Granular Resources Inventory
- Southern Mackenzie Valley -
Bulmer Lake - 95 I

GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF ENERGY, MINES AND RESOURCES

GRANULAR RESOURCE INVENTORY - SOUTHERN MACKENZIE VALLEY BULMER LAKE (95I) (1:125,000)

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December, 1972

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SUMMARY

Coarse natural granular material and competent, crushable bedrock are rare in the Bulmer Lake map-area. Unconsolidated deposits of alluvial, glaciolacustrine, and glaciofluvial origin contain most of the available sand and gravel. Secondary sources of coarse natural granular material include scattered morainal and eolian deposits. No competent, crushable bedrock is present.

Glaciofluvial outwash plain, ridge, and esker deposits are small in surface area. These deposits are well drained, have little organic cover, and have a fairly high percentage of coarse material.

Glaciolacustrine, alluvial, and morainal deposits contain a higher percentage of fine material, and are often poorly drained. They also have higher ground ice content and more organic cover. At the surface, large, well drained moraine ridges ( ) consist of silty till. Drilling might show gravel and sand at depth within the ridges.

Bedrock is at the surface only along the Willowlake River. Shale of two formations exposed there is too soft to serve as a bedrock source for granular materials.

Carrying out a large scale construction project in any part of the Bulmer Lake map-area will be difficult and costly because of the limited amount of natural granular materials available there.

INTRODUCTION

Granular material for construction purposes can be obtained from unconsolidated deposits or competent bedrock. This report will discuss the distribution and physical characteristics of these sources of granular material and will also present an estimate of the quantity of material available in unconsolidated deposits.

Unconsolidated deposits resulting from various geologic processes, i.e. glacier activity, river deposition, wind action, and mass wasting, are a source of natural granular material of gravel (> 2 mm), sand (1/16-2 mm), silt (1/16-1/256 mm), and clay (< 1/256 mm) sizes.

Good natural granular material for construction uses is generally larger than silt size (1/16 mm)[1]. In the southern Mackenzie Valley good granular material comes primarily from deposits of glaciofluvial and glaciolacustrine origin, and secondarily from morainal, eolian, alluvial, and colluvial deposits.

Bedrock that can be crushed by mechanical means can also supply granular material. Competent bedrock suitable for crushing includes limestone, dolomite, sandstone, and certain igneous and metamorphic rock types. Other less resistant rock types, i.e. shale, can be used for fill material but will not be included here as a bedrock source of granular material. In the southern Mackenzie

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[1] Silt and clay size material < 1/16 mm can be used for fill. This material is unlimited in the unconsolidated deposits of this map-sheet and will not be included in the numerical estimate of the quantity of granular material available.

Valley limestone and dolomite are the best sources of rippable bedrock.

Published and unpublished Geological Survey of Canada maps and reports, personal communication with officers of the Geological Survey, and field investigation have provided the basic data for this report. Supplementary information on distribution, thicknesses, and textures of unconsolidated deposits was obtained from unpublished oil and pipeline company shot hole and drilling records (see sources of information, Appendix A).

A Geological Survey surficial geology map at a scale of 1:125,000 (Rutter, N.W., and Boydell, A.N., in press) provided data on location and areal extent of unconsolidated deposits containing good granular material. This map will be indexed as GSC Open File and when published it may be viewed in the Geological Survey of Canada offices in Ottawa, Calgary and Vancouver. Copies will be obtainable at a nominal cost from Riley's Data-Share International, 631 - 8 Avenue South West, Calgary, Alberta.

Quantities of natural granular material in unconsolidated deposits have been computed using data on areal extent and thicknesses obtained from the surficial geology map, drilling results, and field observations. Variables such as ground ice and height of water table were considered when deriving final volumes of material available in each deposit[2]. The tabular summary at the end of this report contains detailed volumetric data.

