Aggregate Report AR84-2

Surficial Geology and Aggregate Resources of the Fisher Branch Area: Local Government District of Fisher and Rural Municipality of Bifrost

By H.D. Groom

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TABLE OF CONTENTS

FIGURES CAPTIONS

TABLES

MAPS

Abstract

Detailed surficial geology mapping and an aggregate resource inventory were carried out in the Local Government District of Fisher and the Rural Municipality of Bifrost. Air photograph interpretation followed by field investigation was used to delineate the map units on Map AR84-2-1 (scale 1:100 000). Surficial units include bedrock outcrops, till plains, eskers, a moraine, beach ridges, clay plains and recent alluvial and organic deposits.

Aggregate resources are found in glaciofluvial and lacustrine ridges scattered across the area. Sand and gravel reserves are estimated at 54 million cubic metres, more than half of which are located in the Mantagao Ridge (deposit 4902) in the western portion of the study area. Gravel deposits in the east are nearing depletion and the bedrock quarries in 22-24-4E are an important source of aggregate for this region.

INTRODUCTION

OBJECTIVES

Mapping in the Fisher Branch area was carried out in order to:

1) produce a map of the surficial geology of the area at a scale of 1:100 000;
2) delineate the sand and gravel resources; and
3) provide an estimate of the aggregate reserves in the district.

The information is used to facilitate land use planning designed to protect high quality aggregate deposits from sterilization. The resource data are available to the public through the Mines Branch.

LOCATION AND ACCESS

The Fisher Branch area comprises the Local Government District of Fisher and the Rural Municipality of Bifrost. It covers 3000 km^2 between Twps. 22 to 26 and Rges. 4E to 3W (Fig. 1).

The area is primarily a farming district and the villages of Riverton, Arborg, Fisher Branch and Hodgson are the major service centres. With the exception of the northeastern portion of the study area, a network of paved highways and gravelled section roads gives good access to most deposits.

PHYSIOGRAPHY

The study area lies west of Lake Winnipeg in the Interlake Plain. The land has a gentle northeast slope, with elevations of 285 m above sea level (a.s.l.) in the west and 218 m a.s.l. at the shore of Lake Winnipeg. Major drainage channels are the Icelandic and Fisher Rivers.

The terrain changes considerably across the study area. In the west, it is predominantly swell-and-swale topography. The ridges are oriented southeast (135°) across the general slope of the terrain and swamps fill the intervening troughs. Bedrock highs are common, particularly in the west and north-central area, and are a further impediment to drainage. In the east, the land is level as the till plain is overlain by deposits of Lake Agassiz silt and clay.

METHODOLOGY

Surficial deposits were delineated on 1:50 000 scale air photos. Air photo interpretation incorporated information from pit inventory files of the Department of Highways and Transportation Services and from existing soil maps.

During field mapping, all gravel pits were visited and samples collected from deposits considered to be of economic value. Gravel deposits on Crown land were backhoed by the Manitoba Department of Highways, allowing examination of previously unopened deposits. All gravel deposits were delineated on 1:15 840 scale photos and these were used to calculate area and reserve estimates on a per quarter section basis.

The other surficial units were examined in ditch cuts, hand-dug holes and a limited number of backhoe pits. Bedrock striations and till fabrics were measured to determine ice flow directions.

PREVIOUS WORK

The Quaternary geology of the Fisher Branch area has not been mapped in detail although it has been included in regional scale maps and the surficial sediments in adjacent areas have been studied.

Johnston (1931) delineated lacustrine and till deposits in the southern half of the area. His map, at a scale of 1 inch to 8 miles, covered the entire province south of lat.52° N. The elevation and location of the Gimli strandline through the area is given in his report on the deformation of Lake Agassiz beaches (Johnston, 1946). Also at a regional scale, Prest et al. (1968) show the directions of ice flow indicators within and adjacent to the study area.

Quaternary mapping of the Interlake Plain north of and adjacent to the study area has been carried out by Klassen (1968), Nielsen (1978) and James F. MacLaren Limited (1980).

Klassen, working 75 km northeast of the study area in the Waterhen-Grand Rapids area, reports two intervals of Late Wisconsonian glaciation. The first ice advance was to the southeast. The second, to the south-southwest, was of limited extent and advanced over lake deposits. Nielsen, working southeast of Fisher Branch in the Gypsumville area, reports ice flow to the south (190°) in the western portion of his study area and to the southeast (145°) in the central and eastern portions. He notes the occasional mixing of till and lake clay as well as the presence of iceberg scour marks.

James F. MacLaren Limited (1980) mapped the surficial geology immediately south of the present study area as part of an aggregate inventory. Emphasis was placed on the elevations of the beach ridges and the emergence of Lakes Winnipeg and Manitoba as glacial Lake Agassiz receded northward.

The soils of the area have been mapped by Pratt et al. (1961) and Smith et al. (1975). The map units include a brief description of the parent material on which the soil profile developed.

Wardlaw et al. (1969) studied the relationship of striations and grooves in the Gypsumville area. They conclude that both are the result of glacial erosion and that parallel striations and grooves formed contemporaneously. They record four sets of striae orientation: three to the south and southeast (in progressively younger order: 160°, 175° and 135°) and one to the southwest (220°). Their overall picture of ice flow to the southeast followed by an advance to the southwest is the same as Klassen's (1969) for the Waterhen-Grand Rapids area.

Nielsen (1981-83) has reported a two-till sequence in the Interlake Plain in areas west and south of the Fisher Branch area. The lower unit, the Inwood till, is a compact basal till of undetermined thickness. The upper unit, the Komarno till, is a soft diamicton characterized by frequent clay seams. It is 1 to 2 m thick and was deposited by southeast flowing ice.

ACKNOWLEDGEMENTS

I would like to thank foremost Ray Blais of the Materials and Research Branch of the Manitoba Department of Highways whose backhoe program allowed examination of the Mantagao Ridge; Dr. E. Nielsen for ideas, encouragement and critically reading the manuscript; C. Jones for field assistance and knowledge of the regional bedrock; D. Bagwell for drafting the figures and the Word Processing Centre for typing the manuscript.

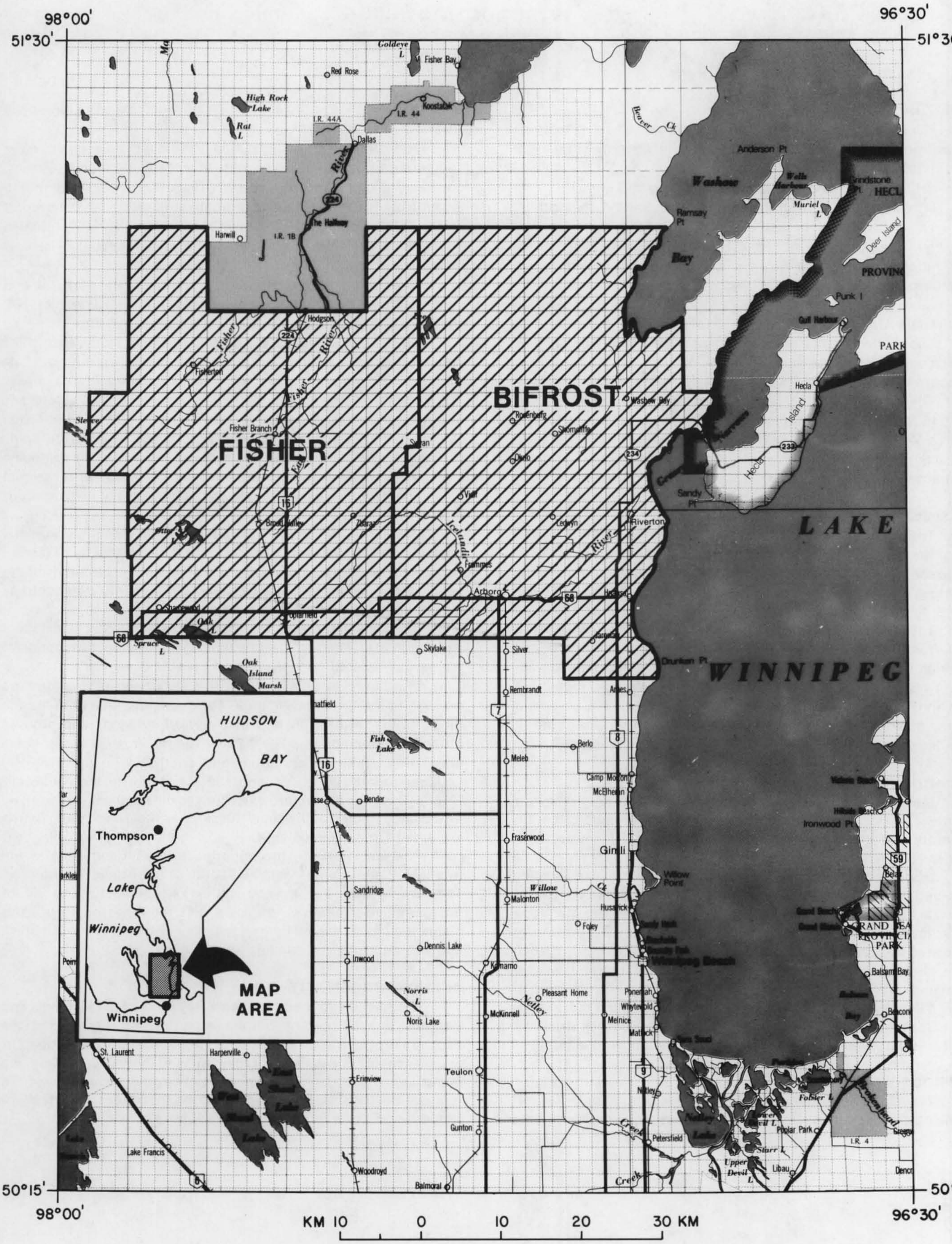


FIGURE 1. Location map of the Fisher Branch area: L.G.D. of Fisher and R.M. of Bifrost.

GEOLOGY

BEDROCK GEOLOGY

The general geology of Manitoba is shown in Figure 2 and that of the Fisher Branch Area in Figure 3. Near-surface bedrock is common and major areas of outcrop have been delineated on Map AR84-2-1 (in pocket).

Within the study area, a succession of Paleozoic carbonate formations overlies the Precambrian basement. These Ordovician and Silurian age strata outcrop in broadly northwest-trending belts and dip gently to the west. The Ordovician Red River, Stony Mountain and Stonewall Formations are predominantly dolomite and dolomitic limestone, yellow-brown in colour and variably fossiliferous.

The Fisher Branch Formation is the only part of the Silurian Interlake Group that is delineated within the study area. It is a yellowish dolomite with highly fossiliferous zones (McCabe and Barchyn, 1982).

Cretaceous age deposits, predominantly kaolinitic clays interbedded with sand and lignite, occur in a channel 30 m deep and 90 m wide located near the town of Sylvan (Fig.3). The channel is buried under 10 m of glacial material and has been delineated in the subsurface for a distance of 7 km (Bannatyne, 1970).

Table I has been summarized from McCabe and Barchyn (1982) who give a detailed description of the formations and provide a depositional framework for Paleozoic strata in Manitoba. Baillie (1951, 1952) and Stearn (1956) include lists of zonal fossils and descriptions of the bedrock units in their reports.

SURFICIAL GEOLOGY

The surficial geology of the Fisher Branch area is delineated on Map AR84-2-1 (in pocket) and generalized in Figure 4. Characteristics of the units are discussed below.

TABLE 1. GENERAL GEOLOGICAL FORMATIONS IN THE FISHER BRANCH AREA

ERA	PERIOD	GROUP	FORMATION	MEMBER	BASIC LITHOLOGY
MESOZOIC	CRETACEOUS		SWAN RIVER		SANDSTONE KAOLINITIC SHALE MINOR LIGNITE
Paleozoic	Silurian	Interlake	Fisher Branch		micritic, fossiliferous dolomite
	Ordovician		Stonewall		fine grained dolomite
			Stony Mtn.	Williams Gunton Penitentiary Gunn	nodular and sandy argillaceous dolomite calcareous shale
			Red River	Fort Garry Selkirk Cat Heat Dog Head	mottled dolomitic limestone and dolomite

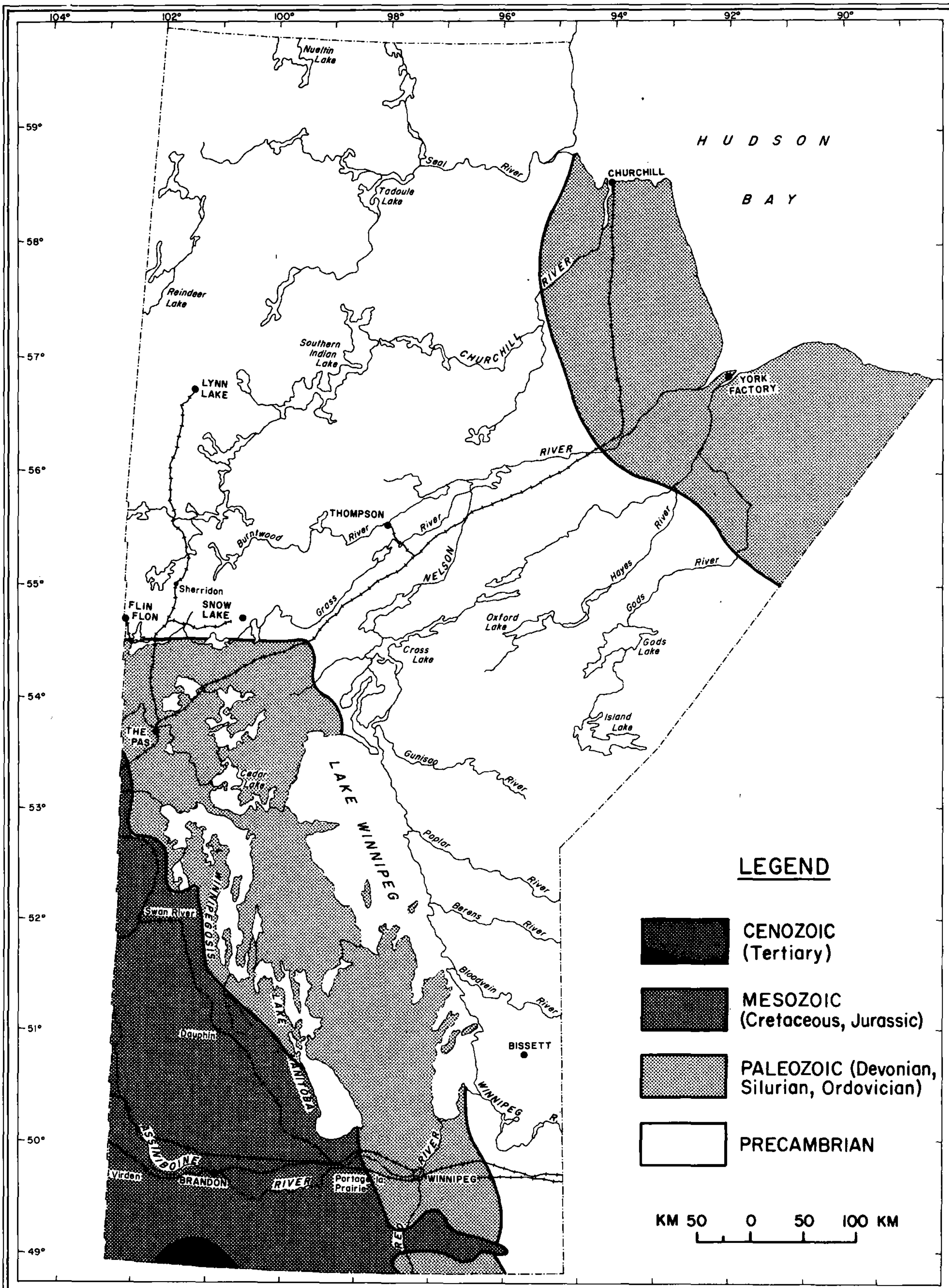


FIGURE 2. Bedrock geology of Manitoba.

