GRANULAR RESOURCE INVENTORY
- MACKENZIE -
FORT NORMAN NTS 96/C
(1:125,000)
Produced for Indian and Northern Affairs
by Dept. of Energy,Mines & Resources

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for - Department of Indian Affairs and
Northern Development

July, 1972

Summary

The Fort Norman map area has abundant sources of unconsolidated granular material, distributed principly along the Redstone and Keele Rivers (fluvial deposits) and in widely scattered glaciofluvial deposits. Several large glaciofluvial deposits consisting mainly of fine and medium grained sand lie adjacent to the river in the southern part of the map area. Two similar deposits are found in the extreme northwest corner of the map area.

Bedrock of the McConnell Range on the east side of the Mackenzie River, consists primarily of coherent limestones, dolomites, and quartzzites and would provide good quality crushed granular material.

Tertiary unconsolidated materials available in vast quantities in the western part of the map area, but is distant from proposed construction activity.

The Fort Norman settlement area has virtually no granular material. This is a prime consideration for future exploration. The possibility of dredging and barging coarse grained material from the mouth of the Redstone and Keele Rivers may be an economic solution to the materials shortage for the area.

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I Introduction

This report attempts to assess the quantity of granular material available for construction use. Both unconsolidated and bedrock sources are considered. Glaciofluvial and fluvial materials are considered first rate sources of sand and gravel. Lacustrine and marine deposits are of variable quality while eolian material is of limited use because of its fine texture. Generally moraines have only been considered where they are known to be hummocky and contain some coarse granular material. Terminal moraines are usually considered to be sources of granular material while ground moraines are not.

Bedrock has only been considered if it is coherent i.e. limestones, dolomites, sandstones and most rocks of Precambrian age. Other rock types i.e. shales have not been considered in this report eventhough they could be used as fill material for road and other construction uses.

The information which appears in this report and on the accompanying map has been compiled largely from published and unpublished manuscripts and personal communication with officers of the Geological Survey of Canada. Supplementary data, mainly on depths, thicknesses and, in some cases, on texture of deposits has been obtained from confidential reports of other government departments and industry. See appendix for details on information sources.

The basic document used in this compilation is a surficial geology map at a scale of 1:125,000 (Hughes, 1969). It is indexed as GSC open file (OF 26) and may be viewed at Geological Survey of Canada offices in Ottawa, Calgary and Vancouver; ozalid copies may be obtained at nominal cost. All areal data is derived from this source; all major and most minor unconsolidated deposits of granular material are represented at this scale.

A derivative map for granular material has been produced from the basic surficial geology map in close association with the field geologist. His field observations provide additional data on thickness, texture, ice content, drainage, and the variability of the deposits.

To supplement thickness and textural data, additional information was gathered from seismic shot hole records and samples and from other drill hole logs.

