RESEARCH COUNCIL OF ALBERTA

REPORT 67-2

BEDROCK TOPOGRAPHY OF THE GLEICHEN MAP-AREA, ALBERTA

by

K. W. Geiger

Research Council of Alberta
Edmonton, Alberta
1968

CONTENTS

ILLUSTRATIONS

BEDROCK TOPOGRAPHY OF THE GLEICHEN MAP-AREA, ALBERTA

Abstract

This report isolates two primary geologic divisions — bedrock and the overlying unconsolidated material — by superimposing a topographic map of the present land surface for the Gleichen map-area (NTS 82I) upon a topographic map of the bedrock surface. An interpretation of the preglacial topography shows that a major preglacial drainage divide trends roughly east-west through this map-area. It separates tributaries of the two major preglacial valley systems in southern Alberta — the Calgary Valley system to the north and the Lethbridge Valley system to the south. The main Calgary Valley trends across the northern part of the map-area; a major tributary of the Lethbridge system — the Teepee Valley — trends across the southern part. The mainly buried alluvial gravels of these ancient valleys range up to 50 feet in thickness; the thickness of the surficial deposits ranges from a few feet up to 200 feet or more.

INTRODUCTION

The purpose of this report is to make available information on the topography of the bedrock surface and the thickness and character of the overlying unconsolidated deposits in the Gleichen map-area. These factors influence the shallow groundwater-flow configuration and determine the distribution of reservoirs capable of storing and transmitting sizable quantities of groundwater.

The area studied is approximately 6,000 square miles in extent and comprises the map-area represented by the National Topographic Series (NTS) map-sheet 82I (Fig. 1).

A contour map of the bedrock surface, on a scale of 1:250,000, has been prepared and superimposed on a contour map of the present land surface (Map 67-2A). The contour interval for both the bedrock surface and the land surface is 100 feet. The bedrock contours are of necessity generalized. Nevertheless the location and general shape of important bedrock-surface features are believed to be reliable. Knowledge of the bedrock topography has made possible a reasonably detailed interpretation of the most recent preglacial drainage (Fig. 2).

Similar contour maps of the bedrock surface have been produced for various areas in Alberta (Farvolden, 1961, 1963a, 1963c;

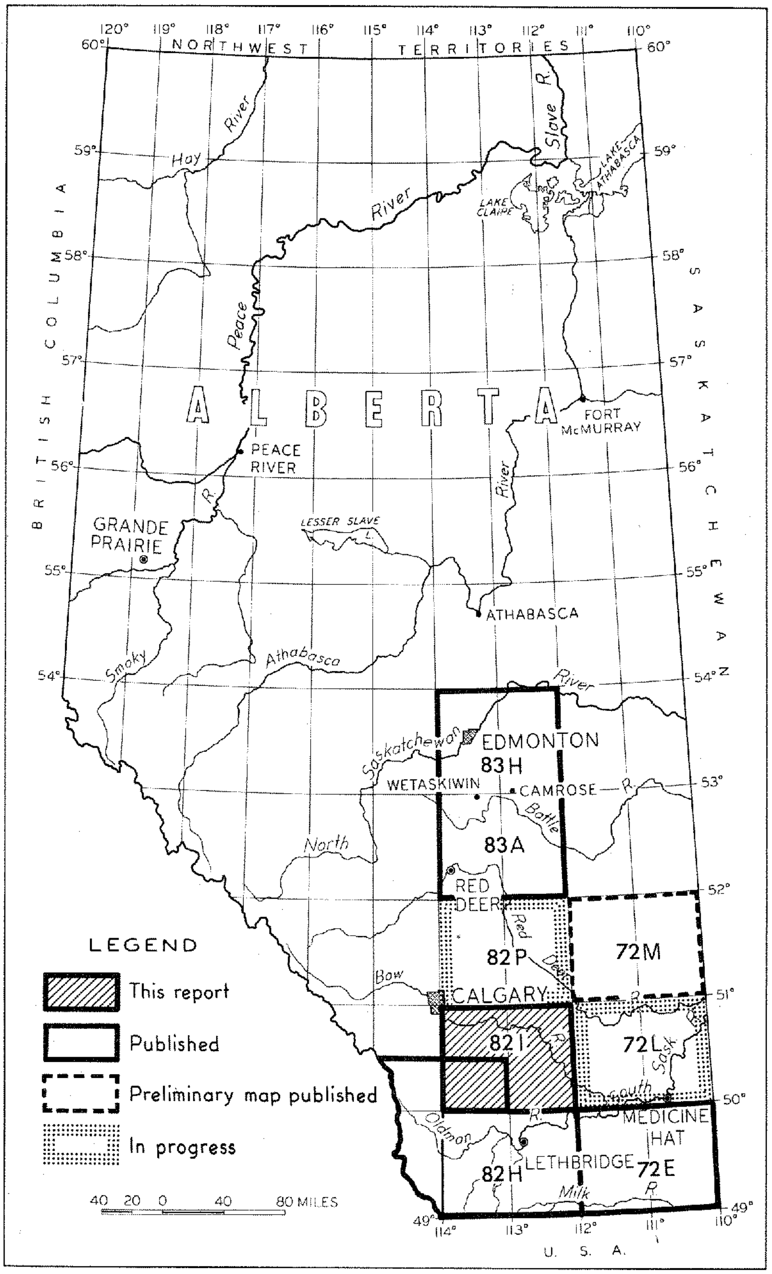


Figure 1. Bedrock-topography mapping in Alberta.