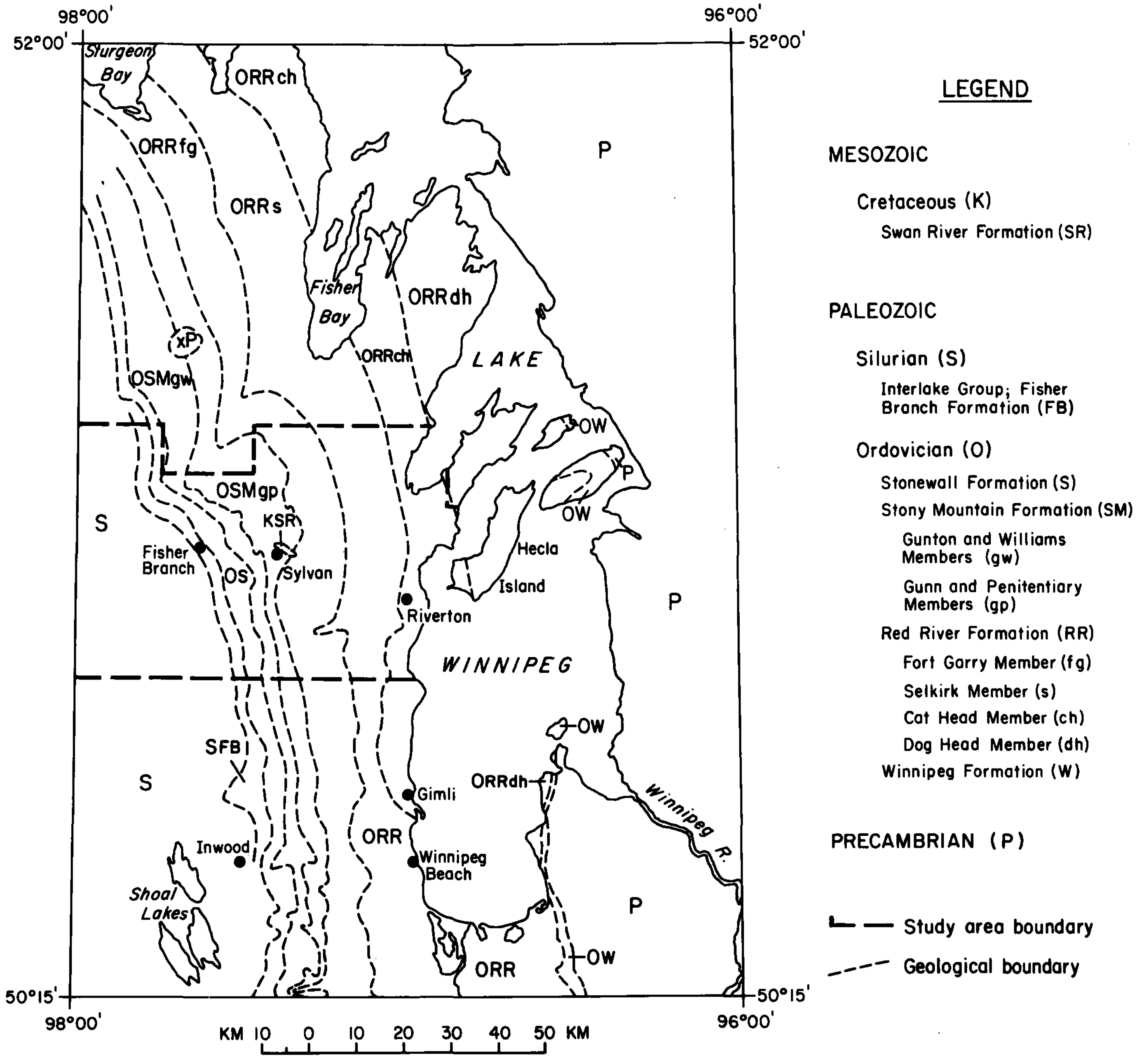


FIGURE 3. Bedrock geology of the Fisher Branch area; after C.W. Jones and B.B. Bannatyne (1982).

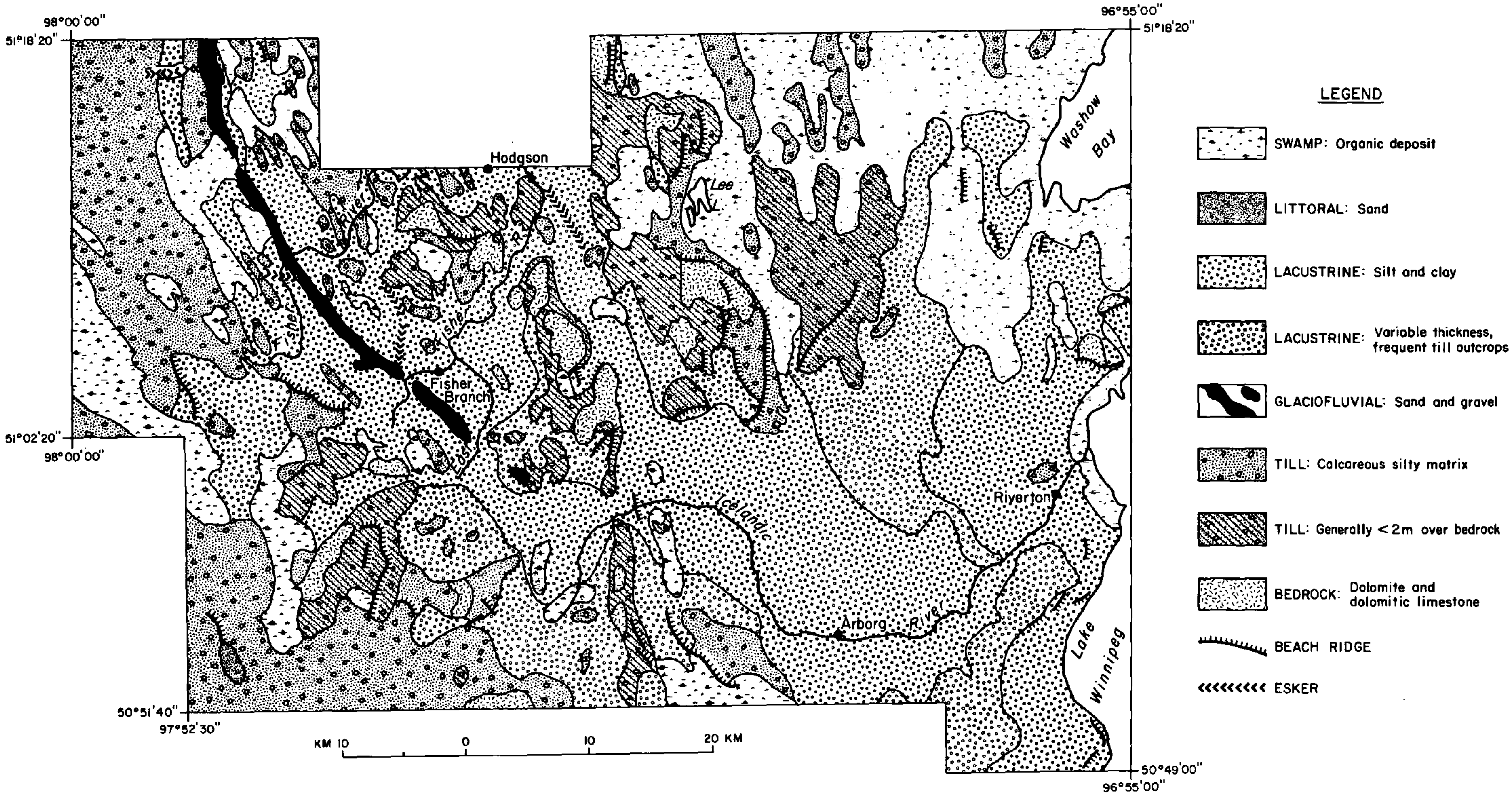


FIGURE 4. Generalized surficial geology of the Fisher Branch area.

GLACIAL DEPOSITS

Till: map unit 2

In the western portion of the study area, the till surface is gently fluted wih flutes averaging 1 to 2 metres high. In the east, the till ridges are masked by clay deposition and iceberg scouring has further obscured the original till morphology.

A small field of drumlinoid ridges occurs in Twp.26, Rges 2 and 3W (Fig. 5). The ridges average 10 m in height and are from 0.5 to 1.5 km in length. Most are composed of till although the presence of large flaggy limestone boulders indicates that at least some of the ridges may be streamlined bedrock with a till veneer. Orientation of the ridges is 155°.

The till in the study area is calcareous and silty; mean carbonate content and textural data are given in Table 2. The till is yellowish grey (5Y8/1, Munsell colour of sample) or very pale orange (10YR8/2). In places, the till is fissile but it is most often massive. Irregular clay seams, up to 5 cm thick, and sand lenses are common (Fig. 6A). As well, iceberg scouring has resulted in the mixing of till and the overlying lake clay in many areas (Fig. 6B).

Figure 7 shows the direction of striae measurements and till fabrics within and adjacent to the area. While ice flow from the north and nortwest is indicated, analysis of grain size and lithology revealed no trends across the area. Till samples from north of the study area, where flutes and striae trend southward, have the same characteristics as samples from areas where ice flow was towards the southeast.

FIGURE 5. Airphotograph showing drumlinoid ridges in Twp. 26, Rges. 2 and 3W.

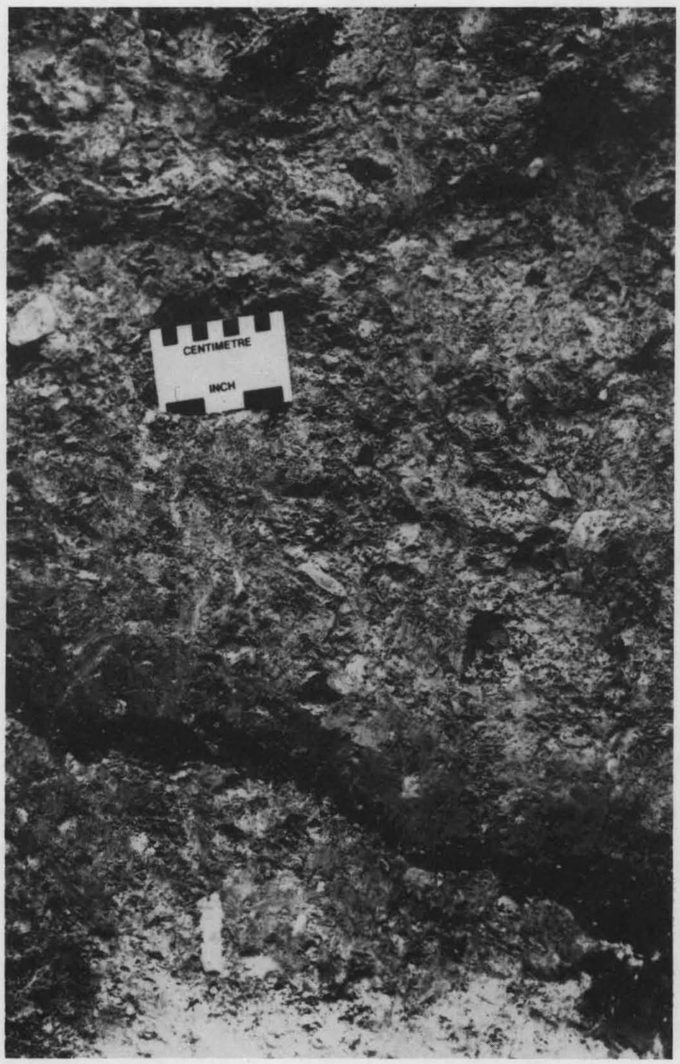


FIGURE 6A. Till exposed in backhoe pit (NE30-23-3W). Note clay seam in lower portion of photograph.

FIGURE 6B. Till overlain by Lake Agassiz clay (SE31-23-3W). Till intermixed with clay in upper part of photograph is a result of iceberg scouring.

Southwest oriented striae (225°) indicate ice from the northeast advanced into the area at least as far west as the town of Fisher Branch. Till of northeastern provenance does not outcrop in the study area but was sampled 45 km north of Riverton (site locations on Fig. 7). Characteristics of this sandy till are given in Table 2.

Figure 8 shows the matrix grain size composition of till samples from areas where flute and striation directions are southeast, south and southwest.

Nielsen (1981-1983) has reported two tills in the Interlake Plain in areas west and south of the study area. The upper unit, the Komarno till, was deposited by ice flowing from the northwest. It is an uncompacted, pinkish grey (5YR8/1) silt till, 1 to 2 m thick, with frequent clay seams. The surface till in the Fisher Branch area is tentatively correlated with the Komarno till. The compact underlying till, the Inwood (described by Nielsen) was not seen in section or backhoe pits within the study area.

GLACIOFLUVIAL DEPOSITS

The only glaciofluvial deposits in the area are the Mantagao ridge and four eskers, three of which are tributaries of the Mantagao ridge. Esker sediments are described more fully in the aggregate section of this report.