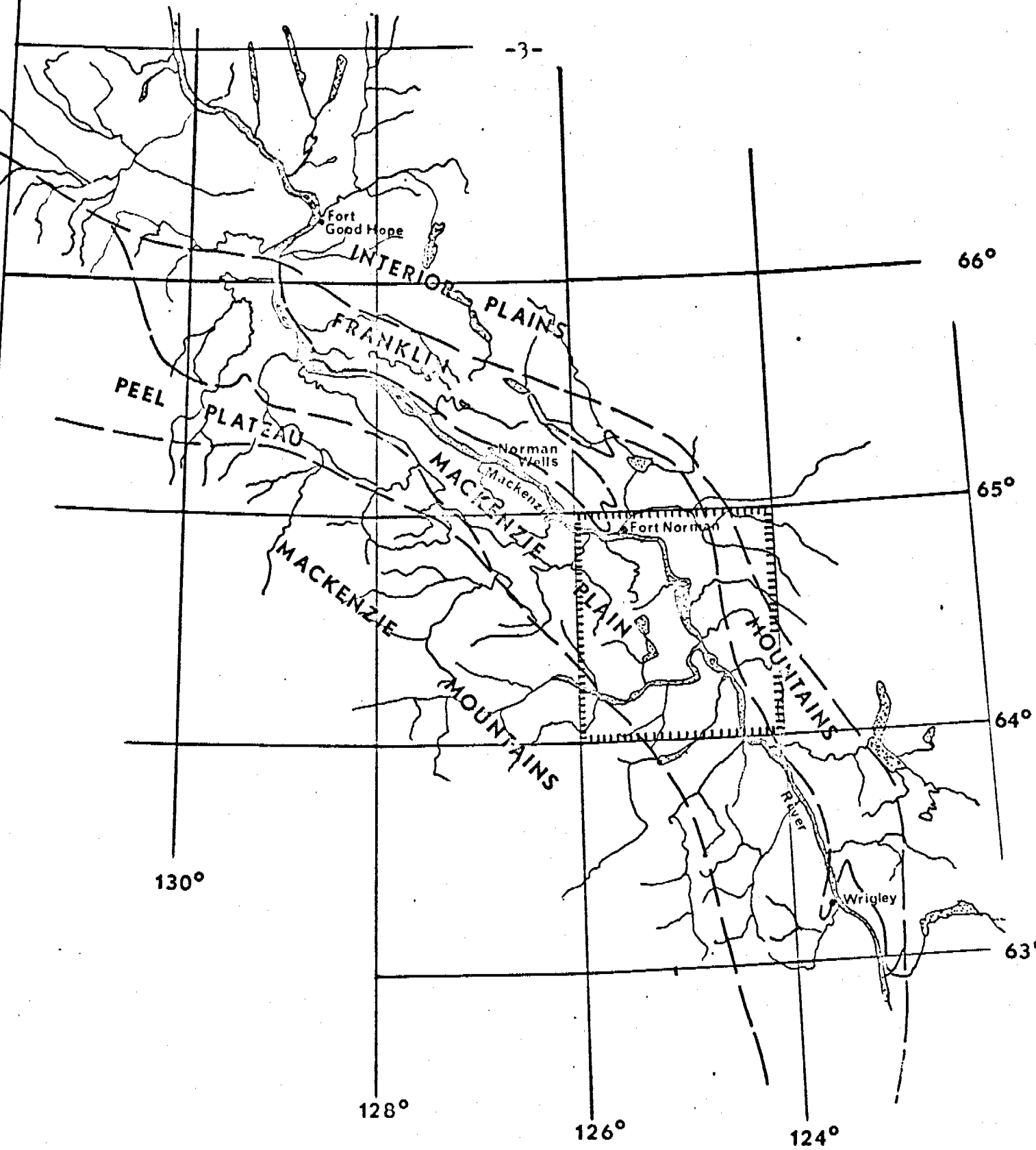
Areal extent of deposits was estimated by using planimetered areas from the map. Average thickness for the deposit estimated from the data mentioned above and adjusted according to several other variables such as drainage, height above water table, amount of ground ice etc. From this, a volume of available granular material was estimated. All estimated volumes of material appear in a tabular summary in section IV.

In addition to the estimates of unconsolidated granular material, a derivative bedrock geology map appears on an overlay sheet. This is intended to indicate where suitable bedrock for crushing or fill could be extracted if unconsolidated material is not available.

For purposes of description areas of granular material are outlined on a transparent overlay and are numbered to correspond to a tabular summary of materials. Those areas containing either potential granular material or which require more detailed work are discussed in the body of this report.

I General Geology and Physiography

Four physiographic regions are represented in the Fort Norman map area. From east to west the regions are: the Interior Plains, Franklin Mountains; Mackenzie Plain; and Mackenzie Mountains (Figure 1). The bedrock mapped in part (Cook, 1972), occurs largely in the Franklin and



PHYSIOGRAPHIC REGIONS

FORT NORMAN

1 : 2,500,000

after Bostock 1943

Mackenzie Mountains, but some is found in the Mackay Range. Hughes (1969) has mapped the surficial geology of the map area, except in the Mackenzie Mountains.

The bedrock deposits consist mainly of carbonates and shales with some unconsolidated material of Tertiary age. Glaciation produced glaciofluvial outwash and channel deposits and a small number of eskers. Rivers have reworked the unconsolidated deposits and produced fluvial plain and terrace deposits. Wind has also reworked some material to produce fine sandy eolian deposits. All of these unconsolidated deposits are important as sources of granular material.

