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GLACIAL SPILLWAYS IN THE PRAIRIES

A NATURAL HISTORY THEME STUDY OF GLACIAL SPILLWAYS IN NATURAL REGIONS 12, 13, AND 14

by

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SUMMARY

The three best and most outstanding glacial spillways in the Prairies are the Qu'Appelle, Milk River, and Battle. The Qu'Appelle Spillway is the longest, widest, and deepest of these three and has the highest natural value score. Even though 11 points were deducted from the Qu'Appelle Spillway score for human impact, the final rating for this spillway is six more than for the Milk River and Battle Spillways.

In the opinion of the author, the Qu'Appelle Spillway is the best and most outstanding spillway in the Prairie Provinces.

CONTENTS

Text

Illustrations

INTRODUCTION

Objective

The objective of this study of "Glacial Spillways in the Prairies" is fourfold:

1. To prepare a professional discussion on the origin and character of spillways.
2. To inventory glacial spillways of the Prairie Provinces incorporating the following:
   a. name of spillway;
   b. location of spillway;
   c. a brief descritpion of spillway including length, width of valley floor, vertical relief, and other factors;
   d. a brief description of natural values associated with spillway;
   e. a brief description of the significant human impact on spillways; and
   f. a list of references.
3. To comparatively rank all spillways in terms of quality of representing the glacial landform theme.
4. To select from the above inventory the best and most outstanding example of a glacial spillway in the Prairie Provinces.

Previous Work

Publications used in the compilation of this report are listed in the references cited, and the material used in the inventory is also cited on the inventory sheets in the Appendix.

Much of the material presented in the report is taken from a paper being prepared for submission to the Canadian Journal of Earth Sciences which is entitled, "History of deglaciation of southern Saskatchewan and adjacent areas". This compilation covers an area between 112°W. Long. in Alberta and Lake Agassiz in Manitoba and between 48°N. Lat. in the U.S.A. and 58°N. Lat. in Canada.

Present Study

The discussion on the origin and character of glacial spillways is based on the published information cited in the bibliography and on original unpublished material gathered by the author during studies of the Quaternary geology of Saskatchewan.

The inventory of glacial spillways is based primarily on office work in Saskatoon but includes a two-day office study of maps and photographs at the Alberta Department of Energy and Resources, Edmonton; a two-day field study of Alberta spillways; and after the first phase of the inventory was completed, a four-day field study of the best spillways in the Prairies. Because the history of the last deglaciation was not compiled for much of Alberta, it was necessary to determine the various glacial lake levels and associated ice frontal positions in order to locate the spillways of that Province.

GLACIAL DRAINAGE

As the continental glacier retreated upslope from the Mississippi River Basin (Fig. 1), meltwater was carried directly away from the retreating ice in meltwater channels which emptied into the Missouri River. Most meltwater channels occur in interlobate areas which were formed by the protrusion of pre-existing topographically high areas within the drainage basins (Fig. 2). As the lobes of ice retreated downslope from these uplands, the meltwater traced out ice-marginal meltwater channels (Manybone Creek, Fig. 3; and Arm River, Fig. 4) which were compelled to follow the surface contour rather than trending down the regional slope.

As the glacier retreated downslope in the Nelson, Churchill, and Mackenzie River Basins (Fig. 1), however, extra-glacial channels such as the South and North Saskatchewan Rivers (Fig. 5) carried runoff from the region that sloped toward the continental glacier and meltwater from the Rocky Mountain glaciers into ice-dammed glacial lakes. This extra-glacial water and the meltwater from the continental glacier drained southeastward from lake to lake through glacial spillways (Assiniboine Spillway, Fig. 5) which cut major valleys in drift and bedrock, particularly in drainage basin divides.

GLACIAL SPILLWAYS

Glacial spillways were formed by overflow of water from glacially dammed lakes. As the glacier retreated down the regional slope to the northeast in the Prairie Provinces, successively lower and younger glacial lakes were dammed by the retreating ice and, consequently, successively lower and younger spillways were formed. The level of a glacial lake at a particular time was governed not only by the position of the glacier but also by the level of the lake into which the spillway drained. The level of glacial Lake Melfort (Fig. 5), for example, was governed by the level of glacial Lake Agassiz into which the

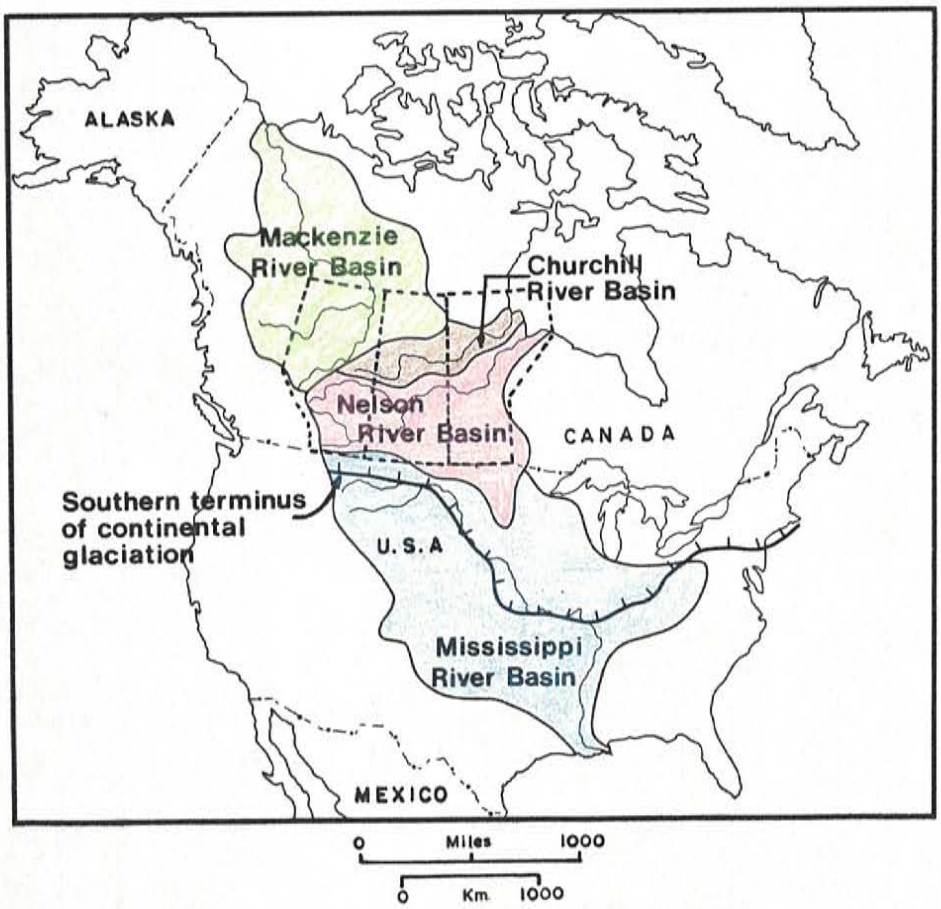

Figure 1. Map showing major drainage basins in the Prairie Provinces.

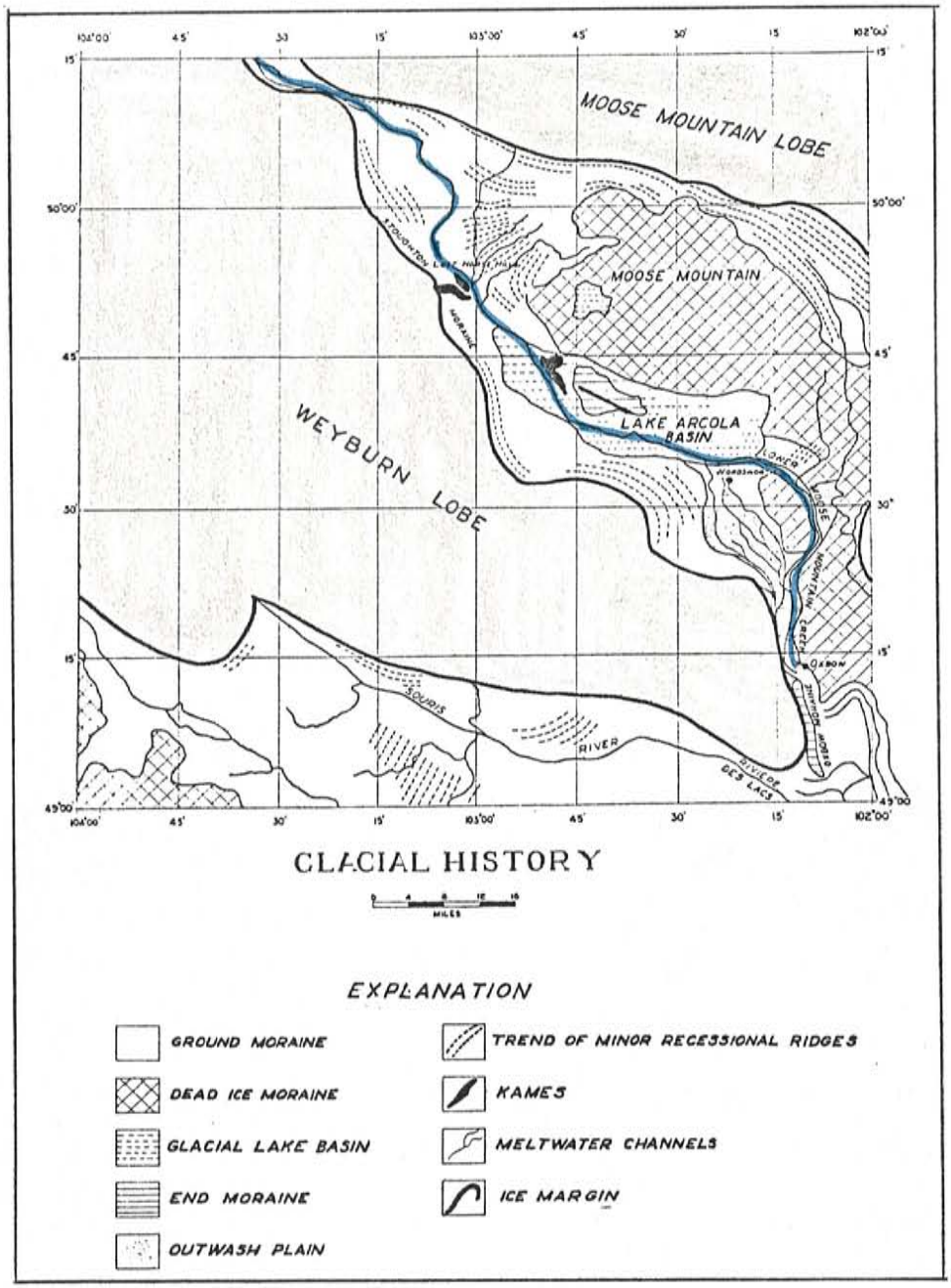

Figure 2. Origin of the Moose Mountain Creek meltwater channel. This interlobate area was initiated by the protrusion of the Moose Mountain Upland. (From Christiansen, 1956, p. 29).

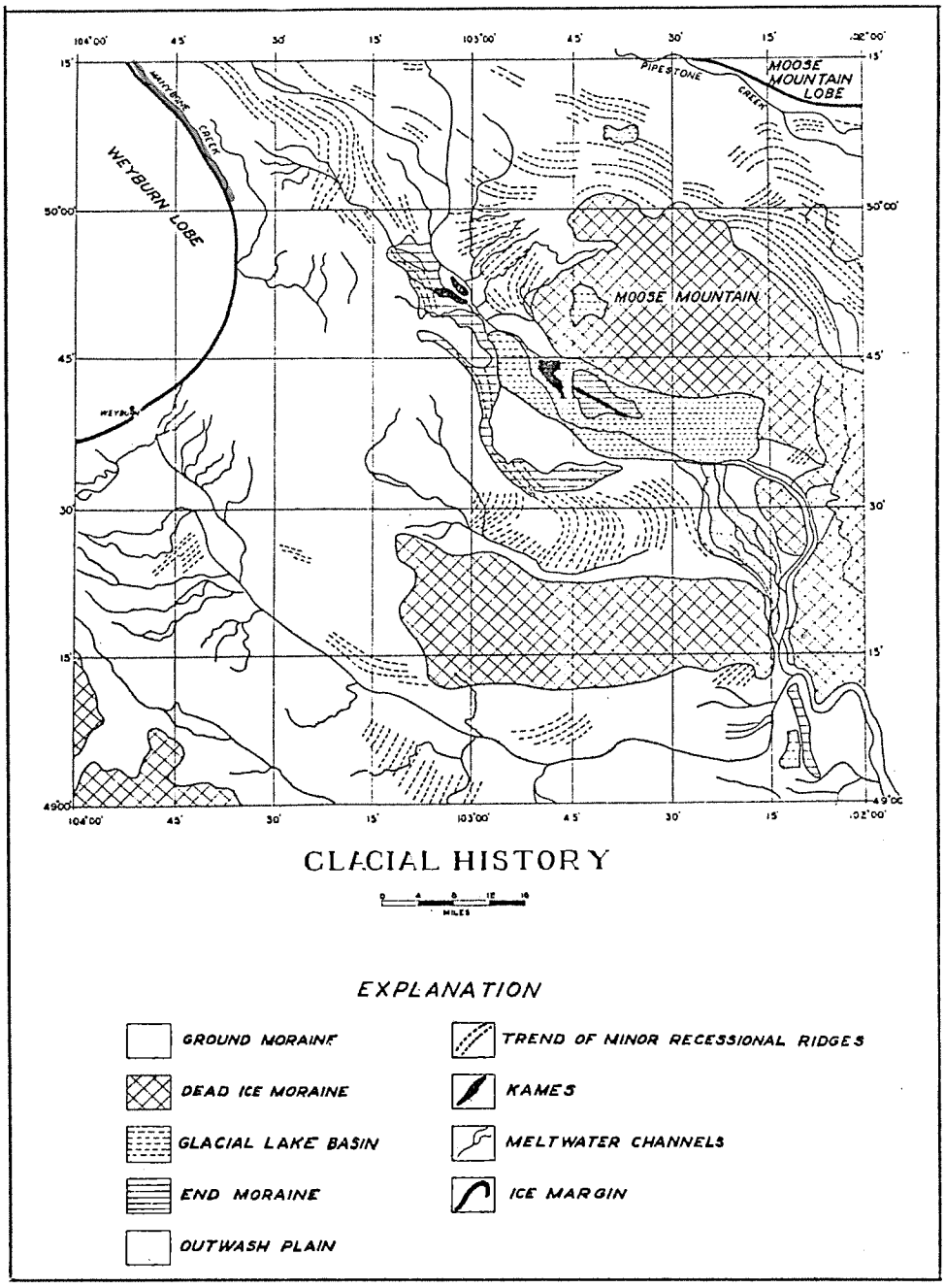

Figure 3. Origin of the ice-marginal meltwater channel, Manybone Creek. (From Christiansen, 1956, p. 31).

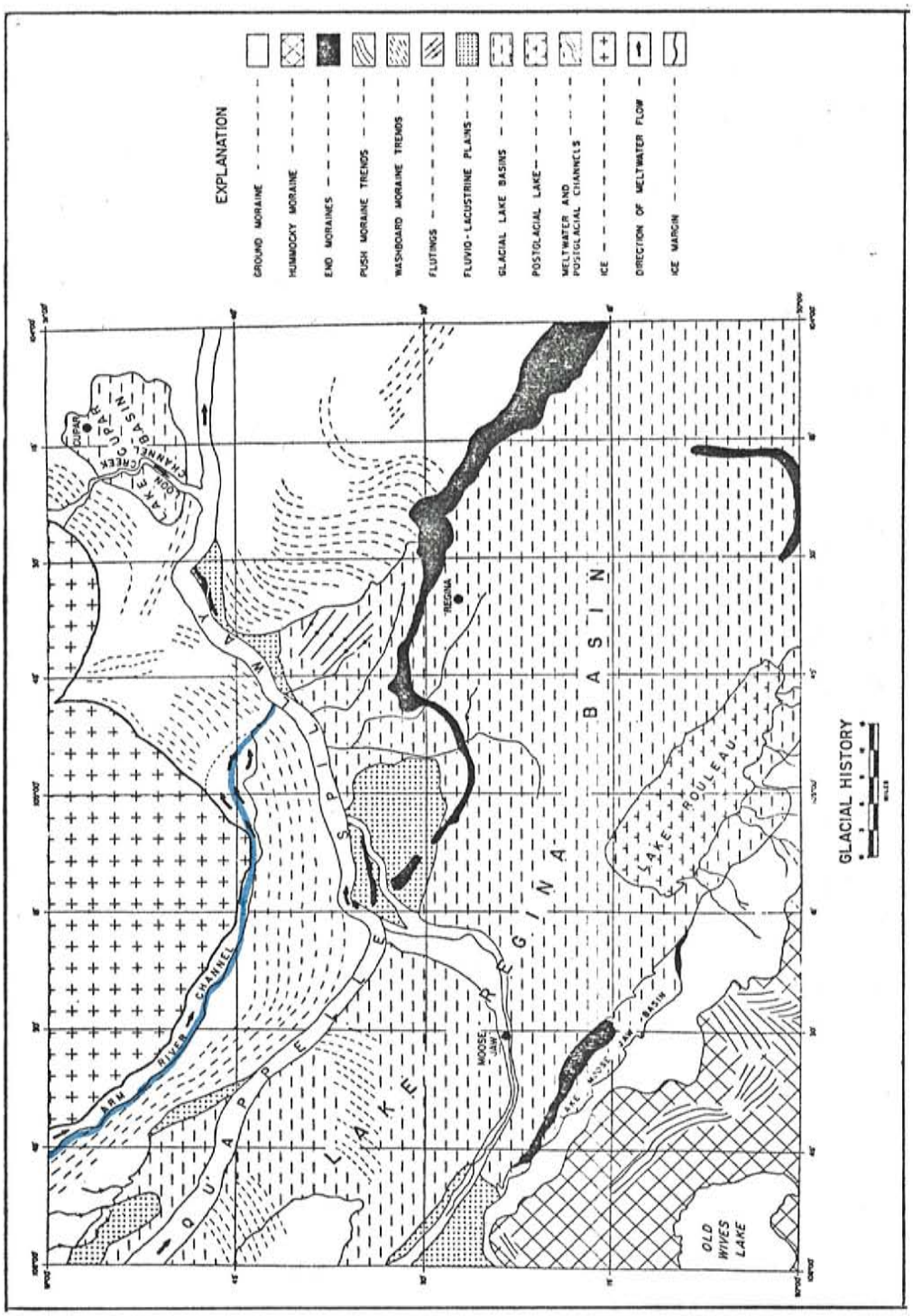

Figure 4. Origin of Arm River Channel. (From Christiansen, 1961, p. 51).

