

RESEARCH COUNCIL OF ALBERTA

Preliminary Report 65-2

SURFICIAL GEOLOGY OF THE
CYPRESS HILLS AREA, ALBERTA

by

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SURFICIAL GEOLOGY OF THE CYPRESS HILLS

AREA, ALBERTA

Abstract

The surficial deposits of the Cypress Hills area consist predominantly of till, mainly in the form of ground moraine, hummocky disintegration moraine and end moraine. Glacio-fluvial deposits of sand and gravel, in the form of outwash plains, kames, eskers, drumlins and terraces along meltwater channels, occur chiefly in the southeastern part of the map-area. Extensive glacio-lacustrine deposits, consisting of sand with minor amounts of gravel, are confined to Glacial Lake Pakowki Basin and Glacial Lake Wild Horse Basin. Loess occurs on top of the unglaciated Cypress Hills Plateau. Aeolian sand is found immediately east of Lake Pakowki, and gravelly to silty alluvium is present in all postglacial valleys.

INTRODUCTION

The types, distribution and composition of the surficial deposits of the Cypress Hills area are shown on six contiguous map sheets reproduced herein on a scale of one inch to one mile. These accompanying notes should be considered only as an expanded legend; a comprehensive account of the surficial geology is to be included in a memoir on the surficial geology of the Foremost-Cypress Hills area, which is in preparation.

The Cypress Hills area is located in the southeastern corner of Alberta. The map-area covers some 2400 square miles between 49°00' and 49°47' north latitude and 110° and 111° west longitude. The province of Saskatchewan lies immediately to the east, the United States of America to the south.

Fieldwork was carried out during the summers of 1961, 1962 and 1963. The area was systematically covered: north-south traverses were spaced one mile apart, east-west traverses two miles apart. Traverses were made at closer intervals in the Cypress Hills proper.

This work was done whilst the writer held a University of Alberta - Research Council of Alberta joint appointment in the field of Pleistocene geology. Dr. L.A. Bayrock, Research Council of Alberta,

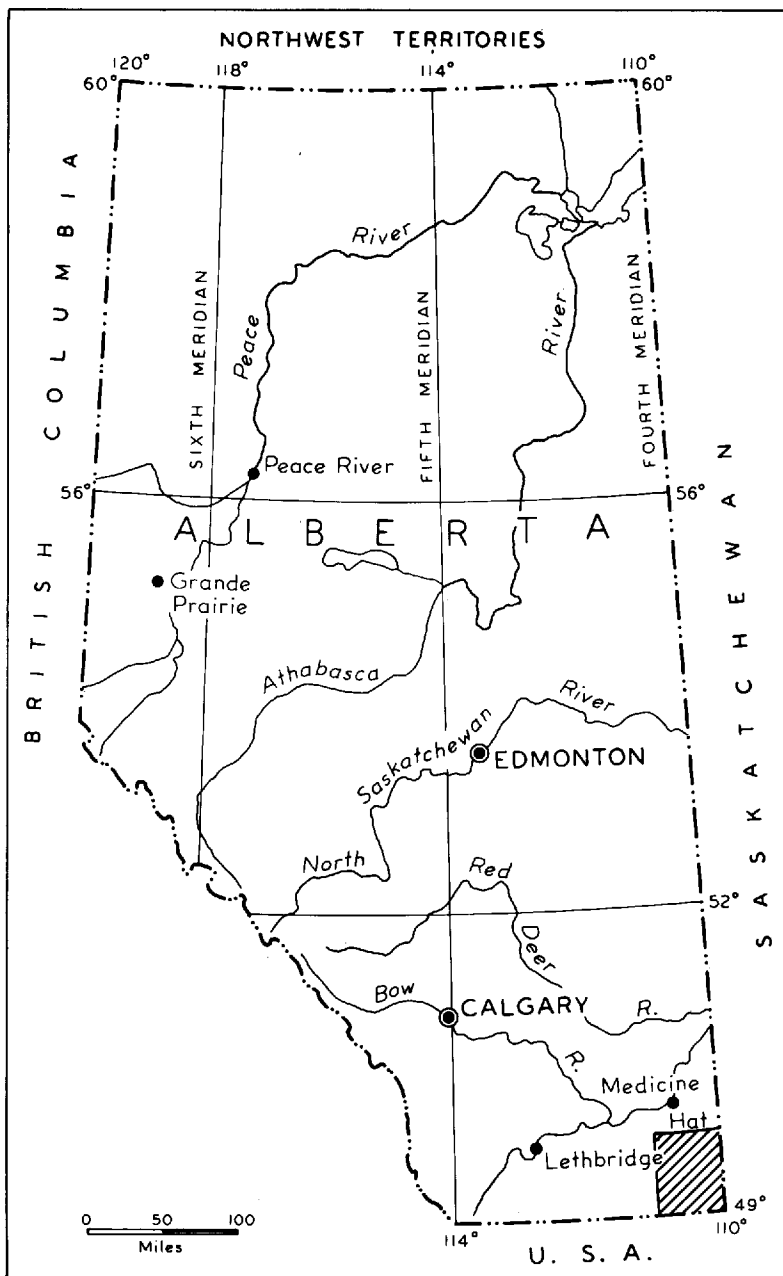


Figure 1. Location of the Cypress Hills area

and Dr. R.E. Folinsbee, University of Alberta, supervised the work throughout all its stages and sincere thanks are extended to them for their help and encouragement.

The writer expresses his appreciation to Dr. Peters for permission to camp at the Manyberries Range Experimental Station.

S. J. Groot, map production office, Research Council of Alberta, prepared the accompanying maps. Excellent field assistance was provided by Messrs. G. Ryznar, L. Hanson, and A. Vilonyay.

DESCRIPTION OF DEPOSITS

General Statement

The Cypress Hills area was glaciated by Laurentide glaciers; there is no evidence of Cordilleran ice entering this region. At the time of the most extensive Laurentide glaciation, the Cypress Hills themselves formed a nunatak 120 square miles in area and approximately 300 feet high. The northern slopes of this upland were glaciated up to a height of 4500 feet above sea level, but the southern slopes were not glaciated above 4050 feet (Elkwater Sheet). North of the Cypress Hills the glaciers flowed in a southerly direction, but to the south they were forced to flow southeastwards along the stretch of relatively low land between the Cypress Hills and the Sweet Grass Hills (situated a few miles southwest of the map-area). All of the surface drift sheets in the map-area are believed to be of Wisconsin age.

Bedrock

Upper Cretaceous sandstones and shales with some coal seams and bentonite beds crop out over the greater part of the map-area. Tertiary conglomerate (mainly quartzite pebbles and cobbles) and sandstone cap the Cypress Hills.

Till

Till is an unsorted, unstratified sediment deposited by a glacier. In the Cypress Hills area it forms most of the surface deposits and varies in texture from clay loam to loam. The tills are yellow olive grey or light olive grey in colour, but turn a dusty yellow or yellowish brown when oxidized. Granite, metamorphic rocks, dolomite and limestone, derived from the Canadian Shield and the adjacent belt of Paleozoic rocks, commonly form over 50 per cent of the pebble fraction of the till. In places, however, rocks of local derivation constitute over 70 per cent of the pebble fraction

(clay pebbles excluded).

South of the Cypress Hills, the till cover is predominantly thin and bedrock is exposed at the surface over extensive areas. Till thicknesses here are generally less than 20 feet but exceed 50 feet in places. North and west of the Cypress Hills the till cover is generally thicker. Maximum thicknesses, however, occur along the western boundary of the map-area, north of Milk River, where till extends to a depth of over 150 feet.

