Granular Resources Inventory
- Southern Mackenzie Valley -
Camsell Bend - 95 J

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GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF ENERGY, MINES AND RESOURCES

GRANULAR RESOURCE INVENTORY -
SOUTHERN MACKENZIE VALLEY
CAMSELL BEND (95J)
1:125,000

Gretchen V. Minning
J. A. Rennie
J. L. Domansky
A. N. Sartorelli
Terrain Sciences Division
Geological Survey of Canada
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SUMMARY

In the Camsell Bend map-area, sources of granular material are concentrated north of Willowlake River and west of the Mackenzie River. Both unconsolidated deposits with granular material and competent rippable bedrock are rare from Willowlake River to the southern edge of the map-sheet.

Unconsolidated deposits with considerable sand and gravel are primarily of glaciofluvial origin. Most of these deposits are located north of Willowlake River and along the west bank of the Mackenzie and eastern edge of the North Nahanni Rivers.

Secondary sources of natural granular material include scattered glaciofluvial and alluvial deposits in the mountainous western third of the map-sheet, glaciolacustrine sands and silts with minor gravel near the Mackenzie River, and minor morainal and eolian deposits.

Mackenzie River alluvial terraces sometimes contain gravel and sand-size material, but alluvial plain deposits are mostly made of silt and clay.

Bedrock that can be crushed to provide granular material includes limestone and dolomite of eight formations which occur in the McConnell Range and Willow Ridge, in the Camsell Range and the Ram Plateau, and in the Nahanni Range.

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

[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., Minning G.V., and Netterville, J.A., 1972) provided data on location and areal extent of unconsolidated deposits containing good granular material. This map is indexed as GSC Open File 93 and may be viewed at the Geological Survey of Canada offices in Ottawa, Calgary and Vancouver. Copies may be obtained at a nominal cost from Riley's DataShare 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 61-13. Map 22-1961, 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

The eastern two-thirds of the Camsell Bend map-area lies within the Great Slave Plain physiographic region. Parts of the Mackenzie Plain, the Camsell Range, the Nahanni Range, and the McConnell Range fall in the western third of the map-sheet (see location map, Figure 1).

Bedrock geology was mapped by the Geological Survey on Operation Mackenzie in 1957 (Douglas, R.J.W., and Norris, D.K., 1961). A reconnaissance surficial geology investigation was undertaken by B. G. Craig as part of this operation (Craig, 1965). A detailed surficial geology map based on air photo interpretation and field investigations was compiled by the Geological Survey in 1971 (Rutter, N.W., Minning, G.V., and Netterville, J.A., 1972).

Bedrock formations [3] are primarily shales, limestones, and dolomites with minor siltstones and sandstones. Most of these formations are Devonian or Cretaceous in age.

The Upper Devonian and Cretaceous shales which occur in the lowlands east and west of the Mackenzie River are poor sources of ganular material.

