SAND AND GRAVEL RESOURCES OF THE FT. McMURRAY AREA

MAP SHEETS

WOOD CREEK (TO TOP OF Tp90 IN 74D/14)

FT. McMURRAY (74D/11)

UNNAMED (Tp83 R11 IN 74D/5)

HORSE RIVER (Tp83 R11 IN 74D/4)

Open File Report 1988-16

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1988

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ILLUSTRATIONS

ABSTRACT

Aggregate materials present in parts of the Fort McMurray (74D) map area were studied in 1987. This study areas covers 1385km^2 on four 1:50000 map sheets at a regional mapping level. The program consisted of compiling existing information, air photo interpretation, field investigation of sites and laboratory analyses. In addition, selected sites, identified as prospects in a previous air photo study, were evaluated. Sand and gravel are distributed unevenly and are of variable quality and quantity. Most of the granular material in the study area is sand. The major sand and gravel deposits in the study area are glaciofluvial in origin (meltwater channel and kame). Major deposits in the northern part of the study area, adjacent to the Clearwater and Athabasca Rivers, are meltwater channel deposits. In the southern part of the study area, aggregate material has been extracted from kames.

INTRODUCTION

This study is part of a program initiated in 1976 by the Alberta Research Council and Alberta Forestry, Lands and Wildlife to provide information on the aggregate resources of the Province of Alberta. The area of study (Figure 1), level of detail and materials to be investigated were determined by the Resource Evaluation and Planning Division (REAP) of Alberta Forestry, Lands and Wildlife (AFLW). The actual investigations were conducted by the Alberta Geological Survey, a department of the Alberta Research Council.

The study was completed at the regional mapping level (category 3, Table 1). This type of mapping is designed to provide a minimum data level for local and regional planning and management of aggregate resources in the province and to form a base for resource management.

Two major study areas are defined in the Fort McMurray (74D) map sheet. The northern study area is bounded on the south by the southern boundary of map sheet 74D/11 and on the north by the northern boundary of Township 90 in map sheet 74D/14. The eastern and western boundaries of the northern study area are the boundaries of the map sheets. The southern study area consists of Townships 83 and 84, Range 11 in map areas 74D/4 and 74D/5. Selected sites were visited in map sheets 74D/3 and 74D/6. Ft. McMurray, with a population of approximately 35 000 is the population centre for the region.

ACKNOWLEDGMENTS

Dianne Goulet performed the laboratory analyses and Monica Price gave her usual superior assistance in the office. Barry Fildes provided major assistance during production of the report. Funds for the project were provided by Resource Evaluation and Planning Division of Alberta Forestry, Lands and Wildlife. Special acknowledgment is given to Alberta Forest Service Chief Ranger Ralph Woods and his associates for their many courtesies during the field program. Provision of helicopter time and

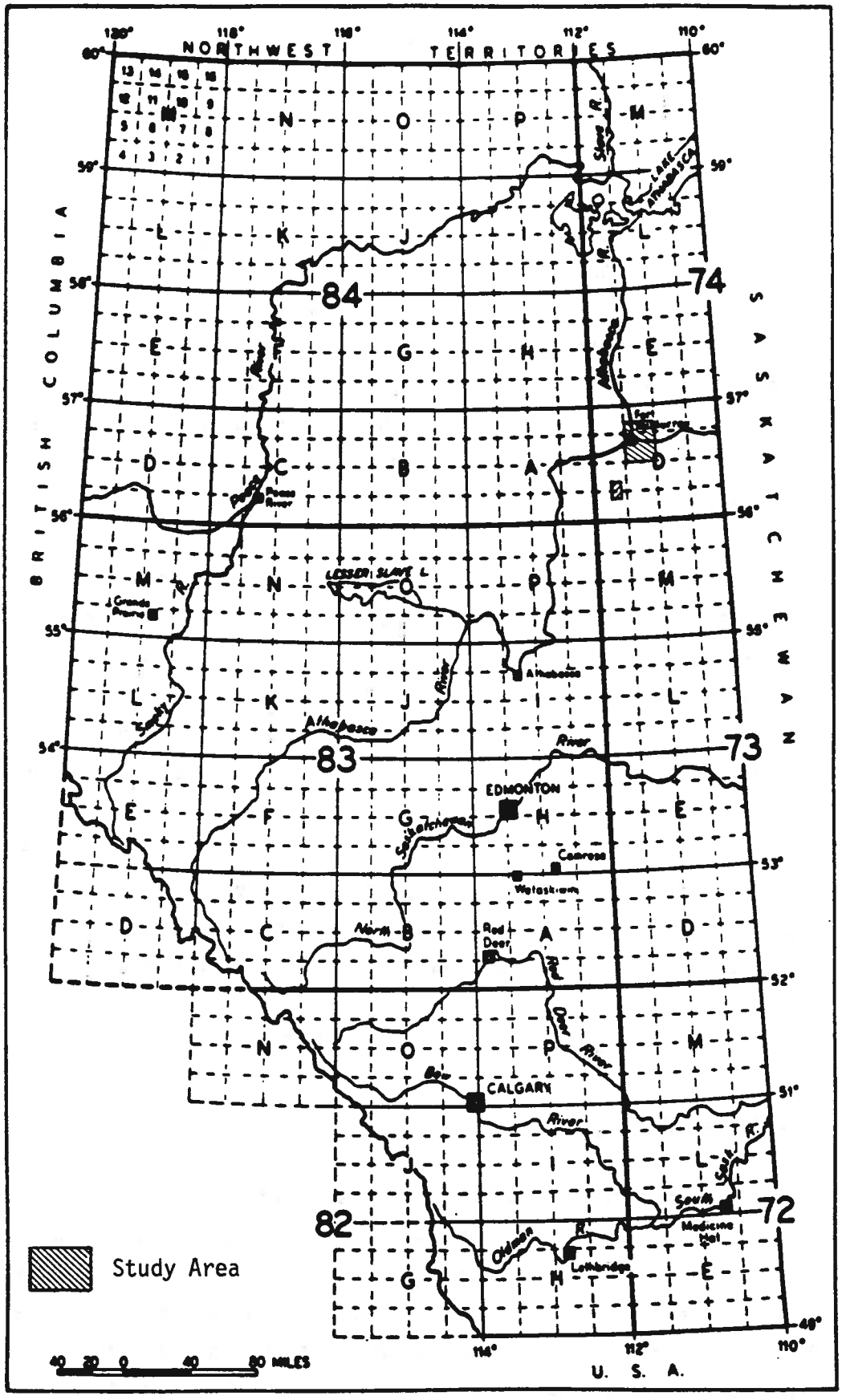

Figure 1 Location Map

camp were of special assistance.