Ground moraine, hummocky disintegration moraine, and end moraine are all glacial land forms that are composed dominantly of till with minor amounts of sand and gravel. Ground moraine is a level to undulating till plain with a local relief seldom exceeding 10 feet. It is commonly dotted with undrained depressions. Hummocky disintegration moraine, which is well developed north of the Cypress Hills, is characterized by an irregular "knob-and-kettle" topography with steep-sided circular, oval, or irregular depressions and linear ridges. The local relief varies from 15 to over 50 feet. An end moraine consists of a series of aligned ridges or hummocks that parallel former positions of the ice front and formed at or close to the margin of the glacier. In the map-area most of them have an elongate, linear or curvilinear outline and are usually several miles wide. End moraine surrounds the Cypress Hills and is well developed around Lake Pakowki.

Glacio-fluvial Deposits

Glacio-fluvial deposits are composed mainly of gravel and sand. They are found along meltwater channels as terraces and undoubtedly line the channel floors but are usually covered by recent alluvium. The outwash plain in the southeastern part of the map-area (Wild Horse Sheet) consists of sand with minor amounts of gravel. These deposits are generally less than 10 feet thick and lie on till or bedrock, both of which are commonly exposed at the surface. The smaller outwash plains around the Cypress Hills contain a high percentage of quartzite pebbles and cobbles.

Numerous stagnant-ice features exist in the Wild Horse district. All are composed of stratified gravel and sand. Kames, or mounds of stratified drift, occur in section 2, township 1, range 4 and are 50 feet high. Close by, similar mounds have the streamline form characteristic of drumlins as do many of the linear ridges in this area. An esker system is also present in the Wild Horse district. The largest member of this system extends from the southeastern corner of township 2, range 4 southeastward to Wild Horse, a distance of over 12 miles, and continues into Montana. In places it rises 50 feet above the surrounding prairie level and is over a mile wide for a considerable part of its length.

Glacio-lacustrine Deposits

Glacio-lacustrine deposits accumulated in proglacial and superglacial lakes. Proglacial lakes formed when meltwater became ponded against the ice margin as the latter retreated down regional slope. Superglacial lakes developed on the surface of ablating stagnant ice masses.

North of the Cypress Hills, where the regional slope was into the glacier, many small, thin, patches of lacustrine sand, silt or clay cover the ground moraine. Glacial Lake Pakowki (Manyberries Sheet) was the largest proglacial lake in the map-area. It formed between the ice front and part of the preglacial divide which extends from the Cypress Hills southwestward to the Sweet Grass Hills. The eastern part of Glacial Lake Pakowki Basin contains medium to coarse sand, at least 10 feet thick, that is covered by about 3 feet of recent alluvial silt or clay. Deltaic gravels and sands occupy the western part of the basin.

Small patches of lacustrine sand, silt and clay are common in areas of hummocky moraine. These lacustrine deposits may be draped over till knobs or occur as deformed stringers in till. They undoubtedly accumulated in shallow superglacial ponds and were let down on to the basal till as the ice melted away.

Glacial Lake Wild Horse is situated in the southeastern corner of the map-area. It formed when the esker that passes through Wild Horse emerged above the downwasting ice surface and dammed the southeasterly draining meltwaters to the north. Thus, during its early stages, this lake was superglacial. Lake Wild Horse sediments are mainly sand and fine gravel with some silt, but in township 1, range 2 they are covered by recent alluvial and lacustrine silt and clay.

Cypress Hills Loess

The loess plain is co-extensive with the unglaciated Cypress Hills Plateau and adjacent slopes to the south. The loess overlies the weathered, oxidised cap of the Cypress Hills conglomerate, varies in thickness from 1 to 8 feet, and contains numerous quartzite pebbles from the underlying Cypress Hills conglomerate that were elevated into it by frost action. At the northern end of the plateau the loess is coarse grained, and, in places, over 50 per cent sand. It becomes finer grained to the south.

Recent Deposits

Extensive postglacial dune development is found just east of Lake Pakowki, where lacustrine sand has been blown on to the adjacent ground and end moraine by westerly winds. The sand extends on to the till

as a group of lobes, convex to the east, within which occur blowouts, parabolic and transverse dunes. These thin, lobate sheets of sand, together with their superimposed dunes, are now stabilised by grasses, shrubs, and trees, but in places have been reactivated.

Alluvial deposits of gravel and sand with some silt and clay occur along all of the postglacial river valleys. Colluvium mantles all steep slopes and is composed of a mixture of all materials present on these slopes.

LEGEND

QUATERNARY

- RECENT
- Alluvium: sand, silt and clay; some gravel
 - Lacustrine sediments: sand, silt and clay
 - Aeolian deposits: sand; parabolic dunes present

PLEISTOCENE AND RECENT

- Colluvium and alluvial fan: sand, silt and clay; some alluvium
- Eroded slope: mainly bedrock; some glacial drift and colluvium

PLEISTOCENE

- GLACIO-LACUSTRINE
- Lacustrine sediments: sand, silt and clay; till in places; includes recent lacustrine sediment and alluvium
 - Lake Pakowki sediments: sand, silt and clay; veneered with recent lacustrine sediment and alluvium
 - Lake Pakowki sediments: lacustrine sand and till (undifferentiated)
 - Delta: sand; pockets of grayish sand with glacial pebbles; fragmental bone material (mainly bison) and remains of *Equisetum* sp., both in situ and transported
 - Delta: gravel and sand; large-scale festoon cross-bedding prominent

GLACIO-FLUVIAL

- Kame: mainly gravel and sand
- Spillway deposits veneered with recent lacustrine silt and clay
- Eroded plains: in part scoured by meltwater; till, gravel, sand, silt and clay; bedrock exposures common; extensive badland

GLACIAL

- Controlled linear disintegration ridge: till; some gravel and sand
- Bedrock upland veneered with till; surface expression of drift commonly controlled by bedrock; gravel and sand in places
- Till ridge: some gravel and sand; ridge over 50 feet high
- Hummocky end moraine: mainly till; aligned knobs and closed disintegration ridges; large local relief
- End moraine: stony till; aligned and parallel ridges; large to medium local relief
- End moraine: till veneered in places with gravel, sand, silt and clay; stony surface with many blowouts; saline soils; small local relief
- Hummocky disintegration moraine: mainly till; knobs, closed and linear disintegration ridges; local relief less than 25 feet
- Ground moraine: till covered in places with gravel, sand, silt and clay; blowouts numerous; saline soils
- Ground moraine: mainly till -- unsorted rocks, sand, silt and clay; patches of lacustrine sand, silt and clay; local relief less than 10 feet; includes valley fill deposits of till

