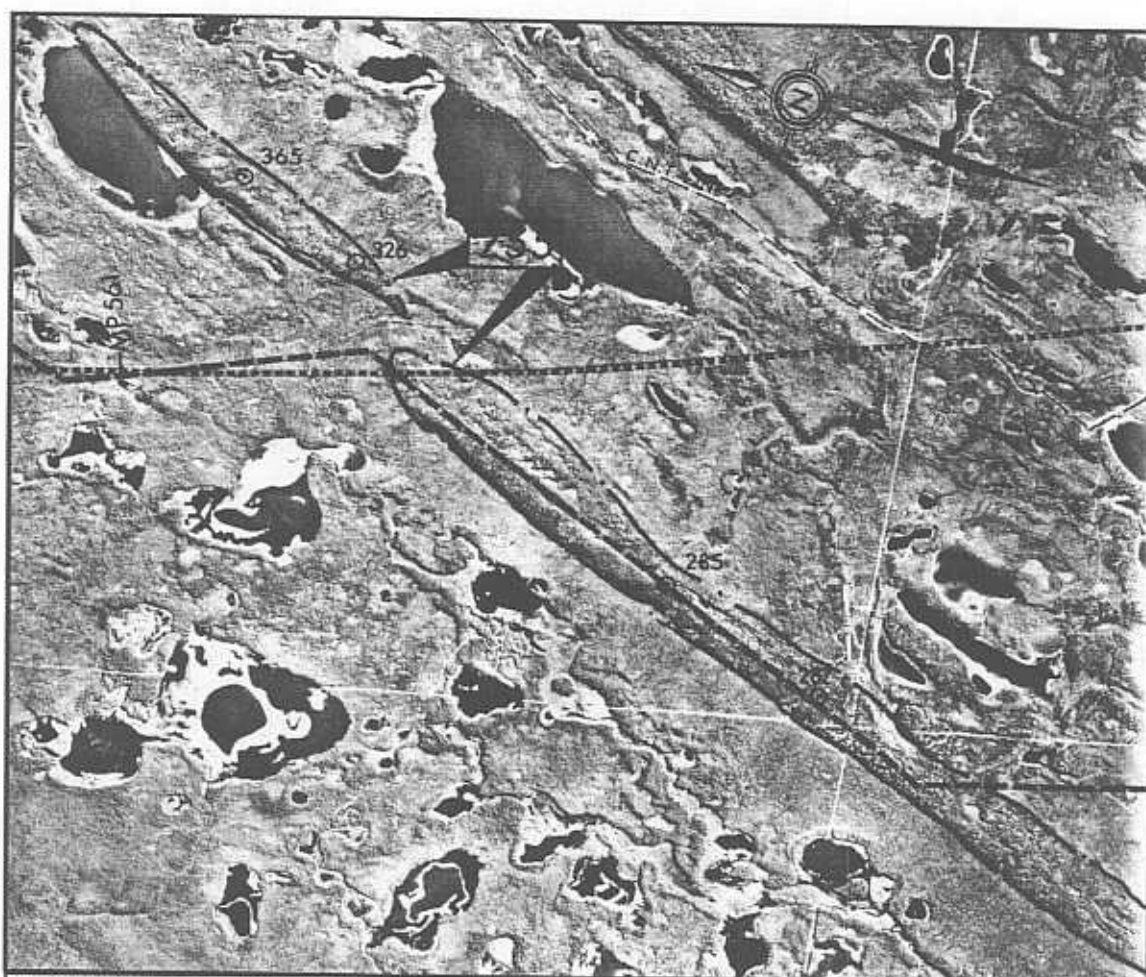
SITE NO. 255

Located approximately 22 miles southeast of Fort Norman, Site 255 consists of a large sand dune which encompasses the proposed Mackenzie Highway from Mile 558 to Mile 560.

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

Estimated Volume: 7,000,000 cubic yards.

Assessment: Site 255 is not considered as a source of granular materials; however, the fine eolian sand may be used 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. A22933/23

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 255 is located approximately 22 miles southeast of Fort Norman and encompasses the proposed Mackenzie Highway right-of-way from Mile 558 to Mile 560. This site consists of a large sand dune located immediately west of Site 254 and comprises a portion of a major sand dune complex located on an ancient glacial lake bed. The dune is approximately 5 miles in length and 600 to 700 feet in width. The sand dunes exhibit a relatively flat profile ranging in height to 30 feet above the adjacent flat terrain, which is poorly drained and is characterized with numerous lakes and muskeg bogs. The surface of this large glaciolacustrine plain has been reworked by wind action.

The sand dunes contain very fine, eolian sand which is very dry to depths investigated. The dune slopes are covered with a shallow layer of organic topsoil which supports a dense growth of spruce, poplar and tamarack ranging in height to 40 feet and in trunk diameter to 12 inches. The understory growth consisting of sedge grass and small shrubs is quite dense. Wet areas in the flat muskeg terrain supports growths of spruce and tamarack.

There are no known critical wildlife areas in the immediate vicinity of this site; however, the site is within a region which is periodically hunted and trapped by northern residents.

The proposed Mackenzie Highway right-of-way from Mile 558 to Mile 560 traverses the top of this large sand dune and the proposed gas pipeline route cuts across the northern portion of the site.

DEVELOPMENT

The exploratory drilling which was conducted on Site 255 by the engineering consultant for The Federal Department of Public Works showed the following conditions relative to the quantity and quality of available materials:

- The in situ sand dune material consists of very fine grained, poorly graded, eolian sand with a trace of silt. This material is considered suitable only for very low quality, marginal fill material in the construction of subgrades for roads or utility backfill.
- The organic topsoil overburden on the dune slopes is very shallow, generally, less than 6 inches in depth.
- The depth of recoverable material is in excess of 15 feet and is very dry to depths investigated.
- The initial 1 to 10 feet of the dune sand, although frozen during the field drilling, only exhibited very low ground ice content.

Site 255 is not recommended as a source of granular material; however, this fine eolian sand may be used as a low quality fill material in the construction of road subgrades or utility



backfill. The following operational guidelines should be followed if this site is developed for marginal fill requirements.

- The on-site tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil should be carefully stripped and stockpiled along the lower slopes of the dune for future utilization in the restoration of the borrow pit areas.
- Vegetation buffer zones should be maintained between work areas to minimize erosion and instability of the dune area.
- Vertical excavation opposed to horizontal excavation should be considered to minimize the erosion of the exposed borrow areas by wind and rain action.
- The access for future borrow pit development during the construction of the proposed Mackenzie Highway is excellent.

ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation guidelines should include the following if Site 255 is developed as a borrow pit.

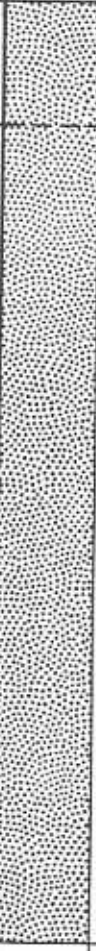

- Recontouring of borrow pit areas to maintain drainage to the adjacent terrain.
- Replacement and spreading of organic topsoil from pre-production stockpiles on to the recontoured exposed borrow pit area.
- Revegetation of the restored borrow pit areas.

DETAILED DRILL HOLE LOG

SITE NO. 255

HOLE NO. C 283

DATE: JAN. 17, 1973	LOGGED BY: <input type="checkbox"/> PEMCAN <input checked="" type="checkbox"/> R.M. HARDY & ASSOCIATES		
DRILLING METHOD: <input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> AIR REVERSE CIRCULATION <input type="checkbox"/> OTHER:			

				CONVENTIONAL			CIRCULATION			OTHER:		
DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND CONDITIONS		ICE CONDITIONS		SAMPLE TYPE	DEPTH (feet)			
				GEN'L CLASS	N.R.C. CLASS	EST'D CONT.						
0			SAND: very silty, slightly organic, fine grained, non plastic		M				0			
2		2.0						2				
4		- silty - inorganic - grey brown		Nbn			4					
6							6					
8							8					
10							10					
12							12					
14							14					
15.0		15.0	END OF HOLE 15.0'				15.0					
16							16					






















DETAILED DRILL HOLE LOG

SITE NO. 255

HOLE NO. C 287

DATE: JAN. 17, 1973 LOGGED BY: ☐ PEMCAN ☒ R.M. HARDY & ASSOCIATES

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	2.0-- SAND: organic, silty, fine grained, non plastic - inorganic - grey brown			M		0
4		SM			Nbn			4
8								8
12								12
16								16
20								20
24								24
28								28
32								32
36								36
40			40.0-- END OF HOLE 40.0'					40

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



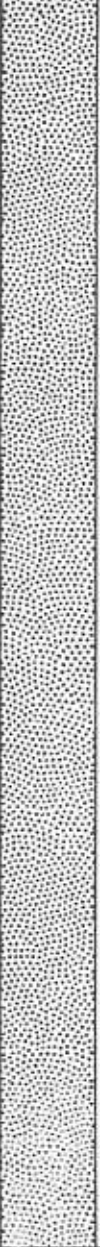


PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 255

HOLE NO. B22 326

DATE: JAN. 20, 1973		LOGGED BY: <input type="checkbox"/> PEMCAN <input checked="" type="checkbox"/> R.M. HARDY & ASSOCIATES	
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 CONDITIONS		ICE EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS			
0		SM	SAND: silty, fine grained, non plastic, uniform, brown with black specks		Nf			0
3								3
6				UF				6
9								9
12								12
15					Nbn	M		15
18								18
21								21
24								24
27		SM			Nbn			27
30							30	
			30.0 — END OF HOLE 30.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 255

HOLE NO. B22 365

DATE: JAN. 30, 1973

LOGGED BY: ☐ PEMCAN

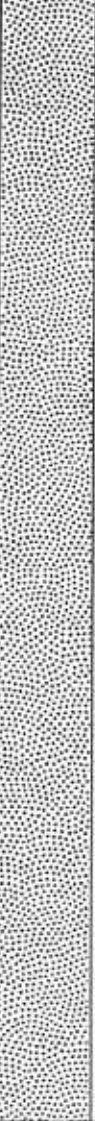

☒ R.M. HARDY & ASSOCIATES

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		SM	SAND: silty, fine grained, non plastic, mottled light and dark brown		Nbn Nf			0
5								5
10								10
15								15
20								20
25								25
30								30
35								35
40								40
45								45
			45.5 END OF HOLE 45.5'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