Kunkle, 1962; Le Breton, 1963; Meyboom, 1963; Campbell and Almadi, 1964; Geiger, 1965; Tóth, 1966; Carlson, 1967; Westgate, 1968). Of these, the maps covering complete 1:250,000 scale NTS map-areas are shown on figure 1 for reference purposes.

Compilation, Interpretation, and Accuracy

Most of the information has been taken from seismic shot-hole logs on file with various oil companies in Alberta. Supplementary information has been gained from exploration holes drilled in the search for coal and in the evaluation of dam-site locations, from drill logs submitted by water-well drilling contractors, and from observation of exposed sections along some present-day valleys.

Although a shot-hole log may be considered an unreliable source of stratigraphic information since such logs are recorded by the driller only, the writer has found that changes from till to gravel and from till or gravel to bedrock are indicated fairly precisely in most logs. Data from logs in marked disagreement with most of the other logs of nearby holes have not been used.

Compilation of information from shot-hole or drill-hole logs was done by technicians of the Groundwater Division. The bedrock topography of the area was then contoured at 50-foot intervals by the writer. On the final map (Map 67-2A) only 100-foot bedrock contours have been retained.

The locations of drill holes from which useful information was obtained are indicated on map 67-2A as an index of the control, and therefore of the precision of the contours. Locations where gravel was encountered and is interpreted as preglacial are differentiated from other drill-hole locations. In some areas, notably on the Blackfoot Indian Reserve, practically no control was available and bedrock contouring was very difficult. The bedrock contours have been modified, where necessary, to conform generally to the surface topography. These changes were necessary mainly in parts of the area with poor control where present-day valleys have cut deeply into bedrock.

The south boundary of map 67-2A adjoins part of the north boundary of the bedrock topography map for southwestern Alberta (Geiger, 1965) and there is, in addition, some overlap between the two maps. Contours in the area common to the two maps and along the common boundary in some instances fail to match. Where there is disagreement, it reflects the better and more abundant data on which the map for the Gleichen map-area is based. Recent information has also led to modifications in a valley system in map-area 82H to the north of Lethbridge. These modifications are also included on figure 2.

Acknowledgments

The following companies and agencies contributed the data used in the compilation of the maps (Fig. 1, Map 67-2A) and their co-operation in this project is gratefully acknowledged: Alberta Coal Ltd.; Alberta Department of Agriculture, Water Resources Division; Altana Exploration Company; Amerada Petroleum Corp.; British American Oil Company Ltd.; Calgary Power Ltd.; Canada Department of Agriculture, Prairie Farm Rehabilitation Administration; Canadian Pacific Oil and Gas Ltd.; Canadian Superior Oil Ltd.; Chevron Standard Ltd.; French Petroleum Company of Canada Ltd.; Great Plains Development Company of Canada Ltd.; Home Oil Ltd.; Hudson's Bay Oil and Gas Company Ltd.; Imperial Oil Ltd.; Pacific Petroleums Ltd.; Pan American Petroleum Corp.; Richfield Oil Corp.; Royalite Oil Company Ltd.; Shell Canada Ltd.; Socony Mobil Oil of Canada Ltd.; Tenneco Oils and Minerals, Ltd.; Texaco Exploration Company; Union Oil Company of Canada Ltd.

Most of the tedious work of producing maps for this report has been cut to a minimum by using existing federal and provincial government base maps. The writer sincerely appreciates the help of Mr. W. H. Bogdan and his staff in the mapping office, Alberta Department of Highways, for providing proper up-to-date base overlays, for reducing the pertinent additional information for map 67-2A from a scale of 1 inch to 1 mile to a scale of 1:250,000, for scribing the necessary overlays, and for arranging for the production of map 67-2A.

The expenses of collection, compilation, and processing of seismic shot-hole logs and other data were shared equally between the Federal and Provincial Governments under the terms of the Federal Agricultural Rural Development Act (ARDA) through ARDA Project 9024. This financial assistance is greatly appreciated.

BEDROCK SURFACE

General Statement

In Tertiary and early Pleistocene time, weathering and erosion produced a much more mature topography than the present-day youthful topography of the area. The most recent evolutionary stage of this preglacial landscape, since modified somewhat by glacial erosion, is now buried and preserved under surficial deposits left upon retreat of the continental ice sheet and the mountain glaciers. Modification of the preglacial landscape has continued in certain areas where glacial and Recent streams have cut into the bedrock, particularly where preglacial drainage patterns have been disrupted by glacial action and probable Recent uplift.