CRETACEOUS

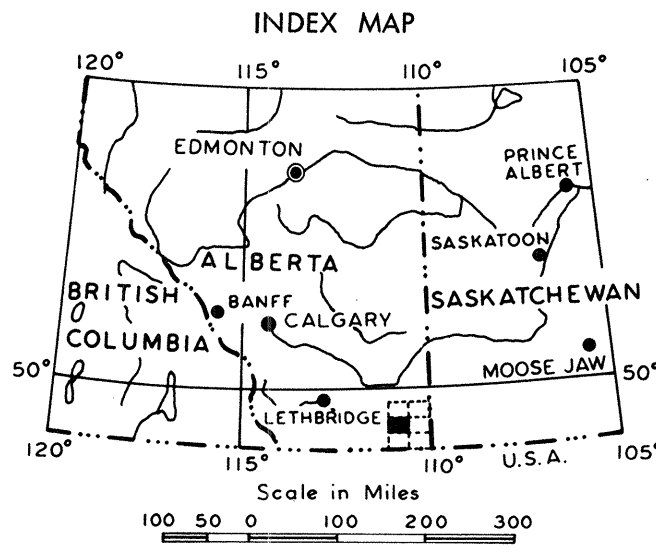
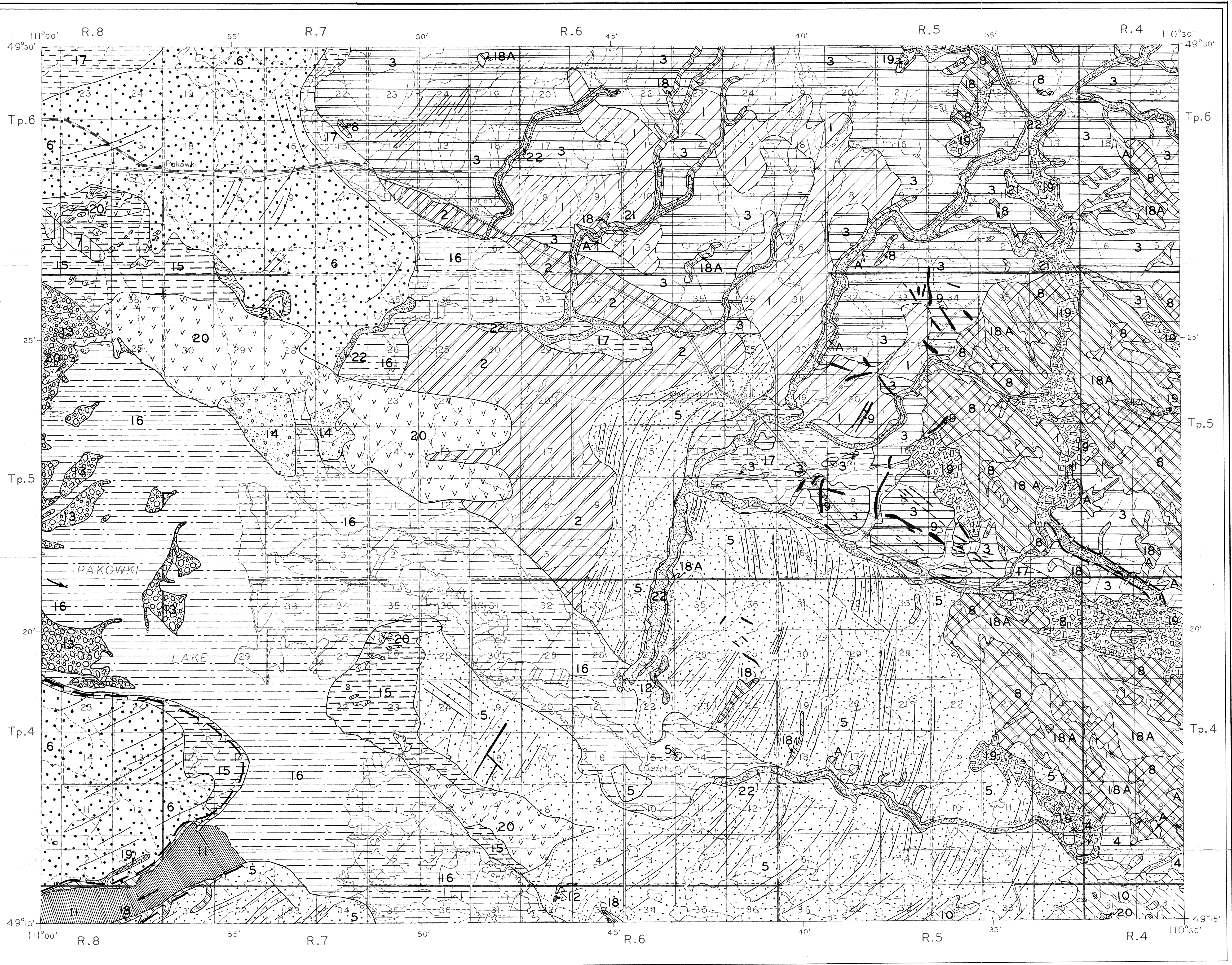
- Bearpaw and Oldman Formations: dark shale; light-coloured shale and sandstone with coal seams

- Geological boundary -- definite
- Geological boundary -- approximate
- Spillway or ice-marginal channel
- Postulated direction of meltwater flow
- Fluting
- Glacial lineament

Geology by J. A. Westgate

- Main highway
- Local road, well travelled
- Local road, not well travelled
- Trail
- Railway
- Irrigation ditch
- Township boundary
- Section line

Cartography taken from Department of Lands and Forests, Alberta, Aerial Survey sheet No. 72E - 7

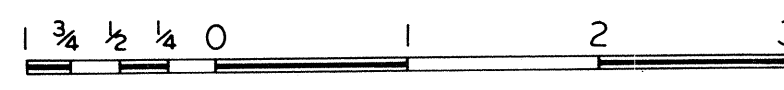


Map to be used in conjunction with Preliminary Report No. 65-2

PRELIMINARY MAP 65-2C
SURFICIAL GEOLOGY

MANYBERRIES DISTRICT, ALBERTA

WEST OF FOURTH MERIDIAN
Scale: One Inch to One Mile 63,360



Published in 1965

LEGEND

QUATERNARY

- RECENT**
- Alluvium: sand, silt and clay; some gravel
 - Lacustrine sediments: sand, silt and clay
- PLEISTOCENE AND RECENT**
- Colluvium and alluvial fans: sand, silt and clay; some alluvium
 - Eroded slopes: mainly bedrock; some glacial drift and colluvium
 - Slumps: mainly bedrock materials involved; some glacial drift and colluvium
- PLEISTOCENE**
- GLACIO-FLUVIAL**
- Outwash: gravel and sand; quartzites abundant
 - Ice-marginal channel deposits: gravel and sand
 - Ice-marginal channel deposits: silt and clay; commonly associated with recent lacustrine sediment; 148 = fill present
 - Collapsed ice-contact stratified drift: sand, silt and clay; some gravel
 - Eroded plains: in part scoured by meltwater; gravel, sand, silt, and clay; bedrock exposures common; extensive badland
- GLACIAL**
- Controlled linear disintegration ridge: till; some gravel and sand
 - Bedrock upland veneered with till: surface expression of drift commonly controlled by bedrock; gravel and sand in places
 - Hummocky end moraine: mainly till; aligned knobs; large to medium local relief
 - End moraine: aligned till ridges; some gravel and sand; medium local relief -- less than 20 feet
 - End moraine: till veneered in places with gravel, sand, silt and clay; stony surface with many blowouts; saline soils; small local relief
 - Hummocky disintegration moraine: mainly till; well-defined knobs and kettles, closed and linear disintegration ridges; large local relief
 - Hummocky disintegration moraine: mainly till; knobs, closed and linear disintegration ridges; medium local relief
 - Hummocky disintegration moraine: mainly till; stony surface in places, knobs often indistinct and blowouts common; saline soils; medium to small local relief
 - Ground moraine: mainly till -- unsorted rocks, sand, silt and clay; some gravel and sand; small local relief -- less than 10 feet; includes valley fill deposits of till