Information on bedrock that can supply granular material comes mainly

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[2]The area of each deposit was measured on the surficial geology map with a planimeter. The average thickness of the deposit was multiplied by the area to get the total volume of the deposit. Variables, i.e. water table, type of deposit, were assessed to obtain the final percentage of the total volume that is listed in the table as material available for exploitation.

from Geological Survey of Canada Paper 59-11. Map 48-1959 which accompanies this paper, has been used as a base for indicating competent bedrock that is available at or near the surface.

GENERAL GEOLOGY AND PHYSIOGRAPHY

Except for the Horn Plateau at its sourtheastern corner, the Bulmer Lake map-area falls entirely in the Great Slave Plain physiographic region (see location map, Figure 1).

Bedrock geology was mapped by the Geological Survey on Operation Mackenzie in 1957 (Douglas and Norris, 1960). A reconnaissance surficial geology investigation was undertaken by B. G. Craig as part of this operation (Douglas and Norris, 1960; Craig, 1965). A detailed surficial geology map based on airphoto interpretation and field investigations is being compiled by the Geological Survey (Rutter and Boydell, in press).

Bedrock formations[3] are basically Cretaceous and Devonian shales with minor sandstone.

These formations which underlie most of the area and outcrop along Willowlake River and its tributaries are poor sources of granular material.

Morainal deposits mantle the bedrock with shot hole records showing them to be at least 50 feet thick in most places[4]. Throughout the map-sheet

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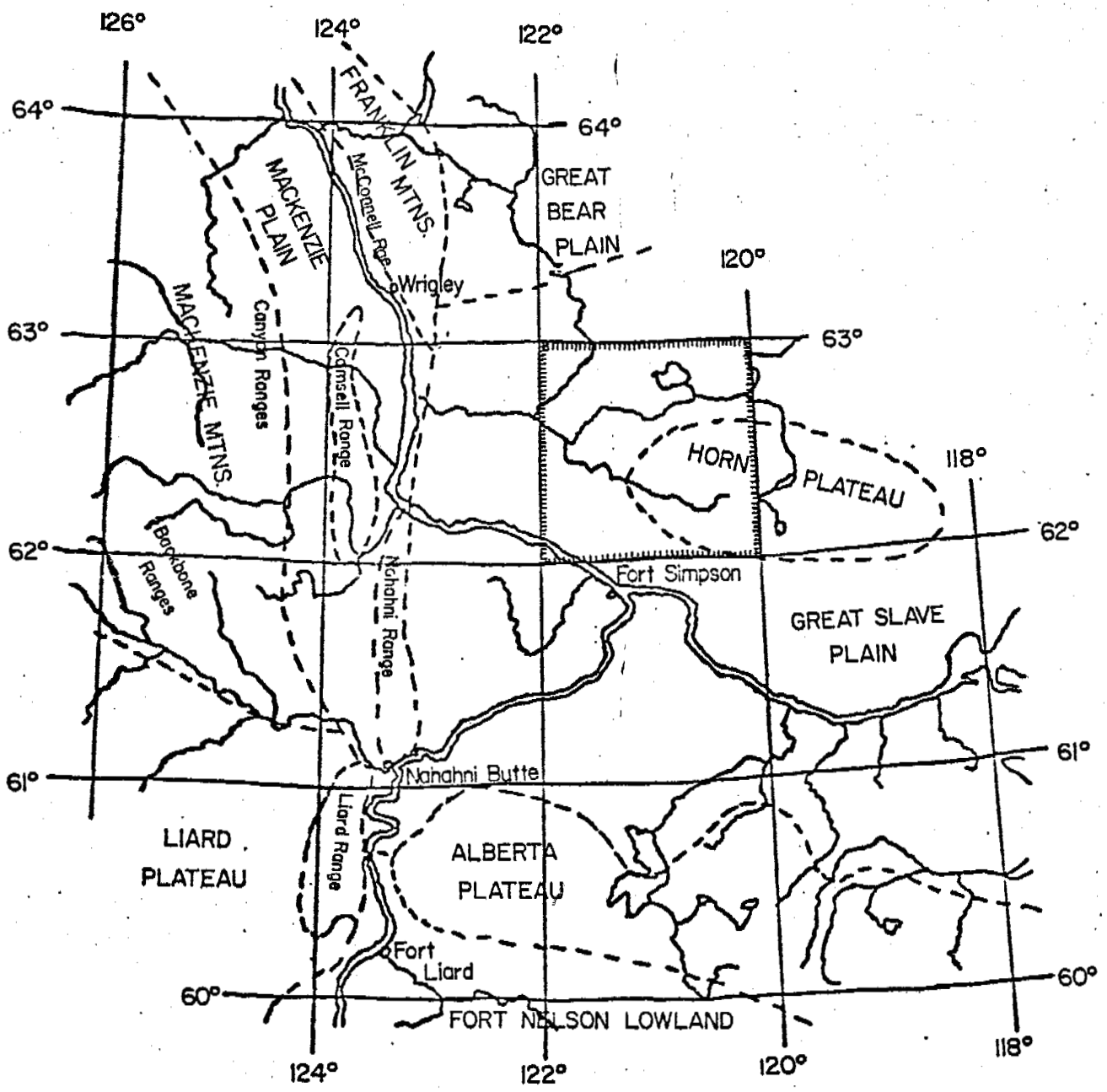
[3] A formation is a bed (of rocks) or assemblage of beds with well-marked upper and lower boundaries that can be traced and mapped over a considerable tract of country (Holmes, 1965).

