

SAND AND GRAVEL RESOURCES
OF THE
BISTCHO LAKE (NORTHERN THREE QUARTERS, 84M)
AND
STEEN RIVER (WEST HALF, 84N) AREAS

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ABSTRACT

Sand and gravel deposits in the Bistcho Lake (northern three quarters, 84M) and Steen River (west half, 84N) areas were studied in 1985 to provide information on their distribution and characteristics.

The study was carried out at a reconnaissance level and consisted of compiling existing information, aerial photograph interpretation, some site investigation and laboratory analysis of sand and gravel samples.

In the study area, sand and gravel materials are unevenly distributed and of variable quality. The Hay River valley has the greatest concentration of deposits, with active pits located in the vicinity of Meander River. Few deposits are available in the western part of the study area (84M) where there is a high demand for sand and gravel for oil company needs. A kame, some 25 km northeast of Zama City may serve to alleviate, for a time, the supply situation in that area. In the northern part of the map area, in the vicinity of Bistcho Lake, deposits with good potential do occur, but the demand for sand and gravel in this area is low.

Glaciofluvial deposits are the main sources of sand and gravel in the study area. No preglacial deposits were observed and recent sediments hold little promise for sand and gravel exploitation.

INTRODUCTION

This study is part of a program initiated in 1976 by the Alberta Research Council and Alberta Energy and Natural Resources to provide information on the aggregate resources of the Province of Alberta.

The study area is situated in northwestern Alberta (figure 1) and consists of the Bistcho Lake area (NTS 84M/5 to 16) and the Hay River area (NTS 84N/3,4,5,6,11,12,13,14). The Bistcho Lake area lies between 118°00' and 120°00' west longitude and 59°15' and 60°00' north latitude. It is an area of approximately 975 km² and covers Townships 118 to 126, and Ranges 1 to 12, West of the Sixth Meridian. The Hay River area lies between 117°00' and 118°00' west longitude and 59°00' and 60°00' north latitude. It is approximately 650 km² in area and covers Townships 115 to 126 and Ranges 18 to 24, West of the Fifth Meridian.

The area of study (figure 1) and level of detail were determined by the Resource Evaluation and Planning Division of Alberta Energy and Natural Resources. The actual investigations were conducted by the Aggregate Inventory of the the Geological Survey Department, Alberta Research Council. The purpose of the study was to complete at an enhanced reconnaissance level (Table 1) a survey of sand and gravel deposits.

ACKNOWLEDGMENTS

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Helicopter time was provided by C. Leary, Superintendent, Footner Lake Forest.

Funds for the project were provided by the Resource Evaluation and Planning Division of Alberta Energy and Natural Resources.

METHODS

The study was initiated with a compilation and review of existing information dealing with surface and sub-surface materials. Such information included water well logs from Alberta Environment, data provided by Alberta Transportation and soil reports from the Alberta Research Council. Although this information does not deal specifically with sand and gravel resources they do, however, provide a background upon which the study was partially based.

A preliminary surficial geology map, outlining areas of differing material types, was produced by L.D. Andriashek, Terrain Sciences Department, Alberta Research Council for the Aggregate Inventory. Additional aerial photograph interpretation of the area was performed by the principal investigator. A number of deposits were identified within the map area as having potential for sand and gravel and formed targets for the field component of the study.

Field work at the enhanced reconnaissance level consisted of obtaining information on selected sand and gravel deposits. This information included geological description, grain size and depth where observable. The work entailed road and air traverses with some sampling for laboratory analysis.

