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Ontario Geological Survey

**Northern Ontario
Engineering Geology Terrain Study 54**

SEINE RIVER AREA

(NTS 52C/NE)

District of Rainy River

by

M.A. Roed

1980



Ontario

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Data Base Map, Seine River (NTS 52C/NE). Scale 1:100 000.

Map 5072 (coloured) – Northern Ontario Engineering Geology Terrain Study,
Sand and Gravel Resources Map, Seine River (NTS 52C/NE).
Scale 1:100 000.

**Northern Ontario
Engineering Geology Terrain Study 54**

SEINE RIVER AREA

(NTS 52C/NE)

District of Rainy River

by

M.A. Roed¹

1.0 INTRODUCTION

This report and the accompanying map present the results of an engineering geology terrain study for the Seine River area, District of Rainy River. The area, which covers NTS block 52C/NE, lies between Latitudes 48°30'N and 49°00'N and Longitudes 92°00'W and 93°00'W. The report and map form part of a series of publications which provide similar terrain data for approximately 370 000 km² of northern Ontario.

The purpose of this study is to provide an inventory of engineering geology terrain conditions that will serve as a basic data framework for engineering and resource planning activities, at a level of detail consistent with a scale of 1:100 000. The terrain information is contained on the Data Base Map (OGS Map 5070, accompanying this report). The Sand and Gravel Resources Map (OGS Map 5072, accompanying this report) is a derived map which illustrates the potential for finding surficial deposits of aggregate within the various terrain units.

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Interpretation of 1976 black and white aerial photographs, at a scale of approximately 1:50 000, formed the basis of the terrain mapping process. The interpretation was compared to relevant published information for the study area. The main roads in the area were traversed during the summer of 1978 to provide spot checks of the office studies. Thus, the Data Base Map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common information base for the entire map series. This legend is shown on the accompanying Data Base Map. Further discussion on the mapping techniques, legend format, and possible uses of this engineering geology information is available in the Ontario Engineering Geology Terrain Study Users' Manual (Gartner, Mollard, and Roed 1980), a companion publication to this series of maps and reports.

Appreciation is expressed to the Ontario Geological Survey for providing a manuscript copy of the aggregate inventory map for the area, prepared by E.V. Sado.

2.0 GEOLOGIC SETTING

The Seine River area is underlain by crystalline bedrock of Precambrian age, which is covered in places by a patchy mantle of Quaternary surficial deposits. The terrain is dominated by rocky uplands and lowlands covered with patches of ground moraine. Extensive moraine deposits occupy a wide belt across the east-central part of the area. Kame features, glaciofluvial units, and glaciolacustrine plains are well represented. Alluvial terrain is not well developed. Organic deposits are widespread, but occur mainly in association with poorly developed streams.

2.1 BEDROCK GEOLOGY

The Seine River area lies within the Wabigoon Belt in the Superior Structural Province of the Canadian Shield. The oldest rocks are Early Precambrian metavolcanics and metasediments which occur as (1) a wide easterly trending belt extending across the central part of the area from Seine Bay in the west to Niven Lake in the east, (2) a narrow easterly

trending belt lying to the north of the first and extending from Little Turtle Lake in the east to Moosetrack Lake in the west, and (3) a wide belt extending northwest from Redgut Bay in the northwest corner of the area. Large mafic and ultramafic bodies are scattered throughout the first of these belts, particularly near Bad Vermillion Lake, Bennett Lake, and Niven Lake. A very thick sequence of steeply dipping metasediments, believed to be younger than the metavolcanics, occupies the entire southern part of the map-area. These rocks are intruded by several widely separated felsic plutons. The northern half of the area is dominated by Early Precambrian felsic intrusive and metamorphic rocks, believed to be younger than the metavolcanics or metasediments. Diabase dikes of Proterozoic age may also occur in the area (Davies and Prysak 1967).

Much of the large, centrally located, east-trending metavolcanic-metasedimentary belt has medium to high mineral potential, particularly for base metals. Parts of the metavolcanic belt in the northwest corner of the area have medium potential, particularly for gold, silver, and base metals. The remainder of the map-area has low mineral potential (Springer 1978).

2.2 QUATERNARY GEOLOGY

Northwestern Ontario has been affected by several stages of continental glaciation during the Pleistocene. However, only deposits of the last glaciation, the Laurentide of Wisconsinan age, are preserved in the Seine River area. The ice began to advance approximately 100 000 years ago and travelled as far south as central Wisconsin before receding. The ice disappeared from the Seine River area approximately 15 000 years ago (Prest 1970). Zoltai (1961) gives a more complete account of the glacial history of the region.

Widespread stagnation of the ice mass resulted in the deposition of a variety of surficial materials. Till was deposited directly by the ice in the form of ground moraine and hummocky moraine. Meltwater from the glacier formed glaciofluvial outwash deposits, kames, and the linear moraine features in the area. Ponded meltwater accumulated in lowlands to form glacial lakes. These grew in size and eventually coalesced to form an enormous body of water called Glacial Lake Agassiz. Widespread deposits of glaciolacustrine silt and clay occur wherever this lake covered the land in the lowlands adjacent to Rainy Lake. In some localities,

bedrock hills were swept clean of unconsolidated material during the high water stage of Glacial Lake Agassiz, as evidenced by numerous bare bedrock knobs. In other parts of the area, the bedrock topography has been completely covered by the lake deposits. In the rocky uplands, the glacier overdeepened valleys, rounded off bedrock outcrops, and left scattered patches of moraine and boulders. Glacial lake water did not inundate large parts of these uplands.

The complete disappearance of glacial ice and the gradual draining or drying up of glacial lakes marked the end of the Pleistocene Stage of the Quaternary Period in the area. Since that time, approximately 9 000 years ago (Prest 1970), modern streams have developed alluvial flood plains and organic deposits have accumulated in wet depressions. These deposits are nonglacial in origin and, together with the various glacial materials, comprise the variety of Quaternary unconsolidated deposits that forms a discontinuous mantle over the bedrock in the Seine River area.

2.3 PHYSIOGRAPHY

Rugged hilly rock terrain of moderate relief dominates the map-area, with the exception of an east-trending belt of land between the Pipestone River and the Seine River in the east-central part of the area. This belt is part of a narrow rock and moraine lowland that borders the southeastern part of Rainy Lake. Elevations range from 338 m at Rainy Lake to 457 m west of the Turtle River in the northwestern part of the area. Rugged rock terrain of high relief occurs to the east of Dovetail Lake in the northeast corner of the area and ridged rock characterizes the terrain flanking Big Sawhill Lake in the northwest corner of the area. Scarps are particularly prominent along the valleys and bays of northeastern Rainy Lake.

Unusual physiographic features include the straight deep bedrock valley of the Turtle River in the northwestern part of the area and a crater-like depression occupied by Holmes Lake in the northeastern part. Also, a substantial kame moraine occurs to the west of Holmes Lake and a linear moraine feature borders the southern shore of Clearwater West Lake in the northeast corner of the area.

3.0 ENGINEERING TERRAIN UNITS

Engineering terrain units are composed of a combination of various materials (unconsolidated and/or bedrock) which form recognizable landforms with certain engineering characteristics. Major terrain unit groups, and the engineering significance of each, are discussed in detail. These include bedrock terrain (RN, RR), ground moraine (MG), glaciofluvial outwash (GO), kames (GK), and deltas (GD), glaciolacustrine plains (LP), alluvial plains (AP), and organic terrain (OT). A diagrammatic sketch of a typical terrain setting is given in Figure 1. Table 1 summarizes the characteristics and engineering significance of the major terrain units in the Seine River area.