[4] There might be >50 feet of till over bedrock, but shot holes end at 50 feet even if bedrock is not encountered.



PHYSIOGRAPHIC REGIONS - BULMER LAKE, 951

1 miles 50 Scale

Figure 1

after Bostock 1969

where this ground moraine covers the nearly flat lying Cretaceous and Devonian shales there is usually poor drainage and thick organic deposits. In addition to the ground moraine cover, glacier activity has produced moraine ridges, minor glaciofluvial channel and esker deposits, and glaciolacustrine plain deposits. Rivers and creeks have reworked unconsolidated material into alluvial plain and terrace deposits. Wind activity has caused glaciolacustrine sands to be redeposited into dunes. All of these unconsolidated deposits contain natural granular material.

GEOLOGIC DESCRIPTION OF EXPLOITABLE MAP UNITS

Unconsolidated deposits and bedrock that can supply granular material appear on Figures 2 and 3 respectively.

Figure 2 is adapted from a Geological Survey of Canada surficial geology map. Unconsolidated deposits with good natural granular material are labelled with the appropriate map-unit name and assigned a pattern designation (see Figure 2, 2b). Pattern designations are based on geologic origin and texture of material in the deposit. Where map-unit names are used without pattern designations, the deposit either consists almost entirely of material less than 1/16 mm or has organic material and high water table present throughout 50% of its surface area.

Figure 3 is a Geological Survey of Canada bedrock geology map. Bedrock at or near the surface is indicated by an x. Bedrock formations

preceded by an asterisk (*) in the legend (see legend, Fig. 3) could be crushed to obtain granular material.

Unconsolidated Deposits

Glacial Deposits

Glaciofluvial deposits contain high quality granular material of gravel and sand size. Glaciolacustrine plain deposits consist mainly of silt and sand. Morainal deposits are generally fine material, but ridges may contain some sand and gravel.

Glaciofluvial Deposits (Gp, Gr, Gt, eskers)

Small glaciofluvial deposits scattered throughout the area consist of sand and gravel. They have been indicated by a dot and circle pattern or an esker symbol on the natural granular materials map (see Figure 2).

The capital G in the unit mapped indicates the glaciofluvial origin of the deposit and the lower case prefix denotes the principal types of material, e.g. silt (si), sand (s), and gravel and sand (g). It should be noted that if two prefixes are used, the first refers to the most abundant constituent (see legend for surficial geology maps, Figure 2b).