Previous Work

Relatively little attention has been given to the buried bedrock topography of the study area or of southern Alberta in general until very recently. Early work was incidental to investigations either of the surficial deposits or of the bedrock. Dawson (1885) recognized the existence of buried preglacial valleys where present river valleys crossed them. Dowling (1917) mentions the thick surficial deposits which filled preglacial channels, as for example in the Lethbridge area. Williams and Dyer (1930) describe some aspects of the buried channels crossed by the Oldman River at Lethbridge and by the Milk River. Allan (1934) mentions the presence of a few sections of buried channels in southern Alberta. Horberg (1952) describes several Pleistocene sections along the Oldman River in which the Saskatchewan Gravels and Sands (Rutherford, 1937; Westgate and Bayrock, 1964) are exposed and discusses in a general way the preglacial land surface. Horberg (1954) interprets the positions of several preglacial valleys in the Waterton region of southwestern Alberta on the basis of geomorphic evidence. Campbell and Almadi (1964) interpret the sequence of preglacial valley development in the Vulcan-Gleichen area.

Within the last few years considerable interest has been shown by geologists in the bedrock surface and the preglacial drainage of Alberta. Two papers (Stalker, 1961; Farvolden, 1963b) have been published outlining interpretations of the locations of major preglacial valleys for central and southern Alberta. Stalker based his interpretation on field observation between 1946 and 1959 augmented with data from water-well and seismic shot-hole drillers' logs, topographic maps, and air photos. Farvolden compiled his map — originally published in a report by Gravenor and Bayrock (1961) — mainly from water-well and seismic shot-hole data but he also incorporated observations made during four years of field work. More recently an interpretation of the ancestral drainage pattern for the whole of Western Canada was included in the Geological Atlas of Western Canada (Barton et al., 1966).

These broad regional interpretations are interesting first approximations but all contain significant errors. Detailed and more accurate work on the bedrock surface, including contour maps and interpretations of the preglacial drainage-ways, has been completed for southwestern Alberta (Geiger, 1965), for southeastern Alberta (Westgate, 1968), and for the present study area. These detailed studies have allowed a better interpretation of the locations of preglacial valleys in southern Alberta (Fig. 2).

Studies of the physiography of parts of Alberta, Saskatchewan, and Montana by such workers as McConnell, Darton, Lambe, Williams and Dyer, Collier and Thom, and others indicated the presence of remnants of several ancient land surfaces which are also present in the area of this report. Alden (1932) studied a large area in northwestern United States and southern Alberta east of the continental divide and summarized the findings of the earlier workers. In this area he postulated the presence of four plains, now preserved as benches or terraces, that he considered to be the product of stream erosion and deposition during successive long periods of freedom from uplift or deformation. These are the Cypress Plain, the Flaxville Plain (or No. 1 bench), No. 2 bench, and No. 3 bench. This classification appears subsequently to have been unchallenged except in detail. Horberg (1954) discusses several remnants of these old benches in the southwest corner of Alberta. Campbell and Almadi (1964) interpreted the sequence "of stream development in the Vulcan-Gleichen area, over a time-span of unknown duration, prior to glaciation."

Topography of the Bedrock Surface

Four Regional Divisions

Four large-scale physiographic divisions or units are readily discernible on bedrock-contour maps of southwestern Alberta. They comprise: (1) the 10- to 25-mile wide mountain belt along the Alberta-British Columbia border; (2) the foothills belt, 5 to 25 miles wide, lying immediately to the east; (3) the lowland valley or plains areas covering most of the area to the east of the foothills belt; and (4) the erosional remnants comprising upland areas separating these wide, gentle preglacial valleys. These same units, though differing in detail, form subdivisions of the present-day topography. In the Gleichen map-area, only the two last-named divisions are present.

Near the eastern extremity of the map-area, the broad, well-defined preglacial valleys end at the edge of what appears to be a low, characterless plain on which the preglacial valley is broader and less well defined. This plain, in the shape of a huge incomplete dish, may extend over a large area of southern Alberta but data are required for adjacent map-areas to substantiate this conjecture.

The preglacial Saskatchewan Gravels and Sands (Rutherford, 1937; Westgate and Bayrock, 1964) are largely confined to the valleys and have either been eroded down from higher and older benches or have been brought from the mountains by the preglacial and possibly early glacial rivers which flowed in these valleys.

The latest developmental stage of the preglacial topography is readily discernible in some places but not in others. For example, it is uncertain whether, immediately prior to glaciation, the well-defined preglacial valley at Okotoks turned northeast along the course of the present Highwood River or turned southeast past Aldersyde and eventually joined the Silver Valley drainage network.