A. Unconsolidated Deposits

(i) Glaciofluvial Deposit G (red)

Glaciofluvial deposits occur in three forms on this map sheet: glacial outwash deposits (Gf); glaciofluvial channel deposits (Gfc) and eskers. The first two depositional forms have moderately flat topography, while eskers have a sinuous ridge appearance.

In all of these deposits sand and gravel is abundant and approximately 80% is available as a granular material. The outwash and channel deposits vary in thickness from 10' to 50'. The eskers average approximately 10'-20' in height (Hughes, 1970).

(ii) Fluvial Deposits F (green)

Only the fluvial deposits produced by high energy streams are likely to contain suitable granular material. In the Fort Norman map area such deposits occur at the base of the Mackenzie River, Mackay Range and along the Keele, Redstone and parts of the Mackenzie Rivers. Fluvial fan deposits of variable composition occur at the base of the mountains. The

fluvial plains and terraces are generally flat and contain primarily sand and gravel.

The fluvial fans range in thickness between 15' and 150'; while the plains have a maximum thickness of 30'. Sixty per cent of the deposit is available as granular material.

(iii) Eolian Deposits E (pink)

Eolian deposits are sand deposits which have been reworked by wind action. They are found primarily on the Mackenzie Plain.

The granular material consists mainly of fine to medium grained sand. The deposits range from 10' to 50' in thickness and contain about 60% available granular material (Hughes, 1970).

B. Bedrock

East of the Mackenzie River, the Franklin Mountains are composed almost entirely of carbonate rocks of the Ordovician, Silurian and Devonian Periods. There are minor quantities of Precambrian carbonates, quartzites and shales. West of the Mackenzie River, the Mackenzie Mountains and the Mackay Range consist of the same carbonates plus Cambrian, Devonian and Cretaceous shales, Cretaceous sandstone and unconsolidated sand and gravel deposits of the Tertiary. (See Fig. 2).

This sand and gravel is a prime source of granular material. The carbonate rock is the best material from which crushed material may be obtained. Sandstones, and in some cases shales, can be crushed for granular material when only inferior material is required.

Columns YB67021-24; NTS. 96-C Tertiary Creek.
YB67021: 64°29'N; 135°32'W: YB67022: 64°28'N; 135°34'W: YB67023: 64°28'N; 135°40'W: YB67024: 64°28'N; 135°41'W