Topographic expression of the unit is indicated by the suffix attached, e.g. terrace (t), ridge (r), plain (p). Symbols like esker ( ) also show surface form. Glaciofluvial units vary from flat and gently sloping (Gt, Gp) to ridged (Gr, eskers). Thicknesses of glaciofluvial deposits vary from 10 feet for a small esker system to 25 feet for several plain and terrace deposits.

Glaciofluvial deposits are well drained and have little ground ice or organic cover.

Glaciolacustrine Deposits
(Lp, Lp + $\underset{tm}{Gpv}$)

Glaciolacustrine plain deposits consist mainly of sand and silt but may contain buried gravels. A few of these deposits are found adjacent to Willowlake and Mackenzie Rivers. On the natural granular materials map they have been assigned a striped pattern (see Figure 2).

The capital L in each map-unit indicates its glaciolacustrine origin and the lower case prefixes and suffixes give textural and morphologic information respectively.

Glaciolacustrine plain deposits are generally flat (Lp, Lp + $\underset{tm}{Gpv}$). An average thickness of 20 feet was used for volume calculations. Ground ice and organic cover may make exploitation of these deposits difficult.

Morainal Deposits
(Mr, Mp - Gr,)

Morainal deposits are shown by a capital M with appropriate textural and morphologic modifiers. The deposits which have been assigned a broken line pattern on the granular materials map contain some coarse material, i.e. I-5, I-6, but the percentage is low (10%). Also some morainal deposits (Mp, Mpr) without pattern designation consist of well drained, fine grained

till which could be used for fill and might contain coarser material below the surface[5].

Large moraine ridges ( ) have the best potential for providing coarse material. These ridges range from 6 to 30 feet in height and from 90 to 200 feet in width. They are always well drained with little organic cover. Drilling might show them to have gravel at depth even though fine grained till appears at the surface. Estimates of available coarse material are based on 5% of the total volume of each ridge.

Alluvial Deposits
(Ap, At, Ap + At)

Alluvial deposits are composed of sediments deposited by rivers and streams. Only those with significant coarse material have been assigned a pattern on the accompanying natural granular materials map (see Figure 2). All alluvial deposits are mapped as A with textural and morphologic modifiers.

Alluvial deposits form plains (Ap) with little relief along present river and stream channels and terraces (At) above present channels. Alluvial plain deposits vary in thickness from 3 to 10 feet. Alluvial terrace deposits are thicker and range from 20 to 60 feet. Along Willowlake River where it is difficult to separate alluvial plain and terrace units, a combination

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[5] Some gravel and sand appear in shot hole records for Mr and Mp areas in the east-central and west-central parts of the map-sheet. These areas of coarse material are not represented by surface features like individual moraine ridges or eskers.

map unit (Ap + At) is used. A 30 foot thickness is assumed for volume computations within this unit.

Alluvium with economic deposits of gravel and sand are found along Willowlake River and its tributaries and at one locality on the Mackenzie River.

Eolian Deposits
(Er)

A limited amount of eolian material is found along the Mackenzie River. Sandy glaciolacustrine material has been blown by wind into dune ridges. Eolian deposits are mapped as E with appropriate textural and morphologic prefixes and suffixes and are indicated by a dotted pattern on the natural granular materials map.

Sand in eolian deposits is usually well sorted and medium to fine grained. Dune ridges range from 15 to 60 feet in height and contain dry sand. Between dune ridges organic material, ground ice, and high water table are common. Buried gravel layers can be found in the eolian deposits.

Bedrock

Upper Devonian and Cretaceous shales of two geologic formations and Cretaceous sandstone of a third formation underlie the thick glacial deposits in the Bulmer Lake map-area. The shale formations outcrop along Willowlake River and its tributaries where they are indicated on Figure 3 by an x symbol.

Neither of these two formations are competent enough to be considered as a bedrock source for construction materials.

