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GEOLOGY

OF THE

WILLOW RIDGE ANTICLINE

WRIGLEY AREA, N.W.T.

PREPARED FOR

CANADA-CITIES SERVICE PETROLEUM CORP.

BY

W. E. BRADY CONSULTING LTD.

CALGARY, ALBERTA

AUGUST, 1965

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INTRODUCTION

This report consists of the presentation of the results of a one-week geological investigation in the Wrigley-Fort Simpson area. This operation was carried out on behalf of Canada-Cities Service Petroleum Corporation between May 22 and May 29, 1966 by W. B. Brady Consulting Ltd. of Calgary. A Bell Super-G helicopter, chartered from Bullock Wings and Rotors, was used throughout the operation.

The purpose of the investigation was to study the stratigraphy along the Willow Ridge anticline and to compare and correlate the exposures there with those exposed in the McConnell Range to the west. In addition, a Middle Devonian reef on the Root River was examined in order better to understand the nature of the isolated reefs which may be present in the Corporation's Interior Plains acreage.

Base camp was established at Wrigley airport where board and lodging were supplied by the airport manager, A. Silverton. Gasoline was purchased from the radio operator, J. Ito. The writer wishes to extend his thanks to these gentlemen and to the pilot, R. Crawford, and the geological assistant, D. Gardiner.

The area under discussion had already been mapped by the Geological Survey of Canada during Operation Mackenzie in 1957. No actual landings were made on the Willow Ridge anticline at that time.


INDEX MAP
NORTHWEST CANADA
ALASKA
YUKON
TERRITORY
N.W.T.

Finally, the writer was much fortunate to have been a participant in Operation Nahanni and the regional experience acquired then served well during this research study.

A geological map at the scale of one mile to one inch is enclosed with this report. Formal paleontological identifications of fossil collections are included in the Appendix.

Physical Features of the Area

The map-area lies within the western part of the Interior Plains and encompasses elements of the Franklin Mountains and the Mackenzie Plains.

The elevations within the map-area range from less than 1,000 feet to more than 4,500 feet above sea level. Lakes of various sizes dot the Interior Plains and effect easy access for foot places over much of the area. The Plains are heavily wooded and blanketed with glacial debris. Glacial lineaments are readily visible from air photographs and many of the lakes have their major shorelines parallel to a former direction of ice movement. Traces of two distinct ice movements are apparent, the more prominent, and probably the more recent, having a trend of N 77° W, the less distinct trending N 30° W. Variations occur in both directions, however, due mainly to effects of relief on ice movements.

Aside from Willow Ridge itself, a narrow anticlinal inlier of resistant Middle Devonian rocks, outcrops are limited to the Willowlake River and the McConnell Range.

The Franklin Mountains, of which the Mackenzie Range forms the main element within the map-area, are composed of resistant carbonates which have been brought to the surface by vert-dipping thrust faults. North of the area, in the vicinity of Mt. Cap, a thick sequence of Proterozoic shales and sandstones are exposed.

The Mackenzie Plains, which are occasionally broken by higher elevations such as the Cassell Range and the Sea Plateau, extend to the west of the Franklin Mountains, bounds the western border of the map-area.

Part of the acreage within the map-area has been extensively covered by seismic operations. Many seismic lines resulting from this work can be observed on air-photographs, although some of the work post-dates the photography.

The area is best suited for winter drilling or seismic work after the muskeg is frozen. In preparation for the winter work, heavy equipment should be moved along the Mackenzie River by barge during the summer months.

A telephone line is now in operation at Wrigley, enabling one to speak directly to the "outside world". This line is being extended to North, with completion date being anticipated for the fall of 1966.

Scheduled air service to Wrigley is only available twice monthly, although chartered planes are available from Hay River, Fort Simpson, or Norman Wells.

STRATIGRAPHY

General

Approximately 2,000 to 3,000 feet of strata underlie the Plains to the east of the map-area. On the McConnell Range, some 6,000 feet of strata are present between the top of the Middle Devonian and the top of the Proterozoic. Further to the west, over 15,000 feet of Paleozoic strata are present. This estimate does not include the Upper Devonian and/or Cretaceous rocks, which are very similar in appearance and can be confused in the field.

The great change in thickness of section eastwards presents a potential situation for the occurrence of many natural stratigraphic traps for the containment of hydrocarbons.

The rocks examined in detail during this study were principally the Middle Devonian Nahanni and Arnica formations on the Willow Ridge anticline. Exposures of these formations were compared with equivalent strata on the McConnell Range, although in this latter area the Arnica equivalent is better referred to as Bear Rock formation because of the high degree of brecciation present. In addition to these beds, the Mount Kindle formation was examined along the southern part of the McConnell Range in order to be able to evaluate the eastward extension of this formation into the Plains more precisely.

Exposures of the shales of the Fort Simpson formation and of the Cretaceous are rare but these were examined wherever possible. This work was limited mainly by the availability of helicopter landing sites.

Other formations, which are part of the general regional stratigraphic sequence but which are not exposed in the immediate area, are discussed briefly in a general summary which is based upon published reports and the writer's previous knowledge of the area.

The following two tables, reproduced from Geological Survey of Canada Paper 62-33, provides a succinct outline of correlations in the Lower Paleozoic (Table 1) and in the Devonian (Table 2).

PALEOZOIC

Ordovician and Silurian

The Scubre, Cassell, Delorme, Whittaker and Sumblood formations are exposed to the west in the Root River map-area but are absent within the project area. The Franklin Mountain formation may be equivalent in part to the Sumblood formation, and the Mount Kindle formation of the McConnell Range may be equivalent to the Whittaker formation to the west.

The Mount Kindle was examined in the core of the anticline along the McConnell Range where it is cut by the River Between Two Mountains. Approximately 300 feet of strata assignable to the Mount Kindle was observed at this locality although the base of the formation was not exposed. The formation at this exposure consists of dark grey weathering, thick, irregularly bedded, very fine-grained dolomite. Irregular blebs and nodules of chert are rare to common, many of them representing silicified fossil fragments. In general the formation is quite tight with only a few isolated vugs. At other localities, however, the Mount Kindle is reefy and is quite porous.

	Camsell Bend and Wrigley Map-areas (Douglas and D.K. Norris, 1961)	Dahadinni River Map-area		Wrigley Map-area		Horn River Map-area (Douglas and A.W. Norris, 1960)
		Rouge, Redstone and Dusky Ranges	Dahadinni Range	Camsell Range	McConnell Range	
Overlying beds	Arnica (11)	Arnica (15)	Arnica (15)	Arnica (15)	Bear Rock (16)	(12)
Devonian(?)	Sombre (10)	Sombre (14)				
	Camsell (5)	Camsell (13)	Camsell(?) (13)			
				? (12) ?		
Silurian	Delorme (4)	Delorme (11)				
					?	?
	Whittaker (3)	Whittaker (10)			Mt. Kindle (9)	(10)
					?	?
Ordovician					Franklin Mt. (8)	(9)
	Sunblood (1)				?	?
						(8)
?		?			?	
	?				Saline River (6)	?
					Mt. Cap	(7)
Cambrian					Mt. Clark (5)	?
Proterozoic		(7)			Lone Land (4)	
					(3)	
					(2)	
					(1)	

~~Figure~~ Table 1. Correlation of Lower Palaeozoic formations of Dahadinni River, Wrigley and adjacent map-areas.

The Mount Kindle formation probably correlates with G.S.C. map-unit 10 of the Horn River area and must underlie all of the acreage between the McConnell Range and the Precambrian Shield to the east. Taking into consideration the porosity observed at other localities, the Mount Kindle forms a potential reservoir over a large area.

Devonian

The Bear Rock formation is the oldest Devonian rock found in the project area. It is Middle Devonian in age with the possibility that the lower part ranges as low as Lower Devonian. It consists predominantly of massive breccias composed of angular fragments of limestone and dolomite enclosed in a calcareous matrix. The formation tends to weather into rounded knobs, a situation which has led some geologists into describing such outcrops as reefs. This type of weathering is well developed in the Franklin Mountains (Figure 13). The stratigraphic equivalent of this formation in the subsurface contains much anhydrite, which probably accounts for the brecciation observable in the surface exposures. The Bear Rock formation may be correlated regionally with the Chinchaga formation of northern Alberta and British Columbia.

In outcrop the Bear Rock gives the impression of being more porous than it actually is, due to the weathering out of many individual fragments to form angular vugs. Some interconnected porosity is undoubtedly present, however, as can be deduced from the wells drilled into the formation which have yielded either fresh or salt water on test.

The Bear Rock formation changes facies to the southwest into the more definitely bedded and banded dolomites of the Arnica formation, (formerly called the Lone Mountain formation in some of the older reports). This change can be seen to begin to take place in outcrops south of the River Between Two Mountains and is complete by the time Lone Mountain, an outlier at the northern end of the Camsell Range, is reached.

Willow Ridge lies within the transitional area of the change from the brecciated Bear Rock to the better bedded dolomites of the Arnica. As the strata exposed in the section measured on Willow Ridge are predominantly well bedded, the term 'Arnica' is the better to use for the rocks at this location.

The various abrupt facies changes within the Devonian which are present in the mountains to the west and to the southwest are not present in the map area. A most notable change takes place between the shales and highly argillaceous limestones of the Funeral formation and the coarse crystalline porous dolomites of the Manetoe formation. This change is very abrupt and is well displayed at two locations, one near the Ram River and the other near Iverson Lake. One of the most interesting and unexpected observations made on Willow Ridge is the presence of the "Manetoe facies" in the core of the anticline. The presence of this dolomite on Willow Ridge indicates a much more extensive distribution of this formation than had previously been suspected, enhancing the prospects for possible Manetoe production from additional acreage.

The Nahanni formation is considerably thinner over the map-area than are the equivalent strata to the west. Thickness variations may range from 956 feet in the Iverson Range to the west, to less than 300 feet in the McConnell Range and 242 feet on Willow Ridge. This variation in thickness is due partly to original depositional variations in thickness combined with possible facies changes at the top of the formation.

The Nahanni formation was examined on Willow Ridge where it consisted of micrograined, grey limestone with numerous brachiopods and stromatoporoids near the top. The lithology of this formation, where examined on the McConnell Range, appeared to be quite similar to this in character. The shale facies-equivalent of the Nahanni formation, the Headless formation, is not present in this area, being present only to the west.

A summary of the section exposed on Willow Ridge follows:

Section measured on Willow Ridge anticline at approximately 122° 53' W and 62° 47' N., (described in descending order).

Strata overlying the Nahanni formation not exposed.

	Unit Thickness
Middle Devonian	
Nahanni formation	
Limestone, grey, micrograined, thin (2 - 4") bedded, somewhat rubbly, fossil collection 5-66-A.	63.0

	Unit Thickness
Covered interval - apparently quite shaly.	25.0
Limestone, brownish-grey, micrograined, finely laminated, a few blebs of calcite - possibly algal.	68.0
Partly covered but appears similar to interval below.	35.0
Limestone, pale brown, grey, micrograined, thin to medium bedded	21.0
Covered interval.	30.0
Total thickness of Nahanni formation	242.0

Nahanni formation was measured approximately 3/4 mile south of the lower part of the section. The 12-foot dolomite bed was present at both localities.

Arnica formation

Dolomite, light grey, coarse-grained, coarsely laminated, porous, may vary in thickness along strike.	12.0
Dolomite, brownish-grey, finely granular, brownish-grey,weathering, irregularly bedded, locally brecciated near top.	163.0
Dolomite, light grey, coarse crystalline, vuggy in part.	55.0
Limestone, grey, micrograined, grey weathering.	5.0
Dolomite, white to mottled, coarse crystalline, massive, faint traces of stromatoporoids.	10.0
Dolomite, grey to brownish-grey, finely granular, brownish-grey weathering, bedding planes irregular, calcite veins common, locally brecciated.	200.0

Total thickness of exposed Arnica formation	445 feet
Total thickness measured	687 feet

The Nahanni formation is overlain by the Fort Simpson formation which consists of shale which is non-calcareous, dark grey, fissile and locally iron-stained. The upper part of this formation consists of medium to dark grey mudstone which is calcareous and silty and is interbedded with fine-grained argillaceous limestone and thinly bedded, laminated, fine-grained calcareous siltstone and sandstone. The lower non-calcareous unit of the formation may correlate with the Horn River formation.

The Fort Simpson formation was examined on the Willowlake River where it has been compressed into gentle undulating folds.

Numerous other Upper Devonian units which occur west of the map-area are not present to the east. One of these (G.S.C. map-unit 20 in the Camsell Bend-Root River area, or G.S.C. map-unit 25 in the Dahadinni-Wrigley area) is of some interest in that it is composed largely of stromatoporoids and reefy coralline limestone beds which occur as isolated patches enclosed by the surrounding shale.

Cretaceous

Much of the Interior Plains is underlain by strata of Cretaceous age. They are shown on the geological map as flanking the Willow Ridge anticline, being separated from the Middle Devonian carbonates by the Fort Simpson shales. In the project area however, there appears to be no

distinctive mappable horizon which can be used to separate the Cretaceous from the Fort Simpson formation. Further to the south, the contact is placed at the base of a resistant ridge, although there has not been sufficient sampling of the outcrop to be certain that this is the actual boundary. It should be recognized therefore that although much of the Interior Plains to the east is indicated as being underlain by Cretaceous, at least part of the area presently mapped as Cretaceous may prove to be of Upper Devonian age. Detailed field work combined with micropaleontological determinations would be required for the solution of this problem.

POTENTIAL RESERVOIRS

The porous strata of the Sombre and Delorme formations which are exposed in the mountains west of the map-area are not present on the McConnell Range or on Willow Ridge. These formations may lie in a favourable structural position for the accumulation of hydrocarbons to the west of the map-area but should not be considered as potential horizons to the east of the area.

The Mount Kindle formation is a possible reservoir over much of the Interior Plains and is also present in the Horn River area (assuming that the correlation with G.S.C. map-unit 10 in that area is correct).

It should be noted at this point that it would be more accurate to relate all Middle Devonian terminology to facies as, in many cases, two distinct facies are found to be interbedded and it then becomes difficult to apply standard formation names. This situation occurs in the Nahanni

Range where Douglas has mapped the Landry formation, a micrograined limestone equivalent of the Manetoe dolomites. In actual fact both the Landry and the Manetoe facies are present jointly over most of the Nahanni Range.

The presence of the "Manetoe-type" facies is extremely interesting. These coarse-grained porous dolomites are obviously more widespread in development than had previously been suspected, increasing the potential area over which a reservoir may be anticipated.

What may become the main reservoirs in the area, however, are the isolated Devonian reefs similar to that present on the Horn River. At this latter locality the reef consists of massive, very coarse-grained, light to medium brown, richly fossiliferous limestone exposed on a circular hill 1/4 mile in diameter. These reefoid beds grade upwards into massive, pale brown, fine-grained limestone. A similar reef occurs on the Root River at Longitude 125° 15'. At this locality the reef forms a massive exposure (Figure 14) which consists of coarse-grained, crinoidal limestone in the lower part and fine-grained, stromatoporoidal limestone in the upper part. The reef is over 300 feet thick and extends for nearly two miles along strike. Its total lateral extent down-dip is presently unknown. The reef passes horizontally into shales which are eroded to form a broad valley. Brecciated, red and green shales are present between the reef and the Nahanni formation, which outcrops near the northern end of the reef. These shales contain much anhydrite together with what appears to be specular hematite, a possible indication of back-reef evaporitic deposits.

Fossils collected at the top of the Nahanni formation below the base of the reef on the Root River include:

Proetus spp.

Spinatrypa sp.

Ambocoelia sp.

Thamnopora sp.

Atrypa spp. aff. arctica Warren

Warrenella sp.

'Hypothyridina' aff. cameroni Warren

Productella sp.

Schizophoria sp.

Small rugose coral

Crinoid ossicles - abundant

Sponge spicules

Gastropod fragments

Small pelecypod.

Near the base of the reef, the following fossils were collected:

cf. Stringocephalus axius Crickmay

Large rugose coral fragment

Stromatoporoid - indet

cf. Atrypa sp.

Crinoid ossicles.

Near the top of the reef, a collection yielded the following:

Stringocephalus burtini Defrance in de Blainville

Atrypa sp.

Spinatrypa sp.

Rugose coral fragment

Crinoid ossicles - abundant

Stromatoporoid fragments.

This upper collection indicates a correlation with the Kee Scarp reef of the Norman Wells area. The other collections, although indicating a Middle Devonian age, are not sufficiently diagnostic to indicate if an unconformity exists between the reef and the Nahanni formation, nor if the reef actually represents continuous sedimentation from the top of the Nahanni through the Hare Indian to the Kee Scarp equivalent.

As the reefs are isolated features, with only the two known locations at Horn and Root Rivers respectively, no trend along which other reefs may occur can be predicted with any reliability. The mere presence of the reef on Root River, however, indicates that other similar structures may occur under the Corporations acreage on the Interior Plains.

An interesting feature was observed in an area south of the Willowlake River at approximately 121° 35' W and 63° 20' N, following a study of air photographs. This feature consisted of a series of concentric (oval) and radial fractures forming a pattern approximately six miles long and three miles wide, trending east-west. Such a pattern might well be the surface reflection of one of the isolated reefs mentioned above. In any event, it is strongly recommended that this, and any similar features which may be located, be investigated in any proposed seismic work in the area.

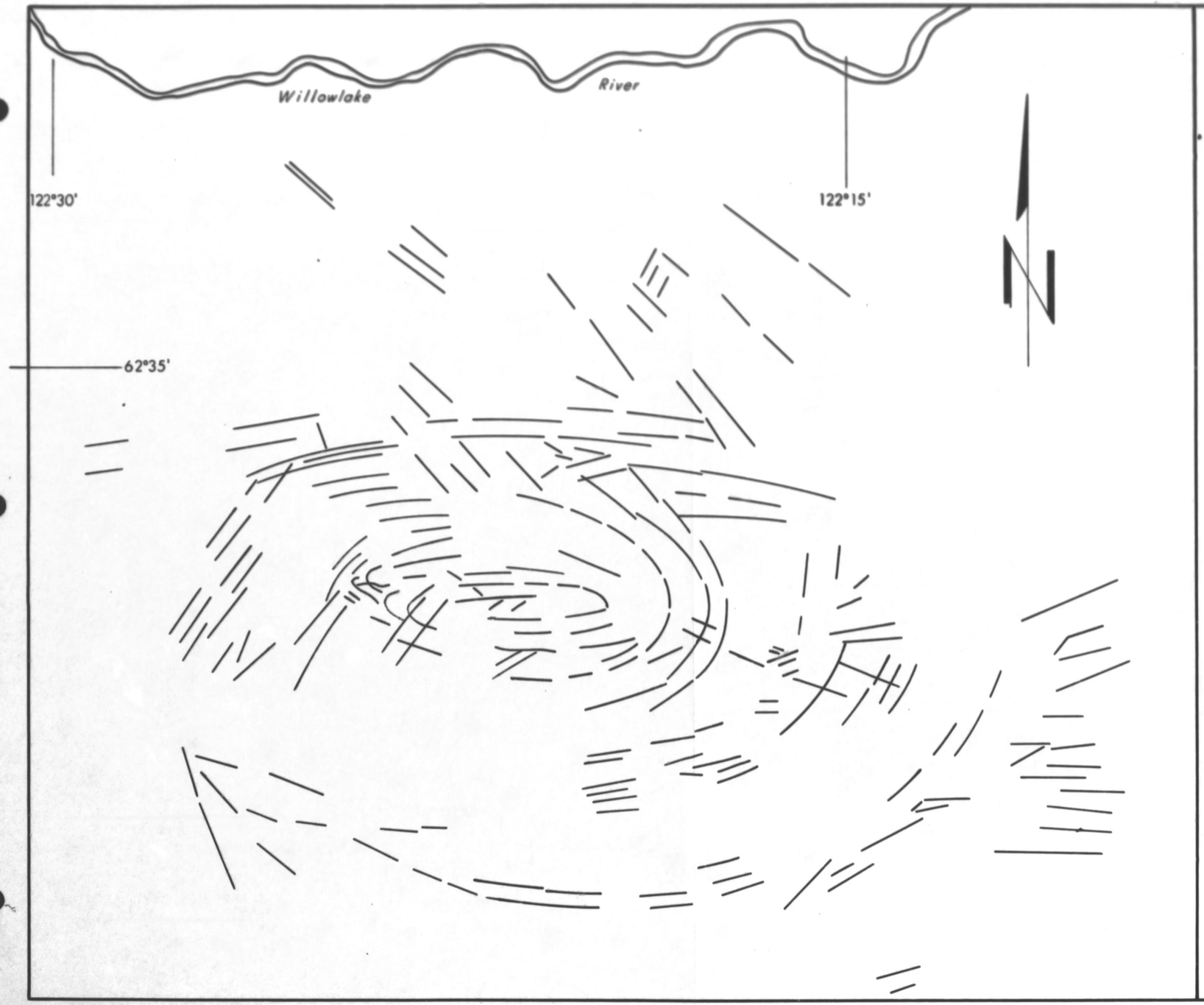

PHOTO ANOMALY

WILLOWLAKE RIVER

N.W.T.

Scale: Approximately 1" = 0.7 miles

RADIAL AND CONCRETIC LINES FROM AIR PHOTOGRAPH PROBABLY REPRESENT FRACTURE PATTERN.

W. B. Brady, Consulting Ltd.

STRUCTURE

Folding has been the most prominent result of tectonic activity within the map-area. The two main anticlines observed are the Willow Ridge anticline and the anticline along the McConnell Range.

The Willow Ridge anticline, (Figures 3, 4 and 10) approximately 28 miles long, forms a doubly-plunging fold which brings resistant Middle Devonian rocks to the surface. Dips off the flanks of the structure range from 30 to 75 degrees. The widest band of Middle Devonian rocks occurs in the southern part of the fold, where the outcrop is two miles wide. The main part of the anticline is narrow and rarely exceeds a width of more than one-half mile. The northerly plunge of the structure is gentle and the fold dies out in a series of small en-echelon anticlines. The main anticline plunges more steeply to the south, however, and has no obvious expression in the shales immediately to the south on Willowlake River. These shales are folded into a series of smaller folds, a phenomenon which is quite common where less competent beds overlie tightly folded competent beds.

The part of McConnell Range which lies within this map-area is also folded into an anticline (Figure 12) which is strongly asymmetric to the east. Dips on the west flank of the structure range from 25 to 35 degrees compared with east flank dips which range up to the vertical. Such a situation suggests the presence of a west dipping thrust fault on the east side of the structure.

Other folds similar to the Willow Ridge anticline may occur to the east beneath the western part of the Interior Plains. Such folds, if present, should be easily definable by seismic investigation.

CONCLUSIONS

As already mentioned the main objective of this field work was to establish the age and lithology of the strata exposed in the core of the Willow Ridge anticline and to effect a correlation between these beds and adjacent sections. A section measured in the most critical position for obtaining the maximum amount of information indicated that the strata consisted of elements of the Arnica and Nahanni formations. Out of a total of 687 feet of section measured, 445 feet were assigned to the Arnica and 242 feet to the Nahanni. The most interesting new observation, however, was the detection of the presence of the Manetoe facies within the Arnica bedded dolomites at this locality, indicating a wider distribution of this facies than had previously been thought to exist. Time permitted the investigation of an unmapped Middle Devonian reef on the Root River. The presence of this reef, which may correlate with that exposed on the Horn River, indicates the possibility of the existence of similar reefs (with sufficient cover to be of economic interest) beneath the Corporation's acreage on the Interior Plains.

A photo-anomaly consisting of concentric and radial fracture patterns may represent the surface expression of a buried reef such as mentioned above. It is recommended that any proposed seismic program should be planned so as to investigate such photo-anomalies thoroughly.

Finally, it is recommended that a regional geological study be undertaken which combines all subsurface data with published and unpublished surface information, a study which does not appear to have been carried out in this region by anyone to date. With regard to unpublished data, a little-known fact is that the Geological Survey of Canada in Ottawa maintains, on open file, unpublished descriptions of sections measured during Operation Mackenzie. Samples to accompany these section descriptions are also available for examination. Such material would form an excellent basis for the regional study mentioned above.

Respectfully submitted,

W. B. Brady

W. B. Brady, P. Geol.

Figure 3 View looking northwest through the gap near the southern part of the Willow Ridge anticline. The McConnell Range can be seen through the gap to the west.