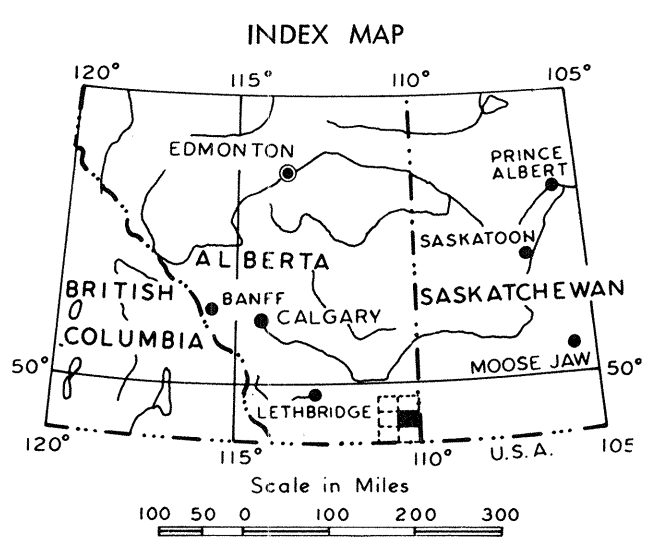
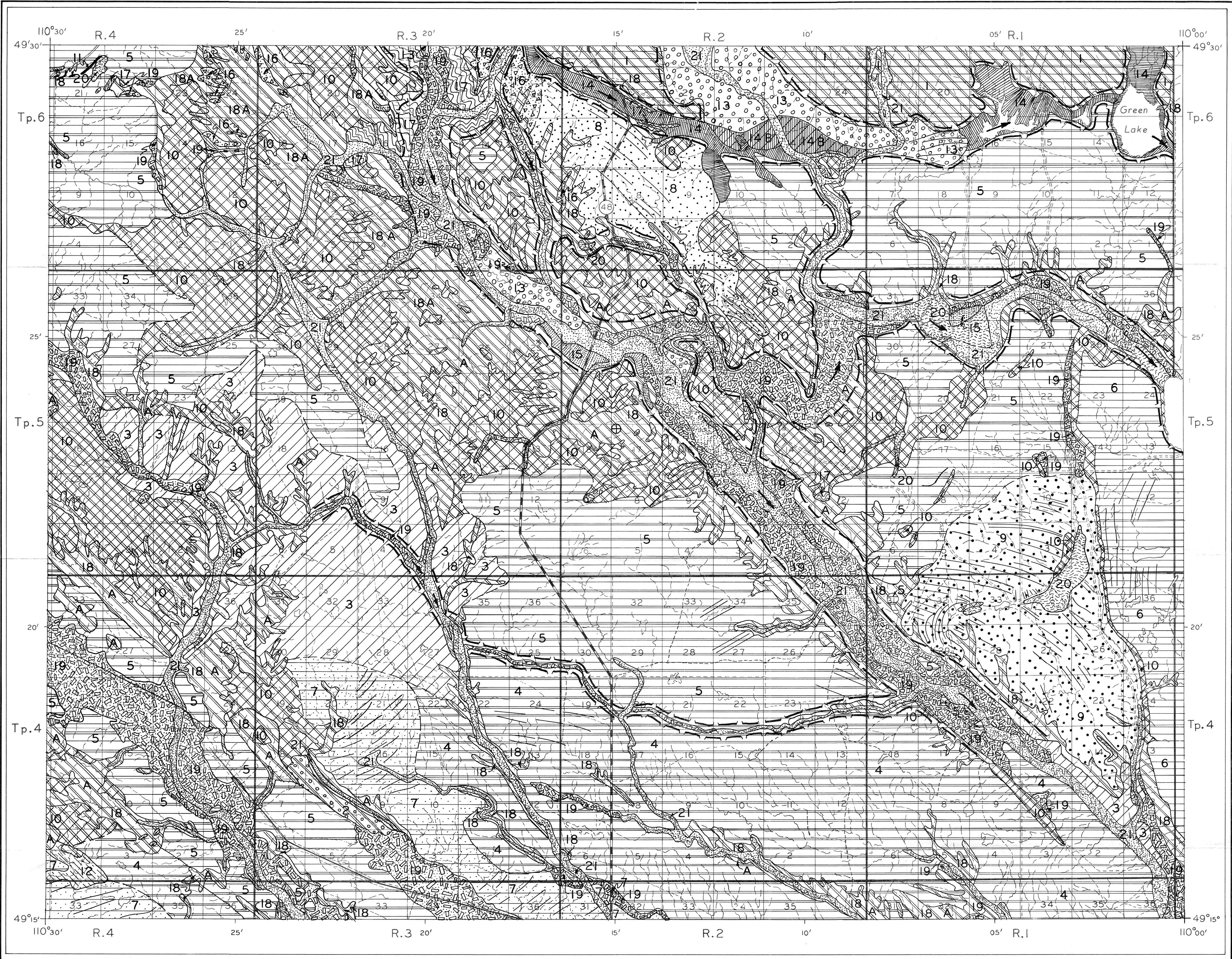
- CRETACEOUS AND QUATERNARY**
- Bedrock-cored ridges (?) veneered with glacial gravel
 - Bedrock with patches of glacial drift including Laurentian erratics

- CRETACEOUS**
- Bearpaw and Oldman Formations: dark shale; light-coloured shale and sandstone with coal seams

- Geological boundary -- definite
- Geological boundary -- approximate
- Ice-marginal channel
- Postulated direction of meltwater flow
- Glacial lineaments
- Site of numerous large erratic blocks of Cypress Hills
- Conglomerate
- Fluting

- Geology by J. A. Westgate
- Main highway
 - Local road, well travelled
 - Local road, not well travelled
 - Trail
 - Railway
 - Irrigation ditch
 - Township boundary
 - Section line

Cartography taken from Department of Lands and Forests, Alberta, Aerial Survey sheet No. 72E - 8



Map to be used in conjunction with Preliminary Report No. 65-2

PRELIMINARY MAP 65-2D
SURFICIAL GEOLOGY
GREEN LAKE DISTRICT, ALBERTA
WEST OF FOURTH MERIDIAN

Scale: One Inch to One Mile 63,360
1 3/4 1/2 1/4 0 1 2 3

Published in 1965

LEGEND

QUATERNARY

- RECENT
- 17 Alluvium: sand, silt and clay; some gravel; includes terraces
 - 16 Lacustrine sediments: sand, silt and clay; some alluvium
 - M5 Aeolian deposits: sand

PLEISTOCENE AND RECENT

- 19 Colluvium and alluvial fan: sand, silt and clay mixed; some gravel
- 18 Eroded slope: mainly bedrock; some glacial drift and colluvium

PLEISTOCENE

- GLACIO-LACUSTRINE
- 12 Lake Pakowki sediments: sand, silt and clay; veneered with recent lacustrine sediment and alluvium
 - 11 Lake Pakowki sediments: shoreline deposits of sand with some gravel
 - 10 Lake Pakowki sediments: thin shoreline deposits of gravel and sand overlying till
- GLACIO-FLUVIAL
- 9 Undifferentiated outwash gravel and sand and till; bedrock exposed in places
 - 8 Meltwater channel sediments: sand, silt and clay; some gravel; partly covered with alluvium, colluvium and recent lacustrine sediment
 - 7 Eroded plains: in part scoured by meltwater; till, gravel, sand, silt and clay; bedrock exposures common; extensive badland
- GLACIAL
- 6 End moraine: aligned till ridges; some gravel and sand; large to medium local relief
 - 5 End moraine: till veneered in places with gravel, sand, silt and clay; stony surface with many blowouts; saline soils; small local relief
 - 4 Hummocky end moraine: mainly till; knobs; large to medium local relief
 - 3 Ground moraine: mainly till; some gravel, sand, silt and clay; saline soils; small local relief -- less than 10 feet
 - 2 Ground moraine: mainly till; grooved; bedrock at surface in few places; generally less than 10 feet thick; small local relief
 - 1 Valley fill deposits: till -- unsorted rocks, sand, silt and clay