3.1 BEDROCK

Examples: $\frac{RN(tsMG) (pOT)}{Mnj-D(W)}$

$\frac{RN(cmLP) (tsMG)}{Mn-D}$

$\frac{RR(tsMG)}{Mnj-D}$

Much of the bedrock terrain is hilly (n) and of moderate relief (M). Rugged topography (j) is characteristic of the northern part of the map-area and some high relief (H) bedrock terrain occurs east of Dovetail Lake in the northeast corner. Low relief hilly bedrock terrain (Ln) is common in the west-central part of the area. A thin, discontinuous layer of sandy boulder till (tsMG) mantles the rock in many localities, although bare bedrock is common. Patches of till greater than 10 m in thickness may occur locally. Varved red and grey clay (cmLP) is widespread in this unit, primarily in depressions, but clay is rare or absent in the northernmost part of the map-area. Glaciofluvial sand and gravel outwash deposits are common in bedrock terrain, particularly around Sturgeon Falls in the eastern part of the area. Minor organic terrain is common in poorly drained localities.

The principal engineering significance of bedrock terrain is that it is difficult and expensive to excavate. Due to the rugged topographic character, extreme alignment techniques and extensive cut-and-fill operations are necessary for adequate road construction. Since, in many places, this unit has a limited supply of unconsolidated material and a shortage of aggregate, importation of suitable materials would be

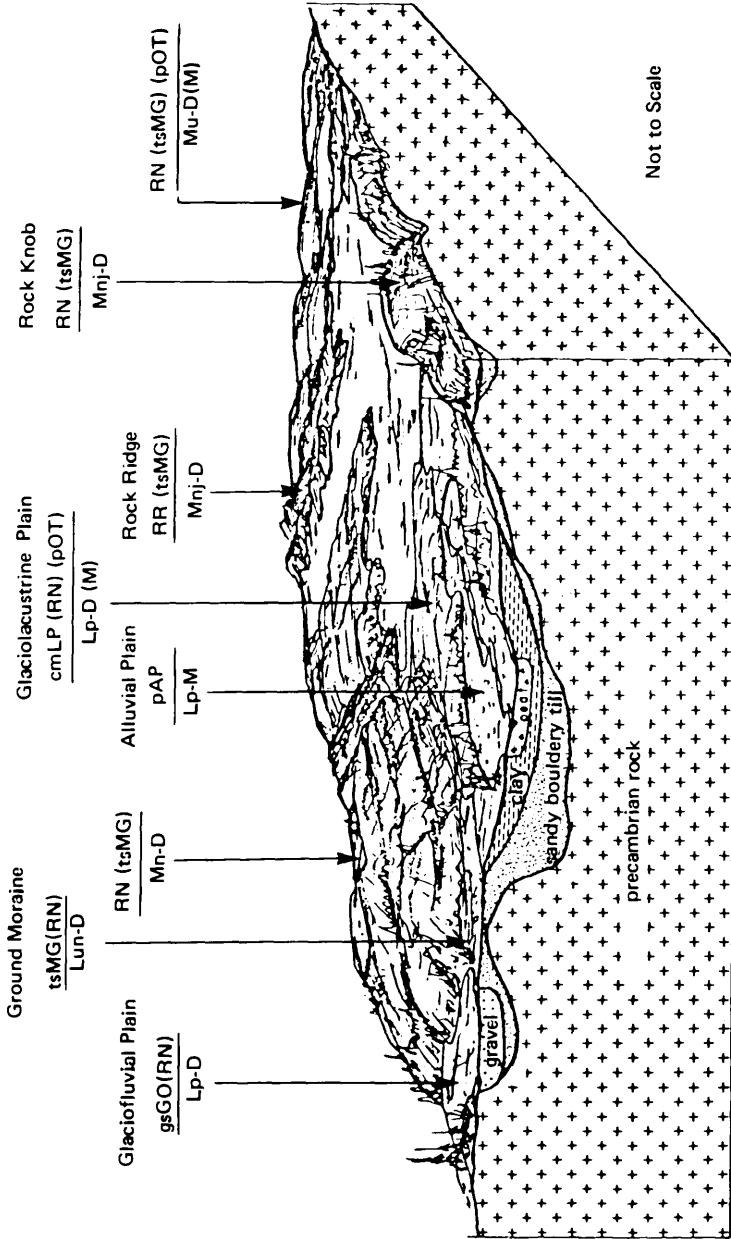


FIGURE 1 – DIAGRAMMATIC SKETCH SHOWING TYPICAL TERRAIN TYPES AND THEIR REPRESENTATIVE LETTER SYMBOLS.

necessary and would involve substantial expense. It was noted, however, that thick blankets of ground moraine till do occur in association with some bedrock landforms and that pockets of glaciolacustrine silt and clay are particularly common in the central part of the area. Careful exploration for these soil types could substantially decrease engineering difficulties in bedrock terrain. Although local deposits of glaciofluvial sand and gravel can be expected and some raised beach gravel deposits occur along rock buttressed shorelines, aggregate is generally scarce.

Groundwater can occur in fractures and along fault zones in the rock, but this terrain unit is considered to have only poor to fair potential for groundwater supply. Rock terrain is unsuitable for surface waste disposal of any kind, except where there is a thick layer (at least 1.5 m) of attenuating soil material.

3.2 MORAINE

Examples: $\frac{tsMG(RN)}{Ln \cdot D}$ $\frac{tsMG(RN) (cmLP)}{Lup \cdot D}$ $\frac{sgbGK(ME)}{Mr \cdot D}$

Large expanses of ground moraine (MG) are located (1) to the southwest of Otukamamoan Lake in the northwest corner of the area (Blackburn 1973), and (2) in a wide east-trending belt south of the Seine River in the east-central part of the area. Sandy till (tsMG) is the main constituent in this ground moraine, but local pockets of sand and gravel are not uncommon. Also, numerous rock knobs occur in the unit and small patches of glaciolacustrine clay are common, especially in the moraine south of the Seine River. This belt is of low relief and is gently undulating. It is presently undergoing an extensive pulpwood harvest.

A linear moraine feature occurs along the southwestern shore of Clearwater Lake but is mapped as mainly kame (GK) material. Since till ridges are evident on its surface, it has been given a subordinate end moraine (ME) designation. To the northwest this feature is esker-like and, in places, contains deltaic deposits and till.