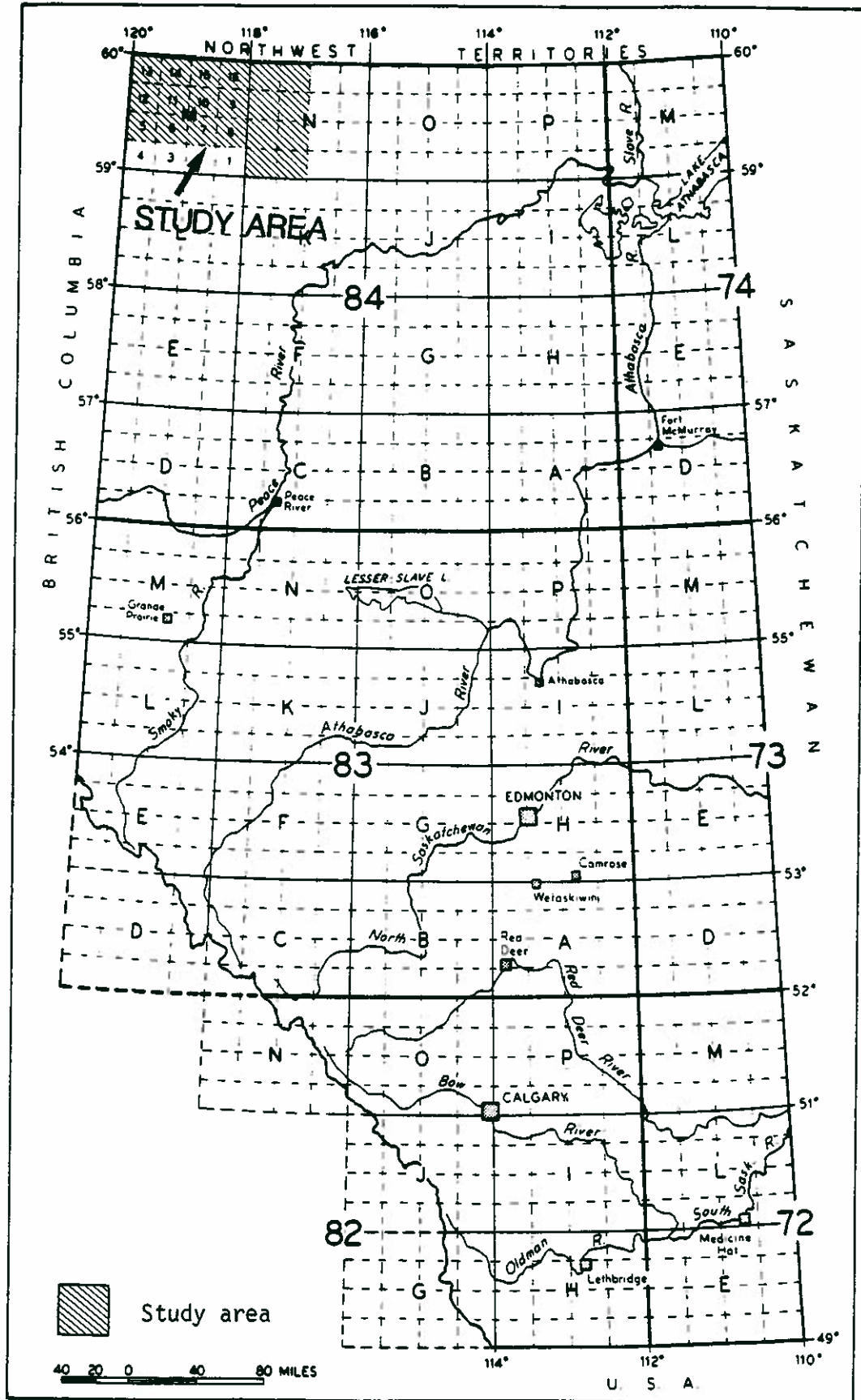


Figure 1. Field Study area and location map.

Table 1. AGGREGATE INVENTORY MAPPING LEVELS

Format	Reconnaissance Study 5	Enhanced Reconnaissance Study 4	Regional Mapping 3	Detailed Mapping 2	Deposit Evaluation 1
Scale (Common)	1:250,000 (approx. 11x14 townships)	1:250,000 (approx. 11x14 townships)	1:50,000 (approx. 3x3 townships)	1:10,000	1:10,000 or larger
Mapping Methodology	Derived from existing surficial geology information. Aerial photograph interpretation.	Derived from existing surficial geology information. Aerial photograph interpretation. Some field traverses and site examination.	Aerial photograph interpretation. Field traverses. Site examinations. Selected deposit testing. Laboratory testing.	Sedimentological studies. Site examination. Deposit testing. Laboratory testing.	Test pitting on an established grid. Hole logging. Materials analysis.
Uses	Broad scale planning. Preliminary aggregate exploration.	Broad scale planning. Preliminary aggregate exploration. Preliminary resource assessment.	Land use planning. Resource management. Resource estimates.	Land management. Reserve estimates. Deposit management.	Deposit evaluation. Development plan preparation.
Comments	Only potential areas suitable for finding deposits shown.	Potential areas suit- able for finding deposits are shown. Some deposits are examined.	Estimates deposit boundaries and gives quality and quantity estimations.	Establishes deposit boundaries. Refines quantity/ quality information.	Precise quality and quantity estimates. Deposit variations identified.
	Fairly quick and in- expensive to produce.	A map will take 6 months to a year to produce.	A map may take 8 months to a year to produce.	Fairly expensive survey.	Very expensive survey.
Output	2 map sheets per prof-year	1 map sheet per prof-year	2 to 3 map sheets prof-year	Special projects only.	Special projects only.

GEOLOGY

Physiography

Two major physiographic subdivisions occur in the study area (Pettipiece, 1984):

- (1) The Cameron Hills Upland in the northwest of the study area. The Uplands are comprised of the Cameron Hills, Elsa Hill and Bootis Hill rising some 2300 feet a.s.l. The Uplands form a semicircle around the Bistcho Plain which is drained by the Petitot River to the west.
- (2) The Hay River Plain covers the remainder of the study area. The plain is drained to the north by the Hay River.

Bedrock Geology

The eastern part of the Hay River Plain is underlain by the Loon River Formation (Lower Cretaceous). The formation is described as "dark grey fossiliferous silty shale and laminated siltstone; nodules and thin beds of concretionary ironstone; marine" (Green, 1972). The remainder of the area is underlain by the Shaftesbury Formation (Lower and Upper Cretaceous). This is described as "dark grey fish-scale bearing shale, silty in upper part; numerous nodules and thin beds of concretionary ironstone; bentonite partings; lower part with silty and sandy intervals; marine" (Green, 1972).

Surficial Geology

The distribution of surficial materials in the study area, based on aerial photograph interpretation and limited field checking, is shown on figure 3.

Generally, a thick mantle of glacial drift was deposited over the study area by Laurentide ice from the northeast during late Wisconsinan time.

Deglaciation saw the establishment of glacial lakes in the vicinity of High Level and the upper reaches of the Hay River. These glacial lakes eventually drained to the north forming through a spillway presently occupied by the Hay River (Mathews, 1980).

The dominant surficial materials in the study area are organics and till. Areas of alluvial deposits occur around the edges of the Uplands. The Cameron Hills Uplands are composed of glacial materials possibly up to 300 m thick and do not appear to be bedrock highs (Borneuf, et. al., 1980). The maximum thickness of surficial material in the area is 363 m as reported for an oil well.