CRETACEOUS

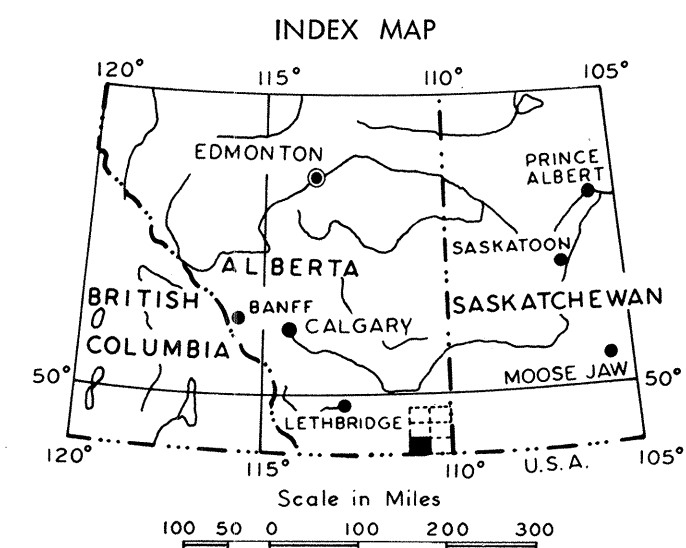
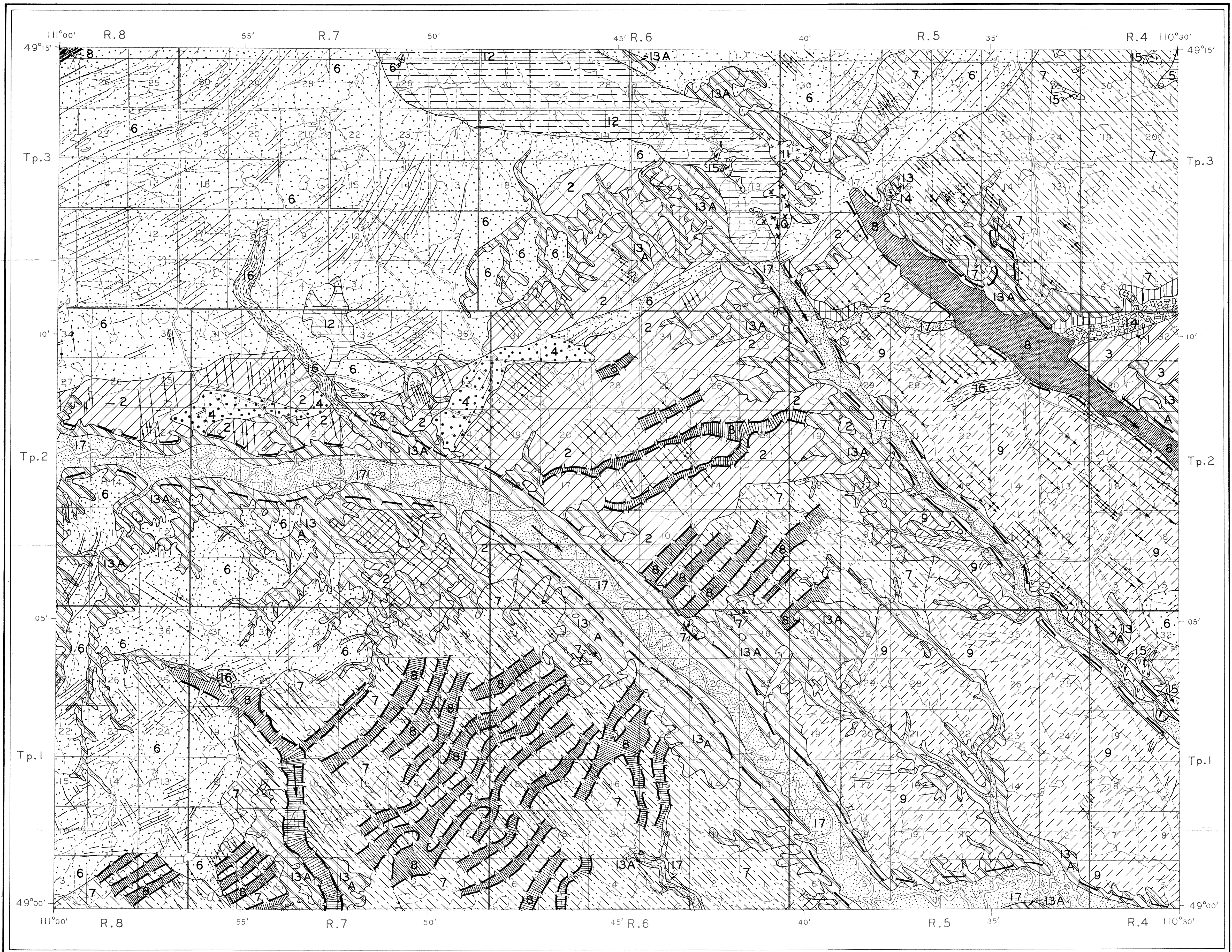
- A Bearpaw, Oldman, Foremost and Pakowki Formations: sandstone, shale, bentonitic clay and coal

- Geological boundary -- definite
- Geological boundary -- approximate
- Meltwater channel (includes ice-marginal and spillway channels)
- Postulated direction of meltwater flow
- Drumlin or drumlinoid ridge: gravel and sand
- Fluting
- Glacial lineament

Geology by J.A. Westgate

- Main highway
- Local road, well travelled
- Local road, not well travelled
- Trail
- Railway
- Irrigation ditch
- Township boundary
- Section line

Cartography taken from Department of Lands and Forests, Alberta, Aerial Survey sheet No. 72E - 2



Map to be used in conjunction with Preliminary Report No. 65-2

PRELIMINARY MAP 65-2E
SURFICIAL GEOLOGY
COMREY DISTRICT, ALBERTA

WEST OF FOURTH MERIDIAN
Scale: One Inch to One Mile 63,360

Published in 1965

LEGEND

QUATERNARY

RECENT

- Alluvium: sand, silt and clay; some gravel
- Aeolian deposits: sand

PLEISTOCENE AND RECENT

- Colluvium and alluvial fan: sand, silt and clay mixed; some gravel
- Eroded slope: mainly bedrock; some glacial drift and colluvium

PLEISTOCENE

GLACIO-LACUSTRINE

- Lake Wild Horse sediments veneered with recent lacustrine and alluvial silt and clay
- Lake Wild Horse sediments: mainly sand

GLACIO-FLUVIAL

- Undifferentiated outwash gravel and sand and till; bedrock exposed in places
- Meltwater channel sediments: silt and clay; partly covered with alluvium and colluvium
- Esker: gravel and sand; in places local relief approaches 50 feet
- Kame: gravel and sand; local relief approximately 50 feet
- Ice-contact deposits: thin patches of gravel on till
- Eroded plains: in part scoured by meltwater; till, gravel, sand, silt and clay; bedrock exposures common; extensive badland

GLACIAL

- Hummocky end moraine: mainly till; aligned knobs and closed disintegration ridges; large local relief
- End moraine: aligned till ridges; medium to small local relief
- End moraine: till veneered in places with gravel, sand, silt and clay; stony surface with many blowouts; saline soils; small local relief
- Hummocky disintegration moraine: mainly till; knobs, closed and linear disintegration ridges; medium local relief
- Hummocky disintegration moraine: mainly till; stony surface in places; knobs often indistinct and blowouts common; saline soils; medium to small local relief
- Ground moraine: mainly till; some gravel, sand, silt and clay; saline soils; small local relief—less than 10 feet
- Ground moraine: mainly till; in places some gravel, sand, silt and clay; knobs present; saline soils; small local relief
- Valley fill deposits: till — unsorted rocks, sand, silt and clay