Ground moraine till is an excellent source of well-graded fill in this map-area and may contain local pockets of sand and gravel. The unit is generally well drained and provides good foundation conditions, but is quite irregular in topography. Rock knobs occur unpredictably and most

TABLE 1 SUMMARY OF TERRAIN UNIT CHARACTERISTICS AND ENGINEERING SIGNIFICANCE, SEINE RIVER AREA

Terrain Unit and Location	CLASSIFICATION		ENGINEERING USE					Major Constraints
	Material; Relief; Topography; Drainage	General Construction	Transportation Routes	Waste Disposal	Groundwater Supply			
ROCK TERRAIN (RN) , most extensive in northern portion of area	rock; moderate relief (15 to 30 m); knobby to rugged; good drainage	excavation and fill necessary; blasting	excavation and fill required; blasting; aggregate in small pockets	pollution potential high	deep wells provide enough water for domestic requirements in most places		blasting is required for most excavations; limited aggregate	
GROUND MORaine (MG) , mainly in west-central part of area	sandy till (ts); low relief (less than 15 m); undulating; drainage good	excavations and fill necessary for some types	excavations and fill may be required; aggregate in small pockets	suitable for septic systems where deposit is at least 1.5 m thick	poor to fair potential		thin deposit; rock knobs; minor organic units	
GLACIOFLUVIAL KAMES (GK) , mainly in the northeast quadrant	sandy, gravelly till (sgt); moderate relief; knobby and ridged; drainage good	good conditions	aggregate abundant	pollution potential high	good potential		quality of aggregate	
GLACIOFLUVIAL OUTWASH (GO) , throughout the area	sand and gravel (sg); low to moderate relief (less than 30 m); planar to knobby; drainage good	excellent conditions	suitable base and aggregate	pollution potential high	excellent potential where deposits are thick		quantity of aggregate	

GLACIOLACUSTRINE PLAIN (LP) , mainly in central portion of area	sand, silt, and clay (smc); low relief; planar; drainage mixed	excavations are easy; frost susceptible; low bearing capacity	aggregate scarce	suitable where deposit is thick and groundwater table low	poor to fair potential for domestic supply	lack of aggregate; frost susceptible
ORGANIC TERRAIN (OT) , throughout the area	peat (p); low relief; planar; drainage poor	frost susceptible; low bearing capacity; compressible	unsuitable subgrade	pollution potential high	poor potential	low strength; high frost susceptibility; poor drainage
ALLUVIAL PLAINS (AP) , along major streams	sand and peat (sp); low relief; planar; drainage poor	low bearing capacity; frost susceptible	unsuitable subgrade; poor drainage	pollution potential high	poor potential	frost susceptible; low bearing strength; poor drainage

depressions are wet and may contain clay, organic material, or both. Linear moraine features likely contain large quantities of sand and/or gravel.

Groundwater potential is fair to good. This unit is generally suitable for municipal waste disposal and septic drain tile fields.

3.3 GLACIOFLUVIAL

Examples: $\frac{\text{sgGO(RN)} (\text{tsMG})}{\text{Mn-D}}$	$\frac{\text{sgGO(cmLP)} (\text{RN})}{\text{Lup-D}}$	
$\frac{\text{sgGO(pAP)}}{\text{Lp-M}}$	$\frac{\text{sgtGK(RN)}}{\text{Mr-D}}$	$\frac{\text{sgGD(RN)}}{\text{Lp-D}}$

Numerous glaciofluvial outwash plains occur in the Seine River area; however, because of irregular topography, their distribution is difficult to show. The most extensive outwash plains include those (1) between Clearwater West Lake and Sandbeach Lake in the northeast corner of the area, (2) west of Manion Lake in the north-central part of the area, and (3) in the broad valley occupied by Darby Creek in the southeast corner of the area. These generally consist of sand with subordinate amounts of gravel (sgGO). Sandy gravel (gsGO) occurs in ill-defined glaciofluvial channels over a large area west of Flanders and to a lesser degree on the Sturgeon Falls Indian Reserve. Most of these glaciofluvial materials occur in association with moraine, rock knobs and glacio-lacustrine units. In some places along the Little Turtle River in the central part of the area, glaciofluvial outwash sand and gravel are overlain by a mantle of varved clay (cmLP/sgGO).

Very thick glaciofluvial kame (GK) or deltaic (GD) gravelly sand occurs in the linear moraine feature along the southwestern shore of Clearwater West Lake. In this locality, however, the unit has been mapped in association with an end moraine (ME) since till ridges are apparent.

Extensive kame-like features (sgtGK), containing some sand and gravel, considerable bouldery till, and finer grained material, occur elsewhere in the map-area. The most prominent of these units is a discontinuous belt of kame material which extends from the west shore of Sandbeach Lake southwest for a distance of nearly 45 km to Wild Potato Lake. Other kames occur near Burton Lake in the eastern part of the area.

Glaciofluvial terrain units are notably rare in the rugged bedrock terrain of the northwestern part of the map-area. Perhaps here the glaciofluvial deposits are restricted to narrow terrace-like features along valleys which are not easily recognized on the airphotos.

Glaciofluvial deposits are a potential source of considerable quantities of surficial aggregate. This unit also provides good foundation conditions where drainage is adequate, and is considered as a good potential groundwater aquifer. It is generally unsuitable for waste disposal, except for the location of widely separated septic drain tile fields.

3.4 GLACIOLACUSTRINE

Examples: $\frac{\text{scLP/sgGO(RN)}}{\text{Lpd-D}}$ $\frac{\text{cmLP(RN)}}{\text{Lun-D}}$

Varved clay, varying from grey to red in colour, is widespread in the lowlands of the Seine River area, with the exception of the northwestern part. The unit is usually at least 3 to 4 m thick and probably attains its maximum thickness along the Little Turtle River and west of Moosetrack Lake in the central part of the area. Glaciolacustrine clay and silt plains are also a common subordinate landform in other terrain units. Many of the organic deposits in the area are likely underlain by glaciolacustrine clay. Sand is the major constituent of the glaciolacustrine plain located west of Moosetrack Lake, and sandy silt is the common glaciolacustrine material in the vicinity of Clearwater West Lake. Glaciolacustrine clay overlies glaciofluvial outwash sand and gravel (cmLP/sgGO) in places along the Little Turtle River.

The silt and clay plains of glaciolacustrine origin are ideally suited to excavation engineering projects such as pipeline and transportation routes. The material is easy to dig and, in many places, it is dry, although wet conditions may prevail locally. It is a poor fill material because it is subject to settling. Susceptibility to frost action reduces its foundation suitability. Bank stability is a potential problem along the steep slopes of river banks and along shorelines subject to wave action.

Interbedded sand layers may occur at depth and underlying gravel units are known to be present. These would form potential groundwater aquifers, but generally the unit has poor groundwater potential. The

basic framework of resource characteristics that allows development of a wide variety of engineering or planning derivative maps. A derivative map can be defined as a graphic representation of the terrain in terms of its potential with respect to a specific engineering or planning use, or a number of uses. Derived maps are needed because many people who have special interests in the map-area may not have the necessary geological or engineering expertise to fully interpret the Data Base Map for their particular application. The objective of presenting such a map in this report, therefore, is to demonstrate how an easily understood illustration can be produced from the Data Base Map.

The derivative map (OGS Map 5072) included in the report is a Sand and Gravel Resources Map which rates the terrain units of the Seine River area with respect to potential for producing aggregate from the unconsolidated Quaternary deposits. Similarly, derivative maps can be developed which rate the terrain units for other important uses, such as groundwater potential, septic system suitability, solid waste disposal, general construction suitability, route assessment, and some aspects of mineral exploration. It is also possible to prepare a derivative map which would show those areas with little or no suitability for various types of development. Such a map would assist planners in avoiding hazardous lands.

4.2 SAND AND GRAVEL RESOURCES MAP

The Sand and Gravel Resources Map (OGS Map 5072, accompanying this report) rates the various terrain units of the Seine River area with respect to potential for surficial aggregate supply. The map shows seven categories of varying potential for the production of aggregate. Bedrock, alluvial, and organic terrain units have only limited relative potential and are not included on the derivative map.

Each category (A through G) has been delineated according to the intrinsic or natural factors associated with the type of terrain under examination. An effort was made in each case to express both quantity and quality considerations, and to evaluate each area as a unique entity, rather than simply rank each general terrain unit from 'highest potential' to 'lowest potential'. This method allows the user of the map to weigh the factor most important for his particular purpose, and removes some of the subjectivity involved when the ranking of aggregate resources is attempted.

