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BEDROCK TOPOGRAPHY AND SURFICIAL AQUIFERS OF THE EDMONTON DISTRICT, ALBERTA

by

V. A. Carlson

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BEDROCK TOPOGRAPHY AND SURFICIAL AQUIFERS OF THE EDMONTON DISTRICT, ALBERTA

Abstract

The bedrock topography of the Edmonton district consists of broad valleys separated by low, broad divides. The preglacial drainage pattern over most of the district is dendritic. The maps presented in the report, showing sand and gravel deposits and bedrock topography, indicate a number of areas offering good groundwater production potential.

INTRODUCTION

Purpose and Scope

The primary purpose of this report is to present maps and descriptions giving the bedrock surface configuration and the location of surficial materials that are potential sources of groundwater in the Edmonton district. This information is mainly for the benefit of future groundwater users, water-well drilling contractors, and groundwater consultants, but will probably also be of use to others interested in the near-surface geology of the Edmonton district. No attempt has been made to discuss the groundwater hydrology or chemistry of the surficial deposits, except in the most general terms.

Three maps have been prepared for this report. The first (Fig. 2) shows superimposed contours for the bedrock topography and the present-day land surface. The interval used for both sets of contours over most of the map-area is 25 feet. Selected reports of sand and gravel resting on bedrock are also included on this map by means of symbols showing the reported location and thickness of these deposits. The second map (Fig. 4) shows the thalwegs (lines through the deepest portions) of what are interpreted to be the preglacial valleys of the study area. A third and final map (Fig. 5) shows the thickness of glacial and Recent sand and gravel, as interpreted from the drillers' logs, superimposed on a surficial geology map.

Location of the District

The Edmonton district is the area covered by National Topographic Series map-sheets 83H 5, 6, 11, and 12 (Fig. 1). It is bounded by meridians of longitude 113°00' and 114°00' west, and parallels of latitude 53°15' and 53°45' north. The area of the district is about 1,400 square miles.

Previous Investigations

The surficial geology of the Edmonton district has been mapped on a scale of one inch to one mile by Bayrock and Hughes (1962). Their study area is identical to that of the present investigation. The groundwater geology of the Edmonton Formation in the Edmonton district has been described by Domenico (1963). A brief description of bedrock topography is included in this study.

An early attempt to define the courses of bedrock valleys of central and southern Alberta was made by Stalker (1961). In the same year a map constructed by Farvolden showing the paths of the preglacial valleys in roughly the same area was published by Gravenor and Bayrock (1961). The Edmonton district was covered in both of these preliminary interpretations.

A bedrock-topography map of the Edmonton-Red Deer map-area was published by Farvolden (1963a). In the same publication is a bedrock-topography map of an area of about 8 square miles near Devon, a town within the Edmonton district (Farvolden, 1963c).

Figure 1, in addition to showing the area covered by the present study, also shows the area covered by Farvolden's (1963a) Edmonton-Red Deer study and the areas covered by similar studies elsewhere in the province.

Method of Investigation and Accuracy

Logs from seismic shot holes provided the bulk of the information used in compiling the maps accompanying this report. Information gained from this source was supplemented by logs obtained from water-well drilling contractors and by logs from a few test holes drilled by the Groundwater Division of the Research Council. Bedrock elevations and sand and gravel thicknesses obtained from two published reports (Farvolden, 1963c; Bayrock and Berg, 1966) were also incorporated into the data used for this report.

While compiling the data, there was found to be considerable

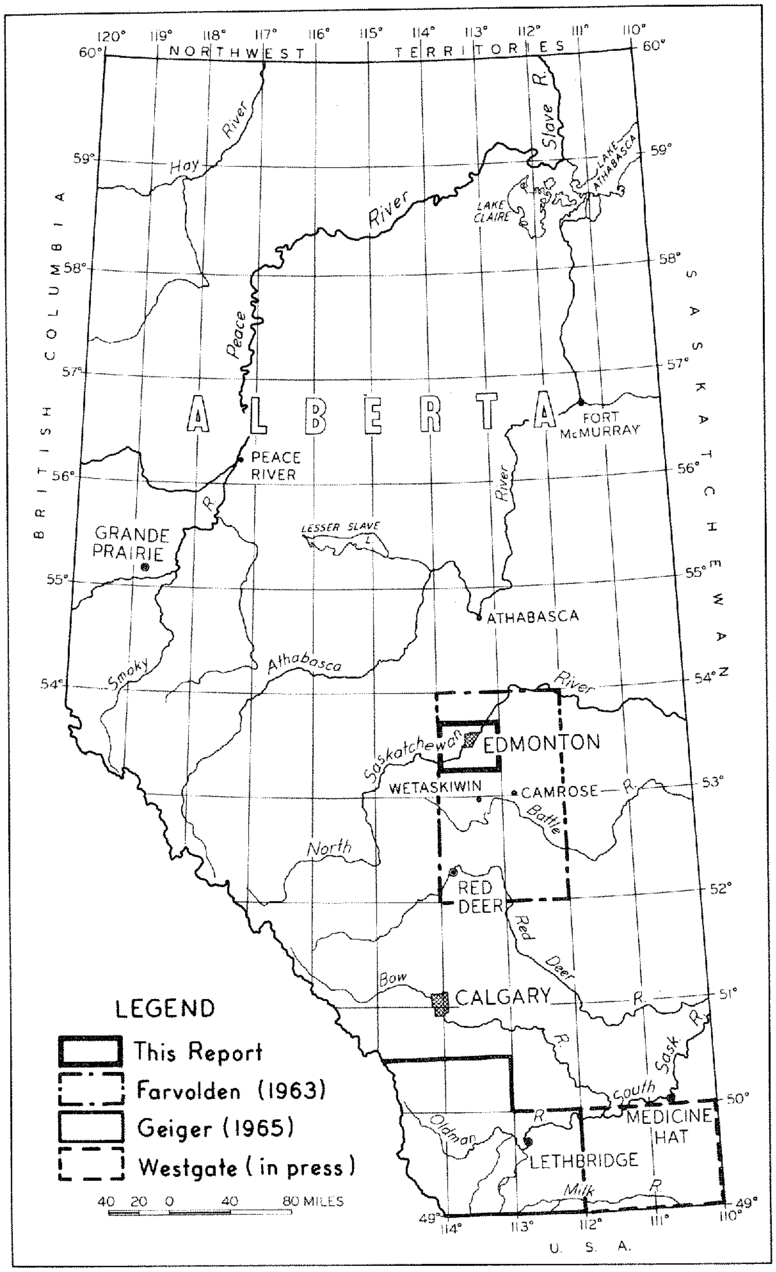

Figure 1. Index map.

overlap of shot-hole information from the different oil companies plus additional control from other sources. In only three townships was there found to be information from fewer than three sources. Bedrock elevations that appeared incorrect when compared to nearby information were eliminated from the base map. A number of shot holes did not penetrate to bedrock and they were also generally eliminated from consideration, except in areas of sparse coverage. From an original 16,000 logs, an estimated 6,000 were eliminated, leaving about 10,000 bedrock elevations to be contoured (an average of seven elevations per square mile). The township with the most information is Tp. 51, R. 27*, with an average of 11 bedrock elevations per square mile. The township with the least information, exclusive of the city of Edmonton, is Tp. 51, R. 26, with three elevations per square mile. Because seismic prospecting is not allowed within the limits of a city, this primary source of information was not available in the city of Edmonton. Hence, the density of information within city limits is low, a fact which is reflected in the general use of a 50-foot contour interval within this area.

The final step was to contour the bedrock-surface elevations for figure 2, and the sand and gravel thicknesses in the glacial and Recent deposits for figure 5. It should be noted that the contouring was originally done strictly on the basis of control obtained from the sources previously indicated. Other information available from existing topographic and surficial-geology maps was ignored until after contouring was completed. The bedrock contours were then modified in those instances where they indicated a bedrock elevation higher than the present land surface. This was generally the case along narrow, modern valleys – such as those of Conjuring Creek and Blackmud Creek – which have been cut deeply into bedrock.

Acknowledgments

The shot-hole data, which comprised more than 90 per cent of the information available for the area, was supplied by the following oil companies and it is a pleasure to acknowledge their cooperation: Hudson's Bay Oil and Gas Company Ltd., Imperial Oil Ltd., Shell Canada Ltd., Mobil Oil Canada, Ltd., and Texaco Exploration Company.

Logs sent in by the water-well drilling contractors operating in the area were of material assistance and their use is gratefully acknowledged, as is the assistance rendered by the Oil and Gas Conservation Board. Some additional information within the city of Edmonton was made available by R. M. Hardy and Associates, and in Tp. 51, R. 26 by Mr. G. M. Gabert.

*All locations are west of the fourth meridian (110°) except where otherwise noted.

Costs of test drilling in parts of the study area where information was sparse or interpretations doubtful were shared equally between the federal and provincial governments as a part of ARDA (the federal Agricultural Rehabilitation and Development Act). This financial support was most helpful and is sincerely appreciated.

BEDROCK SURFACE

Throughout almost the entire Edmonton district the bedrock surface is sculptured in poorly consolidated materials comprising the Edmonton Formation of late Cretaceous age. This formation consists largely of bentonitic shales with lenticular sandstone layers and coal zones (Ower, 1958) and is generally considered to be of low transmissibility. According to map 1002A (Geol. Surv. Can., 1951) the underlying Bearpaw Formation is present in Sec. 23, Tp. 54, R. 23; however, neither Ower (1958) nor Bayrock and Hughes (1962) could find evidence of its existence at this location. The bedrock in the extreme northeastern corner of the district belongs to the Belly River Formation which consists largely of poorly consolidated shales. Both the Edmonton and Belly River Formations have a regional northwest-southeast strike and a dip of a few tens of feet per mile to the southwest.