Glaciofluvial deposits are of greatest interest as possible sources for sand and gravel. In the study area glaciofluvial deposits are found mainly in the Hay River valley (Lindsay, et. al., 1980), in small channels at the east side of Bistcho Lake and in a spillway channel north of May Lake in the northwest corner of the map area. Crevice fillings are found in the area surrounding Bistcho Lake.

SAND AND GRAVEL RESOURCES

Sand and gravel deposits in the map area are of variable composition and are distributed unevenly. Some deposits are extensive, while others are only small scattered bodies of gravel or thin sheets of sand.

Locations of sand and gravel deposits, sample site and pits are shown in figure 2 (in pocket). Individual deposit descriptions with grain size data and locational information are found in Appendix 1. Also contained in Appendix 1 is a map (figure 4) showing the location of all deposits described.

The dominant type of surficial deposit in the map area from which sand and gravel can be gained are glaciofluvial deposits. Preglacial deposits have not been found in the area, and glaciolacustrine and recent

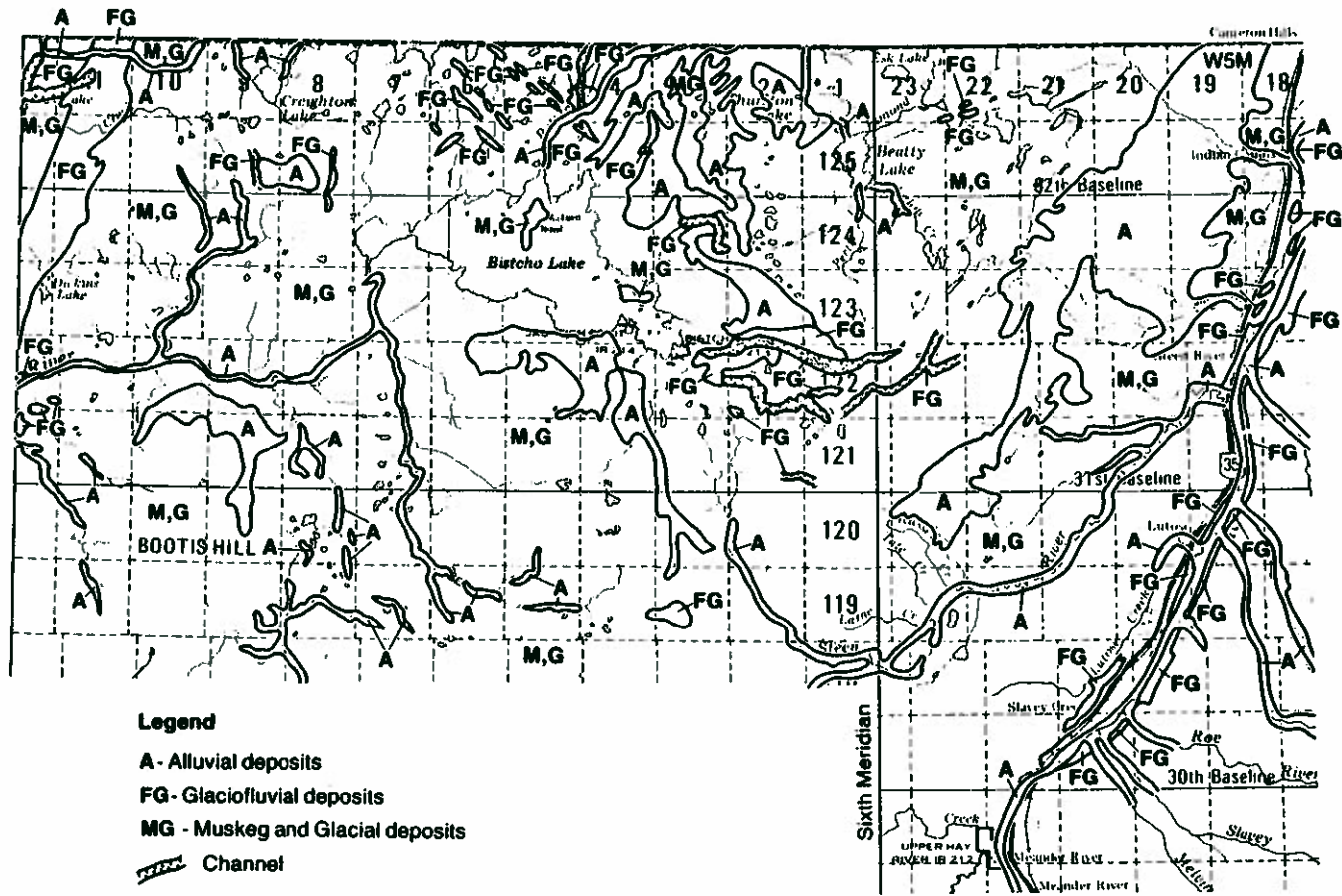


Figure 3 Surficial Geology Map

alluvial processes have produced few sand and gravel sources. Various types of glaciofluvial deposits and their major groupings are discussed below.

Channel Deposits

1. Hay River Valley (Appendix 1, deposits 15 to 32). The valley originated with the drainage of glacial lakes in the area (see surficial geology section). Glaciofluvial materials were subsequently deposited along the spillway.

Sand and gravel has been extracted from deposits in the Hay River Valley. The greatest number of pits and the most active pits occur in the southern part of the valley. Here the deposits are generally thicker, coarser in grain size and most accessible from the Zama oil fields.

The deposits throughout the valley range from gravel to sand. Generally, the coarsest material occurs in the southern (upstream) part of the valley and becomes finer (sandy) to the north.

Deposits range in thickness from 2 m to 15 m and are usually at least 3 m thick. The thickest deposits occur in the south.