As can be seen from the map, the Seine River area has good potential for aggregate resources. There are numerous kame deposits (GK), where quantity is high, but quality will vary due to the heterogeneity of materials. The glaciofluvial outwash deposits (GO) generally produce a high quality of aggregate, but quantities may be limited, particularly in those areas where bedrock is prevalent. Other sand and gravel sources, such as pockets in bedrock terrain and subsurface deposits, also exist and may be further evaluated by detailed airphoto interpretation and field investigation.

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Ontario Geological Survey

**Northern Ontario
Engineering Geology Terrain Study 54**

SEINE RIVER AREA

(NTS 52C/NE)

District of Rainy River

by

M.A. Roed

1980



Ontario

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Natural
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Map 5072 (coloured) – Northern Ontario Engineering Geology Terrain Study,
Sand and Gravel Resources Map, Seine River (NTS 52C/NE).
Scale 1:100 000.

**Northern Ontario
Engineering Geology Terrain Study 54**

SEINE RIVER AREA

(NTS 52C/NE)

District of Rainy River

by

M.A. Roed¹

1.0 INTRODUCTION

This report and the accompanying map present the results of an engineering geology terrain study for the Seine River area, District of Rainy River. The area, which covers NTS block 52C/NE, lies between Latitudes 48°30'N and 49°00'N and Longitudes 92°00'W and 93°00'W. The report and map form part of a series of publications which provide similar terrain data for approximately 370 000 km² of northern Ontario.

The purpose of this study is to provide an inventory of engineering geology terrain conditions that will serve as a basic data framework for engineering and resource planning activities, at a level of detail consistent with a scale of 1:100 000. The terrain information is contained on the Data Base Map (OGS Map 5070, accompanying this report). The Sand and Gravel Resources Map (OGS Map 5072, accompanying this report) is a derived map which illustrates the potential for finding surficial deposits of aggregate within the various terrain units.

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Interpretation of 1976 black and white aerial photographs, at a scale of approximately 1:50 000, formed the basis of the terrain mapping process. The interpretation was compared to relevant published information for the study area. The main roads in the area were traversed during the summer of 1978 to provide spot checks of the office studies. Thus, the Data Base Map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common information base for the entire map series. This legend is shown on the accompanying Data Base Map. Further discussion on the mapping techniques, legend format, and possible uses of this engineering geology information is available in the Ontario Engineering Geology Terrain Study Users' Manual (Gartner, Mollard, and Roed 1980), a companion publication to this series of maps and reports.

Appreciation is expressed to the Ontario Geological Survey for providing a manuscript copy of the aggregate inventory map for the area, prepared by E.V. Sado.

2.0 GEOLOGIC SETTING

The Seine River area is underlain by crystalline bedrock of Precambrian age, which is covered in places by a patchy mantle of Quaternary surficial deposits. The terrain is dominated by rocky uplands and lowlands covered with patches of ground moraine. Extensive moraine deposits occupy a wide belt across the east-central part of the area. Kame features, glaciofluvial units, and glaciolacustrine plains are well represented. Alluvial terrain is not well developed. Organic deposits are widespread, but occur mainly in association with poorly developed streams.

2.1 BEDROCK GEOLOGY

The Seine River area lies within the Wabigoon Belt in the Superior Structural Province of the Canadian Shield. The oldest rocks are Early Precambrian metavolcanics and metasediments which occur as (1) a wide easterly trending belt extending across the central part of the area from Seine Bay in the west to Niven Lake in the east, (2) a narrow easterly

trending belt lying to the north of the first and extending from Little Turtle Lake in the east to Moosetrack Lake in the west, and (3) a wide belt extending northwest from Redgut Bay in the northwest corner of the area. Large mafic and ultramafic bodies are scattered throughout the first of these belts, particularly near Bad Vermillion Lake, Bennett Lake, and Niven Lake. A very thick sequence of steeply dipping metasediments, believed to be younger than the metavolcanics, occupies the entire southern part of the map-area. These rocks are intruded by several widely separated felsic plutons. The northern half of the area is dominated by Early Precambrian felsic intrusive and metamorphic rocks, believed to be younger than the metavolcanics or metasediments. Diabase dikes of Proterozoic age may also occur in the area (Davies and Prysak 1967).

Much of the large, centrally located, east-trending metavolcanic-metasedimentary belt has medium to high mineral potential, particularly for base metals. Parts of the metavolcanic belt in the northwest corner of the area have medium potential, particularly for gold, silver, and base metals. The remainder of the map-area has low mineral potential (Springer 1978).

2.2 QUATERNARY GEOLOGY

Northwestern Ontario has been affected by several stages of continental glaciation during the Pleistocene. However, only deposits of the last glaciation, the Laurentide of Wisconsinan age, are preserved in the Seine River area. The ice began to advance approximately 100 000 years ago and travelled as far south as central Wisconsin before receding. The ice disappeared from the Seine River area approximately 15 000 years ago (Prest 1970). Zoltai (1961) gives a more complete account of the glacial history of the region.

Widespread stagnation of the ice mass resulted in the deposition of a variety of surficial materials. Till was deposited directly by the ice in the form of ground moraine and hummocky moraine. Meltwater from the glacier formed glaciofluvial outwash deposits, kames, and the linear moraine features in the area. Ponded meltwater accumulated in lowlands to form glacial lakes. These grew in size and eventually coalesced to form an enormous body of water called Glacial Lake Agassiz. Widespread deposits of glaciolacustrine silt and clay occur wherever this lake covered the land in the lowlands adjacent to Rainy Lake. In some localities,

bedrock hills were swept clean of unconsolidated material during the high water stage of Glacial Lake Agassiz, as evidenced by numerous bare bedrock knobs. In other parts of the area, the bedrock topography has been completely covered by the lake deposits. In the rocky uplands, the glacier overdeepened valleys, rounded off bedrock outcrops, and left scattered patches of moraine and boulders. Glacial lake water did not inundate large parts of these uplands.

The complete disappearance of glacial ice and the gradual draining or drying up of glacial lakes marked the end of the Pleistocene Stage of the Quaternary Period in the area. Since that time, approximately 9 000 years ago (Prest 1970), modern streams have developed alluvial flood plains and organic deposits have accumulated in wet depressions. These deposits are nonglacial in origin and, together with the various glacial materials, comprise the variety of Quaternary unconsolidated deposits that forms a discontinuous mantle over the bedrock in the Seine River area.

2.3 PHYSIOGRAPHY

Rugged hilly rock terrain of moderate relief dominates the map-area, with the exception of an east-trending belt of land between the Pipestone River and the Seine River in the east-central part of the area. This belt is part of a narrow rock and moraine lowland that borders the southeastern part of Rainy Lake. Elevations range from 338 m at Rainy Lake to 457 m west of the Turtle River in the northwestern part of the area. Rugged rock terrain of high relief occurs to the east of Dovetail Lake in the northeast corner of the area and ridged rock characterizes the terrain flanking Big Sawhill Lake in the northwest corner of the area. Scarps are particularly prominent along the valleys and bays of northeastern Rainy Lake.

Unusual physiographic features include the straight deep bedrock valley of the Turtle River in the northwestern part of the area and a crater-like depression occupied by Holmes Lake in the northeastern part. Also, a substantial kame moraine occurs to the west of Holmes Lake and a linear moraine feature borders the southern shore of Clearwater West Lake in the northeast corner of the area.