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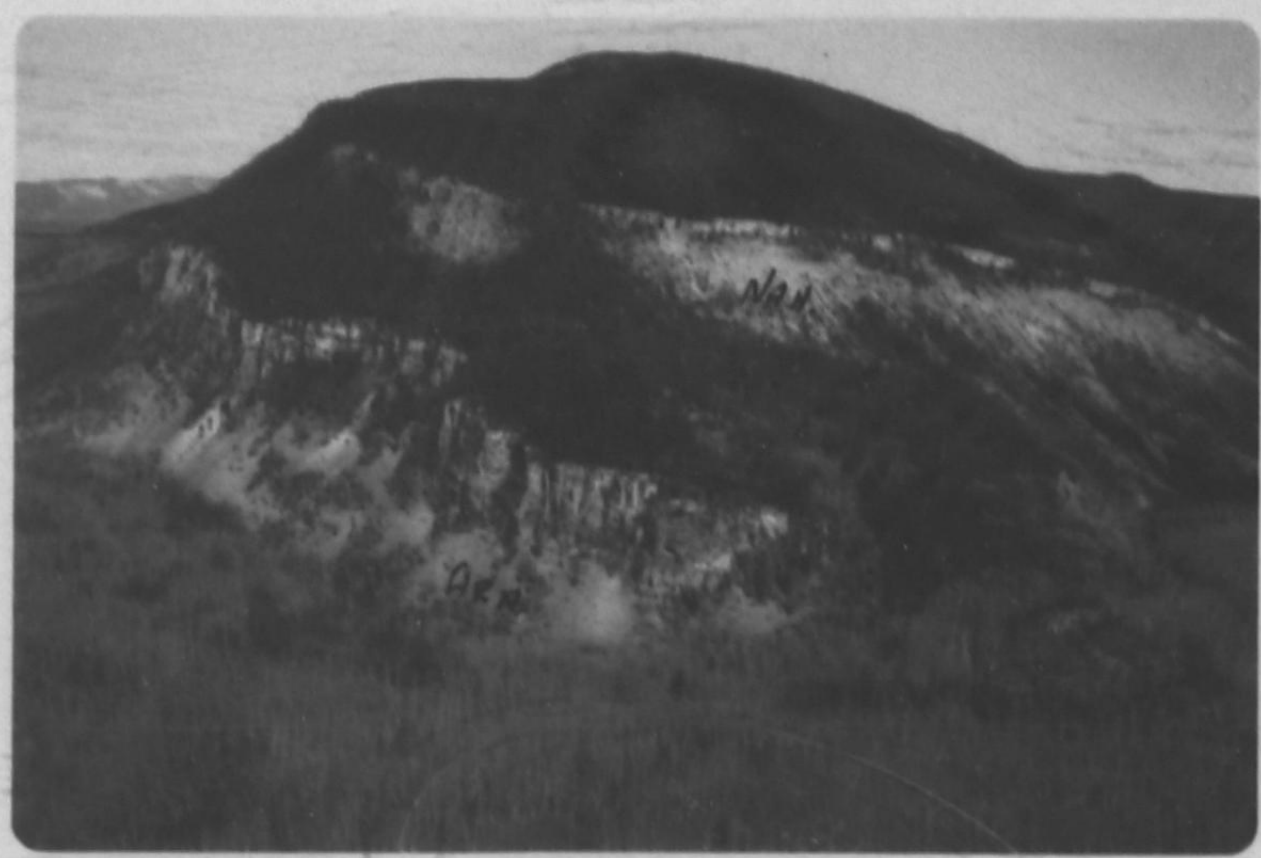

Figure 4 View looking north of the gap shown in Figure 3. Top of lower cliff is capped by 12-foot bed of coarse-crystalline dolomite at the top of the Arnica formation. The upper cliff and covered interval between is the Nahanni formation.

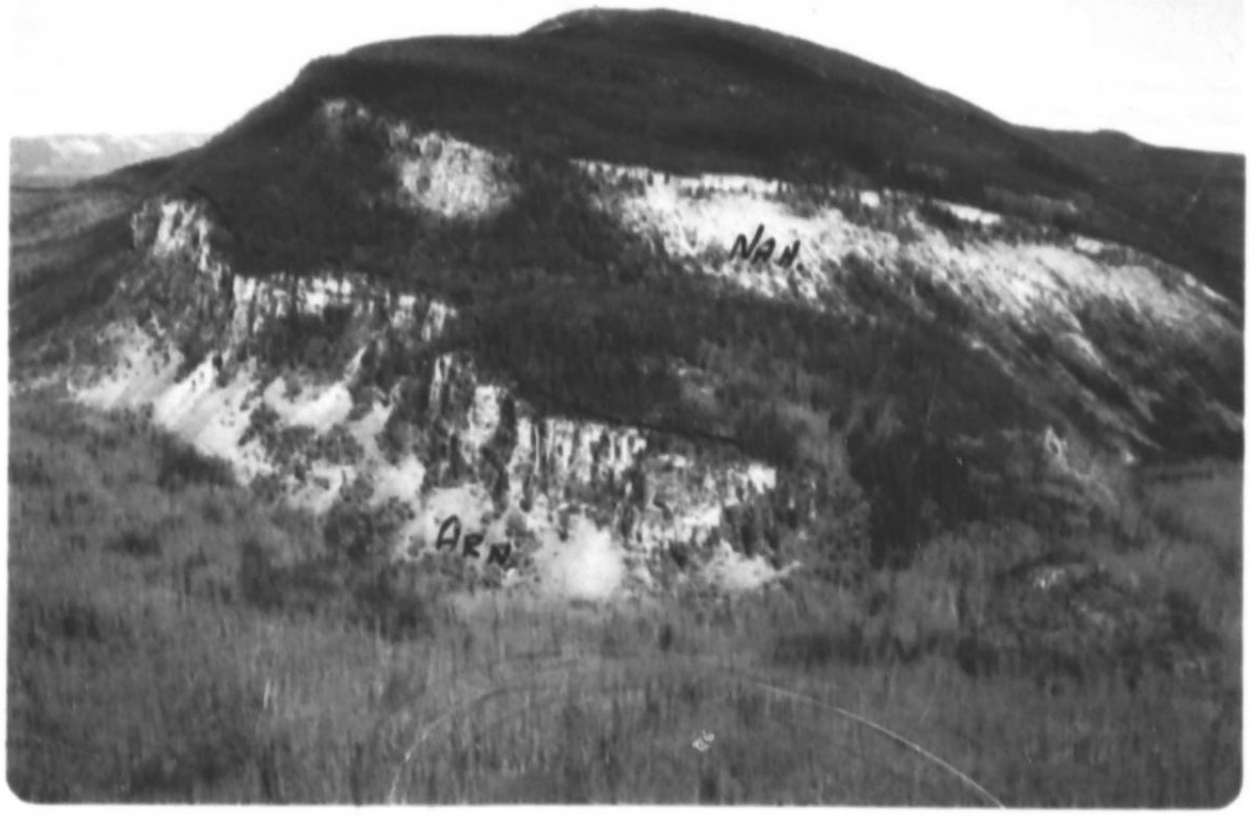

Figure 4 View looking north of the gap shown in Figure 3. Top of lower cliff is capped by 12-foot bed of coarse-crystalline dolomite at the top of the Arnica formation. The upper cliff and covered interval between is the Nahanni formation.

Figure 5 Section measured in core of Willow Ridge anticline. There is more section exposed here than at the gap as shown in Figure 4. The lower coarse crystalline dolomite is outlined followed by very fine-grained dolomite and finally overlain by the upper 12-foot unit of coarse dolomite. The Nahanni formation was measured approximately one-mile south.

Figure 5 Section measured in core of Willow Ridge anticline. There is more section exposed here than at the gap as shown in Figure 4. The lower coarse crystalline dolomite is outlined followed by very fine-grained dolomite and finally overlain by the upper 12-foot unit of coarse dolomite. The Nahanni formation was measured approximately one-mile south.

Figure 6 View looking north along the Willow Ridge anticline immediately north of section shown in Figure 5. The upper light grey coarse-crystalline dolomite is overlain on the far right by the Nahanni formation.

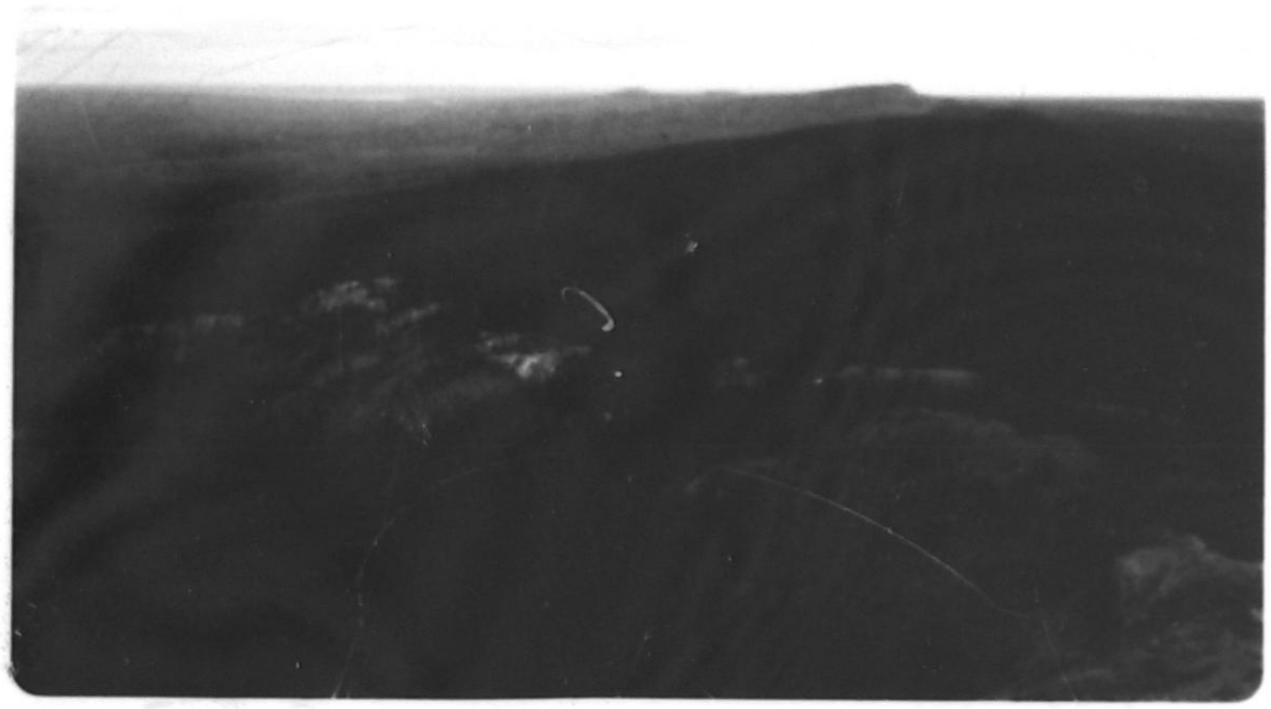

Figure 6 View looking north along the Willow Ridge anticline immediately north of section shown in Figure 5. The upper light grey coarse-crystalline dolomite is overlain on the far right by the Nahanni formation.

Figure 7 Upper coarse crystalline dolomite (here thicker than where section was measured) in right foreground. The Nahanni formation can be seen through the trees in left foreground. The McConnell Range and the gap formed by The River Between Two Mountains can be seen in the background.

Figure 7 Upper coarse crystalline dolomite (here thicker than where section was measured) in right foreground. The Nahanni formation can be seen through the trees in left foreground. The McConnell Range and the gap formed by The River Between Two Mountains can be seen in the background.

Figure 8 Close-up view of the coarse-crystalline Manetoe "type-facies". Note porosity parallel to the rudimentary bedding, probably representing solution of fossil fragments.

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Figure 9 Irregular contact between the course-crystalline dolomite on the right and Wahanni-type limestone on the left.

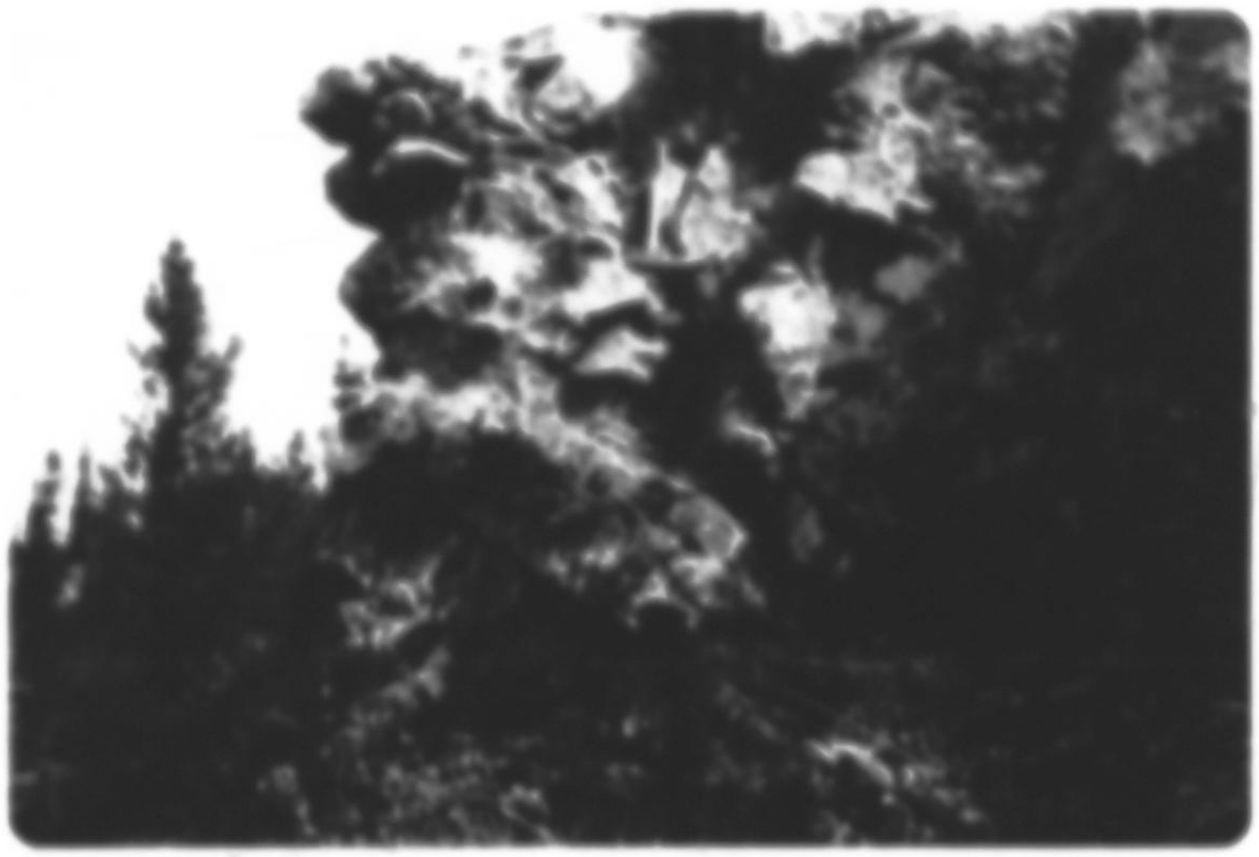


Figure 9 Irregular contact between the coarse-crystalline dolomite on the right and Nahanni-type limestone on the left.

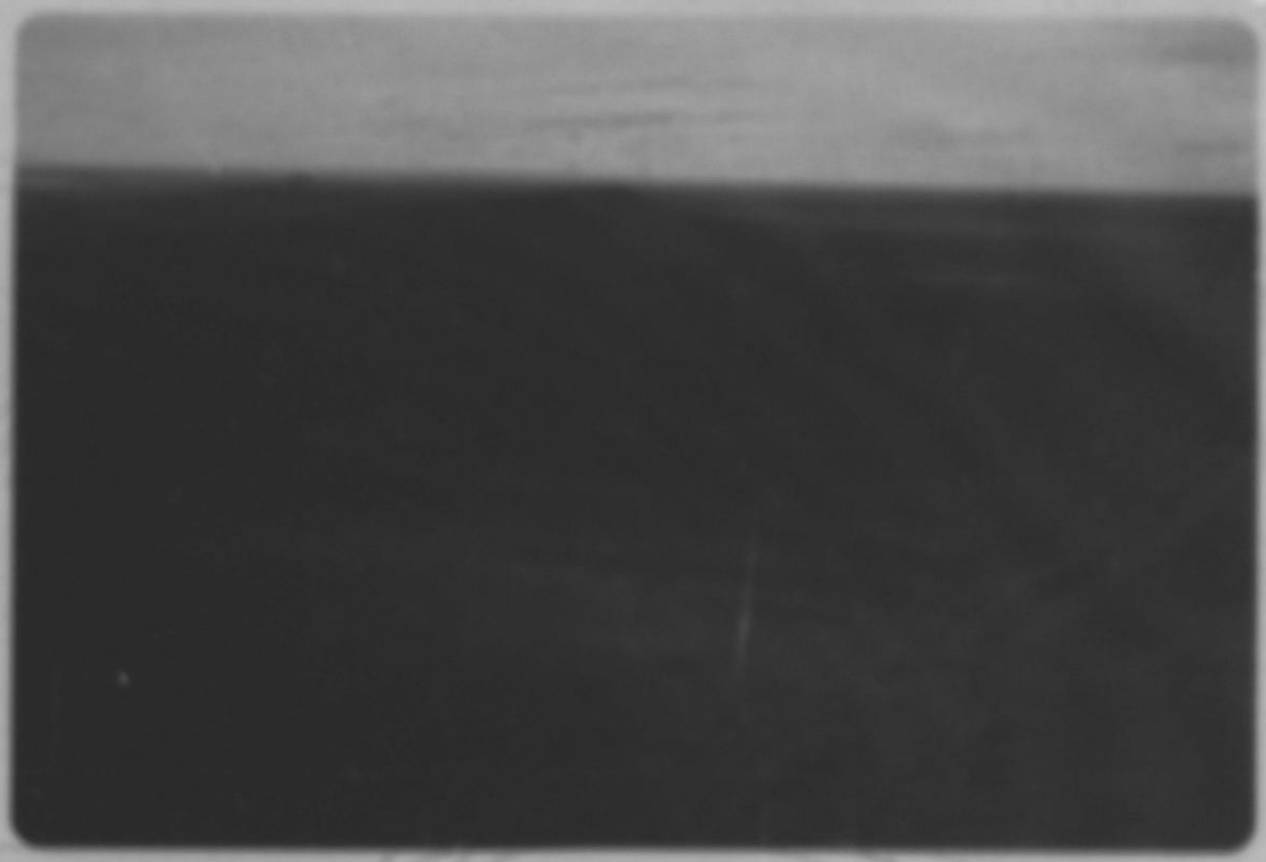


Figure 10 View looking north along Willow Ridge anticline. This structure, especially in this northern part is very tight and plunges northward in a series of en echelon folds. It is mainly tree covered affording few helicopter landing locations.

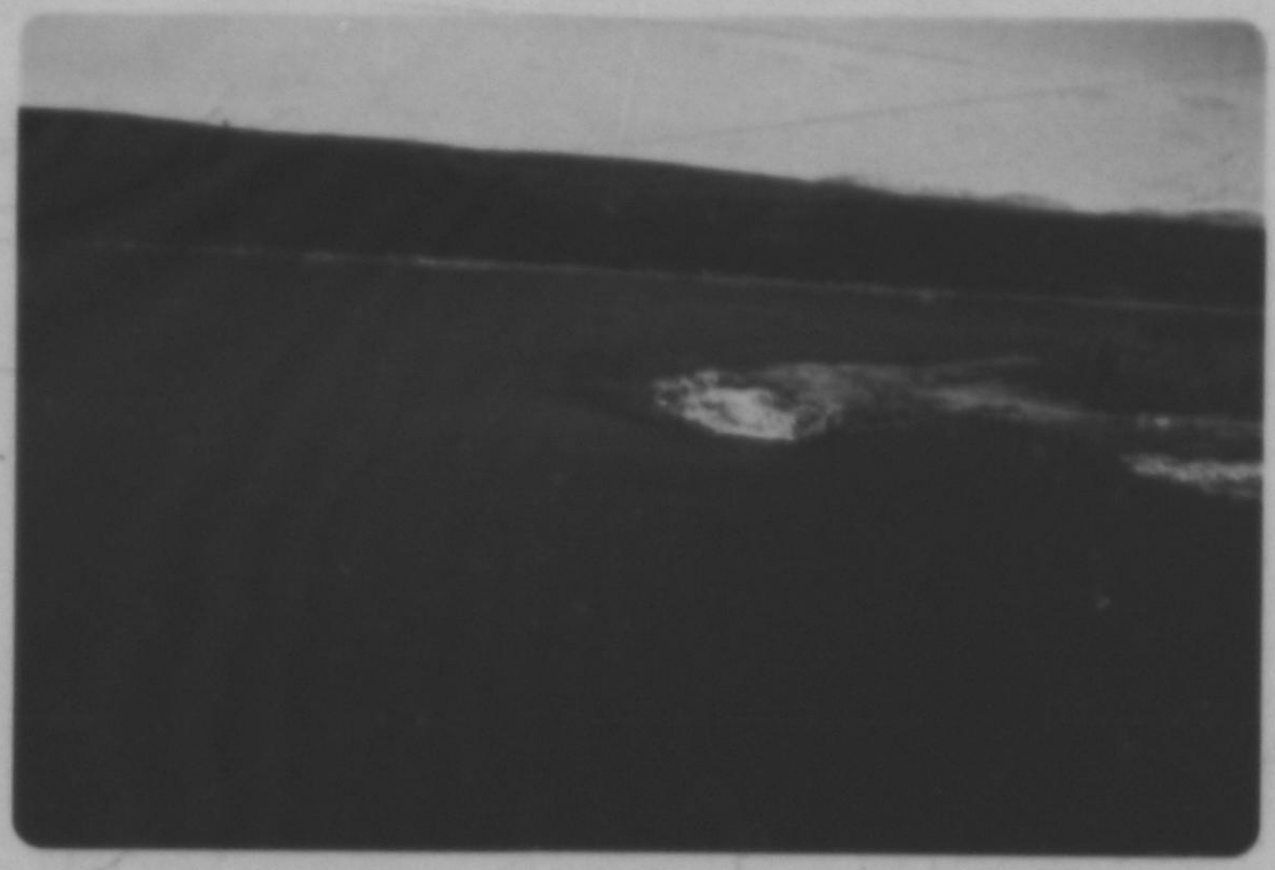


Figure 11 Low dipping beds of the Nahanni formation near the south end of Old Fort Island on the Mackenzie River. View is looking northwest with the Camsell Range in the distance.

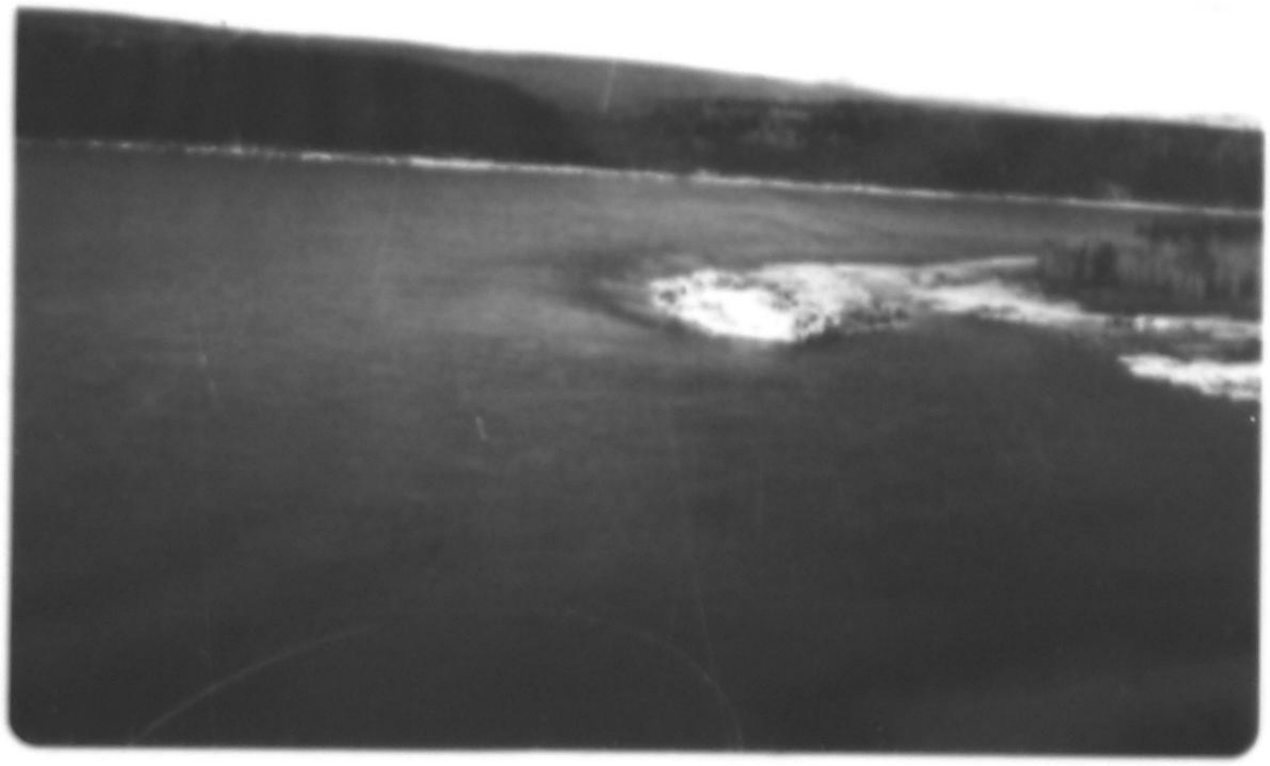


Figure 11 Low dipping beds of the Nahanni formation near the south end of Old Fort Island on the Mackenzie River. View is looking northwest with the Camsell Range in the distance.