TABLE 2. COMPARISON OF TILLS

		SILTY TILL	SANDY TILL
Grain size of matrix:	sand	30.1 ± 10.2	62.4 ± 13.9
	silt	49.3 ± 5.9	23.8 ± 9.2
	clay	20.6 ± 6.4	13.8 ± 8.3
% carbonate clasts: 4-16 mm		88.8 ± 4.9	63.5 ± 11.9
% CO_3: less than 63 microns		39.3 ± 4.1	13.9 ± 10.5

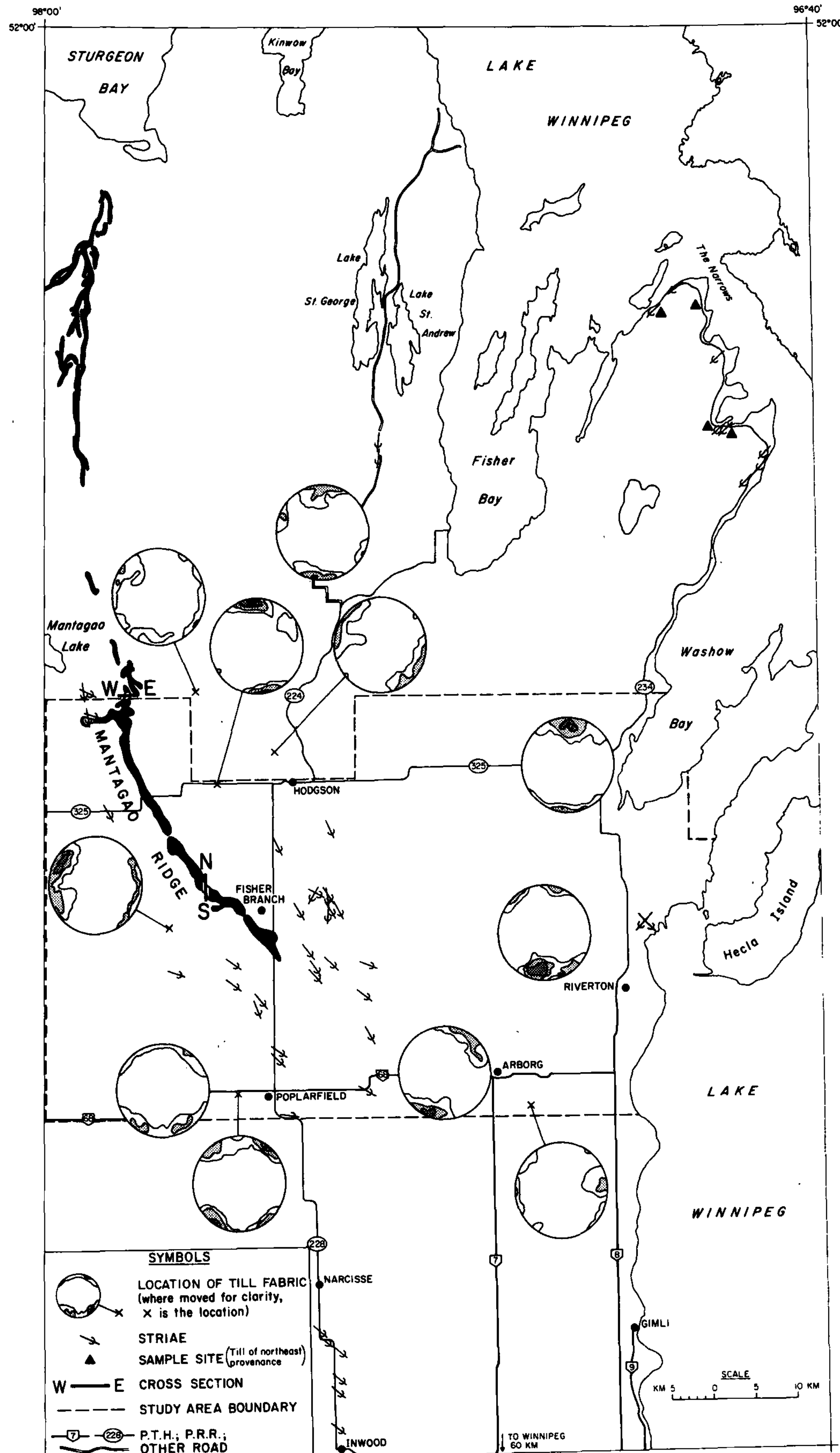


FIGURE 7. Map showing location of sample sites of northeast provenance tills, cross-section locations and results of till fabric and striae direction measurements.

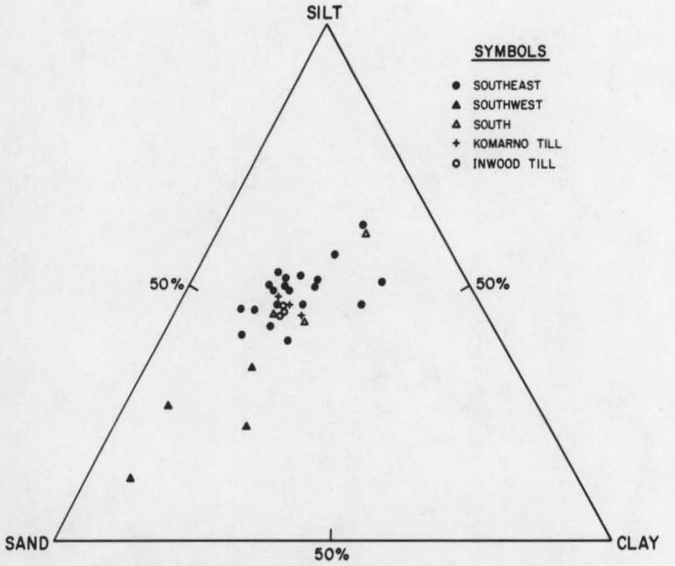


FIGURE 8. Ternary diagram of grain size distribution of matrix of tills within and adjacent to study area.

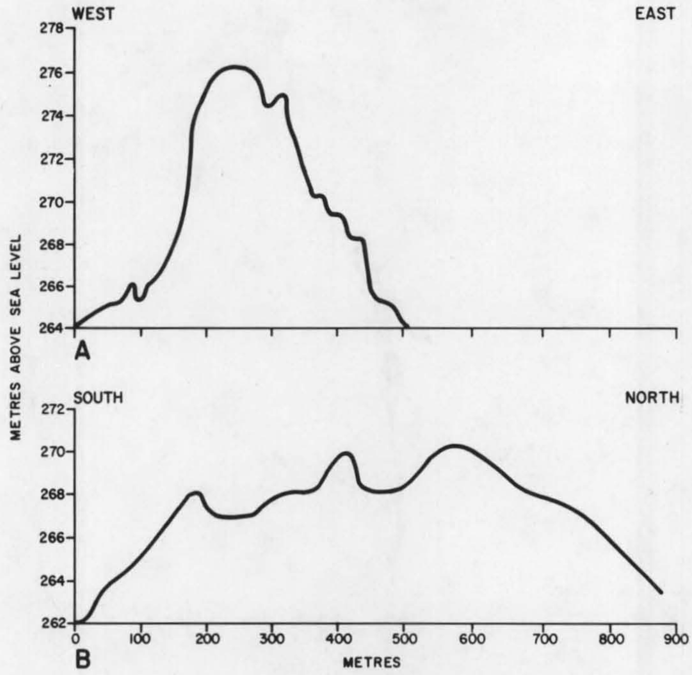


FIGURE 9. Profiles of the northern (A) and middle (B) segments of the Mantagao ridge. Locations of profiles is shown in Fig. 7.

Mantagao ridge: map unit 3b

The Mantagao ridge consists of three segments that are broadly lobate in outline. The northern segment is steep sided with flanking beach ridges; it averages 12 m in height and has a subsurface depth of at least 6 m. The middle section is 800 m wide and is capped by three beach ridges, the highest rising 8 m above the surrounding terrain. Figure 9 illustrates the differences in morphology between the two segments. The ridge widens to 1.5 km at the southern terminus. Relief is only 1 to 2 m but the subsurface depth is 13 m. Lacustrine sediments flank this segment; a Manitoba Department of Natural Resources borehole in SE11-24-2W shows 3 m of sand overlying 6 m of clay.

Although beds of till and silt are common in the poorly sorted gravels of the small eskers, the Mantagao ridge is composed of moderately to well sorted sand and sandy gravel. The only till encountered was minor bands of flow till interbedded with the gravels in the north end of the ridge.

Glaciofluvial sediments are well exposed in a large pit in the southern segment (SW12-24-2W) and in three small pits in the

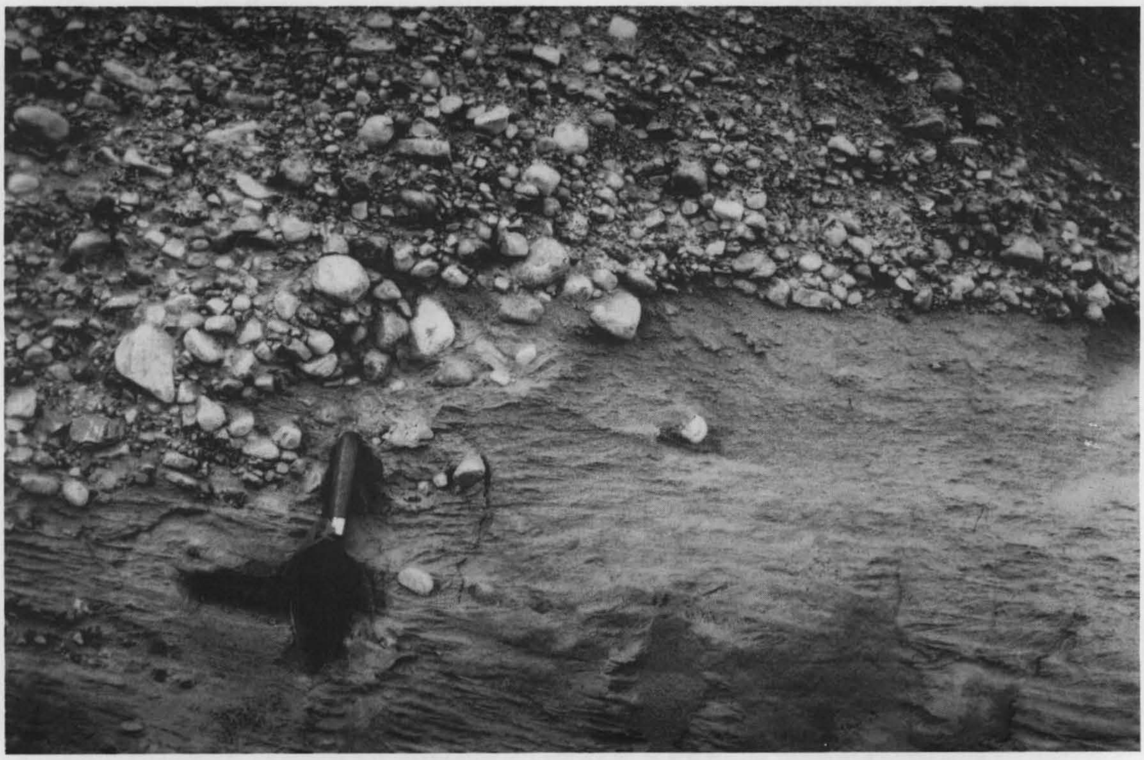


FIGURE 10. Erosional contact between glaciofluvial sands and gravels (SE22-24-2E); trowel is 26 cm long.

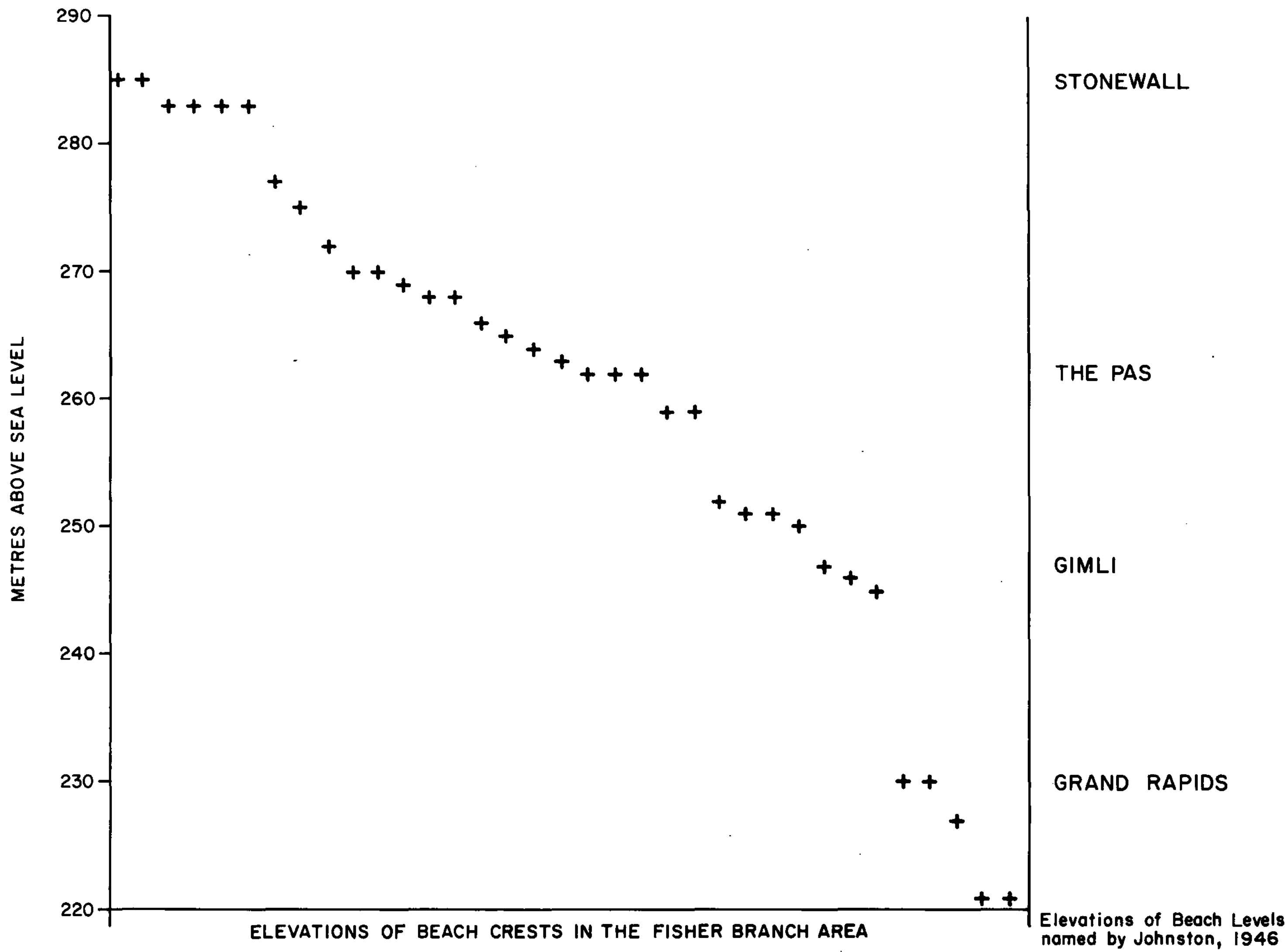


FIGURE 11. Elevations of beach crests in the Fisher Branch area.

middle and northern segments. The material ranges from massive and crossbedded sands to coarse gravel. Contacts between the lower sands and gravels are erosional (Fig. 10). Faulting is rare but was observed in the lower sands of the southern segment.