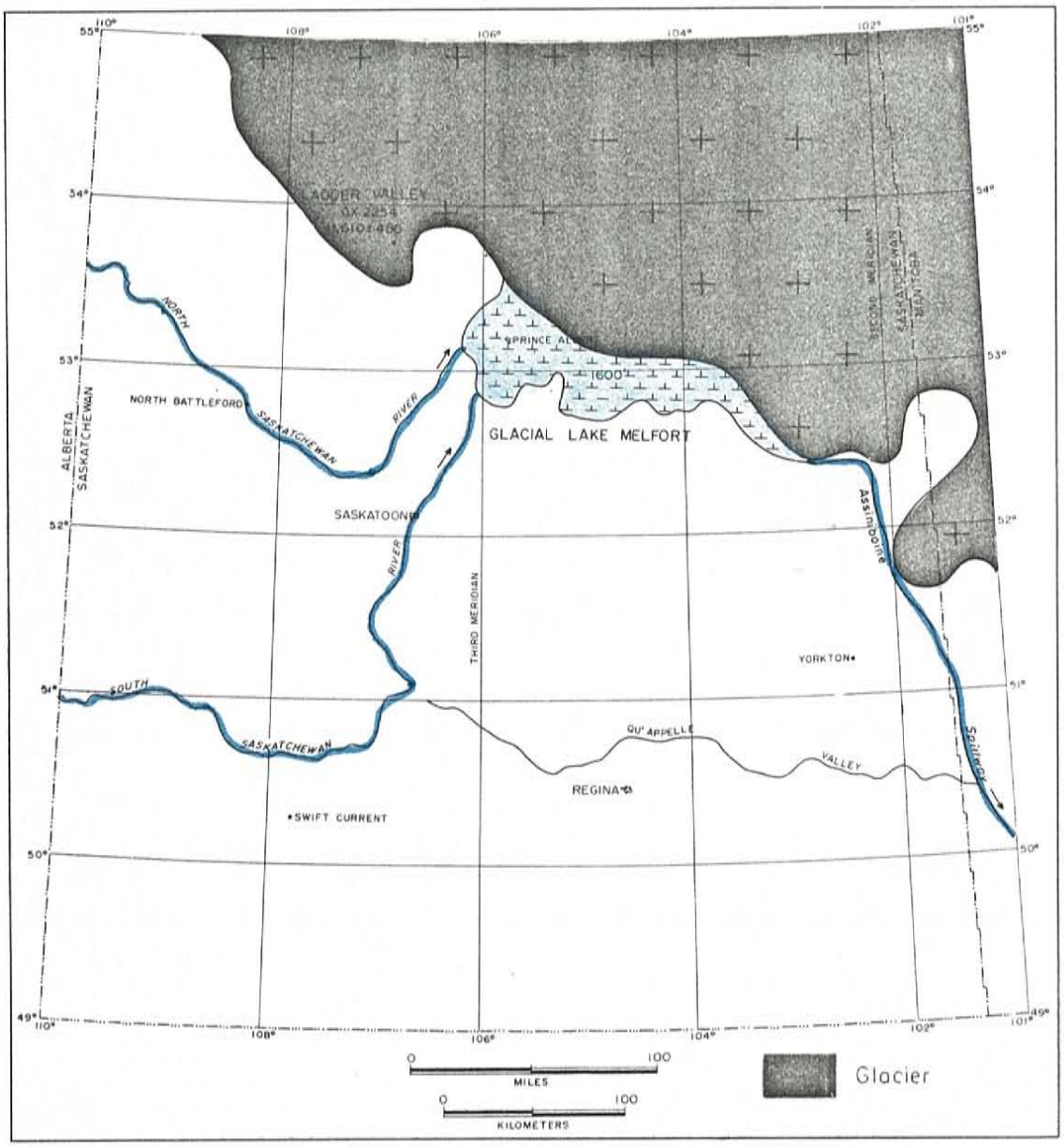

Figure 5. Extra-glacial South and North Saskatchewan Rivers. (From Christiansen, 1972 p. 43).

Assiniboine Spillway drained.

Glacial spillways carried water from glacial lakes which in turn were replenished by flow through extra-glacial channels (South and North Saskatchewan, Fig. 5) and by meltwater flow through meltwater channels. The Assiniboine Spillway (Fig. 5) carried both extra-glacial water and meltwater from the continental glacier, whereas the Cutarm Spillway (Fig. 6), for example, carried only meltwater from glacial Lake Saltcoats.

As in the case of meltwater channels, many spillways were formed along the ice margin (Pipestone Spillway, Fig. 7). Other spillways, however, were quite remote from the glacier (Souris Spillway, Fig. 7). The separation of these two spillways was caused by the Moose Mountain Uplands which formed the drainage divide between them. It was the protrusion of such pre-existing topographically high areas that dominated the shape of the ice margin and, consequently, the pattern of the meltwater channels and spillways.

Presently both meltwater channels and glacial spillways are being filled with sediments derived mainly from erosion in the valley walls and adjacent uplands as shown by well-developed, piedmont alluvial fans and plains that flank the valley walls. Between the alluvial fans and the slump blocks, the latter of which are abundant where the valley is cut in shale, particularly glacially disturbed shale, alluvial flood plains meander on top of alluvial fills. In the Qu'Appelle Valley, testholes indicate the alluvium is up to 90 metres thick. The flood plains are occupied by underfit streams, marshes, and temporary or permanent lakes.

Both meltwater channels and spillways are out-of-equilibrium with the postglacial environment. Since glaciation, more sediment has been brought into the valleys than the underfit streams can remove resulting in deposition of alluvium. Although recent, unpublished radiocarbon dates from the Qu'Appelle Valley indicate the rate of sedimentation is decreasing, ultimately these valleys will be filled with sediment.

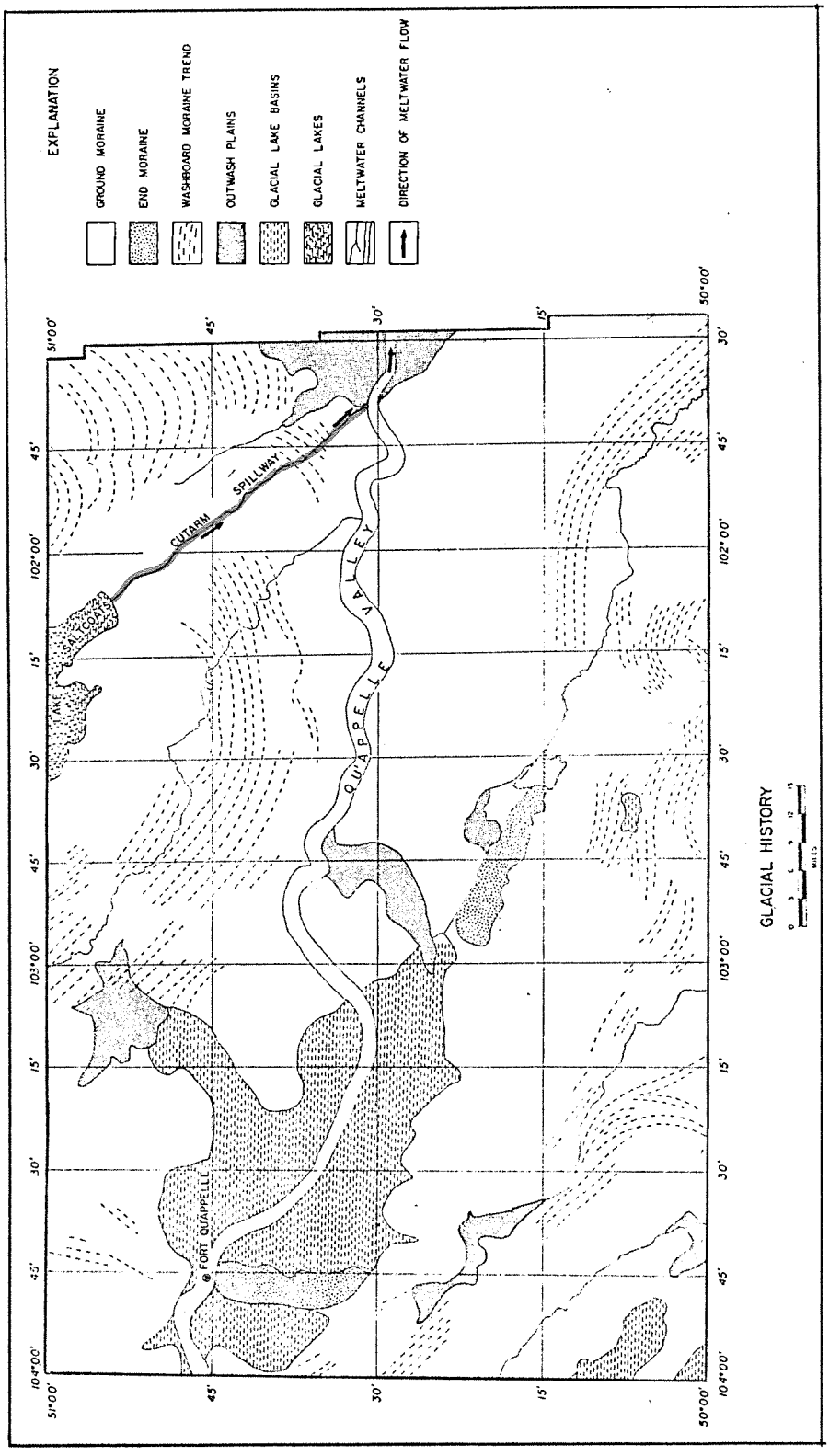

Figure 6. Origin of the Cutarm Spillway. (From Christiansen, 1960, p. 41).

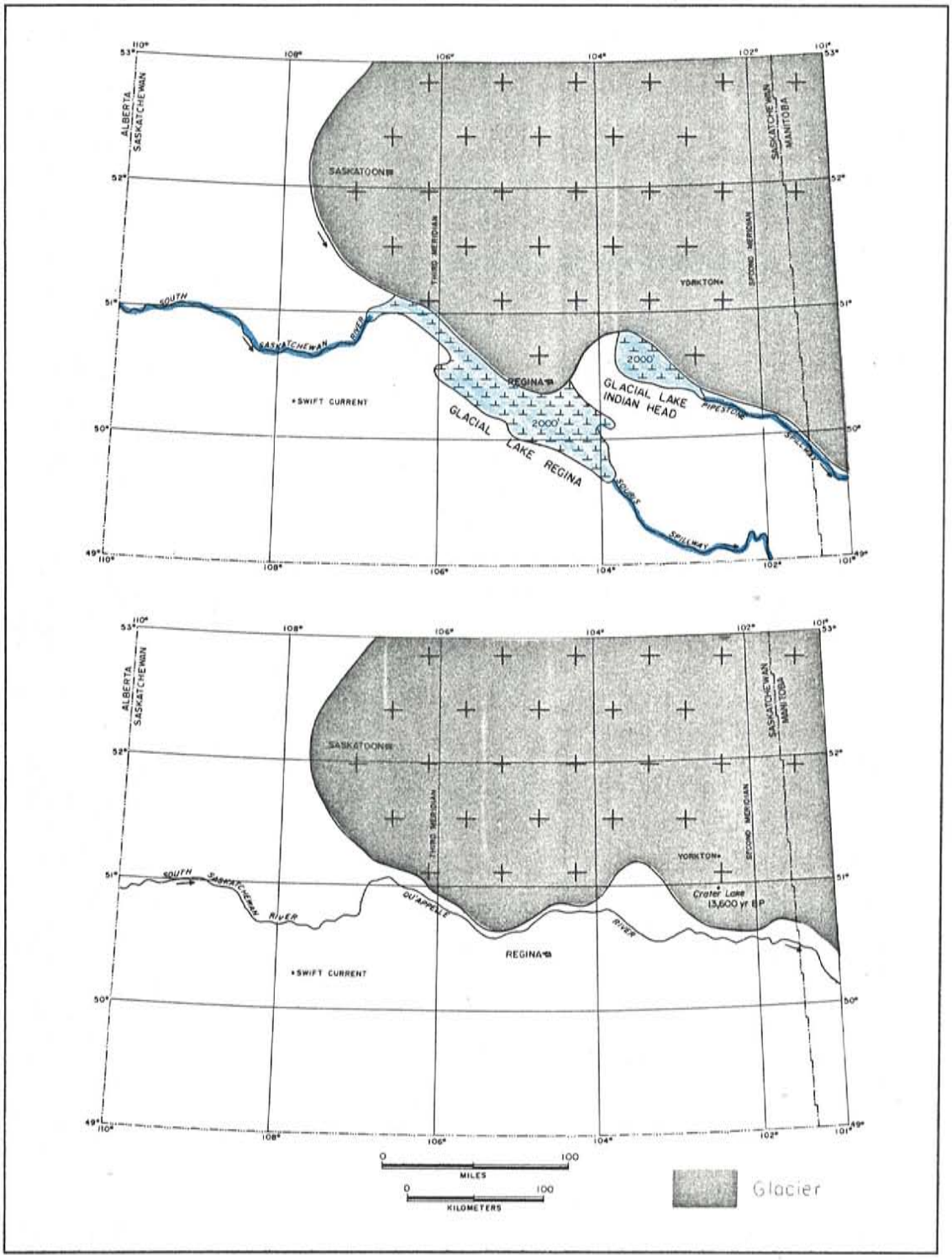

Figure 7. Origin of glacial Lakes Regina and Indian Head and the Souris and Pipestone Spillways. (From Christiansen, 1972, p. 42).

INVENTORY OF GLACIAL SPILLWAYS

Introduction

The spillways were inventoried under the following headings: (1) name of spillway; (2) location of spillway; (3) description of spillway; (4) natural values associated with spillway; and (5) significant human impact on spillway; (Appendix, pages 1 and 2 of 3). A list of references for each spillway appears on pages 2 of 3 (Appendix).

Name of Spillway

The name of the spillway was taken from the literature or from a stream or lake occupying it. The words "creek" or "river" may or may not appear in the name depending of the sound of the spillway name.

Location of Spillway

The location of the spillway is shown on a map (Appendix, page 1 of 3). A scale was chosen which would permit the location of the spillway to be shown on a map with demensions less than 13x18 centimetres.

The seven best developed spillways have a part of their courses also located on topographic maps at a scale of 1:250,000 with 100-foot contour intervals. In addition to these location maps, the three best spillways have the best part of their courses located on topographic maps at a scale of 1:125,000 with 25-foot contour intervals (Appendix, between pages land 2 of 3).

Description of Spillway

The description of the spillway includes length, width of valley floor, relief, depth of fill, whether in drift only or in drift and bedrock, and whether it drained meltwater only or meltwater and extra-glacial runoff. The length of a spillway is taken as the length occupied by the present stream from which the spillway was named. Although the Qu'Appelle Spillway at one time, for example, extended to the Assiniboine Delta east of Brandon (Klassen, 1975, p. 50), the spillway between the confluence of the present Qu'Appelle and the Assiniboine Delta was assigned to the Assiniboine Spillway.

The width of the spillway was measured at the widest point along its coarse but not where it is locally anomalously wide because of some peculiarity. The relief measured represents the maximum relief along the entire course of the spillway. Because the depth of the fill is only known for the Qu'Appelle

and Assiniboine Valleys, this item was not included in the description although it appears in the inventory sheets.

NATURAL VALUES ASSOCIATED WITH SPILLWAYS

Introduction

Natural values in the uplands within 20 kilometres of the spillway include ridged moraine, ice-thrust moraine, end moraine, flutings, eskers, tunnel valleys, glacial lake basins, outwash plains, and meltwater channels. Natural values within the spillways include landslides, bedrock exposures, springs, alluvial fans, flood plains, streams, marshes, lakes, deltas, beaches, and terraces (Appendix, pages 2 of 3).

Ridged Moraine

Ridged moraine is used herein to describe minor, subparallel, generally arcuate ridges (1-5 m high) and intervening swales in till. Gwynne (1942) demonstrated the ridged moraine trend is parallel to the position formerly occupied by the ice margin.

Ice-thrust Moraine

Ice-thrust moraine is used herein to describe major, subparallel generally arcuate ice-thrust ridges (up to 60 m high) and intervening swales. The landform is similar to ridged moraine except the ice-thrust ridges are larger. Byers (1959) demonstrated the ice-thrust moraine is the surface expression of glacial thrusting and that the ridges are parallel to the position formerly occupied by the ice margin. The ice-thrust moraine associated with the Qu'Appelle Spillway south of Esterhazy (Appendix, p. 3) was overridden by ice as shown by the occurrence of till that blankets the moraine. The similar appearance of the ice-thrust moraine associated with the Milk River Spillway (Appendix, p. 8) suggests that this thrust moraine was also overridden by ice.

End Moraine

The broad, long ridges (up to 50 m high) that are conspicuous on 1:50,000 topographic sheets are interpreted as end moraines. In some localities, end moraines are composed of belts of hummocky moraine.

Flutings

Flutings are narrow, straight to gently curved, parallel ridges and grooves in till. The ridges are 1 to 10 metres high and the inter-ridge distance is up to 130 metres. Chapman and Putnam (1951, p. 15, 99, 212) concluded that the grooves are erosional features formed at the base of a moving glacier and that the ridges and grooves trend in the direction of ice movement.

Eskers

Eskers are sinuous ridges of sand and gravel formed in tunnels at the base of melting glaciers. For the most part, eskers are poorly developed in the Prairies.

Tunnel Valleys

Meltwater flowing beneath the ice can either form depositional features (eskers) or erode valleys in the material under the glacier to form tunnel valleys (Embleton and King, 1968).

Glacial Lake Basins

As the glacier retreated down the regional slope to the northeast in the Prairies, successively lower glacial lakes were dammed by the retreating ice. These lakes are recorded in the present landscape by deltaic sands and gravels and lacustrine silts and clays and are called glacial lake basins.

Outwash Plains

Outwash plains are used herein to describe blankets of sand and gravel which are either derived from the melting glacier or from the erosion of drift, mainly till. Outwash plains form either where there was a decrease in gradient or an increase in the width of the stream.

Meltwater Channels

Meltwater channels are channels which carried meltwater directly from the retreating glacier (Fig. 2). Meltwater channels appear in the present landscape as valleys which are identical in appearance to spillways and which can only be distinguished on the basis of origin.

Landslides

Landslides are perceptible downward movement of relatively dry drift and bedrock. These features are best developed where the spillway was eroded in bedrock, particularly disturbed bedrock shales.

Bedrock Exposures

Bedrock exposures are best developed in sandy bedrock which is less susceptible to sliding than shale. Where the spillway is cut into the weaker shales, most of the bedrock is covered with landslide debris which is composed of a mixture of bedrock and drift.

Springs

Springs discharge into the valley slopes of the spillways from bedrock sand, from sand and gravel between bedrock and till, from intertill sand and gravel, and from surficial sand and gravel. The rate of discharge from these springs depends on the areal extent and permeability of the water bearing material.

Alluvial Fans

Alluvial fans are low, outspreading, gently sloping masses of loose gravel, sand, silt, and clay shaped like an open fan. This landform develops where tributary valleys enter the spillway floor. Alluvial fans are the most important sedimentary environment in the alluvial fills in the spillways.