Figure 12 View looking north along the McConnell Range with the main part of the Franklin Mountains in the distance. This picture shows clearly the anticlinal nature of the McConnell Range. The gap formed by the River Between Two Mountains is immediately to the north. The upper coarse-crystalline dolomite, as on the Willow Ridge anticline is in the left foreground underlain here by Bear Rock. The Mount Kindle formation can be seen in the core of the anticline with the Nahanni formation on the flank to the left.

Figure 12 View looking north along the McConnell Range with the main part of the Franklin Mountains in the distance. This picture shows clearly the anticlinal nature of the McConnell Range. The gap formed by the River Between Two Mountains is immediately to the north. The upper coarse-crystalline dolomite, as on the Willow Ridge anticline is in the left foreground underlain here by Bear Rock. The Mount Kindle formation can be seen in the core of the anticline with the Nahanni formation on the flank to the left.

Figure 13 Knobby weathering Bear Rock formation immediately north of Figure 14. On the Willow Ridge anticline the same stratigraphic interval would be called Arnica as it is better bedded.

Figure 13 Knobby weathering Bear Rock formation immediately north of Figure 14. On the Willow Ridge anticline the same stratigraphic interval would be called Arnica as it is better bedded.

Figure 14 Massive bioherma1 reef overlying the Nahanni formation on Root River. The lower part of this reef is coarse-grained crinoidal limestone and the upper part is composed of Stromatipora limestone with "Stringocephalus".

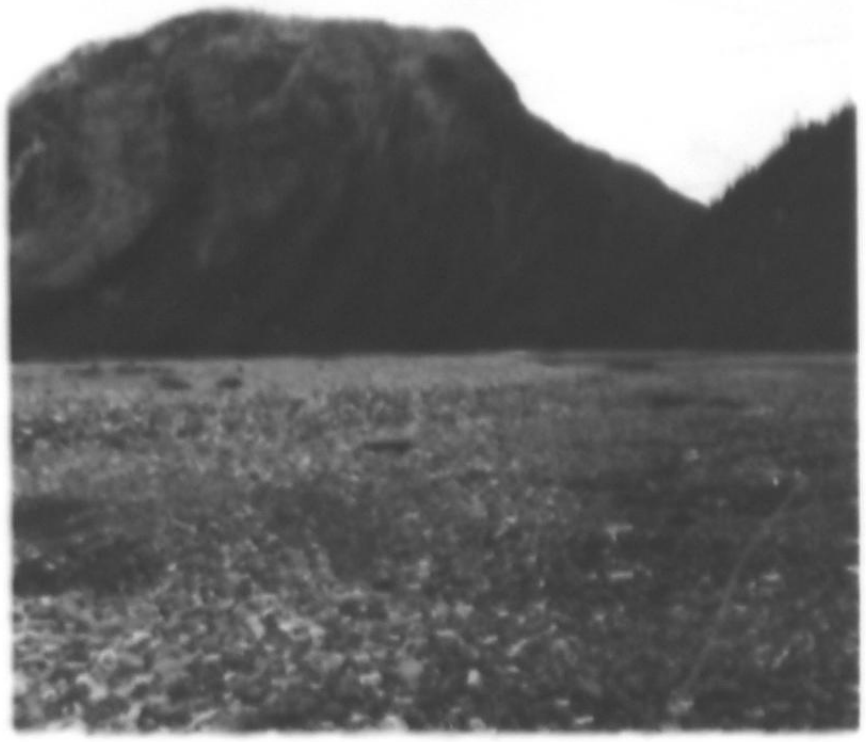


Figure 14 Massive biohermal reef overlying the Nahanni formation on Root River. The lower part of this reef is coarse-grained crinoidal limestone and the upper part is composed of Stromatipora limestone with "Stringocephalus".

Collection locality or trap: | Lat. Number | Grid. and Year | Square and Footage from Grove | Catching Number

1 - 66 - A

Damage or Pest Stage | Location | Population Name

Field Designation	Date	Notebook	Page	Field Determination	Date	Notebook	Page

Data and remarks: Phenacoccus sp. = mealybug

Card of

Stage	Process or Stage equivalents	Identn. by	Date	Lifestage of interest
	Adult = Pl. Obs.	DW	June/66	

Validity of age determination (Checked)

☒ Good ☐ Fair ☐ Poor

ENVIRONMENT

Collection locality or trap: | Lat. Number | Grid. and Year | Square and Footage from Grove | Catching Number

1 - 66 - B

Damage or Pest Stage | Location | Population Name

Field Designation	Date	Notebook	Page	Field Determination	Date	Notebook	Page

Data and remarks: Pinkamyrtilla spp. = mealybug species figured at Hawaii.
Ambrosiella sp.
Fusarium sp. = important at cephalon.
Growth results misleading, forms figured at Hawaii.
Continued - ambrosia.

Card of

Stage	Process or Stage equivalents	Identn. by	Date	Lifestage of interest
Cephalon	Hawaii	DW	June/66	

Validity of age determination (Checked)

☒ Good ☐ Fair ☐ Poor

ENVIRONMENT

Collectors Initials or Name	Loc. Number	Dist. and Year	Datum and Footage from Datum	Catalog Number	MACRO / MICRO
1-66-C					

Outcrop or Well Name	Location	Formation Name

(Field) Geologist	Date	Notebook	Page	Field Paleontologist	Date	Notebook	Page

Biota and remarks:

Large stromatoporoid 'heads' including:
Clathrodictyon sp.
cf. Stromatopora sp.

Card of

Stage	Biozone or Strat. equivalents	Ident. by	Date	Lithology of Interval
	Cambrian - Permian	D.W.	June/66	

Validity of age determination (Checked)

☑ Good ☐ Fair ☐ Poor

ENVIRONMENT

Collectors Initials or Name	Loc. Number	Dist. and Year	Datum and Footage from Datum	Catalog Number	MACRO / MICRO
3-66-A					

Outcrop or Well Name	Location	Formation Name

(Field) Geologist	Date	Notebook	Page	Field Paleontologist	Date	Notebook	Page

Biota and remarks:

cf. Devonogypa sp. (Gypidula sp A. & McLaren)
Leperditia sp.
Small gastropod: cross-sections
Crinoid ossicles
Ostracoda: cross-sections.
Coenites sp.

Card of

Stage	Biozone or Strat. equivalents	Ident. by	Date	Lithology of Interval
	M Devonian	DW.	June 66	

Validity of age determination (Checked)

☑ Good ☐ Fair ☐ Poor

ENVIRONMENT

Collectors Initials or Name	Loc. Number	Dist. and Year	Datum and Footage from Datum	Catalog Number	MACRO / MICRO
5-66-A					

Outcrop or Well Name	Location	Formation Name

(Field) Geologist	Date	Notebook	Page	Field Paleontologist	Date	Notebook	Page

Biota and remarks:

Schuchertella adacta Crickmay
Donwillina sp.
Productella sp. - fragments.
Hexagonaria sp.
Stromatoporoids - indet.
Crinoid ossicles including typical Hunne forms.
Proetid fragments
Gastropod fragments

Card of

Stage	Biozone or Strat. equivalents	Ident. by	Date	Lithology of Interval
Convinian	Hunne	D.W.	June/66	

Validity of age determination (Checked)

☑ Good ☐ Fair ☐ Poor

ENVIRONMENT

Collectors Initials or Name	Loc. Number	Dist. and Year	Datum and Footage from Datum	Catalog Number	MACRO / MICRO
6-66-A					

Outcrop or Well Name	Location	Formation Name

(Field) Geologist	Date	Notebook	Page	Field Paleontologist	Date	Notebook	Page

Biota and remarks:

Hexagonaria sp.

Card of

Stage	Biozone or Strat. equivalents	Ident. by	Date	Lithology of Interval
	Devonian	DW	June/66	

Validity of age determination (Checked)

☑ Good ☐ Fair ☐ Poor

ENVIRONMENT

Collectors Initials or Name	Loc. Number	Dist. and Year	Datum and Footage from Datum	Catalog Number	MACRO / MICRO
8 - 66 - A					

Outcrop or Well Name	Location	Formation Name

(Field) Geologist	Date	Notebook	Page	Field Paleontologist	Date	Notebook	Page

Biota and remarks:

Proetus spp. - pygidia and fragments of cephalon.
Spinatrypa sp. - fragments
Ambocoelia sp.
Thamnopora sp.
Small rugose coral - fragments.
Small pelecypod - indet.
Gastropod fragments - some aff. Loxonema sp.
Sponge spicules.
Crinoid ossicles

Card of

Stage	Biozone or Strat. equivalents	Ident. by	Date	Lithology of Interval
	Devonian - probably middle Devonian	D.W.	June /66	

Validity of age determination (Checked)

☑ Good ☐ Fair ☐ Poor

ENVIRONMENT

Collectors Initials or Name	Loc. Number	Dist. and Year	Datum and Footage from Datum	Catalog Number	MACRO / MICRO
8 - 66 - B.					

Outcrop or Well Name	Location	Formation Name

(Field) Geologist	Date	Notebook	Page	Field Paleontologist	Date	Notebook	Page

Biota and remarks:

Atrypa spp. aff. aretica Warren.
Spinatrypa spp.
Warrenella sp.
Ambocoelia sp.
Thamnopora sp.
Hypothyridina aff. cameroni Warren
Productella sp. - fragments
Schizophoria sp. - fragments.
Small rugose coral
Crinoid ossicles - abundant.

Card of

Stage	Biozone or Strat. equivalents	Ident. by	Date	Lithology of Interval
	M Devonian.	D.W.	June 166	

Validity of age determination (Checked)

☑ Good ☐ Fair ☐ Poor

ENVIRONMENT

Collectors Initials or Name	Loc. Number	Dist. and Year	Datum and Footage from Datum	Catalog Number	MACRO / MICRO
8-66-C					

Outcrop or Well Name	Location	Formation Name

(Field) Geologist	Date	Notebook	Page	Field Paleontologist	Date	Notebook	Page

Biota and remarks:

cf. Stringocephalus ozina Cooksey
large ribbed spirif. - fragment.
Stromatoporoid - indet.
cf. Atrypa sp.
Crinoid ossicles.

Card ' of

Stage	Biozone or Strat. equivalents	Ident. by	Date	Lithology of Interval
	M. Devonian.	D.W.	June/66	

Validity of age determination (Checked)

☐ Good ☑ Fair ☐ Poor

ENVIRONMENT

Collectors Initials or Name	Loc. Number	Dist. and Year	Datum and Footage from Datum	Catalog Number	MACRO / MICRO
15					

Outcrop or Well Name	Location	Formation Name

(Field) Geologist	Date	Notebook	Page	Field Paleontologist	Date	Notebook	Page

Biota and remarks:

Stringocephalus burtini Defrance in de Blainville.
Atrypa sp.
Spinatrypa sp.
Rugose coral fragment.
Crinoid ossicles - abundant.
Stromatoporoid fragments.

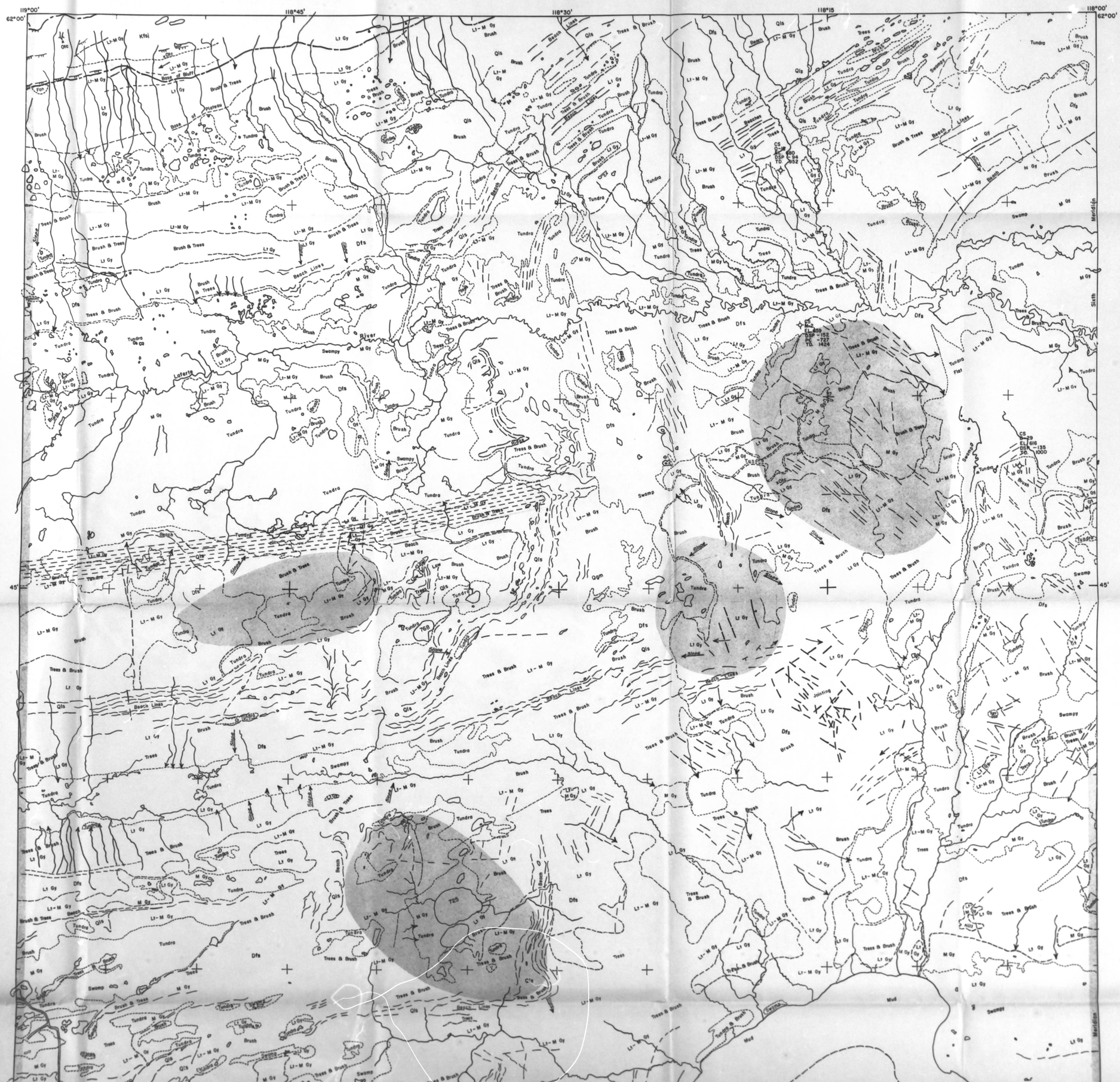
Card of

Stage	Biozone or Strat. equivalents	Ident. by	Date	Lithology of Interval
Givetian	Kee Scarp.	D.W.	June/66	

Validity of age determination (Checked)

☑ Good ☐ Fair ☐ Poor

ENVIRONMENT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118°45'
118°30'
118°15'
118°00'
62°00'
45'
Base of Bluff
Base of Plateau
Beach Lines
Laferte
River
Swampy
Tundra Flat
Sixth Meridian
Mud
Jointing
Slope
Swamp
Tundra
Brush
Trees & Brush
Brush & Trees
Trees
Dfs
Qls
Qm
Lt Gy
Lt-M Gy
M Gy
768
725

Mills Lake
Mac Kenzie River
Winter Road
White Swamp Road
Sixth Meridian
7 MERRILL
BM 475
BM 476
BM 478
471
468
473
489
502
663
598
725
768
30'

2 of

Base Map Control from Canada, Mills Lake Quad (E/2) 1:250,000 Sheet 85E
Photography— RCAF 1947, 1948, 1950 & 1951

Cities Service Acreage

Local Photo Anomaly
Regional Photo Anomaly

EXPLANATION

QUATERNARY

- **Qal** — Alluvium
- **Qls** — Beach Deposits and Lake Silts
- **Qgm** — Pleistocene Moraine Deposits

CRETACEOUS

- **Kfn** — Fort Nelson
- **Kfsj** — Fort St. John

DEVONIAN — UPPER

- **Dtr** — Trout River
- **Dk** — Kakisa Ls.
- **Dgu** — Grumbler, Upper
- **Dgm** — Grumbler, Middle
- **Da** — Alexandra Fm.
- **Dh** — Hay River Sh. & Ls.
- **Dfs** — Fort Simpson

DEVONIAN — MIDDLE

- **Dsp** — Slave Point (?) Reef
- **Dhr** — Horn River Fm., Sh. & Ls. (Presqu'ile)
- **Dpp** — Pine Point Fm.

CITIES SERVICE OIL CO.

PRELIMINARY PHOTOGEOLOGIC MAP
CANADA, NORTHWEST TERRITORIES
Ft. Providence Project
Mills Lake Quad E/2

Dip Component
Dip-Strike
Topographic Slope
Formation boundaries
Steep form lines
Faults — dash on downthrown side
Inferred faults or fractures
Elevations
Vegetation boundary
Bluffs
Thrust Fault — upthrown
Ctg — Bedrock Outcrop
Surface Color — Lt Gy (Light Gray)

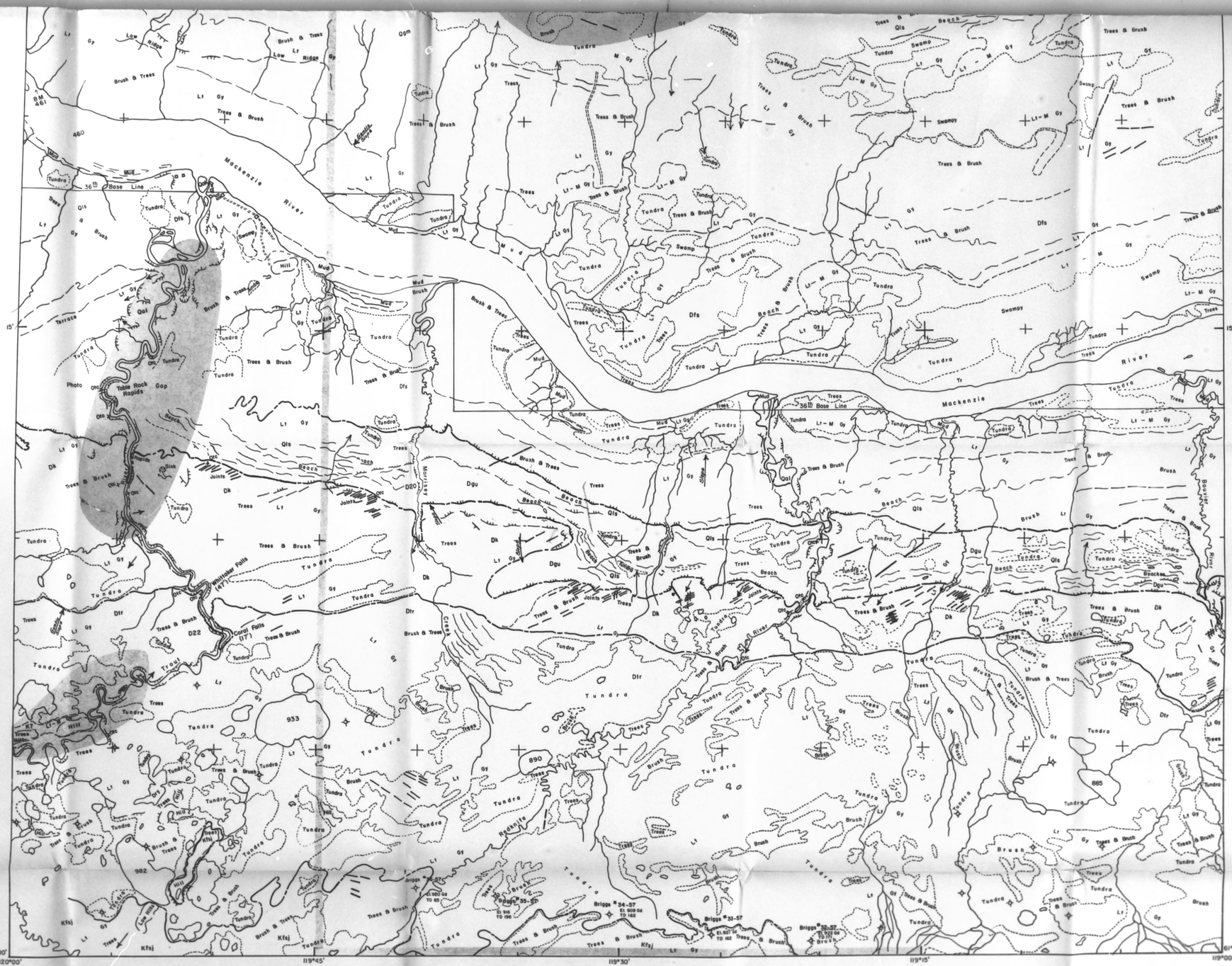
SCALE	1:5 1 Mile
DATE	November, 1969
GEOLOGY	E.G. Tiedeke
PLOTTING	E.G. Tiedeke
DRAFTING	M.G.G.
CHECKED	E.G. Tiedeke

Graphic Scale

3 of 3


120°00'
62°00'
119°45'
119°30'
119°15'
119°00'
62°00'
45'
45'
HORN PLATEAU
Winter Road
Winter Road
Robitskin River
Base of Plateau
Base of Plateau
Beaches
Beach
Tundra
Trees
Trees & Brush
Brush & Trees
Brush
Swamp
Slump
Outwash
Kfn
Kfn?
Kfsj
Ksfj
Qoi
Qgm
Qls
Dfs
Otc
Sh
Lt Gy
Lt-M Gy
M Gy
845
765

Swamp
Trees & Brush
Tundra
Lt Gy
M Gy
Lt-M Gy
Dfs
Brush & Trees
Beaches
Robbiesalin
River
Joints
Low Ridge
Qgm
Qls
Mackenzie
36th Base Line
Mud
Hill
Terrace
Brush
Trees
30'
15'



Base Map Control from Canada, Mills Lake Quad (W/2) 1:250,000 Sheet 85E
Photography – RCAF 1947, 1948, 1950 & 1951

Cities Service Acreage

Local Photo Anomaly
Regional Photo Anomaly

EXPLANATION

QUATERNARY

- Qal — Alluvium
- Qls — Beach Deposits and Lake Silts
- Qgm — Pleistocene Moraine Deposits

CRETACEOUS

- Kfn — Fort Nelson
- Kfsj — Fort St. John

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UPPER

- Dtr — Trout River
- Dk — Kakisa Ls
- Dgu — Grumbler, Upper
- Dgm — Grumbler, Middle
- Da — Alexandra Fm.
- Dh — Hay River Sh. & Ls.
- Dfs — Fort Simpson

MIDDLE

- Dsp — Slave Point (?) Reef
- Dhr — Hare River Fm., Sh. & Ls. (Presq'Ile)
- Dpp — Pine Point Fm.

CITIES SERVICE OIL CO.