Drainage Basins of the Preglacial Topography

A revised picture of the main valley trends of the most recent preglacial topography in southern Alberta is presented in figure 2. The present study area can be seen in relationship to the main preglacial valley systems of southern Alberta. In the segments of southern Alberta where detailed contouring of the bedrock surface is available, as in NTS map-areas 72E (Westgate, 1968), 82G and 82H (Geiger, 1965), and 82I, interpretation and reconstruction of the preglacial drainage basins are relatively complete except in small portions of these areas where the shortage of information did not allow adequate contouring. The major and many of the secondary preglacial valleys are shown on figure 2 for these segments by marking the thalweg (line through the lowest points) of each valley. In the map-areas of southern Alberta where detailed bedrock contour mapping is not yet available, only the locations of the major preglacial valleys have been shown. This interpretation is based on a knowledge of the above-mentioned areas, the use of topographic maps, and certain selected information from previous publications.

Most of the nomenclature of Stalker (1961) for the various river and stream valleys of the preglacial drainage has not been retained because his valley names were taken from present-day rivers or streams. Current geologic usage, adopted by the Research Council of Alberta, dictates that preglacial valley names should not be the same as those of present-day streams or stream valleys because of the confusion that naturally results from such duplication. McGregor Valley has been retained because the valley is named after McGregor Lake. Farvolden's (1963b) use of the proposed valley names "Stavely" and "Carmangay" has also been retained. Other names were chosen from local communities, physical features, or historical locations (Appendix A).

Two large integrated valley systems drained nearly all of southern Alberta (from divides in townships 28 to 35 to the United States border) in preglacial time. These were the Calgary Valley system and the Lethbridge Valley system (Fig. 2). They joined in township 22, range 2 to form the preglacial valley which is the ancestral valley for the present South Saskatchewan River at the Alberta-Saskatchewan border and which is called the Tyner Valley in Saskatchewan (Christiansen, 1965). Within the present study area, about three-fifths of the northern part of the area contributed directly to the Calgary Valley system. In the southern part, the Teepee Valley system, a major tributary of the Lethbridge Valley system, drained most of the remaining two-fifths of the area. The part of the divide between these two valley systems and within the study area has been emphasized on figure 2. Farther east the position of this divide becomes quite speculative.

The part of the southern major preglacial valley system in Alberta between the confluence of the Lethbridge and Medicine Hat Valleys in township 16, range 6, and the confluence of this system and the Calgary system in township 22, range 2 was called the Medicine Hat Valley by Meyboom (1963). Much more complete information on the preglacial drainage pattern is now available and it is now evident (Fig. 2) that the Lethbridge Valley system was the dominant valley system and that the Medicine Hat Valley was a major tributary to the Lethbridge Valley. The area drained by the Lethbridge system was much more extensive and it is also quite possible that the Skiff Valley, a tributary of the Lethbridge Valley system, captured the upper part (Whisky Valley) of the Medicine Hat Valley system. Therefore the valley downstream from the confluence of the Medicine Hat and Lethbridge Valleys should be called the Lethbridge Valley.

The exact extent of modification of the preglacial land surface accomplished by glacial erosion and by any glaciofluvial or Recent fluvial erosion is uncertain. A few of the smaller tributary valleys shown could have been formed during glacial or Recent time.

Calgary Valley System

The main Calgary Valley originates west of the city of Calgary, and becomes well defined in the vicinity of the Ghost River Dam (Tp. 26, R. 6, W. 5th Mer.). From this point the valley trends eastward to Cochrane (Tp. 26, R. 4, W. 5th Mer.) and then southeastward to the Elbow River forming the depression under Glenbow Lake (Tp. 25, R. 3, W. 5th Mer.). It subsequently follows the depression in which the Elbow River now flows until it is joined by the Bow River in township 22 or 23 (Meyboom, 1961). Near the fifth meridian the valley changes direction and runs nearly due eastward across the northern part of the Gleichen map-area (NTS 82I). The valley leaves the map-area in township 22 and crosses the Red Deer River. Eastward to the Saskatchewan border the valley is the very large depression in part of which the present-day Red Deer River is situated.

Within the Gleichen map-area the main Calgary Valley is very broad and well defined between the fifth meridian and range 20, west of the fourth meridian, where it is presently occupied by the Bow River. From range 19 eastward, the present and preglacial land surfaces both abruptly become dish-shaped, low, and monotonous. At this point the Calgary Valley becomes less well defined and the Bow River diverges southward.