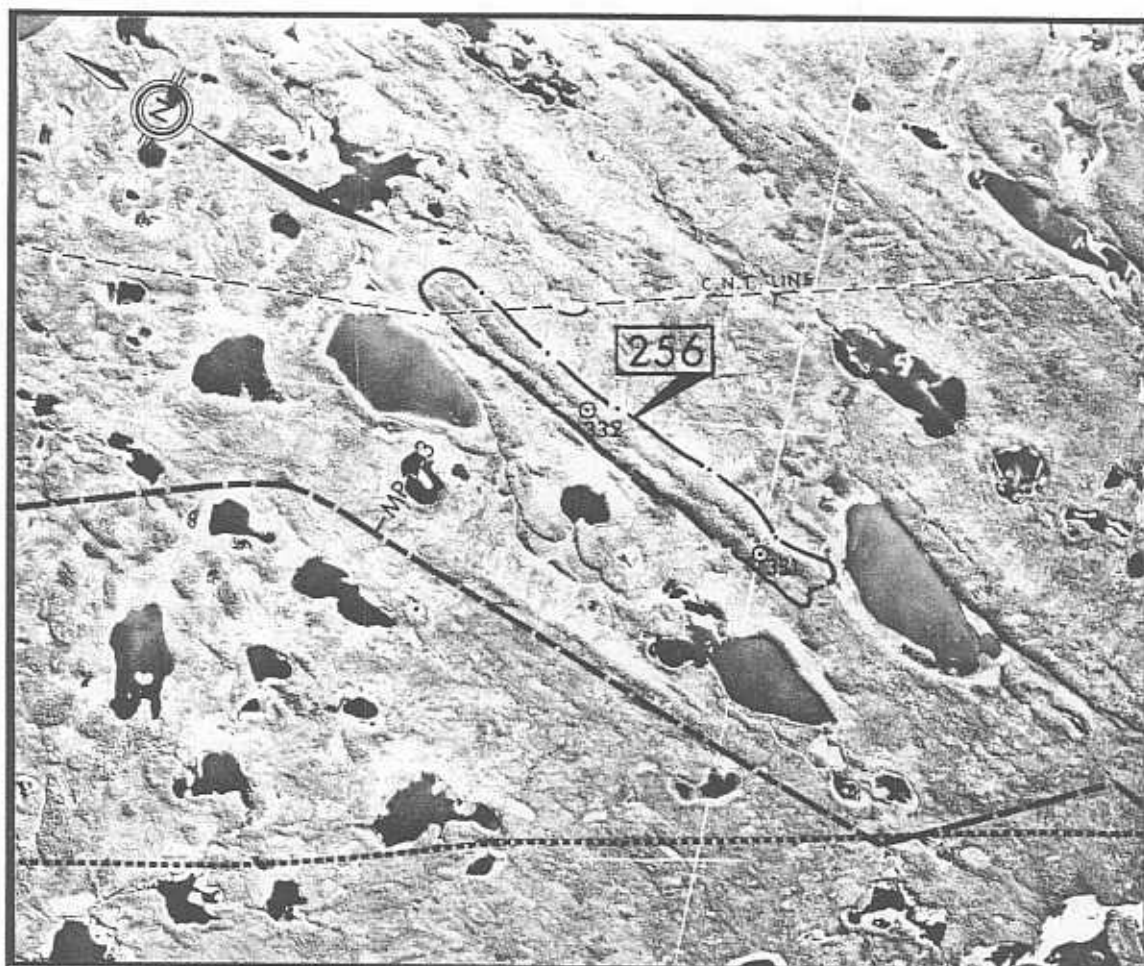
SITE NO. 256

Located approximately 21 miles southeast of Fort Norman and $\frac{1}{2}$ mile east of the proposed Mackenzie Highway at Mile 563, Site 256 consists of a large sand dune.

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

Estimated Volume: 1,500,000 cubic yards.

Assessment: Site 256 is not considered as a source of granular materials; however, the fine eolian sand may be used as a 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. A22933/24

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 256 is located approximately 21 miles southeast of Fort Norman and $\frac{1}{2}$ mile east of the proposed Mackenzie Highway right-of-way at Mile 563. This site consists of a large sand dune located immediately southwest of Site 257 and comprises a portion of a major sand dune complex located on an ancient glacial lake bed. The dune is approximately $1\frac{1}{2}$ miles in length and averages 600 feet in width. The sand dunes exhibit a relatively flat profile ranging in height to 30 feet above the adjacent flat terrain, which is poorly drained and is characterized with numerous lakes and muskeg bogs. The surface of this large glacio-lacustrine plain has been reworked by wind action.

The sand dunes contain very fine, eolian sand which is very dry to depths investigated. The dune slopes are covered with a shallow layer of organic topsoil which supports a dense growth of spruce, poplar and tamarack ranging in height to 40 feet and in trunk diameter to 12 inches. The understory growth consisting of sedge grasses and small shrubs is quite dense. Wet areas in the flat muskeg terrain support growths of spruce and tamarack.

There are no known critical wildlife areas in the immediate vicinity of this site; however, the site is within a region which is periodically hunted and trapped by northern residents.

The only existing access to Site 256 consists of the CNT pole line which traverses the northern tip of the site. The proposed Mackenzie Highway right-of-way is located approximately $\frac{1}{2}$ mile west of the site area. The proposed gas pipeline route is located 1 mile west of the site area.

DEVELOPMENT

The exploratory drilling which was conducted on Site 256 by the engineering consultant for the Federal Department of Public Works showed the following conditions relative to the quantity and quality of available materials:

- The in situ sand dune material consists of very fine grained, poorly graded, eolian sand with a trace of silt. This material is considered suitable only for very low quality, marginal fill material in the construction of subgrades for roads or utility backfill.
- The organic topsoil overburden on the dune slopes is very shallow, generally less than 6 inches in depth.
- The depth of recoverable material is in excess of 15 feet and is very dry to depths investigated.
- The initial 0 to 10 feet of the dune sand, although frozen during the field drilling, only exhibited very low ground ice content.

Site 256 is not recommended as a source of granular material; however, this fine eolian



sand may be used as a low quality fill material in the construction of road subgrades or utility backfill. The following operational guidelines should be followed if this site is developed for marginal fill requirements:

- The on-site tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil should be carefully stripped and stockpiled along the lower slopes of the dune for future utilization in the restoration of the borrow pit areas.
- Vegetation buffer zones should be maintained between work areas to minimize erosion and instability of the dune area.
- Vertical excavation opposed to horizontal excavation should be considered to minimize the erosion of the exposed borrow areas by wind and rain action.
- The access from proposed utility right-of-ways entails the traversing of thermally sensitive lacustrine silts and sands; therefore, borrow pit development may be restricted to the winter months unless an all weather access road is constructed.

ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation guidelines should include the following if Site 256 is developed as a borrow pit:

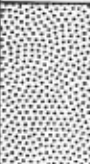




- Recontouring of borrow pit areas to maintain drainage to the adjacent terrain.
- Replacement and spreading of organic topsoil from pre-production stockpiles on to the recontoured exposed borrow pit area.
- Revegetation of the restored borrow pit areas.

DETAILED DRILL HOLE LOG

SITE NO. 256

HOLE NO. B27 331

DATE: JAN. 22, 1973 LOGGED BY: ☐ PEMCAN ☒ R.M. HARDY & ASSOCIATES
 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		SM	SAND: silty, non-plastic, brown		Nbn			0
5				UF				5
10					Nbn			10
15		SM			Nbn			15
20								20
25								25
30								30
35								35
40								40
45								45
			45.0 END OF HOLE 45.0'					

GOVERNMENT OF CANADA
 DEPARTMENT OF INDIAN AFFAIRS
 AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

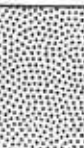


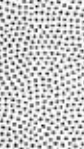

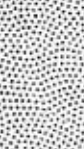

DETAILED DRILL HOLE LOG

SITE NO. 256

HOLE NO. B27 332

DATE: JAN. 22, 1973 LOGGED BY: ☐ PEMCAN ☒ R.M. HARDY & ASSOCIATES

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		SM	SAND: very silty, fine grained, uniform, non plastic, light brown		Nbn	L		0
5			5.0 ----- - silty - brown	UF				5
10					Nbn	M		10
15		SM			Nbn	M		15
20								20
25								25
30								30
35		SM			Nbn	M		35
40								40
45								45
			44.0 ----- END OF HOLE 44.0'					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

SITE NO. 257

Located approximately 17 miles southeast of Fort Norman and adjacent to the proposed Mackenzie Highway at Mile 566, Site 257 consists of a small sand dune.