CRETACEOUS

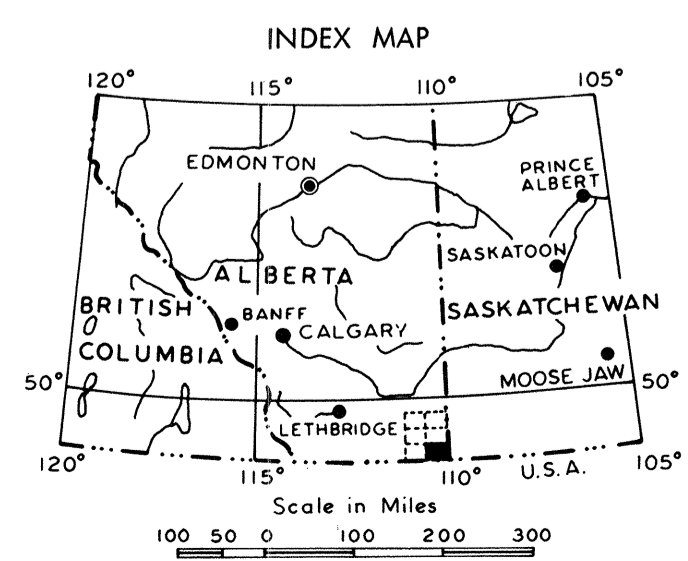
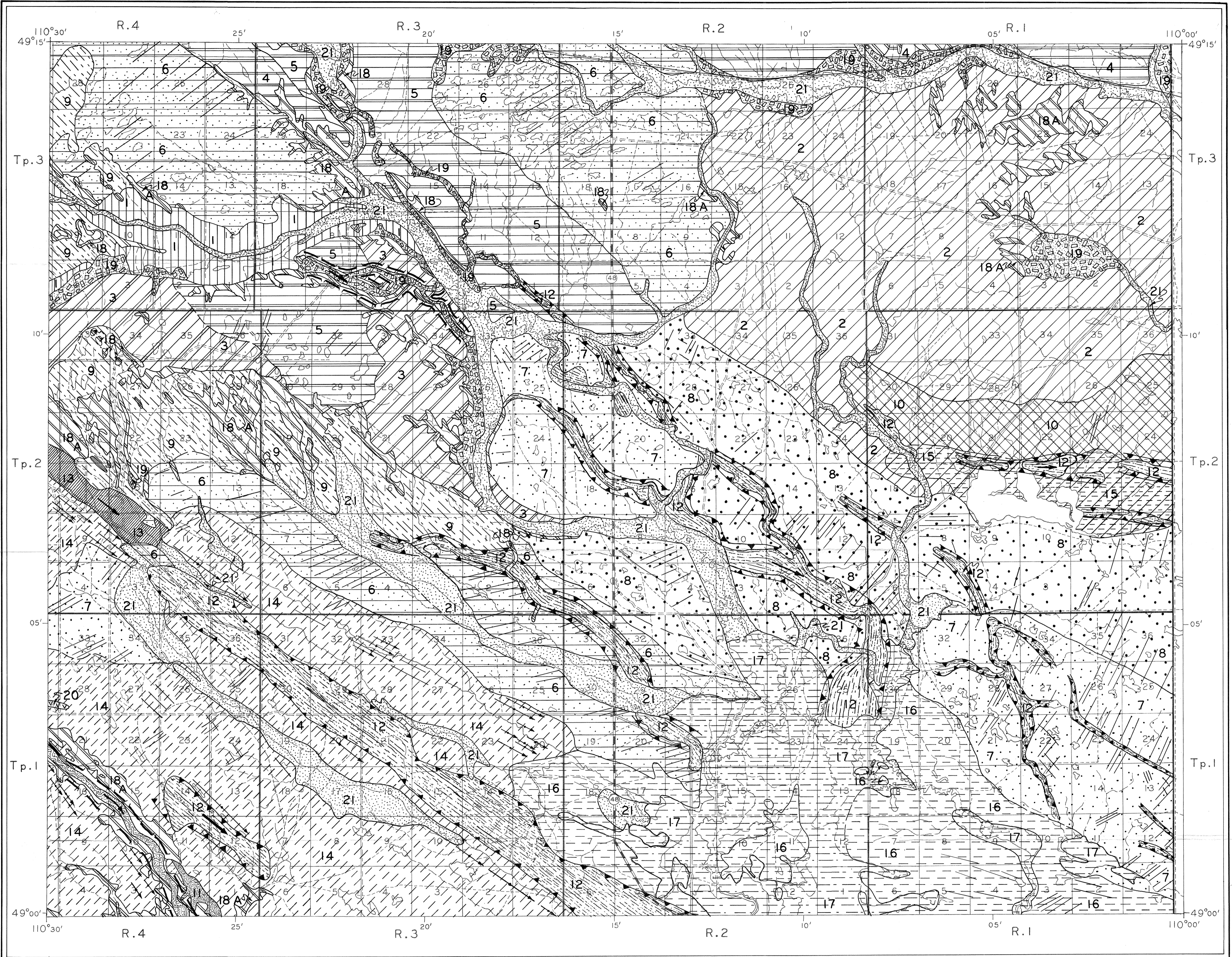
- Bearpaw and Oldman Formations: dark shale; light-coloured shale and sandstone with coal seams

- Geological boundary — definite
- Geological boundary — approximate
- Meltwater channel
- Subglacial tunnel or ice-walled channel
- Postulated direction of meltwater flow
- Drumlin or drumlinoid ridge: gravel and sand
- Glacial lineament

Geology by J.A. Westgate

- Main highway
- Local road, well travelled
- Local road, not well travelled
- Trail
- Railway
- Irrigation ditch
- Township boundary
- Section line

Cartography taken from Department of Lands and Forests, Alberta, Aerial Survey sheet No. 72E - 1

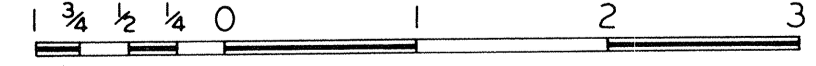


Map to be used in conjunction with Preliminary Report No. 65-2

PRELIMINARY MAP 65-2F SURFICIAL GEOLOGY

WILD HORSE DISTRICT, ALBERTA

WEST OF FOURTH MERIDIAN Scale: One Inch to One Mile 63,360



Published in 1965

LEGEND

QUATERNARY

RECENT

- Alluvium: sand, silt and clay; some gravel
- Lacustrine sediments: sand, silt and clay

PLEISTOCENE AND RECENT

- Colluvium and alluvial fan: sand, silt and clay mixed
- Eroded slope: mainly bedrock; some glacial drift and colluvium; minor slumping
- Slump: mainly bedrock materials involved; some glacial drift and colluvium

PLEISTOCENE

GLACIO-LACUSTRINE

- Lacustrine sediments: sand, silt and clay; till in places; includes recent lacustrine sediment and alluvium

GLACIO-FLUVIAL

- Ice-marginal channel deposits: silt and clay; commonly associated with recent lacustrine sediment