The divide separating the Calgary and Lethbridge systems can be traced northeastward and eastward from the Porcupine Hills southwest of Nanton (Tp. 16, R. 28, W. 4th Mer.), through a point just south of Vulcan (Tp. 17, R. 24, W. 4th Mer.) and across the southern end of the valley in which McGregor Lake is now situated, to the village of Lomond (Tp. 16, R. 20, W. 4th Mer.). From this locality the divide swings acutely back toward the northwest to Armada (Tp. 17, R. 21, W. 4th Mer.), thence in an arc toward the northeast and east until it intersects the Bow River along the boundary of townships 18 and 19 in range 18. The divide then trends southeast and east until it reaches the eastern border of the Gleichen map-area 6 miles southwest of Brooks (Tp. 18, R. 14, W. 4th Mer.). Between this divide and the main valley of the Calgary system the McGregor Valley tributary basin and the Silver Valley tributary basin drained most of the intervening land in preglacial time. The writer agrees with Campbell and Almadi (1964) that the most recent preglacial valley over which the northern part of McGregor Lake (Tp. 18, R. 22, W. 4th Mer.) is now situated drained northward. Their interpretation of the chronological sequence of preglacial valley development may not be completely valid, but the over-all interpretation seems reasonable. In the vicinity of Okotoks and High River (Tp. 19-20, R. 28-29, W. 4th Mer.) it is difficult to determine where the preglacial valleys were situated because of the present-day river development. In the Lathom, Southesk, Cassils area (Tp. 19-20, R. 15-17, W. 4th Mer.), between the major divide and the Calgary Valley thalweg, relatively few bedrock data are available and the valley and divide locations could not be established with complete confidence.

Within the study area (NTS 82I), the only two significant and well-defined preglacial tributary valleys converging on the main Calgary Valley from the north are the Eagle and Makepeace Valleys. Deadhorse Valley, which is well defined topographically to the north, loses definition as it enters the study area in township 23, range 18.

Lethbridge Valley System

Three major tributary basins comprised the Lethbridge Valley system in preglacial time. The largest of these was the Lethbridge Basin itself, the second was the Medicine Hat Basin, and the smallest was the Teepee Basin (Geiger, 1965).

South of the divide between the Calgary and Lethbridge systems in the Gleichen map-area, most of the area is occupied by a major eastward-trending tributary of the Lethbridge system, the Teepee Valley. The minor tributaries of this basin within 82I are all well defined.

Along the southern border of the Gleichen map-area, in ranges 20, 21, and 22, the preglacial drainage was apparently to the south into Keho Valley, a tributary of the Lethbridge Valley.

ECONOMIC GEOLOGY

An important economic byproduct of a study of the bedrock topography lies in its help in locating the late preglacial gravel deposits called the Saskatchewan Gravels and Sands (Rutherford, 1937; Westgate and Bayrock, 1964). These deposits overlie much of the bedrock in southern Alberta and they are potential sources of gravel and sand as well as potential reservoirs suitable for the production of groundwater.

Drill holes reporting preglacial gravels lying on the bedrock and buried by later surficial deposits are differentiated on map 67-2A. These gravels are reported to range in thickness up to 50 feet or more at a few localities. Surficial deposits range from a few feet in thickness over bedrock high areas to 200 feet or more over some of the preglacial valleys. Proving up the distribution, depth to, and thickness of the gravels requires drilling and checking.

Preglacial valleys contain the main accumulations of these gravels and sands. Where the preglacial valley floors are lower than the present river valleys, any Saskatchewan Gravels and Sands in the preglacial valleys are potential reservoirs for groundwater. In most of the map-area this potential has not been tested. Where the present rivers have cut deeper than the old valley floors, the deposits usually have been drained of water, but are potential sources of sand and gravel for industrial purposes. Comparison of the contours on the preglacial and present surfaces will indicate promising situations in any particular area.

In the eastern part of the map-area, where the bedrock relief is low and the topography relatively characterless, the bedrock valleys become broad, and the preglacial gravels may blanket large areas, as in the northeastern corner of the area (Map 67-2A). The preglacial gravels in this area extend into NTS map-area 82P (V. A. Carlson, pers. comm.). Preliminary testing of this potential aquifer in township 23, range 17, west of the fourth meridian has indicated yields of good quality water in the range of 75 to 100 imperial gallons per minute (W. R. Turner, pers. comm.).

REFERENCES CITED

Allan, J. A. (1934): Relation of the geology to the soils in the Lethbridge sheet; in Geology of Alberta soils; Res. Coun. Alberta Rept. No. 34, Part 3, p. 60-146.

Alden, W. C. (1932): Physiography and glacial geology of eastern Montana and adjacent areas; U.S. Geol. Surv. Prof. Paper 174, 133 pages.

Barton, R. H., Christiansen, E. A., Kupsch, W. O., Mathews, W. H., Gravenor, C. P. and Bayrock, L. A. (1966): Ancestral drainage map; in Geological history of Western Canada; Alberta Soc. Pet. Geol., p. 197.

Campbell, J. D. and Almadi, I. S. (1964): Coal occurrences of the Vulcan-Gleichen area, Alberta; Res. Coun. Alberta Prelim. Rept. 64-2, 58 pages.

Carlson, V. (1967): Bedrock topography and surficial aquifers of the Edmonton district, Alberta; Res. Coun. Alberta Rept. 66-3, 21 pages.

Christiansen, E. A. (1965): Preglacial valleys in southern Saskatchewan; Saskatchewan Res. Coun. Map No. 3.