The predominant rock types occurring in the gravels are igneous and metamorphic rocks from the Precambrian Shield and hard sandstone. Small quantities of deleterious ironstone, shale and siltstone rocks also occur.

2. Channels at the east end of Bistcho Lake. The potential for finding sand and gravel in these channels is high (Appendix 1, deposits 8 and 9). No direct information is available on the deposits.

3. The channel north of May Lake. This channel, in the very northwest corner of the study area, has a high potential for sand and gravel. Limited information is available. However, clean gravelly sand (30% gravel) 15 m in thickness was seen at one site. The gravel is composed

mainly of rocks of Precambrian Shield origin (Appendix 1, deposit 1).

Ice Contact Deposits

Two eskers composed primarily of sand occur in the northwest part of the map area (Appendix 1, deposits 2 and 13).

Crevasse fillings occur in the area surrounding Bistcho Lake (Appendix 1, deposits 4,6 and 11). These features appear to be composed mainly of till, but have some potential for sand and gravel.

A kame is situated approximately 25 km northeast of Zama City and some 9 km beyond a gravel road (Appendix 1, deposit 10). This deposit, although of small volume compared to the Hay River Valley deposits, has good potential as a source of sand and gravel. This deposit may assist in serving the local Zama City and area oil field demand and reduce reliance upon distant deposits in the vicinity of Meander River.

Outwash Deposits

Outwash deposits (Appendix 1, deposits 3,5,7 and 14) are found in the area but are mainly thin and sandy.

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APPENDIX 1
DEPOSIT DESCRIPTIONS

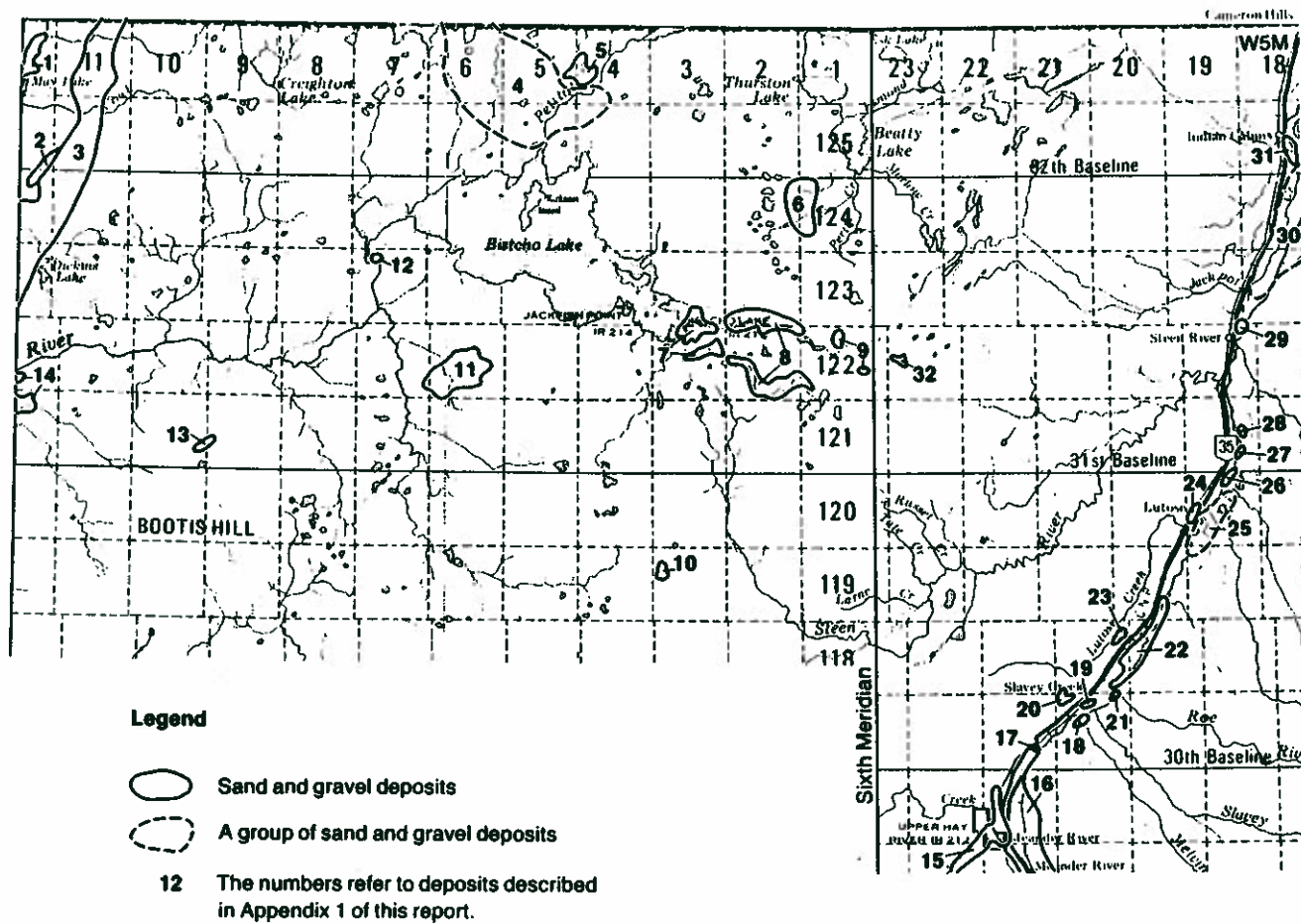


Figure 4 Location of sand and gravel deposits

NTS 84 M - Bistcho Lake

Deposit No. 1

Location: Sec. 10,11,14,23,24 & 25, Tp. 126, R 12, W6th Mer.