The bedrock topography of Alberta is largely the result of erosion during Tertiary and early Pleistocene time. This preglacial land surface was modified to some extent during the glacial age. The resulting modified form has been preserved beneath the glacial deposits, except in those areas where postglacial rivers have cut through the glacial material and eroded the bedrock (Farvolden, 1963b; Geiger, 1965).

The configuration of the bedrock surface shown in figure 2 is the end product of the geologic processes outlined above. The degree of modification of the preglacial land surface by glacial erosion is not known in detail and for this reason the contours on the bedrock surface have been constructed according to the bedrock-elevation data presently available; no attempt has been made to restore their preglacial configuration. No contours were drawn on the bedrock surface within the valley of the present-day North Saskatchewan River because control in this area was almost completely lacking. In the North Saskatchewan River valley west of range 23, bedrock and surface elevations coincide closely, because this portion of the valley is postglacial (Bayrock and Hughes, 1962) and is incised into bedrock.

In discussing the bedrock topography of the Edmonton-Red Deer map-area, Farvolden (1963a) divided the upland areas into a number of plains separated by low divides and provided names for these features. In Farvolden's terminology the study area lies almost completely within the Edmonton Plain with the Cooking Lake Divide being located in the southeastern portion of the district.

In this report the bedrock topography is discussed from the point of view of preglacial divides and drainage basins rather than from that of existing bedrock plains and divides. The name Cooking Lake Divide is retained in this study since Farvolden considered this feature to be preglacial, but the term Edmonton Plain is not used because it denotes both preglacial and glacial features.

The locations of those bedrock valleys which are interpreted to be preglacial are shown on figure 4 by lines along their thalwegs (deepest portions). The interpretation was carried out on the premise that a bedrock valley is a preglacial valley except where it has been specifically classified as being of glacial or Recent origin by Bayrock and Hughes (1962). Thalwegs were not drawn for the three bedrock valleys so classified: The Sturgeon River valley east of St. Albert, the Gwynne Outlet, and the valley of the North Saskatchewan River west of range 23. In the case of the Sturgeon River valley east of St. Albert an interpretation, not based on the present configuration of the bedrock valley, was made as to the position of the two preglacial valley thalwegs which are thought to have occupied the same location. Revisions in classification may become necessary as borehole samples from the minor bedrock valleys become available. However, the integration of the valleys in figure 4 into what appears to be a consistent preglacial drainage pattern over the major part of the map-area indicates that the premise on which the interpretation is based is generally valid. Added encouragement can be drawn from the lack of correlation between the smaller glacial stream trenches as given by Bayrock and Hughes (1962), and the bedrock valley courses shown in figure 4.

Topography of the Bedrock Surface

With the exception of the area east of the Cooking Lake Divide, the entire district was, in preglacial times, part of a drainage basin which utilized the Beverly Valley as its main drainage artery. The area of this basin was in excess of 11,000 square miles according to Farvolden's map of the bedrock channels of southern Alberta (1963b, Fig. 15).

The drainage pattern for most of the preglacial land surface in the Edmonton district (Fig. 4) is dendritic, which is to be expected in an area of undisturbed, soft, relatively flat-lying, and relatively impermeable bedrock such as the Edmonton Formation.

The dominant feature of the bedrock topography of the

Edmonton district (Fig. 2) is the Beverly Valley which follows a path from west to east through the northern part of the district. In the southeastern corner of the district is the Cooking Lake Divide, which is the only regional divide present in the study area. It enters the Edmonton district in Tp. 49, R. 22, skirts around the western shore of Cooking Lake, and leaves the study area in Tp. 52, R. 21 (Fig. 4). This is slightly west of the location given by Farvolden (1963a, Fig. 14) and suggests that the present Ministik, Joseph, Cooking, and Oliver Lakes are all located in the drowned headwaters of preglacial valleys that extended down the eastern flank of the Cooking Lake Divide. Glacial deposits, which apparently fill these valleys up to the eastern boundaries of the lakes, are evidently absent or very thin in the area underlying the lakes.

In the eastern half and the extreme southwest corner of the Edmonton district, the preglacial topography apparently is controlled by long, fairly broad, minor tributary valleys separated by broad, rounded ridges running northwestward into the Beverly Valley from the south and southeastward into the Beverly Valley from the north. One of the ridges, the Sherwood Ridge, extends northwest from Sec. 33, Tp. 51, R. 22 (Fig. 4); its trend closely follows the strike of the bedrock formations of the area, and the ridge is therefore probably the expression of a relatively erosion-resistant layer within the Edmonton Formation. The possibility of joint control of the valleys and divides in the area is not, however, ruled out. The ridge encounters the Beverly Valley in about Sec. 30, Tp. 53, R. 23, which accounts for the slightly narrower and steeper-sided portion of the Beverly Valley at this location. Continuing to the northwest, this low ridge is interrupted by the valley of the present Sturgeon River in about Sec. 36, Tp. 54, R. 25. The very steep-sided and narrow cross section of the Sturgeon Valley at this point suggests that the valley was not there during preglacial times and that the Sherwood Ridge was breached during glacial or Recent times. This agrees with the interpretation of the preglacial drainage made by Farvolden (1963a, Fig. 14) and with the conclusion of Bayrock and Hughes (1962, p. 8) that the portion of the Sturgeon River valley east of the town of St. Albert is at least partially the result of erosion by glacial or interglacial meltwaters.

The west-central and northwestern parts of the preglacial topography of the study area are complicated by two major tributary valleys (the Stony and the Onoway) which have a general easterly trend. The Stony Valley enters the Edmonton district in Tp. 52, R. 28, forms a loop to the south around Tp. 52, R. 26, and then turns northeastward to the Edmonton Valley. The Onoway Valley trends eastward from Tp. 55, R. 27 before turning southeastward toward the Beverly Valley which it joins just west of the town of St. Albert.

A bedrock high, which is totally isolated except for a small bedrock ridge in Sec. 36, Tp. 52, R. 28, is located between the Beverly and Stony Valleys. The drainage pattern in the area of this high, and in the area to the west and southwest of the Stony Valley, deviates from the expected dendritic pattern and shows a marked tendency to a radial-annular pattern. A good example, centered on Tp. 52, R. 26, has radial drainage emanating from the center of the township and annular drainage around its perimeter.

Two possible explanations are offered for this deviation from the normal drainage pattern. The first is that it results from glacial modification of the normal preglacial dendritic pattern. The second and more probable is that the drainage pattern is preglacial and is the result of structural control. Present data are, however, not definitive.

North of the Beverly Valley, a bedrock high (elevation 2,475 feet) is located in Sec. 1, Tp. 54, R. 28. This is the highest bedrock elevation in the Edmonton district outside of the Cooking Lake Divide. Immediately to the north and east of this high is the Onoway Valley.

Bedrock Valleys

A large number of valleys are defined on the bedrock surface map (Fig. 2). These range in size from major to very minor, but discussion will be limited to the main valleys and large tributaries. The locations of the preglacial valleys discussed are given on figure 4, and the locations of the communities or physical features after which they were named are listed in the appendix.

Beverly Valley

The Beverly Valley is the same valley referred to as the North Saskatchewan Bedrock Channel by Farvolden (1963a). The name has been changed in accordance with present practice of not naming a preglacial valley after a modern river so as to avoid possible confusion.

The Beverly Valley is broad, having a width of several miles. The valley walls are not steep, particularly on the south bank; only locally do their slopes exceed 1.5 degrees. Using the bedrock topography map (Fig. 2) a typical cross section of the Beverly Valley (Fig. 3a) was constructed. Portions of the valley noticeably narrower and more steep-sided than the cross section indicates are located in Tp. 53, R. 28, and near the east end of Big Lake immediately after the valley