Dawson, G. M. (1885): Report on the region in the vicinity of the Bow and Belly Rivers, Northwest Territories; Geol. Surv. Can. Rept. Prog. 1882-83-84, pt. C., 169 pages.

Dowling, D. B. (1917): The southern plains of Alberta; Geol. Surv. Can. Mem. 93, 200 pages.

Farvolden, R. N. (1961): Groundwater resources Pembina area, Alberta; Res. Coun. Alberta Prelim. Rept. 61-4, 26 pages.

Farvolden, R. N. (1963a): Bedrock topography, Edmonton-Red Deer map-area, Alberta; in Early contributions to the groundwater hydrology of Alberta; Res. Coun. Alberta Bull. 12, p. 57-62.

———————— (1963b): Bedrock channels of southern Alberta; in Early contributions to the groundwater hydrology of Alberta; Res. Coun. Alberta Bull. 12, p. 63-75.

———————— (1963c): Rate of groundwater recharge near Devon, Alberta; in Early contributions to the groundwater hydrology of Alberta; Res. Coun. Alberta Bull. 12, p. 98-111.

Geiger, K. W. (1965): Bedrock topography of southwestern Alberta; Res. Coun. Alberta Prelim. Rept. 65-1, 14 pages.

Gravenor, C. P. and Bayrock, L. A. (1961): Glacial deposits of Alberta; in Soils in Canada; Roy. Soc. Can. Spec. Publ. 3, p. 33-50.

Horberg, L. (1952): Pleistocene drift sheets in the Lethbridge region, Alberta, Canada; Jour. Geol., Vol. 60, No. 4, p. 303-330.

———————— (1954): Rocky Mountain and continental Pleistocene deposits in the Waterton region, Alberta, Canada; Bull. Geol. Soc. Am., Vol. 65, No. 11, p. 1093-1150.

Kunkle, G. R. (1962): Reconnaissance groundwater survey of the Oyen map-area, Alberta; Res. Coun. Alberta Prelim. Rept. 62-3, 23 pages.

Le Breton, E. G. (1963): Groundwater geology and hydrology of the Andrew area, Alberta; in Early contributions to the groundwater hydrology of Alberta; Res. Coun. Alberta Bull. 12, p. 13-24.

Meyboom, P. (1961): Groundwater resources of the city of Calgary and vicinity; Res. Coun. Alberta Bull. 8, 72 pages.

———————— (1963): Induced infiltration, Medicine Hat, Alberta; in Early contributions to the groundwater hydrology of Alberta; Res. Coun. Alberta Bull. 12, p. 88-97.

Rutherford, R. E. (1937): Saskatchewan gravels and sands in central Alberta; Trans. Roy. Soc. Can., Vol. 31, Sec. 4, p. 81-95.

Stalker, A. M. (1961): Buried valleys in central and southern Alberta; Geol. Surv. Can. Paper 60-32, 13 pages.

Tóth, J. (1966): Groundwater geology, movement, chemistry, and resources near Olds, Alberta; Res. Coun. Alberta Bull. 17, 126 pages.

Westgate, J. A. (1968): Surficial geology of the Foremost-Cypress Hills area, Alberta; Res. Coun. Alberta Bull. 22, 113 pages.

Westgate, J. A. and Bayrock, L. A. (1964): Preglacial structures in the Saskatchewan Gravels and Sands of central Alberta, Canada; Jour. Geol., Vol. 72, No. 5, p. 641-648.

