GRANULAR RESOURCE INVENTORY
SOUTHERN MACKENZIE VALLEY

DAHADINNI RIVER, 95 N

GEOLOGICAL SURVEY OF CANADA

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DEPARTMENT OF ENERGY, MINES AND RESOURCES

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SOUTHERN MACKENZIE VALLEY
DAHADINNI RIVER (95N)
1:125,000

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SUMMARY

In the Dahadinni River map-area, sources of granular material are plentiful and widely scattered. Good quality natural granular material is available primarily in alluvial deposits. Glaciofluvial, glaciolacustrine, morainal, and colluvial deposits also contain some coarse material. Competent crushable bedrock is exposed on Rouge, Redstone, Dusky, Dahadinni, and Iverson Ranges and in the Painted Mountains.

Alluvial plain and terrace deposits of the Redstone, Dahadinni, and Johnson Rivers, and some smaller creeks contain gravel, sand, and silt. Organic cover, poor drainage, and ground ice may make some of the fine-grained alluvial deposits difficult to exploit. Alluvial fan deposits adjacent to bedrock ridges often consist of coarse material which could be utilized for construction purposes when slope angles are low.

Glaciofluvial terrace and ridge deposits along the Mackenzie and Redstone Rivers consist almost entirely of gravel and sand. These deposits are generally unfrozen and well drained with little organic cover.

Glaciolacustrine and morainal deposits contain fine material with minor sand and gravel. Glaciolacustrine silt deposits have high ground ice content and are often poorly drained. Till of morainal deposits is usually fine grained with ridged deposits having a higher percentage of gravel-sized material.

Colluvial deposits contain both rock fragments and unconsolidated material. These deposits are commonly found adjacent to bedrock ridges and in river valleys. Only deposits with stable slopes could be exploited for construction materials.

Bedrock that can be crushed to obtain granular material occurs in the Mackenzie Mountains which occupy the western two-thirds of the map-area. Bedrock resources include limestone, dolomite, and sandstone of twelve geologic formations.

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 62-33. Map 44-1962, 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 third of the map-area lies within the Mackenzie Plain physiographic region. The Painted Mountains, and Rouge, Redstone, Dusky, Dahadinni, and Iverson Ranges of the Mackenzie Mountains are represented in the western two-thirds of the map-sheet (see location map, Figure 1).

Bedrock geology was mapped by the Geological Survey on Operation Mackenzie in 1957 (Douglas and Norris, 1963). A reconnaissance surficial geology investigation was undertaken by B. G. Craig as part of this operation (Douglas and Norris, 1963; Craig, 1965). A detailed surficial geology map based on airphoto interpretation and field investigations is being compiled by the Geological Survey in 1972-73 (Rutter, N. W., and Boydell, A. N., in press).

Bedrock formations[3] are basically Mesozoic (Cretaceous shales and sandstones) and Paleozoic (Devonian, Ordovician, and Silurian dolomites, limestones, and shales).

The shales which generally occur in the Mackenzie Plain and in lower areas between Mackenzie Mountain ranges are poor sources of granular material.