METHODS

The study was initiated with the review and compilation of existing information. Included were data from water well logs from Alberta Environment and the files of Alberta Transportation.

The next stage of the investigation involved air photo interpretation of the study area by the principal investigators. This provided a base of information comparable to category 5 as shown on table 1. The primary area of interest to AFLW was then studied in more detail and a number of sites were identified for ground checking.

Field work was conducted in June, July and August, 1987 by foot, three-wheel all terrain cycle, truck amd helicopter. Summer access by wheeled vehicles is limited. However, all of the important features identified were visited. Samples were returned to the laboratory for grain size and petrographic analyses. A limited number of geophysical traverses using a Geonics EM31 were made in an attempt to detect buried granular material.

This report is based mainly on surface geological observation, field checking and limited laboratory data. Application of the results should take into account the reconnaissance nature of the study.

GEOLOGY

Physiography and Bedrock

Major physiographic features (Pettapiece, 1986) within the northern study area are classified in two sections from the Northern Alberta Lowlands Region and one section from the Saskatchewan Plains Region. The two sections in the Northern Alberta Lowlands Region (Figure 2) are the McMurray Lowland Section and the Wabasca Lowland Section. Within each of these sections are two districts. The Dover Plain District in the McMurray

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 suitable 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 inexpensive 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 per prof-year.	Special projects only.	Special projects only.

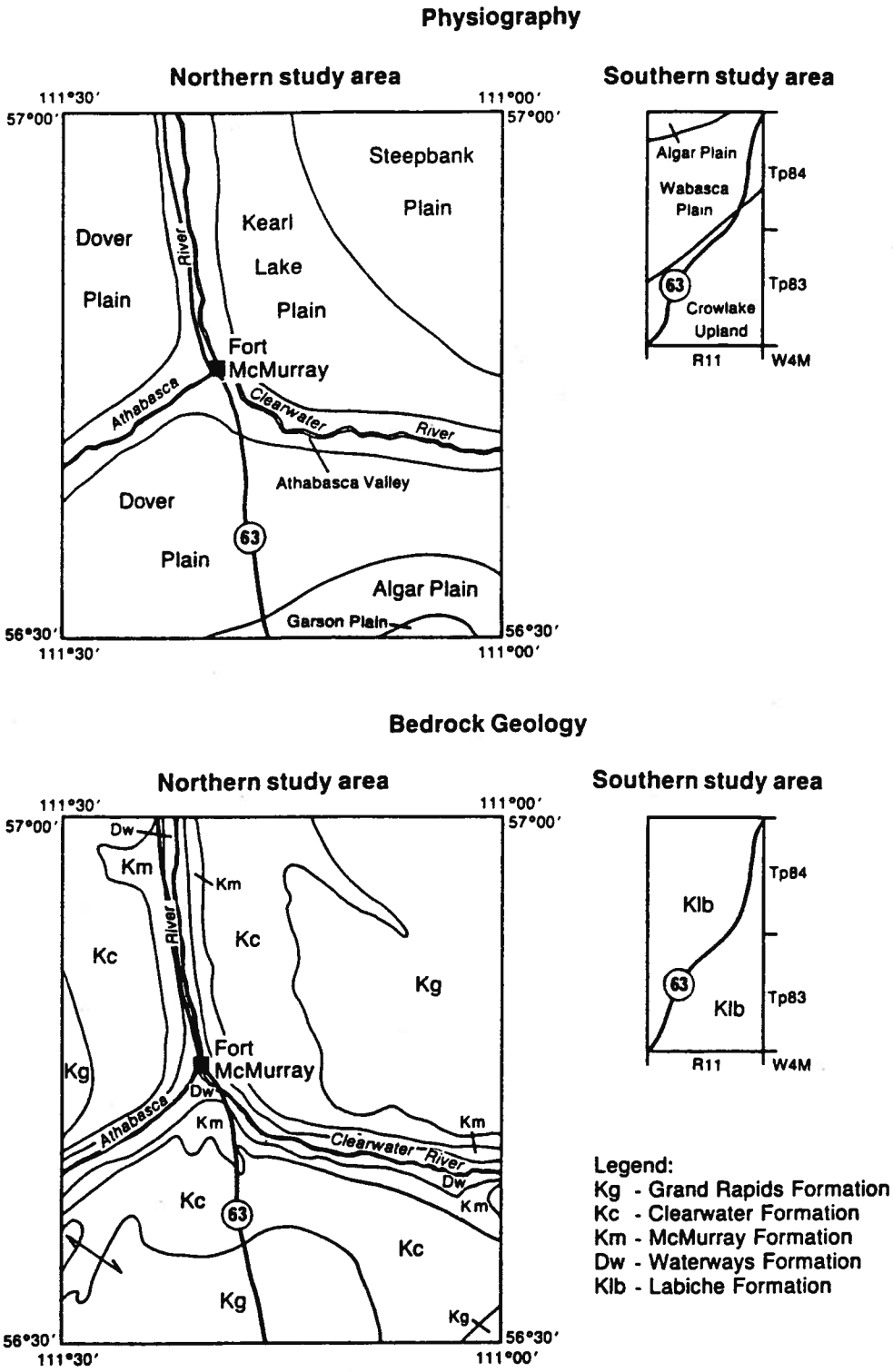

Figure 2. Physiography and Bedrock of the Study Area.