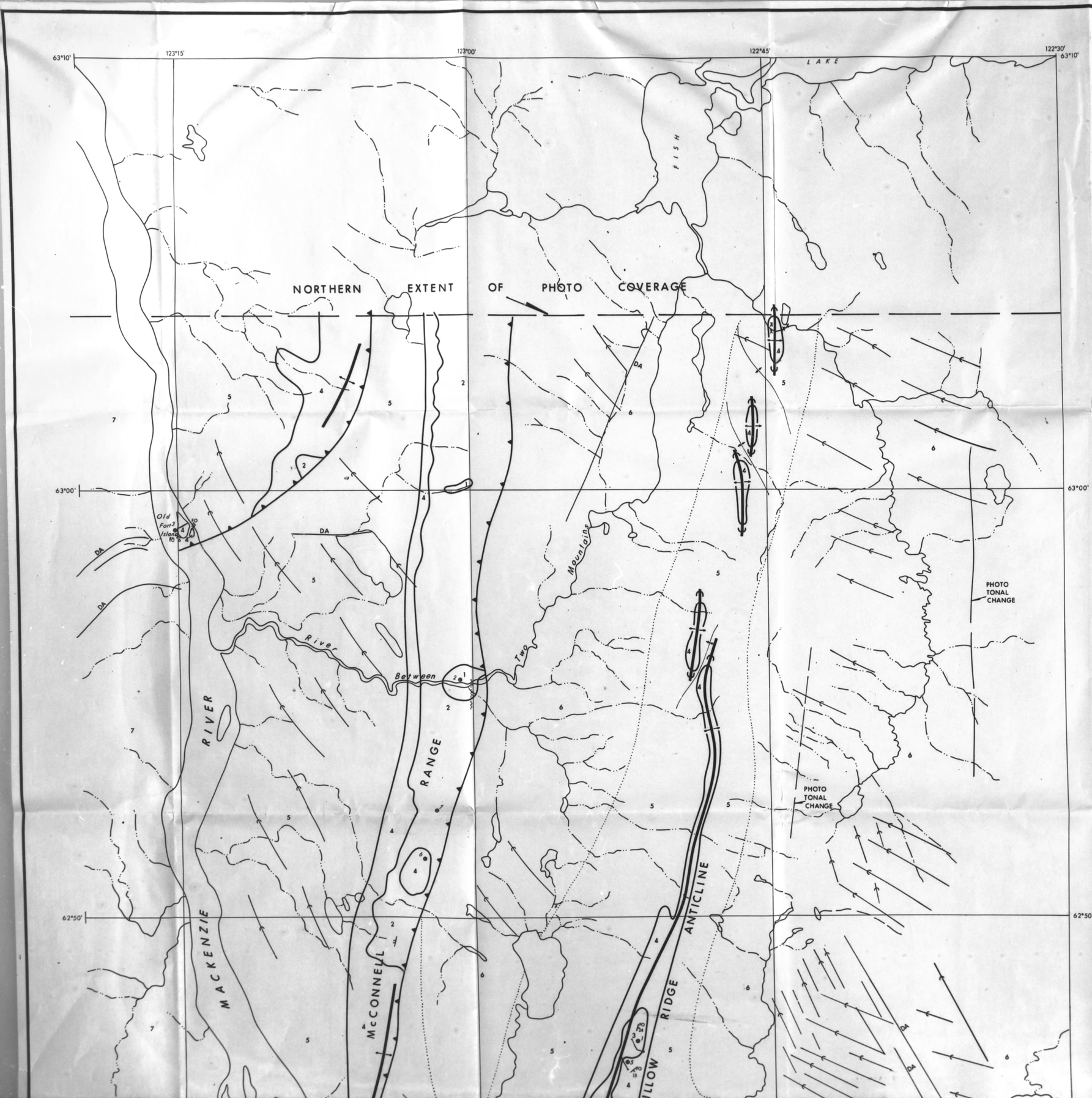
PRELIMINARY PHOTOGEOLOGIC MAP
CANADA, NORTHWEST TERRITORIES
Ft. Providence Project
Mills Lake Quad W/2

Dip Concealed
Dip Strike
Topographic Slope
Formation Boundaries
Slope North Slope
Faults
Mineral Veins or Fractures
Elevation
Vegetation Boundary
Brush
Tree Line
City – Geologic Outcrop
Surface Color – Lt Gy (Light Gray)

SCALE 1 in. = 1 mile
DATE Nov. 1956
GEOLOGY E.K. Thorne
PLOTTING E.K. Thorne
DRAFTING M.R.S.
CHECKED E.K. Thorne

Graphic Scale

3 of 5



GEOLOGICAL MAP
OF THE

WILLOW RIDGE ANTICLINE

WRIGLEY — CAMSELL BEND AREA
N.W.T.

PREPARED FOR
CANADA – CITIES SERVICE PETROLEUM CORP.

BY

W.B. Brady, Consulting Ltd.
Calgary, Alberta.
AUGUST, 1966

0 1 2 3 4 5
MILES

MAP UNITS

PLEISTOCENE AND PRESENT

7 — Alluvial sands and silts of the MacKenzie River.

CRETACEOUS

6 — Shale, dark grey.

UPPER (AND MIDDLE ?) DEVONIAN

5 — FORT SIMPSON FORMATION: Shale and mudstone, grey

MIDDLE DEVONIAN

4 — NAHANNI FORMATION: Limestone, micrograined, grey.

3 — ARNICA FORMATION: Dolomite, grey bedded and banded.

2 — BEAR ROCK FORMATION: Breccia of Limestone and dolomite; Facies equivalent of the Arnica Fm.

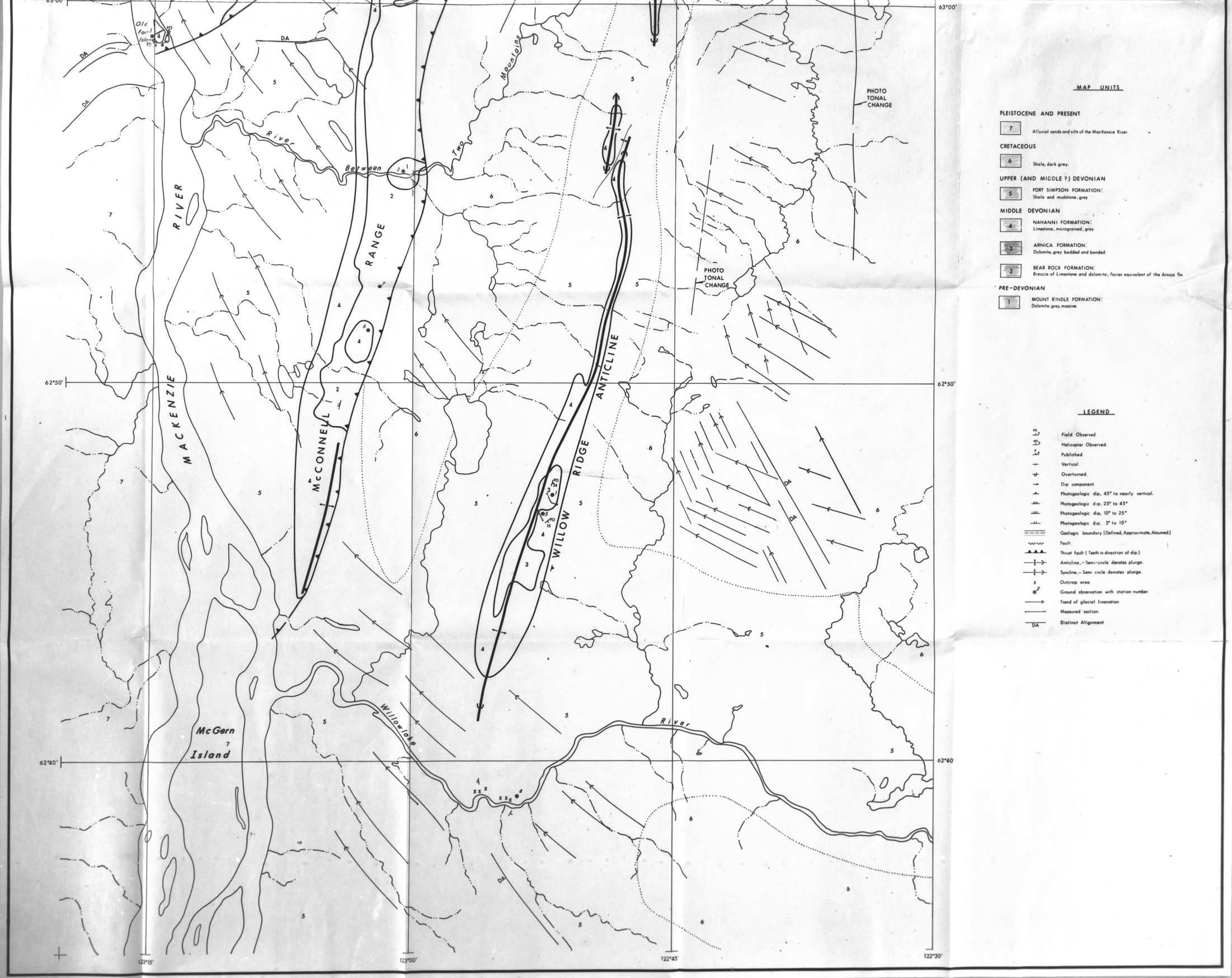
PRE-DEVONIAN

1 — MOUNT KINDLE FORMATION: Dolomite, grey, massive.

LEGEND

- Field Observed
- Helicopter Observed
- Published
- Vertical
- Overturned
- Dip component
- Photogeologic dip, 45° to nearly vertical.
- Photogeologic dip, 25° to 45°
- Photogeologic dip, 10° to 25°
- Photogeologic dip, 3° to 10°
- Geologic boundary (Defined, Approximate, Assumed)
- Fault

1 of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62°50'
62°40'
123°15'
123°00'
122°45'
122°30'
Old Fort Island
DA
River
Between
Two
Mountains
MACKENZIE
RIVER
McCONNELL
RANGE
WILLOW
RIDGE
ANTICLINE
PHOTO TONAL CHANGE
PHOTO TONAL CHANGE
McGern Island
Willowlake
River
MAP UNITS
PLEISTOCENE AND PRESENT
7 Alluvial sands and silts of the MacKenzie River.
CRETACEOUS
6 Shale, dark grey.
UPPER (AND MIDDLE ?) DEVONIAN
5 FORT SIMPSON FORMATION: Shale and mudstone, grey
MIDDLE DEVONIAN
4 NAHANNI FORMATION: Limestone, micrograined, grey.
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PRE-DEVONIAN
1 MOUNT KINDLE FORMATION: Dolomite, grey, massive.
LEGEND
Field Observed.
Helicopter Observed.
Published.
Vertical.
Overturned.
Dip component.
Photogeologic dip, 45° to nearly vertical.
Photogeologic dip, 25° to 45°
Photogeologic dip, 10° to 25°
Photogeologic dip, 3° to 10°
Geologic boundary (Defined, Approximate, Assumed.)
Fault.
Thrust fault (Teeth in direction of dip.)
Anticline, – Semi-circle denotes plunge.
Syncline, – Semi circle denotes plunge.
Outcrop area
Ground observation with station number.
Trend of glacial linenation.
Measured section.
DA Distinct Alignment

2 of 2

CANADA

MINES AND TECHNICAL SURVEYS

SURVEYS AND MAPPING BRANCH

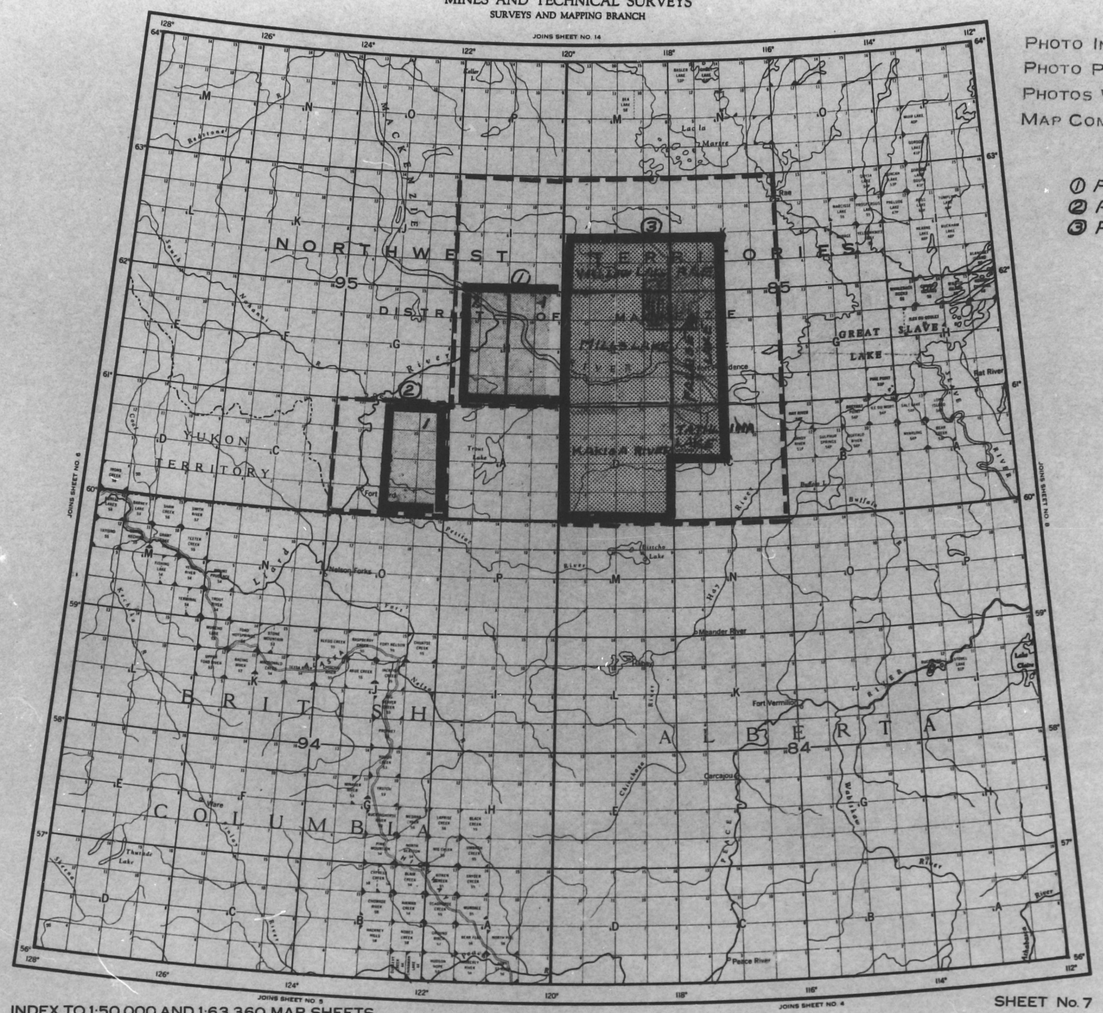

PHOTO INDEX

PHOTO PROJECT

PHOTOS WORKED

MAP COMPLETE

Project

① Ft. Simpson

② Ft. Liard

③ Ft. Providence

INDEX TO 1:50,000 AND 1:63,360 MAP SHEETS OF THE NATIONAL TOPOGRAPHIC SYSTEM

CORRECTED TO MAY 31, 1959

When ordering maps, the map name and number should be quoted. EXAMPLE: — HAY RIVER 85 B/13

Map name ..... HAY RIVER

Block number 85

Letter ..... B

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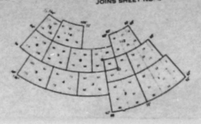
1:50,000 — 1:63,360

1:50,000 Provisional Edition (incomplete as to colour, place names, etc.)

1:50,000 Advance Print (print of manuscript one colour only)

P ..... indicates an uncontoured map



Published maps may be obtained from the Map Distribution Office, Department of Mines and Technical Surveys, Ottawa, Ont., at 25 cents per sheet. Maps at 1:50,000 scale are published in two sheets (E½ & W½), south of Latitude 62°. Remittance should accompany order

SHEET No. 7

8-30-66

CANADA

MINES AND TECHNICAL SURVEYS

SURVEYS AND MAPPING BRANCH

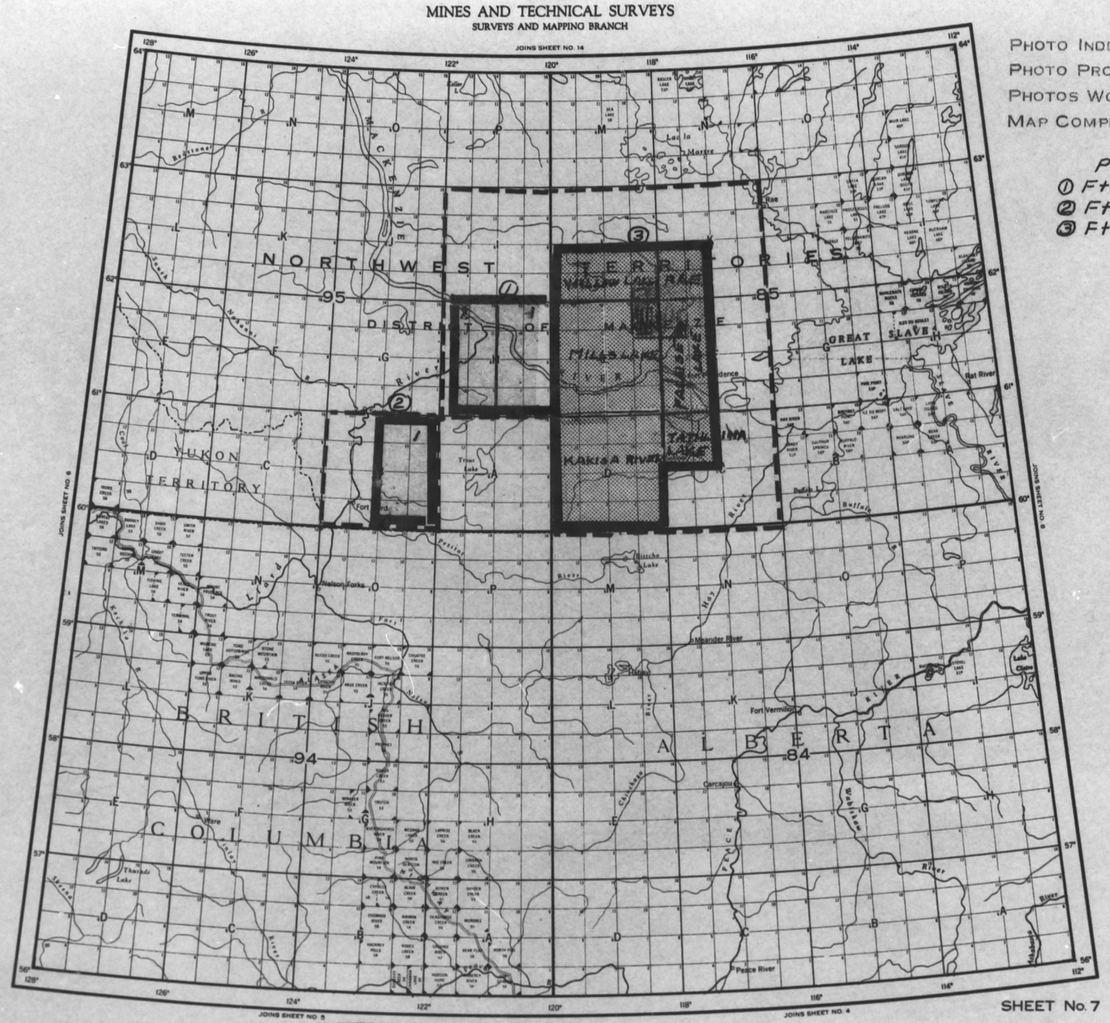


PHOTO INDEX

PHOTO PROJECT

PHOTOS WORKED

MAP COMPLETE

Project

① Ft. Simpson

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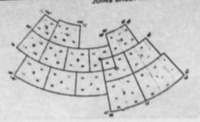
P indicates an uncontoured map



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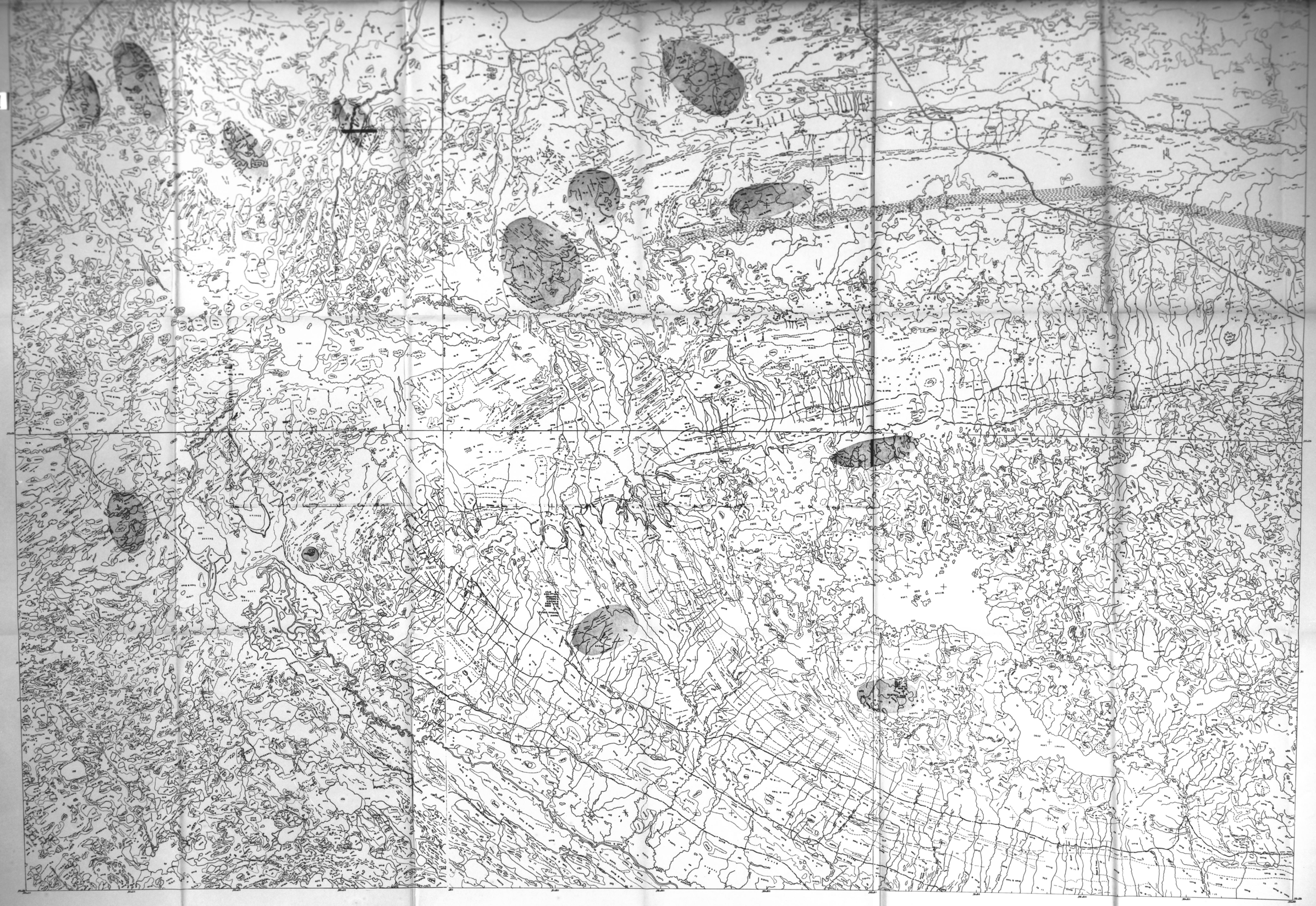
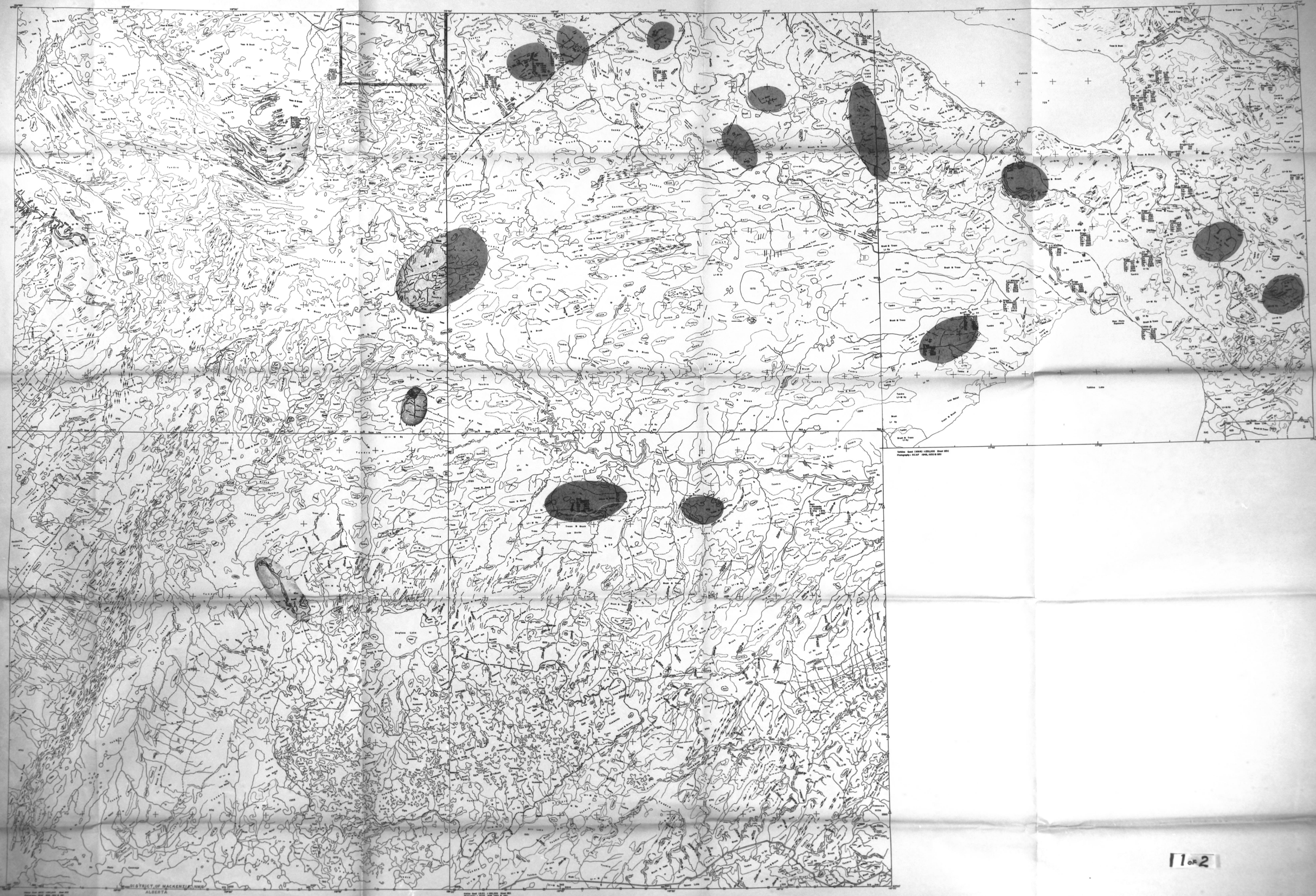
8-30-66