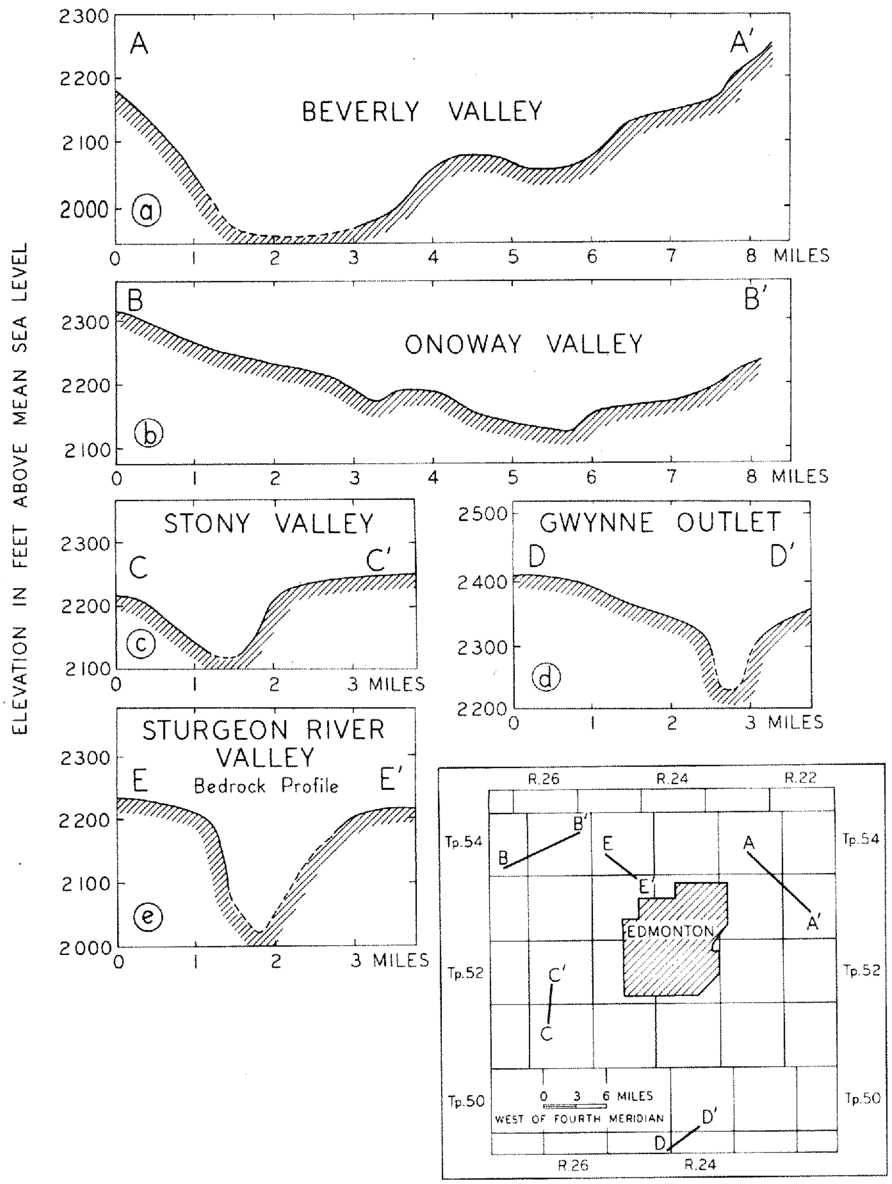

Figure 3. Inferred cross sections of bedrock valleys.

turns southeast to enter the city of Edmonton. A third location with a narrower and steeper section of valley has been previously mentioned in connection with the Sherwood Ridge (Sec. 30, Tp. 53, R. 23). The depth of the Beverly Valley is generally between 200 and 250 feet and the average gradient in the map-area is 4 feet per mile.

Examination of the Beverly Valley gradient in more detail reveals what appears to be a local depression centered on Big Lake (Tp. 53, Rgs. 25 and 26). Specifically, this depression appears to run along the Beverly Valley from about Sec. 15, Tp. 53, R. 27 to its confluence with the Onoway Valley. The control available is not adequate to be certain that the 2,000- and 2,025-foot contour lines, which appear to rim the depression, do not exit downstream through the narrow northeast-southwest portion of the Beverly Valley in Tp. 53, R. 25. If they do, however, this would result in what, for this district, is an uncommonly steep-sided and narrow preglacial valley. For this reason the closed depression underlying Big Lake is the preferred interpretation. The only explanation that can be offered at present for the existence of such a depression is that it is due to glacial overdeepening of this portion of the Beverly Valley.

Onoway Valley

The Onoway Valley is generally broad with gently sloping sides (Fig. 3b) but, as in the case of the Beverly Valley, short lengths of narrow and steep-sided valley are in evidence. No explanation for these changes in valley shape can be offered. There are insufficient bedrock-elevation data along the center of the valley to allow an estimate of its gradient to be made. The information available, however, does indicate that the valley becomes very steep in the vicinity of the junction of the Onoway and Beverly Valleys. Present control is not detailed enough to determine whether or not the 2,025- and 2,050-foot bedrock contours extend up into the Onoway Valley, although the available data indicate the presence of a small closed depression with elevations less than 2,050 feet farther up the valley, in Secs. 1 and 2, Tp. 54, R. 26. If these contours do not extend into the Onoway Valley then this may well be a hanging valley at its junction with the Beverly Valley; if they do, then the Onoway Valley is utilizing a local gradient much steeper than is normal for the remainder of the valley in order to descend to the floor of the Beverly Valley. Such a condition would require deepening of the narrow portion of the Beverly Valley in Tp. 53, R. 25 until it could act as an outlet for the water which caused the local steepening of the Onoway Valley gradient. The existence of this narrow outlet would not necessarily destroy the hypothesis that the portion of the Beverly Valley underlying Big Lake was glacially overdeepened, since the local steepening of the Onoway Valley gradient and the cutting of an outlet from the central depression could both have been accomplished during an interglacial period. In any case the preferred interpretation, based on what data are available, is that the 2,025- and 2,050-foot contours do not extend into the Onoway Valley.

Stony Valley

The character of the Stony Valley differs from that of the two valleys previously described. Whereas the Beverly and Onoway are generally wide valleys which narrow over short stretches, the Stony is a rather narrow valley with a uniform width of 1 to 3 miles. A cross section typical of this valley is given in figure 3c. The gradient of the Stony Valley is 5 feet per mile. Notably, there is no apparent steepening of the Stony Valley gradient immediately prior to its junction with the Beverly Valley. The course of the Stony Valley in the area between the east boundary of Sec. 36, Tp. 51, R. 26 and Sec. 16, Tp. 52, R. 25 is uncertain. The present interpretation is that the valley follows a direct route between these two points. It may later be established that the valley swings to the south, crosses the North Saskatchewan River Valley near Sec. 29, Tp. 51, R. 25, and joins the northeast-trending valley which crosses the North Saskatchewan River in Sec. 16, Tp. 52, R. 25.

It is possible that the stream which eroded the Beverly Valley originally flowed through the Stony Valley and was subsequently cut off by stream piracy near range 28 where the two valleys are in proximity. Unfortunately, bedrock-surface studies have not yet extended far enough west to indicate whether or not stream piracy occurred.

New Sarepta, Calmar, and Devon Valleys

The New Sarepta Valley, which has its headwaters near the village of New Sarepta in Tp. 49, R. 22, is a tributary of the Stony Valley. Its gradient of about 15 feet per mile is roughly 3 times that of the Beverly and Stony Valleys. The valley relief ranges from 25 to 75 feet.

Those small portions of the Devon and Calmar Valleys that lie within the Edmonton area have a width of from 1 1/2 to 3 miles and a relief of from 50 to 100 feet.

Control along the Devon Valley is not abundant, therefore its course cannot be firmly established. It is interpreted to extend from Sec. 30, Tp. 49, R. 25 through Sec. 25, Tp. 50, R. 26 to a junction with the Stony Valley in Sec. 31, Tp. 51, R. 25. It may, however, follow a more easterly course through Sec. 28, Tp. 50, R. 25 and either join the presently favored valley course in Sec. 18, Tp. 51, R. 25 or it may follow the alternate course of the Stony Valley between Sec. 20, Tp. 51, R. 25 and Sec. 16, Tp. 52, R. 25. Because of the uncertain control along this valley and its short length in the map-area no reliable estimate of its gradient can be made.

The control along the Calmar Valley in the immediate vicinity of the North Saskatchewan River is also scant. The valley is interpreted as crossing the North Saskatchewan River valley in Sec. 36, Tp. 50, R. 27 and joining the Stony Valley in Sec. 35, Tp. 51, R. 26. The gradient of the Calmar Valley can be estimated at about 18 feet per mile which is comparable with the gradient of 15 feet per mile obtained for the New Sarepta Valley.

Other Preglacial Bedrock Valleys

The only remaining preglacial valleys that warrant discussion are the Simmons, Ardrossan, Bretona, and Boag Valleys. These are all minor valleys extending consequently down the erosional slope between the Beverly Valley and the Cooking Lake Divide. With the possible exception of the Simmons, which enters the map-area in Tp. 53, R. 21, these valleys are only about 12 miles in length, have a relief of up to 150 feet and a gradient of some 30 feet per mile, which is higher than any others in the district. The higher gradient is perhaps a reflection of the short distance between the regional divide and the main preglacial valley.

Glacial or Recent Valleys

The Gwynne Outlet was recognized by Gravenor and Bayrock (1956) as an outlet to the south for glacial Lake Edmonton. The valley can easily be distinguished from the preglacial bedrock valleys in the district by its narrow and steep-sided cross section (Fig. 3d). Some erosion of the bedrock surface occurred in the headwaters region of the Gwynne Outlet. This region of modified preglacial bedrock surface is marked on figure 4 as the Gwynne Outlet (channeled scabland). The vertical extent of this modification is not known; however, Bayrock and Hughes (1962, p. 22) state that in some cases bedrock was eroded in this area. Evidently, according to their observations, the overlying glacial materials succeeded in protecting the underlying bedrock surface over most of the channeled scabland area.

The portion of the Sturgeon River valley east of St. Albert (Fig. 2), is according to Bayrock and Hughes (1962, p. 8), "related to bedrock topography and to glacial or possibly interglacial drainage systems." It can be distinguished from those valleys which owe their shape to only preglacial erosion by its comparatively narrow and steep-sided cross section (Fig. 3e).

The North Saskatchewan River valley west of range 23 has been cut since the retreat of the glaciers (Bayrock and Hughes, 1962). The modification of the preglacial topography is obvious because the present valley cuts across and follows preglacial valleys and bedrock highs with impartiality. As was the case with the glacial bedrock valleys, this portion of the North Saskatchewan River valley is narrow and steep-sided in comparison to the preglacial bedrock valleys of the district.