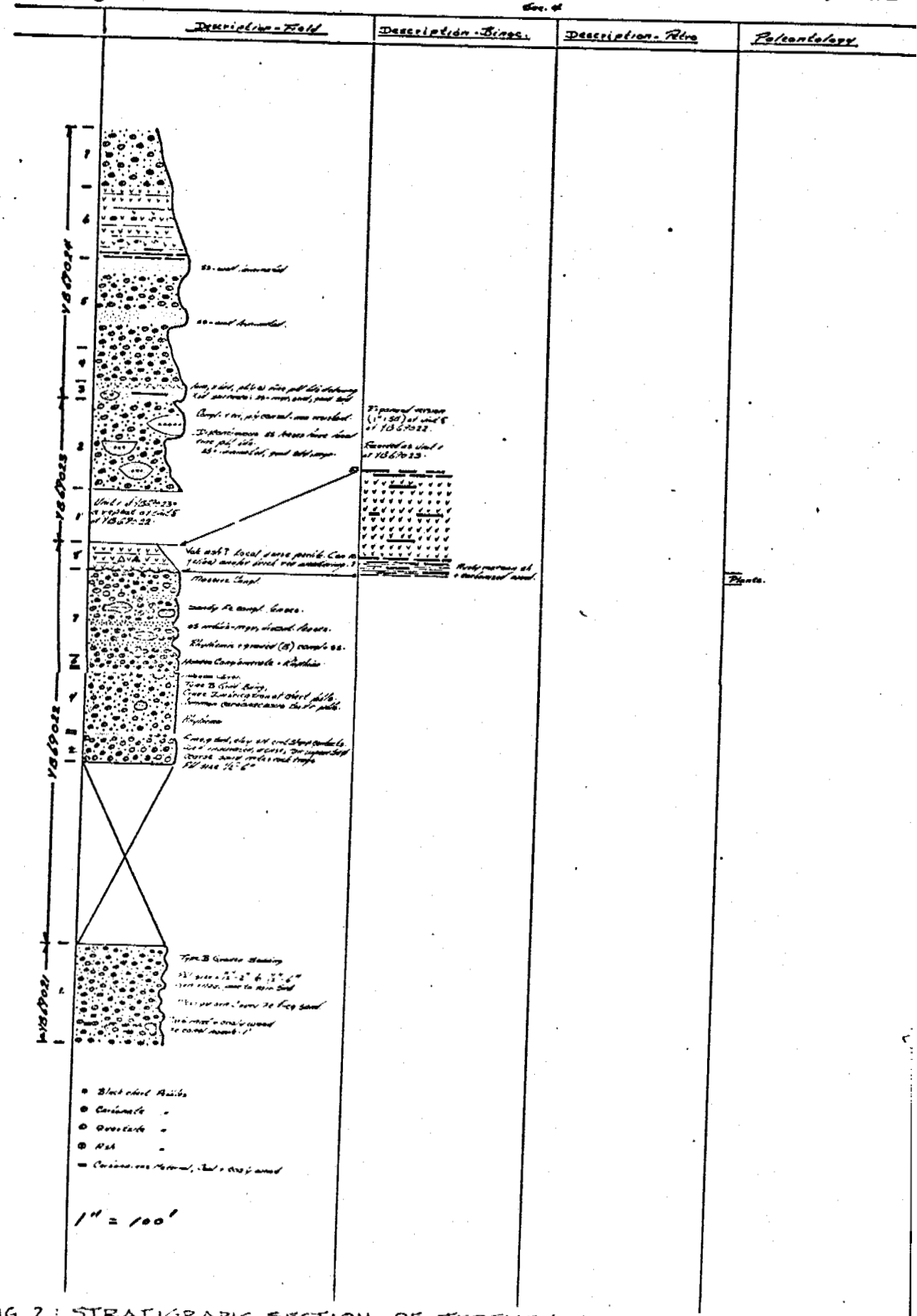


FIG 2: STRATIGRAPIC SECTION OF TERTIARY HILLS

II Materials

The sources of unconsolidated granular material are mainly glaciofluvial and fluvial in origin. In addition to these, there is a major source of material available from the unconsolidated deposits of sand and gravel from the Tertiary Hills. These are located in the west-central portion of the map sheet. For a stratigraphic section see fig. 2.

Resistant bedrock units are found in the McConnell Range and at Bear Rock. On the east side of the Mackenzie River in the Mackay Range and in the southwest corner of the map area similar rock types are exposed.

In the immediate vicinity of Fort Norman there are no granular sources. The closest units are the glaciofluvial units across the Great Bear and Mackenzie Rivers and the eolian units approximately 8 miles to the west of the settlement. With the exception of the three small glaciofluvial units west of Bear Rock, all the above units are sandy. There are additional sandy eolian units southwest of Fort Norman. These units appear as north-south oriented dunes. They are more extensive and thicker than the units near Tagatui and Loon Lakes.

The glaciofluvial channel units on either side of the Mackenzie River in the central and southern parts of the map area are mostly sand; usually 30' or more in thickness. Widely scattered smaller units are found in and to the west of the Franklin Mountains. They also tend to be coarser in texture. The Franklin Mountains which run parallel to the river provide suitable rock for crushed granular material. The principle rock types are limestones and dolomites of Devonian and Ordovician age but at Mount Clarke quartzite is the dominant lithology. Similarly, the Mackay Range south-southwest of Fort Norman is predominantly limestone and dolomite. The rock types exposed in the south west portion of the map area are predominantly Devonian limestones.

Other unconsolidated deposits on the west side of the Mackenzie River include: the eolian sand ridges near the Keele - Mackenzie River junction; the numerous glaciofluvial units distributed throughout the western part of the map area; and the fluvial deposits of the Keele and Redstone Rivers. The eolian material, although close to the river, is of limited extent and is fine grained. The glaciofluvial units are more extensive and would provide superior material. Good quality material is available from the flood plains and fluvial terraces of the Redstone and Keele Rivers. Much of this coarse granular material has also been deposited in the Mackenzie River downstream from these large tributaries. Dredging may be an acceptable method of recovering this material while at the same time improving channel conditions. Transportation of this material over long distances could be easily and economically handled by barges.