Description: Field checked. Glacial spillway. Clean gravelly sand (approx. 30% gravel). Good potential for sand and gravel. At site deposit is 15 m thick. Recommend further investigation.

Deposit No. 2

Location: Sec. 26,35,36, Tp. 124, R 12, W6th Mer.
 Sec. 6 & 7, Tp. 125, R 11, W6th Mer.
 Sec. 1, Tp. 125, R 12, W6th Mer.

Description: Field checked. Esker, approximately 5 m elevation and 15 m across base. Materials observed range from clean gravelly sand to fine sand. Good potential for sand and gravel.

Deposit No. 3

Location: Parts of: Tp. 123, R 11, W6th Mer.
 " Tp. 123, R 12, W6th Mer.
 " Tp. 124, R 11, W6th Mer.
 " Tp. 124, R 12, W6th Mer.
 " Tp. 125, R 11, W6th Mer.
 " Tp. 126, R 11, W6th Mer.

Description: Helicopter fly-over. Area of discontinuous glaciofluvial materials over till. Some of these materials may be sand and gravel. Poor potential.

Deposit No. 4

Location: Parts of: Tp. 125, R 4, W6th Mer.
 " Tp. 125, R 5, W6th Mer.
 " Tp. 125, R 6, W6th Mer.
 " Tp. 126, R 4, W6th Mer.
 " Tp. 126, R 5, W6th Mer.
 " Tp. 126, R 6, W6th Mer.

Description: Field checked. Area of crevasse fillings. Site investigated revealed clay till. Limited potential for sand and gravel.

Deposit No. 5

Location: Sec. 5 to 8, 17 to 20, Tp. 126, R 4, W6th Mer.
Sec. 12 & 13, Tp. 126, R 5, W6th Mer.

Description: Field checked. Thin (1.5 m) glaciofluvial deposit of clean fine sand.

Deposit No. 6

Location: Parts of: Tp. 124, R 1, W6th Mer.
" Tp. 124, R 2, W6th Mer.

Description: Aerial photograph interpretation. Area of crevasse fillings. Limited potential for sand and gravel.

Deposit No. 7

Location: Sec. 21 to 28, 33 to 35, Tp. 122, R 3, W6th Mer.
Sec. 3 & 4, Tp. 123, R 3, W6th Mer.

Description: Aerial photograph interpretation. The two glaciofluvial deposits appear to be sand.

Deposit No. 8

Location: Sec. 1 to 4, 8,9,12, 16 to 18, Tp. 122, R 2, W6th Mer.
Sec. 3 to 6, Tp. 123, R 2, W6th Mer.

Description: Aerial photograph interpretation. Glaciofluvial channel deposits. Good potential for sand and gravel. Recommend further investigation.

Deposit No. 9
 Location: Sec. 13,27,28, Tp. 122, R 1, W6th Mer.
 Description: Aerial photograph interpretation. Two deposits with moderate potential for sand and gravel.

Deposit No. 10
 Location: Sec. 19,30, Tp. 119, R 3, W6th Mer.
 Description: Field checked. Kame, maximum height 25 m. Materials range from silt to sand to gravelly sand. Appears to be mainly gravelly sand (25% - 30% gravel).

Deposit No. 11
 Location: Part of: Tp. 122, R 6, W6th Mer.
 Description: Aerial photograph interpretation. Area of crevasse fillings. Limited potential for sand and gravel.

Deposit No. 12
 Location: Sec. 28 & 29, Tp. 123, R 7, W6th Mer.
 Description: Aerial photograph interpretation. River bars. Moderate potential for sand and gravel.

Deposit No. 13
 Location: Sec. 7, Tp. 121, R 9, W6th Mer.
 Sec. 1 & 12, Tp. 121, R 10, W6th Mer.
 Description: Field checked. Esker, 5 m high. Fine sand at one site.

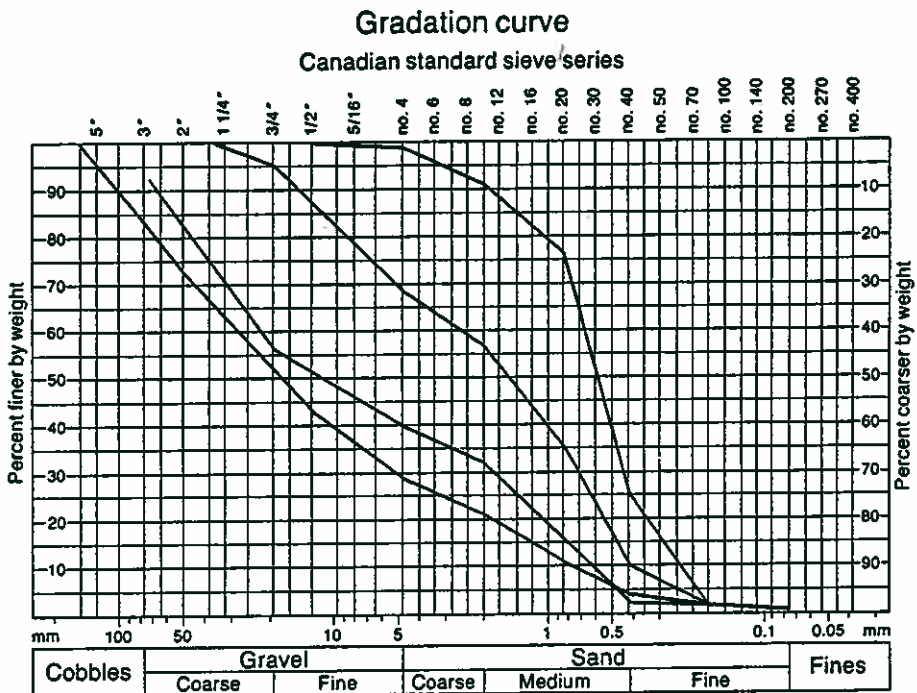
Deposit No. 14
 Location: Sec. 27, 28, 33 & 34, Tp. 121, R 12, W6th Mer.
 Sec. 4, Tp. 122, R 12, W6th Mer.
 Description: Field checked. Area of shallow sand (1-2 m) overlying till.