GLACIAL

- Controlled linear disintegration ridge: till; some gravel and sand
- Bedrock upland veneered with till: surface expression of drift commonly controlled by bedrock
- End moraine: aligned till ridges; large to medium local relief
- Hummocky end moraine: mainly till; aligned closed disintegration ridges; large local relief
- Hummocky disintegration moraine: mainly till; well-defined knobs and kettles, closed and linear disintegration ridges; large local relief
- Hummocky disintegration moraine: mainly till; knobs, closed and linear disintegration ridges; medium local relief
- Ground moraine: mainly till; patches of lacustrine and outwash sand, silt and clay; some knobs, closed and linear disintegration ridges; small local relief -- less than 10 feet
- Ground moraine: mainly till -- unsorted rocks, sand, silt and clay; patches of lacustrine and outwash sand, silt and clay; local relief less than 10 feet; includes valley fill deposits of till

CRETACEOUS

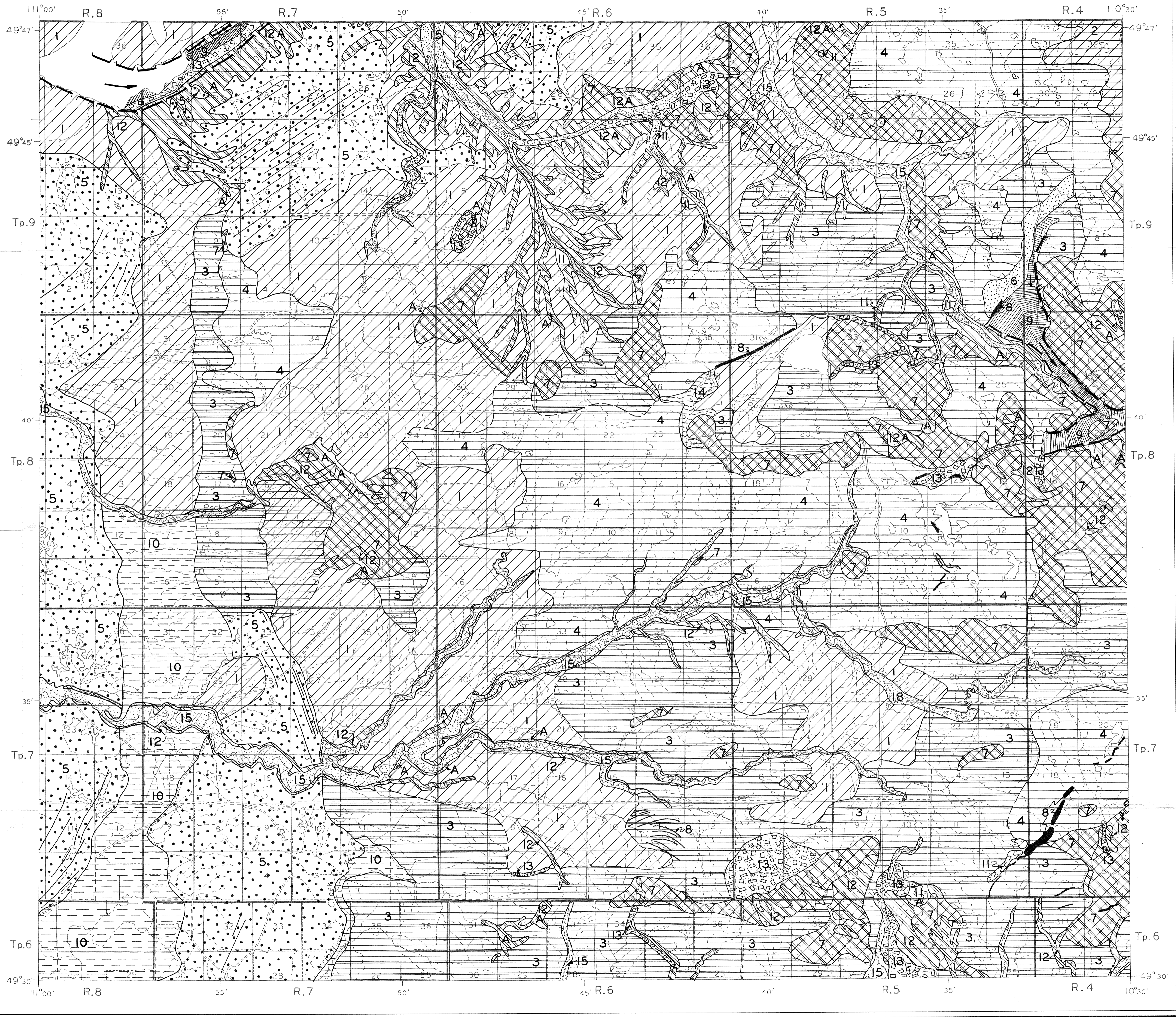
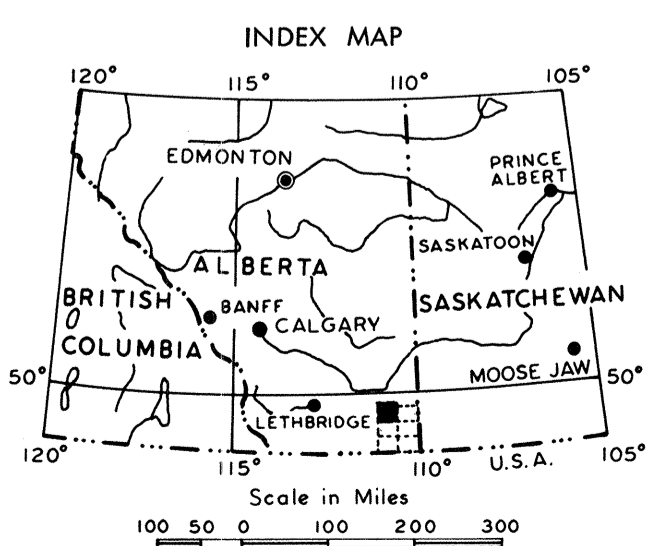
- Frenchman, Battle, Whitemud, Eastend, Bearpaw, Oldman and Foremost Formations: sandstone, shale, bentonitic clay and coal

- Geological boundary -- definite
- Geological boundary -- approximate
- Ice-marginal channel
- Postulated direction of meltwater flow
- Glacial lineament

Geology by J.A. Westgate

- Main highway
- Local road, well travelled
- Local road, not well travelled
- Trail
- Railway
- Irrigation ditch
- Township boundary
- Section line

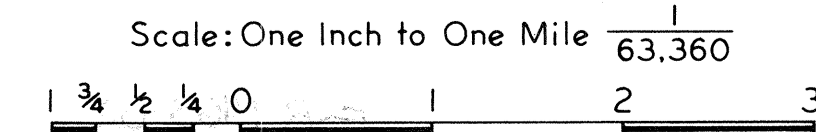
Cartography taken from Department of Lands and Forests, Alberta, Aerial Survey sheet No. 72E - 10



Map to be used in conjunction with Preliminary Report No. 65-2

PRELIMINARY MAP 65-2A SURFICIAL GEOLOGY

WISDOM DISTRICT, ALBERTA WEST OF FOURTH MERIDIAN



Published in 1965

LEGEND

QUATERNARY

RECENT

- Alluvium: gravel, sand, silt and clay
- Lacustrine sediments: silt and clay
- Aeolian deposits: sand

PLEISTOCENE AND RECENT

- Colluvium and alluvial fan: sand, silt and clay mixed
- Eroded slope: mainly bedrock; some glacial drift and colluvium; minor slumping
- Slump: mainly bedrock materials involved; some glacial drift and colluvium
- Thickly wooded slope, slump and colluvium

PLEISTOCENE

GLACIO-LACUSTRINE

- Lacustrine sediments: sand, silt and clay; fill in places; some loess may be present