Flood Plains

Flood plains are strips of relatively smooth land adjacent to stream channels and are constructed when the streams overflow their banks in times of high water. The positions of the flood plains and streams on the spillway bottoms are controlled primarily by the growth of the alluvial fans. Where the fans are extensive on one side of the valley, the flood plains are restricted to the opposite side of the spillway floor.

Streams

All streams on the spillway floors are underfit and in many cases ephemeral. With a normal snowmelt, these streams generally reach flood stage. During the remainder of the year, however, they flow at a very reduced rate or dry-up entirely.

Marshes

Marshes develop in water-saturated areas that are covered by shallow water at least during the growing season. Marshes occur in oxbow lakes, in low-lying parts of the flood plain, in deltas, in the periphery of alluvial fans extending into lakes, or wherever there is a relatively permanent body of shallow, quiet water.

Lakes

Lakes cover parts of the valley floor of many spillways. Most lakes are shallow and are believed to be dammed by alluvial and colluvial material from fans and landslides. Other lakes are anomalously deep such as The Fishing Lakes in the Qu'Appelle Spillway which are believed to be related to an enormous groundwater discharge that took place from the buried Hatfield Valley during deglaciation.

Deltas

A delta is a low, nearly flat alluvial tract of land deposited at or near the mouth of a stream. Because the spillways are commonly occupied by small ephemeral streams, the deltas are poorly developed. Where the streams are well developed, however, and the distances between lakes are considerable, well-developed deltas occur.

Beaches

The best beaches are developed where the shore is in alluvial fans. In such areas offshore bars, raised beaches, and lagoons occur.

Terraces

Terraces are bench-like features which break the continuity of the valley slope. In a few places, paired terraces occur. In most places, however, terraces are restricted to the inside of meander bends where the ancient stream bottoms were preserved as the stream slipped-off toward the other side of the valley.

SIGNIFICANT HUMAN IMPACT ON SPILLWAYS

The major human impact on spillways are dams and conveyance channels, highways and grid roads, railroads, towns, villages, and resorts. The impact of agriculture on the physical features of the spillway is believed to be negligible. Although sand and gravel operations are common on many of the terraces, a field inventory would be required to assess this impact because most aerial photographs are out-of-date.

Although dams are listed on pages 2 of 3 in the Appendix, they were not evaluated because it could not be determined from the maps and photographs whether they are merely control structures maintaining the level of natural lakes or impounding artifical lakes. Furthermore, most maps and photographs are out-of-date and do not show all the structures.

Because secondary roads are believed to have much less impact than highways on the spillways, only highways are evaluated for their impact. It is known, however, that some grid roads have a major impact because of substantial cuts and fills. An impact assessment of secondary roads would require a field inventory.

EVALUATION OF SPILLWAYS

Introduction

Spillways were evaluated on description, natural values, and human impact. Out of 100 points, 40 were assigned to the description, 40 to the natural values, and 20 to the human impact. The breakdown is shown on pages 3 of 3 of the Appendix.

Evaluation

Twenty one of the best developed spillways were evaluated (Table 1). Although other spillways occur in the Prairie Provinces, they are not well enough developed to be evaluated.

Table 1. Evaluation of Spillways

Qu'Appelle	85	Thunder Creek	66
Milk River	79	Whitebear	66
Battle	79	Chin	65
Pembina	75	Pipestone	65
Assiniboine	74	Cutarm	62
Clearwater	73	Lewis	62
Big Muddy	73	Neidpath	59
Souris	71	Spruce Creek	58
Tramping Lake	71	Crawling Valley	58
Sounding Creek	71	Pass Creek	52
Etzikom	66		

The comparison of the top three spillways is shown in Table 2.

Table 2. Comparison of the Evaluations of the Top Three Spillways

Spillway	Description	Natural Values	Human Impact	Points
Qu'Appelle	38	38	9	85
Milk River	32	27	20	79
Battle	28	33	18	79

The Qu'Appelle Spillway is the longest, widest, and deepest spillway and has the highest natural values associated with it. Compared to the Milk River and Battle Spillways, however, the Qu'Appelle Spillway has a considerably larger human impact.

The Milk River Spillway, although the most spectacular because of its steep walls of exposed, colored bedrock giving it a canyon-like form, has no marshes, lakes, deltas, and beaches within the valley. It could be argued such features are not spillway values but are postglacial landforms. The author, however, has chosen to evaluate the spillways as they appear today rather than as they might have appeared when they functioned as overflow channels.

The Battle Spillway, although shallower than the Milk River Spillway, has more natural values associated with it. As in the case of the Qu'Appelle Spillway, many of the natural values associated with the Battle Spillway are postglacial and, consequently, were not present when it functioned as a spillway.

CONCLUSION

The Qu'Appelle Spillway is selected by the author as the best and most outstanding spillway in the Prairies. The Qu'Appelle Spillway has the longest, widest, and deepest valley and has the most natural values associated with it. Although this spillway lost 11 points in the evaluation because of human impact, it still received 6 points more than the second and third ranking spillways.

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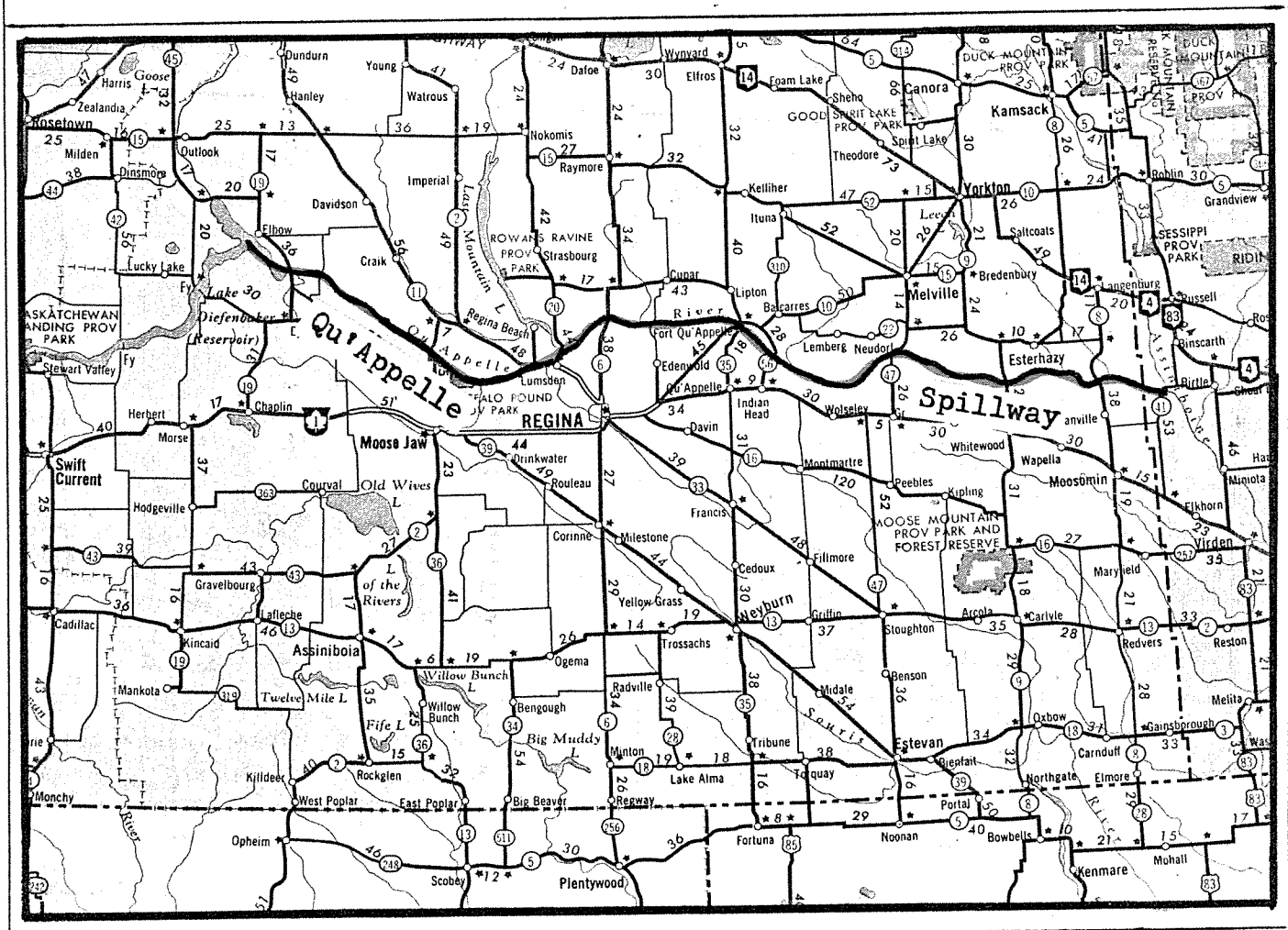
APPENDIX

Inventory and Evaluation of Glacial Spillways in the Prairies

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Qu'Appelle Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	400 km	Depth of fill	m
Width	2500 m	In drift	
Relief	160 m	In drift & bedrock	x
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

0 100

Kilometres

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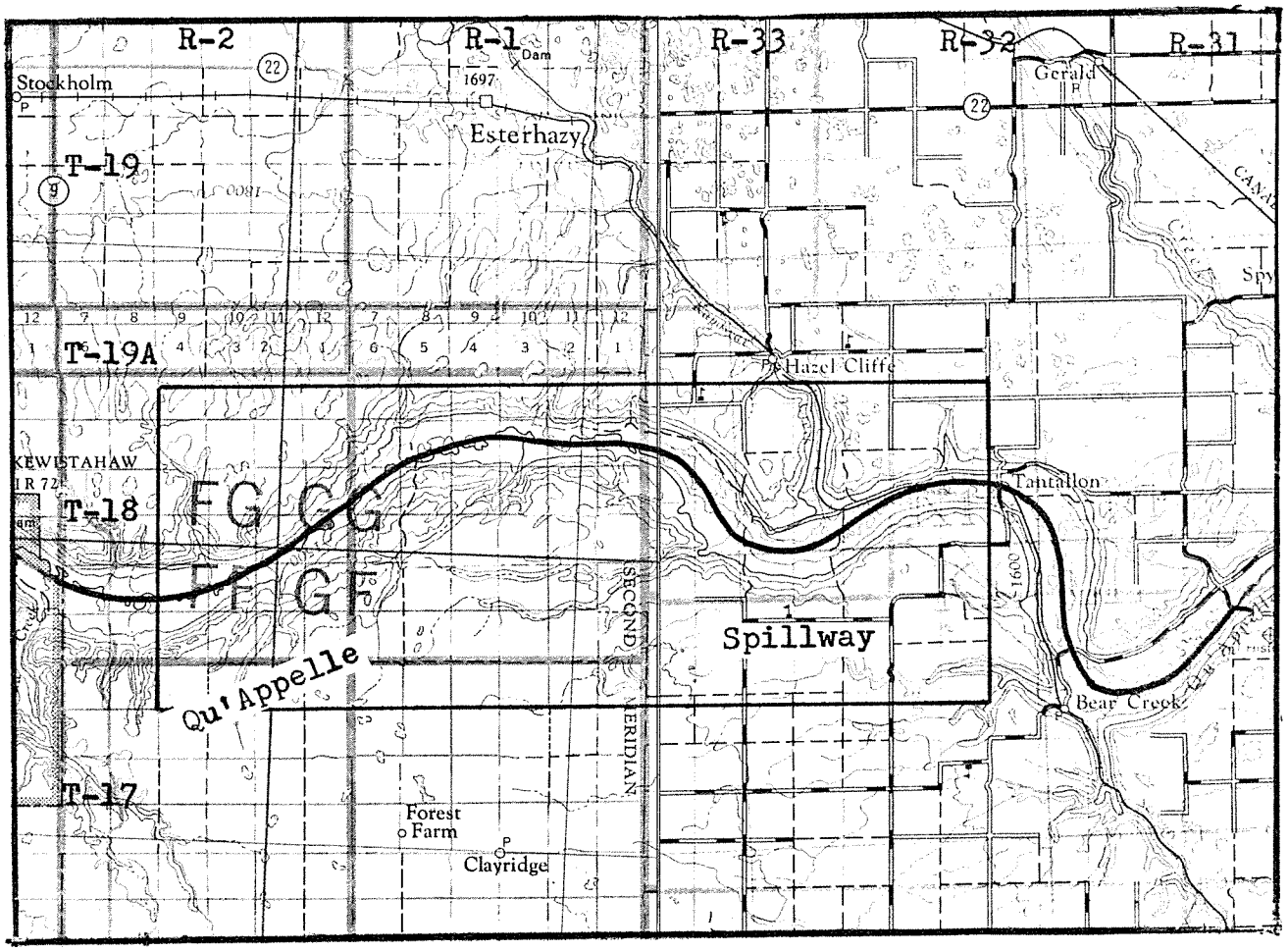
INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Qu'Appelle Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length _____ km

Width _____ m

Relief _____ m

Drained meltwater only _____

Depth of fill _____ m

In drift _____

In drift & bedrock _____

Drained meltwater & runoff _____

Other remarks Best developed part of spillway. Sharp contrast between valley developed in bedrock and in drift.

Miles 5 0 5

Kilometres 5 0 5 10

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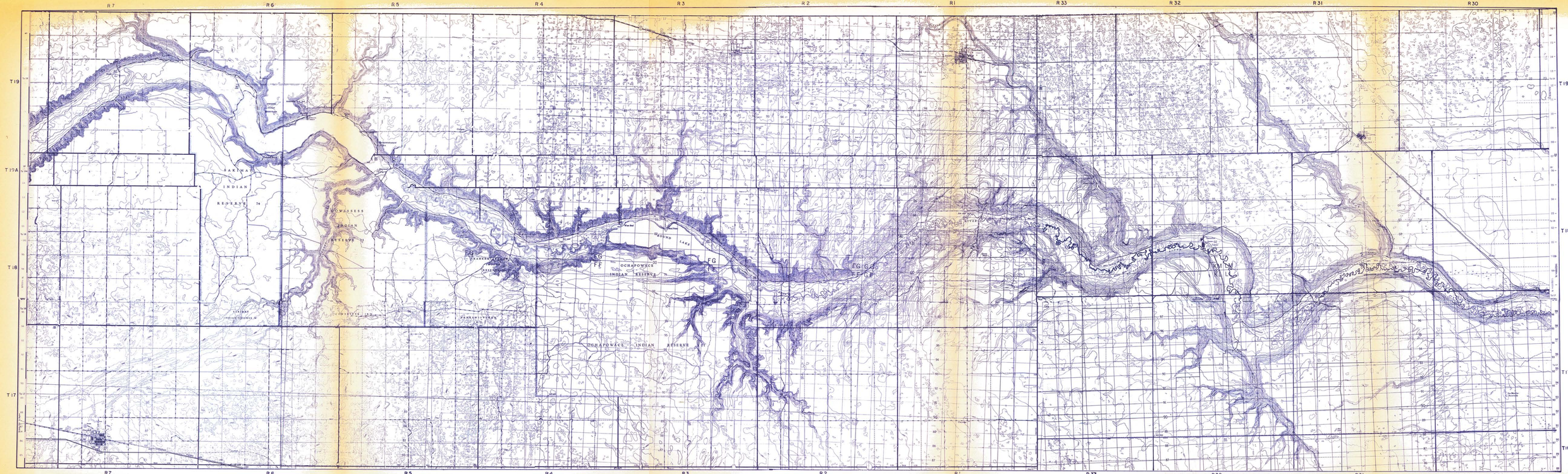


QU'APPELLE SPILLWAY

Contour interval = 25 feet

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	Pg	Bedrock Exposures	Pp
Ice-thrust Moraine	Pg	Springs	Pg
End Moraine	Pg	Alluvial Fans	Pg
Flutings	Pg	Flood Plains	Pg
Eskers	Pp	Stream	Pg
Tunnel Valleys	Pg	Marshes	Pg
Glacial Lake Basins	Pg	Lakes	Pg
Outwash Plains	Pg	Deltas	Pg
Meltwater Channels	Pg	Beaches	Pg
Landslides	Pg	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	7	No. of towns	2
Km of highways	130	No. of villages	5
Km of railroads	60	No. of resorts	7

LIST OF REFERENCES ON SPILLWAY

Christiansen, E.A. 1960. Geology and ground-water resources of the Qu'Appelle area, Saskatchewan. Sask. Res. Counc., Geol. Div., Rept. 1, 53 p.