Probably the most extensive deposits in this map area are the unconsolidated Tertiary deposits of sand and gravel. They cover an area over 25 miles in length and 10 miles in width in the west-central part of the map area. This material is also found in the adjacent map area, Carcajou Canyon. The material of this deposit is mainly carbonate, chert and quartz gravel in a matrix of finer material. Interbedded sand units and lenses are common. Beds of ash, shale and carbonaceous material are also found (Fig. 2). These beds would not be acceptable for granular material.

IV Tabular Summary

	Area (sq. mi.)	Estimated thickness (ft.)	Estimated Volumes of granular material ($yds^3 \times 10^6$) Total	Available
Area I Bear Rock - Great Bear River				
a) Gfc glaciofluvial (channel complex); sand and gravel.	3.9	15'	122.00	97.60
b) Gf glaciofluvial; undifferentiated sands and gravels.	2.14	15'	33.55	26.84
c) Esker: sand and gravel.	1.25mi.	20'	0.04	0.03
d) bedrock; Devonian, Ordovician and Silurian carbonates; Cretaceous shales.				
Area II Little Bear River				
a) Gfc glaciofluvial (channel complex); sand.	19.70	30'	616.10	492.88
b) E eolian, fine grained sand.	1.95	30'	30.50	18.30
Area III Mackay Range				
a) Gf glaciofluvial (outwash); sand and gravel.	.38+	10'	6.10	4.88
b) Bedrock; Devonian carbonates.				
Area IV Southern section of the East Little Bear River				

a)	Fa fluvial (fans or fan aprons); coarse grained sand.	14.44	50'	752.03	376.01
Area V	Between Little Birch River and Mackay River				
a)	Gfc glaciofluvial (channel complex); eolian silt veneer.	0.58	15'	9.15	7.32
b)	Gf glaciofluvial; eolian silt veneer; sand and gravel.	.19	15'	3.05	2.44
c)	3 small eskers; sand and gravel.	1.00mi.	20'	0.04	0.03
Area VI	Tertiary Hills				
a)	Gf glaciofluvial; coarse grained sand and gravel.	8.24	20'	194.57	115.59
b)	Gfc glaciofluvial (channel complex); sand and gravel.	1.36	15'	20.33	16.26
c)	Bedrock, undifferentiated and generally unconsolidated; granular material; Tertiary.				
Area VII	South of Tertiary Creek				
a)	Gf glaciofluvial (channel complex); sand and gravel.	2.33	20'	46.71	37.06

Area XII Moose Prairie				
Bedrock; Devonian carbonates				
Area XIII Southern section of the Mackenzie River East shore				
Gfc glaciofluvial (channel complex); sand and gravel.	13.58	30'	424.5	339.6
Area XIV South of McConnell Range				
Bedrock; Devonian carbonates.				
Area XV South-west section of the Mackenzie River				
a) Gfc glaciofluvial (channel complex); sand and gravel.	7.68	30'	240.3	192.24
b) Fa fluvial (fans or fan aprons); silt, sand and minor gravel.	.19	50'	10.16	5.08
Area XVI Southern section of the McConnell Range				
a) Gf glaciofluvial (out-wash); sand and gravel.	5.07	20'	105.62	84.49

b)	Gf glaciofluvial; sand and gravel.	0.19	10'	2.03	1.62
Area VIII	Steward Lake				
a)	Gf glaciofluvial; sand and gravel.	.57	10'	6.09	4.86
b)	2 Eskers: sand and gravel.	1.50mi.	20'	0.05	0.04
Area IX	Red Dog Mountain				
a)	Gfc glaciofluvial (channel complex); sand and gravel.	4.48	20'	95.42	74.72
b)	Bedrock; carbonates are in half of the unit.				
Area X	Keele River, Mackenzie River and Redstone River				
	Fp, Ft Fluvial (modern flood plains and low terraces); gravel and silt.	123.99	15'	2,397.49	1,175.52
Area XI	South Shore of Keele River				
a)	Bedrock; Devonian carbonates				
b)	Gfc glaciofluvial (channel complex); sand and gravel.	2.55	20'	52.79	42.21