Paleocurrent directions were measured at three locations. In the northern and middle segments of the ridge paleoflow was generally southerly (130° — 170°). At the southern terminus, paleocurrent directions are towards 270° in the lower sands, between 40° and 140° in the gravels and between 30° and 150° in the upper sands.

Despite the similarities of the surface till east and west of the ridge, the Mantagao ridge shows no signs of having been overridden (drag folds, etc.). Nowhere does till overlie the glaciofluvial sediments. As well, the tributary eskers must have been formed at the same time as the ridge and would have been destroyed had they been overridden.

LACUSTRINE DEPOSITS

Glacial Lake Agassiz greatly modified the terrain of the Fisher Branch area. Beach ridges, wave cut scarps and extensive silt and clay deposits resulted from lake action.

Silt and Clay: map unit 4

Silt and clay deposits cover much of the west-central and eastern portions of the map area. In the west, they generally lie below 270 m in elevation. Deposit depths are variable as they overlie an undulating till plain but overall they thicken eastwards.

In the west and central areas, the lacustrine sediments are from 1 to 5 m deep. The surface is irregular, reflecting the underlying till plain morphology. The material is a yellow clayey silt, usually massive and stone-free but stoniness increases where the silt overlies near-surface till. Silt and clay rhythmites were exposed in a 3 m section in NW13-25-3W. Each couplet is approximately 20 cm thick; the lower 5 cm is a silty clay and grades into a blocky yellow-grey silt. The rhythmites are slumped in the upper metre of the section as a result of penecontemporaneous deformation.

To the east, the deposits range from 1 to 10 m in thickness and the clay content increases. They are grey to grey brown and are massive to blocky. At Arborg, the surface of the clay plain is flat as the deposits completely mask the underlying topography.

Iceberg scours are common in areas mapped as unit 4/2 but are less frequent in the deep clays near Arborg.

Beach Ridges: map unit 5b

The sediments and bedding of the beach ridges are described in the aggregate section of this report. In general, the ridges consist of 1 to 5 m of interbedded sand and pebble gravel and are usually found flanking or resting on bedrock highs. The pebble lithology averages 80% carbonate clasts, the same as the surface till which was the source material for these deposits.

Former levels of Lake Agassiz are marked by the elevations of beach ridges and wave cut scarps. Figure 11 shows the beach elevations and records the gradual lowering of the lake across the area. Named levels have been taken from Johnson (1946). The most prominent level recorded is that of the Gimli beach. Deposits 4913, 4915, 4917, 4918, 4921, 4923, 4925, 4926 and 4940 as well as the bedrock escarpments shown on Map AR84-2-1 were all part of the shoreline during the Gimli stage. The bedrock high in Twps. 24-26, Rge. 1E was probably an island during this time. Fenton et al. (1983) place the Gimli level in the late Nipigon Phase of Lake Agassiz, between 9500 and 8500 years B.P.

RECENT DEPOSITS

Alluvium: map unit 6

Alluvium is a minor component of the surficial material and is only found in narrow bands along the Icelandic and Fisher Rivers. The sediments range from clay to sand and are usually less than a metre thick.

Organic: map unit 7

Drainage is poor in the Fisher Branch area and swamps are a common constituent of the landscape. In the northeast, organic material is the major surficial unit. Bannatyne (1980) studied thirteen bogs in the Washow Bay area adjacent to the northeast corner of the study area. The bogs overlie clay and average 2 to 3 m in thickness. The percentage of sphagnum moss is high and these sites have good potential for development by the peat moss industry.

LATE GLACIAL HISTORY

The general sequence of events during the Late Wisconsin glaciation of southeastern Manitoba has been outlined by several authors (McPherson, 1970; Fenton, 1974; Teller and Fenton, 1980). Ice advanced first from the northeast to an undetermined western limit. Retreat of this ice was followed by an advance of the Red River Lobe flowing southeastwards down the Manitoba lowlands, eventually reaching Iowa. A series of readvances characterize the overall retreat of this ice from southern Manitoba.

Figure 12 shows the Fisher Branch area in a regional context. The ridge north of the study area is a glaciofluvial feature mapped by Smith et al. (1975) and is an extension of the Mantagao ridge. Flutes, drumlinoid ridges and bedrock striations show the broad picture of ice flow directions in the region.

There are three general directions of ice flow indicated: to the southwest (220° — 230°), to the south-southwest (180° — 190°) and to the southeast (135°). Immediately east of the Mantagao ridge is a zone where ice flow changed direction southward, from 170° in the north through 155° in the south.

Within the study area, the only record of the advance to the southwest is bedrock striations measured at two locations. The extent of the advance is unknown although striations show it was at least as far west as the town of Fisher Branch.

The surface till in the Fisher Branch area was deposited by ice advancing synchronously from the north and northwest during the last readvance of glacial ice to affect the area. The frequent incorporation of large clay clasts shows that this advance was over lake sediments and therefore late in deglaciation. Numerous iceberg scour marks indicate reworking of the surface till by icebergs over much of the area.

The formation of the Mantagao Ridge also took place during the last glacial event. The position of the Ridge in an area of converging striae indicates that it was deposited in an interlobate position between ice lobes flowing towards the south and the southeast. The change in ice flow direction east of the Ridge was caused by the presence of the ice in the west which forced the northern ice to turn and flow southeastwards.

Following the last ice retreat, Lake Agassiz covered the area. All lake levels in the Fisher Branch area are related to the final drainage of Lake Agassiz, which began about 9500 B.P. (Fenton et al., 1983). The lowest level of Lake Agassiz in the area is the Grand Rapids beach which formed when the ice front stood at the Settee Moraine, northwest of Thompson, Manitoba (Klassen, 1983).

FIGURE 12. Satellite photograph of Fisher Branch area, showing changing direction of ice flow indicators.

SAND AND GRAVEL RESOURCES

The sand and gravel resources of the Fisher Branch area are found in glaciofluvial and lacustrine deposits scattered throughout the area (Map AR84-2-2, in pocket). There are 54 million cubic metres of granular material, concentrated primarily in the Mantagao Ridge system (deposit 4902). Table A-1 (in Appendix 1) summarizes relevant information for each of the deposits. Grain size data are given in Table A-2. Figure A1-1 shows the size limits of granular descriptive terms (e.g. sandy fine pebble gravel) used throughout the text.

GLACIOFLUVIAL DEPOSITS

Glaciofluvial deposits consist of five eskers (deposits 4901, 4903, 4904, 4912 and 4916) and the Mantagao Interlobate Moraine (4902). These six deposits contain 40 million m^3 of sand and gravel — 75 per cent of the total granular material in the study area.

The sediments within the eskers are highly variable and range from clay to cobble gravel. Figure 13 shows the range of the grain size distribution for these deposits. The lithology of the 4-16 mm size range is 80% carbonate clasts, the remainder being erratics from the Precambrian Shield.

Deposits 4903, 4904a and 4916 are all being mined on an intermittent basis; each had a pit in use during the summer of 1982.

The pit in 4903 (SW11-25-3W) shows 3 m of cobbly pebble gravel in juxtaposition with contorted beds of silt and clay. The pit is small and was not used during the summer of 1983.

Deposit 4904a has been extensively mined in the past. The northern portion is predominantly sand and fine pebble gravel but has been sterilized by a farmstead. The pit in the southern portion (NW34-24-2W) shows 3.5 m of sandy, coarse pebble gravel. The pit is active on an intermittent basis and depth is limited by the water table. Deposit 4904b is coarser than the northern segment but has not been as extensively mined. A small pit in the deposit indicates at least 1.5 m of poorly sorted cobbly coarse gravel. All pits in deposit 4904 are sand and gravel floored and none are near depletion.

Deposit 4916 is also an esker comprised of variable material. Sediments range from silt and clay to beds of cobbles and pebble gravel. The southern pits are about 2 m deep and largely revegetated. The northern pit (SE34-25-1W) has been recently active and pit depths reach 3.5 m.

The Mantagao Ridge system (deposit 4902) contains the largest reserves of granular material in the study area (Table A-1; in Appendix I). It is a glaciofluvial feature but was extensively modified during the regression of Lake Agassiz. Wave action eroded much of the surface material and redeposited it as beach ridges on the flanks of the northern segment (4902a) and over the surface of the central portion (4902b). As a result of the two methods of deposition, the

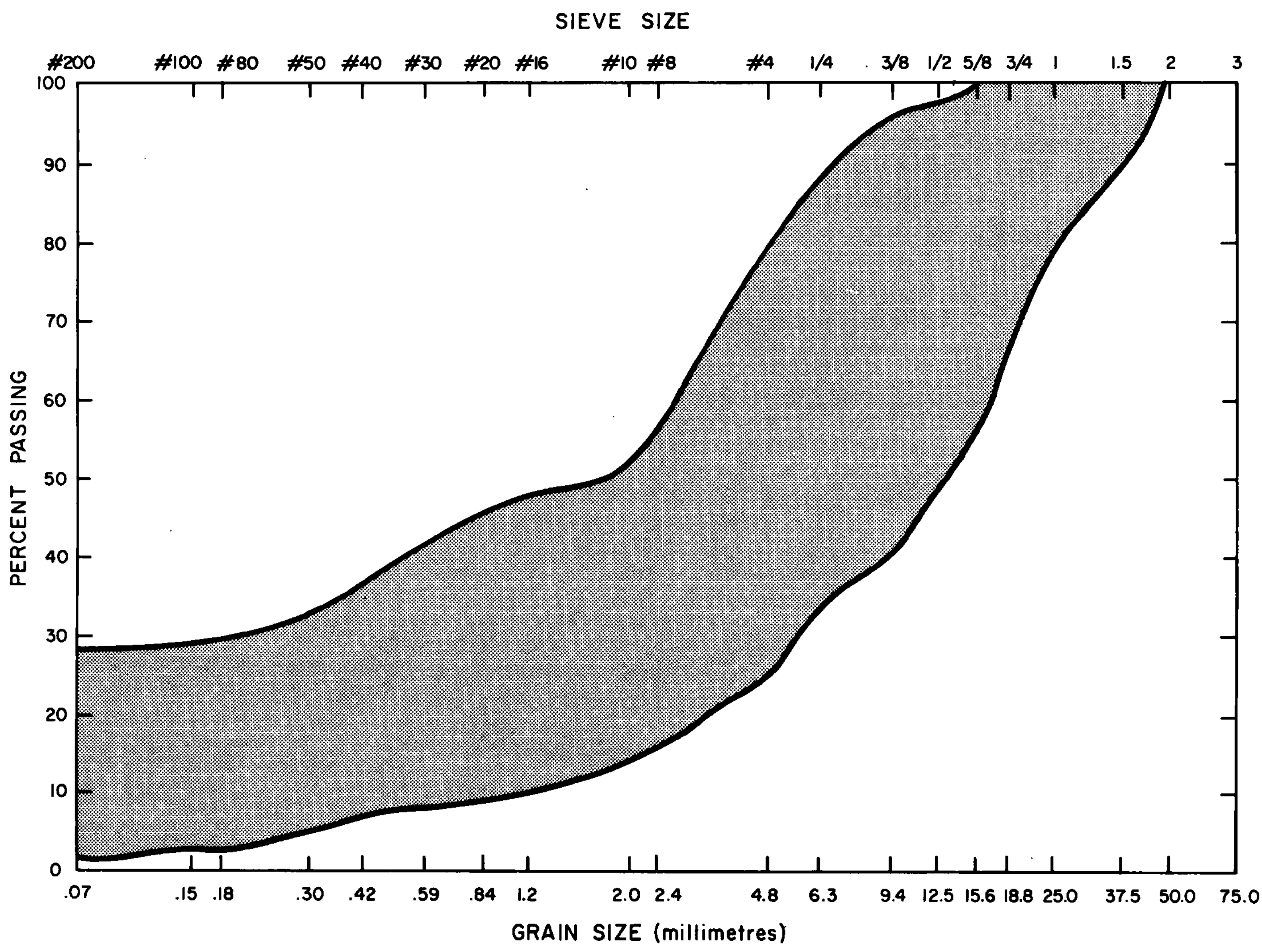


FIGURE 13. Range of grain size distributions in eskers; 6 samples.

materials comprising the ridge vary considerably. The glaciofluvial core is characterized by abrupt changes in grain size, the sediments ranging from fine sand to cobbly pebble gravel. The lacustrine materials are more uniform in grain size and range from medium sand to pebble gravel (Fig. 14).

The northern segment of the ridge (4902a) extends 9 km in a north-south direction. A Manitoba Department of Natural Resources drill hole in 17-25-3W recorded 18 m of sand and gravel without reaching bedrock. There is only one pit opened in this segment (SW17-26-3W) but the Materials and Research Branch of the Manitoba Department of Highways carried out a detailed backhoe program during the summer of 1982. All parts of the ridge on Crown land were tested with the exception of those portions in the Mantagao Lake Wildlife Management Area. The limit of the backhoe was 5m and most holes ended in granular material. Figure 15 shows the location of the test holes in NE5-26-3W and a visual log of each hole. The same type of information for the rest of the sections tested is found in the Appendix 2 (Figs. A2-1 to A2-6).

The minimum reserve figure for this segment of the ridge is 13 million cubic metres; most of it is medium to high quality gravel. However, the deposit is not likely to be mined in the near future as aggregate needs are being met by deposits situated much closer to local markets.

The middle segment (4902b) rises 5 to 8 m above the surrounding terrain and is composed of sand and sandy fine pebble gravel. The southern pits are in lacustrine material and show 2 to 3 m of interbedded sand and pebble gravel. These are minimum depths as the pits are sand and gravel floored. The northern pit (SE33-25-3W) is in glaciofluvial material and there is a minimum of 5 m of crossbedded sand and pebble gravel. The material is much finer than the glaciofluvial portions of 4902a. Boulders are not present and maximum grain size is in the small cobble range.