AQUIFERS IN SURFICIAL DEPOSITS

The surficial deposits are the unconsolidated materials lying between the bedrock surface and the present land surface. Included are the preglacial gravels and sands that were not removed by the glaciers, the till, lacustrine and alluvial deposits of glacial origin, and the postglacial alluvial and lacustrine materials. The total thickness of the surficial (or unconsolidated) material at any location can be obtained by referring to figure 2, and subtracting the bedrock elevation from the surface elevation.

Generally speaking, potential surficial aquifers in the Edmonton district are confined to the sand and gravel portions of the surficial deposits. The chemical properties of groundwater vary from one surficial water-producing zone to another; however, in general the water from buried-valley aquifers ranges from fairly hard to hard. Water from this source can also have a high iron content, although this is not universal. Water from glacial aquifers is usually hard and, in some instances, a large amount of total solids has been reported. When exploring for a water supply from the surficial deposits of the district, careful attention should be paid to determining the chemical quality as well as the quantity of the available water.

Buried-Valley Aquifers

By use of the bedrock contour map (Fig. 2) or the valley thalweg map (Fig. 4), the locations of the bedrock valleys in the district can be found. The thickness of the surficial deposits overlying these valleys can easily be determined from figure 2 as the difference between the bedrock and the present-day surface elevations. Selected reported occurrences of sand and gravel resting on bedrock are shown in symbols on this figure, but no attempt is made to differentiate between glacial and preglacial sand and gravel. At least the lower part of any sands and gravels resting on bedrock in valleys interpreted as preglacial will probably be of preglacial origin.

Where the permeable material rests on a bedrock high it may be either glacial or preglacial in origin. Whether these materials are glacial or preglacial is unimportant from the point of view of the groundwater geologist, except that preglacial sands are generally found to be the more permeable.

Because of their generally greater depth of burial and the possibility that they consist of the somewhat more permeable preglacial sands and gravels, permeable materials on the floor of a bedrock valley probably have a greater production potential than other surficial deposits. Although resting on bedrock, permeable material on a bedrock high will probably have a smaller production potential because of its shallower depth of burial and, in the case of a sand deposit, because it is probably of the finer-grained glacial variety. Domestic supplies are possible from these deposits if the permeable layer remains permanently water-saturated.

Beverly Valley

Farvolden (1963a) reported that in the Edmonton district sand was the only permeable material present in the Beverly Valley above its confluence with the Onoway Valley. The findings of the present study are generally in agreement, although gravel is mentioned in some of the drillers' reports. In this portion of the Beverly Valley gravel is usually reported in conjunction with sand as sand and gravel, and it is assumed that sand is the major constituent. Only one report from the center of this portion of the Beverly Valley lists a distinct gravel layer (Sec. 1, Tp. 53, R. 28; total gravel thickness 10 feet). Reports listing gravel layers are more common from the south slope than from either the north slope or the center of this part of the Beverly Valley. If this part of the Beverly Valley has been glacially overdeepened, as was speculated above, the only surficial material in the valley would be of glacial or Recent origin. This possibly accounts for the lack of gravel in the center of this part of the valley.

Below the confluence with the Onoway Valley, according to Farvolden (1963a), large gravel deposits (up to 40 feet in thickness) appear in the Beverly Valley. The information compiled for this report gives no indication that such large gravel deposits are general for those parts of the valley west of range 23. A substantial thickness of gravel (total thickness 33 feet) was reported from only one location (Sec. 32, Tp. 53, R. 25) in the valley between the confluence with the Onoway Valley and the city of Edmonton. This would seem to indicate that no large gravel deposits exist resting on bedrock in the center of the valley. However, very few shot holes are drilled to a depth sufficient to reach bedrock over valley center, and so substantial, deeply buried sand and gravel deposits may have been missed. On the slopes of this section of the valley, where drift thicknesses are not so great, a number of reports indicating gravel or sand and gravel resting on bedrock have been received, along with a number of sand reports. The maximum thickness of gravel reported on the valley slopes was at Sec. 19, Tp. 53, R. 25 (total thickness 25 feet).

Within the city of Edmonton information is scarce with the exception of Secs. 4, 5, 8, and 9, Tp. 53, R. 24 where data published by Bayrock and Berg (1966) are available. Within these four sections sand and gravel cover of the bedrock is general (Fig. 2) with a basal gravel layer about 4 feet in thickness resting on bedrock. The maximum reported thickness of the basal gravel is 12 feet in Lsd. 1, Sec. 8, Tp. 53, R. 24. Whether or not sand and gravel overlying bedrock is general for the remainder of the Beverly Valley within the city cannot be determined from present data.

To the east of the city of Edmonton the valley is occupied by the North Saskatchewan River which has apparently been eroding the surficial fill material since deglaciation. The North Saskatchewan River level is now from 25 to 50 feet above the base of the Edmonton Valley in the area where the courses of the present and preglacial valleys coincide. What materials are present in this interval is not known. If substantial amounts of gravel exist between the present North Saskatchewan River bottom and the preglacial Beverly Valley bottom they would constitute an aquifer of very good potential. A number of Saskatchewan Sand and Gravel outcrops along the North Saskatchewan River immediately below the city of Edmonton suggest that higher preglacial river terraces in the Beverly Valley are being exposed by the modern river. Near Fort Saskatchewan the North Saskatchewan River and the Beverly Valley diverge sufficiently to allow what appears to be a preglacial river terrace to remain undisturbed on the south slope of the Beverly Valley. A relatively large number of reports of sand and gravel overlying bedrock were received from this part of the map-area (Fig. 2), a number of which were not plotted in order to avoid duplication. The North Saskatchewan River, which is in close proximity to, and at a lower elevation than, most of this postulated preglacial terrace, may have drained the buried sands and gravels to some extent. Drainage is certainly not complete, however, since a water-saturated layer extending about 30 feet above the base of the sand and gravel was reported in two water wells finished in the postulated preglacial river terrace.

Finally, it is interesting to note that the majority of the sites along the Beverly Valley at which sands and gravels are reported are on the gentler south slope. Apparently the prospects for finding a water supply on the south slope of the Beverly Valley are better than on the north slope.

Onoway Valley

Most of the Onoway Valley within the map-area is at present occupied by the Sturgeon River. The base of the Onoway Valley is at a lower elevation that the present Sturgeon River and, therefore, any sand and gravel resting on the preglacial valley bottom will be saturated. Whether or not those sand and gravel deposits found above river level on the slopes of the Onoway Valley are saturated is not known.

Reports of permeable material lying on bedrock along the Onoway Valley are fairly common, especially for the center of the valley and the southwest slope. Two areas of particular groundwater interest are indicated by large numbers of sand and gravel reports and drift thicknesses of about 100 feet, along the north boundary of Secs. 31 and 32, Tp. 54, R. 27, and in Sec. 2, Tp. 54, R. 26.

Stony Valley

Information on sand and gravel deposits resting on bedrock in the Stony Valley is scant. From the reports available (Fig. 2) it appears that sand is the only permeable material to be expected at most locations on the valley floor. Gravel is reported from three widely separated locations along the valley: On the east boundary of Sec. 33, Tp. 51, R. 26, in Sec. 12, Tp. 52, R. 27, and in Sec. 11, Tp. 53, R. 25 where the Stony joins the Beverly Valley. The reported gravel thicknesses are 5, 4, and greater than 8 feet, respectively.

Other Bedrock Valleys

The remaining bedrock valleys hold no deposits of particular interest, although sand and gravel resting on bedrock is reported for a number of locations (Fig. 2). Generally, large groundwater supplies cannot be expected from these valleys, although there may be some exceptions, such as for the New Sarepta Valley in the north half of Tp. 51, R. 24, and in the south half of Tp. 52, R. 24, the Ardrossan Valley in Tp. 53, R. 22, and the Calmar Valley near its junction with the Stony Valley. Prospects for obtaining sufficient quantities for domestic purposes in buried valley aquifers appear to be good, though the buried sands and gravels may not be as general as the map seems to indicate.

Aquifers in Glacial and Recent Deposits

The glacial and Recent sand and gravel thickness map (Fig. 5) was compiled from the same logs as those used for the map of the bedrock surface. Its purpose is to outline those parts of the area containing thick accumulations of permeable glacial and Recent material. Comparison of this map with that on which the permeable material resting on bedrock is reported (Fig. 2), shows that sand and gravel is indicated on both maps for some of the elevated bedrock areas. In these areas glacial sand and gravel is either resting on bedrock or is underlain by similar preglacial material. Since no distinction was made on the logs received between glacial and preglacial sands and gravels, an interpretation had to be made before figure 5 could be prepared. In making this interpretation, it was assumed that all sands or gravels beginning 10 feet or more below the surface and extending to bedrock were probably preglacial in origin and were, therefore, not included on the map. All other reported sands and gravels were included on figure 5, except in those areas where surface outcrops of Saskatchewan Sands and Gravels have been mapped.

The resulting map is, of course, subject to correction as test-hole samples become available for examination. A comparison of the interpreted total thicknesses of glacial or Recent sand and gravel with the surficial geology of the area as given by Bayrock and Hughes (1962, p. 9) is made on figure 5. Large reported sand and gravel accumulations – discussed in some detail below – are located in the areas of pitted outwash delta, Sturgeon Valley fluvial sand, early North Saskatchewan River alluvium, and aeolian deposits. Lesser accumulations are found in other areas and are also discussed, but data in these cases were generally not numerous enough to allow contours to be drawn.