b)	Gfc glaciofluvial (channel complex); sand and gravel.	0.70	20'	14.58	11.66
c)	Bedrock; Ordovician and Silurian carbonates.				
Area XVII	Intersection of Mackenzie River and Saline River				
a)	Gfc glaciofluvial (channel complex); sand and gravel.	3.26	30'	70.70	56.56
b)	Gf glaciofluvial (out-wash); sand and gravel.	0.58	30'	18.30	14.64
c)	Bedrock; carbonates				
Area XVIII	Intersection of the Mackenzie River and the Keele River				
	E Eolian; undifferentiated fine to medium grained sand.	2.53	15'	39.65	23.79
Area XIX	Intersection of the Mackenzie River and the Little Smith Creek				
a)	Gfc glaciofluvial (channel complex); sand and gravel.	3.82	30'	114.5	95.60

b)	Gf glaciofluvial; undifferentiated sand and gravel.	.85	30'	26.8	21.44
Area XX	Mount Clark				
a)	Bedrock; Ordovician, Silurian and Devonian carbonates; undifferentiated Precambrian.				
b)	Gfc glaciofluvial; (channel complex) sand and gravel.	.58	30'	18.30	14.64
Area XXI	Between Franklin Mountains and Little Smith Creek				
a)	Gf glaciofluvial; sand and gravel.	2.23	15'	35.35	28.28
b)	Five eskers; sand and gravel.	4.00mi.	20'	0.14	0.12
c)	Bedrock; Ordovician, Silurian and Devonian carbonates.				
Area XXII	Middle section of the Franklin Mountains				
a)	Gf glaciofluvial; sand and gravel.	0.38	15'	6.10	4.88
b)	3 eskers; sand and gravel.	3.00mi.	20'	0.11	0.08

Area XXIII St. Charles Creek East				
a) Gfc glaciofluvial (channel complex); sand and gravel.	3.24	15'	47.51	38.00
Area XXIV Bear River and St. Charles Creek West				
a) Gf glaciofluvial (out-wash); fine grained sand.	7.39	30'	231.7	185.36
b) Bedrock; Ordovician, Silurian and Devonian carbonates.				
Area XXV Old Fort Point and Police Island				
E eolian; fine grained sand.	3.98	15'	62.80	29.68
Unit XXVI Lake Tagatui				
E eolian; fine grained sand.	3.02	15'	47.55	29.53

V Sources of Information

Bostock, H.S.
1948: Physiography of the Canada Cordillera, with special reference to the area north of the fifty-fifth parallel; Geol. Surv. Can., Mem. 247.

Canadian Hydrographic Surveys
1968: Great Slave Lake and Mackenzie River Bilot including Canadian Hydrographic Service Charts. Dept. of Energy, Mines and Resources.

Cook, D.G.
1972: Manuscript of Bedrock Geology Fort Norman 96C; Geol. Surv. of Canada. (unpublished).

Hughes, O.L.
1969: Manuscript of Surficial Geology Fort Norman 96C; Geol. Surv. of Canada. Open File #26.

Hughes, O.L.
1972: Surficial Geology of Northern Yukon Territory and Northwestern District of Mackenzie, Northwest Territories; Geol. Surv. of Can. Paper 69-36.

Hume, G.S.
1954: The Lower Mackenzie River Area; Northwest Territories and Yukon; Geol. Surv. of Can., Mem. 273.

Pemcan Services
1971: Transportation Corridor Study, Vol. I, II, III; Gas Arctic Systems Study Group; Report.

Prest, V.K., Grant, D.R., Rampton, V.N.
1967: Glacial Map of Canada; Geol. Surv. of Canada, Map 1253A.

Ripley, Klohn and Leonoff Alberta Ltd.
1969: Mackenzie Valley Pipeline Report, Vol. I and II. Report.

Ripley, Klohn and Leonoff Alberta Ltd.
1970: Presentation of Test Hole Log Data. Report.