GEOGRAPHIC DISTRIBUTION OF EXPLOITABLE MATERIALS

All natural granular deposits have been assigned an identification number, e.g. I-1, for use in assembling data (Figure 2). Bedrock formations are shown on Figure 3.

Further details on volume estimates of natural granular material and bedrock resources are found in the tabular summary.

Willowlake River and Adjacent Area

Most of the natural granular materials in the Bulmer Lake map-area are found along Willowlake River. Alluvial plain and terrace deposits contain considerable sand and gravel. Terrace areas would be the most desirable to exploit as they are thicker (40 - 60 feet in most cases).

Glaciolacustrine sands and silts are also available along the western portion of the Willowlake River. These deposits sometime contain buried gravels. Organic cover and ground ice may make them hard to exploit.

Sand and gravel can also be obtained from a group of small eskers north of the Willowlake River. Moraine ridges both north and south of the river might also contain coarse material.

Mackenzie River Area

Glaciolacustrine, eolian, and alluvial deposits along the Mackenzie River contain mostly sand and silt. Buried gravel was noted in one river section. Organic cover and ground ice may make fine grained material difficult to exploit.

Miscellaneous Deposits

Scattered morainal and glaciofluvial deposits contain both coarse and fine natural granular material. The natural granular materials map and tabular summary give further details on these deposits.

TABULAR SUMMARY

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes (Million yds.^{3}) Total	Available
I- 1	glaciofluvial sand and gravel	25	0.15	3.70	2.59
I- 2		25	0.35	8.65	6.05
I- 3	glaciofluvial gravel plain	25	0.11	2.71	1.08
I- 4	till plain with some glaciofluvial	60	0.11	6.80	0.68
I- 5	gravel	60	10.11	626.20	62.62
I- 6	gravelly till	20	1.12	24.29	4.85
I- 7	moraine ridges of till, 30 feet				
I- 8	high and 200 feet wide			5.23	0.26
I- 9	moraine ridge of till, 6 feet high and 50 feet wide			0.12	0.006
I-10	moraine ridges of till, 30 feet				
I-11	high and 90 feet wide			4.22	0.21
I-12					
I-13					
I-14					
I-15	glaciolacustrine silt and sand; some	20	0.81	17.52	7.00
I-17	buried gravel, ground ice, and	20	1.55	33.52	13.40
I-18	organic cover	20	7.50	162.22	64.88

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes (Million yds.^{3}) Total	Available
I-16	glaciolacustrine sand; some silt,	20	1.36	29.42	11.76
I-19	buried gravel, ground ice and organic cover	20	3.42	73.97	29.58
I-20	sand dunes, medium to fine sand	33	5.09	173.00	43.25
I-21	gravelly, sandy alluvial plain deposit along Mackenzie River	10	0.70	6.48	0.64
I-26	gravelly alluvial plain deposit along Willowlake River tributary	10	3.92	36.33	3.63
I-23	alluvial terrace and plain deposits;	30	2.25	69.68	13.92
I-24	mostly sand and gravel, minor silt	30	0.46	14.24	2.84
I-25		30	20.26	627.45	125.48
I-29	alluvial terrace of silt, sand, gravel	40	0.31	12.48	2.49
I-30	alluvial plain deposit of silt, sand, and gravel	10	0.35	3.24	0.32
I-31	glaciofluvial terrace of sand	30	0.39	12.07	4.82

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes (Million yds.^{3}) Total	Available
I-32	silty alluvial plain deposit	40	0.54	21.74	4.34
I-33	glaciolacustrine sand plain; some ground ice and organic cover	60	10.69	662.14	99.32
*I-34					
	No competent bedrock units				
				TOTAL	506.01

Total Granular Resource Estimate - 506.01 million cubic yds.

*I-34	esker ridges of sand and gravel	0.040 0.080	0.032 0.064

[These eskers included in Camsell Bend Report (J-30A, J-71)]

Appendix A

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