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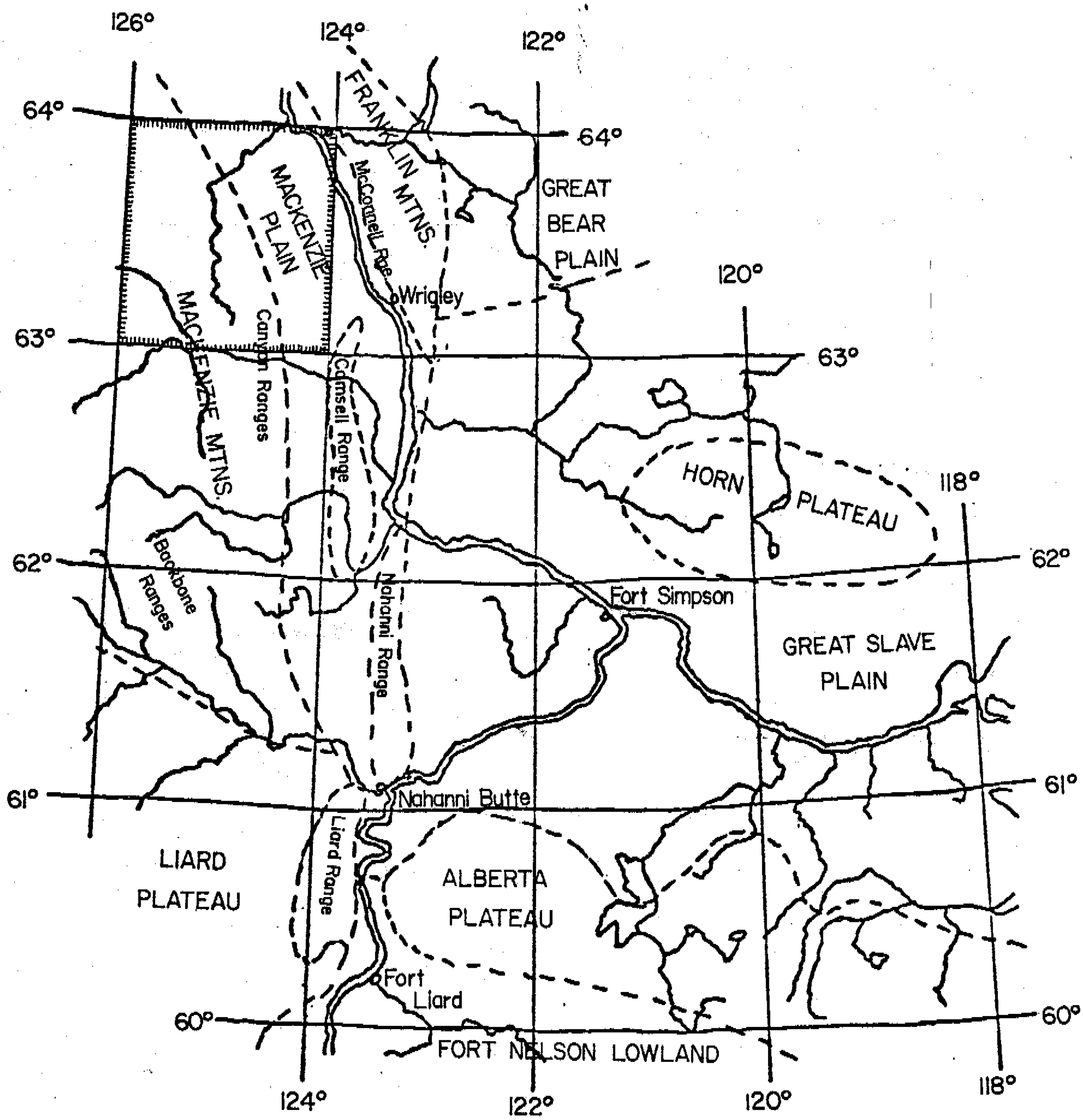
[3] A formation is a bed (of rocks) or assemblage of beds with well-marked upper and lower boundaries that can be traced and mapped over a considerable tract of country (Holmes, 1965).



PHYSIOGRAPHIC REGIONS — DAHADINNI RIVER, 95N

1 miles 50 Scale

Figure 1

after Bostock 1969

Competent limestones, dolomites, and sandstones are found at or near the surface in the Rouge, Redstone, Dusky, Dahadinni, and Iverson Ranges and in the Painted Mountains and could be used to supply construction materials.

Morainal deposits mantle the bedrock with shot records showing them to be from 10 to 50 feet thick in most places[4]. In addition to the ground moraine cover, glacier activity has produced minor glaciofluvial terrace and glaciolacustrine plain deposits. Rivers and creeks have reworked unconsolidated material into alluvial plain and terrace deposits and slope wash has created alluvial fans at the base of bedrock ridges. Mass wasting has also produced colluvial deposits of bedrock and unconsolidated material on mountain slopes and in river valleys.

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

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

used without pattern designations, the deposits either consist almost entirely of material less than 1/16 mm or have frozen ground or extensive swampy organic areas.

Figure 3 is a Geological Survey of Canada bedrock geology map. Bedrock at or near the surface is indicated by solid lines, heavy dashed 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

Glaciofluvial deposits contain high quality granular material of gravel and sand size. Glaciolacustrine plain deposits consist mainly of silt and fine sand. Moraine plain deposits are generally made up of fine material, but ridged areas may contain some sand and gravel.

Glaciofluvial Deposits
(Gp, Gt, Gtx, Gr, $\frac{Av}{Gt}$, eskers)

Small glaciofluvial deposits scattered throughout the area consist of sand and gravel. They have been indicated by several types of dot and circle patterns 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. The lower case prefix denotes the principal type(s) of material present, 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. plain (p), terrace (t), ridge (r). Symbols like esker (⩔) also show surface form. Glaciofluvial units vary from flat and gently sloping (Gp, Gt) to ridged (Gr, eskers). Thicknesses of deposits range from 50 to 100 feet with thickest deposits along the Mackenzie River.