Pitted Outwash Delta

Pitted outwash delta accounts for the large thicknesses of sand reported in Tps. 52 and 53, R. 26, and Tp. 53, R. 27. Drillers' logs indicate that the sand extends from surface to bedrock in many parts of this area. The sands contained in this deposit appear to be very fine. Bayrock and Hughes (1962), however, suggested that coarser-grained material might be found at depth. This hypothesis was borne out by a Groundwater Division test hole in Lsd. 8, Sec. 25, Tp. 52, R. 26 which encountered grey, medium-grained sand about 5 feet above bedrock. Further testing is required to determine whether these coarser deposits are general throughout the delta area.

The thickness of sand is over 50 feet in a large part of the area, and therefore prospects of sufficient quantities of groundwater for domestic supplies are good. Gravel packs will probably have to be used in conjunction with well screens in those parts of this area where the medium-grained sand is not present. Where the coarser sands are found, a well screen alone may suffice.

Sturgeon Valley Fluvial Sand

There are a number of reports of large thicknesses of sand in the Sturgeon River valley between St. Albert and Sec. 24, Tp. 54, R. 25. No gravel has been reported. Bayrock and Hughes (1962) indicate that this portion of the Sturgeon valley may owe its present shape largely to glacial or interglacial drainage systems, so it is probable that the entire thickness reported consists of glacial sand. The make-up of this deposit is uncertain but the upper portions (lying at depths no greater than 30 feet) are known to be of fine- to medium-grained sand (Bayrock and Hughes, 1962, p. 25). Whether or not the sand reported at depth is of similar character is not known.

Early North Saskatchewan River Alluvium

A number of reports of sand and gravel, starting at the surface and extending to below a depth of 50 feet, have been received from the area of the Early North Saskatchewan River alluvium in Tps. 51 to 53, R. 27, and Tp. 52, R. 26. Almost all of the reports indicated sand only. According to Bayrock and Hughes (1962), the Early North Saskatchewan River alluvium does not exceed 20 feet in thickness and consists of fine- to medium-grained sand, some silt and clay, and sporadic occurrences of coarse sand and gravel. Nothing is known about the permeable material below the 20-foot limit except that, according to drillers' reports, it consists almost entirely of sand.

Aeolian Deposits

Sand cover is general in the area of aeolian deposits with the majority of the reports indicating a sand thickness of 10 to 50 feet. There are a number of reports indicating a thickness in excess of 50 feet. According to Bayrock and Hughes (1962), the sand dunes in the area rest on the original Early North Saskatchewan River deposits from which they are derived. It is therefore possible that the latter deposits comprise the lower portions of the thicker sand deposits reported in this area. The aeolian deposits consist of fine to medium sand which is well sorted (Bayrock and Hughes, 1962).

North Saskatchewan River Alluvium

The alluvial deposits of the North Saskatchewan River consist of silt, sand, and gravel (Bayrock and Hughes, 1962). The number and distribution of river-terrace gravel pits – as shown on National Topographic Series map-sheets 83H 5 and 11 – indicate that gravel deposits of substantial size are common over the length of the North Saskatchewan valley in the Edmonton district. Borehole information within the valley is scant. The data available in Tp. 54, R. 23 indicate that the sand and gravel in this township rests on bedrock, so it is uncertain whether the lower portion of this deposit is preglacial or postglacial in origin (the North Saskatchewan River east of range 24 flows in the preglacial Edmonton Valley). There are some attractive prospects for groundwater supplies in the larger terraces of the North Saskatchewan River where they have not been mined out by gravel operators.

Sturgeon River Valley Alluvium

The extent of Recent alluvial deposits along the Sturgeon River valley (Fig. 5) is small. It is felt that these alluvial deposits, which Bayrock and Hughes (1962) list as silt, sand, and gravel, are not by themselves good prospects for development of groundwater supplies. However, where they overlie earlier glacial or preglacial sand and gravel deposits they will add to the total saturated thickness of permeable material.

Big Lake and Cooking Lake Bottomland Deposits

Bayrock and Hughes (1962) list the bottomland deposits on the margins of Big Lake and Cooking Lake as clay, silt, sand, peat, muck, and marl. These deposits appear fairly extensive on Big Lake, particularly where the Sturgeon River enters the lake, but form only a rim around Cooking Lake. There is no information at present on the thickness of these deposits. From present information it would appear that these deposits are not suitable aquifers.

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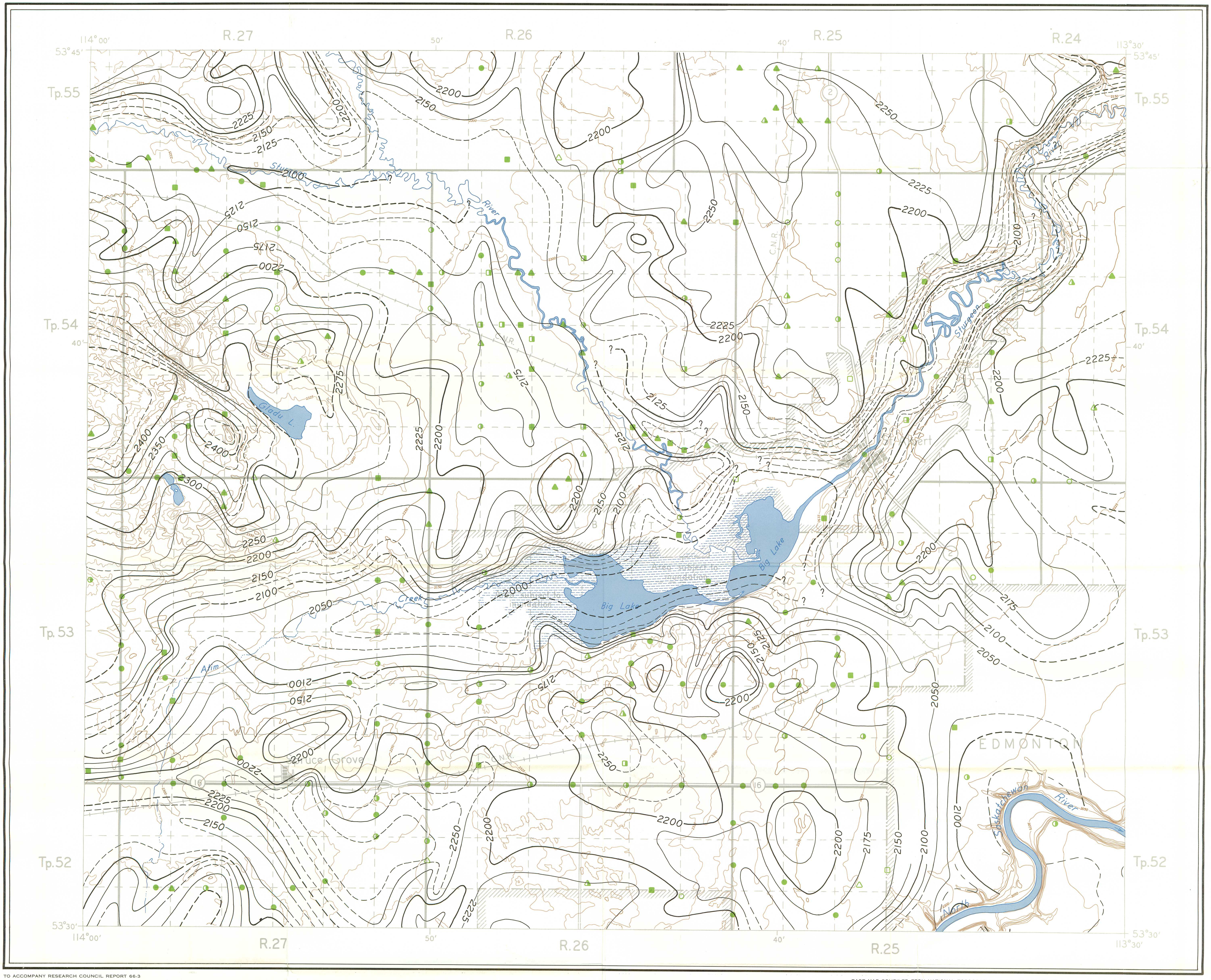
APPENDIX. DERIVATION OF PREGLACIAL VALLEY NAMES

Summarized below are the preglacial valley names used in this report. Included in this summary are the geographic locations after which the valleys and divides were named. The spelling of the geographic locations, where possible, were taken from the Alberta section of the Gazetteer of Canada published in 1958.