Klassen, R.W. 1975. Quaternary geology and geomorphology of Assiniboine and Qu'Appelle Valleys of Manitoba and Saskatchewan. Geol. Surv. Can., Bull. 228, 61 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Qu'Appelle Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km=10; 200-300 km=7;<200 km=4	10
Width (>2000 m=10; 1000-2000 m=7;<1000 m=4)	10
Relief*	8
Drained glacial meltwater only=5	
Drained glacial meltwater and proglacial runoff=10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	2	Bedrock Exposures	1
Ice-thrust Moraine	2	Springs	2
End Moraine	2	Alluvial Fans	2
Flutings	2	Flood Plains	2
Eskers	1	Stream	2
Tunnel Valleys	2	Marshes	2
Glacial Lake Basins	2	Lakes	2
Outwash Plains	2	Deltas	2
Meltwater Channels	2	Beaches	2
Landslides	2	Other Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways=4-(km of highways/length of spillway x 4)	3
Km of railroads=4-(km of railroads/length of spillway x 4)	3
No. of towns (0 or 1=4, 2=3, 3=2, 4 or more=0)	3
No. of villages (0 or 1=4, 2=3, 3=2, 4 or more=0)	0
No. of resorts (0 or 1=4, 2=3, 3=2, 4 or more=0)	0
Total out of 100	85

** Pg=2, Pp=1, and NP=0.

* <100 m=2
100-125 m=4
125-150 m=6
150-175 m=8
175-200 m=10

Qu'Appelle Spillway

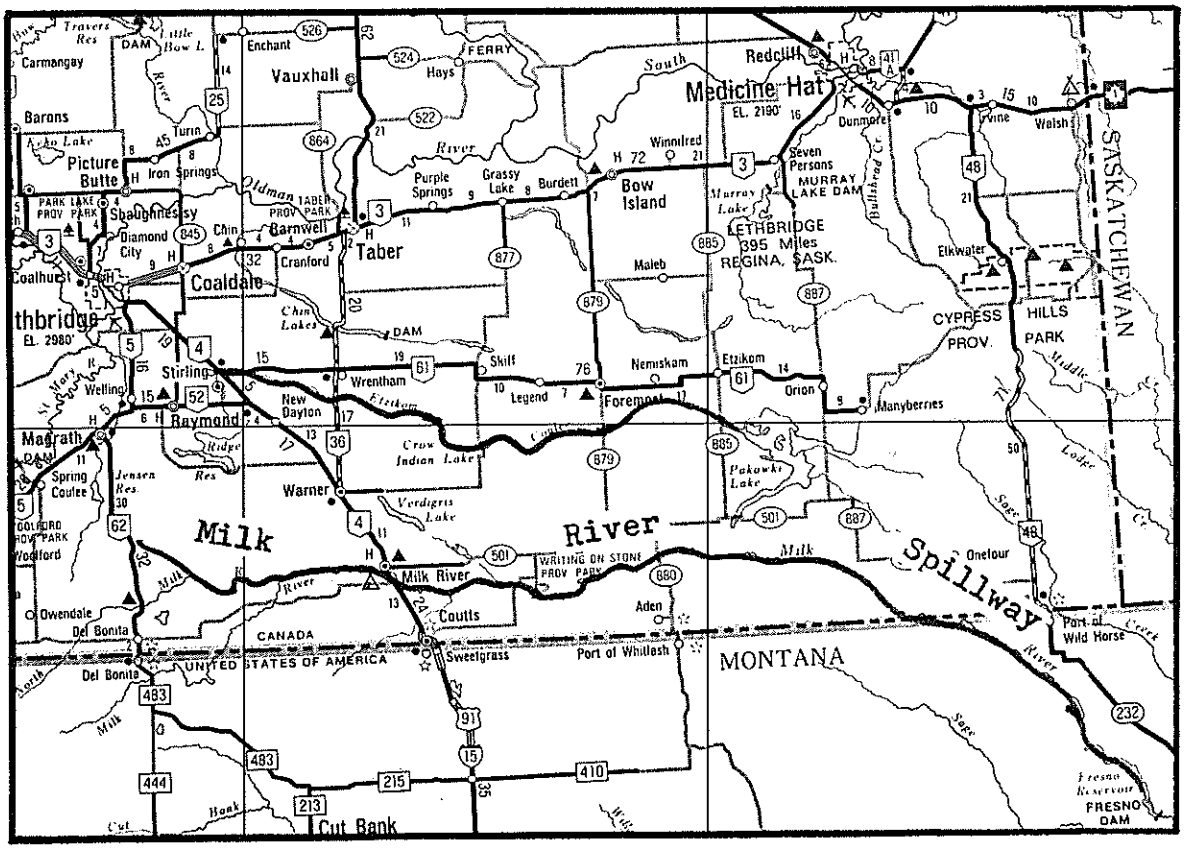
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Milk River Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	240 km	Depth of fill	m
Width	1200 m	In drift	
Relief	150 m	In drift & bedrock	x
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

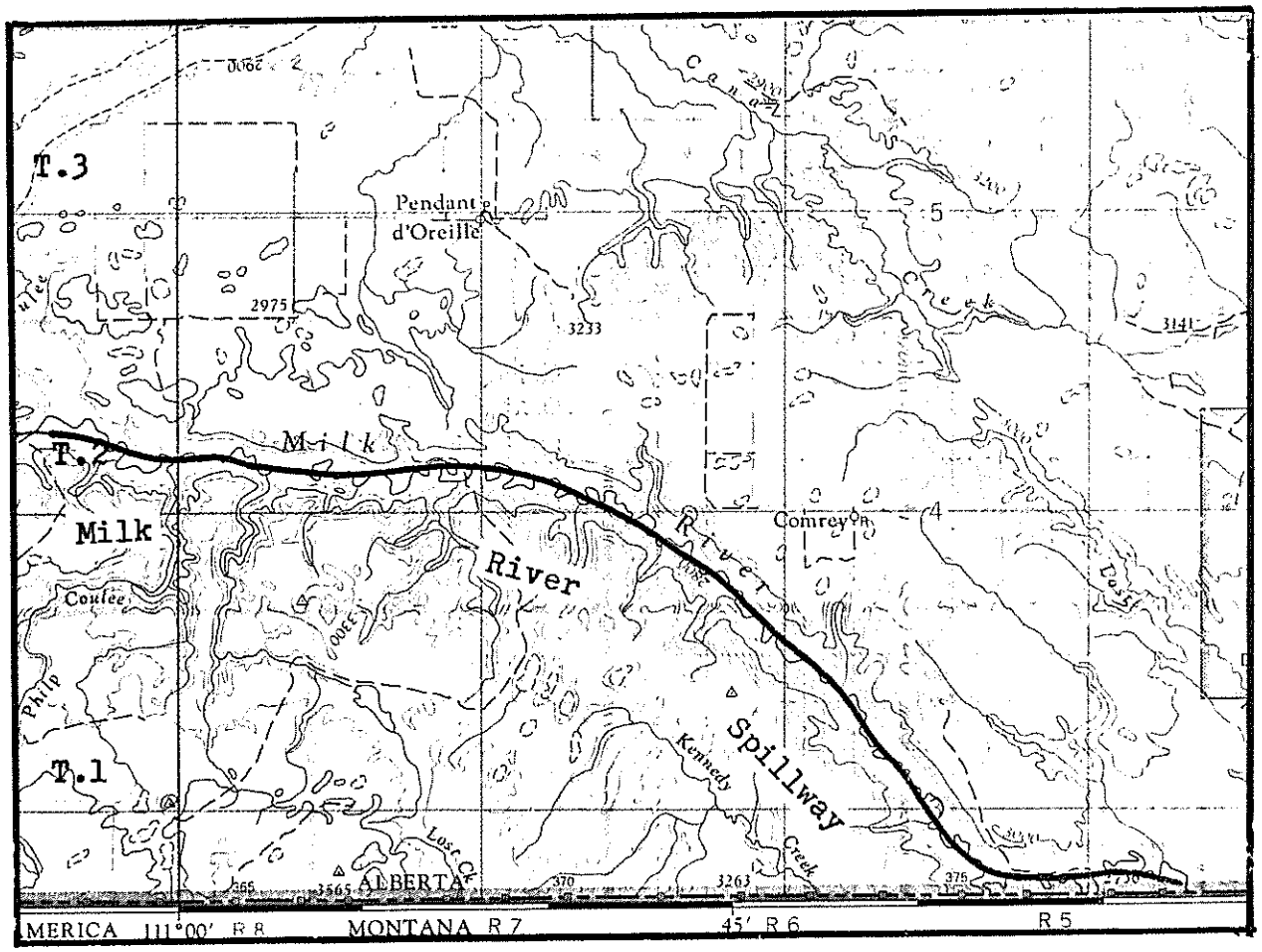
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Milk River Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length _____ km

Width _____ m

Relief _____ m

Drained meltwater only _____

Depth of fill _____ m

In drift _____

In drift & bedrock _____

Drained meltwater & runoff _____

Other remarks _____

Miles 5 0 5 10

Kilometres 5 0 5 10 15

0004-002

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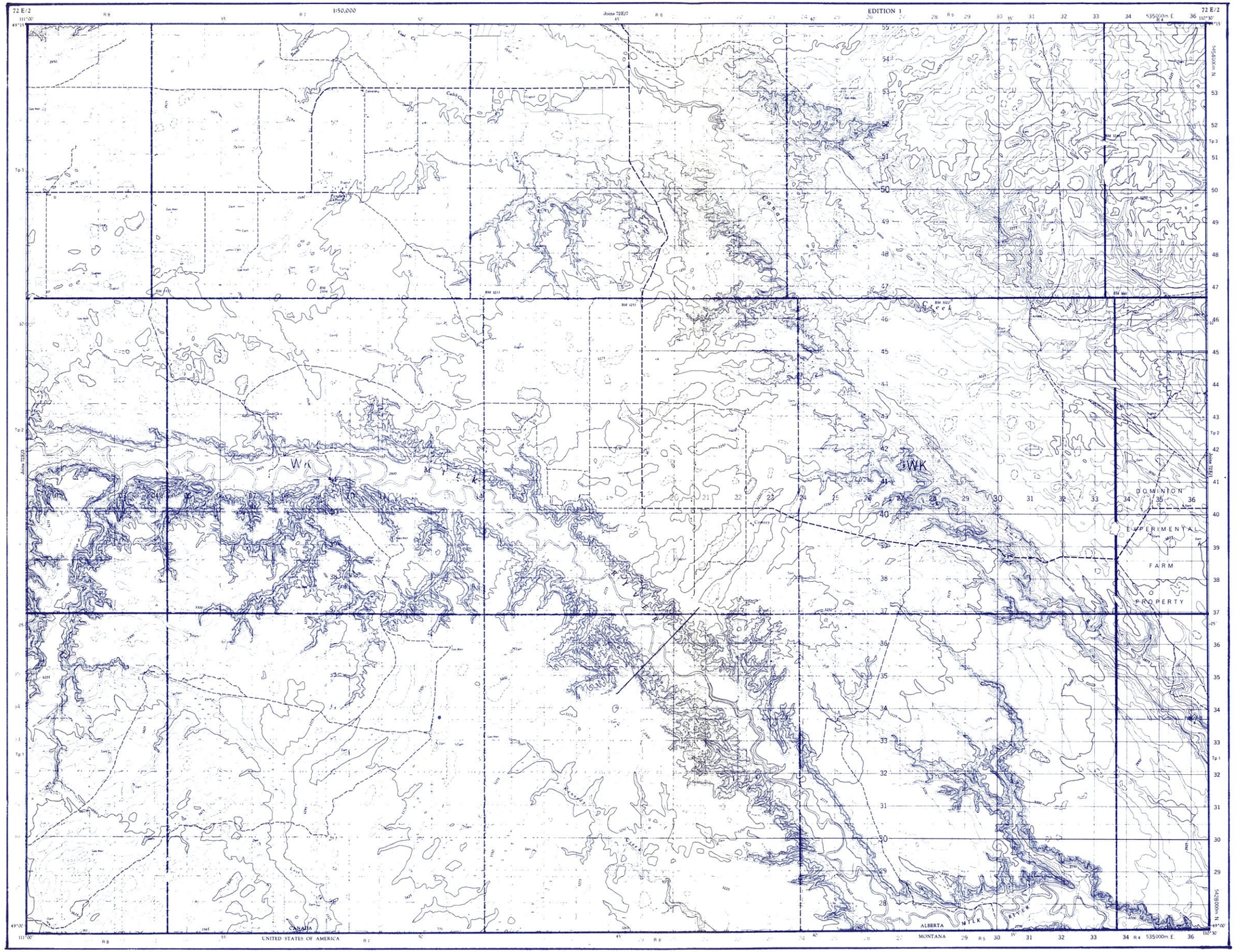

72 E/2
1:50,000
EDITION 1
Joins 72E/7
Joins 72E/3
MILK RIVER SPILLWAY
CANADA
UNITED STATES OF AMERICA
ALBERTA
MONTANA
DOMINION
EXPERIMENTAL
FARM
PROPERTY
Canal
Creek
MILK
RIVER
0 1 2 3 4 5 Miles
0 5 10 Kilometres
Contour interval = 25 feet

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	Pg	Bedrock Exposures	Pg
Ice-thrust Moraine	Pp	Springs	Pp
End Moraine	Pg	Alluvial Fans	Pg
Flutings	Pg	Flood Plains	Pg
Eskers	Pg	Stream	Pg
Tunnel Valleys	Pp	Marshes	NP
Glacial Lake Basins	Pg	Lakes	NP
Outwash Plains	Pg	Deltas	NP
Meltwater Channels	Pg	Beaches	NP
Landslides	Pp	Other Terraces	Pp

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	0	No. of towns	1
Km of highways	2	No. of villages	0
Km of railroads	2	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Bretz, J.H. 1943. Keewatin end moraines in Alberta, Canada. Geol. Soc. Am. Bull., v. 54, p. 31-52.

Westgate, J.A. 1968. Surficial geology of the Foremost - Cypress Hills area, Alberta. Res. Counc. Alta., Bull. 22, 121 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Milk River Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km = 10; 200-300 km = 7; < 200 km = 4	7
Width (>2000 m = 10; 1000-2000 m = 7; < 1000 m = 4)	7
Relief*	8
Drained glacial meltwater only = 5	
Drained glacial meltwater and proglacial runoff = 10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	2	Bedrock Exposures	2
Ice-thrust Moraine	1	Springs	1
End Moraine	2	Alluvial Fans	2
Flutings	2	Flood Plains	2
Eskers	2	Stream	2
Tunnel Valleys	1	Marshes	0
Glacial Lake Basins	2	Lakes	0
Outwash Plains	2	Deltas	0
Meltwater Channels	2	Beaches	0
Landslides	1	Other ---Terraces---	1

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways = 4-(km of highways/length of spillway x 4)	4
Km of railroads = 4-(km of railroads/length of spillway x 4)	4
No. of towns (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of villages (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of resorts (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
Total out of 100	79

** Pg = 2, Pp = 1, and NP = 0.

* < 100 m = 2
100-125 m = 4
125-150 m = 6
150-175 m = 8
175-200 m = 10

Milk River Spillway

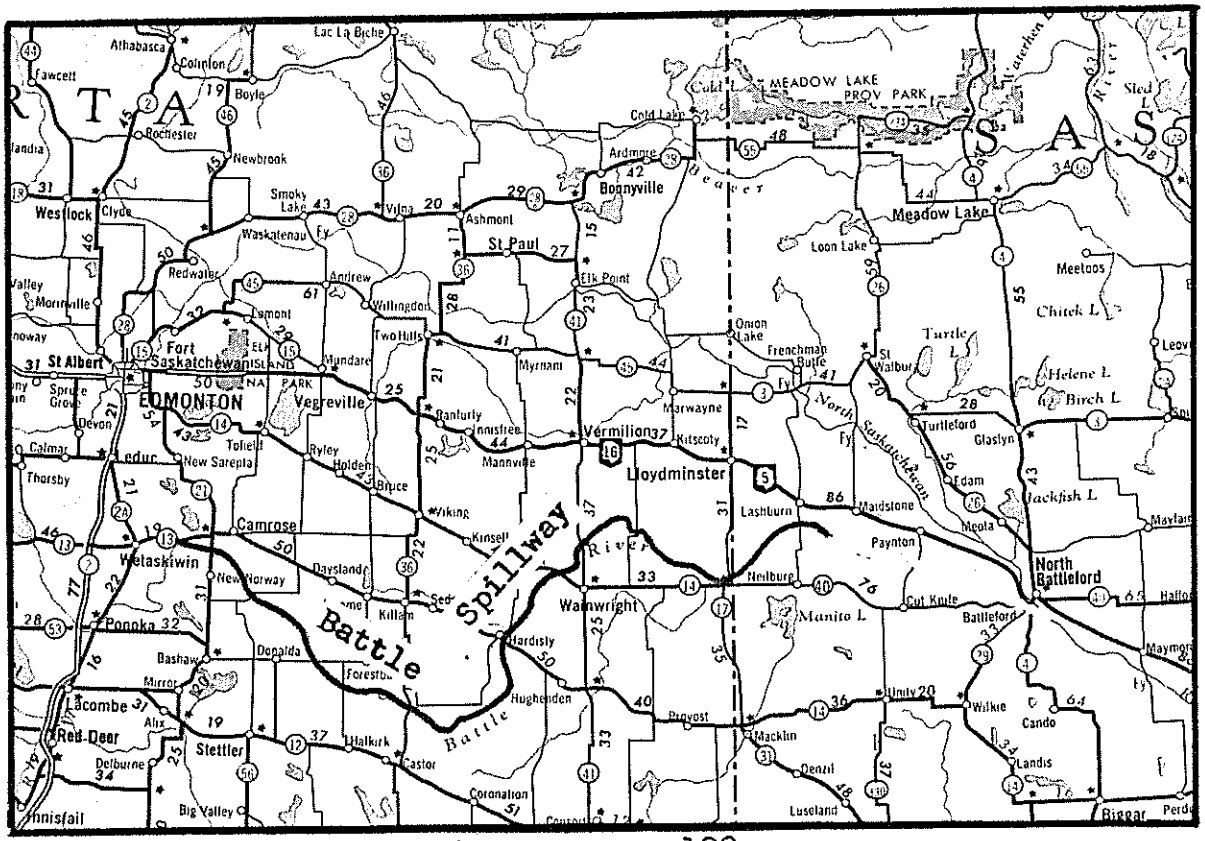
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Battle Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	290 km	Depth of fill	m
Width	1500 m	In drift	
Relief	115 m	In drift & bedrock	x
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

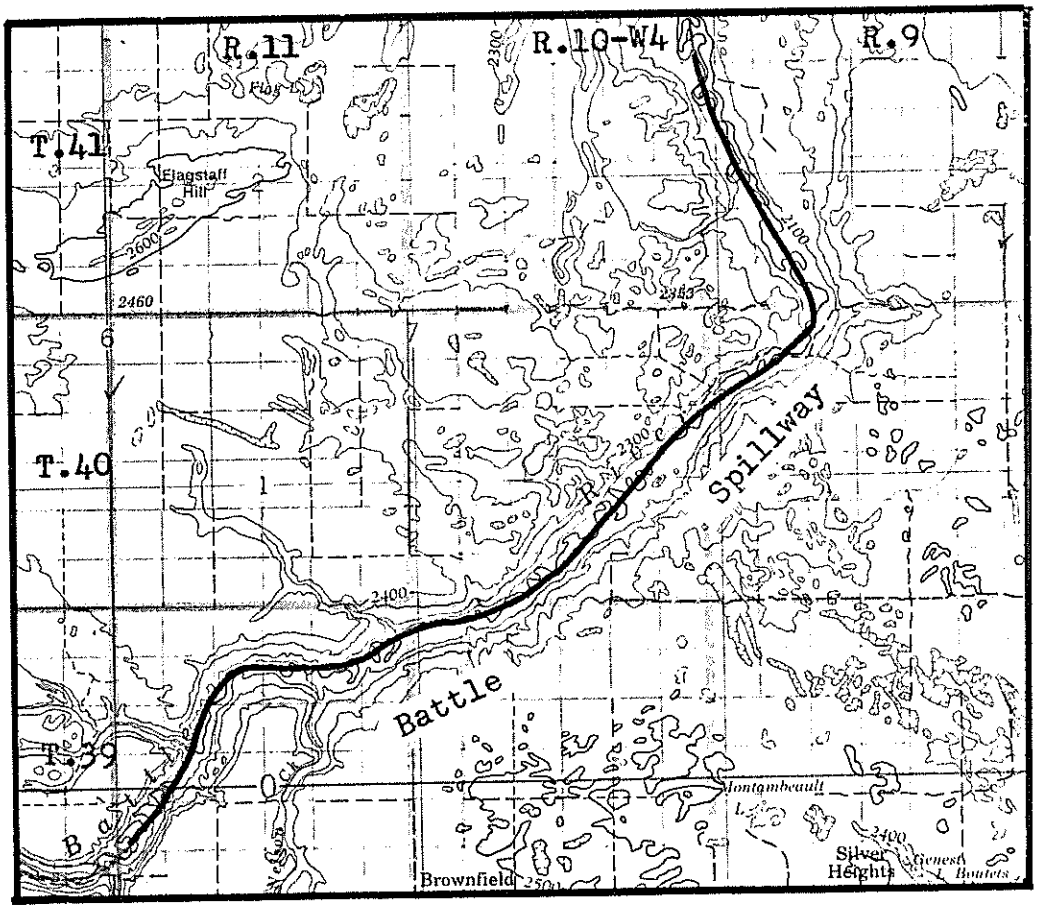
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Battle Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length _____ km