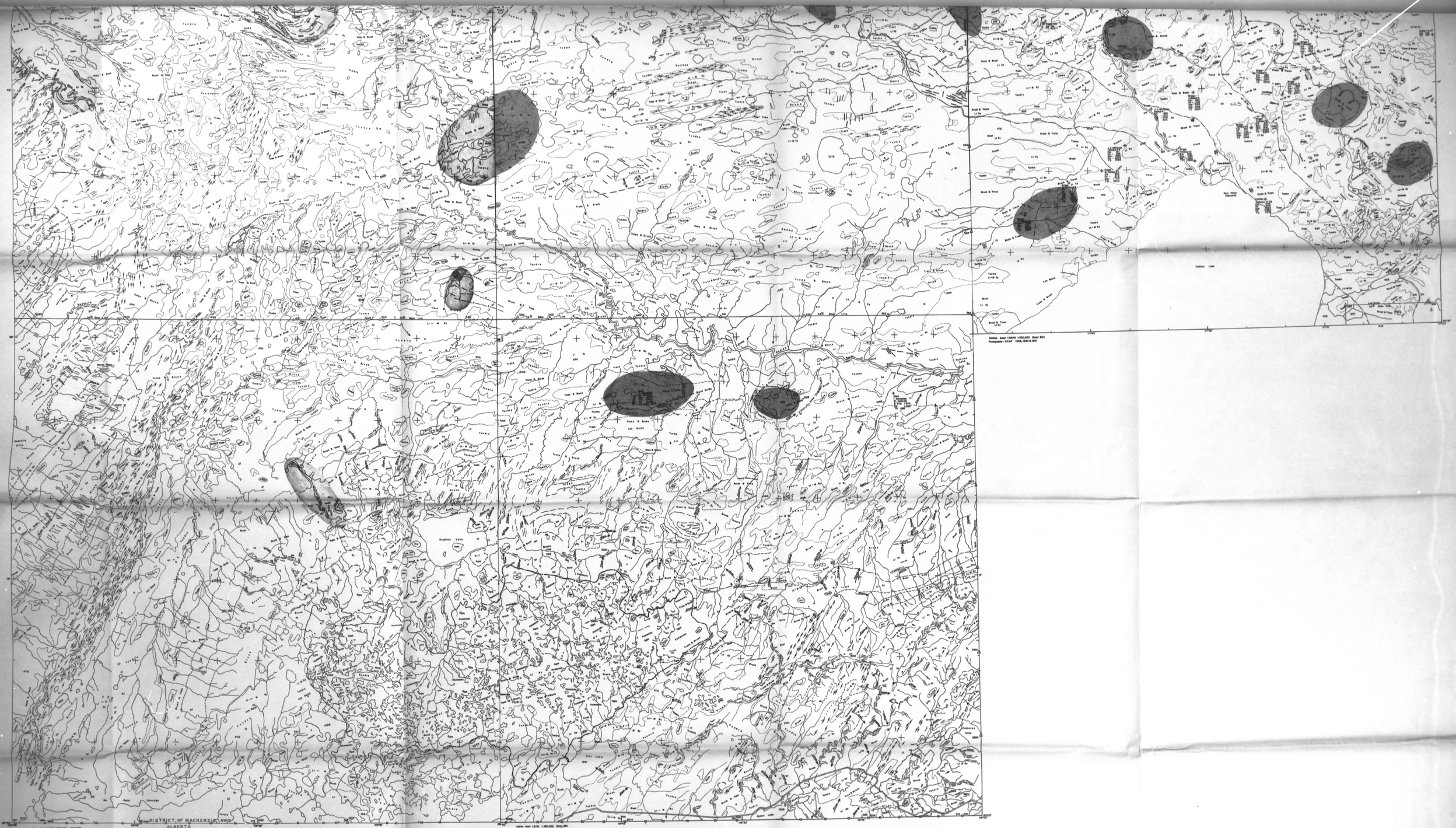
EXPLANATION
2 of 2

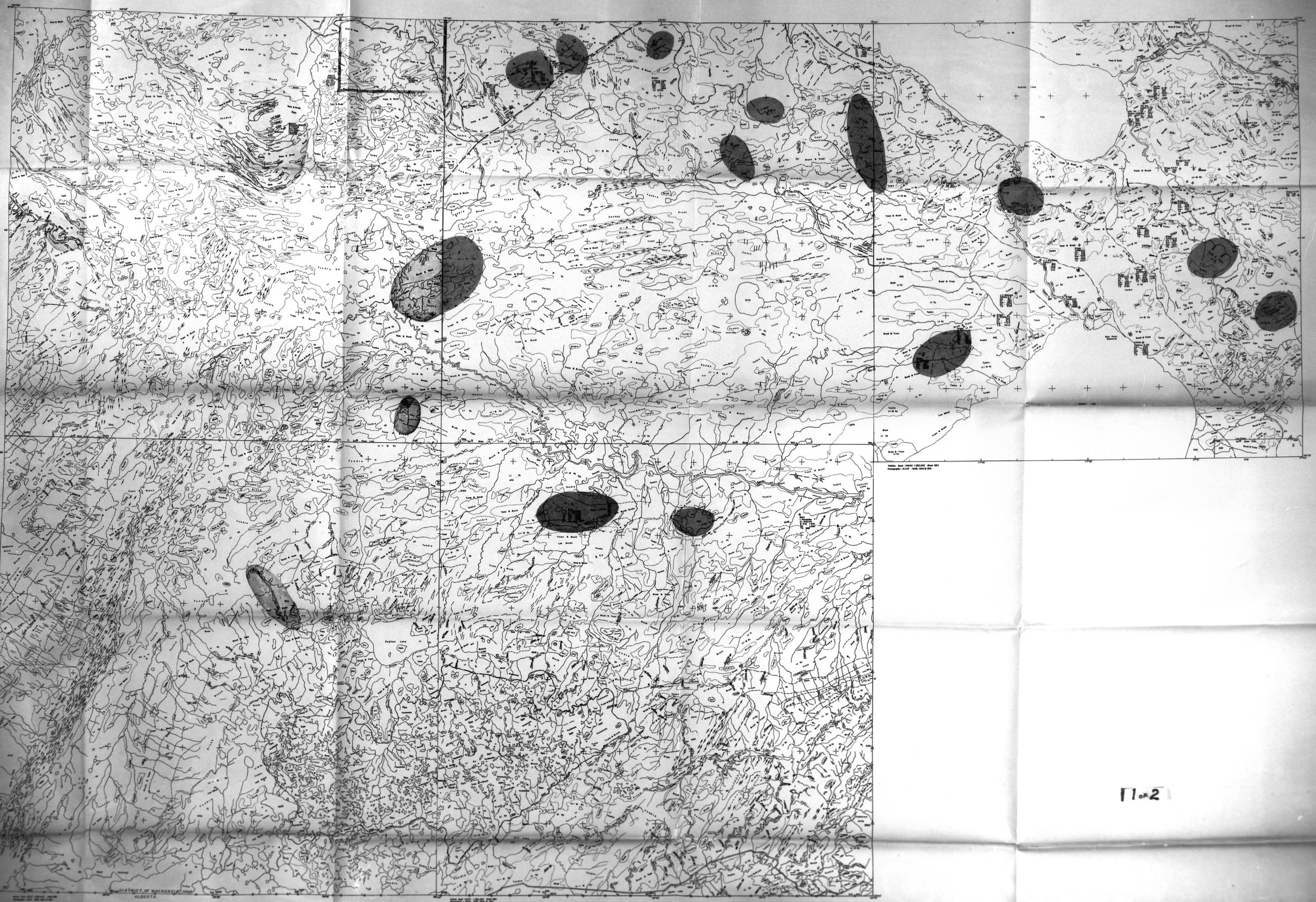


11 OF 2

EXPLANATION

CITIES SERVICE OIL CO
PRELIMINARY PHOTOGEOLOGIC MAP


DISTRICT OF MACKENZIE, N.W.T.
ALBERTA
Tathlina Lake
Deghose Lake
Hill Lake
Upper Lake
Lower Lake
Low Water
Tathlina Quad (NTS) 1:250,000 Sheet 85E
Photographs - R.C.A.F. 1949, 1950 & 1951
EXPLANATION
Lead Photo Assembly
CITIES SERVICE OIL CO
PRELIMINARY PHOTOGEOLOGIC MAP
CANADA, NORTHWEST TERRITORIES
Scale 1:12



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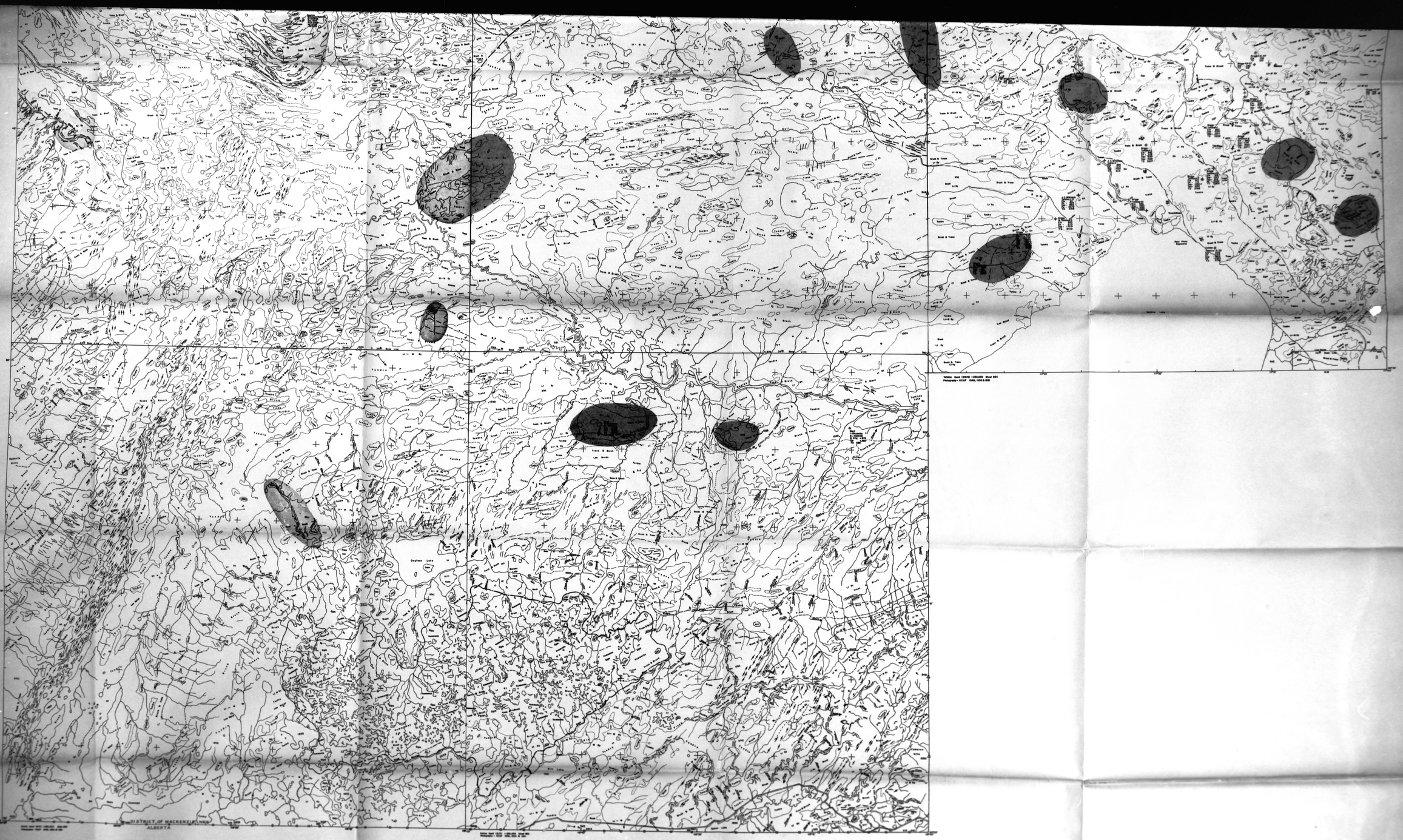

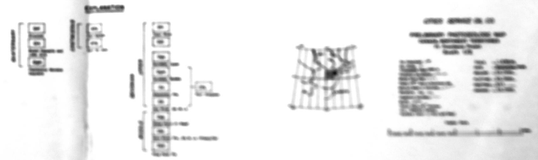

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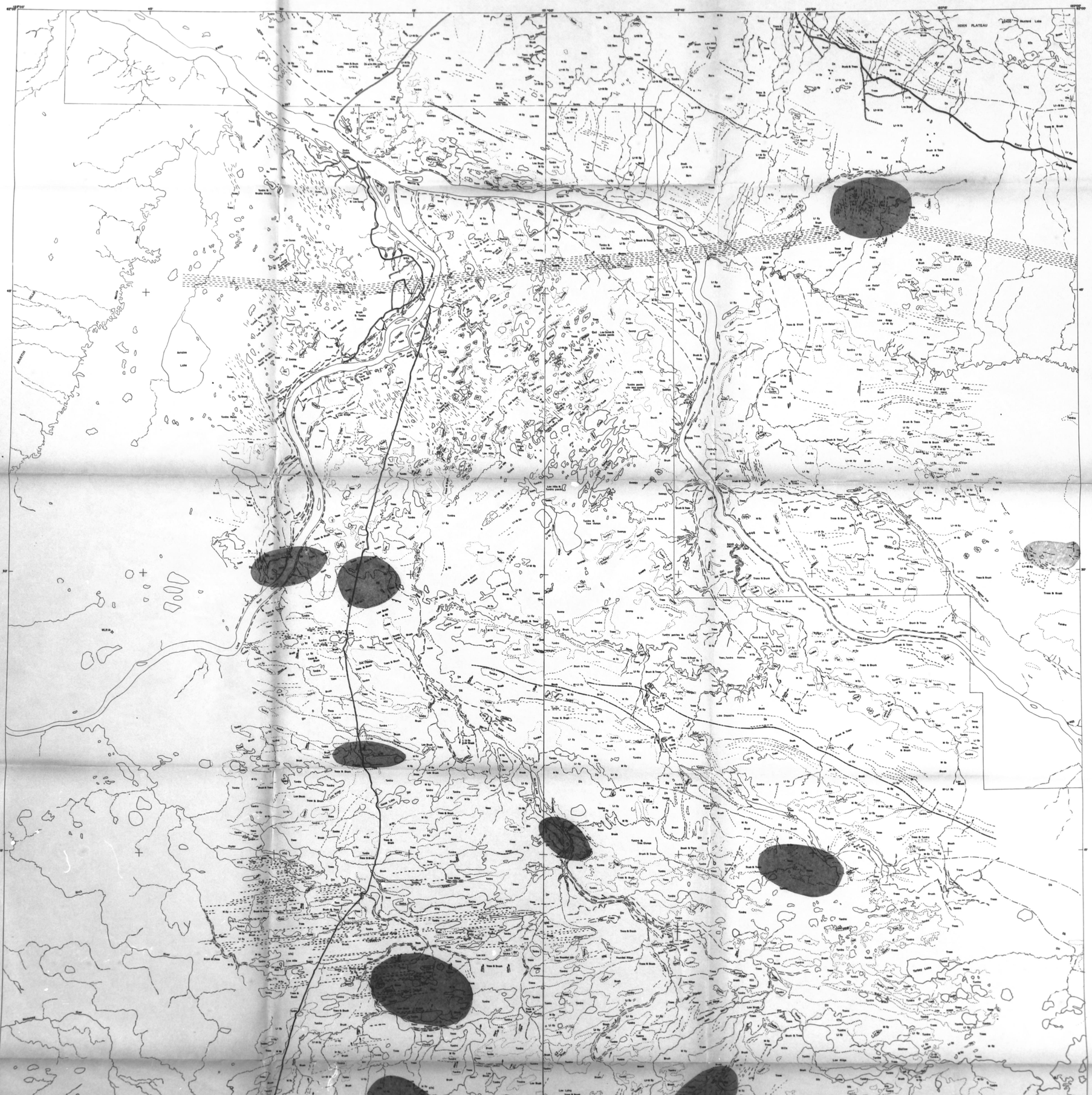

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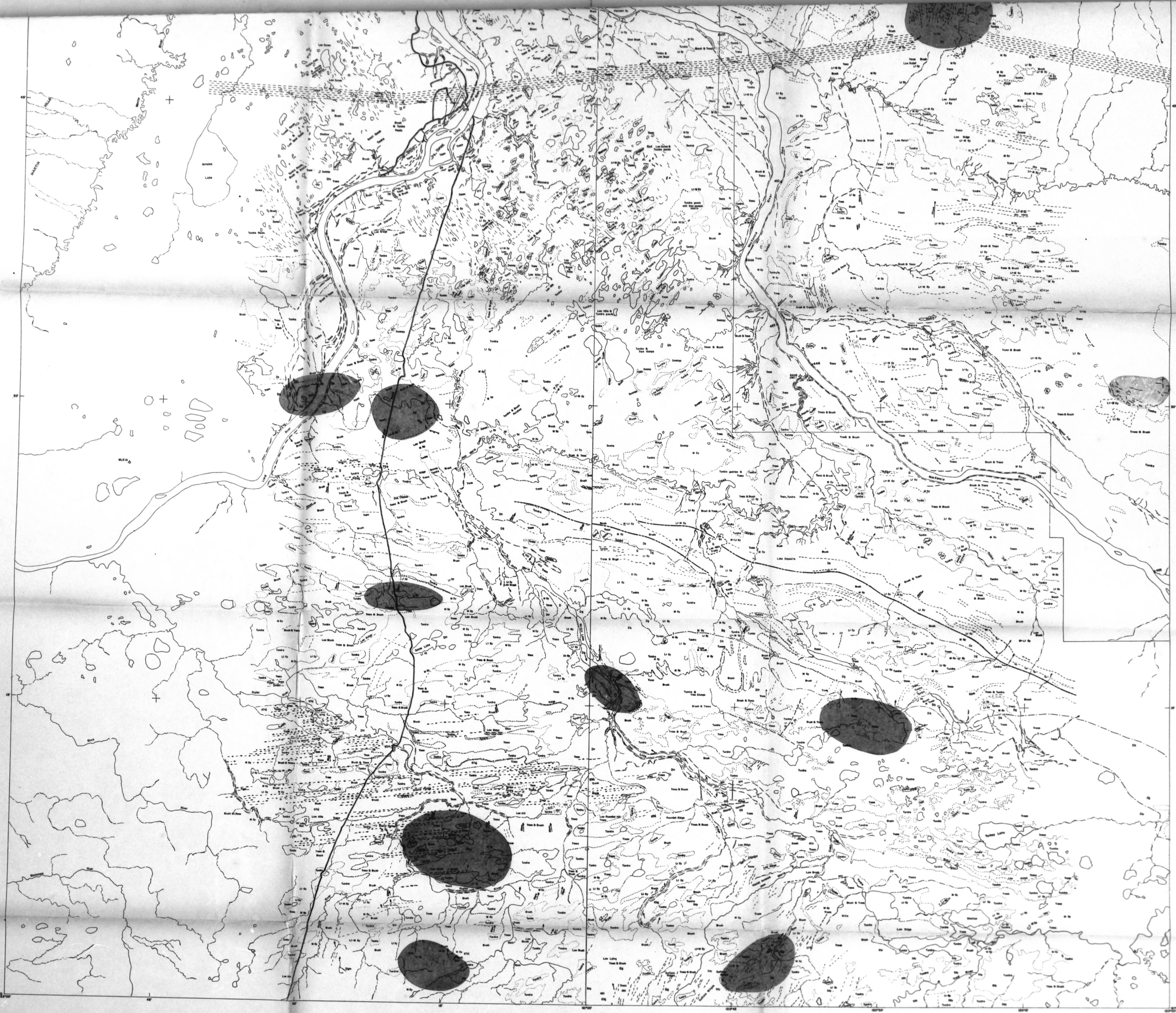


Well Abbreviations

BAHB JMC	British American- Hudson's Bay Jean Marie Creek
BTuL1	Briggs Turkey Lake
W3A	Westerol 3A
W7A	Westerol 7A

Local Photo Anomaly
Regional Photo Anomaly

EXPLANATION

QUATERNARY
- Q Undifferentiated
- Qls Lake Deposits
- Qal Alluvium
- Qg Glacial Undifferentiated
- Qgm Glacial Moraine

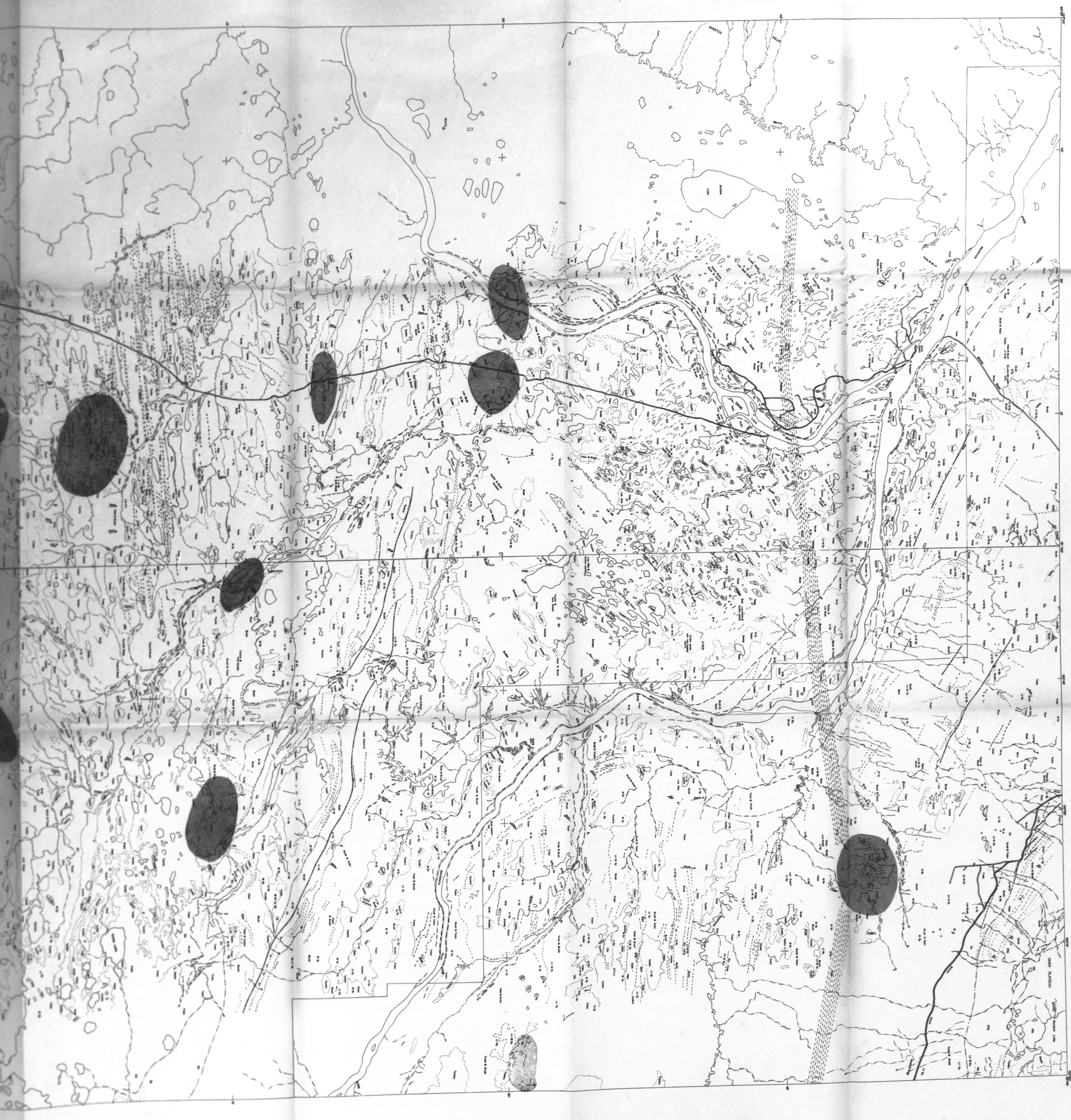
CRETACEOUS
- Kfn Fort Nelson Formation
- Kfsj Fort St.John Group

DEVONIAN
- Dtr Trout River Formation
- Dk Kakisa Ls.
- Dg Grumbler Formation
- Ds Simpson Group

CITIES SERVICE OIL CO.