Feature	Named After	Location			
		Sec.	Tp.	R.	Mer.
Ardrossan Valley	Hamlet of Ardrossan	2	53	22	W.4
Beverly	Suburb in east Edmonton		53	24	W.4
Boag	Boag Lake	29	52	22	W.4
Bretona	Hamlet of Bretona	33	51	23	W.4
Calmar	Town of Calmar		49	27	W.4
Cooking Lake* Divide	Cooking Lake		51	21	W.4
Devon	Town of Devon		50	26	W.4
New Sarepta Valley	Village of New Sarepta	34	49	22	W.4
Onoway* Valley	Village of Onoway**	35	54	2	W.5
Sherwood Divide	Hamlet of Sherwood Park	27	52	28	W.4
Simmons	Hamlet of Simmons	7	54	21	W.4
Stony	Stony Plain Indian Reserve		52	26	W.4

*After Farvolden (1963a)
**Not in the map-area



TO ACCOMPANY RESEARCH COUNCIL REPORT 66-3

BASE MAP COMPILED FROM NATIONAL TOPOGRAPHIC SERIES SHEET 83H/12
DEPARTMENT OF MINES AND TECHNICAL SURVEYS OTTAWA

Scale 1:50,000

1 0 1 2 3 4 5 Miles

FIGURE 2A
BEDROCK TOPOGRAPHY, EDMONTON DISTRICT, ALBERTA

WEST OF FOURTH MERIDIAN

LEGEND

Bedrock contour:

definite 2200

approximate 2200

(Contour interval 25 feet)

Gravel deposit on bedrock:
- △ 2-5 feet thick
- ▲ 6-15 feet thick
- ▲ over 15 feet thick

Sand and gravel on bedrock:
- □ 5-10 feet thick
- ◧ 11-30 feet thick
- ■ over 30 feet thick

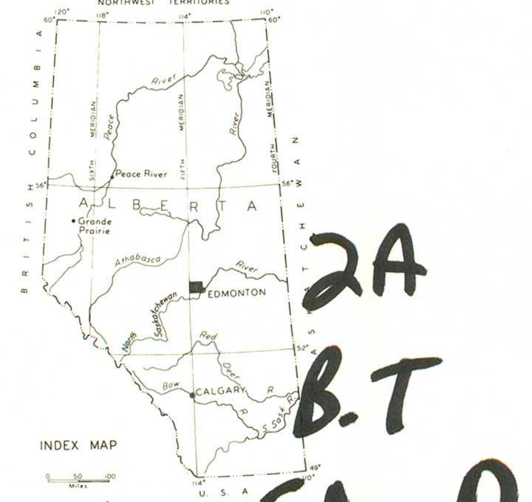
Sand deposit on bedrock:
- ○ 5-10 feet thick
- ◐ 11-30 feet thick
- ● over 30 feet thick

Subdivision of a Township into Sections

31	32	33	34	35	36
30	29	28	27	26	25
19	20	21	22	23	24
18	17	16	15	14	13
7	8	9	10	11	12
6	5	4	3	2	1

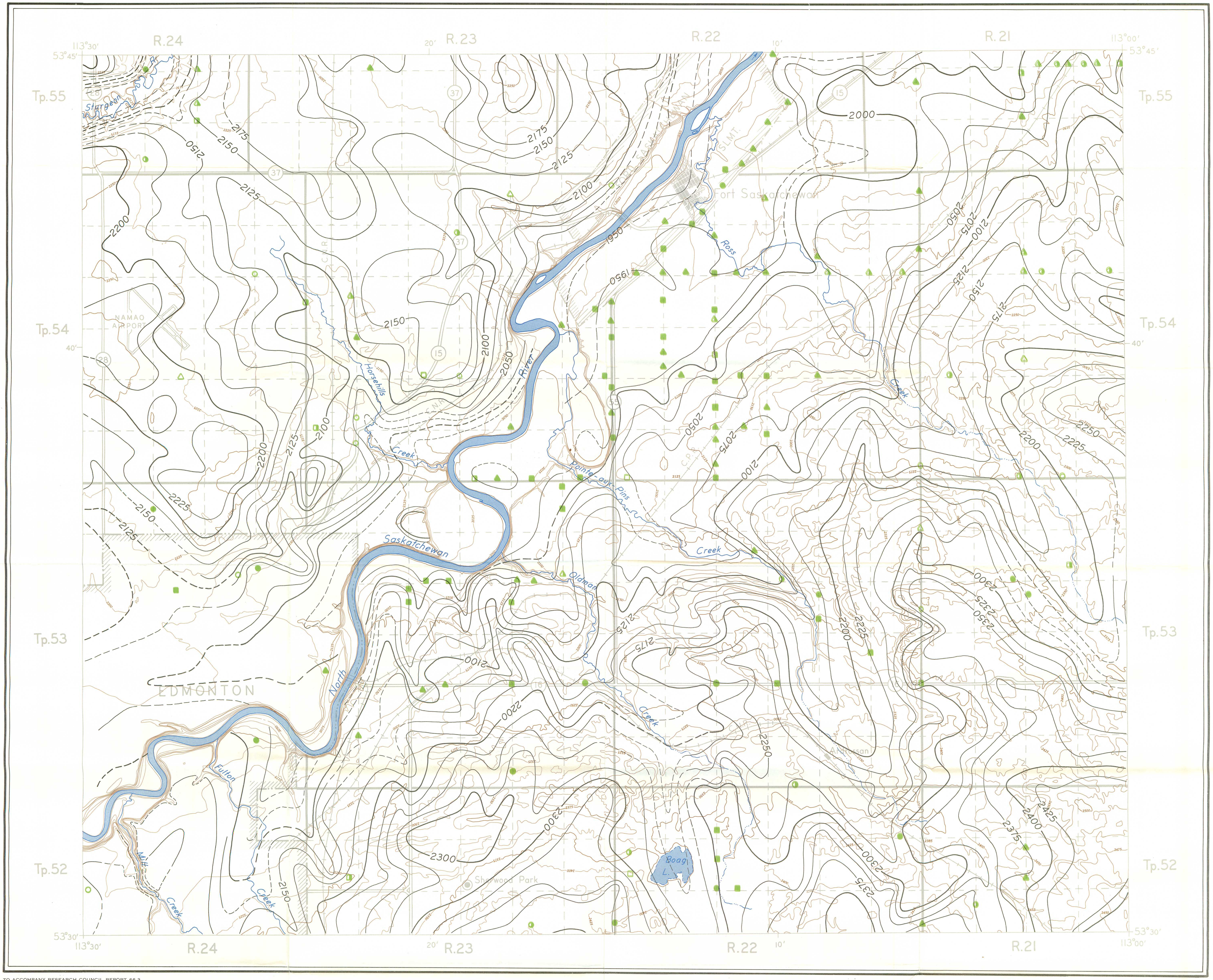
Subdivision of a Section into Legal Subdivisions (LSD)

13	14	15	16
12	11	10	9
5	6	7	8
4	3	2	1



66-3

2A
B.T
Edm. Dist



TO ACCOMPANY RESEARCH COUNCIL REPORT 66-3

BASE MAP COMPILED FROM NATIONAL TOPOGRAPHIC SERIES SHEET 83H/11
DEPARTMENT OF MINES AND TECHNICAL SURVEYS OTTAWA

LEGEND

Bedrock contour:

definite 2200

approximate 2200

(Contour interval 25 feet)

Gravel deposit on bedrock:
- 2-5 feet thick
- 6-15 feet thick
- over 15 feet thick

Sand and gravel on bedrock:
- 5-10 feet thick
- 11-30 feet thick
- over 30 feet thick

Sand deposit on bedrock:
- 5-10 feet thick
- 11-30 feet thick
- over 30 feet thick

Scale 1:50,000

1 0 1 2 3 4 5 Miles

FIGURE 2B
BEDROCK TOPOGRAPHY, EDMONTON DISTRICT, ALBERTA

WEST OF FOURTH MERIDIAN

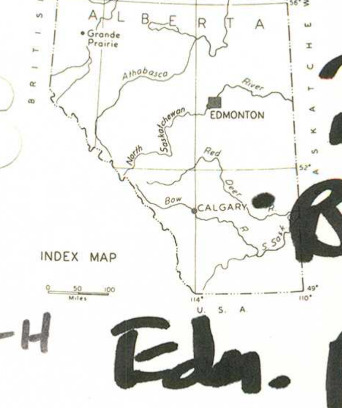
Subdivision of a Township into Sections

31	32	33	34	35	36
30	29	28	27	26	25
19	20	21	22	23	24
18	17	16	15	14	13
7	8	9	10	11	12
6	5	4	3	2	1

Subdivision of a Section into Legal Subdivisions (LSD)