Lowland Section covers parts of two townships and four ranges and reaches a maximum elevation of 490m. The Kearl Lake Plain, also in the McMurray Lowland Section, covers parts of three townships and three ranges and reaches a maximum elevation of 460m. The Athabasca Valley District in the Wabasca Lowland Section covers parts of four townships and four ranges and reaches a minumum elevation of 250m. The section in the Saskachewan Plains Region (Figure 2) is the Methy Portage Plains Section. Within this section, the Steepbank Plain District covers parts of three townships and two ranges and reaches a maximum elevation of 520m.

The southern study area plus the selected sites have physiographic features in one section from the Northern Alberta Lowlands Region and one section from the Northern Alberta Uplands Region. The section in the Northern Alberta Lowlands Region is the Wabasca Lowland Section which in turn is subdivided into two districts. The Wabasca Plain Districts covers parts of two townships and one range and reaches a minimum elevation of 550m. The Algar Plain District covers part of one township and one range and reaches a minimum elevation of 430m. The section in the Northern Alberta Uplands is the Stony Mountain Upland Section. Within this section is the Crow Lake Upland District which covers parts of two townships and one range, at a maximum elevation of 760m.

Bedrock (Figure 2) in the northern study area is mainly Early Cretaceous in age and is underlain by rock of Devonian Age. The Dover Plain District and the Kearl Lake Plain District are underlain by three formations of Lower Creatceous material. The McMurray Formation is a thick bedded, quartzose sandstone and siltstone, oil impregnated, marine deposit. The Clearwater Formation consists of dark gray, marine, fossiliferous, silty shale, laminated siltstone and fine grained cherty sandstone. The Grand Rapids Formation, consisting of fine grained quartzose and feldspathic sandstone, laminated siltstone and silty shale, is a shoreline complex deposit. The Steepbank Plain Section is underlain by the Grand Rapids Formation. The Waterways Formation of Devonian Age, underlying the Athabasca Valley District, is composed of marine, gray and geenish gray shale and argillaceous limestone interbedded with gray and greyish brown, fine grained to coarse clastic limestone.

Bedrock (Figure 2) in the southern study area is the La Biche Formation of Early to Late Creatceous Age. The formation consists of dark gray, marine shale and silty shale with ironstone partings and concretions and silty, fish scale bearing beds in the lower part.

Surficial Geology

The surficial material (Bayrock and Reimchem, 1973) of the northern study area is of Recent and Pleistocene age. The Dover Plain Section is covered mainly by glaciolacustrine deposits of clay and silt with minor eolian deposits of fine sand. The Steepbank Plain Section is covered primarily by till and glaciolacustine material. The Athabasca Valley contains glaciofluvial meltwater, outwash and kame deposits and alluvial deposits of silt, sand and clay.

The southern study area is covered with till, glaciofluvial and minor glaciolacustrine materials.

SAND AND GRAVEL RESOURCES

Gravel and sand deposits in the area are variable. Most are only small pockets of gravel, thin sheets of sand or thin sheets of gravelly sand.

Deposit, pit, site and/or sample locations and a description of the aggregate resources in the study area are given in figures 3 to 6 (in pocket). Deposit, pit and site descriptions and laboratory data are in Appendices I to IV.

The northern study area is covered mainly by glaciolacustrine materials (Bayrock and Reimchem, 1973). Topography of the area, away from the river valleys, is fairly low and the material at the surface is mainly clay and silt with minor amounts of sand. The Clearwater and Athabasca River valley bottoms contain primarily fine grained Recent alluvial and Pleistocene glaciofluvial material. Material with clasts is rare. Glaciofluvial material, on high ground away from the river valleys, is

variable in composition and extent. Such material south of the Clearwater River is a source of sand and gravelly sand for the area (Fox, 1980). The deposits, however, are shallow, lie on the sides of low ridges and overlie clay or till. A drilling and backhoe testing program by Athabaska Realty (1975) in this area revealed material containing clasts in only 17 of 212 test holes. Eolian sand is present in minor amounts north of the Clearwater River (Bayrock and Reimchen, 1973). This area is covered mainly by glaciolacustrine clay and silt and muskeg swamps. The area west of the Athabasca River also is covered mainly by glaciolacustrine clay and silt and muskeg swamp at higher elevations.

The southern study area is covered by till and glaciofluvial material. Topography is rolling. The material in this area is primarily clay and silt. The till contains both clasts of igneous rocks from the Precambrian Shield and quartzite from the Athabasca Formation in northeastern Alberta. Kame and kame moraine deposits (Plate 1) along Hwy 63 have been exploited for aggregate in several areas. The material primarily is sand to gravelly sand. There are no major gravel deposits in the area other than the kame deposits.

All major gravel deposits in the northern and southern study areas have been located and exploited. There are small pockets of aggregate remaining as indicated in the site descriptions. However, our study indicates that no major deposits containing abundant clasts are present in the area. Any additional aggregate exploration in the region should focus on buried deposits which would show no surface expression and would not have been detected by this or previous research programs.