PRELIMINARY PHOTOGEOLOGIC MAP
CANADA, NORTHWEST TERRITORIES
Ft. Simpson Quadrangle

2 of 2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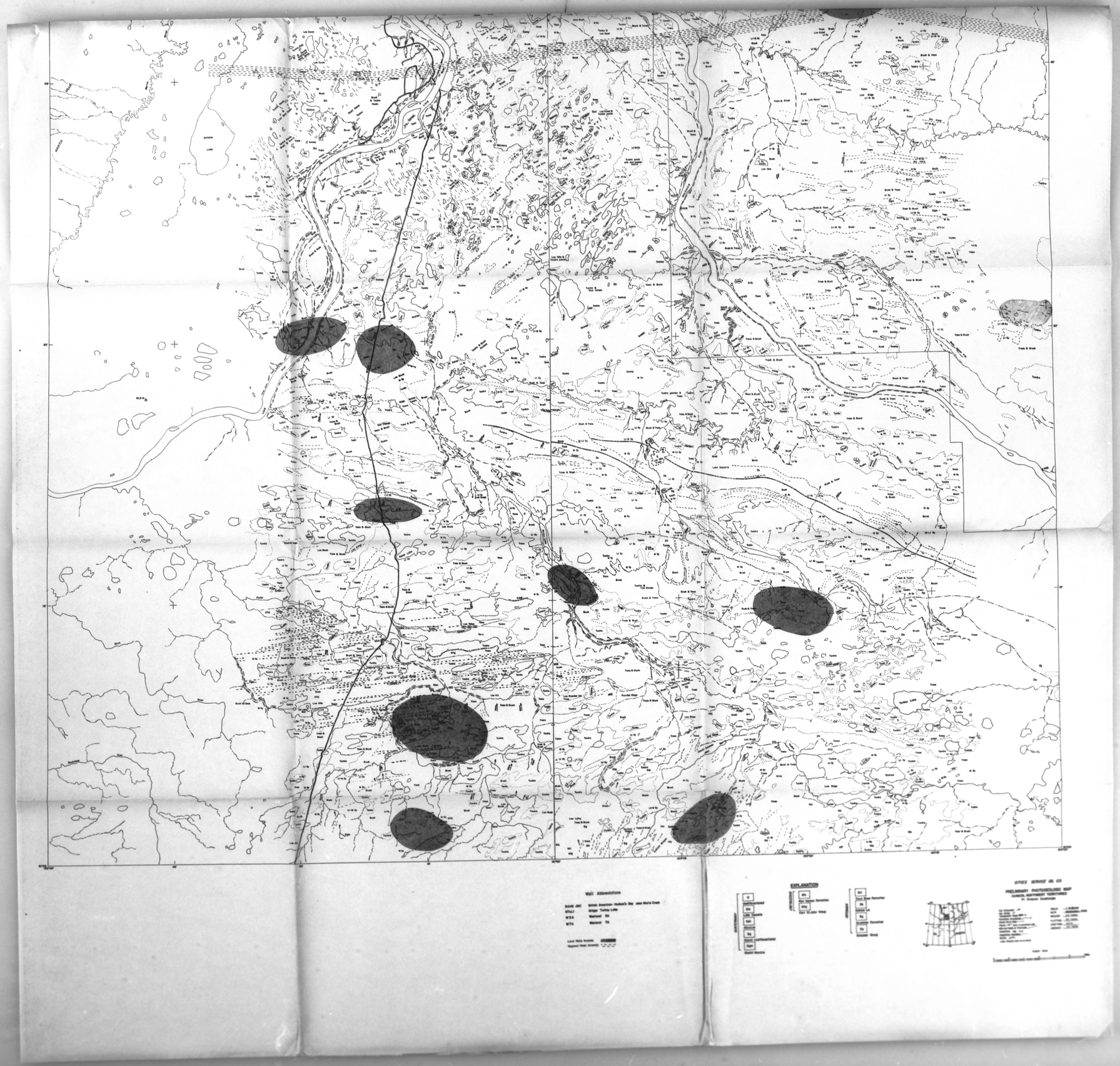
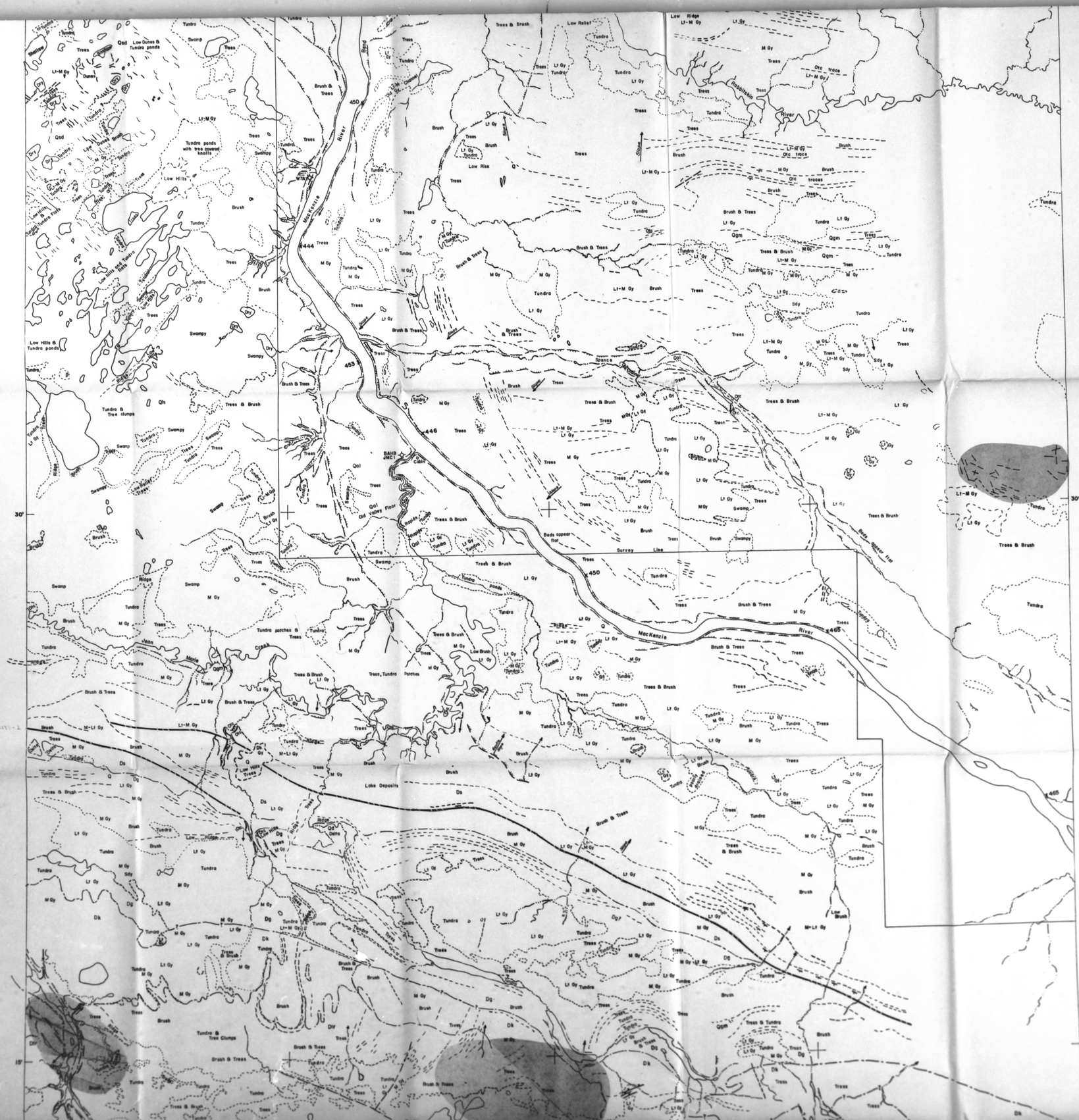
120°45'
120°30'
120°15'
120°00'
62°00'
45'
30'
15'
HORN PLATEAU
Mustard Lake
2400
Winter Road
Mackenzie
Trees
Brush
Trees & Brush
Brush & Trees
Tundra
Lt Gy
Lt-M Gy
M Gy
Low Brush
Old Burn
Survey Line
Kfn
Kfsj
Ds

1 of 2

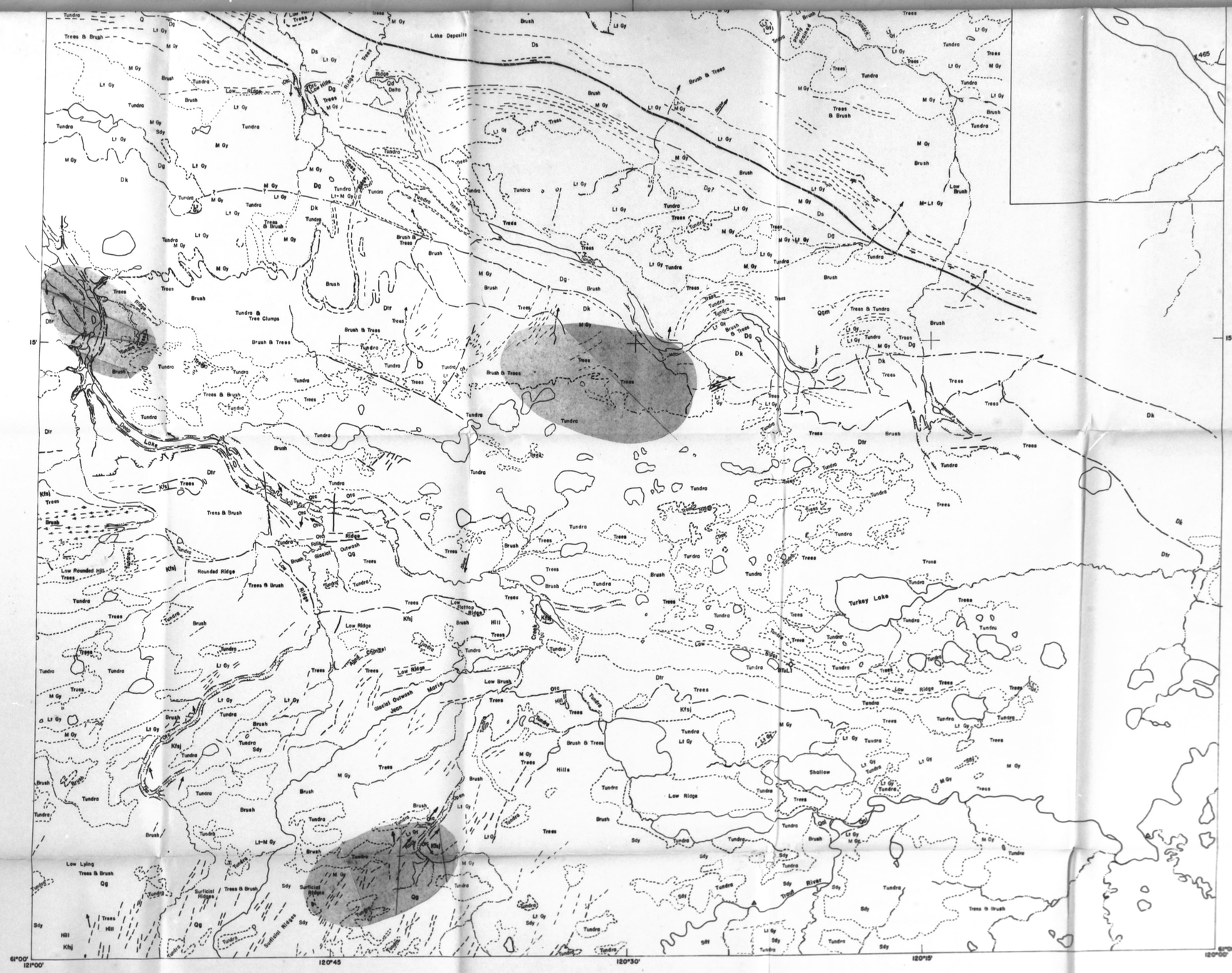

Well Abbreviations
EXPLANATION
PRELIMINARY PHOTOGEOLOGIC MAP

2 of 2


121°00'
62°00'
120°45'
120°30'
120°15'
120°00'
62°00'
45'
HORN PLATEAU
Mustard Lake
Winter Road
Hanson Is.
Green Is.
Mackenzie River
Rabbitskin River
Survey Line
Old Burn
Low Hills
Tundra ponds with tree covered knolls
Low Dunes & Tundra ponds
Tundra & Low Brush
Short Brush
Low Relief
Low Ridge
Low Rise
Swamp
Trees
Brush
Tundra
Burn
Ds
Kfn
Kfsj
Qsd
Qgm
Otc
Sdy
Qh
Qal
W3A
W1A
449
450
453
444


MacKenzie River
River
450
444
453
446
465
Survey Line
Beds appear flat
BAHR JNC
Old Valley Floor
Jean Marie Creek
Lake Deposits
Low Dunes & Tundra ponds
Tundra ponds with tree covered knolls
Low Hills
Low Hills & Tundra ponds
Tundra & Tree clumps
Tundra patches & Trees
Trees, Tundra Patches
Tundra & Tree Clumps
Low Relief
Low Ridge
Low Rise
Ridge
Swamp
Swampy
Tundra
Trees
Brush
Trees & Brush
Brush & Trees
Tundra ponds
Qsd
Qls
Qal
Qgm
Qtc traces
Ds
Dg
Dk
Lt Gy
M Gy
Lt-M Gy
M-Lt Gy
Sdy
30'
15'

2 of



Well Abbreviations

BAHB JMC	British American- Hudson's Bay Jean Marie Creek
BTuLI	Briggs Turkey Lake
W3A	Westerol 3A
W7A	Westerol 7A

Local Photo Anomaly

Regional Photo Anomaly

EXPLANATION

QUATERNARY

- **Q** — Undifferentiated
- **Qls** — Lake Deposits
- **Qal** — Alluvium
- **Qg** — Glacial Undifferentiated
- **Qgm** — Glacial Moraine

CRETACEOUS

- **Kfn** — Fort Nelson Formation
- **Kfsj** — Fort St.John Group

DEVONIAN

- **Dtr** — Trout River Formation
- **Dk** — Kakiso Ls.
- **Dg** — Grumbler Formation
- **Ds** — Simpson Group

CITIES SERVICE OIL CO.

PRELIMINARY PHOTOGEOLOGIC MAP
CANADA, NORTHWEST TERRITORIES
Ft. Simpson Quadrangle
NO. 1

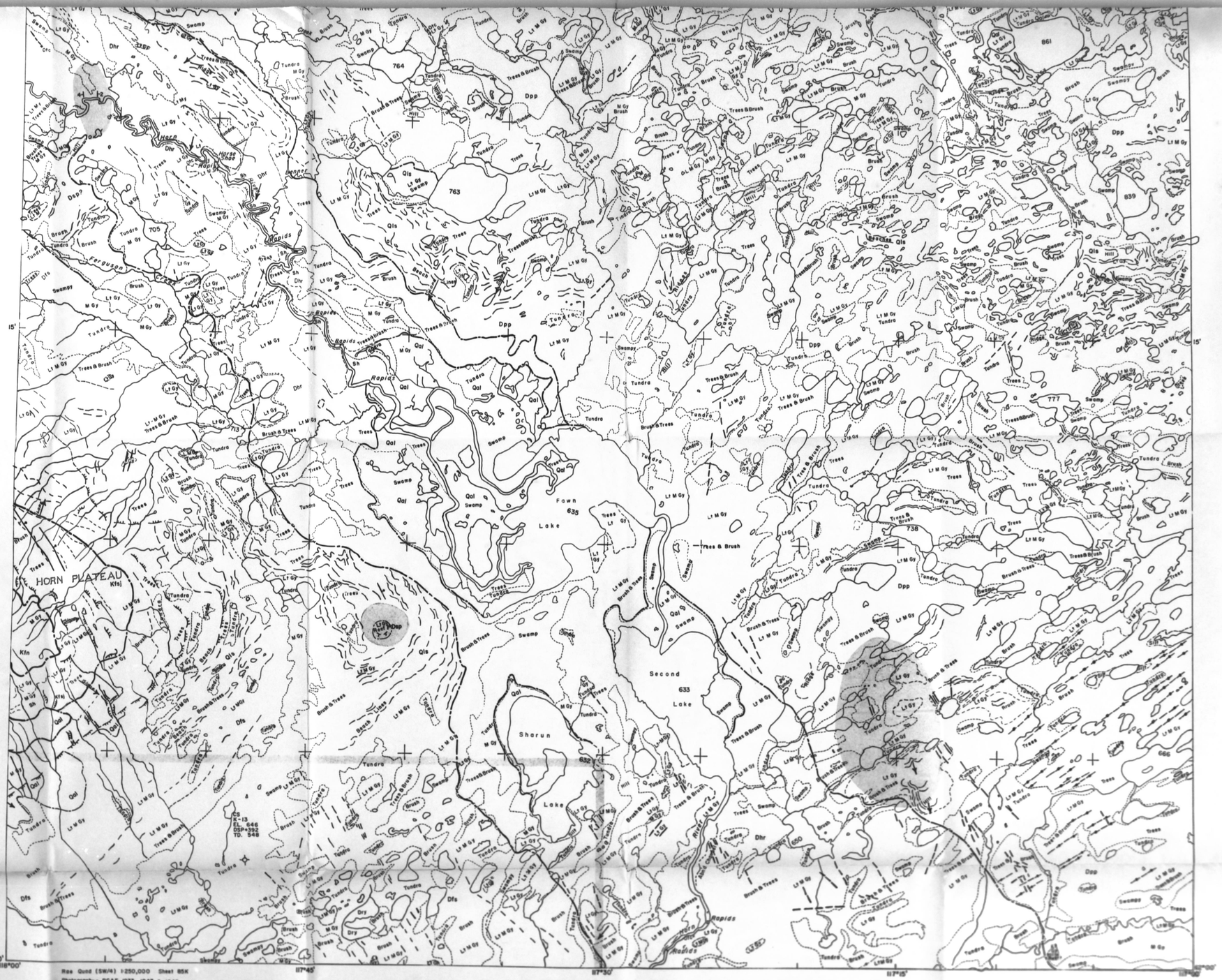
SCALE	1 Mile
DATE	March, 1965
GEOLOGY	G.S. Tedore
PLOTTING	G.S. Tedore
DRAFTING	M.S.G.
CHECKED	G.S. Tedore

Graphic Scale

3 of 5


118°00'
117°45'
117°30'
117°15'
117°00'
62°30'
62°30'
15'
15'
HORN PLATEAU
Lake
Fawn
Second
Sharon
Ferguson
Horse Shoe
Rapids
Ridge
Hill
Tundra
Brush
Trees
Swamp
Brush & Trees
Trees & Brush
Lt M Gy
M Gy
Lt Gy
Dpp
Dhr
Qal
Qls
Ols
878
757
764
763
705
635
633
861
839
901
777
738

1 of 2



Roe Quad (SW/4) 1:250,000 Sheet 85K
Photography - RCAF 1933, 1947 & 1948

EXPLANATION

Cities Service Acreage

Local Photo Anomaly

QUATERNARY

- Qal — Alluvium
- Qls — Beach Deposits and Lake Silts
- Qgm — Pleistocene Moraine Deposits

CRETACEOUS

- Kfn — Fort Nelson
- Kfsj — Fort St. John

DEVONIAN

UPPER

- Dtr — Trout River
- Dk — Kakisa Ls.
- Dgu — Grumbler, Upper
- Dgm — Grumbler, Middle
- Do — Alexandra Fm.
- Dh — Hay River Sh. & Ls.
- Dfs — Fort Simpson

MIDDLE

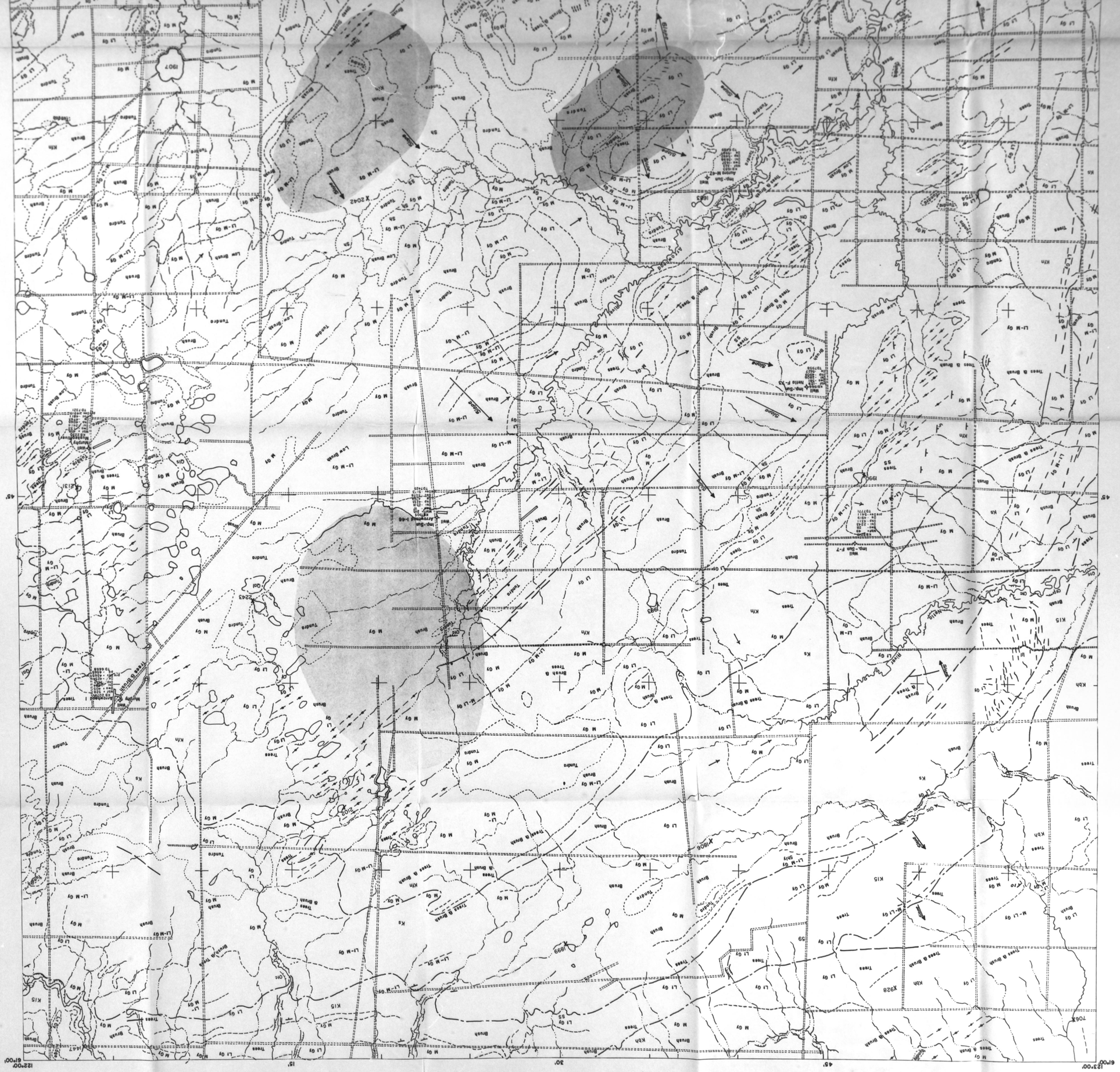
- Dsp — Slave Point (?) Reef
- Dhr — Horn River Fm., Sh. & Ls. (Presqu'ile)
- Dpp — Pine Point Fm.