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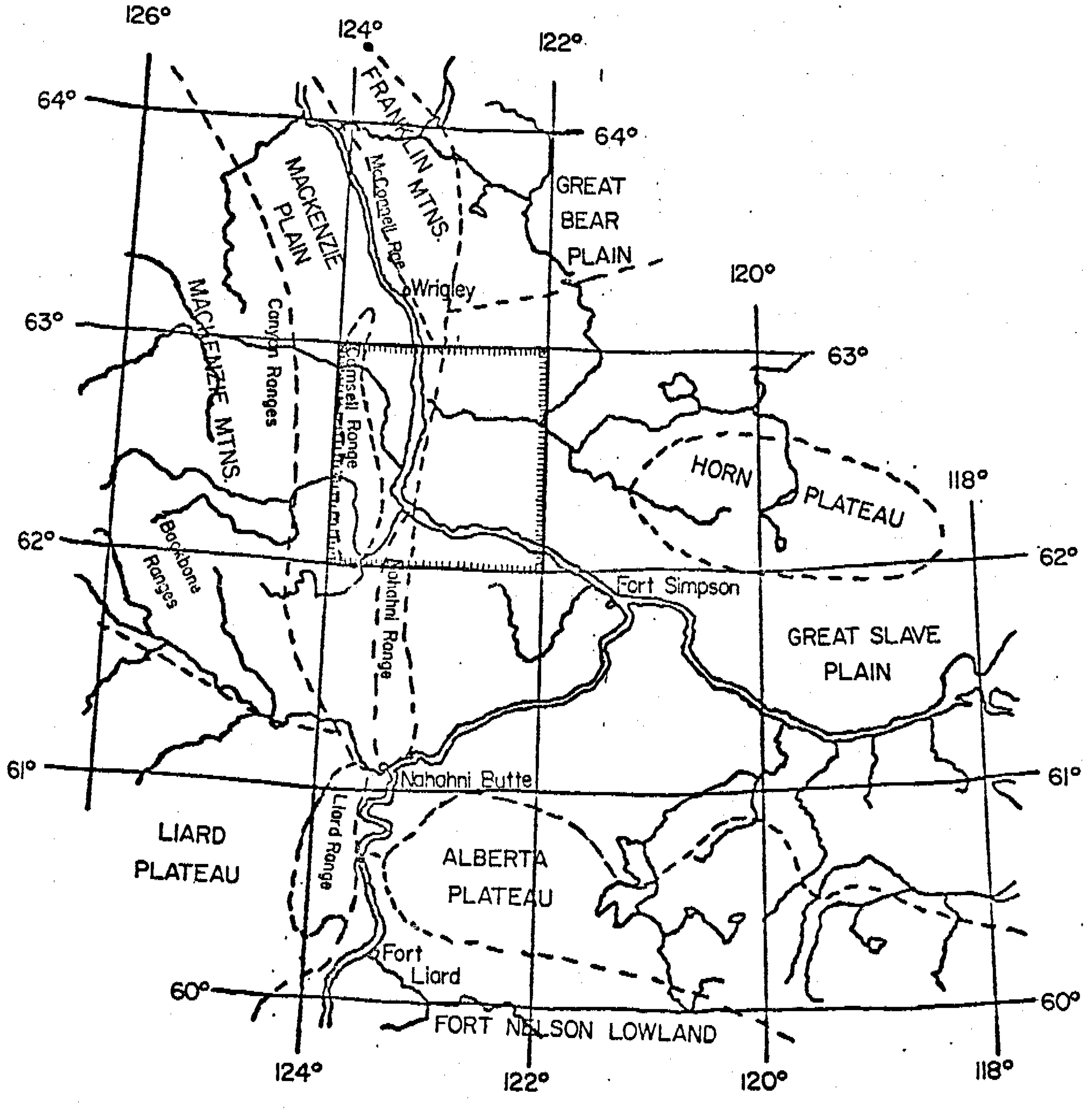
[3] A formation is a bed (of rocks) or assemblage of beds with well-marked upper and lower boundaries that can be traced and mapped over a considerable tract of country.



PHYSIOGRAPHIC REGIONS — CAMSELL BEND, 95J

miles 50 Scale

Figure 1

after Bostock 1969

Competent limestones and dolomites, good for construction materials, are found at or near the surface in the McConnell Range and Willow Ridge, in the Camsell Range and Ram Plateau, and in the Nahanni Range.

Morainal deposits mantle the bedrock throughout the map-area. In addition to this ground moraine cover, glacier activity has produced glaciofluvial plain, terrace, and esker deposits, and glaciolacustrine plain deposits. Rivers have reworked unconsolidated material into alluvial plain and terrace deposits and slope wash has created alluvial fans at the base of bedrock ridges. 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.

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 Figures 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 $<$ 1/16 mm, or has organic material and high water table 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 solid lines or an x. Bedrock formations preceded by an asterisk (*) could be crushed to obtain granular material (see legend, Figure 3).

Unconsolidated Deposits

Glacial Deposits

The best granular material, both coarse and fine, comes chiefly from glaciofluvial outwash. Glaciolacustrine deposits are a good source of fine material and may even contain scattered lenses of gravel. Till of morainal deposits is usually composed of fine material, but in some localities has a high percentage of gravel and coarse sand.

Glaciofluvial Deposits
(Gp, Gpc, $\frac{Gpv}{tm}$, Gt, Gtc, Gh,
Ghp, Ght, Gr, Gtr, Gp + Lp,
Gt + Lp, Gp + Ap, esker)

Glaciofluvial deposits in the Camsell Bend area are composed of good quality sand and gravel. These deposits are extensive north of Willowlake River and along the Mackenzie and North Nahanni Rivers near Camsell Bend and have been indicated by several types of dot and circle patterns 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 type(s) of material, e.g. silt (si), sand (s), gravel and/or sand (g), till (t). It should be noted that if two letters are used the first refers to the most abundant constituent (see legend for surficial geology maps, Figure 2b).