NTS 84N - Steen River

Deposit No. 15
 Location: Sec. 21,22,26,27, 34 to 36, Tp. 115, R 23, W5th Mer.
 Sec. 5 to 7, 18,19, Tp. 116, R 22, W5th Mer.
 Sec. 1, Tp. 116, R 23, W5th Mer.
 Description: Aerial photograph interpretation. Good potential for sand and gravel.

Deposit No. 16
 Location: Sec. 21 to 23, 26 to 29, 32 to 34, Tp. 115, R 22, W5th Mer.
 Sec. 3 to 5,7 to 10,16 & 17,20,21 & 28, Tp 116, R 22, W5th Mer.
 Sec. 29,33 & 34, Tp. 116, R 22, W5th Mer.
 Sec. 3,4 & 10, Tp. 117, R 22, W5th Mer.
 Description: Field checked. Many pits adjacent to highway. Material - sandy gravel to coarse sand (mainly sandy gravel), clean to dirty. Depth 2.4 m plus. Water table 3.0 - 8.0 m.

Range of	% cobbles	% gravel	%sand	%fines
four samples	0.0 - 15.3	1.0 - 54.9	98.7 - 29.1	0.3 - 0.7



Remarks: Samples taken from sand and gravel pits adjacent to Highway 35.

Deposit No. 17

Location: Sec. 11, Tp. 117, R 22, W5th Mer.

Description: Field checked. Small terrace located on west side of railway. Material - clean gravelly sand. Depth 5.0 m.

Deposit No. 18

Location: Sec. 20, Tp. 117, R 21, W5th Mer.

Description: Aerial photograph interpretation. Good potential for sand and gravel.

Deposit No. 19

Location: Sec. 28 & 29, Tp. 117, R 21, W5th Mer.

Description: Aerial photograph interpretation. Good potential for sand and gravel.

Deposit No. 20

Location: Sec. 30 & 31, Tp. 117, R 21, W5th Mer.
Sec. 25 & 36, Tp. 117, R 22, W5th Mer.

Description: Aerial photograph interpretation. Good potential for sand and gravel.

Deposit No. 21

Location: Sec. 35, Tp. 117, R 21, W5th Mer.

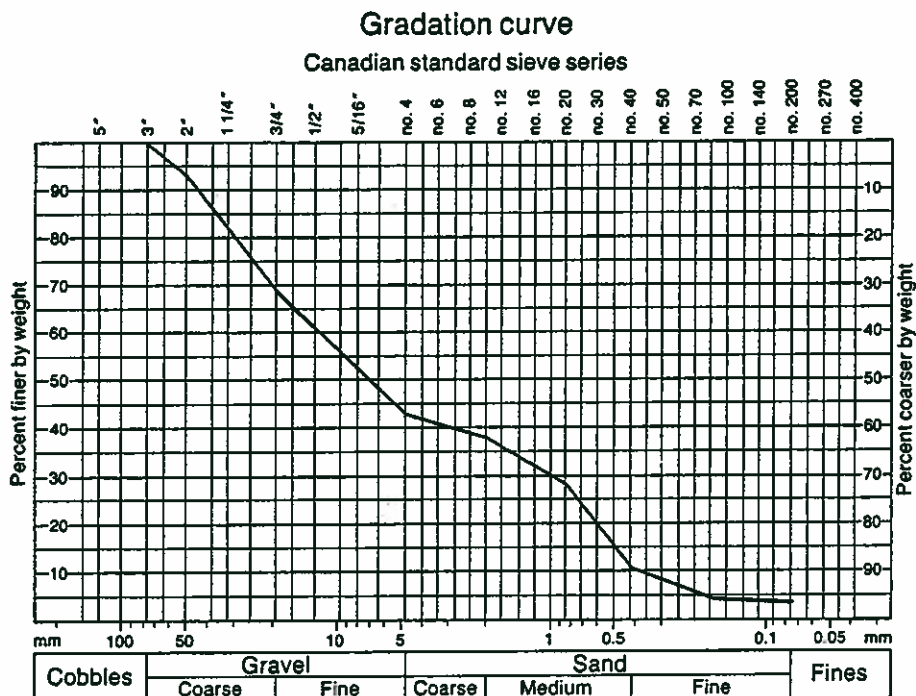
Description: Aerial photograph interpretation. Good potential for sand and gravel.

Deposit No. 22

Location: Sec. 35, Tp. 117, R 21, W5th Mer.
Sec. 18,19,29,30 & 32, Tp. 118, R 20, W5th Mer.
Sec. 2,11,12,13 & 24, Tp. 118, R 21, W5th Mer.
Sec. 3,4 & 10, Tp. 119, R 20, W5th Mer.

Description: Field checked. Three pits, material - clean sandy gravel to gravelly sand. Depth of deposits ranges from 2.5 m to 6.0 m. Water table variable.

Gradation:	-% Cobbles	57.8% Gravel
	39.2% Sand	3.2% Fines



Remarks: Sample taken from pit in central part of the deposit.