Width _____ m

Relief _____ m

Drained meltwater only _____

Depth of fill _____ m

In drift _____

In drift & bedrock _____

Drained meltwater & runoff _____

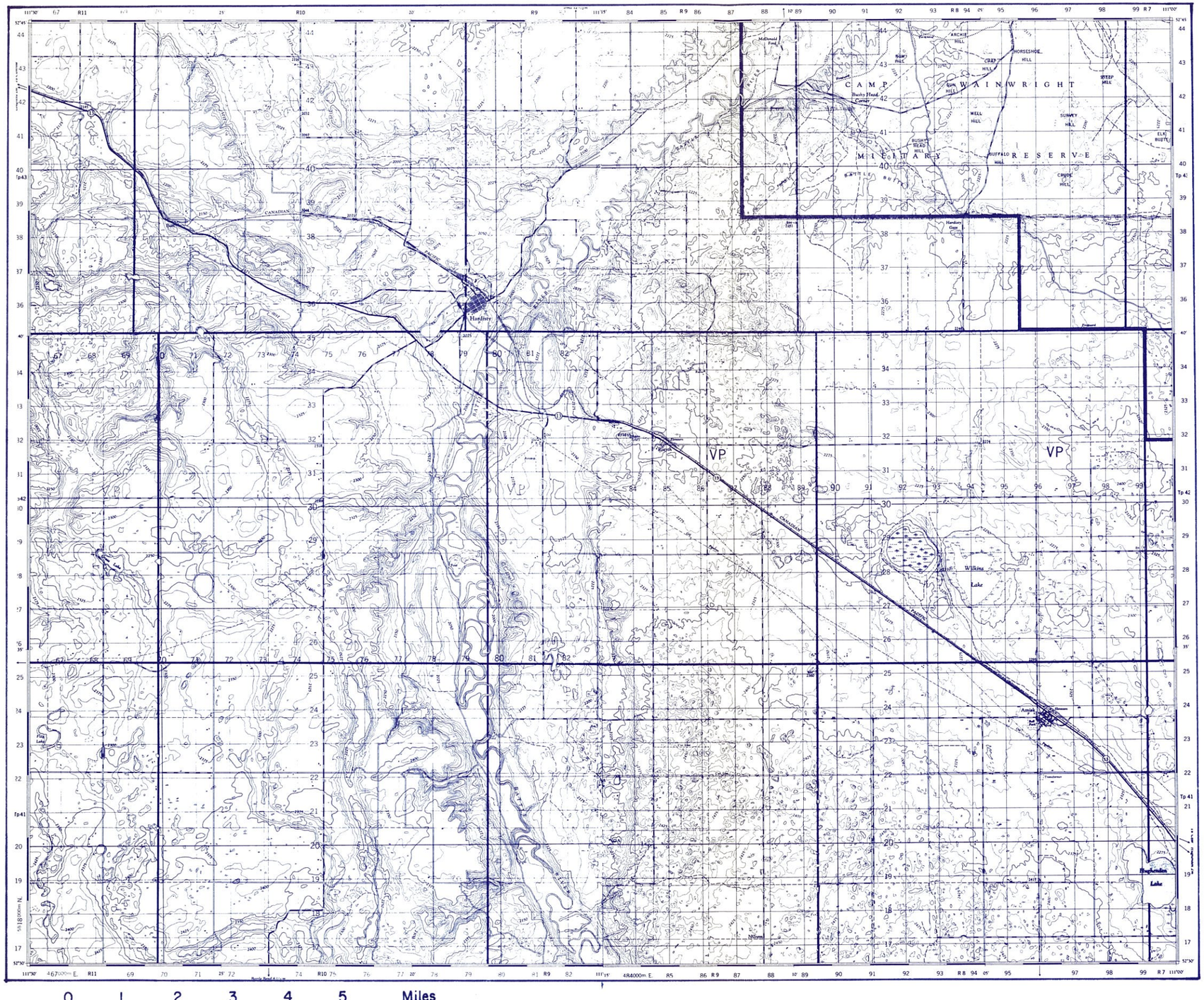
Other remarks _____

Miles 5 0 5

Kilometres 5 0 5 10

0004-002

E. A. Christiansen Consulting Ltd.



-13-

BATTLE SPILLWAY

Contour interval = 25 feet

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	Pg	Bedrock Exposures	Pg
Ice-thrust Moraine	Pg	Springs	Pg
End Moraine	Pg	Alluvial Fans	Pg
Flutings	Pg	Flood Plains	Pg
Eskers	NP	Stream	Pg
Tunnel Valleys	NP	Marshes	Pp
Glacial Lake Basins	Pg	Lakes	Pg
Outwash Plains	Pg	Deltas	Pp
Meltwater Channels	Pg	Beaches	Pp
Landslides	Pg	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	0	No. of towns	1
Km of highways	20	No. of villages	2
Km of railroads	40	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Bayrock, L.A. 1967. Surficial geology of the Wainwright area (East half), Alberta. Res. Counc. Alta., Rept. 67-4.

Bayrock, L.A. 1972. Surficial geology, Edmonton (NTS-83H). Res. Counc. Alta., Map.

Stalker, A.M. 1960. Surficial geology of the Red Deer-Stettler map-area, Alberta. Geol. Surv. Can., Mem. 306, 140 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Battle Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km = 10; 200-300 km = 7; <200 km = 4	7
Width (>2000 m = 10; 1000-2000 m = 7; <1000 m = 4)	7
Relief*	4
Drained glacial meltwater only = 5	
Drained glacial meltwater and proglacial runoff = 10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	2	Bedrock Exposures	2
Ice-thrust Moraine	2	Springs	2
End Moraine	2	Alluvial Fans	2
Flutings	2	Flood Plains	2
Eskers	0	Stream	2
Tunnel Valleys	0	Marshes	1
Glacial Lake Basins	2	Lakes	2
Outwash Plains	2	Deltas	1
Meltwater Channels	2	Beaches	1
Landslides	2	Other Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways = 4-(km of highways/length of spillway x 4)	4
Km of railroads = 4-(km of railroads/length of spillway x 4)	3
No. of towns (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of villages (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	3
No. of resorts (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
Total out of 100	79

** Pg = 2, Pp = 1, and NP = 0.

* <100 m = 2
100-125 m = 4
125-150 m = 6
150-175 m = 8
175-200 m = 10

Battle Spillway

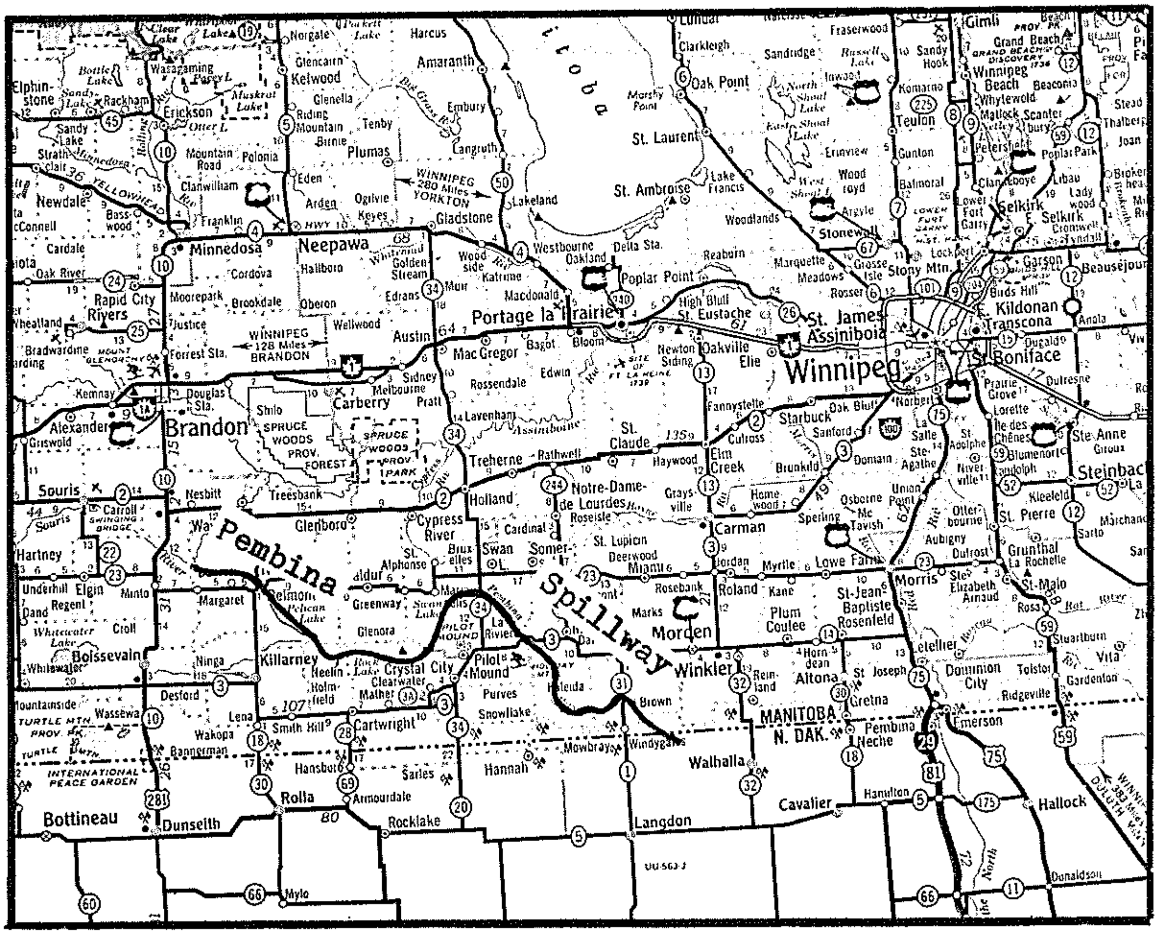
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Pembina Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	160	km	Depth of fill		m
Width	1400	m	In drift		
Relief	120	m	In drift & bedrock	x	
Drained meltwater only			Drained meltwater & runoff	x	

Other remarks

0 50 100

Kilometres

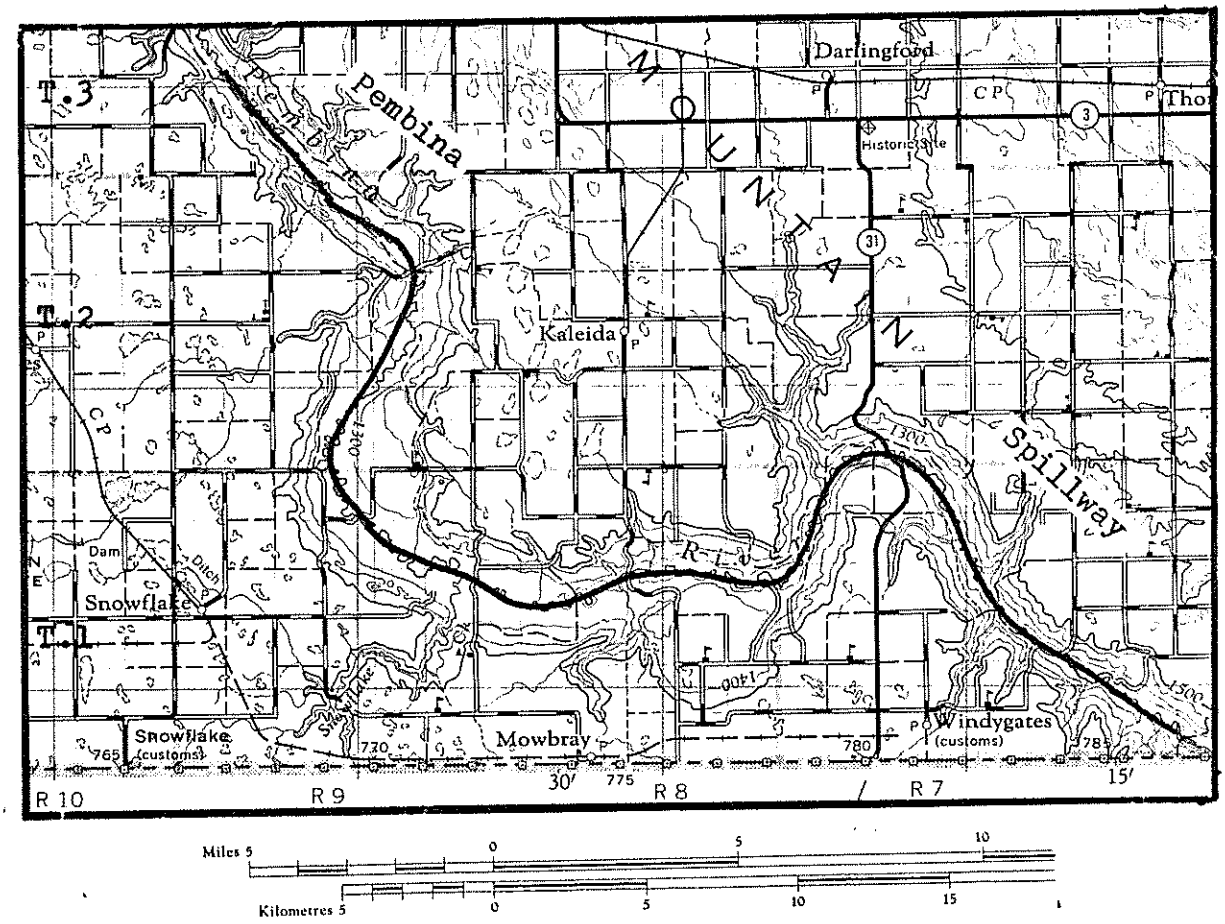
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Pembina Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length _____ km

Width _____ m

Relief _____ m

Drained meltwater only _____

Depth of fill _____ m

In drift _____

In drift & bedrock _____

Drained meltwater & runoff _____

Other remarks _____

Best developed part of spillway.

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	Pg	Bedrock Exposures	Pp
Ice-thrust Moraine	Pp	Springs	Pp
End Moraine	Pg	Alluvial Fans	Pg
Flutings	Pp	Flood Plains	Pg
Eskers	Pp	Stream	Pg
Tunnel Valleys	Pp	Marshes	Pg
Glacial Lake Basins	Pg	Lakes	Pg
Outwash Plains	Pg	Deltas	Pg
Meltwater Channels	Pg	Beaches	Pp
Landslides	Pg	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	0	No. of towns	0
Km of highways	15	No. of villages	3
Km of railroads	25	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Elson, J.A. 1956. Surficial geology of the Tiger Hills region. Unpub. Ph.D. Thesis, Yale Univ., New Haven, Conn., 316 p.

Klassen, R.W., Wyder, J.E., and Bannatyne, B.B. 1970. Bedrock topography and geology of southern Manitoba. Geol. Surv. Can., Paper 70-51.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Pembina Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km=10; 200-300 km=7;<200 km=4	4
Width (>2000 m=10; 1000-2000 m=7;<1000 m=4)	7
Relief*	4
Drained glacial meltwater only=5	
Drained glacial meltwater and proglacial runoff=10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	2	Bedrock Exposures	1
Ice-thrust Moraine	1	Springs	1
End Moraine	2	Alluvial Fans	2
Flutings	1	Flood Plains	2
Eskers	1	Stream	2
Tunnel Valleys	1	Marshes	2
Glacial Lake Basins	2	Lakes	2
Outwash Plains	2	Deltas	2
Meltwater Channels	2	Beaches	1
Landslides	2	Other Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways=4-(km of highways/length of spillway x 4)	4
Km of railroads=4-(km of railroads/length of spillway x 4)	3
No. of towns (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
No. of villages (0 or 1=4, 2=3, 3=2, 4 or more=0)	2
No. of resorts (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
Total out of 100	75

** Pg=2, Pp=1, and NP=0.

* <100 m=2
100-125 m=4
125-150 m=6
150-175 m=8
175-200 m=10

Pembina Spillway

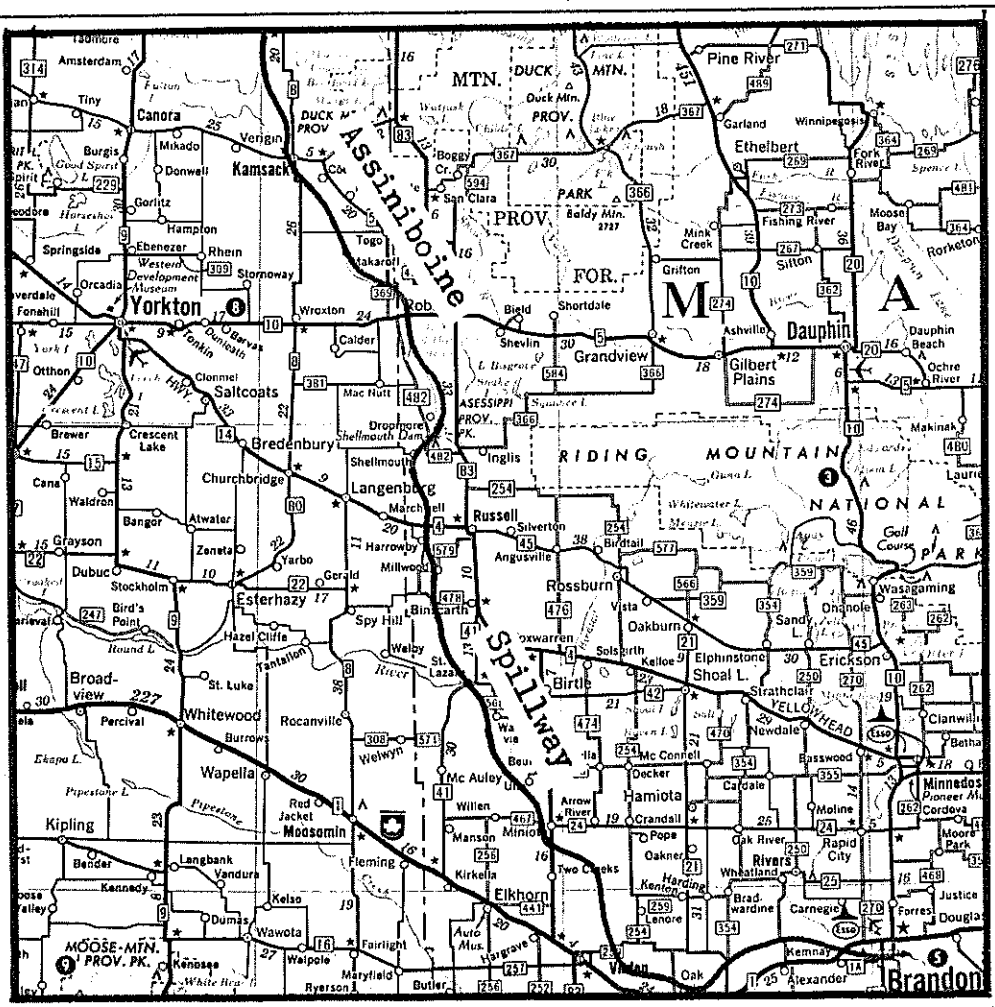
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Assiniboine Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	300 km	Depth of fill	m
Width	1800 m	In drift	
Relief	105 m	In drift & bedrock	x
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