Topographic expression of a unit is indicated by a suffix, e.g. plain (p), terrace (t), ridge (r), hummocky (h), veneer (pv). Certain symbols, such as $\overset{\vee}{\underset{\vee}{\vee}}$ (esker), also show surface features.

Glaciofluvial units vary from flat and gently sloping (Gp, Gt, $\frac{\text{Gpv}}{\text{tm}}$, Gp + Lp, Gpc) to hummocky and ridged [Gh, Ghp, Ght, Gr, Gtr, $\overset{\vee}{\underset{\vee}{\vee}}$ (eskers)]. Thicknesses vary from 15 to 150 feet with thicker deposits occupying mountain valleys. Where no information on thicknesses was available, an average value of 50 feet was used to estimate volumes of glaciofluvial deposits.

Esker ridges ($\overset{\vee}{\underset{\vee}{\vee}}$) are sinuous, ridged deposits formed by rivers beneath glacial ice. These ridges usually consist of clean and fairly well sorted sand and gravel[4]. Eskers in the Camsell Bend area vary in height from 30 to 100 feet, and in width from 50 to 100 feet.

Ground ice (thermokarst-k) and organic deposits (pO, fO) may make exploitation of certain glaciofluvial deposits difficult. Deposits affected are described in the section on geographic distribution of exploitable materials and in the tabular summary.

Glaciolacustrine Deposits
(Lp, $\frac{\text{Lpv}}{\text{tm}}$, Lp + Gp, Lp + Ap)

Glaciolacustrine deposits in the Camsell Bend area consist of sand, silt, and clay. Occasionally they contain lenses of gravel. On the natural granular materials map glaciolacustrine deposits have been assigned one of several striped patterns (see Figure 2).

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[4] Sometimes areas with esker complexes may have some "esker-like" ridges of till i.e., J-61.

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

Glaciolacustrine deposits are generally flat or gently sloping. They sometimes have a discontinuous organic cover. Ground ice may be present, especially in units with much peat.

Glaciolacustrine deposits range in thickness from 5 feet[5] ($\frac{\underline{\text{Lpv}}}{\text{tm}}$ unit north of the Mackenzie) to 240 feet (Lp units in the mountains), but are generally between 15 and 40 feet thick. An average figure of 23 feet was used in computations when exact thicknesses were unknown. Glaciolacustrine deposits are extensive but are not the best source of granular material because they usually lack gravel and often contain ground ice in the top 15 feet. Deposits mapped as Lp + Gp (e.g. S. side of Mackenzie River) are probably best for exploitation because they may contain glaciofluvial gravel lenses.

Morainal Deposits
(Md, Mr,)

Morainal deposits generally do not contain sufficient gravel to be classified as a source of granular material. On the Camsell Bend map-sheet moraine ridges [(Mr),], and one area of ground moraine (g, tMd) contain gravel in addition to till. Morainal deposits have been mapped as M with

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[5] Glaciolacustrine veneer deposits ($\frac{\underline{\text{Lpv}}}{\text{tm}}$) are indicated by map-unit names. They have not been assigned a pattern designation nor included in the tabular summary because they are too thin to exploit economically.

descriptive prefixes and suffixes. They have been assigned a broken line pattern on the natural granular materials map (see Figure 2).

The large moraine ridges () are approximately 60 feet in height. Percentages of available material in the morainal deposits are generally low because of the high content of silt and clay.

Ice content and organic cover in morainal areas are variable and are controlled largely by topography. Ridged areas are the best drained and hence have less organic cover and ground ice.

Alluvial Deposits
(Ap, At, Af, Afx, $\frac{\text{Apv}}{\text{gGp}}$)

Alluvial deposits consist of silt, sand, and gravel-sized material. Only those with sand and/or gravel have been assigned a pattern designation on the accompanying natural granular materials maps (see Figure 2). All alluvial deposits are mapped as A with textural and morphologic prefixes and suffixes. The alluvial deposits with enough gravel-sized material to be economically exploitable generally occur along braided streams and bedrock ridges in the western half of the map-area. Certain Mackenzie River alluvial terrace deposits also contain significant amounts of coarse sand, but most alluvial deposits along the Mackenzie are made of silt and clay.

Alluvial deposits generally form plains with little relief along present river and stream channels, terraces (flat surfaces) above present channels, and fans (sloping surfaces) at the base of mountain slopes.