13	14	15	16
12	11	10	9
5	6	7	8
4	3	2	1

66-3

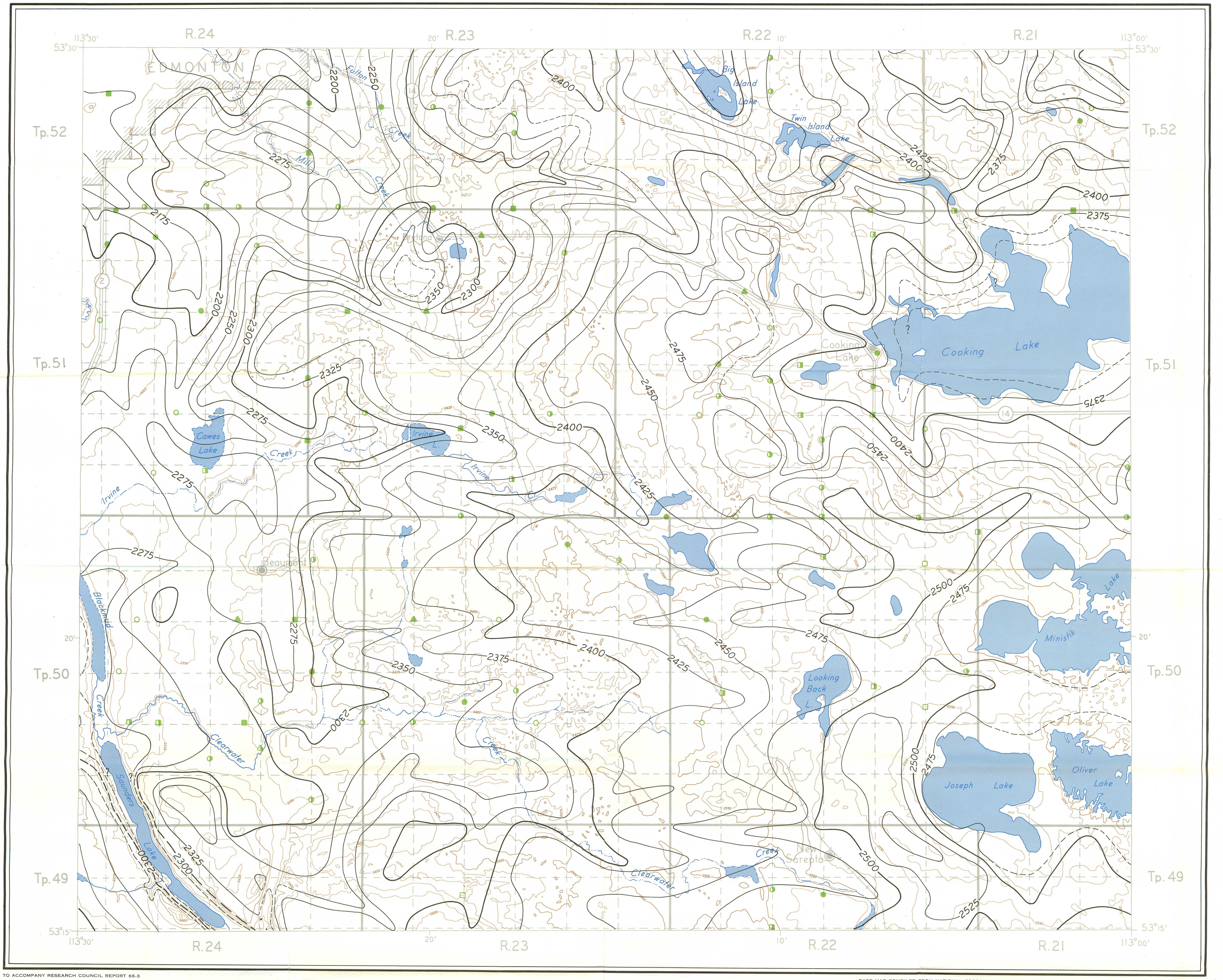


2B
B.T

AGS 1966 - 2b
c.1

83-H

Edm. Dist



TO ACCOMPANY RESEARCH COUNCIL REPORT 66-3

BASE MAP COMPILED FROM NATIONAL TOPOGRAPHIC SERIES SHEET 83H/6
DEPARTMENT OF MINES AND TECHNICAL SURVEYS, OTTAWA

Scale 1:50,000

1 0 1 2 3 4 5 Miles

LEGEND

Bedrock contour:

definite 2200

approximate 2200

(Contour interval 25 feet)

Gravel deposit on bedrock:
- 2-5 feet thick
- 6-15 feet thick
- over 15 feet thick

Sand and gravel on bedrock:
- 5-10 feet thick
- 11-30 feet thick
- over 30 feet thick

Sand deposit on bedrock:
- 5-10 feet thick
- 11-30 feet thick
- over 30 feet thick

FIGURE 2D
BEDROCK TOPOGRAPHY, EDMONTON DISTRICT, ALBERTA

WEST OF FOURTH MERIDIAN

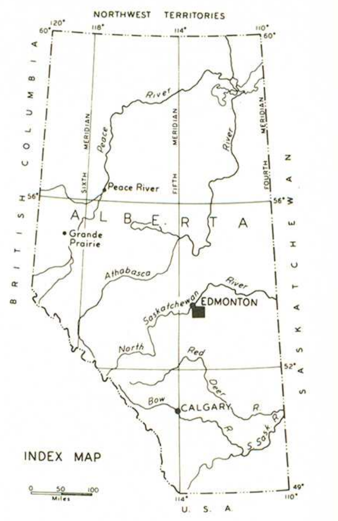
AGS 1966-2D

Subdivision of a Township into Sections

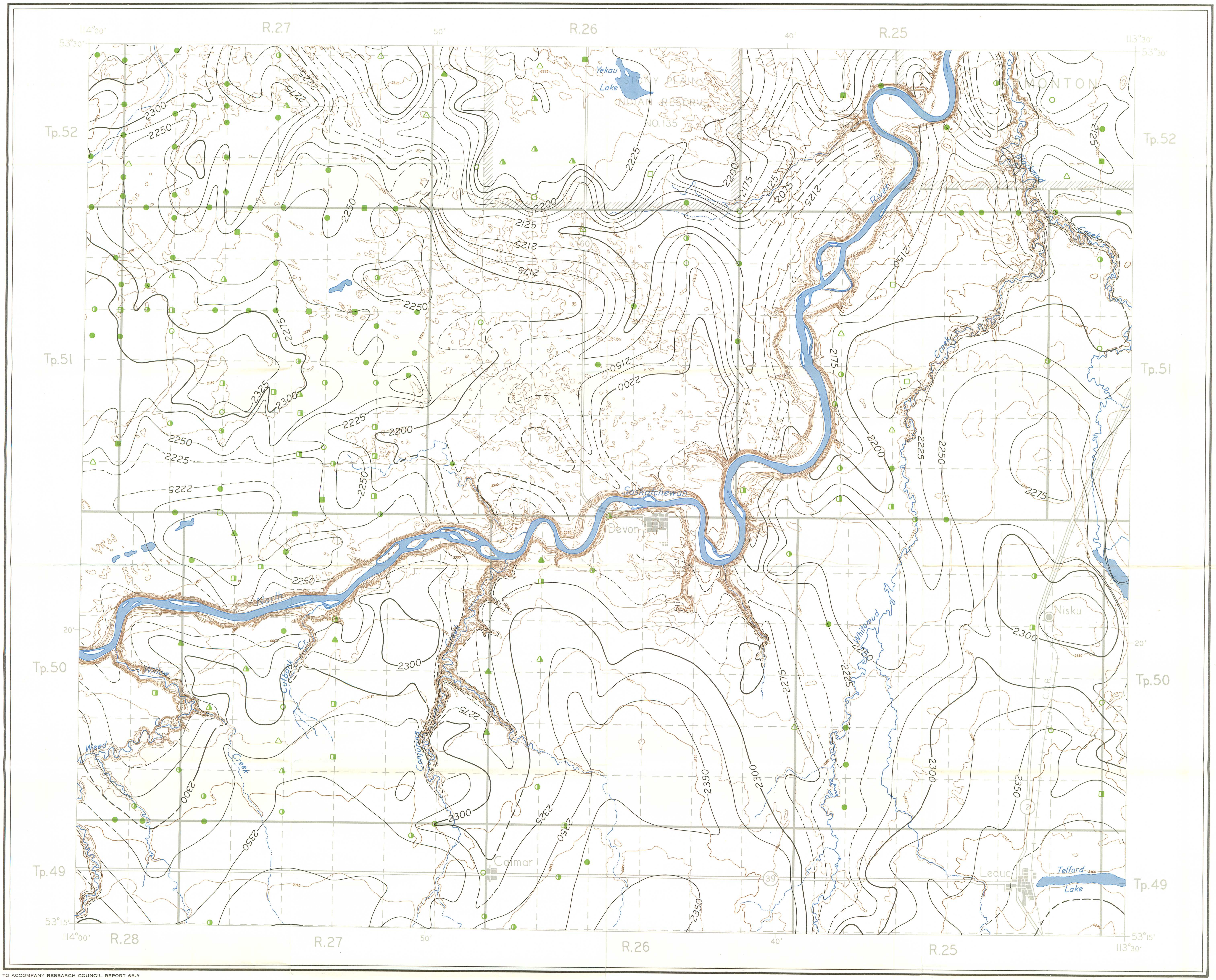
31	32	33	34	35	36
30	29	28	27	26	25
19	20	21	22	23	24
18	17	16	15	14	13
7	8	9	10	11	12
6	5	4	3	2	1

Subdivision of a Section into Legal Subdivisions (LSD)

13	14	15	16
12	11	10	9
5	6	7	8
4	3	2	1



INDEX MAP



TO ACCOMPANY RESEARCH COUNCIL REPORT 66-3

BASE MAP COMPILED FROM NATIONAL TOPOGRAPHIC SERIES SHEET 83H/5
DEPARTMENT OF MINES AND TECHNICAL SURVEYS, OTTAWA

LEGEND

Bedrock contour:

definite 2200

approximate 2200

(Contour interval 25 feet)

Gravel deposit on bedrock:

- △ 2-5 feet thick
- 6-15 feet thick
- ▲ over 15 feet thick

Sand and gravel on bedrock:

- □ 5-10 feet thick
- 11-30 feet thick
- ■ over 30 feet thick

Sand deposit on bedrock:

- ○ 5-10 feet thick
- ◐ 11-30 feet thick
- ● over 30 feet thick

Scale 1:50,000

1 0 1 2 3 4 5 Miles

FIGURE 2C
BEDROCK TOPOGRAPHY, EDMONTON DISTRICT, ALBERTA

WEST OF FOURTH MERIDIAN

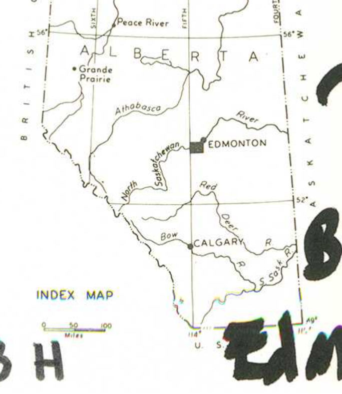
Subdivision of a Township into Sections

31	32	33	34	35	36
30	29	28	27	26	25
19	20	21	22	23	24
18	17	16	15	14	13
7	8	9	10	11	12
6	5	4	3	2	1

Subdivision of a Section into Legal Subdivisions (LSD)

13	14	15	16
12	11	10	9
5	6	7	8
4	3	2	1

AGS
1966-2C
c.1



2C
B.T
83 H
Edm. Dist

FIGURE 4

THALWEGS OF PREGLACIAL VALLEYS

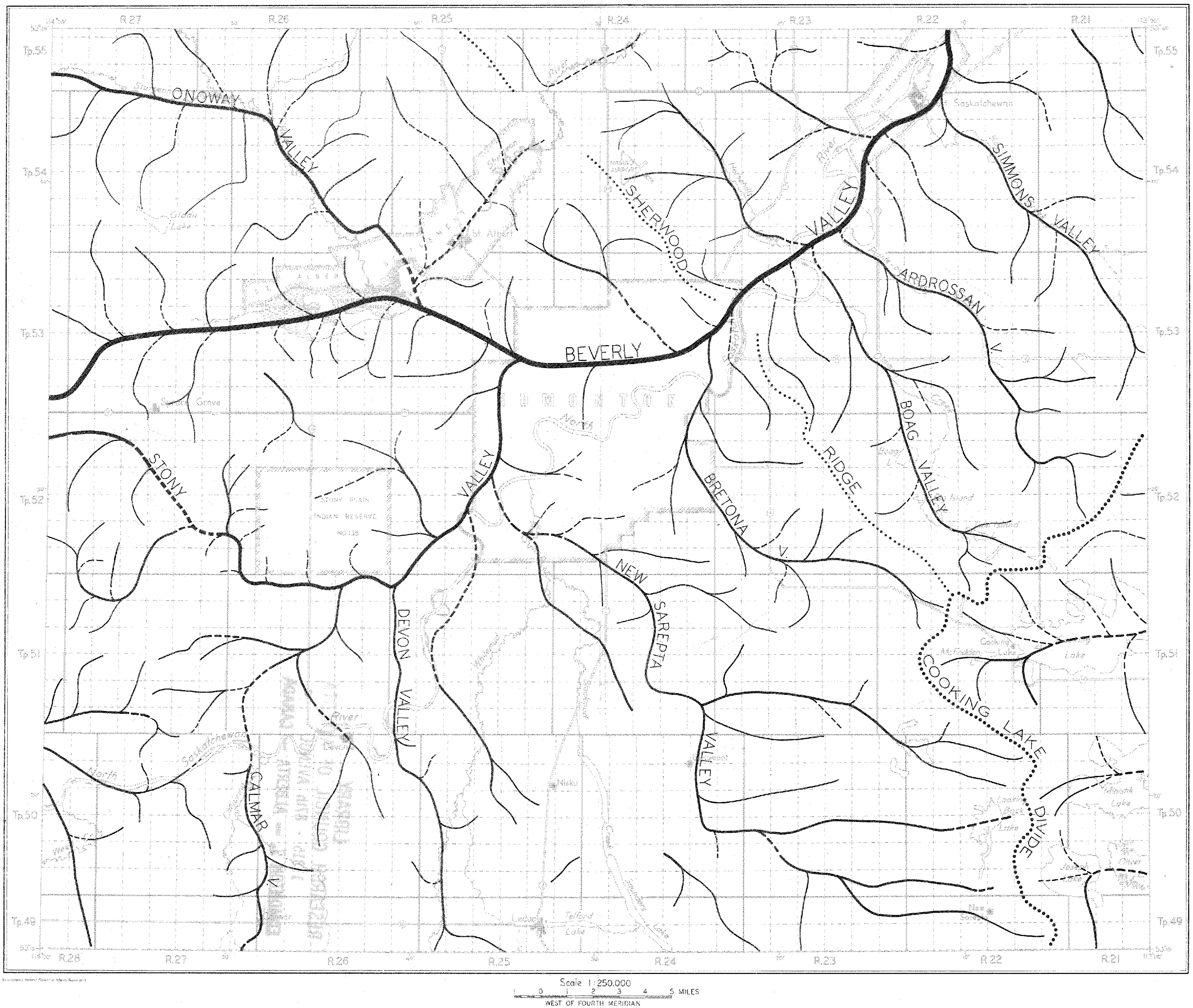
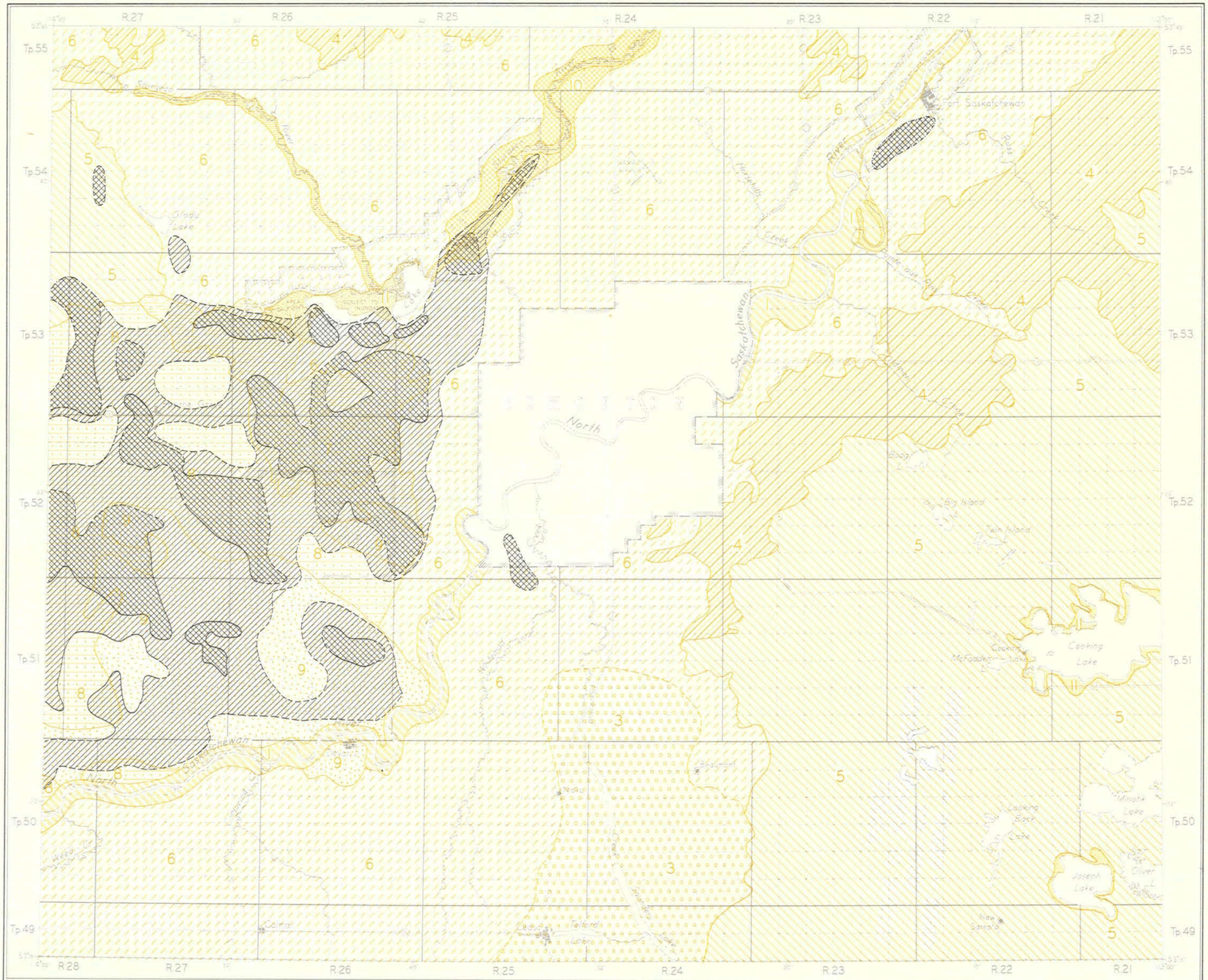


FIGURE 5

ISOPACHS OF GLACIAL AND RECENT SAND AND GRAVEL



To accompany Research Council of Alberta Report 66-3

Scale 1:250,000
1 0 1 2 3 4 5 MILES
WEST OF FOURTH MERIDIAN

Surficial Geology after Bayrock and Hughes (1962)

Boundaries of sand and gravel deposits:
definite ——
indefinite – – –
assumed – · –

Sand and gravel deposits:
10-50 feet thick
over 50 feet thick

LEGEND

1 North Saskatchewan River valley alluvium
2 Sturgeon River valley alluvium
3 Gwynne outlet (channeled scabland)
4 Ground moraine
5 Hummocky dead-ice moraine
6 Lake Edmonton silts and clays
7 Pitted outwash delta
8 Early North Saskatchewan River alluvium
9 Aeolian deposits (dunes)
10 Sturgeon valley fluvial sand
11 Bottomland deposits