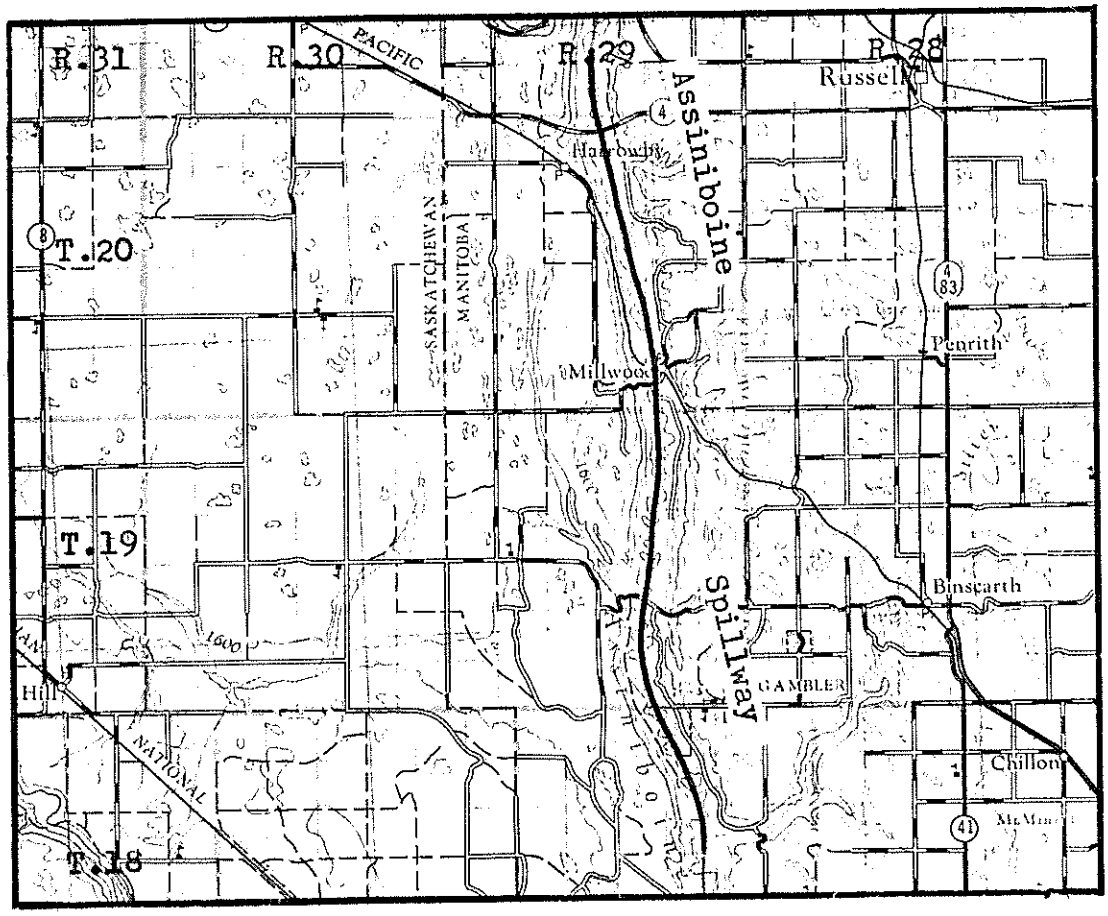
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Assiniboine Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length _____ km

Width _____ m

Relief _____ m

Drained meltwater only _____

Depth of fill _____ m

In drift _____

In drift & bedrock _____

Drained meltwater & runoff _____

Other remarks Best developed part of spillway.

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	Pg	Bedrock Exposures	Pp
Ice-thrust Moraine	NP	Springs	Pg
End Moraine	Pg	Alluvial Fans	Pg
Flutings	Pp	Flood Plains	Pg
Eskers	Pg	Stream	Pg
Tunnel Valleys	Pg	Marshes	Pg
Glacial Lake Basins	Pg	Lakes	NP
Outwash Plains	Pg	Deltas	NP
Meltwater Channels	Pg	Beaches	NP
Landslides	Pg	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	1	No. of towns	2
Km of highways	25	No. of villages	3
Km of railroads	46	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Klassen, R.W., Wyder, J.E., and Bannatyne, B.B. 1970. Bedrock topography and geology of southern Manitoba. Geol. Surv. Can., Paper 70-51.

Klassen, R.W. 1975. Quaternary geology and geomorphology of Assiniboine and Qu'Appelle Valleys of Manitoba and Saskatchewan. Geol. Surv. Can., Bull. 228, 61 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Assiniboine Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km = 10; 200-300 km = 7; < 200 km = 4	7
Width (>2000 m = 10; 1000-2000 m = 7; < 1000 m = 4)	7
Relief*	4
Drained glacial meltwater only = 5	
Drained glacial meltwater and proglacial runoff = 10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	2	Bedrock Exposures	1
Ice-thrust Moraine	0	Springs	2
End Moraine	2	Alluvial Fans	2
Flutings	1	Flood Plains	2
Eskers	2	Stream	2
Tunnel Valleys	2	Marshes	2
Glacial Lake Basins	2	Lakes	0
Outwash Plains	2	Deltas	0
Meltwater Channels	2	Beaches	0
Landslides	2	Other Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways = 4-(km of highways/length of spillway x 4)	4
Km of railroads = 4-(km of railroads/length of spillway x 4)	3
No. of towns (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	3
No. of villages (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	2
No. of resorts (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
Total out of 100	74

** Pg = 2, Pp = 1, and NP = 0.

* < 100 m = 2
100-125 m = 4
125-150 m = 6
150-175 m = 8
175-200 m = 10

Assiniboine Spillway

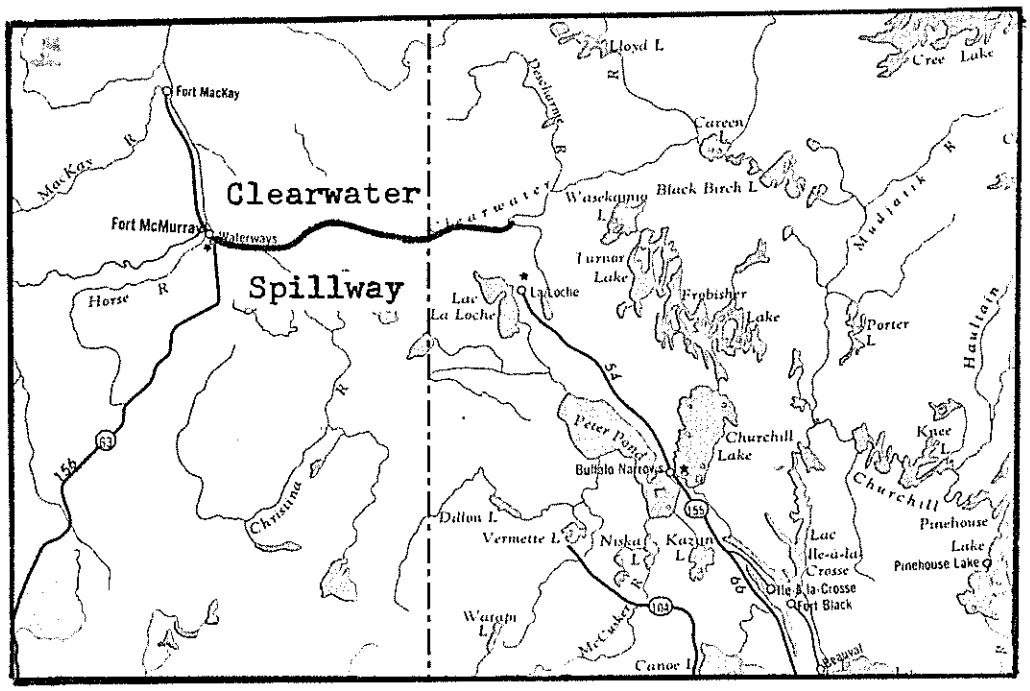
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Clearwater Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	120 km	Depth of fill	m
Width	1500 m	In drift	
Relief	180 m	In drift & bedrock	x
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

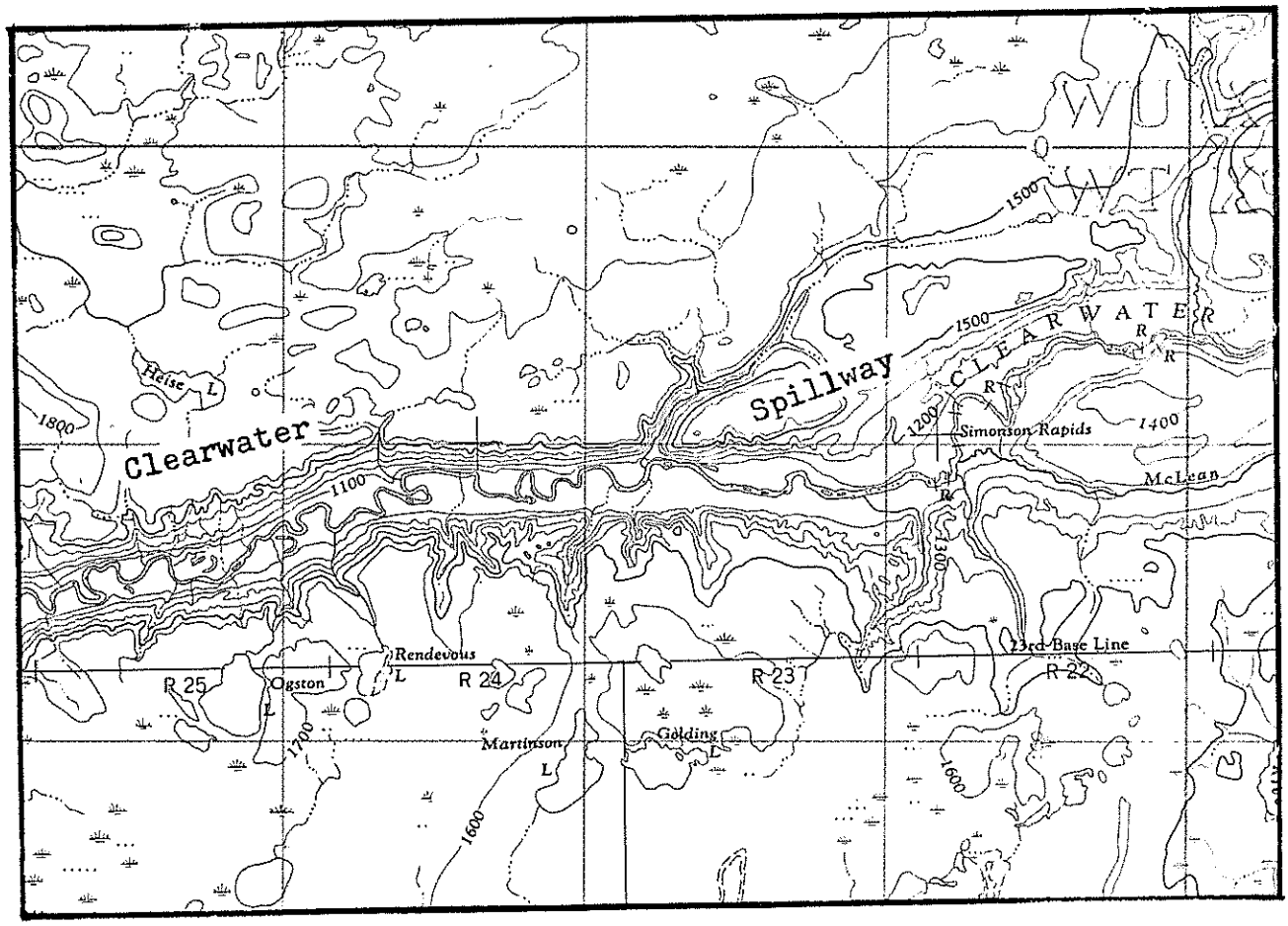
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Clearwater Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length _____ km

Width _____ m

Relief _____ m

Drained meltwater only _____

Depth of fill _____ m

In drift _____

In drift & bedrock _____

Drained meltwater & runoff _____

Other remarks Best developed part of spillway.

Miles 5 0 5 10

Kilometres 5 0 5 10 15

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	NP	Bedrock Exposures	Pg
Ice-thrust Moraine	NP	Springs	Pg
End Moraine	NP	Alluvial Fans	Pg
Flutings	Pg	Flood Plains	Pg
Eskers	NP	Stream	Pg
Tunnel Valleys	NP	Marshes	Pp
Glacial Lake Basins	Pg	Lakes	NP
Outwash Plains	Pg	Deltas	NP
Meltwater Channels	Pg	Beaches	NP
Landslides	Pg	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	0	No. of towns	1
Km of highways	5	No. of villages	0
Km of railroads	22	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Bayrock, L.A. and Reimchen T.H.F. 1973. Surficial geology, Waterways (NTS-74D). Res. Counc. Alta., Map.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km=10; 200-300 km=7;<200 km=4	4
Width (>2000 m=10; 1000-2000 m=7;<1000 m=4)	7
Relief*	10
Drained glacial meltwater only=5	
Drained glacial meltwater and proglacial runoff=10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	0	Bedrock Exposures	2
Ice-thrust Moraine	0	Springs	2
End Moraine	0	Alluvial Fans	2
Flutings	2	Flood Plains	2
Eskers	0	Stream	2
Tunnel Valleys	0	Marshes	1
Glacial Lake Basins	2	Lakes	0
Outwash Plains	2	Deltas	0
Meltwater Channels	2	Beaches	0
Landslides	2	Other Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways=4-(km of highways/length of spillway x 4)	4
Km of railroads=4-(km of railroads/length of spillway x 4)	3
No. of towns (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
No. of villages (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
No. of resorts (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
Total out of 100	73

** Pg=2, Pp=1, and NP=0.

* <100 m=2
100-125 m=4
125-150 m=6
150-175 m=8
175-200 m=10

Clearwater Spillway

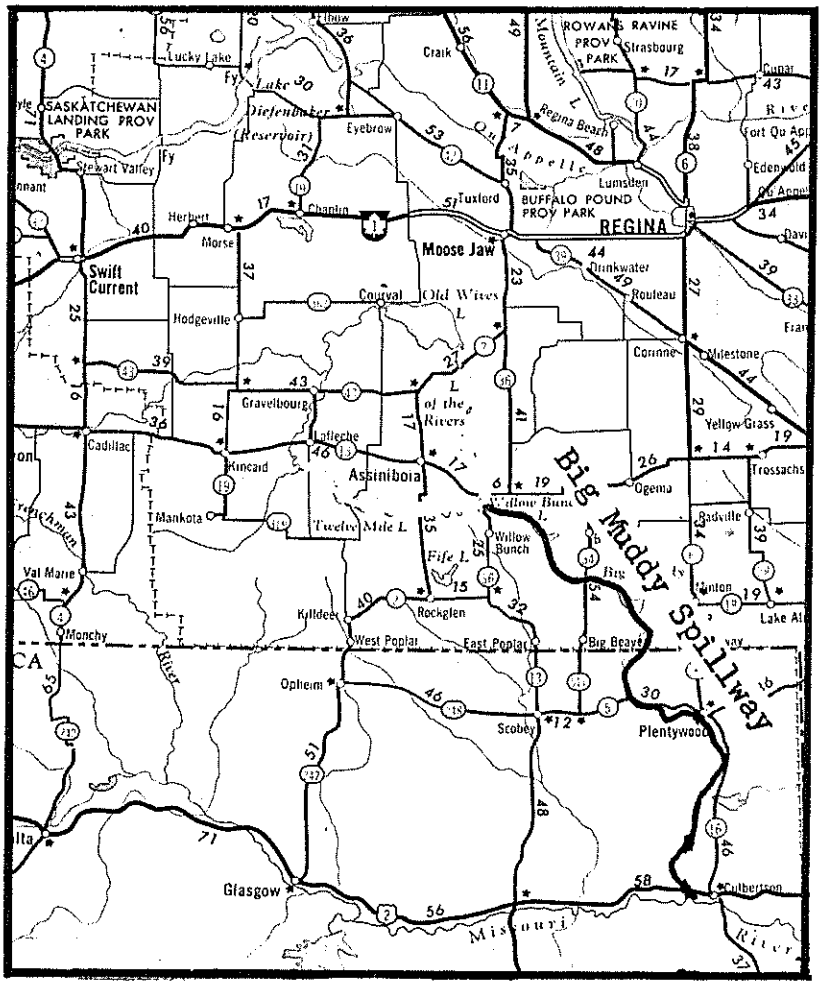
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Big Muddy Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	200 km	Depth of fill	m
Width	2000 m	In drift	
Relief	170 m	In drift & bedrock	x
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

0 100
Kilometres

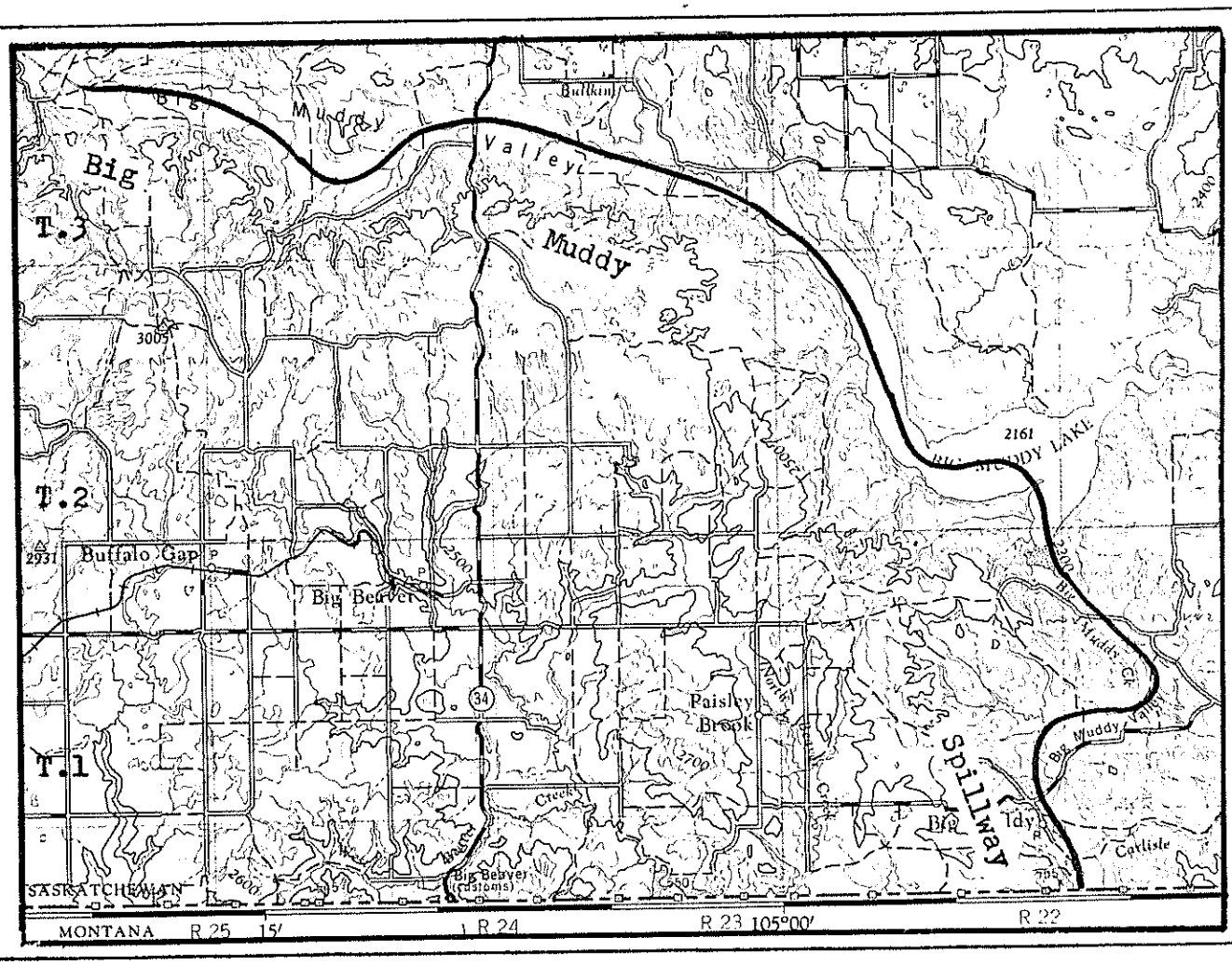
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Big Muddy Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length _____ km

Width _____ m

Relief _____ m

Drained meltwater only _____

Depth of fill _____ m

In drift _____

In drift & bedrock _____

Drained meltwater & runoff _____

Other remarks Best developed part of spillway. Well dissected landscape.