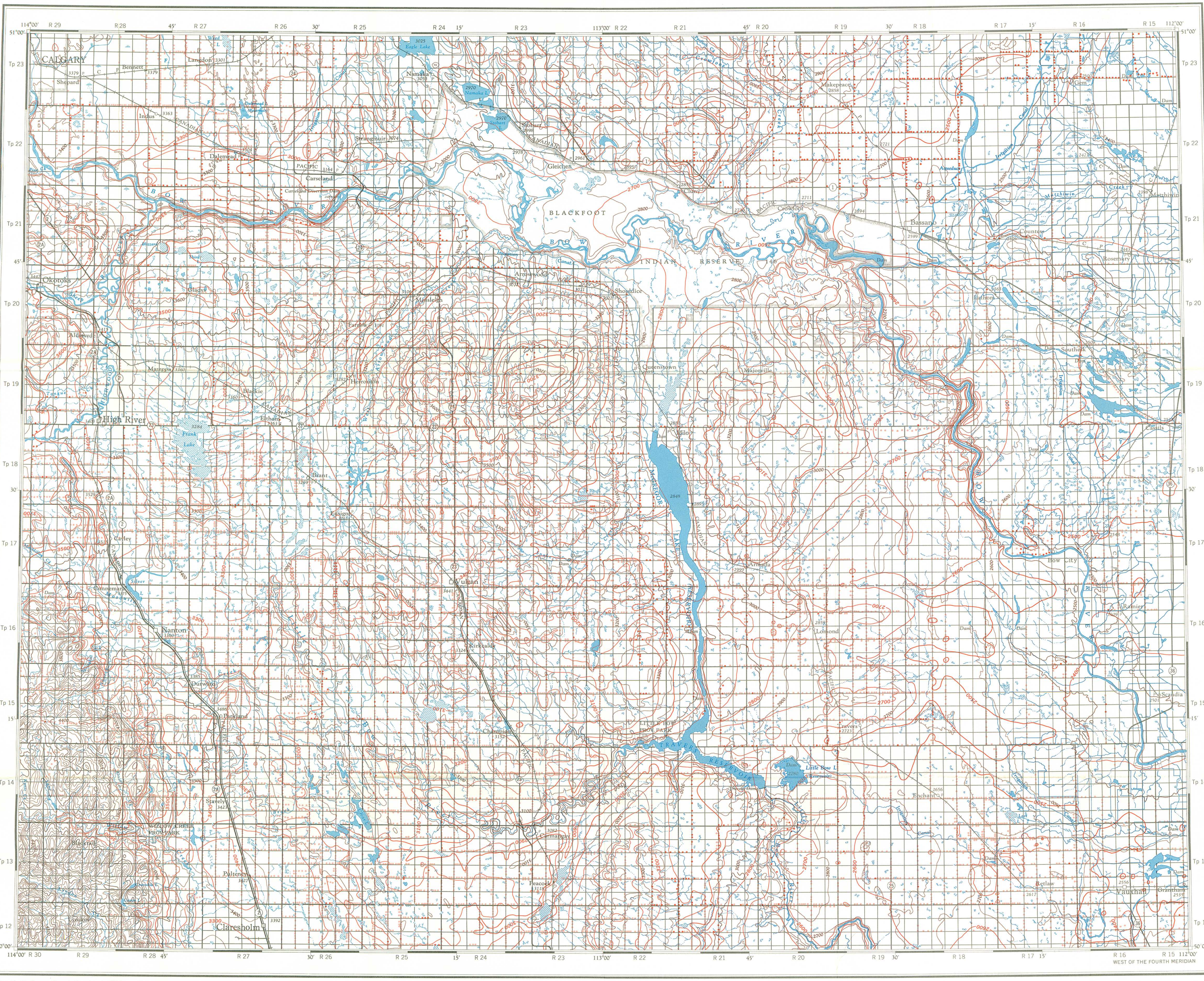
Williams, M. Y. and Dyer, W. S. (1930): Geology of southern Alberta and southwestern Saskatchewan; Geol. Surv. Can. Mem. 163, 160 pages.

APPENDIX A. DERIVATION OF PREGLACIAL VALLEY NAMES

The preglacial valleys described in this report have been named after nearby population centers, lakes, peculiar physical features, or geographical locations of historical interest. The spelling and location of all the population centers, lakes, and streams, where possible, were taken from the Alberta section of the Gazetteer of Canada published in 1958 or its supplements. A tabular summary of name sources and their locations is given below.

Valley Name	Named After	Location		
		Tp.	R.	W. of Mer.
1. Armada	Post office of Armada	17	21	4
2. Blackie	Village of Blackie	19	27	4
3. Bow City	Post office of Bow City	17	17	4
4. Calgary	City of Calgary	24	1	5
5. Carmangay*	Village of Carmangay	13	23	4
6. Champion**	Village of Champion	15	23	4
7. Deadhorse	Deadhorse Lake	24	19,20	4
8. Eagle	Eagle Lake	23	24	4
9. Kirkcaldy**	Hamlet of Kirkcaldy	16	24	4
10. Lethbridge**	City of Lethbridge	8,9	21	4
11. Lomond	Village of Lomond	16	20	4
12. Makepeace	Railroad station	23	19	4
13. Majorville	Post office of Majorville	19	20	4
14. Medicine Ring	Location of an Indian medicine ring on the top of a large hill overlooking East Arrowwood Creek	19	23	4
15. McGregor***	McGregor Lake	16,17,18	21	4
16. Silver**	Silver Lake	16, 17	28	4
17. Stavely*	Town of Stavely	14	27	4
18. Teepee**	Location of Indian teepee rings at a provincial campground near Carmangay	13	23	4
19. Vauxhall	Village of Vauxhall	13	16	4
20. Vulcan**	Town of Vulcan	17	24	4

* Named by Farvolden (1963b)
** Named by Geiger (1965)
*** Named by Campbell and Almadi (1964)



Produced by the Surveys Branch, Department of Highways, 1967
Base maps provided by the Surveys and Mapping Branch,
Department of Energy, Mines and Resources, Ottawa
Map to accompany Research Council of Alberta Report 67-2
Bedrock topography by K.W. Geiger, 1967