Deposit No. 23

Location: Sec. 23,25 & 26, Tp. 118, R 21, W5th Mer.

Description: Aerial photograph interpretation. Material probably sand.

Deposit No. 24

Location: Sec. 7 & 18, Tp. 120, R 19, W5th Mer.

Description: Field checked. Material - fine clean sand.

Deposit No. 25

Location: Sec. 36, Tp. 119, R 20, W5th Mer.
 Sec. 5 to 8, 16,17 & 21, Tp. 120, R 19, W5th Mer.
 Sec. 1, Tp. 120, R 20, W5th Mer.

Description: Aerial photograph interpretation. Good potential for sand and gravel.

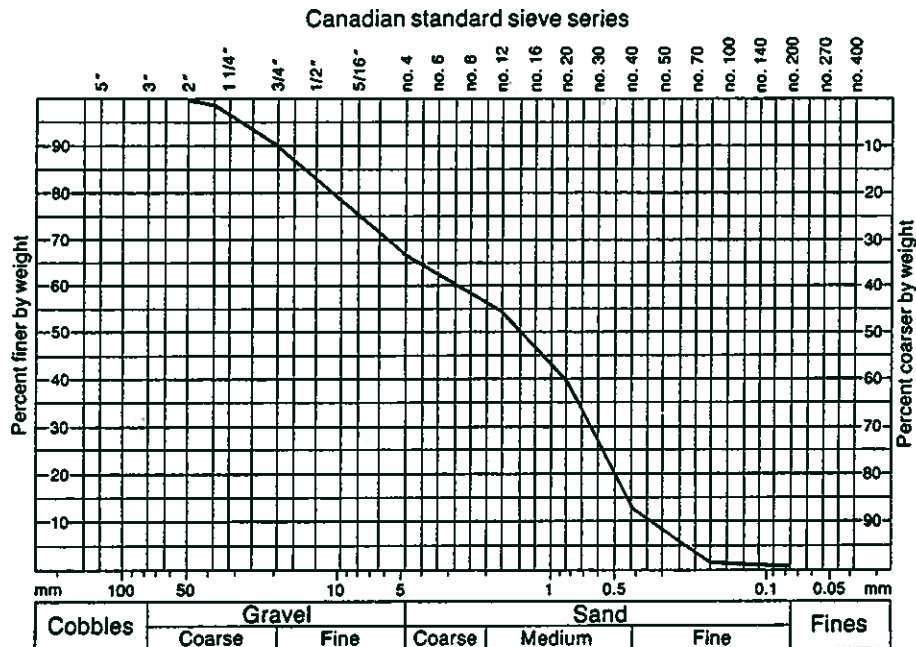
Deposit No. 26

Location: Sec. 28,33 & 34, Tp. 120, R 19, W5th Mer.

Description: Field checked. Two pits. Material - clean gravelly sand. Depth up to 5 m in places. Water table variable.

Gradation: -% Cobbles 33.4% Gravel
 66.1% Sand 0.5% Fines

Gradation curve



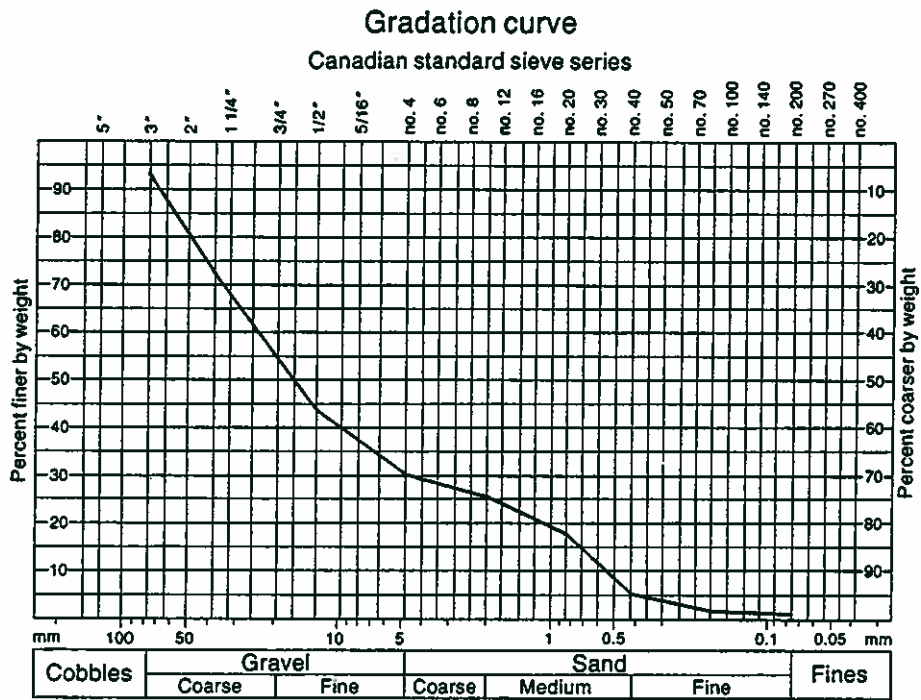
Remarks: Sample taken from the northern sand and gravel pit.

Deposit No. 27

Location: Sec. 2,3,10 & 11, Tp. 121, R 19, W5th Mer.

Description: Field checked. Two pits. Material - clean sandy gravel sand to gravelly sand. Depth 3.0 m to water table.

Gradation: 6.7% Cobbles 63.3% Gravel
29.6% Sand 0.4% Fines



Remarks: Sample taken from southern sand and gravel pit.

Deposit No. 28

Location: Sec. 14 & 15, Tp. 121, R 19, W5th Mer.