Although this portion of the deposit has the largest reserves in the study area, much of it is sand or is sterilized by farmsteads. There are only three pits opened and all are used on an intermittent basis. The northern pit has been recently active. The gravel is of high quality but it is overlain by 3 m of sand.

The southern segment of the ridge (4902c) has only 1 to 2 m of surface relief but subsurface reserves are substantial. The large active pit in SW12-24-2W is over 6 m deep and is sand and gravel floored. The pit is sandy on the north and west walls but on the south side 4 m of high quality coarse pebble gravel and cobbles underlie 2 m of sand (Fig. 16). The coarse gravel beds are not present in the revegetated pit in the northwest corner of the quarter-section but pit depth reaches 12 m.

Deposit 4912 has 2.5 m of glaciofluvial gravel overlying bedrock. The material is very poorly sorted and ranges from silt and clay to cobbles and boulders. However, the pit in this deposit is extensive and was active during the summer of 1982.

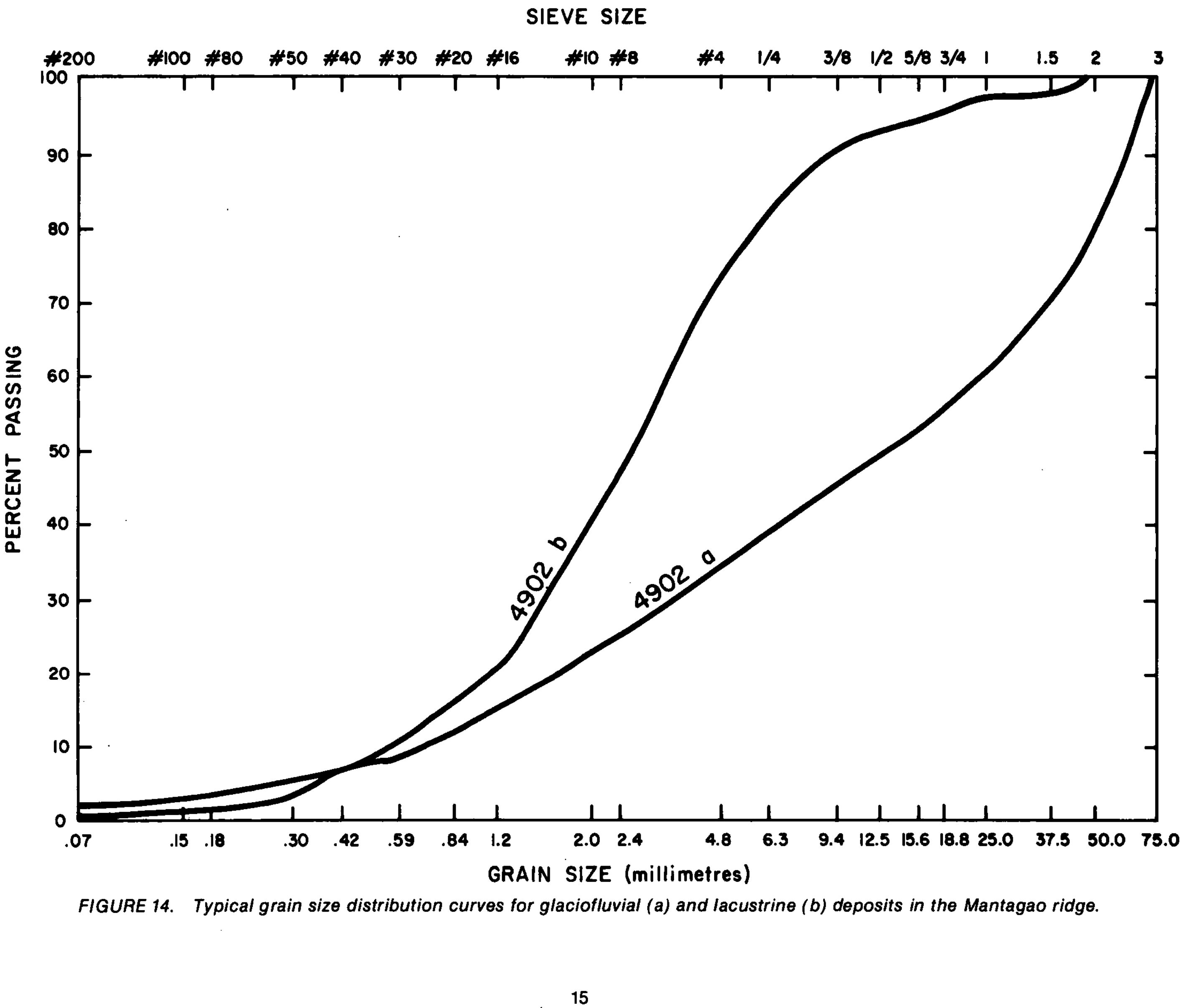
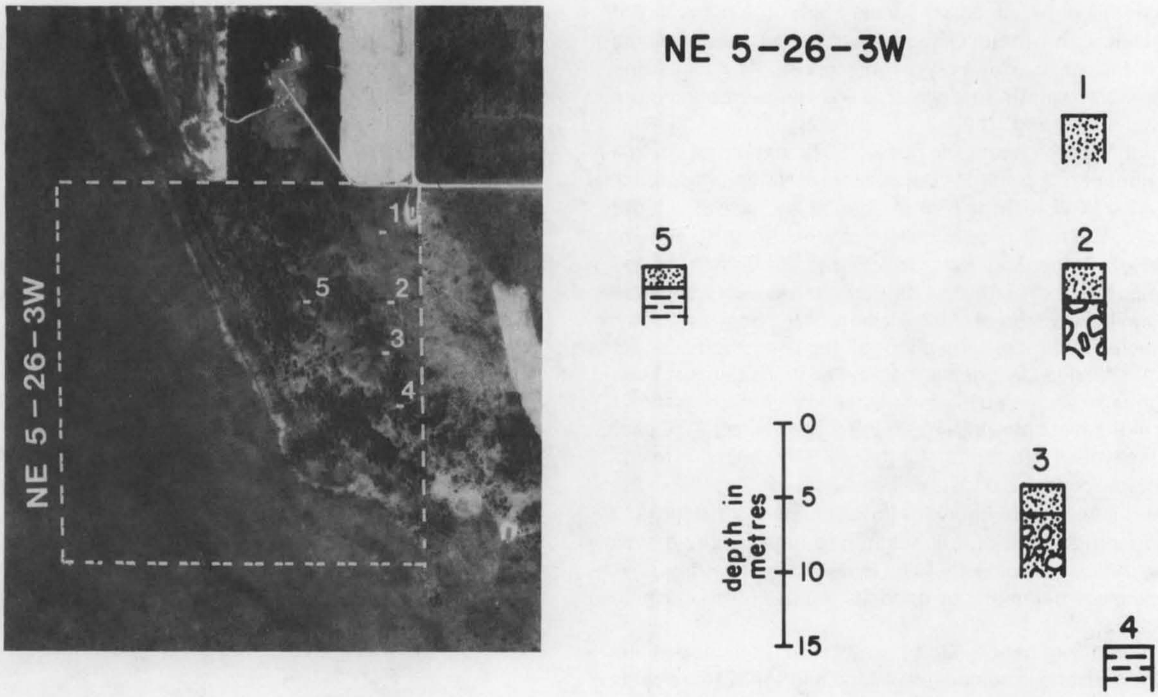


FIGURE 14. Typical grain size distribution curves for glaciofluvial (a) and lacustrine (b) deposits in the Mantagao ridge.



LEGEND

(applies to the above and all subsequent diagrams)

AIRPHOTO IDENTIFIES QUARTER-SECTION AND LOCATION OF BACKHOE TESTPITS WITHIN QUARTER-SECTION. THE SCALE BELOW APPLIES TO ALL PHOTOS. A LOG SCALE APPEARS WITH EACH DIAGRAM.

LOG OF TEST PITS

- COARSE GRAVEL; COBBLES
- PEBBLE GRAVEL; SAND
- SAND
- CLAY

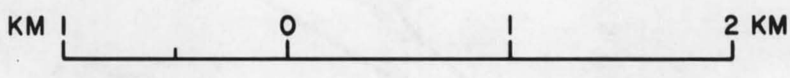


FIGURE 15. Location and log of backhoe test pits in the Mantagao ridge.

LACUSTRINE DEPOSITS

The remaining granular deposits in the area are beach ridges formed during the regression of Lake Agassiz. Most flank or rest on bedrock highs and have consistent depths of 2-3 m. The material ranges from fine sand to sandy coarse pebble gravel. The range of grain size distribution is shown in Figure 17. As with the eskers, lithologies in the beach ridges average 80% carbonate clasts and 20% Precambrian clasts.

The majority of the deposits have been used for gravel extraction. The smaller ones have been used on an intermittent basis. Pits are small and often revegetated. The deposits along Lake Winnipeg are largely depleted and have reverted to other land uses such as pasturage or garbage disposal sites.

All but two of the major deposits (4918 and 4940) have been used for gravel extraction in the past; five had active pits during the summer of 1982 (4905, 4907, 4919, 4921 and 4924).

Deposit 4905 has an active pit in SW14-24-3W that shows 3 m of sandy, coarse pebble gravel with cobbles. A Manitoba Department of Highways backhoe pit in an adjacent quarter-section (SE14-24-3W) indicates a minimum of 5 m of the same material. The ridge becomes shallow and sandier to the east.

Deposits 4907 and 4908 are in the Broad Valley Wildlife Management Area but there are several pits in the ridges and 4907 is currently being used for mineral extraction. The active pit in the south end (NE05-23-2W) has 3 m of sandy, coarse pebble gravel and is limited by the water table. The granular material thins to the north end of the pit where it overlies till at a depth of 1.5 m. Deposit 4908 is a beach ridge flanking a bedrock high. There are four small pits along it. The material is predominantly sand interbedded with pebble gravel.

Deposit 4919 is the major source of gravel for maintaining Provincial Road 235. The material ranges from sandy fine to coarse pebble gravel. The extensive pit in the east half of 3-26-1E is nearing depletion but the deposit extends north into section 10 where depths average 1.5 m. Deposit 4918 has not been mined yet but backhoe pits along the main ridge indicate 2 to 4 m of pebble gravel.

Deposit 4921 has been the major gravel source for the area for many years. The long, narrow pit in 36-24-2E shows 2.5 m of coarse pebble gravel interbedded with sand. The deposit is rapidly becoming depleted although good material is still present in the northern (1-25-2E) and southern (22-24-2E) ends.

Deposit 4923 has been extensively mined in the southern end. The material is fairly uniform: in 7-24-2E there is 3 m of sandy, coarse pebble gravel; in 6-24-2E, 2 m of pebble gravel overlies sand; in 5-24-2E there is 3 m of coarse pebble gravel. To the north, the ridge thins and narrows as it flanks a bedrock high.

As deposits 4921 and 4923 become depleted, deposit 4924 will be the next major source of gravel. There is a large active pit in SE25-24-1E; depths average 3 m but reach 5 m at the south end. The material is well sorted, interbedded sand and pebble gravel (Fig. 18). The material in the ridge extending southeast from 4924 varies in thickness and quality; in S18-24-2E there is at least 2 m of sandy, fine pebble gravel whereas 1.5 km north less than 1 m of coarse pebble and cobble gravel overlies till.

Deposit 4926 is nearing depletion in the southern half. Reserves of cobbly coarse gravel occur in SE12-22-1E but the pit has not been used recently. The municipal garbage dump is located in a revegetated pit in 11-22-1E. The remaining material in the northern half of the deposit is predominantly sand with occasional pebble beds. Mining is limited by the water table which occurs 1.5 m below the crest of the ridge.

Deposit 4935 has large reserves of sandy fine pebble gravel but has not been utilized because the surrounding swampy terrain has made access by gravel trucks a problem.

Deposit 4937 has varying depths of gravel. Section 17-25-4E has a minimum of 2 m of high quality sandy pebble gravel but to the north less than a metre of gravel overlies clay.

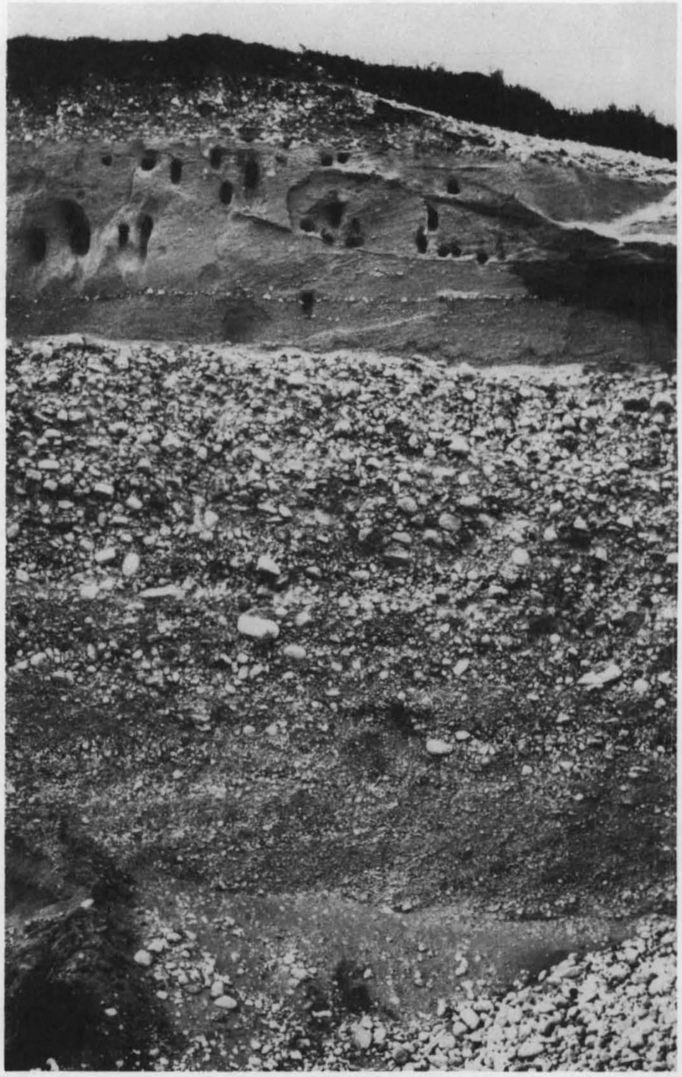


FIGURE 16. Glaciofluvial sand and gravel in deposit 4902C (SW12-24-2W). Pit face is 7 metres.