Yorath, C.
1972: Stratigraphic Section of Tertiary Hills; Geol. Surv. of Canada; (unpublished).

APPENDIX I, Part I

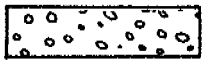
Unconsolidated Granular Materials

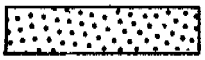
Each map sheet has a surficial geology legend (see appendix I, part IV). The following legend only indicates granular material, classified by genetic characteristics. In some cases, only part of a map unit has been patterned, indicating that only that portion is considered a suitable source for granular material.

Legend

GLACIOFLUVIAL

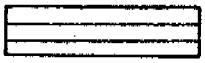

coarse grained granular material, cobbles, pebbles, gravel; may be mixed with some coarse sand.


mixed or interbedded sand and gravel


predominantly sand or sand with undesireable fines

GLACIOLACUSTRINE


gravel, lacustrine


sand and gravel


sand

FLUVIAL

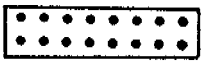

fluvial (only sand and gravel deposits are patterned)

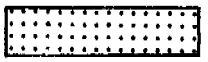
MORAINAL


morainal deposit

MARINE


coarse-grained material, cobbles, pebbles, gravel, may be mixed with coarse sand


mixed or interbedded sand and gravel


predominantly sand or sand with undesireable fines

APPENDIX I, Part II

Bedrock Geology

(black line overlay)

The rock units which appear on the accompanying overlay are an engineering geological grouping according to gross lithology and age.

These units were derived from a more detailed geological map (whose units were subdivided largely on the basis of airphoto and stratigraphic interpretation (Cook 1972). The units are identified by a two letter identification code. The first character is an upper case letter designating age which is followed by a mnemonic designating gross lithology e.g. Dls - Devonian limestone.

Legend

I - AGE

T - Tertiary

K - Cretaceous

M - Mississippian

D - Devonian

S - Silurian

O - Ordovician

C - Cambrian

P - Precambrian

OS- Ordovician/Silurian

P - Precambrian/Cambrian

II - LITHOLOGY

car - carbonates
limestone and/or dolomite

ss - sandstone

sh - shale

no lower case mnemonic modifier - rocks are undifferentiated

Symbols

Boundary of bedrock unit (approximate)

Boundary of bedrock unit inferred in areas of surficial cover

limit of mapping

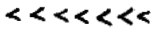
EOLIAN

usually fine and medium-grained sandy material

COLLUVIUM

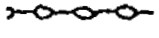
primarily coarse grained material

Symbols



eskers

gravel mounds

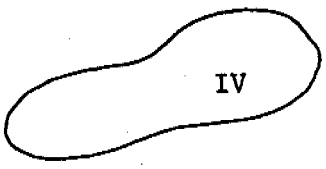


morainal ridge found within moraine

APPENDIX I, Part III

GRANULAR RESOURCE UNITS

I GRANULAR RESOURCE AREAS (black)



granular resource area

(see text corresponding description)

APPENDIX 1, Part (iv)

Surficial Geology and Landforms

TEXTURE	GENESIS	MORPHOLOGY	SLOPE (superscript)
f fen	O organic	v veneer	1 moderate ($<5^{\circ}$)
p peat	M morainic	p plain	2 steep (5° - 15°)
c clay	G glaciofluvial	d drumlin	$>15^{\circ}$ normally in Cx unit
si silt	L lacustrine	s fluted striated	
s sand	A alluvial	t terrace	
g gravel	F fluvial	h hummocky	
b boulder	C colluvial	r ridged	
t till	E eolian	e eroded	
	U upland, rolling bedrock controlled	a fan	
		m rolling	
	R rock outcrop	c channelled	
		k kettled thermokarst	
		x complex	

Complex Units:

e.g. in: Mp-fO, fO constitutes 25% to 49% of area
: Mp fO, fO=5% - 24% of area

Using all four elements of the legend, a smooth ground moraine surface with moderate slope would be tMp^{1}; hummocky and ridged glaciofluvial gravel would be gGhr. Note that there are inconsistencies in the use of Mp and Mv mainly because of the difficulty in estimating till thickness.