CITIES SERVICE OIL CO

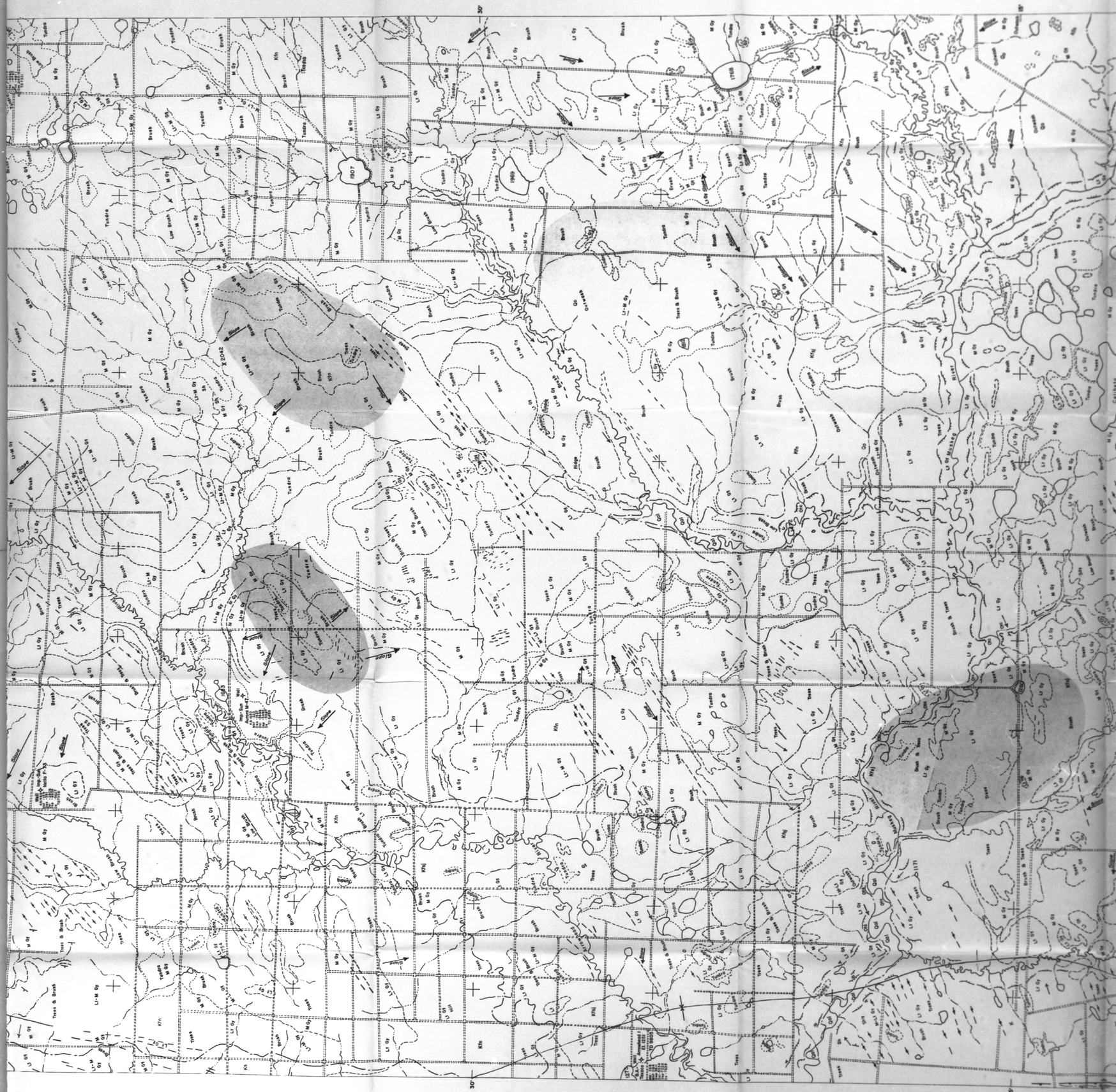
PRELIMINARY PHOTOGEOLOGIC MAP
CANADA, NORTHWEST TERRITORIES
Ft. Providence Project
Roe Quad SW/4

Graphic Scale

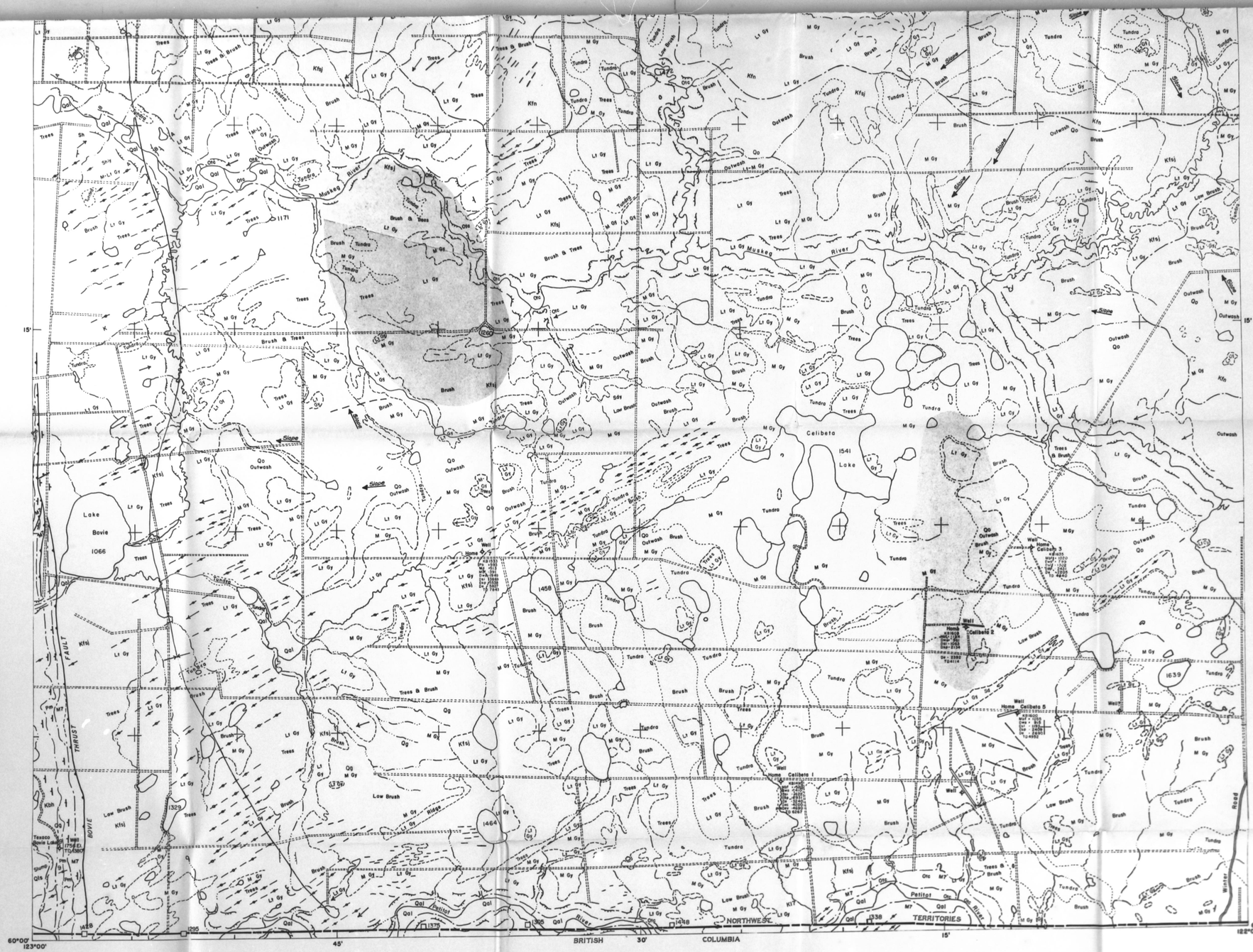
2-42


123°00'
61°00'
45'
30'
15'
122°00'
61°00'
45'
45'
Well
Imp.-Sun F-7
KB2019
Mbf+ 49
Deo- 28
Dsi - 2243
Dsp - 4311
De - 4919
preDev - 5411
TD7771
Well
Imp.-Sun
Arrowhead I-46
KB1905
Mbf + 295
Dsi -2514
Dsp -4233
De -4764
Dec -5078
preDev -5173
TD7425
Well
Murphy
Arrowhead I
KB 2078
Mbf + 528
Dwo + 405
De - 4254
preDev - 4365
pЄ - 4565
TD 6668
Well
Imp.-Sun
Netla F-X3
KB1966
Mbf -129
Dwo -581
Dsi -2806
Dsp -4903
De -5627
TD7958
Well
Imp.-Sun
Aurora M-47
KB1683
Murphy
Netla River
Arrowhead River
Slope
Trees
Brush
Trees & Brush
Tundra
Low Brush
Lt Gy
M Gy
Lt-M Gy
M-Lt Gy
Kbh
Ks
Kfn
K15
Qlc
Ql
SS
Sh
706
928
59
1899
1806
2102
2243
1993
1990
2131
1683
2042
1907
1447

14


Arrowhead River
Muskeg River
Tundra
Brush
Trees & Brush
Low Brush
Lt Gy
M Gy
Lt-M Gy
Kfn
Kfsj
Qo
Qal
Outwash
Ridge
Slope
1907
1969
1768
1813
1683
1171
2042
30'
15'

2 of



Base Map Control from Canada, Ft. Laird Quad. 1:250,000 Sheet 95B
Photography- Bradley 1961 1:60,000
Hunting 1964 1:60,000

WELL DATA LEGEND
Pb - Permian Belly
Md - Mississippian Debolt
Mbf - Mississippian Banff
Dwa - Devonian Wabamun
Dsi - Devonian Simpson
Dsp - Devonian Slave Point
De - Devonian Elk Point
Dec - Devonian Chincaga
pre-Dev - pre-Devonian

Local Photo Anomaly

EXPLANATION

QUATERNARY

- **Qal** — Stream Alluvium
- **Qls** — Landslide
- **Qo** — Outwash deposits
- **Qg** — Glacial Undifferentiated

CRETACEOUS

- **Kfn** — Fort Nelson Fm.
- **Kfsj** — Fort St. John Gp.
  - **Ks** — Sikanni Fm.
  - **Kl5** — ss., slts. and sh. CGS Bull. 59-6
  - **Kbh** — Buckinghorse Fm.

PERMIAN & CARBONIFEROUS

- **P9** — chert and ss. CGS Bull. 59-6
- **Pm** — Mattson Fm.

MISSISSIPPIAN

- **M7** — Gy lm., Gy sh. and Gy ss. CGS Bull. 59-6

CITIES SERVICE OIL CO.

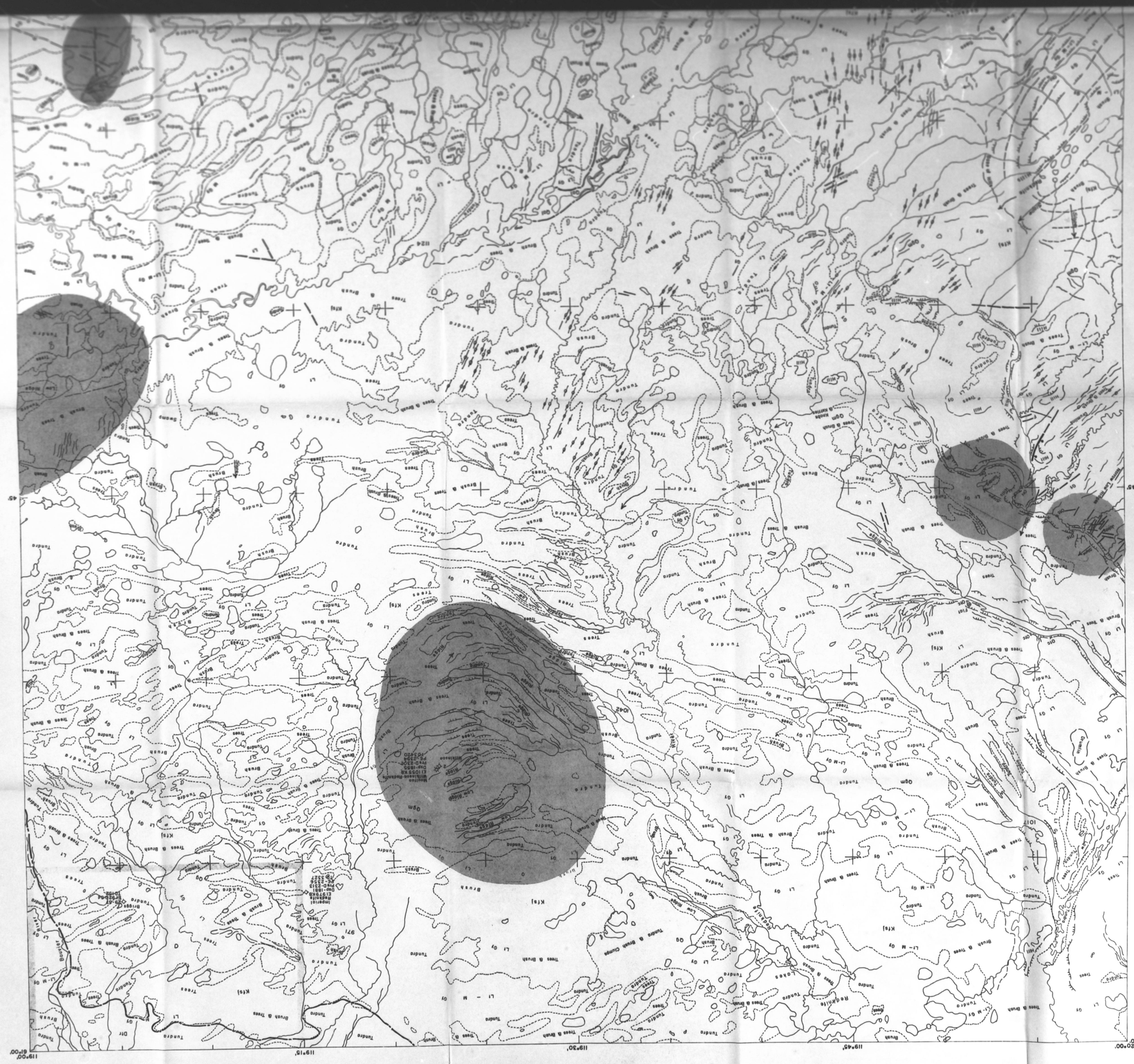
PRELIMINARY PHOTOGEOLOGIC MAP
CANADA, NORTHWEST TERRITORIES
FT. LIARD QUADRANGLE
NO. 1

Dip Component
Dip-Strike
Topographic Slope Break
Formation boundaries
Strata form lines
Faults — bars on Downthrown side
inferred faults or fracturs
Elevations
Vegetation boundary
Bluffs
Thrust Fault — Upthrown
Otc - Bedrock Outcrop
Surface Color - Lt Gy (Light Gray)

SCALE 1" = 1 Mile
DATE August '65
GEOLOGY E.E. Trabka
PLOTTING E.E. Trabka
DRAFTING H.G.S.
CHECKED E.E. Trabka

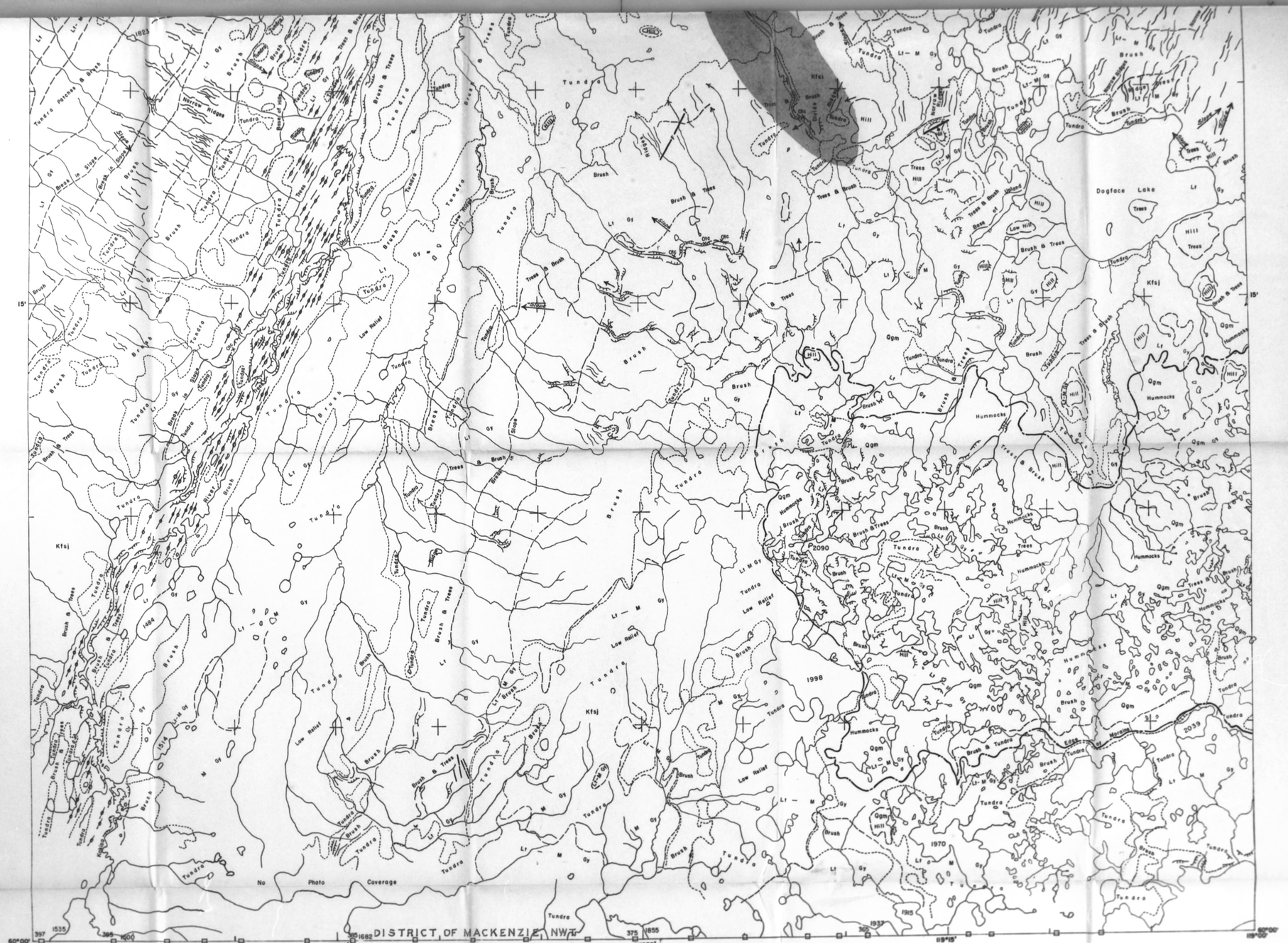
Graphic Scale

3 of 3


120°00'
61°00'
119°45'
119°30'
119°15'
119°00'
61°00'
45'
45'
Redknife Lakes
Redknife
Kfsj
Qgm
Qg
Lt-M Gy
Lt Gy
Dtr
Tundra
Trees & Brush
Brush & Trees
Tundra & Brush Clumps
Low Ridge
Ridge
Hill
Flat
Swamp
971
1011
1042
1124
Imperial
Redknife
E1979KB
Dsp-1881
PreD-2313
PЄ-2356
TD 3327
Briggs
29-57
E1920
TD152
Bouvier River
Moulton
Wilkinson-Redknife
E11055 KB
Dsp-1855
PreD-2302
PЄ-2354
TD3420
Wilkinson
Kettles

14

34th Base Line
30'
Redknife Hills
Narrow Ridge
Kfsj
Qal
Tundra
Trees & Brush
Brush & Trees
Swamp
Low Ridge
Low Hill
Hill
Lake
Drumlins
Base of Hills
Stream
Dogface Lake
2090
1426
1238
1231
1124
1206
1156



Kakisa Quad (W/2) 1:250,000 Sheet 85D
Photography- RCAF 1948, 1950 & 1951

Cities Service Acreage

Local Photo Anomaly

EXPLANATION

QUATERNARY

- Qal — Alluvium
- Qls — Slope Deposits and Lake Silts
- Qgn — Pleistocene Moraine Deposits

CRETACEOUS

- Kfn — Fort Nelson
- Kfsj — Fort St. John

DEVONIAN

Upper

- Dfr — Trout River
- Dk — Kakisa L.s.
- Dgu — Grumbler, Upper
- Dgm — Grumbler, Middle
- Dis — Alexandra Fm.
- Dfs — Fort Simpson
- Dh — Hay River Sh. & L.s.

Middle

- Dsp — Slave Point (?) Reef
- Dhr — Hare River Fm., Sh. & Ls. (Presqu'ile)
- Dsr — Rose Point Fm.

CITIES SERVICE OIL CO.

PRELIMINARY PHOTOGEOLOGIC MAP
CANADA, NORTHWEST TERRITORIES
Ft. Providence Project
Kakisa River (W/2)

Graphic Scale


Willowlake
Hornell Lake
Willow Lake
Douglas
Creek
Ridge
Hollow Ridge
Bluff
Tundra
Brush & Trees
Trees & Brush
Brush
Kin
Qsm
Qm
Qbs
Qtsl
Li Gy
Li-M Gy
Ss
2090
2228
2258
2280
2255
1877
1152
1140
62°30'
120°00'
119°45'
119°30'
119°15'
119°00'
118°45'
118°30'

EXPLANATION

QUATERNARY

- Qal — Alluvium
- Qls — Beach Deposits and Lake Silts
- Qgm — Pleistocene Moraine Deposits

CRETACEOUS

- Kfn — Fort Nelson
- Kfsj — Fort St. John

DEVONIAN

UPPER

- Dfr — Trout River
- Dk — Kakisa Ls.
- Dgu — Grumbler, Upper
- Dgm — Grumbler, Middle
- Dc — Alexandra Fm.
- Dh — Hay River Sh. & Ls.
- Dfs — Fort Simpson

MIDDLE

- Dsp — Slave Point (?) Reef
- Dhr — Hare River Fm., Sh. & Ls. (Presquile)
- Dpp — Pine Point Fm.