Deposits 4906, 4917 and 4936 still have reserves of gravel but all are nearing depletion.

BEDROCK QUARRIES

Of three bedrock quarries in the study area, two are active and one is inactive. The active quarries are located north of Riverton in Twp. 24, Rge. 4E, The quarry in Sec. 22 (Fig. 19) was originally opened in 1970 to provide stone for the Hecla Island causeway. The second, in sec. 35, has recently been used to provide fill for Provincial Road 233. The small quarry in 18-25-1W is a past producer of decorative building stone and terrazzo but has not been in use for at least ten years.

Further information about these quarries is on file with the Exploration Services Section of the Manitoba Mines Branch.

DEMAND FOR SAND AND GRAVEL

The annual demand for aggregate (Table 3) has been estimated by averaging the usage during the last five years. The area uses 165 000 m^3 annually. As reserves are estimated at 54 130 900 m^3, there should be no shortage of aggregate in the foreseeable future.

The R.M. of Bifrost has five major deposits: 4921, 4923, 4924,

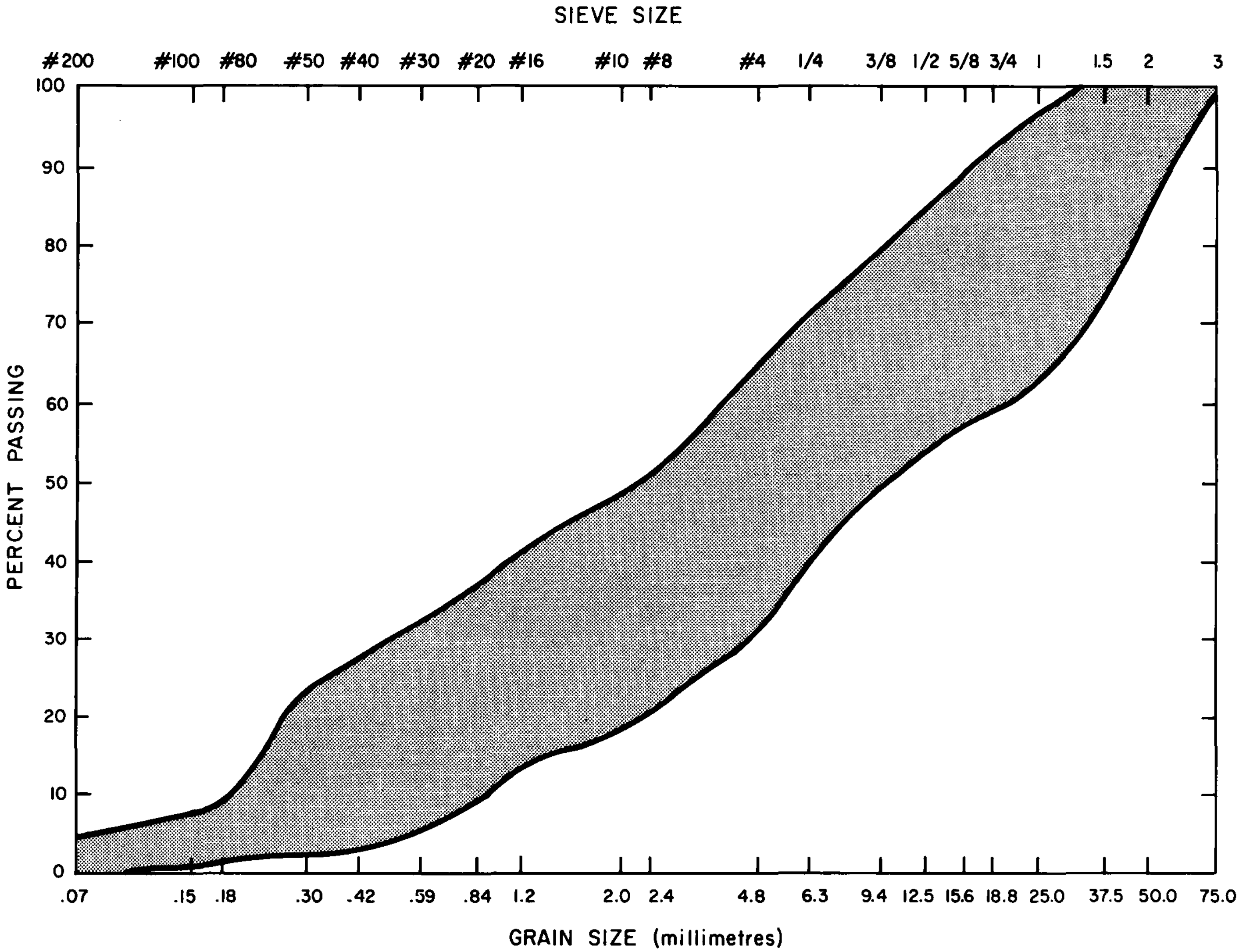


FIGURE 17. Range of grain size distribution in beach ridge deposits; 16 samples.

4926 and 4937. Deposit 4921 is near depletion and the remaining reserves in 4926 are primarily sand. However, the recent expansion of the municipal boundary to include deposit 4924 ensures an adequate gravel supply for the next ten to fifteen years. The bedrock quarry in 22-24-4E is already an important alternate source of aggregate.

The L.G.D. of Fisher has an abundance of sand and gravel located primarily in the Mantagao Ridge. However, due to isolation and sterilization only the southern segment is being mined on a large scale and local needs are met by smaller deposits scattered across the district. Of these, deposits 4924, 4919, 4916 and 4907 are the most important sources of aggregate.

TABLE 3. ESTIMATED DEMAND FOR SAND AND GRAVEL

	R.M. OF BIFROST (000's cu. m)		L.G.D. OF FISHER (000's cu. m)		COMBINED AREA (000's cu. m)	
	1 year	25 years	1 year	25 years	1 year	25 years
Dept. of Highways	41.3	1032.8	39.3	983.5	80.6	2015.0
Local	21.4	535.5	62.5	1563.6	83.9	2097.5
Total	62.7	1568.3	101.8	2547.1	164.5	4112.5

[1]Demand figures based on 1982 Municipal boundaries.

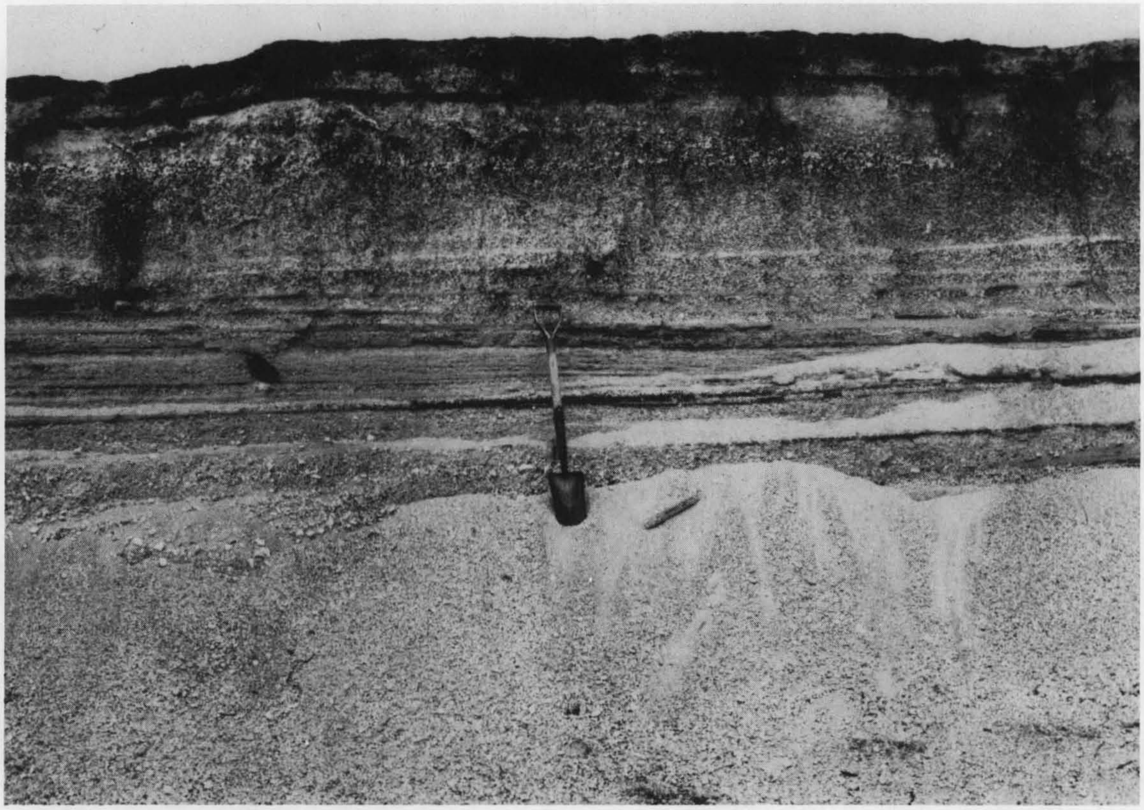


FIGURE 18. Active pit in beach ridge (SE25-24-1E); shovel is 1 metre high.

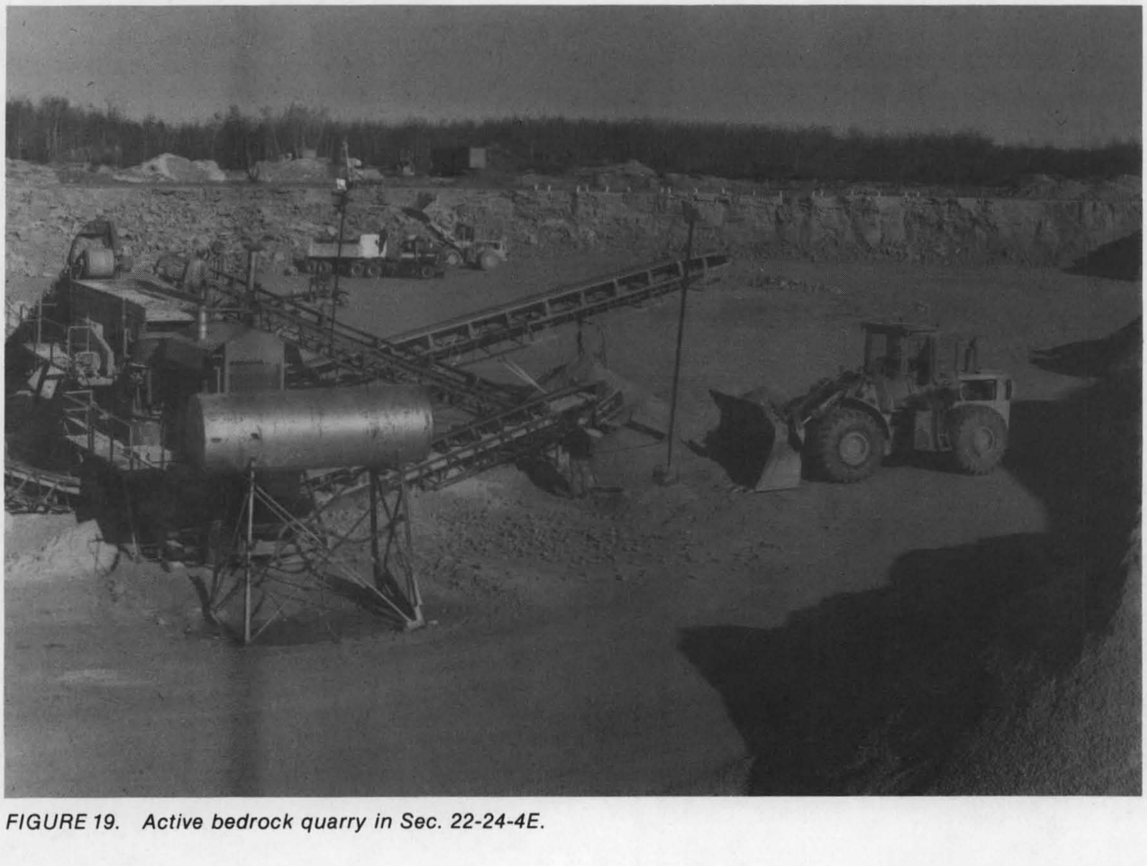


FIGURE 19. Active bedrock quarry in Sec. 22-24-4E.