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

Estimated Volume: 250,000 cubic yards.

Assessment: Site 257 is not considered as a source of granular materials; however, the fine eolian sand may be used as a 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. A22933/26

257-1

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 257 is located approximately 17 miles southeast of Fort Norman and immediately adjacent to the north side of the proposed Mackenzie Highway right-of-way at Mile 566. This site consists of a small sand dune which comprises a portion of a major sand dune complex located on an ancient glacial lake bed. The dune is approximately 4000 feet in length and averages 200 feet in width. The sand dunes exhibit a relatively flat profile ranging in height to 30 feet above the adjacent flat terrain, which is poorly drained and is characterized with numerous lakes and muskeg bogs. The surface of this large glacio-lacustrine plain has been reworked by wind action.

The sand dunes contain very fine, eolian sand which is very dry to depths investigated. The dune slopes are covered with a shallow layer of organic topsoil which supports a dense growth of spruce, poplar and tamarack ranging in height to 40 feet and in trunk diameter to 12 inches. The understory growth consisting of sedge grass and small shrubs is quite dense. Wet areas in the flat muskeg terrain supports growths of spruce and tamarack.

There are no known critical wildlife areas in the immediate vicinity of this site; however, the site is within a region which is periodically hunted and trapped by northern residents.

The existing access to Site 257 is excellent because the CNT pole line and the proposed Mackenzie Highway both traverse the southern extremity of the site area. The proposed gas pipeline route is located $1\frac{1}{2}$ miles to the southwest.

DEVELOPMENT

The exploratory drilling which was conducted on Site 257 showed the following conditions relative to the quantity and quality of available materials.

- The in situ sand dune material consists of very fine grained, poorly graded, eolian sand with a trace of silt. This material is considered suitable only for very low quality, marginal fill material in the construction of subgrades for roads or utility backfill.
- The organic topsoil overburden on the dune slopes is very shallow, generally, less than 6 inches in depth.
- The depth of recoverable material is in excess of 15 feet and is very dry to depths investigated.
- The initial 0 to 10 feet of the dune sand, although frozen during the field drilling, only exhibited very low ground ice content.

Site 257 is not recommended as a source of granular material; however, this fine eolian sand may be used as a low quality fill material in the construction of road subgrades or utility backfill. The following operational guidelines should be followed if this site is developed for marginal fill requirements.



- The on-site tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.
- The organic topsoil should be carefully stripped and stockpiled along the lower slopes of the dune for future utilization in the restoration of the borrow pit areas.
- Vegetation buffer zones should be maintained between work areas to minimize erosion and instability of the dune area.
- Vertical excavation opposed to horizontal excavation should be considered to minimize the erosion of the exposed borrow areas by wind and rain action.
- Good access from the CNT pole line or the proposed Mackenzie Highway right-of-way is available.

ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation guidelines should include the following if Site 257 is developed as a borrow pit.

- Recontouring of borrow pit areas to maintain drainage to the adjacent terrain.
- Replacement and spreading of organic topsoil from pre-production stockpiles on to the recontoured exposed borrow pit area.
- Revegetation of the restored borrow pit areas.

DETAILED DRILL HOLE LOG

SITE NO. 257

HOLE NO. B30 432

DATE: JAN. 31, 1973 LOGGED BY: ☐ PEMCAN ☒ R.M. HARDY & ASSOCIATES
 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
3			SAND: silty, fine grained, non plastic, light brown		Nbn			3
6			- grey brown					6
9								9
12								12
15								15
18								18
21								21
24								24
27		SM			Nbn			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"



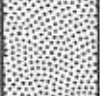
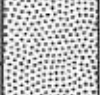
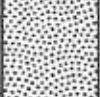
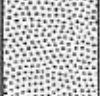
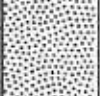
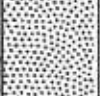
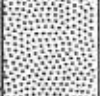
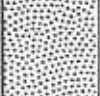
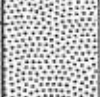
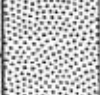
DETAILED DRILL HOLE LOG

SITE NO. 257

HOLE NO. B30 434

DATE: JAN. 31, 1973 LOGGED BY: ☐ PEMCAN ☒ R.M. HARDY & ASSOCIATES

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	SILT: organic					0
3			SAND: silty, fine grained, non plastic	UF				3
6								6
9					Nbn			9
12								12
15								15
18								18
21								21
24								24
27		SM			Nbn			27
30			END OF HOLE 30.0'					30