3.0 ENGINEERING TERRAIN UNITS

Engineering terrain units are composed of a combination of various materials (unconsolidated and/or bedrock) which form recognizable landforms with certain engineering characteristics. Major terrain unit groups, and the engineering significance of each, are discussed in detail. These include bedrock terrain (RN, RR), ground moraine (MG), glaciofluvial outwash (GO), kames (GK), and deltas (GD), glaciolacustrine plains (LP), alluvial plains (AP), and organic terrain (OT). A diagrammatic sketch of a typical terrain setting is given in Figure 1. Table 1 summarizes the characteristics and engineering significance of the major terrain units in the Seine River area.

3.1 BEDROCK

Examples: $\frac{RN(tsMG) (pOT)}{Mnj-D(W)}$

$\frac{RN(cmLP) (tsMG)}{Mn-D}$

$\frac{RR(tsMG)}{Mnj-D}$

Much of the bedrock terrain is hilly (n) and of moderate relief (M). Rugged topography (j) is characteristic of the northern part of the map-area and some high relief (H) bedrock terrain occurs east of Dovetail Lake in the northeast corner. Low relief hilly bedrock terrain (Ln) is common in the west-central part of the area. A thin, discontinuous layer of sandy boulder till (tsMG) mantles the rock in many localities, although bare bedrock is common. Patches of till greater than 10 m in thickness may occur locally. Varved red and grey clay (cmLP) is widespread in this unit, primarily in depressions, but clay is rare or absent in the northernmost part of the map-area. Glaciofluvial sand and gravel outwash deposits are common in bedrock terrain, particularly around Sturgeon Falls in the eastern part of the area. Minor organic terrain is common in poorly drained localities.

The principal engineering significance of bedrock terrain is that it is difficult and expensive to excavate. Due to the rugged topographic character, extreme alignment techniques and extensive cut-and-fill operations are necessary for adequate road construction. Since, in many places, this unit has a limited supply of unconsolidated material and a shortage of aggregate, importation of suitable materials would be

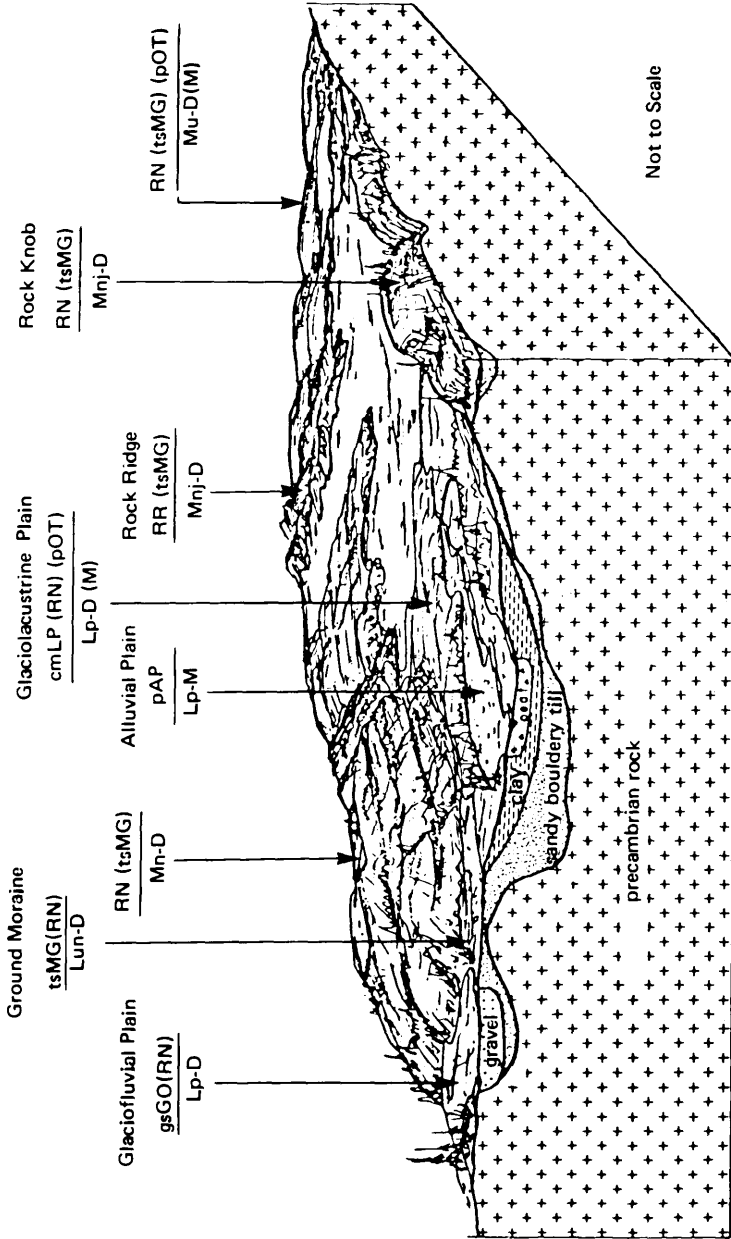


FIGURE 1 – DIAGRAMMATIC SKETCH SHOWING TYPICAL TERRAIN TYPES AND THEIR REPRESENTATIVE LETTER SYMBOLS.

necessary and would involve substantial expense. It was noted, however, that thick blankets of ground moraine till do occur in association with some bedrock landforms and that pockets of glaciolacustrine silt and clay are particularly common in the central part of the area. Careful exploration for these soil types could substantially decrease engineering difficulties in bedrock terrain. Although local deposits of glaciofluvial sand and gravel can be expected and some raised beach gravel deposits occur along rock buttressed shorelines, aggregate is generally scarce.

Groundwater can occur in fractures and along fault zones in the rock, but this terrain unit is considered to have only poor to fair potential for groundwater supply. Rock terrain is unsuitable for surface waste disposal of any kind, except where there is a thick layer (at least 1.5 m) of attenuating soil material.

3.2 MORAINE

Examples: $\frac{tsMG(RN)}{Ln \cdot D}$ $\frac{tsMG(RN) (cmLP)}{Lup \cdot D}$ $\frac{sgbGK(ME)}{Mr \cdot D}$

Large expanses of ground moraine (MG) are located (1) to the southwest of Otukamamoan Lake in the northwest corner of the area (Blackburn 1973), and (2) in a wide east-trending belt south of the Seine River in the east-central part of the area. Sandy till (tsMG) is the main constituent in this ground moraine, but local pockets of sand and gravel are not uncommon. Also, numerous rock knobs occur in the unit and small patches of glaciolacustrine clay are common, especially in the moraine south of the Seine River. This belt is of low relief and is gently undulating. It is presently undergoing an extensive pulpwood harvest.

A linear moraine feature occurs along the southwestern shore of Clearwater Lake but is mapped as mainly kame (GK) material. Since till ridges are evident on its surface, it has been given a subordinate end moraine (ME) designation. To the northwest this feature is esker-like and, in places, contains deltaic deposits and till.