Local Photo Anomaly

Cities Service Acreage

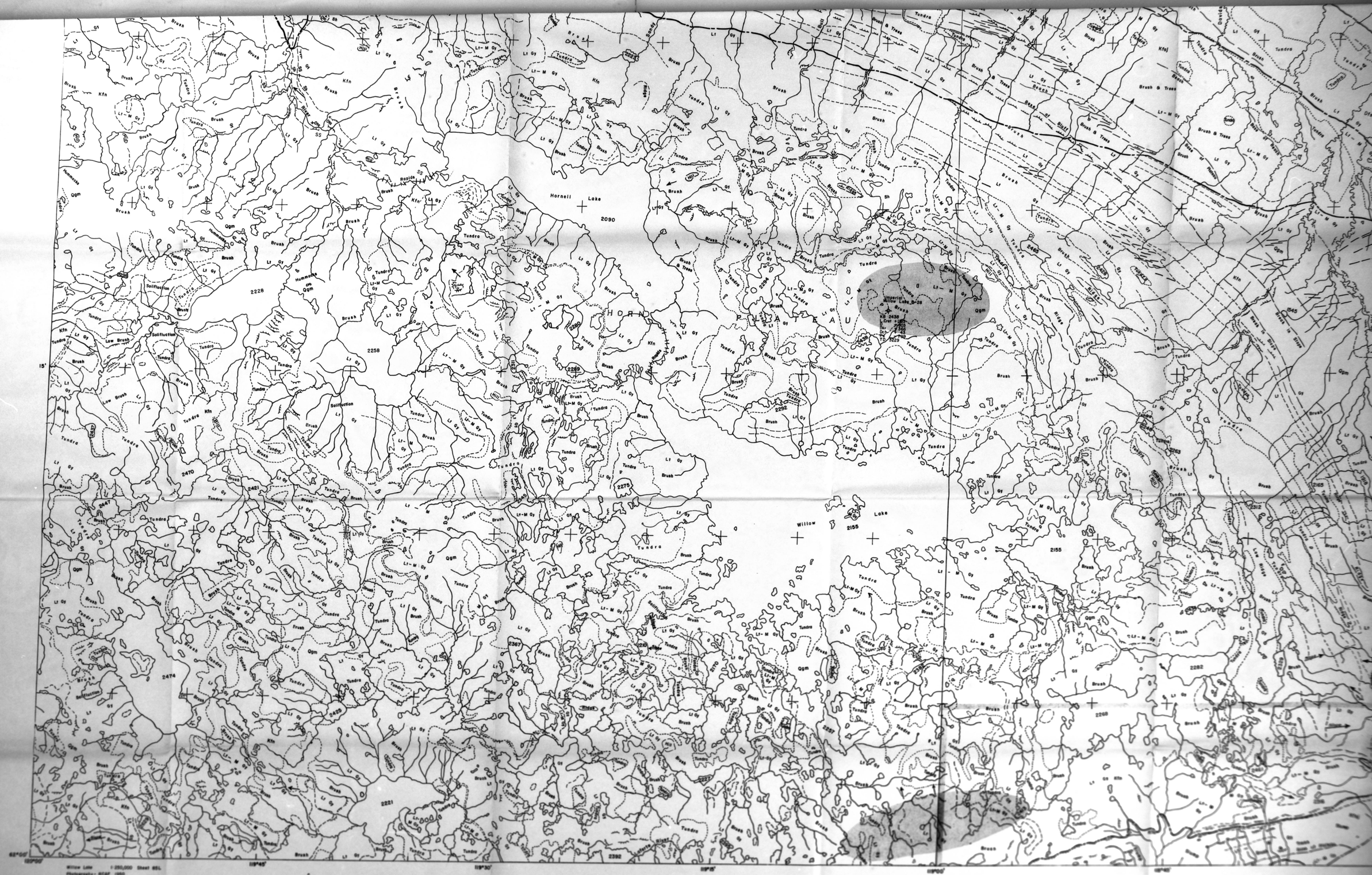
2

CITIES SERVICE OIL CO.

PRELIMINARY PHOTOGEOLOGIC MAP
CANADA, NORTHWEST TERRITORIES
Ft. Providence Project
Willow Lake

Dip Component
Dip-Strike
Topographic Slope
Formation Boundaries
Strata Form Line
Faults
Faults with Downthrown Side
Inferred Faults or Fractures
Elevations

SCALE
DATE
GEOLOGY
PLOTTING
DRAFTING
CHECKED


Hornell Lake
2090
HORN PLATEAU
Imperial Willow Lake 9-28
KB 2430
Crest 2385
Tar 2365
Sh 2360
TD 2325
Willow Lake
2155
Rapids
Rivers
Sandy
Sand
Base of Slope
Base of Bluff
Base of Flatter Slope
Base in Slope
Solifluction
Hummocks
Low Brush
Brush & Trees
Tundra
Brush
Lt Gy
Lt-M Gy
Kfn
Qgm
2228
2258
2470
2421
2441
2474
2428
2221
2367
2275
2269
2292
2282
2268
2257
2155
2312
2365
2363
2345
2325
2392
119°45'
119°30'
119°15'
119°00'
118°45'
Willow Lake 1:250,000 Sheet 85L
Photography - RCAF 1950

13

EXPLANATION

QUATERNARY

- **Qal** — Alluvium
- **Qls** — Beach Deposits and Lake Silts
- **Qgm** — Pleistocene Moraine Deposits

CRETACEOUS

- **Kfn** — Fort Nelson
- **Kfsj** — Fort St. John

DEVONIAN

UPPER

- **Dfr** — Trout River
- **Dk** — Kakisa Ls.
- **Dgu** — Grumbler, Upper
- **Dgm** — Grumbler, Middle
- **Da** — Alexandra Fm.
- **Dh** — Hay River Sh. & Ls.

MIDDLE

- **Dsp** — Slave Point (?) Reef
- **Dhr** — Horn River Fm., Sh. & Ls. (Presqu'ile)
- **Dpp** — Pine Point Fm.

Dfs — Fort Simpson

Local Photo Anomaly

Cities Service Acreage

CITIES SERVICE OIL CO

PRELIMINARY PHOTOGEOLOGIC MAP
CANADA, NORTHWEST TERRITORIES
Ft. Providence Project
Willow Lake

Virgin Data

444


Foetus Lake
Two Island Lake
Rabbit Lake
Bouvier River
Gull Creek
Abnd Channels
Low Ridge
Low Relief
Swamp
Swampy
Tundra
Trees
Brush
Trees & Brush
Dk
Lt Gy
Lt—M Gy
Dtr
Slope
Sinks
Sink Holes
Low Hill
Abnd Channel
Briggs
E. Foetus Lake
Dep -1659
Dep -1907
PC -1654
TD 2744
Briggs
E. Rabbit Lake
Dep -1298
Dep -1314
Dep -1760
PC -1760
TD 2836
Briggs
E. Rabbit Lake
Dep -1409
Dep -1614
PC -1614
TD 2310
1072
1064
1012
1150
1122
1153
1135
1118
1125
1004
1005
949
984
118°30'
118°45'
119°00'
61°00'
45'

34th Base Line
Shell
Y-Alexandra
El. 1257 KB
Dsp -2749
Dpr -3012
PC -3485
TD 4751 1066
Shell
I-Alexandra
El. 1020 KB
B. Kfsj +870
Dp +780
TD 426
Low Divide
Low Broad Divide
Rapids
Tathlina Lake
Browns Lake
Swamp
Tundra
Trees & Brush
Brush
Hill
Ridge
Slope
Base of Hills
Hummocks
Low Hills

Lucci Photo Anomaly

EXPLANATION

QUATERNARY

- **Qal** — Alluvium
- **Qls** — Beach Deposits and Lake Silts
- **Qgm** — Pleistocene Moraine Deposits

CRETACEOUS

- **Kfn** — Fort Nelson
- **Kfsj** — Fort St. John

DEVONIAN

UPPER

- **Dtr** — Trout River
- **Dk** — Kakisa Ls.
- **Dgu** — Grumbler, Upper
- **Dgm** — Grumbler, Middle
- **Da** — Alexandra Fm.
- **Dh** — Hay River Sh. & Ls.
- **Dfs** — Fort Simpson

MIDDLE

- **Dsp** — Slave Point (?) Reef
- **Dhr** — Horn River Fm., Sh. & Ls. (Presqu'ile)
- **Dpp** — Pine Point Fm.

CITIES SERVICE OIL CO.

PRELIMINARY PHOTOGEOLOGIC MAP
CANADA, NORTHWEST TERRITORIES
Ft. Providence Project
Kakisa River (E/2)

Dip Component
Dip-Strike
Topographic Slope
Formation Boundaries
Sports Rock Slope
Faults — seen on Stereoscope
Inferred faults or fractures
Elevations
Vegetation boundary
Bluffs
Thrust Fault — upthrown
Dip - Bedrock Outcrop
Surface Color - Lt Gy (Light Gray)

SCALE	1" = 1 Mile
DATE	June, 1955
GEOLOGY	S.S. Tredale
PLOTTING	S.S. Tredale
DRAFTING	S.S. T.
CHECKED	S.S. Tredale

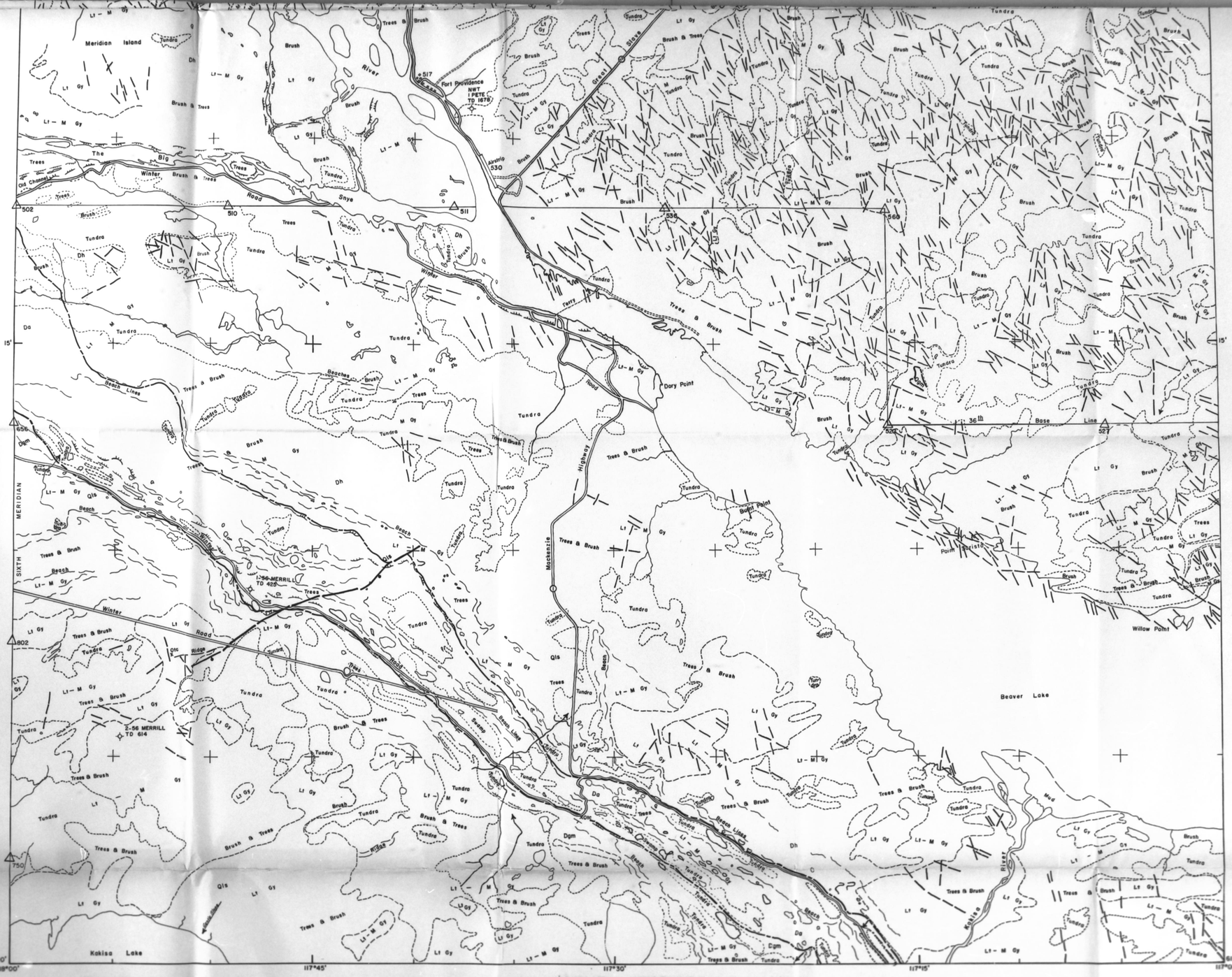
Graphic Scale

3 2 1 0 1 2 3 Miles

3&3


118°00'
117°45'
117°30'
117°15'
117°00'
62°00'
45'
Mink Lake
CS
A-36
EL 605
DSP +157
TD 605
CS
D-74
EL 602
DSP +129
TD 712
CS
B-48
EL 624
DSP +202
PE -636
TD 1277
Tundra
Swamp
Trees
Brush
Trees & Brush
Brush & Trees
Ridge
Low Hill
Hill
Old Shore
Mud
Dry

Mackenzie
River
Bluefish
Mission Island
Meridian Island
Fort Providence
Great Slave
Highway
Swamp with Tree Clumps
Swamp
Tundra
Trees & Brush
Brush & Trees
Trees
Brush
Lt-M Gy
Lt Gy
M Gy
Hill
Beach
Low Rise
Low Ridge
Dry
664 Water
Caen Lake
30'



Fokise Lake Quad (W/2) 1:250,000 Sheet 81F
Photography - RCAF 1947, 1948, 1950 & 1951

Cities Service Acreage

Local Mute Anomaly

EXPLANATION

QUATERNARY

- **Qal** — Alluvium
- **Qls** — Beach Deposits and Lake Silts
- **Qgm** — Pleistocene Moraine Deposits

CRETACEOUS

- **Kfn** — Fort Nelson
- **Kfsj** — Fort St. John

DEVONIAN — UPPER

- **Dtr** — Trout River
- **Dk** — Kakisa Ls.
- **Dgu** — Grumbler, Upper
- **Dgm** — Grumbler, Middle
- **Do** — Alexandra Fm.
- **Dfs** — Fort Simpson
- **Dh** — Hay River Sh. & Ls.

DEVONIAN — MIDDLE

- **Dsp** — Stone Point (?) Reef
- **Dhr** — Hare River Fm., Sh. & Ls. (Hiesp/Ta)
- **Dpp** — Pine Point Fm.

CITIES SERVICE OIL CO.

PRELIMINARY PHOTOGEOLOGIC MAP
CANADA, NORTHWEST TERRITORIES
Ft. Providence Project
Fokise Lake Quad W/2

Dip Component
Dip-Strike
Topographic Slope
Formation Boundaries
Strata Rock Slope
Faults
Inferred Faults or Lineaments
Elevations
Vegetation Boundary
Bluffs
Thrust Fault
Dip - Bedrock Outcrop
Surface Outcrop of Rock (Lower Map)

SCALE
DATE
GEOLOGY S.S. Thomas
PLOTTING S.S. Thomas
DRAFTING S.S.T.
CHECKED S.S. Thomas
FIELD CHECK

Graphic Scale

3 of 5


118°00'
61°00'
117°45'
117°30'
117°15'
117°00'
61°00'
45'
Kakisa Lake
Tathlina Lake
Kakisa River
Winter Road
Poor Photo Exposures
Lt Gy
Trees & Brush
Brush & Trees
Tundra
Beach
Swamp
Low Relief
Hill
Ridge
Low Ridge
Low Knobs
Kame Terrace
Kakisa Rapids
Karst Topography
Old Channel
Briggs #70-56
Ele 845
TD 252
Briggs #71-56
Ele 888
TD 172
Briggs #21-57
Ele 758
TD 130
Briggs #9-57
Ele 793
TD 212
Briggs #5-57
Ele 769
TD 165
Briggs NE Tathlina #1
Ele 850
Dsp - 1090
Dpp - 1350
TD 2222
Briggs Tathlina #8
Ele 883
Dsp - 1197
Dpp - 1450
TD 2371
Briggs Tathlina #5
Ele 892
Dh - 208
Dsp - 1298
Dpp - 1628
TD 2607
J.C. Wilkinson Kakisa #1
Ele 885
Dh - 415
Dsp - 1535
TD 3115
Briggs Tathlina #7
Ele 927
Dh - 113
Dsp - 1292
Dpp - 1654
TD 2765
Briggs Tathlina #9
Ele 953
Dsp - 1267
Dpp - 1614
Pc - 2002
TD 2928
J.C. Wilkinson Tathlina #4
Ele 911
Dh - 334
Dsp - 1439
Pc - 2279
TD 3198
Briggs Tathlina #3
Ele 939
Dh - 310
Dsp - 1580
Pc - 1849
TD 2890
Briggs Tathlina #4
Ele 920
Dh - 610
Dsp - 1720
TD 3410
Colston Tathlina D-39
Ele 956
Dh - 244
Dsp - 1463
Pc - 2000
TD 3210
Pan Am Kakisa F-35
Ele 756
Dh - 217
Dpp - 1332
Dc - 1614
TD 2395
Pan Am Kakisa H-36
Ele 762
Dh - 320
Dpp - 1601
Dc - 2406
Pan Am Kakisa I-36
Ele 767
Dh - 329
Dpp - 1585
Dc - 1840
TD 2572
Briggs Cy
Ele 965
TD 620
Briggs W. Tathlina #1
Ele 935
Dsp - 1811
Pc - 2270
TD 3255
Briggs W. Tathlina #2
Ele 930
Dh - 745
Dsp - 1859
Dpp - 2070
Dpc - 2280
Pc - 2455
TD 3438
Briggs W. Tathlina #3
Ele 930
Dh - 310
Dsp - 1720
TD 3410
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Qgm
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Lt Gy
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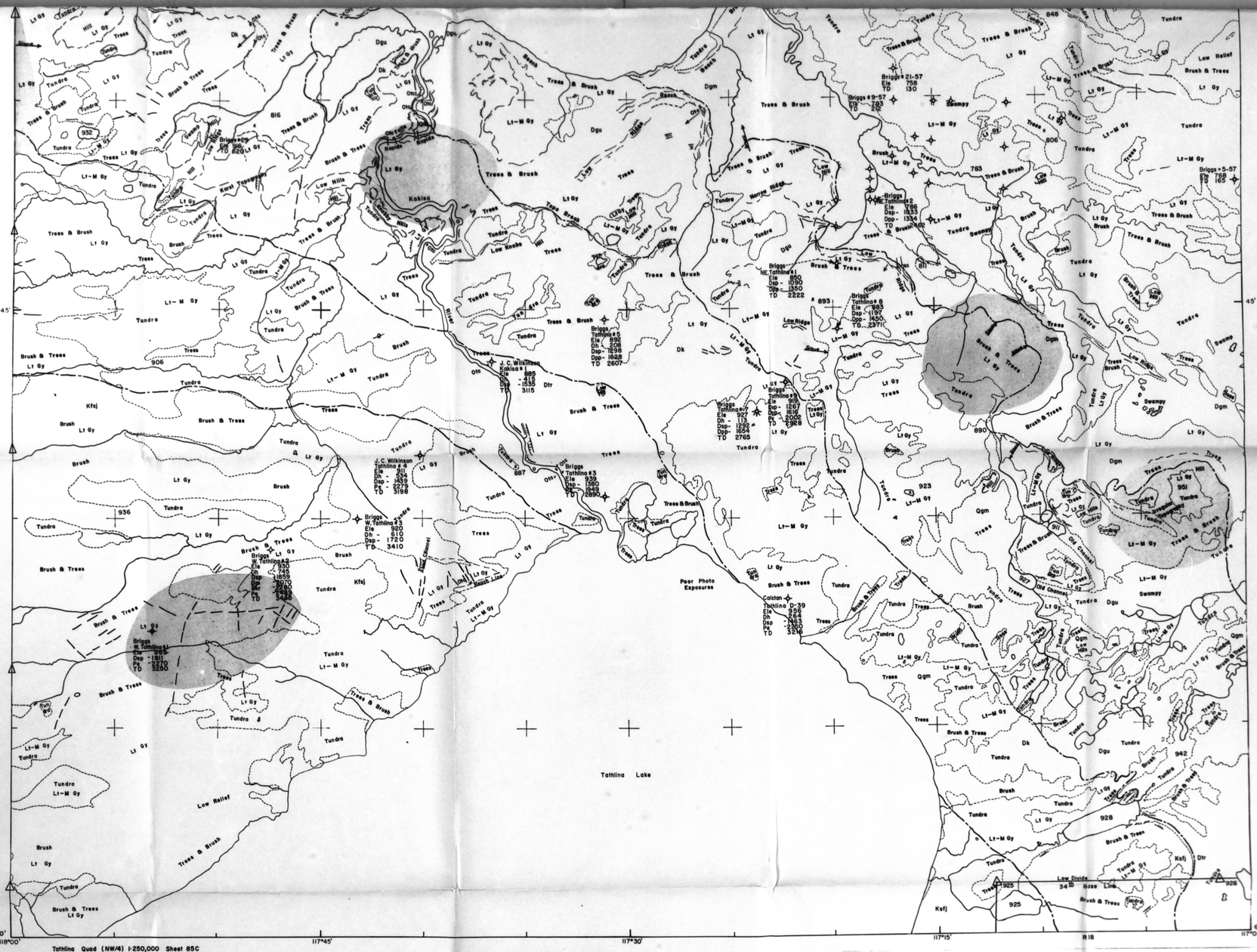
Swampy



Tathlina Quad (NW/4) 1:250,000 Sheet 85C
Photography – RCAF 1948, 1950 & 1951

EXPLANATION

QUATERNARY

- Qal — Alluvium
- Qls — Beach Deposits and Lake Silts
- Qgm — Pleistocene Moraine Deposits

CRETACEOUS

- Kfn — Fort Nelson
- Kfsj — Fort St. John

DEVONIAN

UPPER

- Dtr — Trout River
- D2l
- Dgu — Grumbler, Upper
- Dgm — Grumbler, Middle
- Da — Alexandra Fm.
- Dh — Hay River Sh. & Ls.
- Dfs — Fort Simpson

MIDDLE

- Dsp — Slave Point (?) Reef
- Dhr — Horn River Fm., Sh. & Ls. (Presqu'ile)
- Dpp — Pine Point Fm.

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PRELIMINARY PHOTOGEOLOGIC MAP
CANADA, NORTHWEST TERRITORIES
Ft. Providence Project
Tathlina Lake NW/4

Dip Component
Dip-Strike
Topographic Slope
Formation boundaries
Strata form lines
Faults — dots on downthrown side
Inferred faults or fractures
Elevations
Vegetation boundary
Bluffs
Thrust Fault — upthrown
Ore — Deposits Outcrop
Surface Color — Lt Gy (Light Gray)

SCALE	1" = 1 Mile
DATE	November, 1969
GEOLOGY	E.E. Tisdale
PLOTTING	E.E. Tisdale
DRAFTING	S.G.K.
CHECKED	E.E. Tisdale

Graphic Scale

2 of 2


122°00'
62°00'
45'
30'
15'
121°00'
62°00'
45'
Mackenzie
River
x409
x397
Survey Line
Winter Road
Low Bluff
Radio Towers
Ft. Simpson
Gros Cap
Martin Is.
x430
W4A
Liard
Old Channel
Antoine Lake
HILLS
MARTIN
Martin
River
Manners
Tundra
Trees
Brush
Brush & Trees
Trees & Brush
Lt Gy
Lt-M Gy
M Gy
Ridge
Low Hills
Low Hill
Low Hummocks with Trees
Ds with thin cover of Q
Swampy
Swamp
Shallow
Dunes
Low Dunes
Small Dunes
Tundra & Brushy Knolls
Tundra Ponds
Qls
Sd
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Dry
Low Ridge
Old Channel

14

MARTIN
Antoine
Lake
30'
30'
WLR IA
Lake
River
Water
Manners
Tundra
Trees
Brush
Swampy
Low Hills
Low Ridge
Dunes
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Shallow
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Barren
Low Relief
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Brush & Tundra Ponds
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Well Abbreviations

WLR IA	Westerol Laird Rapids IA
W4A	Westerol 4A

Lake Photo Anomaly

Regional Photo Anomaly

EXPLANATION

QUATERNARY

- Q — Undifferentiated
- Qls — Lake Deposits
- Qal — Alluvium
- Qg — Glacial Undifferentiated
- Qgm — Glacial Moraine

CRETACEOUS

- Kfn — Fort Nelson Formation
- Kfsj — Fort St.John Group

DEVONIAN

- Dtr — Trout River Formation
- Dk — Kakisa Ls.
- Dg — Grumbler Formation
- Ds — Simpson Group

CITIES SERVICE OIL CO.

PRELIMINARY PHOTOGEOLOGIC MAP
CANADA, NORTHWEST TERRITORIES
Ft. Simpson Quadrangle
NO. 2

Graphic Form