Miles 5 0 5

Kilometres 5 0 5 10

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	Pp	Bedrock Exposures	Pg
Ice-thrust Moraine	NP	Springs	Pp
End Moraine	Pg	Alluvial Fans	Pg
Flutings	Pp	Flood Plains	Pp
Eskers	NP	Stream	Pp
Tunnel Valleys	NP	Marshes	Pp
Glacial Lake Basins	Pg	Lakes	Pg
Outwash Plains	Pg	Deltas	Pp
Meltwater Channels	Pg	Beaches	Pp
Landslides	Pp	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	0	No. of towns	1
Km of highways	20	No. of villages	1
Km of railroads	50	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Parizek, R.R.1964. Geology of the Willow Bunch Lake area (72-H), Saskatchewan. Sask. Res. Counc.,Geol. Div.,Rept. 4, 47 p.

Whitaker, S.H. 1965. Geology of the Wood Mountain area (72-G), Saskatchewan. Unpub. Ph.D. Thesis, Univ. Ill., Urbana, 151 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Big Muddy Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km=10; 200-300 km=7;<200 km=4	4
Width (>2000 m=10; 1000-2000 m=7;<1000 m=4)	7
Relief*	8
Drained glacial meltwater only=5	
Drained glacial meltwater and proglacial runoff=10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	1	Bedrock Exposures	2
Ice-thrust Moraine	0	Springs	1
End Moraine	2	Alluvial Fans	2
Flutings	1	Flood Plains	1
Eskers	0	Stream	1
Tunnel Valleys	0	Marshes	1
Glacial Lake Basins	2	Lakes	2
Outwash Plains	2	Deltas	1
Meltwater Channels	2	Beaches	1
Landslides	1	Other Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways=4-(km of highways/length of spillway x 4)	4
Km of railroads=4-(km of railroads/length of spillway x 4)	3
No. of towns (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
No. of villages (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
No. of resorts (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
Total out of 100	73

** Pg=2, Pp=1, and NP=0.

* <100 m=2
100-125 m=4
125-150 m=6
150-175 m=8
175-200 m=10

Big Muddy Spillway

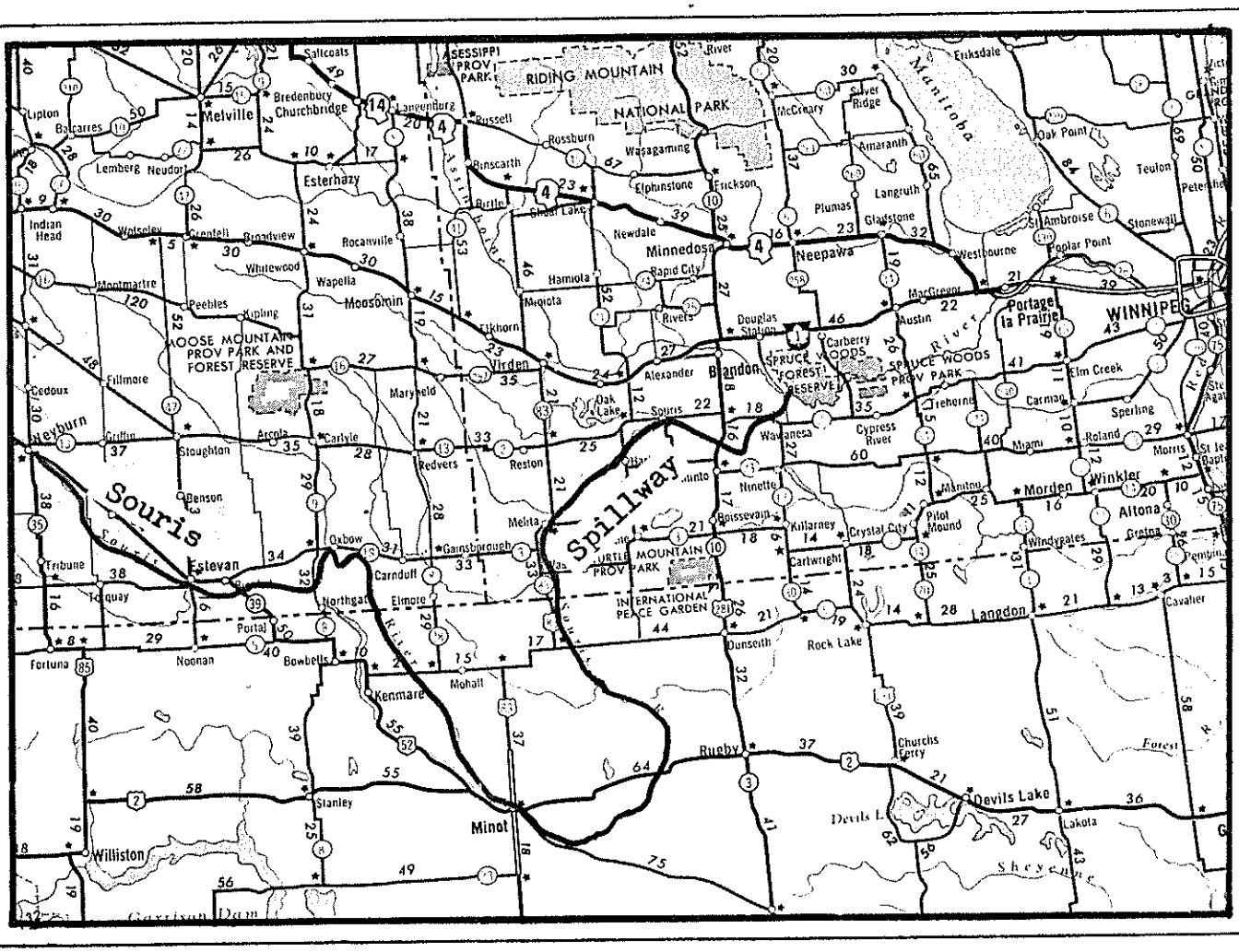
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Souris Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	590 km	Depth of fill	m
Width	1000 m	In drift	
Relief	60 m	In drift & bedrock	x
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

0004-002

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NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	Pg	Bedrock Exposures	Pg
Ice-thrust Moraine	NP	Springs	Pp
End Moraine	Pg	Alluvial Fans	Pg
Flutings	Pg	Flood Plains	Pg
Eskers	NP	Stream	Pg
Tunnel Valleys	NP	Marshes	Pg
Glacial Lake Basins	Pg	Lakes	NP
Outwash Plains	Pg	Deltas	NP
Meltwater Channels	Pg	Beaches	NP
Landslides	Pp	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams		No. of towns	4
Km of highways	20	No. of villages	1
Km of railroads	50	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Christiansen, E.A. 1956. Glacial geology of the Moose Mountain area, Saskatchewan. Sask. Dept. Min. Res., Rept. 21, 35 p.

Elson, J.A. 1956. Surficial geology of the Tiger Hills region. Unpub. Ph.D. Thesis, Yale Univ., Connecticut, 316 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Souris Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km = 10; 200-300 km = 7; < 200 km = 4	10
Width (>2000 m = 10; 1000-2000 m = 7; < 1000 m = 4)	7
Relief*	2
Drained glacial meltwater only = 5	
Drained glacial meltwater and proglacial runoff = 10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	2	Bedrock Exposures	2
Ice-thrust Moraine	0	Springs	1
End Moraine	2	Alluvial Fans	2
Flutings	2	Flood Plains	2
Eskers	0	Stream	2
Tunnel Valleys	0	Marshes	2
Glacial Lake Basins	2	Lakes	0
Outwash Plains	2	Deltas	0
Meltwater Channels	2	Beaches	0
Landslides	1	Other Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways = 4 - (km of highways/length of spillway x 4)	4
Km of railroads = 4 - (km of railroads/length of spillway x 4)	4
No. of towns (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	0
No. of villages (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of resorts (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
Total out of 100	71

** Pg = 2, Pp = 1, and NP = 0.

* < 100 m = 2
100-125 m = 4
125-150 m = 6
150-175 m = 8
175-200 m = 10

Souris Spillway

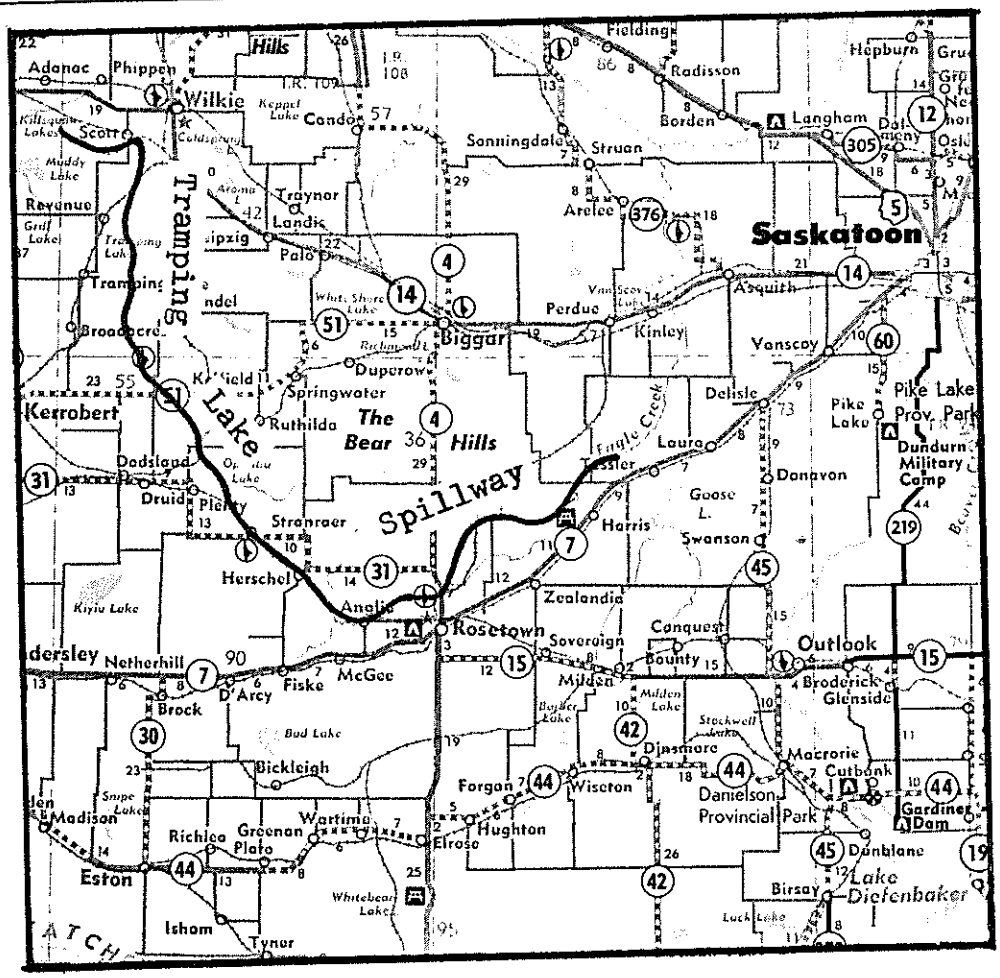
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Tramping Lake Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	160 km	Depth of fill	m
Width	1200 m	In drift	
Relief	75 m	In drift & bedrock	x
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	Pg	Bedrock Exposures	Pp
Ice-thrust Moraine	Pg	Springs	Pp
End Moraine	Pg	Alluvial Fans	Pg
Flutings	Pg	Flood Plains	Pg
Eskers	NP	Stream	Pp
Tunnel Valleys	NP	Marshes	Pg
Glacial Lake Basins	Pg	Lakes	Pg
Outwash Plains	Pg	Deltas	Pg
Meltwater Channels	NP	Beaches	Pp
Landslides	Pg	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	1	No. of towns	0
Km of highways	10	No. of villages	2
Km of railroads	50	No. of resorts	1

LIST OF REFERENCES ON SPILLWAY

Christiansen, E.A. 1965 . Geology and groundwater resources of the Kindersley area (72-N), Saskatchewan. Sask. Res. Counc., Geol. Div., Rept. 7, 26 p.

Craig, B.G. 1959. Surficial geology, Battleford, West of Third Meridian, Saskatchewan. Geol. Surv. Can., Map 15-1959.

Scott, J.S. 1971. Surficial geology of Rosetown map-area. Geol. Surv. Can., Bull. 190, 40 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Tramping Lake Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km = 10; 200-300 km = 7; <200 km = 4	4
Width (>2000 m = 10; 1000-2000 m = 7; <1000 m = 4)	7
Relief*	2
Drained glacial meltwater only = 5	
Drained glacial meltwater and proglacial runoff = 10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	2	Bedrock Exposures	1
Ice-thrust Moraine	2	Springs	1
End Moraine	2	Alluvial Fans	2
Flutings	2	Flood Plains	2
Eskers	0	Stream	1
Tunnel Valleys	0	Marshes	2
Glacial Lake Basins	2	Lakes	2
Outwash Plains	2	Deltas	2
Meltwater Channels	0	Beaches	1
Landslides	2	Other Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways = 4-(km of highways/length of spillway x 4)	4
Km of railroads = 4-(km of railroads/length of spillway x 4)	3
No. of towns (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of villages (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	3
No. of resorts (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
Total out of 100	71

** Pg = 2, Pp = 1, and NP = 0.

* < 100 m = 2
100-125 m = 4
125-150 m = 6
150-175 m = 8
175-200 m = 10

Tramping Lake Spillway

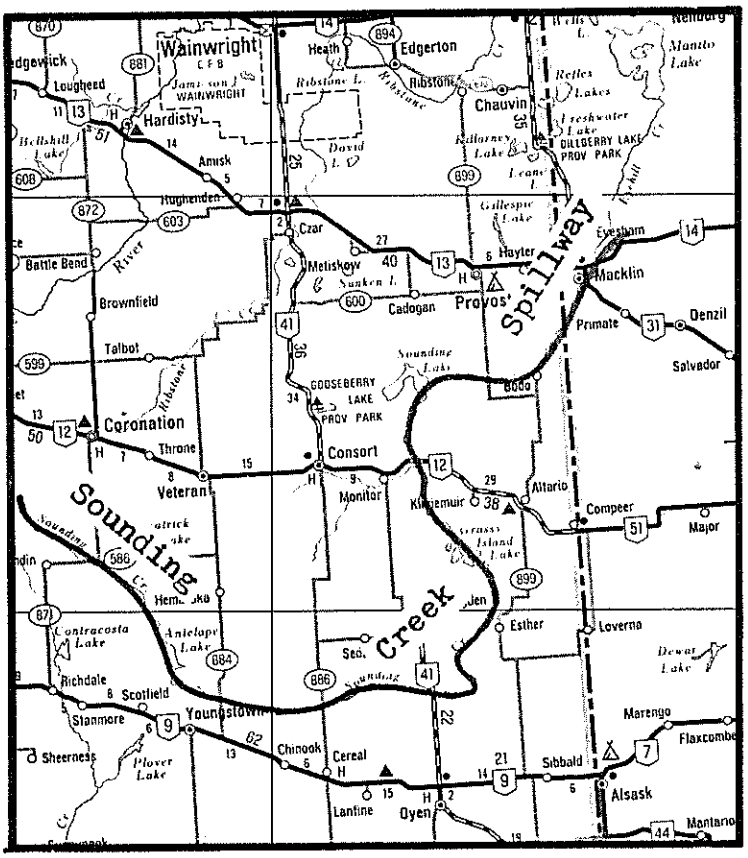
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Sounding Creek Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	220* km	Depth of fill	m
Width	1800 m	In drift	
Relief	120 m	In drift & bedrock	x
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

0 50 100

Kilometres

* Only 50 kilometres have distinct valley walls.