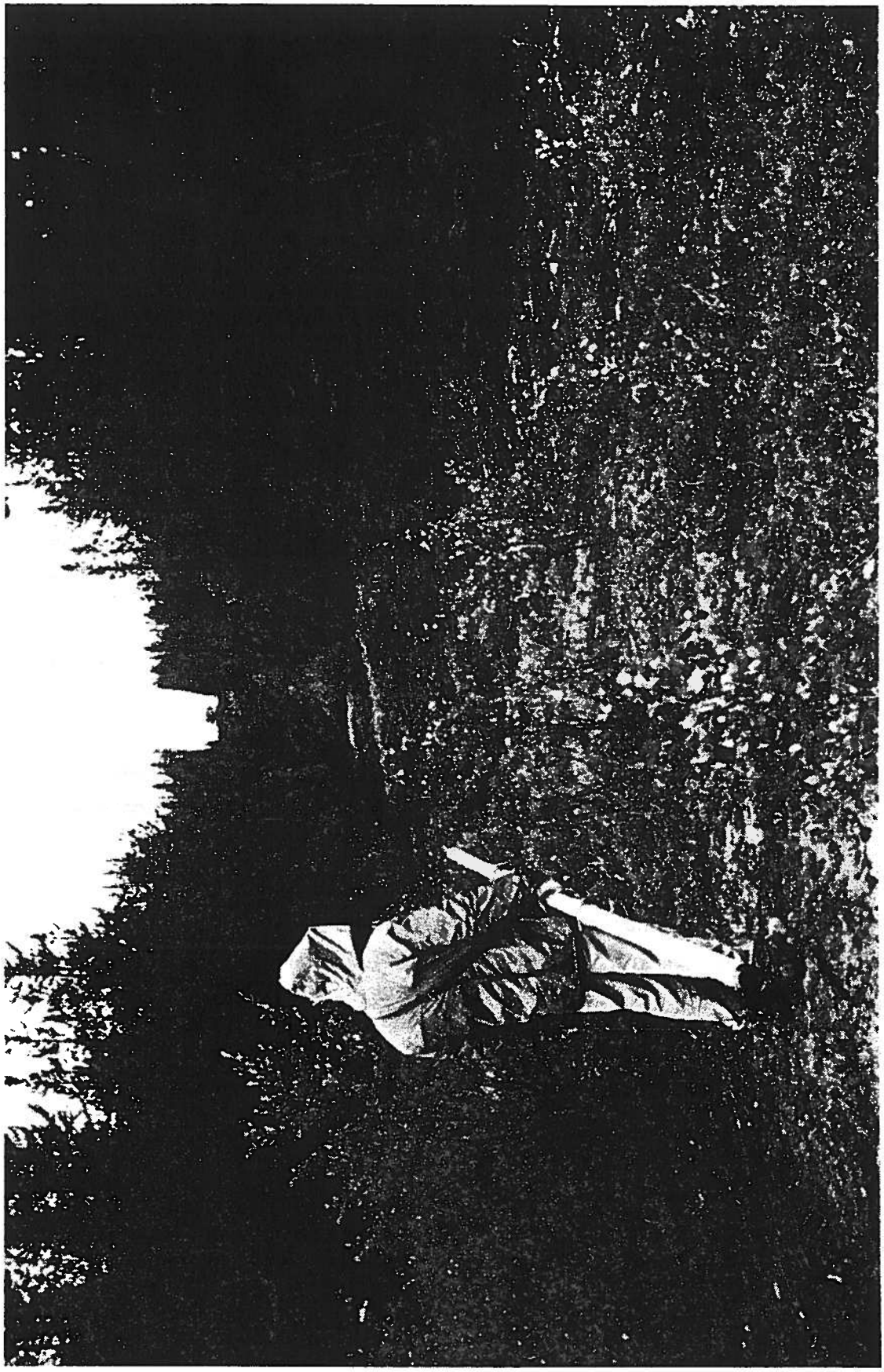

Plate 1. EM31 traverse across a large kame moraine deposit in LSD9 Sec7 Tp83 R11 W4M

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APPENDIX I

PIT/SITE DESCRIPTIONS FOR MAP AREA 74D/14

DEPOSIT 1

LOCATION: LSD14 Sec21 Tp90 R9 W4M
LSD3,4 Sec28 Tp90 R9 W4M
LSD3,5,6 Sec28 Tp90 R9 W4M
LSD8 Sec29 Tp90 R9 W4M

No. of associated pits/sites: 1

No. of samples analysed: None

DEPOSIT DESCRIPTION:

See site description below.

Site Location: LSD5 Sec28 Tp90 R9 W4M

Site Description:

Ridge 6m high of slighly dirty, fine sand with fewer than 1% clasts. Mollard (1974) Site 231.

DEPOSIT 2

LOCATION: LSD14 Sec 21 Tp90 R9 W4M
LSD2,3,6,7,8,9,10,11,12,15,16 Sec33 Tp89 R9 W4M

No. of associated pits/sites: 1

No. of samples analysed: None

DEPOSIT DESCRIPTION:

See site description below.

Site Location: LSD16 Sec33 Tp89 R9 W4M

Site Description:

Clean, fine to medium grained sand.

DEPOSIT 3

LOCATION: LSD10,11,12,13,14,15 Sec 32 Tp89 R8 W4M
LSD3,4,5,6 Sec5 Tp90 R8 W4M
LSD1,2,7,8 Sec6 Tp90 R8 W4M

No. of associated pits/sites: 1

No. of samples analysed: None

DEPOSIT DESCRIPTION:

See site description below.

Site Location: LSD3 Sec5 Tp90 R8 W4M

Site Description:

Clean, fine sand. Mollard (1974) Site 82.

DEPOSIT 4

LOCATION: LSD13 Sec13 Tp90 R8 W4M
LSD15,16 Sec14 Tp90 R8 W4M
LSD1,2 Sec23 Tp90 R8 W4M
LSD1,2,4,6 Sec24 Tp90 R8 W4M

No. of associated pits/sites: 1

No. of samples analysed: None

DEPOSIT DESCRIPTION:

See site description below.

Site Location: LSD1 Sec23 Tp90 R8 W4M

Site Description:

Ridge 5m high of fine to medium grained sand. Mollard (1974) Site 232/85.

PITS/SITES OUTSIDE DEPOSIT BOUNDARIES

Site Location: LSD16 Sec35 Tp89 R9 W4M

Site Description:

Clayey silt with 1% clasts to 15cm on 11m high ridge. Mollard (1974) Site 81.

Site Location: LSD15 Sec34 Tp89 R9 W4M

Site Description:

Helicopter flyover. Poplar and spruce forest with standing water. Probably clayey silt or till below.

Site Location: LSD10 Sec30 Tp90 R9 W4M

Site Description:

Clayey silt.

Site Location: LSD8 Sec30 Tp90 R7 W4M

Site Description:

Ridge 2m high with fine to medium clean sand and 1% clasts to 5cm.