Ground moraine till is an excellent source of well-graded fill in this map-area and may contain local pockets of sand and gravel. The unit is generally well drained and provides good foundation conditions, but is quite irregular in topography. Rock knobs occur unpredictably and most

TABLE 1 SUMMARY OF TERRAIN UNIT CHARACTERISTICS AND ENGINEERING SIGNIFICANCE, SEINE RIVER AREA

Terrain Unit and Location	CLASSIFICATION		ENGINEERING USE					Major Constraints
	Material; Relief; Topography; Drainage	General Construction	Transportation Routes	Waste Disposal	Groundwater Supply			
ROCK TERRAIN (RN) , most extensive in northern portion of area	rock; moderate relief (15 to 30 m); knobby to rugged; good drainage	excavation and fill necessary; blasting	excavation and fill required; blasting; aggregate in small pockets	pollution potential high	deep wells provide enough water for domestic requirements in most places		blasting is required for most excavations; limited aggregate	
GROUND MORaine (MG) , mainly in west-central part of area	sandy till (ts); low relief (less than 15 m); undulating; drainage good	excavations and fill necessary for some types	excavations and fill may be required; aggregate in small pockets	suitable for septic systems where deposit is at least 1.5 m thick	poor to fair potential		thin deposit; rock knobs; minor organic units	
GLACIOFLUVIAL KAMES (GK) , mainly in the northeast quadrant	sandy, gravelly till (sgt); moderate relief; knobby and ridged; drainage good	good conditions	aggregate abundant	pollution potential high	good potential		quality of aggregate	
GLACIOFLUVIAL OUTWASH (GO) , throughout the area	sand and gravel (sg); low to moderate relief (less than 30 m); planar to knobby; drainage good	excellent conditions	suitable base and aggregate	pollution potential high	excellent potential where deposits are thick		quantity of aggregate	

GLACIOLACUSTRINE PLAIN (LP) , mainly in central portion of area	sand, silt, and clay (smc); low relief; planar; drainage mixed	excavations are easy; frost susceptible; low bearing capacity	aggregate scarce	suitable where deposit is thick and groundwater table low	poor to fair potential for domestic supply	lack of aggregate; frost susceptible
ORGANIC TERRAIN (OT) , throughout the area	peat (p); low relief; planar; drainage poor	frost susceptible; low bearing capacity; compressible	unsuitable subgrade	pollution potential high	poor potential	low strength; high frost susceptibility; poor drainage
ALLUVIAL PLAINS (AP) , along major streams	sand and peat (sp); low relief; planar; drainage poor	low bearing capacity; frost susceptible	unsuitable subgrade; poor drainage	pollution potential high	poor potential	frost susceptible; low bearing strength; poor drainage

depressions are wet and may contain clay, organic material, or both. Linear moraine features likely contain large quantities of sand and/or gravel.

Groundwater potential is fair to good. This unit is generally suitable for municipal waste disposal and septic drain tile fields.

3.3 GLACIOFLUVIAL

Examples: $\frac{\text{sgGO(RN)} \text{ (tsMG)}}{\text{Mn-D}}$	$\frac{\text{sgGO(cmLP)} \text{ (RN)}}{\text{Lup-D}}$	
$\frac{\text{sgGO(pAP)}}{\text{Lp-M}}$	$\frac{\text{sgtGK(RN)}}{\text{Mr-D}}$	$\frac{\text{sgGD(RN)}}{\text{Lp-D}}$

Numerous glaciofluvial outwash plains occur in the Seine River area; however, because of irregular topography, their distribution is difficult to show. The most extensive outwash plains include those (1) between Clearwater West Lake and Sandbeach Lake in the northeast corner of the area, (2) west of Manion Lake in the north-central part of the area, and (3) in the broad valley occupied by Darby Creek in the southeast corner of the area. These generally consist of sand with subordinate amounts of gravel (sgGO). Sandy gravel (gsGO) occurs in ill-defined glaciofluvial channels over a large area west of Flanders and to a lesser degree on the Sturgeon Falls Indian Reserve. Most of these glaciofluvial materials occur in association with moraine, rock knobs and glacio-lacustrine units. In some places along the Little Turtle River in the central part of the area, glaciofluvial outwash sand and gravel are overlain by a mantle of varved clay (cmLP/sgGO).

Very thick glaciofluvial kame (GK) or deltaic (GD) gravelly sand occurs in the linear moraine feature along the southwestern shore of Clearwater West Lake. In this locality, however, the unit has been mapped in association with an end moraine (ME) since till ridges are apparent.

Extensive kame-like features (sgtGK), containing some sand and gravel, considerable bouldery till, and finer grained material, occur elsewhere in the map-area. The most prominent of these units is a discontinuous belt of kame material which extends from the west shore of Sandbeach Lake southwest for a distance of nearly 45 km to Wild Potato Lake. Other kames occur near Burton Lake in the eastern part of the area.

Glaciofluvial terrain units are notably rare in the rugged bedrock terrain of the northwestern part of the map-area. Perhaps here the glaciofluvial deposits are restricted to narrow terrace-like features along valleys which are not easily recognized on the airphotos.

Glaciofluvial deposits are a potential source of considerable quantities of surficial aggregate. This unit also provides good foundation conditions where drainage is adequate, and is considered as a good potential groundwater aquifer. It is generally unsuitable for waste disposal, except for the location of widely separated septic drain tile fields.

3.4 GLACIOLACUSTRINE

Examples: $\frac{\text{scLP/sgGO(RN)}}{\text{Lpd-D}}$ $\frac{\text{cmLP(RN)}}{\text{Lun-D}}$

Varved clay, varying from grey to red in colour, is widespread in the lowlands of the Seine River area, with the exception of the northwestern part. The unit is usually at least 3 to 4 m thick and probably attains its maximum thickness along the Little Turtle River and west of Moosetrack Lake in the central part of the area. Glaciolacustrine clay and silt plains are also a common subordinate landform in other terrain units. Many of the organic deposits in the area are likely underlain by glaciolacustrine clay. Sand is the major constituent of the glaciolacustrine plain located west of Moosetrack Lake, and sandy silt is the common glaciolacustrine material in the vicinity of Clearwater West Lake. Glaciolacustrine clay overlies glaciofluvial outwash sand and gravel (cmLP/sgGO) in places along the Little Turtle River.

The silt and clay plains of glaciolacustrine origin are ideally suited to excavation engineering projects such as pipeline and transportation routes. The material is easy to dig and, in many places, it is dry, although wet conditions may prevail locally. It is a poor fill material because it is subject to settling. Susceptibility to frost action reduces its foundation suitability. Bank stability is a potential problem along the steep slopes of river banks and along shorelines subject to wave action.

Interbedded sand layers may occur at depth and underlying gravel units are known to be present. These would form potential groundwater aquifers, but generally the unit has poor groundwater potential. The

basic framework of resource characteristics that allows development of a wide variety of engineering or planning derivative maps. A derivative map can be defined as a graphic representation of the terrain in terms of its potential with respect to a specific engineering or planning use, or a number of uses. Derived maps are needed because many people who have special interests in the map-area may not have the necessary geological or engineering expertise to fully interpret the Data Base Map for their particular application. The objective of presenting such a map in this report, therefore, is to demonstrate how an easily understood illustration can be produced from the Data Base Map.

The derivative map (OGS Map 5072) included in the report is a Sand and Gravel Resources Map which rates the terrain units of the Seine River area with respect to potential for producing aggregate from the unconsolidated Quaternary deposits. Similarly, derivative maps can be developed which rate the terrain units for other important uses, such as groundwater potential, septic system suitability, solid waste disposal, general construction suitability, route assessment, and some aspects of mineral exploration. It is also possible to prepare a derivative map which would show those areas with little or no suitability for various types of development. Such a map would assist planners in avoiding hazardous lands.

4.2 SAND AND GRAVEL RESOURCES MAP

The Sand and Gravel Resources Map (OGS Map 5072, accompanying this report) rates the various terrain units of the Seine River area with respect to potential for surficial aggregate supply. The map shows seven categories of varying potential for the production of aggregate. Bedrock, alluvial, and organic terrain units have only limited relative potential and are not included on the derivative map.