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APPENDIX 1. AGGREGATE DEPOSITS AND GRAIN SIZE CLASSIFICATION

TABLE A-1: AGGREGATE DEPOSITS IN THE FISHER BRANCH AREA

DEPOSIT NUMBER	GENETIC TYPE	SAMPLE NUMBER	PER CENT STONE (+ #4) (+ 4.76 mm)	LITHOLOGY 4-16 mm % PRECAMBRIAN	% CARBONATE	ESTIMATED RESERVES '000 m³	COMMENTS
4901	glaciofluvial	—	—	—	—	1452	unopened; Wildlife Management area
4902A	glaciofluvial flanked by lacustrine	HG518	25	12	88	13 226	1 small pit; material variable, from cobbles to pebble gravel to sand.
		HWY01	51	18	22		
		HWY02	76	19	81		
		HWY03	58	20	80		
		HWY04	36	—	—		
		HWY13	48	18	82		
		HWY14	62	19	81		
		HWY16	64	14	86		
4902B	glaciofluvial overlain by lacustrine	HG386	33	17	83	17 279	several small pits; much of deposit sterilized by roads and farmsteads
		HG408	26	19	81		
4902C	glaciofluvial	HG484A	18	11	88	5646	two large pits; 1 active, 1 abandoned
		HG484B	55	13	87		
4903	glaciofluvial	HG515	66	22	78	159	1 pit, intermittent usage
4904A	glaciofluvial	—	—	—	—	347	1 active pit; north half deposit sterilized by farmstead
4904B	glaciofluvial	HG432	74	21	79	350	1 abandoned pit
4904C	glaciofluvial	—	—	—	—	15	unopened
4905	lacustrine	HG360	49	23	77	1343	large pit; used on intermittent basis
4906	lacustrine	HG493	31	19	81	190	pit near depletion; sandy
4907	lacustrine	HG330	35	18	82	200	1 active pit
4908	lacustrine	HG333	61	21	79	1734	shallow deposit; several pits used on intermittent basis
		HG514	40	23	77		
4909	lacustrine	HG338	48	22	78	166	1 abandoned pit
4910	lacustrine	—	—	—	—	60	primarily sand
4911	lacustrine	—	—	—	—	129	shallow deposit; sandy
4912	glaciofluvial	HG352	39	15	85	485	shallow deposit; variable material; high % silt and clay
4913	lacustrine	—	—	—	—	264	sand
4914	lacustrine	—	—	—	—	39	shallow deposit
4915	lacustrine	—	—	—	—	22	depleted; flanking bedrock
4916	glaciofluvial	HG437	37	18	82	1569	three small pits; intermittent usage
		HG443	44	18	82		
4917	lacustrine	—	—	—	—	165	one large pit
4918	lacustrine	—	—	—		1412	no pit, material is sandy coarse pebble gravel; with cobbles
4919	lacustrine	HG494	40	13	87	640	one active pit
4920	lacustrine	—	—	—	—	14	near depletion
4921	lacustrine	HG482	59	10	90	652	active pits; nearing depletion
		HG495	68	10	90		
4922	lacustrine	—	—	—	—	75	unopened
4923	lacustrine	HG393	59	—	—	907	south end extensively mined; north end shallow, flanking bedrock
		HG405	56	14	86		
4924	lacustrine	HG496	11	18	82	2100	large active pit; deposit shallows northward
		HG497	21	19	81		
4925	lacustrine	—	—	18	82	61	near depletion

TABLE A-1: AGGREGATE DEPOSITS IN THE FISHER BRANCH AREA (Cont'd)

DEPOSIT NUMBER	GENETIC TYPE	SAMPLE NUMBER	PER CENT STONE (+ #4) (+ 4.76 mm)	LITHOLOGY 4-16 mm % PRECAMBRIAN	% CARBONATE	ESTIMATED RESERVES '000 m³	COMMENTS
4926	lacustrine	—	—	—	—	573	depleted in south; municipal garbage dump
4927	lacustrine	—	—	—	—	5	sterilized by road
4928	lacustrine	—	—	—	—	28	near depletion; garbage dump
4929	lacustrine	—	—	—	—	67	sterilized by highway
4930	lacustrine	—	—	—		10	pit depleted; sandy
4931	lacustrine	—	—	—		92	sandy
4932	lacustrine	—	—	—	—	154	sandy fine pebble gravel; shallow deposit
4933	lacustrine	—	—	—	—	65	pit near depletion
4934	lacustrine	—	—	—	—	27	garbage dump
4935A	lacustrine	HG530	47	7	93	639	access through swamp; deposit shallow on east half
4935B	lacustrine	—	—	—	—	768	unopened
4936	lacustrine	—	—	—	—	436	sandy; pit revegetated
4937	lacustrine	HG531	54	—	—	452	recently active pit
4938	lacustrine	—	—	—	—	5	sterilized by highway and railroad
4939	lacustrine	HG531	—	—	—	47	coarse pebble gravel; inactive pit
4940	lacustrine	HG532	55	7	93	61	active pit
					Total Reserves	54 130	

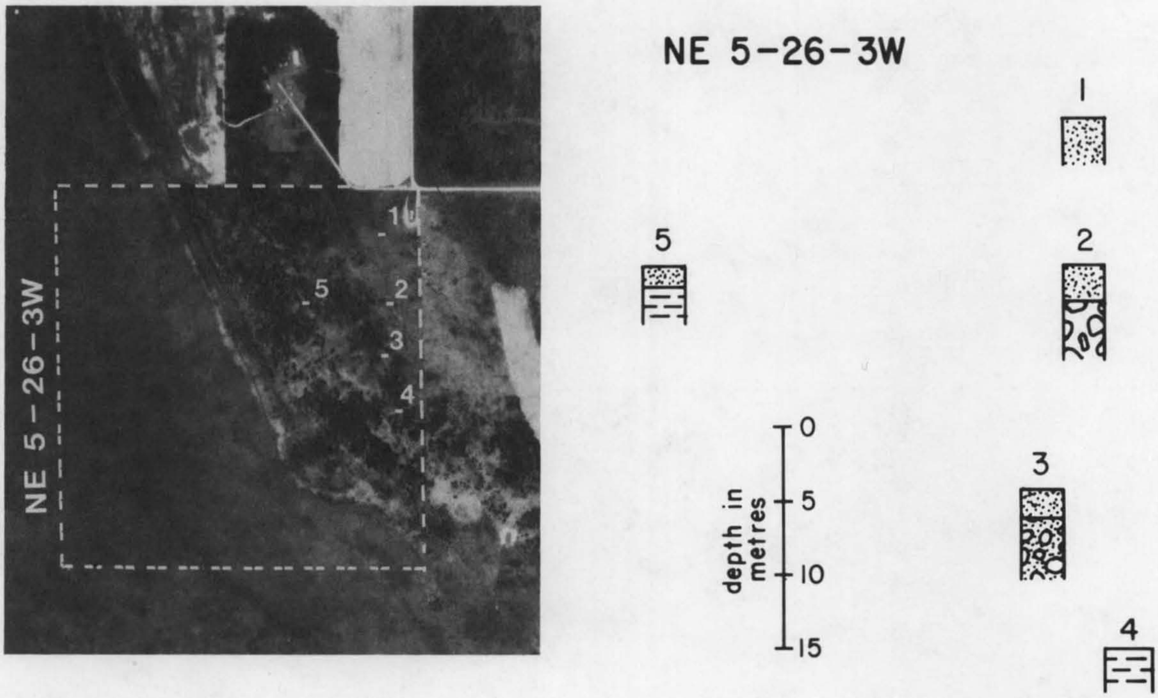
TABLE A-2. GRAIN SIZE DISTRIBUTION OF AGGREGATE SAMPLES

DEPOSIT NUMBER	SAMPLE NUMBER	% PEBBLES 4-64 mm	% GRANULES 2-4 mm	% SAND .06-2 mm	% SILT & CLAY < .06 mm	CRUSHABLE ON SITE >15 cm x YES
4902A	HG518	22.4	39.6	36.3	1.7	x
	99999	61.9	12.5	17.3	8.3	
	HWY16	63.5	19.0	15.5	2.0	
	HWY01	44.5	26.6	27.7	1.3	x
	HWY02	60.6	20.7	14.6	4.1	x
	HWY03	58.2	12.6	28.5	0.7	
	HWY04	35.7	9.2	51.8	3.3	
	HWY13	47.5	18.4	31.8	2.3	
	HWY14	61.9	13.5	22.0	2.5	x
4902B	HG386	33.5	27.3	38.8	0.4	
	HG408	26.0	34.4	39.2	0.4	
4902C	HG484A	18.1	31.2	47.1	2.6	x
	HG484B	54.7	19.7	23.6	2.0	x
4903	HG515	66.2	19.6	11.2	3.0	x
4904B	HG432	74.1	11.2	11.5	3.2	x
4905	HG360A	48.5	3.6	38.6	9.3	x
	HG360B	49.0	10.9	38.1	2.0	x
4906	HG493	30.9	17.4	50.6	1.1	
4907	HG330	34.6	16.8	45.8	2.8	
4908A	HG333	60.6	15.2	24.1	0.1	x
	HG514	40.2	13.4	46.2	0.2	
4909	HG338	47.5	12.0	35.6	4.9	
4912	HG352	38.5	20.0	29.0	12.5	x
4916	HG437	36.7	23.5	37.4	2.4	
	HG443	43.7	6.6	21.1	28.6	
4919	HG494	39.7	23.1	36.0	1.2	
4921	HG482	58.7	8.7	31.4	1.2	
	HG495	68.1	13.9	14.9	3.1	
	HG393	59.4	9.4	29.9	1.3	
4923	HG405	55.6	13.1	29.7	1.6	
4924	HG496	10.9	19.7	68.4	1.0	
	HG497	21.3	33.2	44.4	1.1	
4935A	HG530	46.5	13.3	38.8	1.4	
4937	HG531	54.3	4.9	39.7	1.2	
4940	HG532	55.1	19.6	23.0	2.3	x

Screen	mm			
			Boulders	
			+256mm	
4"	101.6	maximum size sampled		
3 1/2"	88.9		Cobbles	
3"	76.2	Gravel		
2 1/2"	63.5			
2"	50.8			Pebbles
1 1/2"	38.1		Coarse	
1"	25.4			
3/4"	19.1			
5/8"	15.9		Medium	
1/2"	12.7			
3/8"	9.5			
1/4"	6.35		Fine	
# 4	4.76			
# 8	2.38	Sand	Granules	
#10	2.00			
#16	1.19		Coarse	Sand
#30	0.59			
#40	0.42		Medium	
#50	0.30			
#80	0.177			
#100	0.149		Fine	
#200	0.074			
< 200		Fines	Silt & Clay	

FIGURE A1-1. Grain size classification.

APPENDIX 2. TEST PITS IN NORTHERN SEGMENT OF MANTAGAO RIDGE



LEGEND

(applies to the above and all subsequent diagrams)

AIRPHOTO IDENTIFIES QUARTER-SECTION AND LOCATION OF BACKHOE TESTPITS WITHIN QUARTER-SECTION. THE SCALE BELOW APPLIES TO ALL PHOTOS. A LOG SCALE APPEARS WITH EACH DIAGRAM.

LOG OF TEST PITS

- COARSE GRAVEL; COBBLES
- PEBBLE GRAVEL; SAND
- SAND
- CLAY

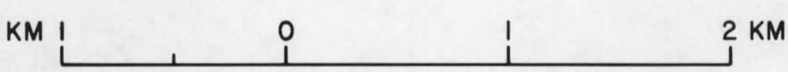


FIGURE A2-1. Location and logs of backhoe test pits in NE5-26-3W.

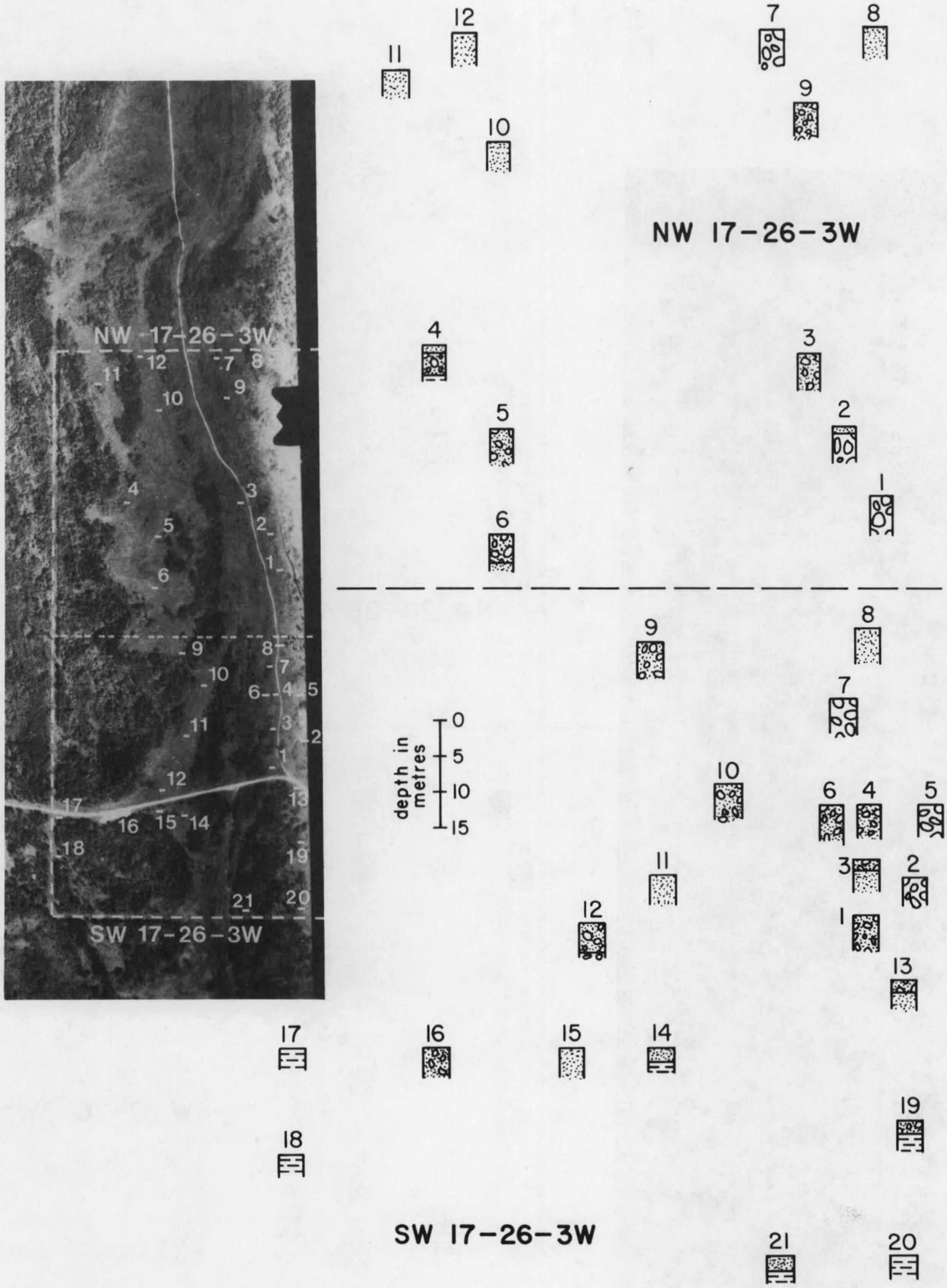


FIGURE A2-2. Location and logs of backhoe test pits in NW, SW17-26-3W.