Glaciofluvial deposits are generally well drained and have lower ground ice content than finer grained deposits.

Glaciolacustrine Deposits (Lp)

Glaciolacustrine deposits are mostly silt and fine sand. On the natural granular materials map lake deposits have been assigned a striped pattern (see Figure 2).

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

Glaciolacustrine plain deposits are generally flat or gently sloping (Lp). They range in thickness from 20 feet in the western part of the map-area to 60 feet near the Mackenzie River. Glaciolacustrine deposits would be difficult to exploit because of high ground ice content.

Morainal Deposits
(Mp, )

Morainal deposits are indicated by a capital M with appropriate textural and morphologic modifiers. Morainal tills generally contain a mixture of grain sizes from boulders to fine clay particles with the greater percentage less than 1/16 mm in size. Bedrock in the eastern third of the map-sheet is covered by at least 60 feet of fine-grained morainal material. Two moraine ridges (N-79 and N-80) are the only morainal deposits indicated on Figure 2.

Ice content and organic cover in morainal areas is variable and largely controlled by topography. Ridges are generally well drained and have less ground ice making them easier to exploit for coarse material or fill.

Alluvial Deposits
(Ap, At, Af, Afx)

Alluvial deposits consist of silt, sand, and gravel-sized material. Only those with significant coarse material have been assigned a cross hatched 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, terraces (At) above present channels, and fans (Af, Afx) at the base of mountain slopes. Alluvial deposits along braided rivers and mountain slopes in the western two-thirds of the map-area contain the most significant amounts of coarse material. Shot hole records and field investigations also show sand and gravel alluvial deposits along the Mackenzie, Redstone, Dahadinni, Johnson, and Blackwater Rivers in the Mackenzie Plain.

Alluvial deposits vary in thickness from 9 to 80 feet. Alluvial plain deposits are from 9 to 40 feet thick while terrace deposits range from 40 to 80 feet. Alluvial plain and terrace deposits with considerable fine material usually have high ground ice content.

Alluvial fan deposits are variable in thicknesses and textures. An average thickness of 25 feet was used in volume estimates.

Colluvial Deposits
(Cx)

These deposits are derived from bedrock or unconsolidated materials and are formed by mass wasting processes. Material in colluvial deposits range from clay size to large rock fragments. Colluvial deposits are common in the mountainous western part of the map-sheet and along major river valleys. It should be noted that colluvial deposits with steep unstable slopes may be potential landslide areas and removal of material from these slopes should be avoided.

Bedrock

Limestone, dolomite, and sandstone of twelve geologic formations can be used to supply granular material. Outcrop areas of these formations are indicated on Figure 3 with solid lines, heavy dashed lines, or an x symbol.

All the formations occur at or near the surface in the Rouge, Redstone, Dusky, Dahadinni, and Iverson Ranges and in the Painted Mountains. East of the mountains, bedrock is mantled by glacial deposits and is exposed only along rivers.

High Quality Bedrock for Construction Materials

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

The Nahanni Formation, unit 21, is a Middle Devonian limestone that is well exposed in all the mountain ranges. 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 formation ranges in thickness from 380 feet on the Redstone Range to 750 feet on the Rouge Range.

The Arnica Formation, unit 15, is a Middle Devonian dolomite that is exposed in the Rouge, Redstone, Dusky, Dahadinni, and Iverson Ranges and in the Painted Mountains. Thickness varies from 1,180 to 2,420 feet. The massive nature of the rocks of this formation may mean that crushing could be difficult. However, numerous calcite veins and brecciated zones at some localities may make ripping easier.

The Landry Formation, unit 18, is a Middle Devonian limestone which ranges in thickness from 410 to 730 feet. It is a competent, partly dolomitized, medium bedded formation. Unit 18 is present in all the mountain ranges.

Unit 14, the Sombre Formation, is a Lower Devonian dolomite. It is thickest (2,870 feet) in the southern Rouge Range and thins northward. On the southern Rouge Range the formation is divided into three parts. The lower part consists of 1,250 feet of dolomite overlain by 550 feet of limestone and dolomite. The middle 250 feet is dolomite, partly brecciated and thinly bedded. The upper part, 820 feet thick, is dolomite which is sometimes vuggy. All parts of the formation are fairly competent and would be good bedrock sources for construction materials.

The Delorme Formation, unit 11, is exposed in the Dusky, Redstone, and Rouge Ranges and in the Painted Mountains. It is Silurian in age and consists of platy limestone and competent dolomitic limestone. In the Rouge Range 2,100 feet of this formation is present.