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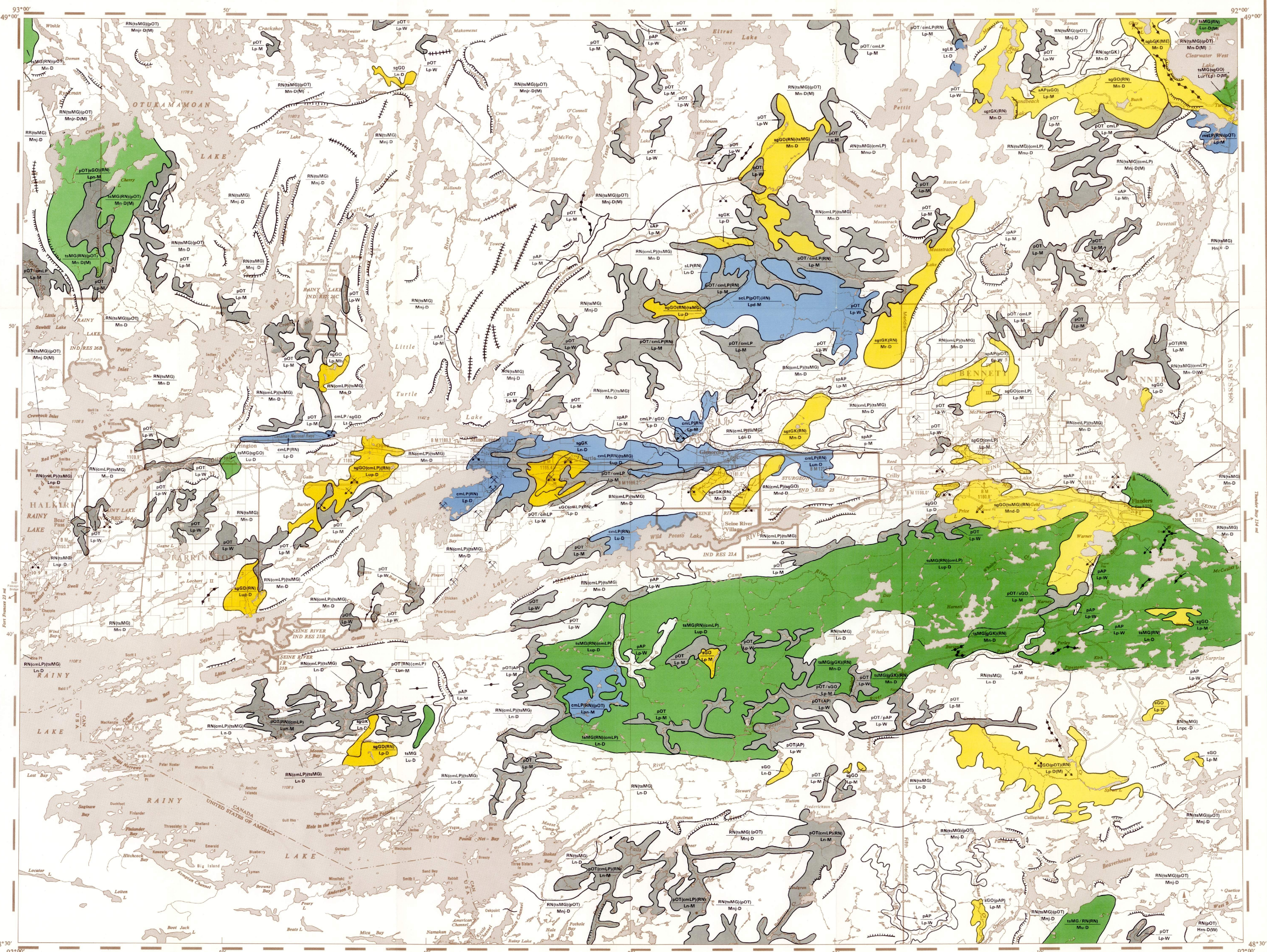
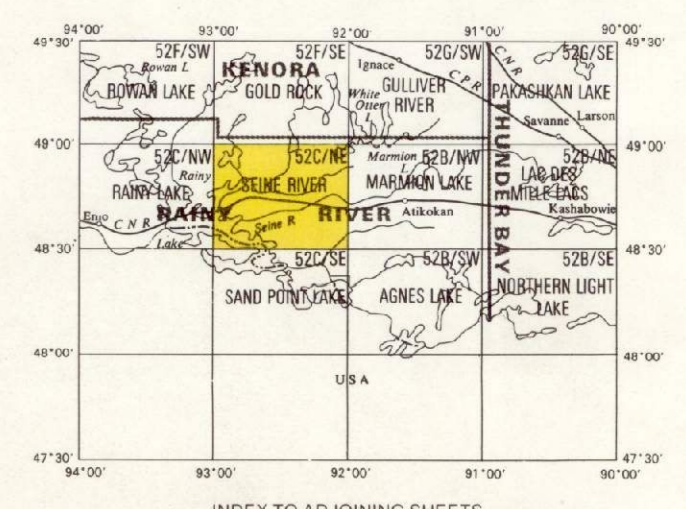
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LEGEND

LANDFORM	MATERIAL
ME End moraine	b boulders, bouldery
MG Ground moraine	c clay, clayey
MM Hummocky moraine	g gravel, gravelly
LM Hummocky moraine	m peat, musk
GLACIOLUVIAL	r rubble
GD Ice contact delta, esker delta, kame delta, delta moraine	s sand, sandy
QE Esker, esker complex, eskers, kame	t till, silty
OK Kame, kame field, kame terrace, kame moraine	l fill
GO Outwash plain, valley train	
GLACIOLACUSTRINE	
LB Raised (abandoned) beach form	
LD Glaciolacustrine delta	
LP Glaciolacustrine plain	
ALLUVIAL	
AP Alluvial plain	
COLLUVIAL	
CS Slope failure	
CT Scarp slope	
CW Slopewash and debris creep sheet, minor scarp	
EOLIAN	
ED Sand dunes	
ORGANIC	
OT Organic terrain	
BEDROCK	
RL Bedrock plateau	
RR Bedrock knob	
RS Bedrock scarp	
RR Bedrock ridge	
R Bedrock before a drift veneer	
TOPOGRAPHY	
H Mainly high local relief	
M Mainly moderate local relief	
L Mainly low local relief	
VARIETY	
c channelled	
d dissected, gullied	
l jagged, rugged, cliffed	
n cliffed volcanic rock signature	
s knobby, hummocky	
p plain	
r rugged	
s sloping	
l lowland	
u undulating to rolling	
w washed, reworked	
DRAINAGE	
SURFACE CONDITION	
W Wet	
D Dry	
M Mixed wet and dry	
h Suspected high water table	

The letter codes describing the terrain units are made up of four components arranged as follows:

MATERIAL	LANDFORM
TOPOGRAPHY	DRAINAGE

Examples:

- material: dominant landform: subordinate landform: drainage: relief of subordinate landform: topographic variety of dominant landform: **MG(M)H-D**
- material: subordinate landform: drainage: relief of subordinate landform: topographic variety of dominant landform: **pOT/sGO**

SYMBOLS

- Significant end moraine or linear moraine feature and drumlin/ridges
- All other linear ice-flow features
- Esker ridge (continuous, discontinuous, the symbol does not indicate direction of flow)
- Abandoned shoreline (continuous, discontinuous)
- Local dune area (type and location of individual dunes not indicated)
- Abandoned river channel, spillway or ice marginal channels
- Escarpment
- Sample location
- Small landslide scar
- Sand or gravel pit
- Quarry or mine workings evident from aerial photos or field observation (crossed picks are shown in the area of open excavations)
- Other man-made features (rock dumps, tailings, lagoons, landfills, etc.; type of feature mentioned where identifiable)
- Sheep-walled valleys, often bedrock-controlled features
- Talus identified, interior base of talus triangle indicates downslope side of escarpment
- Line joining the same terrain units

NOTE 1:
 This map is intended to be an inventory of regional engineering terrain conditions, as determined largely by airphoto interpretation. Its purpose is to provide a guide for engineering and resource planning functions. The boundaries of the terrain units shown on this map are approximate only, consistent with a 1:100 000 scale. Site specific investigations are required in order to obtain detailed information for a particular area. The map user should refer to the accompanying report for a fuller description of terrain in the study area.