Site Location: LSD2 Sec31 Tp90 R7 W4M

Site Description:

Helicopter flyover of section exposing 4m of bedded, clayey silt with 1% clasts to 15cm. Underlain by bedrock. Mollard (1974) Site 93.

Site Location: LSD3 Sec3 Tp90 R8 W4M

Site Description:

Till.

Site Location: LSD8 Sec7 Tp90 R8 W4M

Site Description:

Helicopter flyover. Poplar forest with some pines probably overlying clayey silt.

Site Location: LSD13 Sec8 Tp90 R8 W4M

Site Description:

Clayey silt.

Site Location: LSD16 Sec9 Tp90 R8 W4M

Site Description:

Veneer, 15cm thick, of sand overlying clayey silt and sand with 1% clasts to 25cm. Mollard (1974) Site 232/84.

Site Location: LSD7 Sec13 Tp90 R8 W4M

Site Description:

Helicopter flyover. Vegetation is mainly spruce and poplar, probably overlying till.

Site Location: LSD8 Sec16 Tp90 R8 W4M

Site Description:

Veneer, 10-15cm thick, of fine sand over till. Mollard (1974) Site 232/84.

Site Location: LSD7 Sec22 Tp90 R8 W4M

Site Description:

Dirty silt to fine sand. Mollard (1974) Site 92.

Site Location: LSD1 Sec27 Tp90 R8 W4M

Site Description:

Helicopter flyover. Spruce forest with patches of pine probably underlain with silt or till.

Site Location: LSD8 Sec3 Tp90 R9 W4M

Site Description:

Helicopter flyover. Poplar and spruce forest with standing water. Probably clayey silt or till below.

Site Location: LSD9 Sec8 Tp90 R9 W4M

Site Description:

Till or colluvium with clasts to 10cm. Abundant, angular limestone clasts suggest close proximity to bedrock.

Site Location: LSD15 Sec10 Tp90 R9 W4M

Site Description:

Helicopter flyover. Abundant black spruce and poplar probably overlying clayey silt or till.

Site Location: LSD8 Sec11 Tp90 R9 W4M

Site Description:

Ridge 4m high of slightly clayey silt to fine sand.

Site Location: LSD15 Sec11 Tp90 R9 W4M

Site Description:

Helicopter flyover. Poplar forest on small ridge with some pine interspersed. Probably clayey silt or till below.

Site Location: LSD2 Sec12 Tp90 R10 W4M

Site Description:

Helicopter flyover. Spruce and poplar forest with standing water. Probably clayey silt or till below.

Site Location: LSD7 Sec21 Tp90 R9 W4M

Site Description:

Clayey silt. Mollard (1974) Site 231.

Site Location: LSD10 Sec30 Tp90 R9 W4M

Site Description:

Clayey silt.

Site Location: LSD12 Sec25 Tp90 R10 W4M

Site Description:

Clean, fine to medium grained sand on three ridges 2m above surrounding swamp.

APPENDIX II

PIT/SITE DESCRIPTIONS FOR MAP AREA 74D/11

DEPOSIT 1

LOCATION: LSD6,10,9 Sec19 Tp89 R8 W4M

No. of associated pits/sites: 1

No. of samples analysed: None

DEPOSIT DESCRIPTION:

See site description below.

Site Location: LSD10 Sec19 Tp89 R8 W4M

Site Description:

Clean, fine to medium sand.

DEPOSIT 2

LOCATION: LSD6,7,11,15,16 Sec8 Tp87 R8 W4M
LSD7,8,10,9,15,16 Sec9 Tp89 R8 W4M
LSD1 Sec10 Tp89 R8 W4M
LSD4,5 Sec11 Tp89 R8 W4M

No. of associated pits/sites: 5

No. of samples analysed: None

DEPOSIT DESCRIPTION:

Clean, fine to medium grained sand.

Site Location: LSD6 Sec8 Tp89 R8 W4M

Site Description:

Helicopter flyover. Pine cover, probably over sand.

Site Location: LSD10 Sec8 Tp89 R8 W4M

Site Description:

Helicopter flyover. Poplar and willow cover with standing water. Probably underlain with clayey silt or till.

Site Location: LSD15 Sec8 Tp89 R8 W4M

Site Description:

Helicopter flyover. Mainly pine cover. Probably underlain with sand.

Site Location: LSD9 Sec9 Tp89 R8 W4M

Site Description:

Clean, fine to medium grained sand.

Site Location: LSD1 Sec10 Tp89 R8 W4M

Site Description:

Clean, fine to medium grained sand.

DEPOSIT 3

LOCATION: LSD13 Sec7 Tp89 R7 W4M
LSD9,10,15,16 Sec12 Tp89 R8 W4M
LSD1,2 Sec13 Tp89 R8 W4M

No. of associated pits/sites: 1

No. of samples analysed: None

DEPOSIT DESCRIPTION:

See site description below.

Site Location: LSD13 Sec7 Tp89 R7 W4M

Site Description:

Clean, fine to medium grained sand.

DEPOSIT 4

LOCATION: LSD9,10,11,14,15,16 Sec9 Tp89 R7 W4M
LSD1,2 Sec16 Tp89 R7 W4M

No. of associated pits/sites: 2

No. of samples analysed: None

DEPOSIT DESCRIPTION:

Clean silt to fine sand.

Site Location: LSD1 Sec9 Tp89 R7 W4M

Site Description:

Clean silt to fine sand. Mollard (1974) Site 51.

Site Location: LSD14 Sec9 Tp89 R7 W4M

Site Description:

Kettle hole with clean, fine grained sand. Mollard (1974) Site 51.

DEPOSIT 5

LOCATION: LSD7,10 Sec35 Tp88 R9 W4M

No. of associated pits/sites: 2

No. of samples analysed: None

DEPOSIT DESCRIPTION:

Veneer of cobbly to pebbly, fine to medium grained sand over till.

Site Location: LSD7 Sec35 Tp88 R9 W4M

Site Description:

Cobbly to pebbly, fine to medium grained sand. Maximum clast size is 30cm.