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

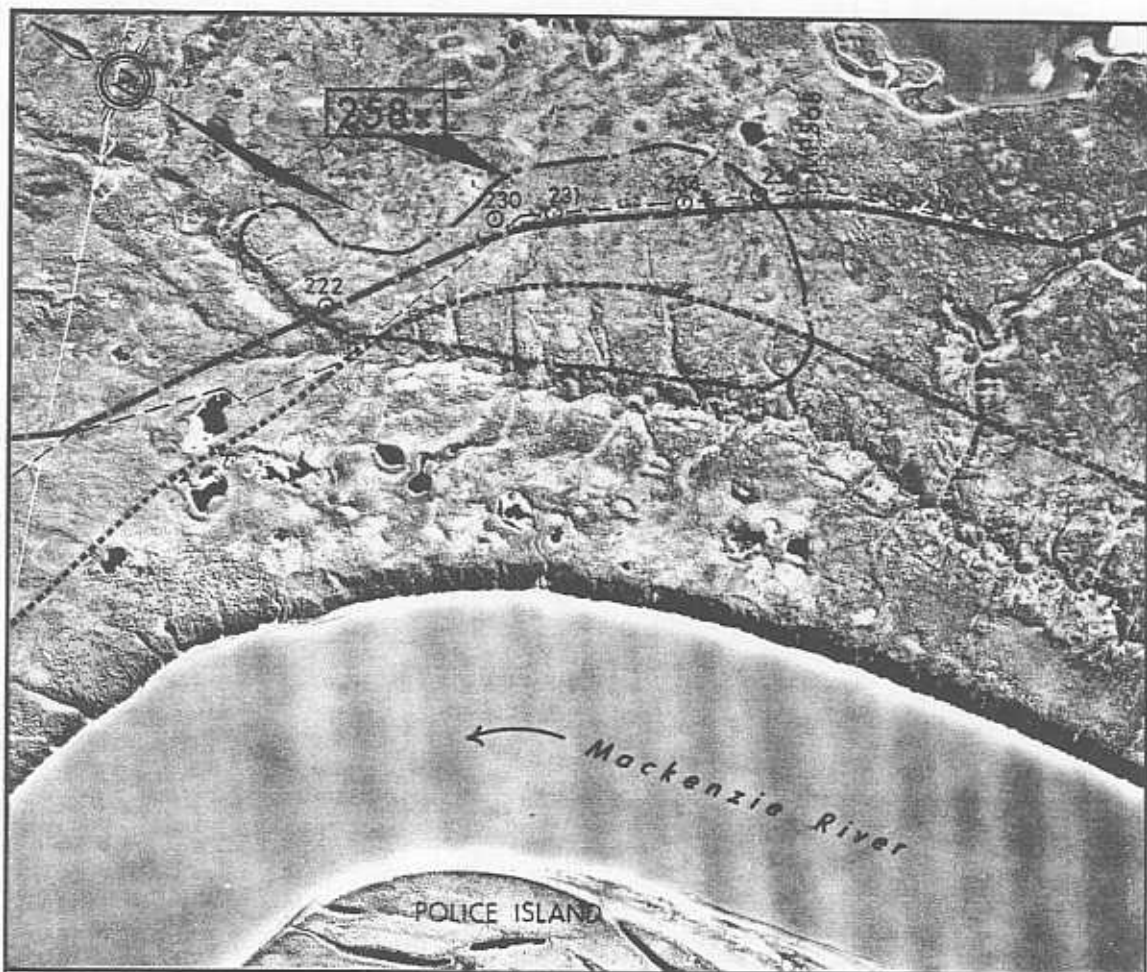
SITE NO. 258X

Located approximately 15 miles southeast of Fort Norman, Site 258X consists of a better drained segment of the glaciolacustrine plain which encompasses the proposed Mackenzie Highway from Mile 568 to Mile 569.5.

Type of Material: Sand; some silt, fine grained.

Estimated Volume: Not applicable.

Assessment: Site 258X is not recommended for development because materials of granular quality were not established during the field drilling program. In addition, high ground ice conditions were encountered.



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. A22933/27

Approximate scale: 1" = 3,000'



ENVIRONMENT

Site 258X is located approximately 15 miles southeast of Fort Norman and encompasses the proposed Mackenzie Highway right-of-way from Mile 568 to Mile 569.5. The site consists of a better drained segment of the glaciolacustrine plain and encompasses an area $1\frac{1}{2}$ miles in length and averages $\frac{1}{2}$ mile in width. The southwestern perimeter of Site 258X is incised with numerous dry erosional gullies which flow into a deeply incised, small creek channel. The adjacent terrain to the northeast is poorly drained and exhibits thermokarst features as characterized by numerous shallow lakes, ponds and muskeg bogs.

The site area consists of deltaic sands which are poorly graded, high in silt content and relatively high ground ice content. A layer of peat and organic topsoil, generally less than 1 foot in depth, overlies the site area and supports moderately dense growths of spruce, poplar and tamarack.

There are no known critical wildlife areas in the immediate vicinity of Site 258X; however, the site is within a region which is periodically hunted and trapped by the northern residents.

The CNT pole line, proposed gas pipeline and the proposed Mackenzie Highway right-of-ways, all traverse the entire length of this site area.

DEVELOPMENT

The exploratory drilling which was conducted on Site 258X by the engineering consultant for The Federal Department of Public Works showed that materials of granular quality are not available at this site. In addition, the relatively high ground ice content of the in situ silty, deltaic sands further restrict the use of this material for construction purposes.

DETAILED DRILL HOLE LOG

SITE NO. 258X

HOLE NO. C 222

DATE: JAN. 11, 1973 LOGGED BY: ☐ PEMCAN ☒ R.M. HARDY & ASSOCIATES

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	1.0 PEAT:		Nbe			0
6		SM	SAND: silty, fine grained, non plastic, greyish brown		Nbn			6
12								12
18								18
24								24
30		SM	31.5 ----- 33.5 ----- coarse grained		Nbe			30
36			- medium to fine grained		Vx	L		36
42								42
48		CI-CH	44.5 ----- CLAY: silty, medium to high plastic, occasional sand lense		Vx	M		48
54			52.0 ----- END OF HOLE 52.0'		Vx	M		54

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"



















DETAILED DRILL HOLE LOG

SITE NO. 258X

HOLE NO. C 230

DATE: JAN. 11, 1973 LOGGED BY: ☐ PEMCAN ☒ R.M. HARDY & ASSOCIATES

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	0.8 PEAT:		Nbn			0
2		SM	SAND: silty, fine grained, non plastic, grey brown					2
4								4
6								6
8								8
10								10
12								12
14								14
16								16
17.0			END OF HOLE 17.0'					18

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 258X

HOLE NO. C 231

DATE: JAN. 11, 1973		LOGGED BY: <input type="checkbox"/> PEMCAN <input checked="" type="checkbox"/> R.M. HARDY & ASSOCIATES	
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 CONDITIONS			SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS	ICE EST'D CONT.		
0		Pt	0.3 PEAT:			M		0
		ML	SILT: fine sandy, low plastic, trace of organics, grey brown			L		3
3		SM	SAND: fine grained, silty, non plastic, brown			L		6
6			7.0 - grey brown					9
9		SM						12
12		ML	SILT: sandy, low plastic, grey brown			L		15
15		SM	15.0 SAND: silty, non plastic, grey brown				18	
18			16.0				21	
21							24	
24							27	
27							30	
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"

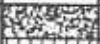


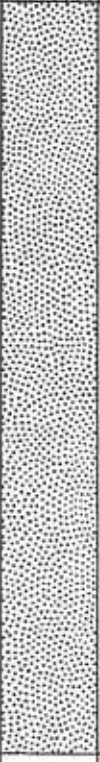
DETAILED DRILL HOLE LOG

SITE NO. 258X

HOLE NO. C 234

DATE: JAN. 15, 1973 LOGGED BY: ☐ PEMCAN ☒ R.M. HARDY & ASSOCIATES

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:		Nbn			0
2		MH	SILT: organic, non plastic, 2.0 — <u>grey brown</u> - fine sandy - non plastic - brown					2
4		SM	4.0 — SAND: silty, fine grained, non plastic, uniform, brown					4
6								6
8								8
10								10
12								12
14								14
16			16.0 — END OF HOLE 16.0'					16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY



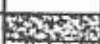

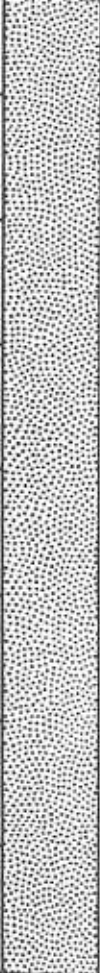
PEMCAN SERVICES "72"


DETAILED DRILL HOLE LOG

SITE NO. 258X

HOLE NO. C 236

DATE: JAN. 15, 1973		LOGGED BY: <input type="checkbox"/> PEMCAN <input checked="" type="checkbox"/> R.M. HARDY & ASSOCIATES	
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	0.5 PEAT:		Nbn			0
2		SM	SAND: silty, fine grained, non plastic, grey brown					2
4								4
6								6
8								8
10								10
12								12
14								14
16								16

<p align="center">GOVERNMENT OF CANADA DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT</p> <p align="center">GRANULAR MATERIALS INVENTORY</p>	 <p align="center">PEMCAN SERVICES "72"</p>
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PEMCAN SERVICES

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, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. 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.
Screes	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.
Sinuous	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



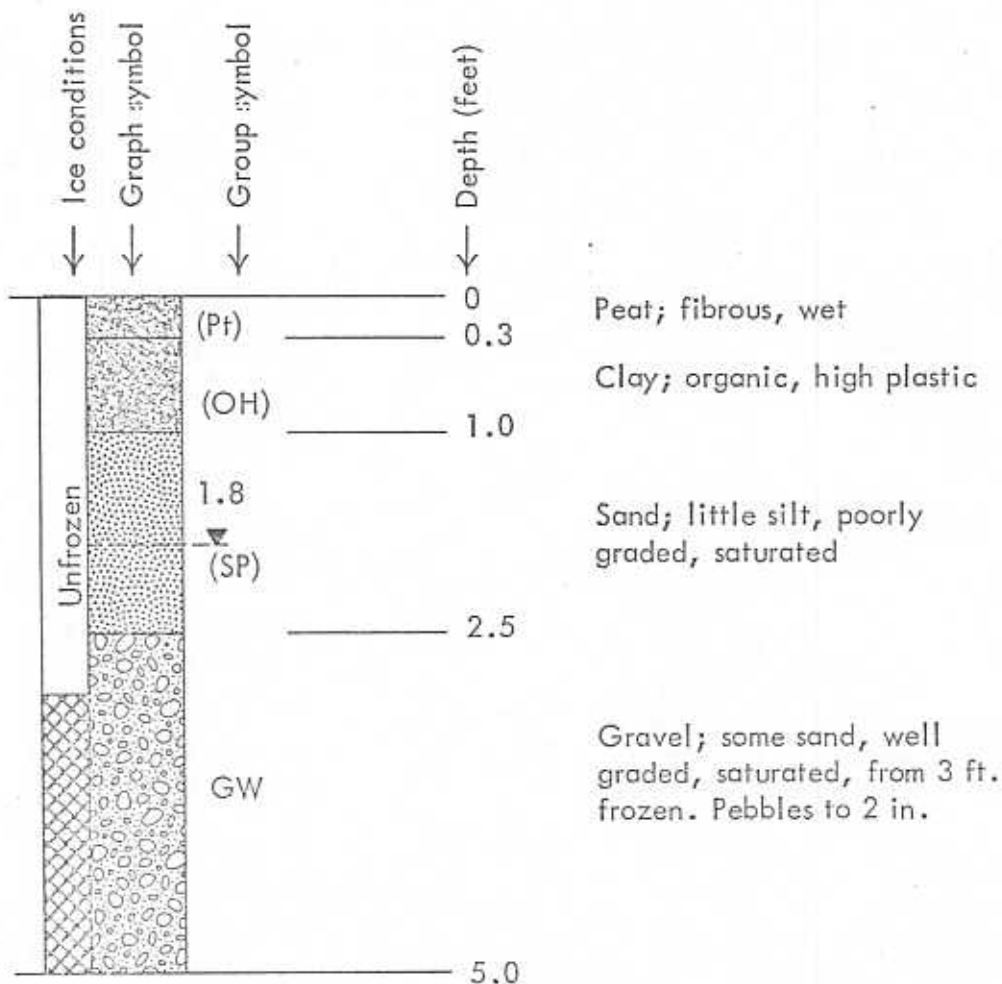
EXPLANATION OF TERMS AND SYMBOLS

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 CON- DIT- IONS	SAMPLE TYPE	DEPTH (feet)
				GEN'L CLASS	N.R.C. CLASS			
0		OL	1.0 TOPSOIL: organic, dark brown		NF	L		0
2		GM-GP	GRAVEL: some silt, little sand, frequent pebbles to 4" size, occasional boulders, medium brown		Vs	L-M		2
4								4
6								6
8		ML	7.0 SILT: some clay, trace of rust and coal specks, frequent pebbles to 1" size, occasional boulders, medium brown					8
10								10
12								12
			12.0 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:

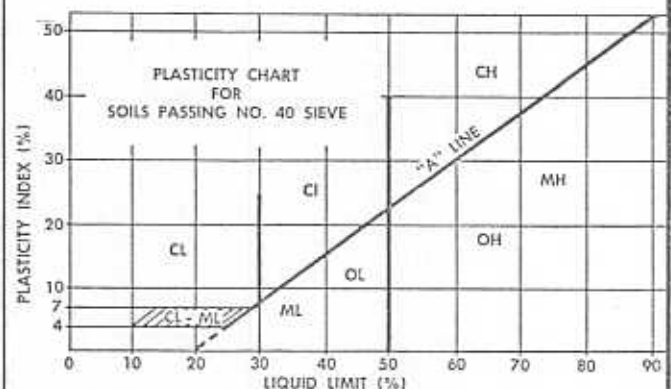
Composite Sand-Gravel Soils		Composite Sand-Silt Soils	
Percentages	Identification	Percentages	Identification
90 to 10	Gravel; trace Sand	95 to 5	Sand; trace - Silt
80 to 20	Gravel; little Sand	90 to 10	Sand; trace + Silt
65 to 35	Gravel; some Sand	80 to 20	Sand; little Silt
50 to 50	Gravel and Sand	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)	GW		WELL GRADED GRAVELS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 6$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			GP		POORLY GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY GRAVELS (WITH SOME FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE P.I. LESS THAN 4
			GC		CLAYEY GRAVELS, GRAVEL-SAND-(SILT) CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7
	SANDS MORE THAN HALF FINE GRAINS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 4$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			SP		POORLY GRADED SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY SANDS (WITH SOME FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE P.I. LESS THAN 4
			SC		CLAYEY SANDS, SAND-(SILT) CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES 200 SIEVE)	SILTS BELOW "A" LINE NEGLECTIBLE ORGANIC CONTENT	$W_L < 50\%$	ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (see below)	
		$W_L > 50\%$	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS		
	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		
		$30\% < W_L < 50\%$	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS		
		$W_L > 50\%$	CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS BELOW "A" LINE ON CHART	$W_L < 50\%$	OL		ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	WHENEVER THE NATURE OF THE FINE CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "I", E.G. SF IS A MIXTURE OF SAND WITH SILT OR CLAY	
		$W_L > 50\%$	OH		ORGANIC CLAYS OF HIGH PLASTICITY		
	HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE

SPECIAL SYMBOLS

	BEDROCK (UNDIFFERENTIATED)		OVERBURDEN (UNDIFFERENTIATED)
	SANDSTONE		LIMESTONE (fragments & blocks)
	SHALE		
	LIMESTONE		
	TALUS (angular rock fragments)		
	TILL (mixed silty sand & clay)		



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

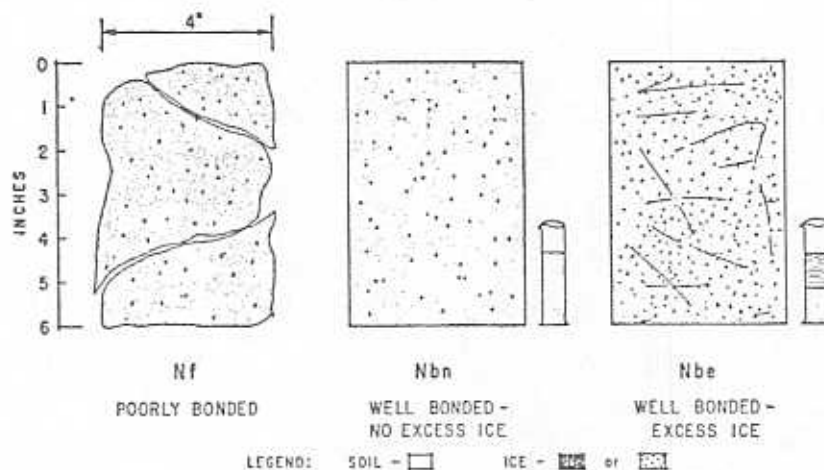




TABLE I (cont'd)
ICE DESCRIPTIONS
B. VISIBLE ICE—LESS THAN 1 INCH THICK^(a)

Group Symbol	Subgroup		Field Identification
	Description	Symbol	
V	Individual ice crystal or inclusions	V _x	For ice phase, record the following when applicable: Location Size Orientation Shape Thickness Pattern of arrangement Length Spacing Hardness Structure Colour Estimate volume of visible segregated ice present as percentage of total sample volume.
	Ice coatings on particles	V _c	
	Random or irregularly oriented ice formations	V _r	
	Stratified or distinctly oriented ice formations	V _s	

^(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.

FIG B. VISIBLE ICE LESS THAN ONE INCH THICK

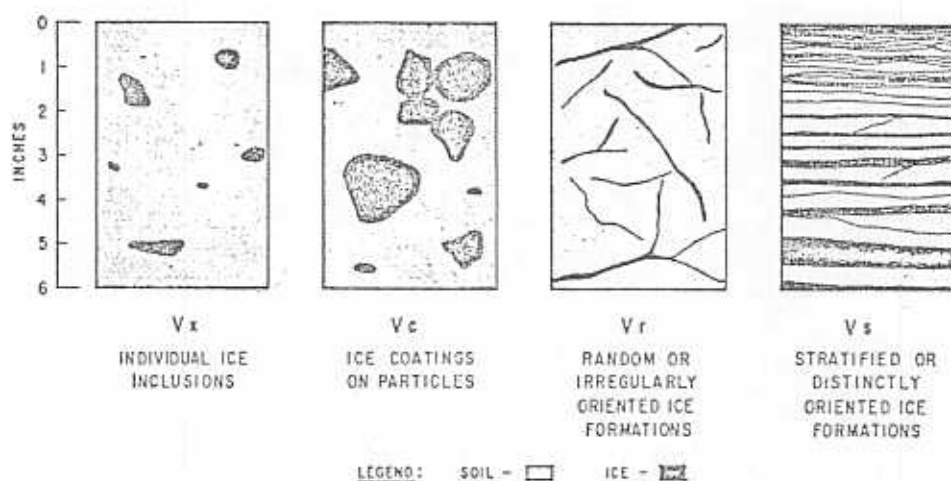




TABLE I (cont'd)
ICE DESCRIPTIONS
C. VISIBLE ICE—GREATER THAN 1 INCH THICK

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: <table><tr><td><u>Hardness</u></td><td><u>Structure^(b)</u></td></tr><tr><td>HARD</td><td>CLEAR</td></tr><tr><td>SOFT</td><td>CLOUDY</td></tr><tr><td>(of mass, not individual crystals)</td><td>POROUS</td></tr><tr><td></td><td>CANDLED</td></tr><tr><td></td><td>GRANULAR</td></tr><tr><td></td><td>STRATIFIED</td></tr><tr><td><u>Colour</u></td><td><u>Admixtures</u></td></tr><tr><td>(Examples):</td><td>(Examples):</td></tr><tr><td>COLOURLESS</td><td>CONTAINS</td></tr><tr><td>GRAY</td><td>FEW THIN</td></tr><tr><td>BLUE</td><td>SILT INCLUSIONS</td></tr></table>	<u>Hardness</u>	<u>Structure^(b)</u>	HARD	CLEAR	SOFT	CLOUDY	(of mass, not individual crystals)	POROUS		CANDLED		GRANULAR		STRATIFIED	<u>Colour</u>	<u>Admixtures</u>	(Examples):	(Examples):	COLOURLESS	CONTAINS	GRAY	FEW THIN	BLUE	SILT INCLUSIONS
	<u>Hardness</u>	<u>Structure^(b)</u>																									
HARD	CLEAR																										
SOFT	CLOUDY																										
(of mass, not individual crystals)	POROUS																										
	CANDLED																										
	GRANULAR																										
	STRATIFIED																										
<u>Colour</u>	<u>Admixtures</u>																										
(Examples):	(Examples):																										
COLOURLESS	CONTAINS																										
GRAY	FEW THIN																										
BLUE	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