NOTE 2:
 Colour is used to enhance what is considered to be the dominant engineering condition in simple, complex or layered terrain units.

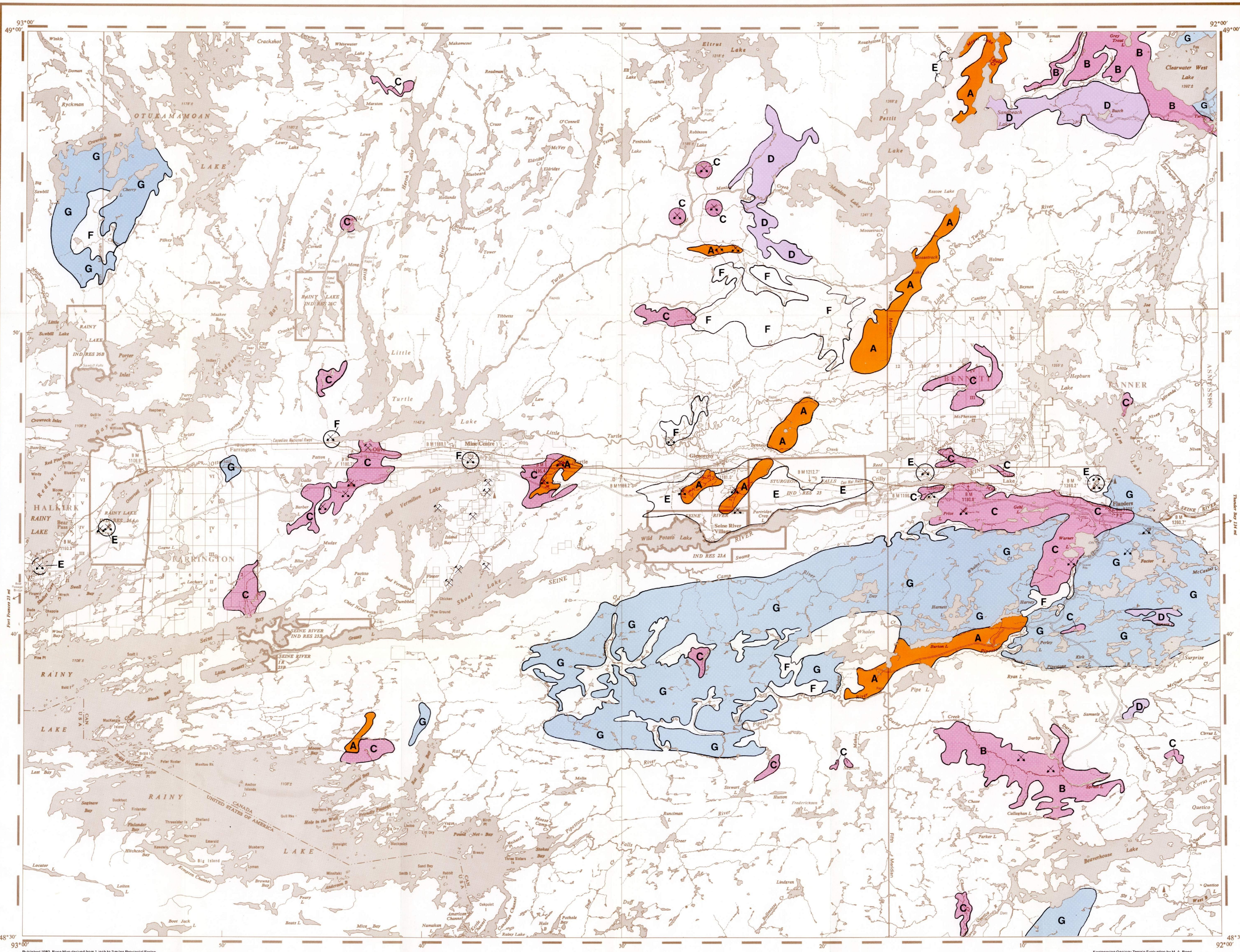
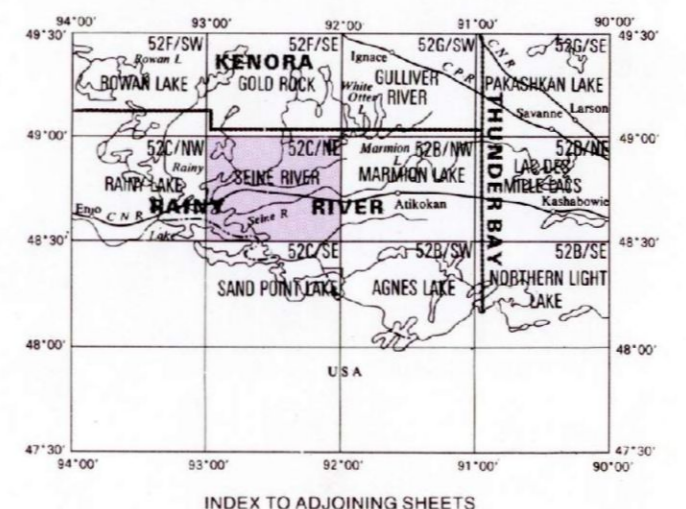
NOTE 3:
 Not all letter and graphic symbols shown in the legend necessarily appear on this map sheet.

Information from this publication may be quoted if appropriate credit is given. Reference to this map is recommended as follows:
 Road M. A.
 1982. Northern Ontario Engineering Geology Terrain Study.
 Data Base Map: Seine River.
 Ontario Geological Survey, Map 5070. Scale 1:100 000.

Ontario Geological Survey

Map 5072
SEINE RIVER
 NTS 52C/NE

Sand and Gravel Resources
 Northern Ontario Engineering
 Geology Terrain Study



LEGEND

SYMBOL	TERRAIN UNIT	CHARACTERISTICS & CONSTRAINTS OF DEPOSITS
A	Kame (GK)	Large quantities; wide range of materials; highly variable quality
B	Kame (GK) or glacioluvial (GO)	Large quantities; sand or gravelly sand; limited quality
C	Glacioluvial (GO)	High quality; sand and gravel; possibly limited quantity
D	Glacioluvial outwash sand plains (GC)	High quality; poor quality sand plains; good gravel potential at depth
E	Rock (RK), with small local kame (GK), glacioluvial (GO), or beach (LB) forms	Small local deposits; good quality; restricted quantity
F	Clay or organic over gravel (LP/GC/GK)	Largely unpredictable; no surface expression
G	Moraine (M) (MG, MH, MC) beach (LB) and kame (GK) glacioluvial (GO) may occur	Scattered gravel pockets; possibly extensive and good quality but not readily recognized on all photos