The Whittaker Formation, unit 10, occurs in the Redstone and Dusky Ranges. The formation is Silurian and Ordovician in age. On the Redstone Range north of Blue Lake 3,360 feet of strata is present and the formation is divided into three parts. The lower part is dolomite (620 feet thick) with some argillaceous layers. The middle part is 2,060 feet thick and consists of massive resistant, somewhat cherty dolomite. The upper part consists of thin to medium bedded dolomite. This formation, especially the cherty middle part, could be used as a source of granular materials.

Unit 7 consists of resistant sandy dolomite and sandstone and forms the core of the western ranges. In the Redstone Range the formation is several thousand feet thick.

Unit 25 is an Upper Devonian reef limestone that would be a good source for granular materials. It has a limited distribution in the Wrigley and Dahadinni map-areas.

Secondary Bedrock Sources for Construction Materials

Four formations, units 24, 19, 13, and 16, can be used as sources of rippable bedrock. However, the outcrop pattern and rock types involved make them less desirable than the eight previously mentioned units.

The Upper Devonian unit 24 is a sandstone with shale and siltstone interbeds. It is found mainly in the eastern third of the map-area and in lower areas between the Mackenzie Mountain ranges. At most localities it is mantled by glacial deposits of variable thicknesses. Exposures are found along Dahadinni, Redstone, and Mackenzie Rivers.

The Middle Devonian Funeral Formation, unit 19, is an argillaceous limestone. It is abundant in the Dahadinni Range and at Mount Haywood it is 550 feet thick. The Funeral Formation grades into the more resistant unit 18 at the south end of Dahadinni Range.

The Camsell Formation, unit 13, is exposed in the Dusky, Redstone, and Rouge Ranges and is composed of limestone and dolomite. It is usually massive to thickly bedded and the dolomite is commonly brecciated. Basal beds are often less resistant than the upper part of the unit. The formation is Ordovician or older and is approximately 1,800 feet thick when exposed.

The Middle Devonian Bear Rock Formation, unit 16, is a limestone breccia. It is represented by 1,000 feet of strata at Mount Haywood in Dahadinni Range. At a well just north of the map-area, this unit was found to contain anhydrite. When rock of the formation is low in anhydrite and the breccia fragments are large enough, it could be used for granular material.

GEOGRAPHIC DISTRIBUTION OF EXPLOITABLE MATERIALS

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

Further details on volume estimates of natural granular materials are found in the tabular summary.

Redstone, Dahadinni, and Johnson Rivers

Most of the natural granular materials in the Dahadinni River map-area are found along the Redstone, Dahadinni, and Johnson Rivers. Alluvial plain and terrace deposits contain considerable sand and gravel. They range from 9 - 80 feet in thickness and are sometimes frozen.

At the junction of North Redstone and Redstone Rivers, there is a large area of glaciolacustrine silt approximately 40 feet thick which is probably frozen.

Sand and gravel can also be obtained from a glaciofluvial ridged area along the Redstone River.

Mackenzie River Area

Glaciofluvial, alluvial, and glaciolacustrine deposits near the Mackenzie River contain sand and gravel resources. Glaciofluvial deposits average 100 feet in thickness and are often unfrozen. Alluvial material along Blackwater River is 40 feet thick while glaciolacustrine plain deposits are approximately 50 feet thick. Alluvial and glaciolacustrine deposits probably contain some ground ice.

Mackenzie Mountains

Limestone, dolomite, and sandstone which outcrop in the Mackenzie Mountain ranges would supply both colluvium and crushable bedrock for granular materials. Eight geologic formations are listed as good units to exploit and four are fair (see tabular summary).

TABULAR SUMMARY

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes Total	(Million yd.^{3}) Available
N- 1	Glaciofluvial outwash plain deposit, channelled; gravel	50	1.67	87.89	35.16
N-10	Glaciofluvial terrace deposits, gravel	50	0.47	24.65	17.26
N-11		50	0.54	28.39	11.36
N-13		50	0.35	18.36	7.34
N-14		50	0.35	18.36	7.34
N- 8	Glaciofluvial terrace complex, gravel	50	1.24	65.28	26.11
N- 6	Glaciofluvial terrace deposit, silt and sand	100	1.36	138.98	55.57
N-12	Glaciofluvial terrace deposit; gravel, 5 - 15% colluvium	50	0.82	43.18	15.11
N- 2	Alluvial veneer of silt and sand over glaciofluvial terrace deposits of gravel and sand	100	2.10	214.50	85.80
N- 3		100	1.28	130.68	52.27
N- 4		100	3.77	385.11	154.04
N- 5		100	3.23	330.00	132.00
N- 9	Silty alluvial veneer over glaciofluvial terrace deposit of gravel	50	0.43	22.61	9.04