MAP 67 - 2A

BEDROCK TOPOGRAPHY OF THE GLEICHEN MAP - AREA ALBERTA

Scale 1:250,000 or 1 Inch to 4 Miles approximately

Miles 5 0 5 10 15 20 Miles

Kilometres 5 0 5 10 15 20 25 30 Kilometres

Transverse Mercator Projection

REFERENCE

- Township outline surveyed
- Township outline unsurveyed
- Section line
- Indian reserve, park, etc.
- City or large town
- Town
- Village or settlement
- Post office
- Highway
- Railway (STATION)
- Stream
- Stream intermittent or dry
- Irrigation canal or ditch
- Lake
- Lake intermittent

REFERENCE

Bedrock Contours

- Elevation (3000)
- Depression (2500)
- Control point
- Control point with gravel

Surface Contours

- Elevation (3000)
- Depression (2500)

Contour interval 100 feet

Elevations are above mean sea level

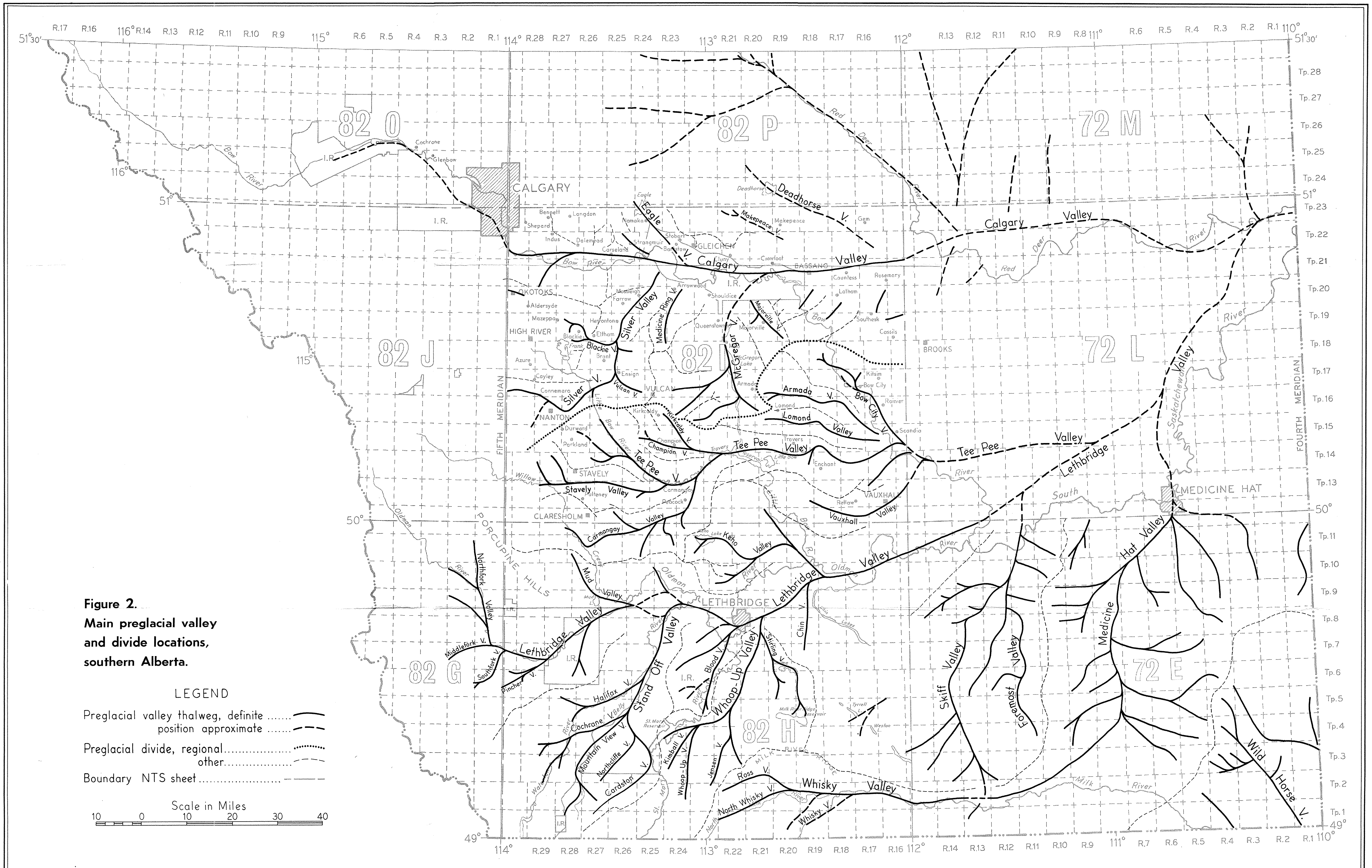


Figure 2.
Main preglacial valley and divide locations, southern Alberta.

LEGEND

Preglacial valley thalweg, definite
position approximate
Preglacial divide, regional
other
Boundary NTS sheet

Scale in Miles
10 0 10 20 30 40

To accompany Research Council of Alberta Report 67-2

Published in 1968