Site Location: LSD10 Sec35 Tp88 R9 W4M

Site Description:

Results of a southward 150m traverse along a cut line with the EM31 indicate that the bouldery sand at the surface probably is a veneer over till.

DEPOSIT 6

LOCATION: LSD3,5,6 Sec36 Tp88 R9 W4M

No. of associated pits/sites: 2

No. of samples analysed: None

DEPOSIT DESCRIPTION:

Fine to medium grained sand. Clean to dirty. Clasts less than 1%.

Site Location: LSD5 Sec36 Tp88 R9 W4M

Site Description:

Clean, fine to medium grained sand with 1% clasts to 40cm. Very few clasts are smaller than 10cm.

Site Location: LSD6 Sec36 Tp88 R9 W4M

Site Description:

Primarily sand, dirty in some areas. One small lens of dirty gravel 2m wide.

DEPOSIT 7

LOCATION: LSD5,12,13 Sec25 Tp88 R9 W4M
LSD8,9,16 Sec26 Tp88 R9 W4M
LSD1,8 Sec35 Tp88 R9 W4M

No. of associated pits/sites: 7

No. of samples analysed: 6

DEPOSIT DESCRIPTION:

Interbeds of fine, clean sand with dirty, poorly graded gravelly sand. Clasts are less than 10% and are primarily subangular to subrounded igneous rocks from the Canadian Shield with some hard sandstone and quartzite. Ironstone and till clasts are common.

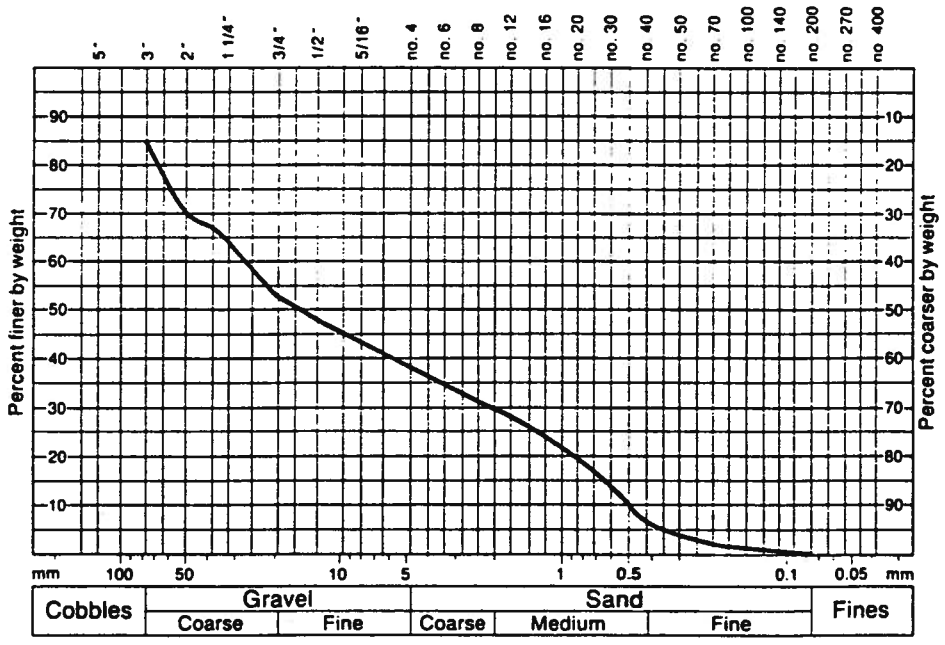
Site Location: LSD5 Sec25 Tp88 R9 W4M

Site Description:

Roadcut exposing 2m of clean, poorly graded gravelly sand overlying till and below 10cm of overburden. Maximum clast size is 75cm but most material is smaller than 4mm. Clasts are mostly subangular to subrounded igneous rocks from the Canadian Shield or quartzite. Ironstone clasts are abundant and commonly are broken. This is an isolated pocket of material with clasts as the material present in the surrounding area is sand.

Gradation:	14.0% cobbles	47.0% gravel
	38.0% sand	1.0% fines

Gradation curve

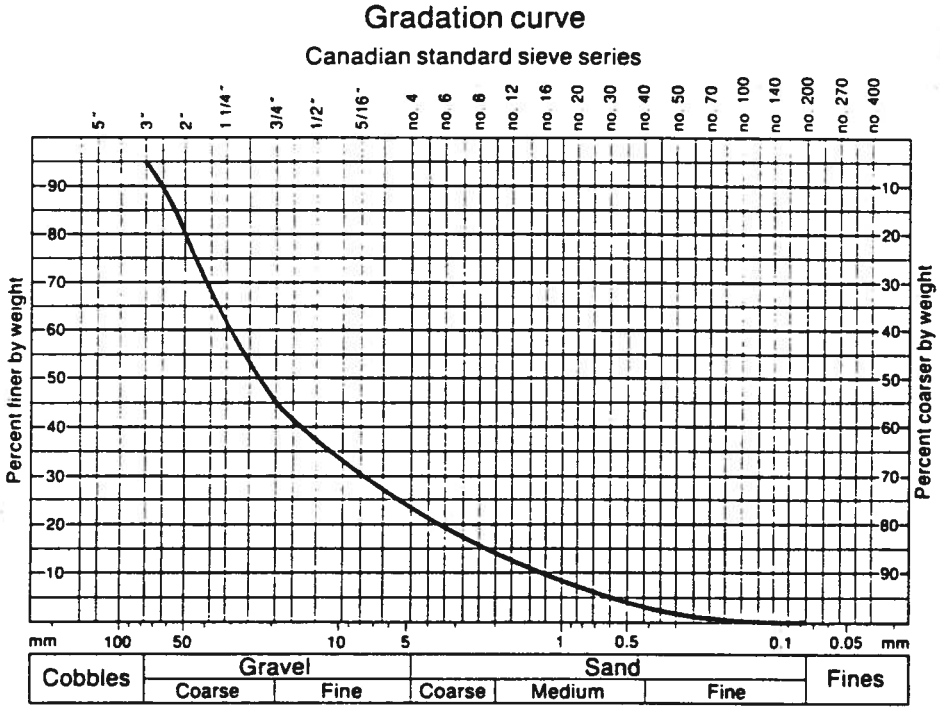


Pit Location: LSD9 Sec26 Tp88 R9 W4M

Pit Description:

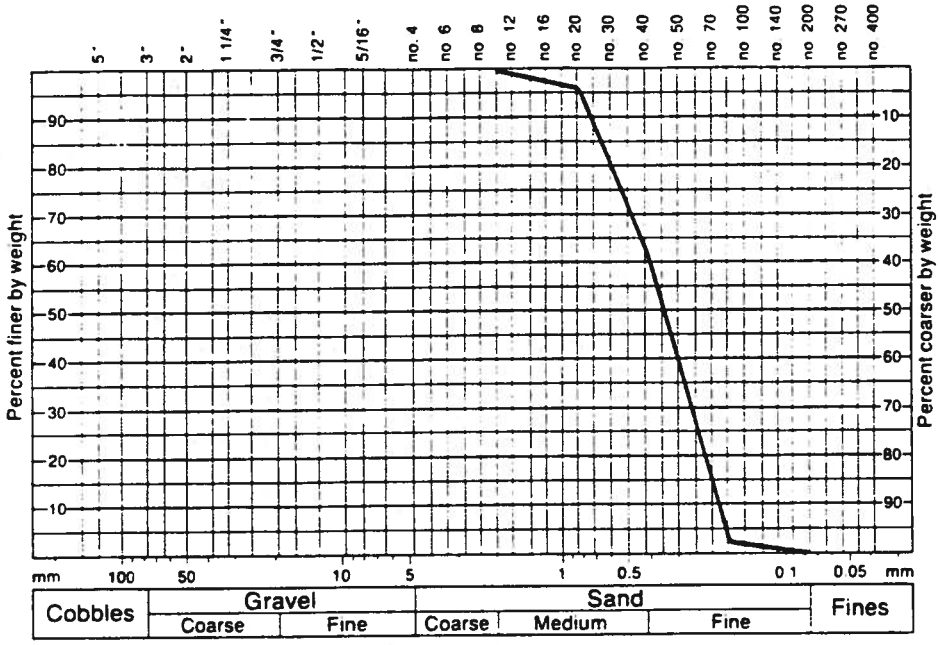
Exposure of 5.75m of well graded, dirty gravel overlain by 10cm of overburden. Maximum clast size is 75cm - 1m. Clast are subangular to subrounded and sand grains are sharp. Igneous rocks from the Canadian Shield compose approximately 40% of the clasts with hard sandstone and quartzite each composing approximately 10%. Till clasts are common and are reported to be more common to the east. Horizontal bedding is poorly developed. A lens, 4m high and 10m long, of fine sand with minor pebbles is present below gravel at the east edge of the exposure. Iron stain blotches are present throughout.

Gradation:	3.8% cobbles	73.1% gravel
	22.5% sand	0.6% fines
	0.0% cobbles	0.4% gravel
	99.4% sand	0.2% fines



Gradation curve

Canadian standard sieve series



Pit Location: LSD9 Sec26 Tp88 R9 W4M

Pit Description:

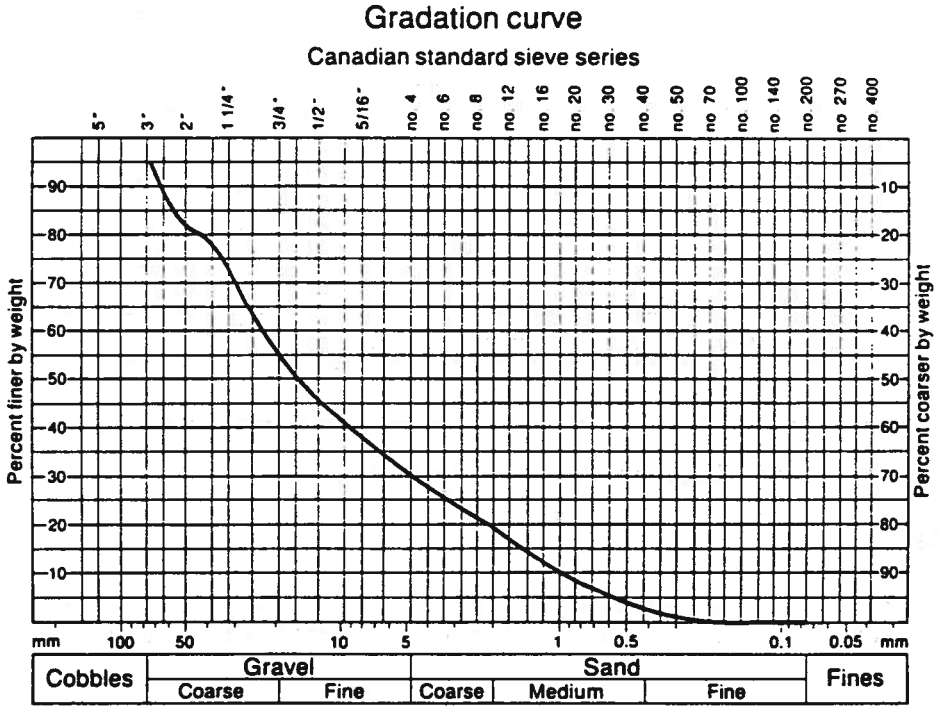
Approximately 3.5m of dirty gravel with abundant till clasts. The largest till clast is 1m and 25cm clasts are abundant.

Pit Location: LSD16 Sec26 Tp88 R9 W4M

Pit Description:

Overburden is removed from above a 4m face of well graded, dirty gravelly sand. Maximum clast size is 40cm but 90% of the material is smaller than 4mm. Clasts are subangular to subrounded and consist primarily of igneous rocks from the Canadian Shield with some quartzite. Till clasts are present but less abundant than in the pit described above. Further north in the pit total depth of granular material is approximately 11m but is primarily sand interbedded with large blocks of till.