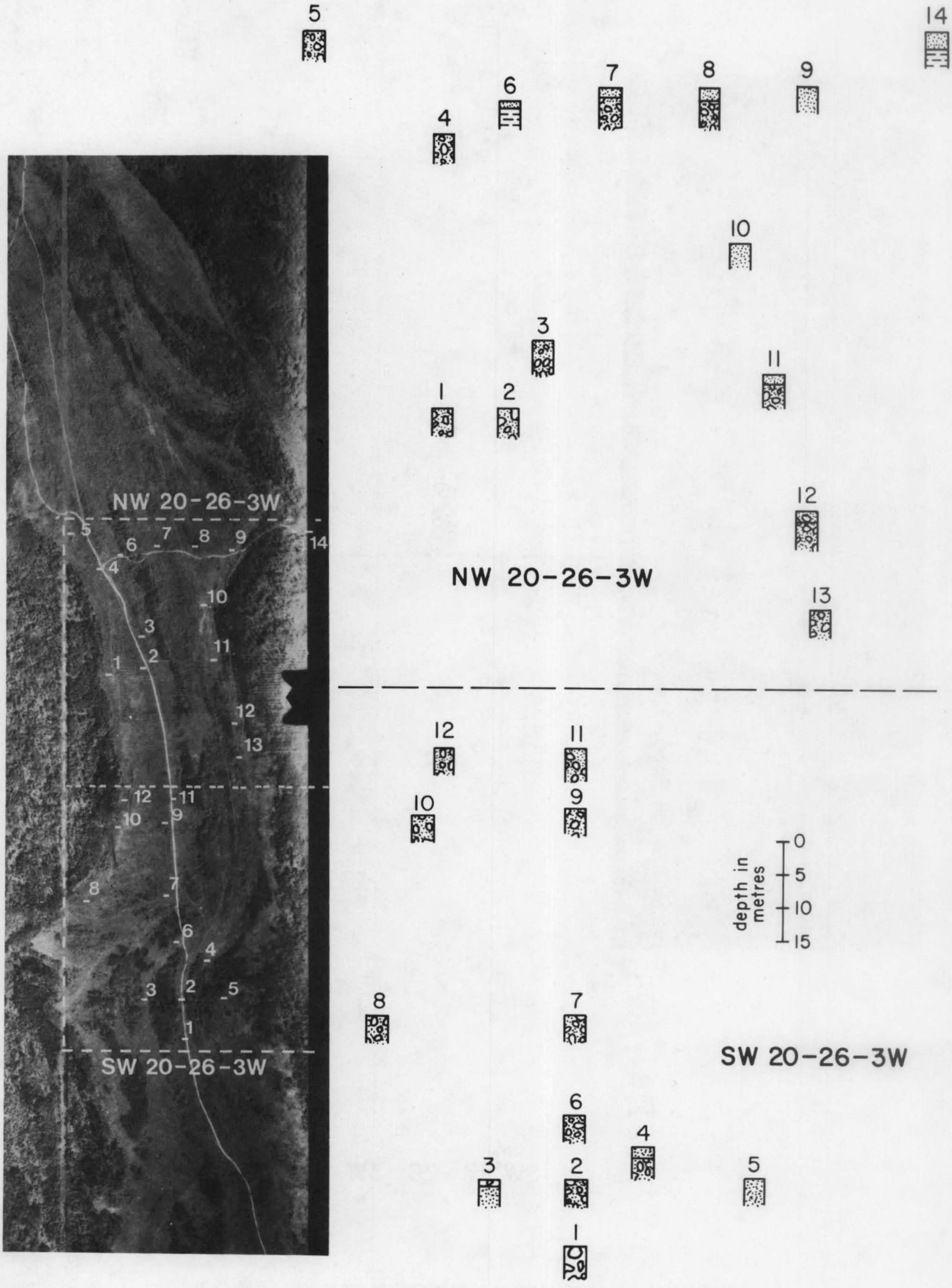


FIGURE A2-3. Location and logs of backhoe test pits in NW, SW20-26-3W.

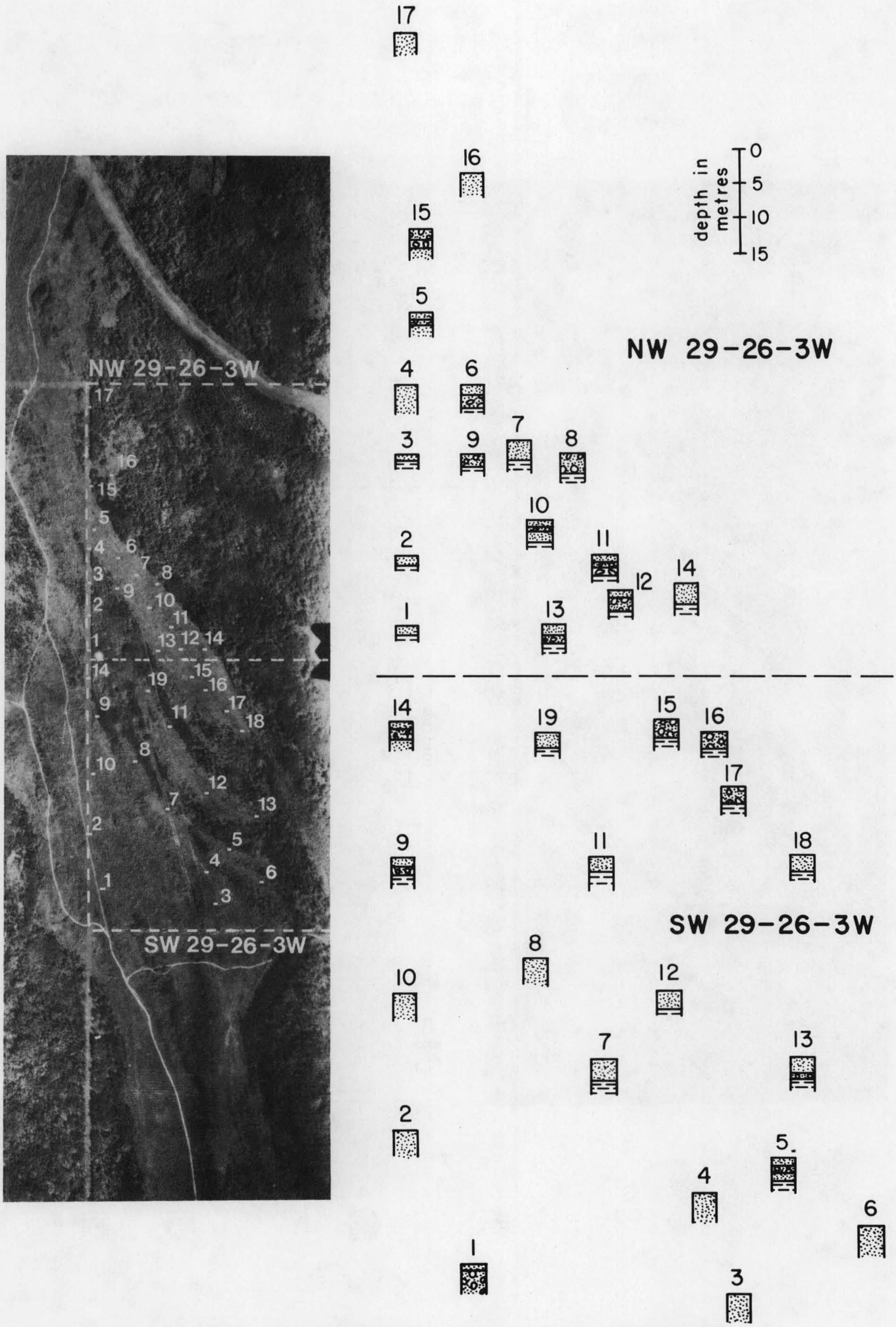


FIGURE A2-4. Location and logs of backhoe test pits in NW, SW29-26-3W.

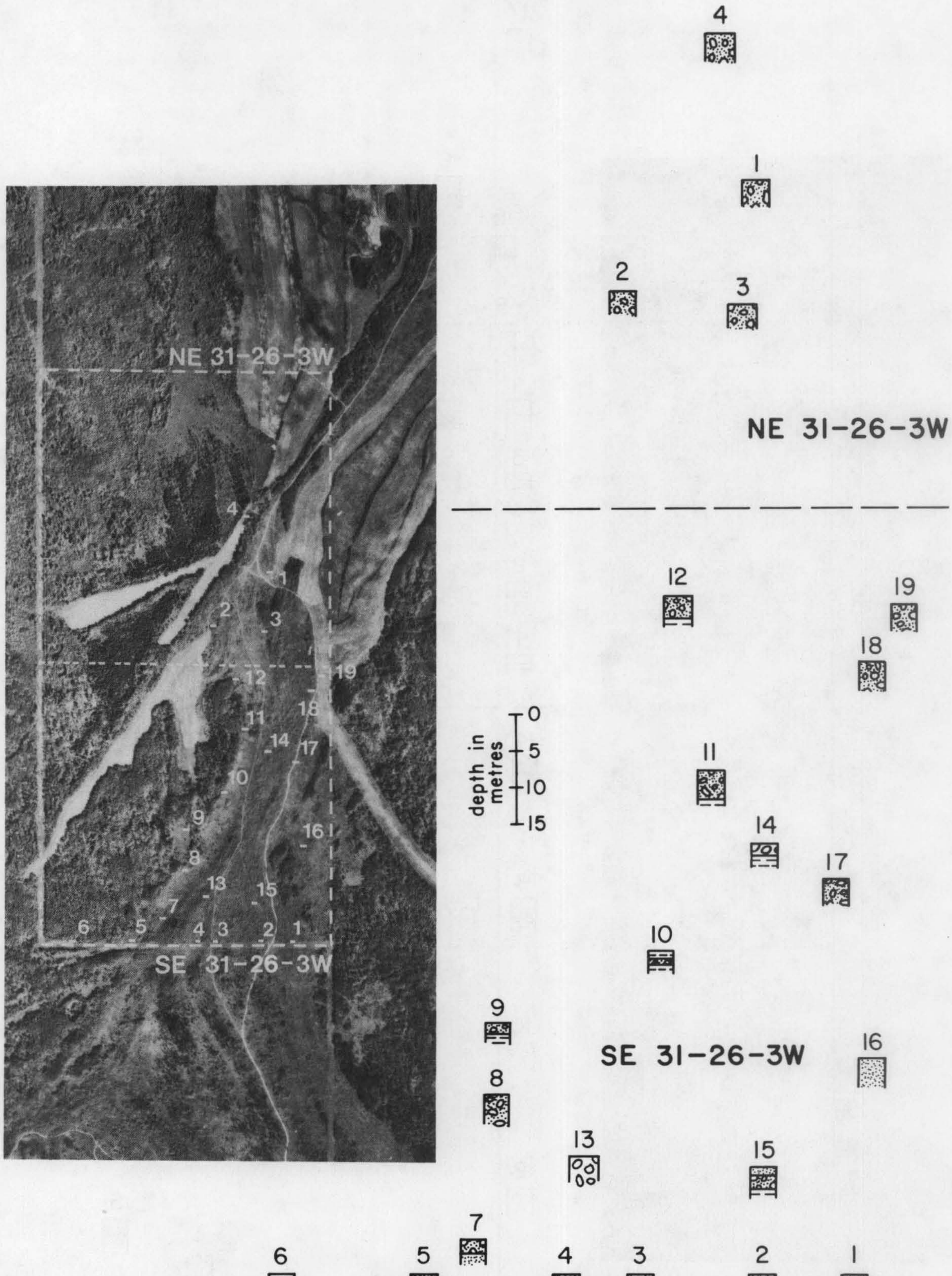


FIGURE A2-5. Location and logs of backhoe test pits in NE, SE31-26-3W.

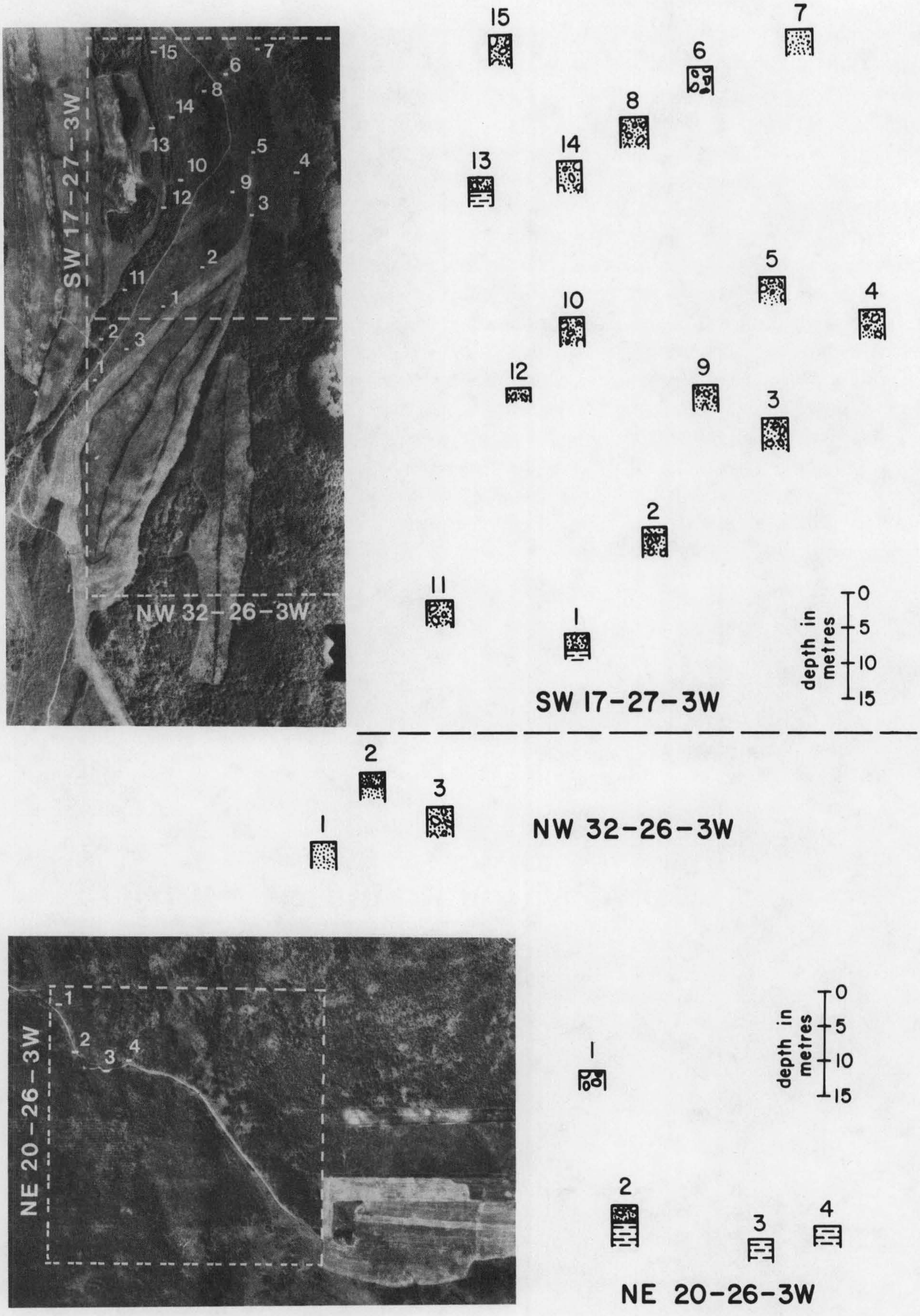


FIGURE A2-6. Location and logs of backhoe test pits in SW17-27-3W, NW32-26-3W, and NE20-26-3W.