Alluvial plain deposits are 3 to 15 feet thick and an average figure of 8 feet was used in volumetric calculations. The terrace deposits are thicker and range from 3 to 85 feet. A figure of 40 feet was used for most calculations.

Alluvial terrace deposits may contain glaciofluvial gravel at depth, but exploitation requires removal of thick, fine-grained surface material. Terrace deposits often have high ground ice content and are covered in many places by organic material.

Alluvial fan deposits are highly variable in textures and thicknesses. Thicknesses range from 15 to 150 feet with a 25 foot average used in volumetric estimates. Fan deposits are located adjacent to bedrock ridges in this map-sheet.

Eolian Deposits
(Er)

Eolian deposits are limited in extent in the Camsell Bend map-area. They have been mapped as E with appropriate textural and morphologic prefixes and suffixes. On the natural granular materials map they have been assigned a fine-dotted pattern (see Figure 2). Eolian deposits occur as dune ridges (Er) with intervening flat areas and are generally a source of sand with little or no gravel. The dune ridges are generally 15 to 60 feet high. The area between the ridges sometimes contains organic material, ground ice or ponds, but sand in the ridges is dry and usable.

Bedrock

Devonian limestone and dolomite from eight geologic formations can be used to supply granular material. Outcrop areas of these formations are indicated on Figure 3 with solid lines or an x symbol. All of the formations occur at or near the surface in the McConnell Range and Willow Ridge, the Cansell Range, the Ram Plateau, and the Nahanni Range.

The eastern two-thirds of the map-area is underlain by Devonian and Cretaceous shales, siltstones, and mudstones which are not good for construction materials. These soft incompetent rocks also outcrop in valleys between mountain ranges in the western part of the map-sheet.

High Quality Bedrock for Construction Materials

Bedrock formations are described in order of their suitability for construction materials.

The Nahanni Formation, unit 17, is a Middle Devonian limestone. Rock of this formation is fairly competent and weathers and breaks into blocks three feet square and larger. A few shaly, less competent beds are present. The Nahanni Formation is approximately 300 feet thick in the northern part of the map-sheet and is fairly widespread in all the mountain ranges.

The Arnica Formation, unit 11, is a Middle Devonian dolomite. It is thick (1,340 feet just north of the map-sheet) and consists of competent rock suitable for construction materials. Outcrops are abundant in mountain ranges, especially the Nahanni Range, the Camsell Range, and the Ram Plateau.

The Middle Devonian Manetoe Formation, unit 12, is stratigraphically above the Arnica and is generally about 175 feet thick. It is a competent dolomite that is highly fractured and cut by calcite and dolomite veins. Rock of this formation breaks into slabs and blocks of tough material upon weathering. The Manetoe, which is not widespread is most abundant in the Camsell Range.

Unit 9, a Devonián dolomite, . occurs almost exclusively in the Nahanni Range. It is a silty dolomite with sandstone interbeds, and varies in thickness from 300 to 900 feet. When accessible it is a good source of competent rock.

Unit 8, the Devonian dolomite which underlies unit 9, is a strong formation. The rock of this formation can be porous and vuggy, but it nevertheless is suitable for construction materials.

The Devonian Mt. Kindle Formation, unit 7, is found only in the McConnell Range. It could supply good construction material because it is composed of strong, somewhat cherty dolomite. North of the Camsell Bend map-area the formation is 900 feet thick.

Secondary Bedrock Sources for Construction Materials

Two formations, units 14 and 22, can be used as sources of rippable bedrock. Their outcrop pattern and lithology, however, make them less desirable than the six units mentioned above.

The Middle Devonian Bear Rock Formation, unit 14, is a limestone breccia. It occurs only in the McConnell Range and Willow Ridge. Part of the formation breaks into blocks and part crumbles into smaller fragments.

The tougher material is sometimes suitable for construction purposes. The formation is 1,100 feet thick in the Wrigley area, but it is poorly exposed in the Camsell Bend map-sheet.

The Upper Devonian silty, sandy limestone of unit 22 is not a recommended source for granular material because of its shale interbeds. Also throughout the Camsell Bend area it is mantled by glacial deposits of variable thicknesses with outcrops limited. It is closest to the surface in the north-western quarter of the map-area and may be used where exposed.

GEOGRAPHIC DISTRIBUTION OF EXPLOITABLE MATERIALS

All natural granular deposits have been assigned an identification number, i.e. J-1, for use in assembling data. Roman numerals I to VIII and geographic names designate groups of natural granular deposits discussed in this report. The lowest Roman numeral applies to the best area of natural granular deposits (see Figure 2). The same system of Roman numerals and geographic names has been used to assemble bedrock information for different localities on the map-sheet (see Figure 3).