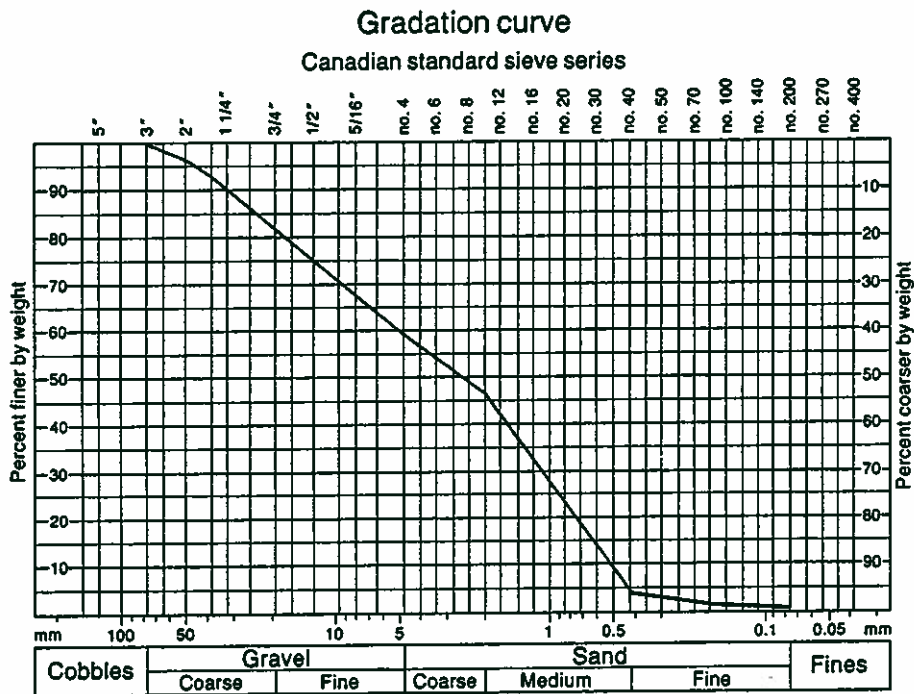
Description: Field checked. One pit. Materials - fine to medium sand, gravel content less than 10%. Depth to 2.0 m to water table.

Deposit No. 29

Location: Sec. 26,27,34 & 35, Tp. 122, R 19, W5th Mer.

Description: Field checked. One pit. Materials - clean, gravelly sand. Depth 3.0 plus.

Gradation: -% Cobbles 40.2% Gravel
 58.9% Sand 0.9% Fines

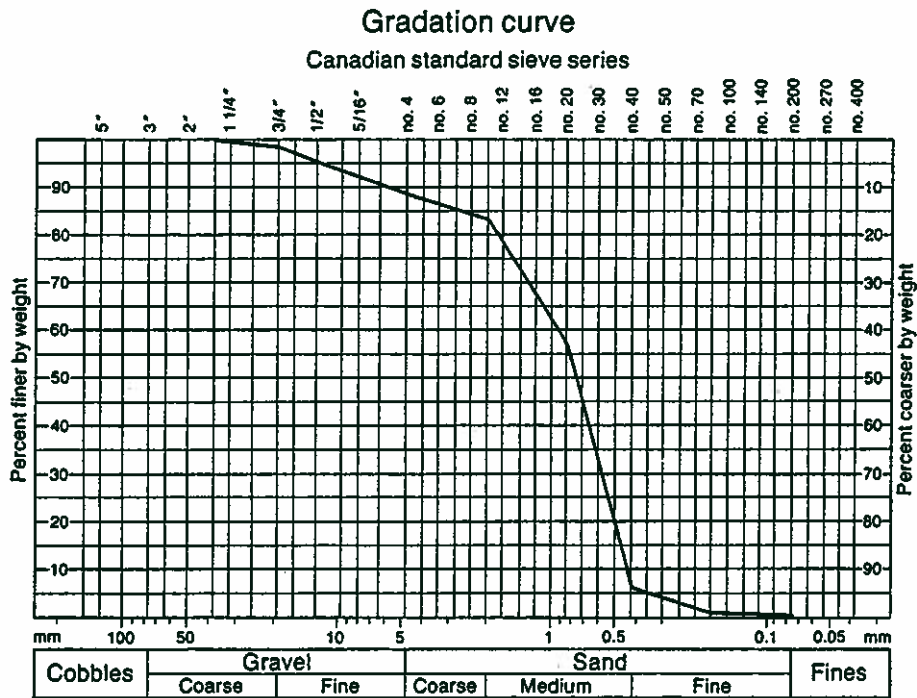


Remarks: Sample taken from the sand and gravel pit.

Deposit No. 30
 Location: Sec. 17,18,20,21,26 to 29,33 & 35, Tp. 123, R 18, W5th Mer.
 Sec. 2 to 4,9 to 11,14,15,22 to 27 & 35, Tp. 124, R 18, W5th Mer.
 Description: Aerial photograph interpretation. Materials - probably sand.

Deposit No. 31
 Location: Sec. 3,10 & 15, Tp. 125, R 18, W5th Mer.
 Description: Field checked. Two pits. Materials - clean to dirty, coarse to medium sand. Depth 2 to 3 m to water table.

Gradation: -% Cobbles 11.5% Gravel
 87.9% Sand 0.6% Fines



Remarks: Sample taken from the southern sand and gravel pit.

Deposit No. 32

Location: Sec. 19,20 & 30, Tp. 122, R 23, W5th Mer.

Description: Aerial photograph interpretation. Good potential for sand and gravel. Recommend further investigation.