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes (Million yd.^{3}) Total	Available
N- 7	Glaciofluvial ridged deposits,	50	0.47	24.65	17.26
N-15	gravel and sand	50	1.59	83.64	58.55
N-16		50	0.16	8.16	5.71
N-17		50	0.39	20.57	14.40
N-18	Esker deposits of gravel and sand			0.06	0.05
N-19				0.06	0.05
N-20	Glaciolacustrine plain deposits, silt	20	1.01	21.84	4.37
N-21		50	11.24	591.77	118.35
N-22		50	4.59	241.57	48.31
N-23		50	8.05	423.81	84.76
N-24		20	7.59	164.57	32.91
N-25		20	2.14	46.34	9.27
N-26		40	11.16	449.28	89.86
N-27		40	6.61	266.11	53.22
N-28		40	3.46	139.23	27.85
N-29		40	31.55	1,270.36	254.07
N-30		40	16.80	676.39	135.28
N-31		40	0.86	34.58	6.92
N-32	Alluvial plain deposits,	9	0.70	6.48	1.30
N-33	gravel and sand	9	0.51	4.71	0.94
N-37		30	23.77	736.20	147.24
N-41		30	10.62	328.90	65.78
N-44		40	19.18	772.33	154.47
N-52		30	1.05	32.50	6.50
N-53		30	0.78	24.10	4.82

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes (Million yd.^{3}) Total	Available
N-54		45	1.44	66.90	13.38
N-56		25	1.44	35.68	7.14
N-58		25	0.74	18.32	3.66
N-59		25	0.39	9.60	1.92
N-60		25	0.62	15.36	3.07
N-61		9	18.75	174.24	34.85
N-62		9	4.20	12.66	2.52
N-63		9	1.05	9.75	1.95
N-43	Alluvial plain deposits,	30	12.60	390.20	78.04
N-49	gravel and silt	30	3.89	120.40	24.08
N-50		40	5.68	228.67	45.73
N-48	Alluvial plain deposits, gravel and sand,	15	3.31	51.25	10.25
N-55	5 - 15% colluvium	15	30.81	477.15	95.43
N-34	Alluvial terrace deposits,	40	0.74	29.77	5.95
N-35	gravel and sand	40	0.35	14.17	2.83
N-36		40	0.43	17.29	3.46
N-38		40	0.39	15.60	3.12
N-39		40	0.39	15.60	3.12
N-40		40	0.47	18.85	3.77
N-46		80	0.86	71.82	14.36
N-47		40	0.78	31.33	6.27
N-57		40	0.51	20.41	4.08
N-42	Alluvial terrace deposits,	40	1.24	49.92	9.98
N-45	gravel and silt	40	1.24	49.92	9.98
N-51		80	1.63	136.08	27.22

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes Total	(Million yd.^{3}) Available
N-64	Alluvial fan deposits	25	0.47	11.60	5.80
N-65		25	0.66	16.32	8.16
N-66		25	0.74	18.32	9.16
N-67		25	0.31	7.68	3.84
N-68		25	0.35	8.64	4.32
N-69		25	0.12	2.96	1.48
N-70		25	0.12	2.96	1.48
N-71		25	0.12	2.96	1.48
N-72		25	0.12	2.96	1.48
N-73		25	0.16	3.92	1.96
N-74		25	0.16	3.92	1.96
N-75	Alluvial fan complex	25	3.06	76.16	38.08
N-76	Alluvial fan deposits, gravel	25	0.62	15.36	7.68
N-77		25	0.16	3.92	1.96
N-78		25	0.51	12.56	6.28
N-79	Moraine ridge deposits, till			0.13	0.007
N-80				0.08	0.004

Bedrock - limestone of unit 21 (good)
dolomite of unit 15 (good)
limestone of unit 18 (good)
limestone and dolomite of unit 14 (good)
limestone of unit 25 (good)
dolomite and sandstone of unit 7 (good)
dolomitic limestone of unit 11 (good)
dolomite of unit 10 (good)
sandstone of unit 24 (fair)
limestone of unit 19 (fair)
limestone and dolomite breccia of unit 13 (fair)
limestone breccia of unit 16 (fair)

[illegible]

Appendix A

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