Further details on volumetric estimates of natural granular material and types of bedrock available in each Roman numeral area are found in the tabular summary of this report.

I. Willowlake River Complex

This area in the north-central part of the map-sheet has good potential sources of granular material. Unconsolidated deposits are basically glaciofluvial outwash sand and gravel, but some morainal, lacustrine, and alluvial material is also present. Competent limestone and dolomite of three formations could also be crushed to obtain granular material.

Volumes of glaciofluvial plain and hummocky deposits have been calculated using 15 or 20 foot thicknesses. These deposits are probably 60 - 70% coarse sand and gravel and estimates of available material in the tabular summary are based on these percentages. The fifteen miles of eskers both inside and outside outwash plain deposits have 80% available sand and gravel. Volume of material in the eskers is calculated by esker, except where exact dimensions are unknown. In these cases an average height of 65 feet and an average width of 75 feet were used.

The volume of gravelly ground moraine was obtained by using a 60 foot thickness. Shot holes and river sections show at least this much unconsolidated material over bedrock. However, a low percentage (2%) of coarse granular material is available from the total volume.

Thicknesses of 7 and 20 feet (observed in river sections) were used to compute volumes of sandy material in the glaciolacustrine deposits at the mouth of Willowlake River and River Between Two Mountains.

Alluvial plain deposits with both sand and gravel are found along Willowlake River. They are approximately 40 feet thick.

All of the unconsolidated deposits included in the Willowlake River Complex are well drained and have minor organic cover.

Limestone of the Nahanni Formation (unit 17) and dolomite of the Mt. Kindle Formation which occur in the McConnell Range and Willow Ridge are good competent rock units. Colluvial material of these two formations and the less desirable, unevenly weathering limestone breccia of the Bear Rock Formation, unit 14, can be used for granular material. Also these formations can be crushed mechanically to obtain granular material.

II. Camsell Bend Outwash

The second most important area for granular material lies west of the Mackenzie and North Nahanni Rivers. Unconsolidated deposits consist primarily of glaciofluvial sand and gravel. Alluvial plain and terrace deposits along the Root River and west side of the North Nahanni contain coarse material. A limited amount of granular material could be obtained from alluvial fans adjacent to bedrock ridges. Competent limestone and dolomite of four formations could also be crushed to provide granular material.

The relative percentages of gravel and sand in the glaciofluvial deposits are unknown but the amount of ground ice and organic cover suggests that sand is more abundant. Thicknesses of glaciofluvial deposits vary from 30 to 75 feet. Ground ice and organic cover may make them have a fairly low yield of good granular material.

Alluvial plain deposits along braided streams and floodplains vary in thicknesses and an average of 8 feet was assumed for volumetric computations while alluvial terrace deposits are thicker and range from 40 to 80 feet. An average thickness of 25 feet was used to calculate volume of material available in alluvial fan deposits.

Limestone of the Nahanni Formation (unit 17) and dolomite of the Manetoe and Arnica Formations in the Camsell Range and could supply crushable bedrock. Limestone of unit 22 is also available at one locality along the north side of the Root River.

III. South Shore Mackenzie River Complex

Although this area contains numerous unconsolidated deposits indicated by patterns on the natural granular materials map, there is relatively little coarse material available at the surface.

Some gravel and sand is found in glaciofluvial outwash deposits along the east side of the North Nahanni River and in alluvial plain, terrace and fan deposits in the same general area. Thicknesses of these deposits vary and are indicated in the tabular summary. Coarse material has also been reported in 6 foot high moraine ridges ( ) but the volume is negligible and has not been included on the tables.

Glaciolacustrine and alluvial deposits near the Mackenzie River consist mostly of sand and silt. Organic cover and ground ice would probably make exploitation of this material difficult. Some of these deposits may have glaciofluvial gravels at depth, but to use this gravel the deposits would have to be excavated from an adjacent alluvial terrace. A gravel pit near Fort Simpson operates on this principle.

Competent limestone and dolomite of six formations in and near the Nahanni Range could be crushed to obtain granular material. The Nahanni limestone (unit 17), Manetoe and Arnica dolomites (units 12 and 11) and two unnamed dolomite formations, units 8 and 9, are all good sources of crushable rock. Limestone of unit 22 is also listed here as a fair source, but it is covered by glacial drift in most places.