Gradation:	3.8% cobbles	65.8% gravel
	30.1% sand	0.3% fines

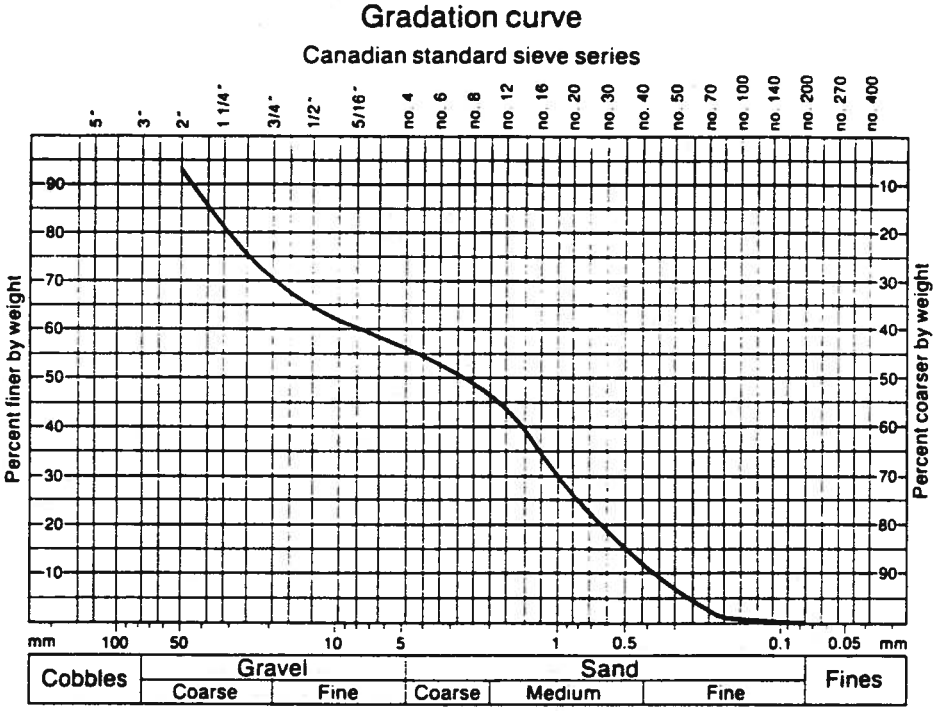


Pit Location: LSD1 Sec35 Tp88 R9 W4M

Pit Description:

Primarily fine sand with minor, local lenses of aggregate draped to the west over till. Sand is fine, clean and with iron stain common on bedding planes. Clay-rich silt or sand to 2m commonly is overburden. Maximum clast size is 1m but 85% of the material is finer than 4mm. Clasts are subangular to subrounded and consist primarily of igneous rocks from the Canadian Shield plus sandstone and quartzite. The sample was taken from a lens of aggregate.

Gradation: 0% cobbles 43.4% gravel
56.1% sand 0.5% fines



Site Location: LSD1 Sec35 Tp88 R9 W4M

Site Description:

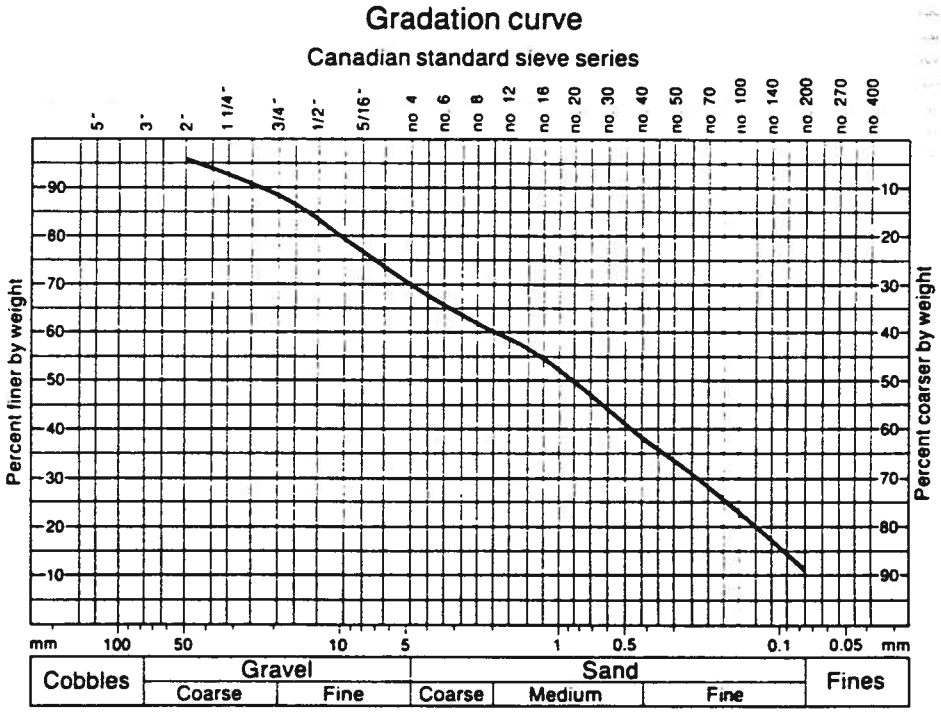
Results of an eastward 150m traverse with the EM31 indicate that the material probably is till overlain with fine sand.

Pit Location: LSD8 Sec35 Tp88 R9 W4M

Pit Description:

Test pit 1.75m deep in very dirty gravelly sand with abundant clay clasts overlying fine to medium grained, clean, iron stained, thin bedded sand. The clasts in the upper 1.25m are subangular to subrounded, compose 5% of the material and consist of igneous rocks from the Canadian Shield plus quartzite. A few oil sand clasts also are present. Results of a northward traverse with the EM31 indicate that the material probably is a continuation of very dirty gravelly sand.

Gradation:	0% cobbles	30.9% gravel	wet sieve
	48.1% sand	21.0% fines	
	0% cobbles	30.9% gravel	dry sieve
	68.3% sand	0.8% fines	



Gradation curve

Canadian standard sieve series