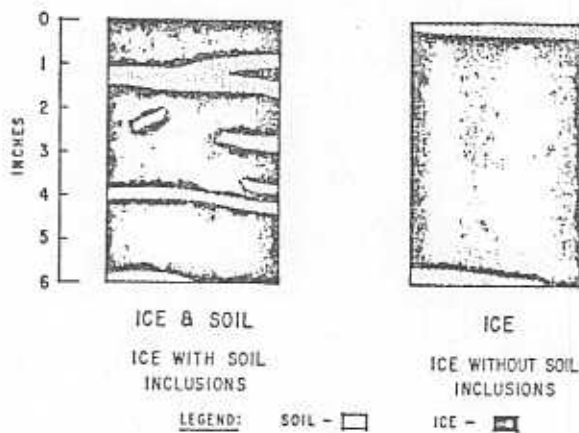




TABLE II

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 Hession, 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.

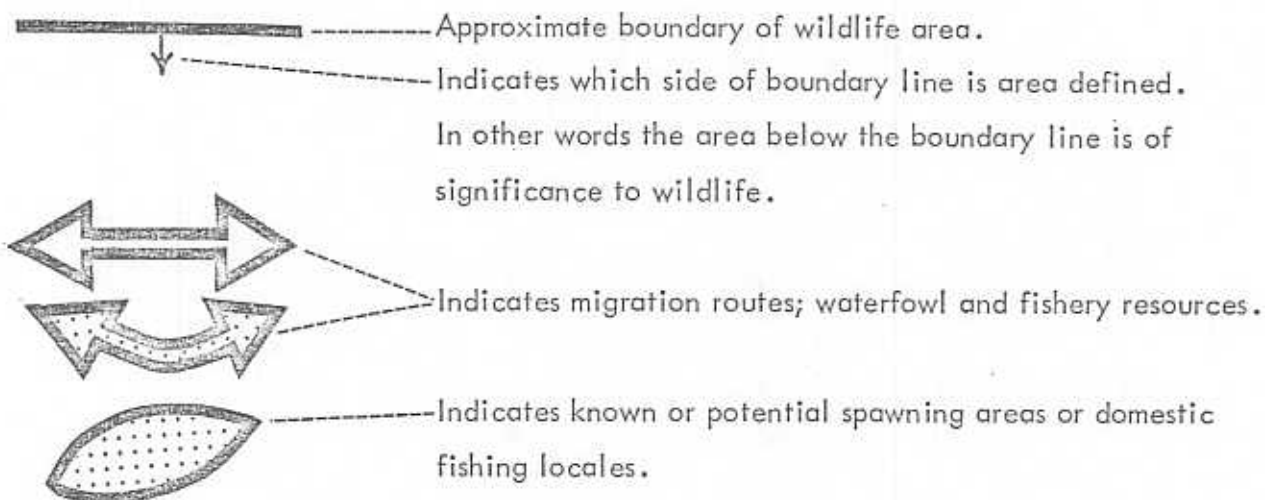
Outlined wildlife areas include both regions of known wildlife habitation and regions which have been historically trapped by northern residents.

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:

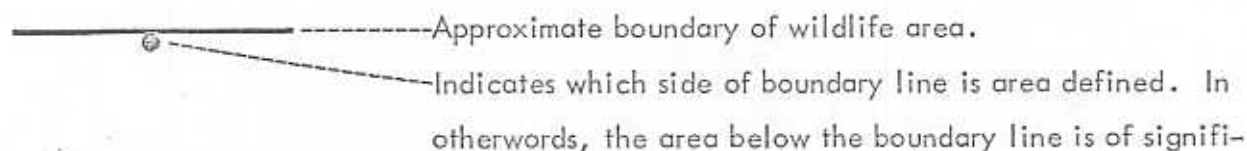


Pertinent wildlife areas are discussed in the Methodology-Evaluation section of the text in each community report. Similar documentation is also presented for sites which occur in significant wildlife areas in the Site Description section of the report.

INTERCOMMUNITY REPORTS

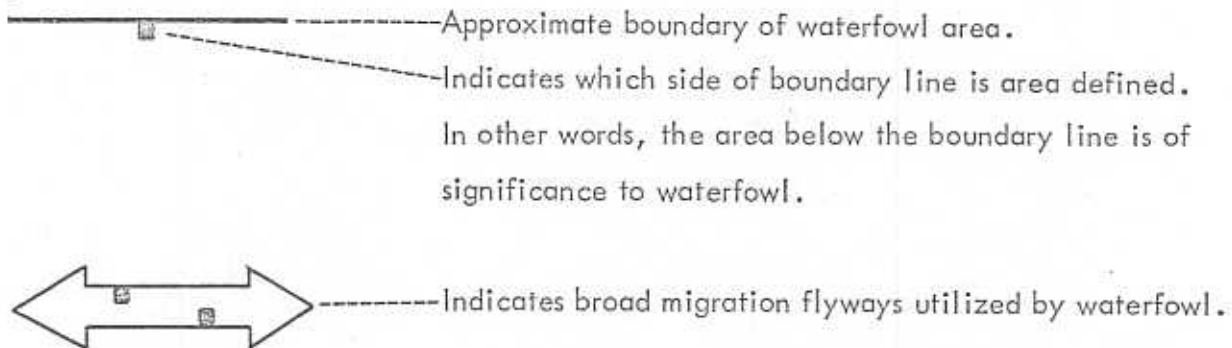
In each Intercommunity Study Area, known "critical" and "important" wildlife, waterfowl and fishery resource areas are outlined on the respective map presentations. A brief description relating to the significance of each area is included within the outlined boundary. Areas that are classified as "critical" 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.



PEMCAN SERVICES

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BIBLIOGRAPHY

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