IV. North Shore Mackenzie River Complex

Coarse granular material in this area is limited to lenses of glacio-fluvial gravel in glaciolacustrine and alluvial deposits, and to one gravelly moraine ridge. Sand can be obtained from glaciolacustrine, alluvial, and eolian deposits, although ground ice and organic deposits may affect exploitation of these sands. No good competent bedrock units are exposed in the area. Several outcrops of unit 22 have been indicated, but they are too limited to exploit.

V. Root River Complex

Coarse granular material is abundant in scattered glaciofluvial and alluvial deposits. Bedrock of four formations also could be used for granular material. The glaciofluvial deposits vary in thickness from 25 to 80 feet.

Alluvial plain deposits have been calculated using an 8 foot thickness and alluvial fan complexes are estimated to be 25 feet thick.

Competent limestone of the Nahanni Formation (unit 17), dolomite of the Arnica (unit 11), dolomite of the Manetoe (unit 12), and limestone of unit 22 are available for granular materials.

VI. Southern Camsell Range Complex

This area is similar to area V. Abundant coarse material is available in glaciofluvial and alluvial deposits along Carlson Creek and the North Nahanni River. Bedrock of three formations (units 17, 11, 12) in the Camsell Range and Ram Plateau could also supply granular material.

VII. Willowlake River East Complex

This area contains scattered eskers with coarse granular material and one sandy glaciolacustrine plain deposit. No bedrock is available for granular material.

VIII. Mackenzie River Deposits

This group of deposits includes all the gravelly and sandy glaciofluvial and alluvial deposits found as islands along the present channel of the Mackenzie River. Islands of silt and clay are not indicated with a pattern on the granular materials map. No bedrock is available.

TABULAR SUMMARY

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes Total	(Million yds.^{3}) Available
	I. Willowlake River Complex				
J- 58	mainly glaciofluvial plain,	20	10.46	227.01	181.60
J- 59	locally hummocky and	20	0.85	18.55	12.98
J- 60	channelled. Sand and gravel,	15	7.39	114.55	74.45
J- 61	some till	15	9.53	147.70	118.16
J- 62		15	1.55	24.13	16.87
J- 63		15	4.86	75.38	60.28
J- 64		15	8.94	138.65	110.92
Eskers in J- 58 to 64	ridges of gravel and sand (one ridge in J-61 is made of till)			0.36	12.33
J- 65 J- 66 J- 68 J- 69	esker ridges of sand and gravel			0.11	0.59
J-184	gravelly drumlinoid ground moraine	60	20.81	1290.00	25.80
J- 13	sandy, silty glaciolacustrine	20	1.86	40.53	8.10
J- 14	plain	7	4.74	29.42	5.88
J-159	gravelly sandy alluvial plain,	40	0.58	23.53	4.70
J-160	some organic, along Willowlake	40	0.27	10.92	2.18
J-161	River channel	40	0.93	37.57	7.51
	Bedrock - limestone of Unit 17 (good), dolomite of Unit 7 (good), limestone breccia of Unit 14 (fair)				
				I TOTAL	642.35

	Description & Material	(ft.)	(sq. mi.)	Total	Available
	II. Camsell Bend Outwash				
J- 30	glaciofluvial plain and terrace	30	5.01	155.50	63.75
J- 46	deposits, mostly sand with some	30	1.82	56.70	14.17
J- 47	gravel channelled in places,	75	1.24	96.50	28.95
J- 48	also some glaciolacustrine sand	75	1.05	81.50	24.45
J- 49	and silt, minor organic deposits	75	9.53	738.50	221.55
J- 50		75	2.21	171.75	51.52
J- 51		75	0.58	45.25	13.57
J- 52		75	0.46	36.25	5.43
J- 31	gravelly, silty glaciofluvial plain +	30	40.14	1244.20	311.05
J- 53	sandy silty glaciolacustrine plain;	50	12.75	672.18	134.43
	some organic and ground ice				
J-142		80	24.15	2021.49	1455.46
J-149	gravel, minor silt in alluvial	40	1.47	59.54	8.93
J-150	plain and terrace deposits of	8	1.28	11.94	8.35
J-151	braided streams and floodplains	8	3.73	34.71	24.29
J-152		8	1.82	17.01	11.90
J-153		8	1.43	13.38	9.36
J-141	silt, sand, gravel in alluvial fan	25	0.54	13.52	6.76
J-148	deposits near bedrock ridges	25	0.81	20.24	10.12