GLACIO-FLUVIAL

- Outwash: gravel and sand; quartzites abundant
- Ice-marginal channel deposits: silt and clay; commonly associated with recent lacustrine sediment
- Ice-marginal channel deposits: gravel and sand
- Kame ridge: gravel, sand, and silt; pockets of till
- Collapsed ice-contact stratified drift: sand, silt and clay; some gravel

AEOLIAN

- Loess: unconsolidated sand, silt and clay overlying the Cypress Hills Formation; generally less than 5 feet thick; slightly deformed by frost action

GLACIAL

- Controlled linear disintegration ridge: till; some gravel and sand
- Bedrock upland veneered with till: surface expression of drift commonly controlled by bedrock; gravel and sand in places
- End moraine: ridges of till, gravel and sand; aligned closed disintegration ridges; some knobs and kettles
- Washboard moraine: parallel, arcuate till ridges; local relief less than 5 feet
- Hummocky disintegration moraine: mainly till; well-defined knobs and kettles, closed and linear disintegration ridges; large local relief
- Hummocky disintegration moraine: mainly till; knobs, closed and linear disintegration ridges; medium local relief
- Ground moraine: mainly till; patches of lacustrine and outwash sand, silt and clay; some knobs, closed and linear disintegration ridges; small local relief - less than 10 feet
- Ground moraine: mainly till - unsorted rocks, sand, silt and clay; patches of lacustrine and outwash sand, silt and clay; local relief less than 10 feet

CRETACEOUS, TERTIARY AND QUATERNARY

CRETACEOUS

- Patch of outwash gravel and Laurentian erratics on bedrock hills capped with Cypress Hills Formation
- Unglaciated bedrock veneered with loess: south of Cypress Hills uppermost 50 feet deformed by movement on Battle and Whittemud clays (low-angle gravity slide)
- Bedrock with patches of glacial drift including Laurentian erratics

TERTIARY

- Cypress Hills and Ravenscrag Formations: conglomerate (mainly quartzite pebbles); sandstone and bentonitic clay

CRETACEOUS

- Frenchman, Battle, Whittemud, Eastend and Bearpaw Formations: sandstone, shale, bentonitic clay and coal

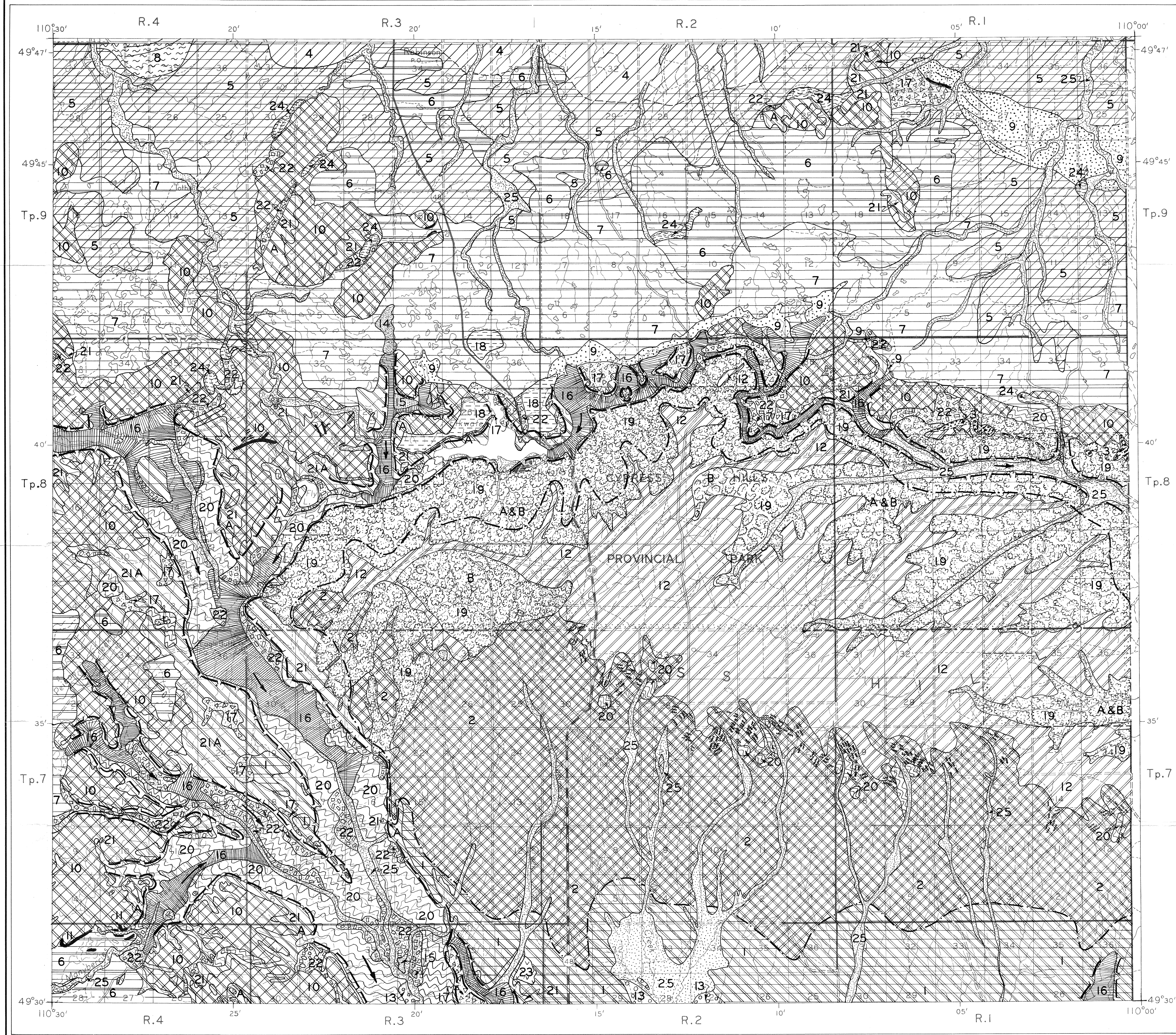
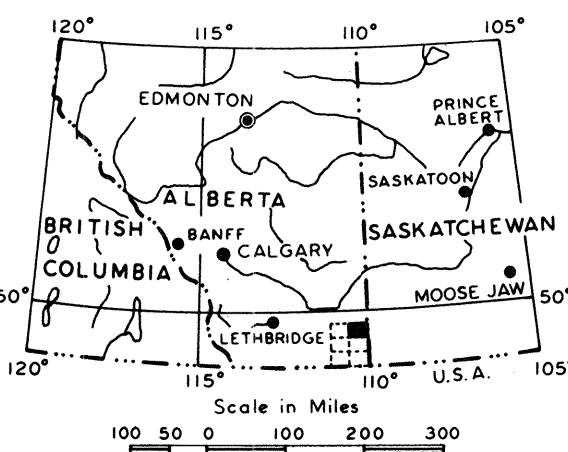
- Geological boundary -- definite
- Geological boundary -- approximate
- Ice-marginal channel
- Postulated direction of meltwater flow
- Limit of glaciation
- Slump fractures
- Glacial lineaments

Geology by J.A. Westgate

- Main highway
- Local road, well travelled
- Local road, not well travelled
- Trail
- Railway
- Irrigation ditch
- Township boundary
- Section line

Cartography taken from Department of Lands and Forests, Alberta, Aerial Survey sheet No. 72E - 9

INDEX MAP



Map to be used in conjunction with Preliminary Report No.65-2

PRELIMINARY MAP 65-2B

SURFICIAL GEOLOGY

ELKWATER DISTRICT, ALBERTA

WEST OF FOURTH MERIDIAN

Scale: One Inch to One Mile 1/63,360



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