Bedrock - limestone of Unit 17 (good), dolomite of Unit 12 (good), dolomite of Unit 11 (good), limestone of Unit 22 (fair)

II TOTAL 2404.04

	Description & Material	(ft.)	(sq. mi.)	Total	Available
	III. South Shore Mackenzie Complex				
J- 24	gravel and sand in glaciofluvial and	15	3.81	59.05	14.76
J- 25	alluvial terrace deposits, also some	30	1.05	32.60	14.67
J- 26	glaciolacustrine sand, minor ground	30	6.49	201.30	84.54
J- 27	ice and organic cover	30	4.55	141.10	59.22
J- 28		30	1.59	49.40	20.74
J- 29		150	2.13	331.50	135.91
J- 8	glaciolacustrine medium to fine sand,	15	14.97	233.10	93.84
J- 9	may contain ground ice	30	0.77	24.10	7.23
J- 19		12	18.82	233.40	74.68
J- 20		12	49.86	618.24	197.83
J- 75	sand and gravel (at depth) in alluvial	40	7.78	313.43	62.68
J- 76	terrace deposits along Mackenzie River	40	2.68	108.16	16.22
J-166	sand, gravel and silt in alluvial terraces	40	4.66	188.24	18.82
J-167	along Mackenzie R.; high ground ice and organic content	40	7.42	299.39	29.94
J-140	N. Nahanni gravelly alluvial deposits of	8	2.41	22.41	15.68
J-145	floodplain and braided stream	80	1.47	123.66	89.03
J-147		80	3.81	318.87	229.57
J-174	gravelly alluvial plain along small stream	8	4.47	41.58	14.55
J-144	mixed sand, gravel and silt of alluvial	25	1.05	26.08	13.04
J-146	fan complexes (fairly steep slope) coming from N. Nahanni bedrock	25	0.89	22.16	11.08

Bedrock - limestone of unit 17 (good)
dolomite of unit 12 (good)
dolomite of unit 11 (good)
dolomite of unit 9 (good)
dolomite of unit 8 (good)
limestone of unit 22 (fair)

III. TOTAL 1204.03

	Description & Material	(ft.)	(sq. mi.)	Total	Available
	IV. North Shore Mackenzie River Complex				
J- 21	glaciolacustrine sand and silt, some glacio-	12	2.95	36.16	11.56
J- 22	fluvial sand and gravel. Ground ice and	35	6.02	224.28	89.71
J- 23	organic cover, tendency to slump	15	13.38	207.35	43.54
J-186	gravelly moraine ridge deposits	60	3.46	214.60	107.30
J- 2	glaciolacustrine plain deposit; very fine	55	1.55	86.76	19.08
J- 3	sand and silt	20	1.78	38.85	15.54
J- 4		15	3.22	50.35	20.14
J- 5		15	0.58	9.05	3.62
J- 6		15	0.27	4.20	1.68
J- 10		15	4.43	68.70	-
J- 7	glaciolacustrine (plain deposit), very fine sand and silt; varies from veneer to 15' thick	15	54.14	839.10	335.64
J- 87	sandy, silty alluvial terrace deposits,	40	2.83	114.40	22.88
J- 92	some gravel and organic material	40	10.19	410.67	86.23
J-163	Eolian deposits, mostly sand ridges of	33	13.34	454.85	90.97
J-164	fine to medium sand	33	1.01	34.43	8.60
J-165		33	0.42	14.63	3.65

Bedrock - None

IV. TOTAL 860.14

	Description & Material	(ft.)	(sq. mi.)	Total	Available
	V. Root River Complex				
J- 32	glaciofluvial plain deposits composed of	30	4.34	43.40	17.79
J- 33	sand and gravel, some colluvial material	45	7.97	370.65	151.96
J- 34	from bedrock ridges, minor organic and	25	2.87	71.36	28.54
J- 56	ground ice	80	5.25	439.56	219.78
J- 57		80	1.51	126.90	63.45
J-116	gravel and sand in alluvial terrace	40	2.21	89.31	17.86
J-106	gravelly alluvial plain deposits of	8	6.69	62.22	43.55
J-108	braided streams	8	8.16	75.96	53.17
J-111		8	10.50	97.65	68.35
J-157		8	1.90	17.73	12.41
J-104*	gravel, silt, and sand in alluvial fan	-	-	-	-
J-107	deposits, slope may affect use	25	1.43	35.68	17.84
J-110	(*Note J-104 mostly silt,	25	1.24	30.88	15.44
J-115	J-114 may be mapped incorrectly so	25	0.73	18.32	9.16
J-109	volumes not calculated)	25	3.37	83.90	41.94
J- 74A		25	3.38	83.92	41.96
J-112		25	.31	76.80	38.40
J-113		25	1.12	28.00	14.00
J-114*		8	.54	-	-
J-154		25	.11	2.88	1.44
J-155		25	.11	2.88	1.44

Bedrock - limestone of unit 17 (good)
dolomite of unit 12 (good)
dolomite of unit 11 (good)
limestone of unit 22 (fair)

V. TOTAL 858.48

	Description & Material	(ft.)	(sq. mi.)	Total	Available
	VI. Southern Camsell Range Complex				
J- 35	glaciofluvial terrace and plain deposits	40	1.75	70.49	35.24
J- 36	of sand and gravel, minor ground ice	40	4.62	186.55	46.63
J- 37		40	3.03	122.20	48.88
J- 38		40	1.08	43.94	21.97
J- 39		175	2.17	391.50	195.75
J- 40		175	2.83	510.40	255.20
J- 41		175	.66	118.90	59.45
J- 42		175	.31	55.68	27.84
J- 43		80	1.28	107.46	53.73
J- 44		80	.54	45.63	22.81
J- 45		80	.38	32.53	16.26
J-171	sandy, silty, glaciofluvial plain deposits, thick organic cover	40	2.95	119.08	39.81
J-117	gravel, sand, silt in alluvial fan	25	0.11	2.88	1.44
J-118	deposits adjacent to bedrock ridges	25	0.46	11.60	5.80
J-119		25	1.59	31.52	15.76
J-120		25	0.38	9.68	4.84
J-122		25	0.35	8.72	4.36
J-123		25	0.31	7.68	3.84
J-124		25	0.89	22.16	11.08
J-125		25	1.06	27.04	13.52
J-126		25	1.43	35.68	17.84
J-128		25	0.70	17.36	8.68
J-129		25	0.23	5.76	2.88
J-130		25	0.42	10.64	5.32
J-133		25	1.01	25.04	12.52
J-133A		25	0.70	17.36	8.68

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volume Total	[illegible] Available
J-135		25	0.89	22.16	11.08
J-135A		25	0.54	13.52	6.76
J-137		25	1.05	26.08	13.04
J-138		25	0.73	18.32	9.16
J-121		25	0.81	20.24	10.12
J-127		40	0.50	20.41	4.08
J-131	gravelly alluvial plain deposits of braided streams	8	5.95	55.35	38.74
J-132		8	6.49	60.39	42.27
J-134		8	3.03	28.20	19.74
J-136		8	0.70	6.51	4.55
J-139		8	3.22	30.03	21.02

Bedrock – limestone of unit 17 (good)
dolomite of unit 12 (good)
dolomite of unit 11 (good)

VI TOTAL 1120.69

VII. Willowlake River East Complex

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volume Total	Available
J- 66A	Eskers (ridges of gravel and sand)			.040	.032
J- 70A				.040	.032
J- 71				.080	.064
J- 72				.080	.064
J- 17	sandy, silty glaciolacustrine, plain deposits	15	5.05	78.32	15.66

Bedrock – None

VII TOTAL 15.85

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes Total	(Million yds.^{3}) Available
	VIII. Mackenzie River Deposits				
J- 54	glaciofluvial sand and gravel deposits	15	3.03	47.00	18.80
J- 55	on islands in the Mackenzie River	15	6.53	101.25	40.50
J-183		3	0.97	3.01	0.03
J- 96	sand and silt alluvial terrace deposits	40	0.50	20.41	3.06
J- 97	on islands in the Mackenzie River,	40	4.08	164.58	24.68
J- 98	some ground ice (possible gravel)	40	1.16	46.99	7.05
J-101		40	1.16	46.99	7.05
J-100		10	1.08	10.18	1.01
J- 99	gravelly alluvial plain deposit	40	0.58	23.53	4.70
	Bedrock - None				
				VIII. TOTAL	106.88
	Miscellaneous Deposits				
J- 67	eskers - ridges of sand and gravel at			.020	.016
J- 70	scattered localities			.020	.016
J- 73				.040	.032
				MISC. TOTAL	.064

Total sand and gravel resources for the Camsell Bend map sheet = 7212.52 million yds.^{3}

Appendix A

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