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	NP	Bedrock Exposures	Pp
Ice-thrust Moraine	Pg	Springs	Pp
End Moraine	Pg	Alluvial Fans	Pg
Flutings	NP	Flood Plains	Pp
Eskers	NP	Stream	Pp
Tunnel Valleys	NP	Marshes	Pg
Glacial Lake Basins	Pg	Lakes	Pg
Outwash Plains	Pg	Deltas	Pg
Meltwater Channels	NP	Beaches	Pp
Landslides	Pg	Other _____	NP

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	1	No. of towns	0
Km of highways	4	No. of villages	0
Km of railroads	20	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Stalker, A.M. Surficial geology of the Red Deer-Stettler map area, Alberta. Geol. Surv. Can., Mem. 306, 140 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Sounding Creek Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km = 10; 200-300 km = 7; <200 km = 4	7
Width (>2000 m = 10; 1000-2000 m = 7; <1000 m = 4)	7
Relief*	4
Drained glacial meltwater only = 5	
Drained glacial meltwater and proglacial runoff = 10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	0	Bedrock Exposures	1
Ice-thrust Moraine	2	Springs	1
End Moraine	2	Alluvial Fans	2
Flutings	0	Flood Plains	1
Eskers	0	Stream	1
Tunnel Valleys	0	Marshes	2
Glacial Lake Basins	2	Lakes	2
Outwash Plains	2	Deltas	2
Meltwater Channels	0	Beaches	1
Landslides	2	Other	0

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways = 4-(km of highways/length of spillway x 4)	4
Km of railroads = 4-(km of railroads/length of spillway x 4)	4
No. of towns (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of villages (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of resorts (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
Total out of 100	71

** Pg = 2, Pp = 1, and NP = 0.

* < 100 m = 2
100-125 m = 4
125-150 m = 6
150-175 m = 8
175-200 m = 10

Sounding Creek Spillway

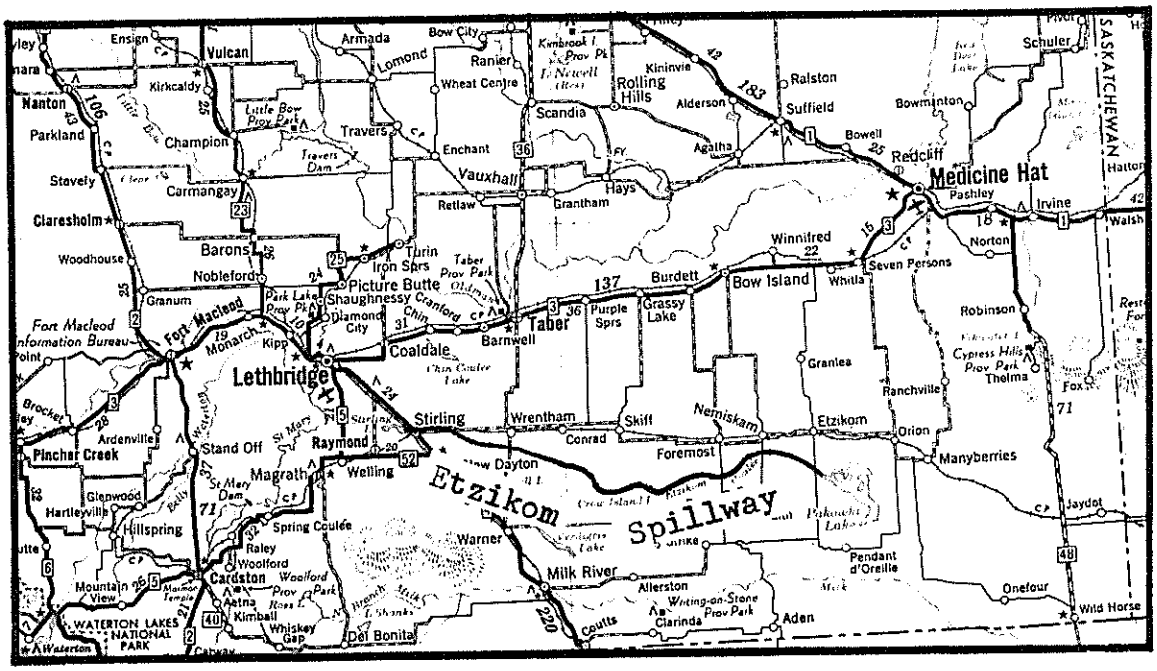
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Etzikom Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	110 km	Depth of fill	m
Width	600 m	In drift	
Relief	55 m	In drift & bedrock	x
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	Pg	Bedrock Exposures	Pp
Ice-thrust Moraine	NP	Springs	Pp
End Moraine	Pg	Alluvial Fans	Pg
Flutings	NP	Flood Plains	Pg
Eskers	NP	Stream	Pp
Tunnel Valleys	NP	Marshes	Pg
Glacial Lake Basins	Pg	Lakes	Pg
Outwash Plains	Pg	Deltas	Pp
Meltwater Channels	Pg	Beaches	Pp
Landslides	Pp	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	0	No. of towns	0
Km of highways	0	No. of villages	0
Km of railroads	0	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Bretz, J.H. 1943. Keewatin end moraines in Alberta, Canada. Geol. Soc. Am. Bull., v. 54, p. 31-52.

Westgate, J.A. 1968. Surficial geology of the Foremost - Cypress Hills area, Alberta. Res. Counc. Alta., Bull. 22, 121p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Etzikom Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km = 10; 200-300 km = 7; < 200 km = 4	4
Width (>2000 m = 10; 1000-2000 m = 7; < 1000 m = 4)	4
Relief*	2
Drained glacial meltwater only = 5	
Drained glacial meltwater and proglacial runoff = 10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	2	Bedrock Exposures	1
Ice-thrust Moraine	0	Springs	1
End Moraine	2	Alluvial Fans	2
Flutings	0	Flood Plains	2
Eskers	0	Stream	1
Tunnel Valleys	0	Marshes	2
Glacial Lake Basins	2	Lakes	2
Outwash Plains	2	Deltas	1
Meltwater Channels	2	Beaches	1
Landslides	1	Other ---Terraces---	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways = 4-(km of highways/length of spillway x 4)	4
Km of railroads = 4-(km of railroads/length of spillway x 4)	4
No. of towns (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of villages (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of resorts (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
Total out of 100	66

** Pg = 2, Pp = 1, and NP = 0.

* < 100 m = 2
100-125 m = 4
125-150 m = 6
150-175 m = 8
175-200 m = 10

Etzikom Spillway

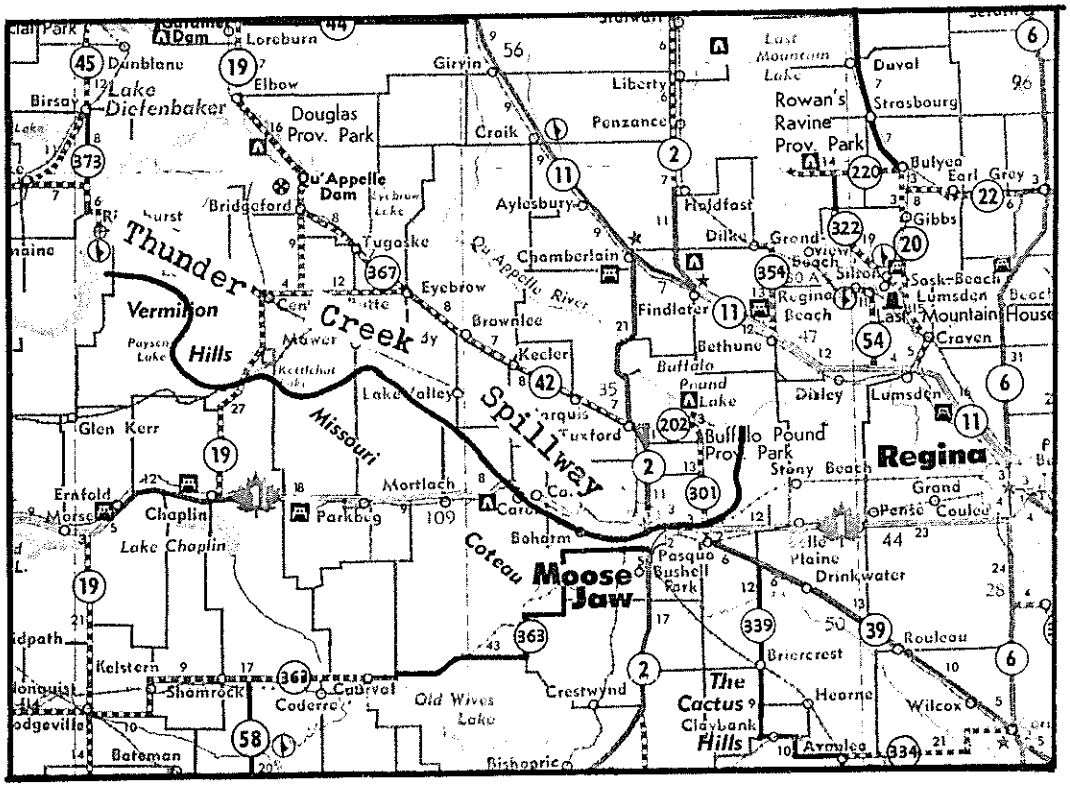
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Thunder Creek Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	150 km	Depth of fill	m
Width	1000 m	In drift	
Relief	60 m	In drift & bedrock	x
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	Pp	Bedrock Exposures	Pp
Ice-thrust Moraine	Pg	Springs	Pp
End Moraine	Pg	Alluvial Fans	Pg
Flutings	Pp	Flood Plains	Pg
Eskers	NP	Stream	Pp
Tunnel Valleys	NP	Marshes	Pg
Glacial Lake Basins	Pg	Lakes	Pg
Outwash Plains	Pg	Deltas	Pp
Meltwater Channels	NP	Beaches	Pp
Landslides	Pg	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	0	No. of towns	1
Km of highways	20	No. of villages	3
Km of railroads	45	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Christiansen, E.A. 1961. Geology and ground-water resources of the Regina area, Saskatchewan. Sask. Res. Counc., Geol. Div., Rept. 2, 72 p.

Edmunds, F.H. 1962. Recession of Wisconsinan glacier from central Saskatchewan. Sask. Dept. Min. Res., Rept. 67, 23 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Thunder Creek Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km = 10; 200-300 km = 7; < 200 km = 4	4
Width (>2000 m = 10; 1000-2000 m = 7; < 1000 m = 4)	7
Relief*	2
Drained glacial meltwater only = 5	
Drained glacial meltwater and proglacial runoff = 10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	1	Bedrock Exposures	1
Ice-thrust Moraine	2	Springs	1
End Moraine	2	Alluvial Fans	2
Flutings	1	Flood Plains	2
Eskers	0	Stream	1
Tunnel Valleys	0	Marshes	2
Glacial Lake Basins	2	Lakes	2
Outwash Plains	2	Deltas	1
Meltwater Channels	0	Beaches	1
Landslides	2	Other Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways = 4-(km of highways/length of spillway x 4)	3
Km of railroads = 4-(km of railroads/length of spillway x 4)	3
No. of towns (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of villages (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	2
No. of resorts (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
Total out of 100	66

** Pg = 2, Pp = 1, and NP = 0.

* < 100 m = 2
100-125 m = 4
125-150 m = 6
150-175 m = 8
175-200 m = 10

Thunder Creek Spillway

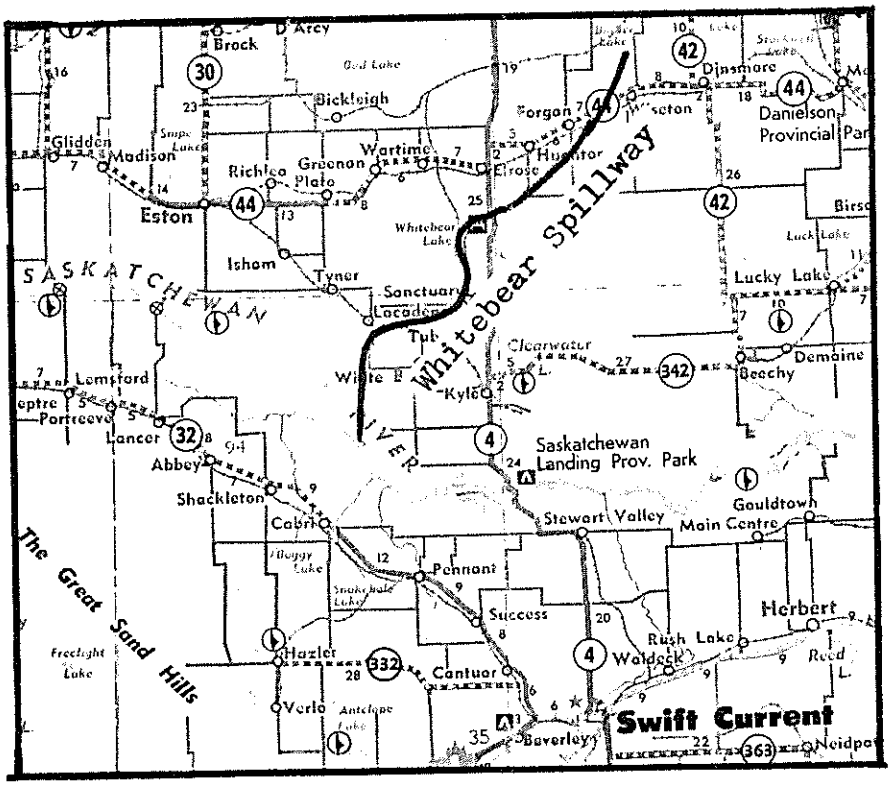
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Whitebear Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	80 km	Depth of fill	m
Width	1000 m	In drift	x
Relief	90 m	In drift & bedrock	
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

Scale in Miles: 10 0 10 20 30

Scale in Kilometres: 10 0 10 20 30 40

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	NP	Bedrock Exposures	NP
Ice-thrust Moraine	Pg	Springs	Pp
End Moraine	Pg	Alluvial Fans	Pg
Flutings	Pg	Flood Plains	Pg
Eskers	NP	Stream	Pp
Tunnel Valleys	NP	Marshes	Pg
Glacial Lake Basins	Pg	Lakes	Pg
Outwash Plains	Pg	Deltas	Pp
Meltwater Channels	NP	Beaches	Pp
Landslides	Pp	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	0	No. of towns	0
Km of highways	5	No. of villages	1
Km of railroads	20	No. of resorts	1

LIST OF REFERENCES ON SPILLWAY

Christiansen, E.A. 1965. Geology and groundwater resources of the Kindersley area, (72-N), Saskatchewan. Sask. Res. Counc., Geol. Div., Rept. 7, 26 p.

David, P.P. 1964. Surficial geology and groundwater resources of the Prelate area (72-K), Saskatchewan, Unpub. Ph.D. Thesis, McGill Univ., Montreal, 329 p.

Scott, J.S. 1971. Surficial geology of Rosetown map - area. Geol. Surv. Can., Bull. 190, 40 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Whitebear Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km = 10; 200-300 km = 7; < 200 km = 4	4
Width (>2000 m = 10; 1000-2000 m = 7; < 1000 m = 4)	7
Relief*	2
Drained glacial meltwater only = 5	
Drained glacial meltwater and proglacial runoff = 10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	0	Bedrock Exposures	0
Ice-thrust Moraine	2	Springs	1
End Moraine	2	Alluvial Fans	2
Flutings	2	Flood Plains	2
Eskers	0	Stream	1
Tunnel Valleys	0	Marshes	2
Glacial Lake Basins	2	Lakes	2
Outwash Plains	2	Deltas	1
Meltwater Channels	0	Beaches	1
Landslides	1	Other Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways = 4-(km of highways/length of spillway x 4)	4
Km of railroads = 4-(km of railroads/length of spillway x 4)	2
No. of towns (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of villages (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of resorts (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
Total out of 100	66

** Pg = 2, Pp = 1, and NP = 0.

* < 100 m = 2
100-125 m = 4
125-150 m = 6
150-175 m = 8
175-200 m = 10

Whitebear Spillway

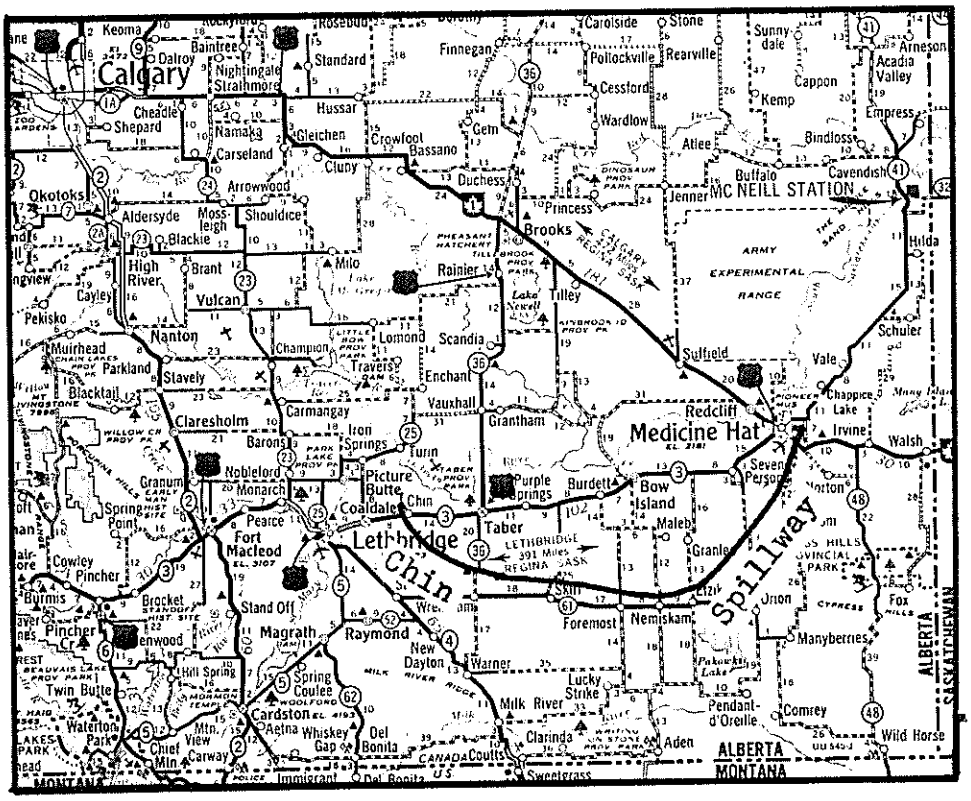
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Chin Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	130 km	Depth of fill	m
Width	1000 m	In drift	
Relief	75 m	In drift & bedrock	x
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	Pg	Bedrock Exposures	Pp
Ice-thrust Moraine	NP	Springs	Pp
End Moraine	Pg	Alluvial Fans	Pg
Flutings	NP	Flood Plains	Pg
Eskers	NP	Stream	Pp
Tunnel Valleys	NP	Marshes	Pp
Glacial Lake Basins	Pg	Lakes	Pp
Outwash Plains	Pg	Deltas	Pp
Meltwater Channels	Pg	Beaches	Pp
Landslides	Pp	Other	NP

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	4	No. of towns	0
Km of highways	2	No. of villages	0
Km of railroads	0	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Bretz, J.H. 1943. Keewatin end moraines in Alberta, Canada. Geol. Soc. Am. Bull., v. 54, p. 31-52.

Westgate, J.A. 1968. Surficial geology of the Foremost - Cypress Hills area, Alberta. Res. Counc. Alta., Bull. 22, 121 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Chin Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km=10; 200-300 km=7;<200 km=4	4
Width (>2000 m=10; 1000-2000 m=7;<1000 m=4)	7
Relief*	2
Drained glacial meltwater only=5	
Drained glacial meltwater and proglacial runoff=10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	2	Bedrock Exposures	1
Ice-thrust Moraine	0	Springs	1
End Moraine	2	Alluvial Fans	2
Flutings	0	Flood Plains	2
Eskers	0	Stream	1
Tunnel Valleys	0	Marshes	1
Glacial Lake Basins	2	Lakes	1
Outwash Plains	2	Deltas	1
Meltwater Channels	2	Beaches	1
Landslides	1	Other	0

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways=4-(km of highways/length of spillway x 4)	4
Km of railroads=4-(km of railroads/length of spillway x 4)	4
No. of towns (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
No. of villages (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
No. of resorts (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
Total out of 100	65

** Pg=2, Pp=1, and NP=0.

* < 100 m = 2
100-125 m = 4
125-150 m = 6
150-175 m = 8
175-200 m = 10

Chin Spillway

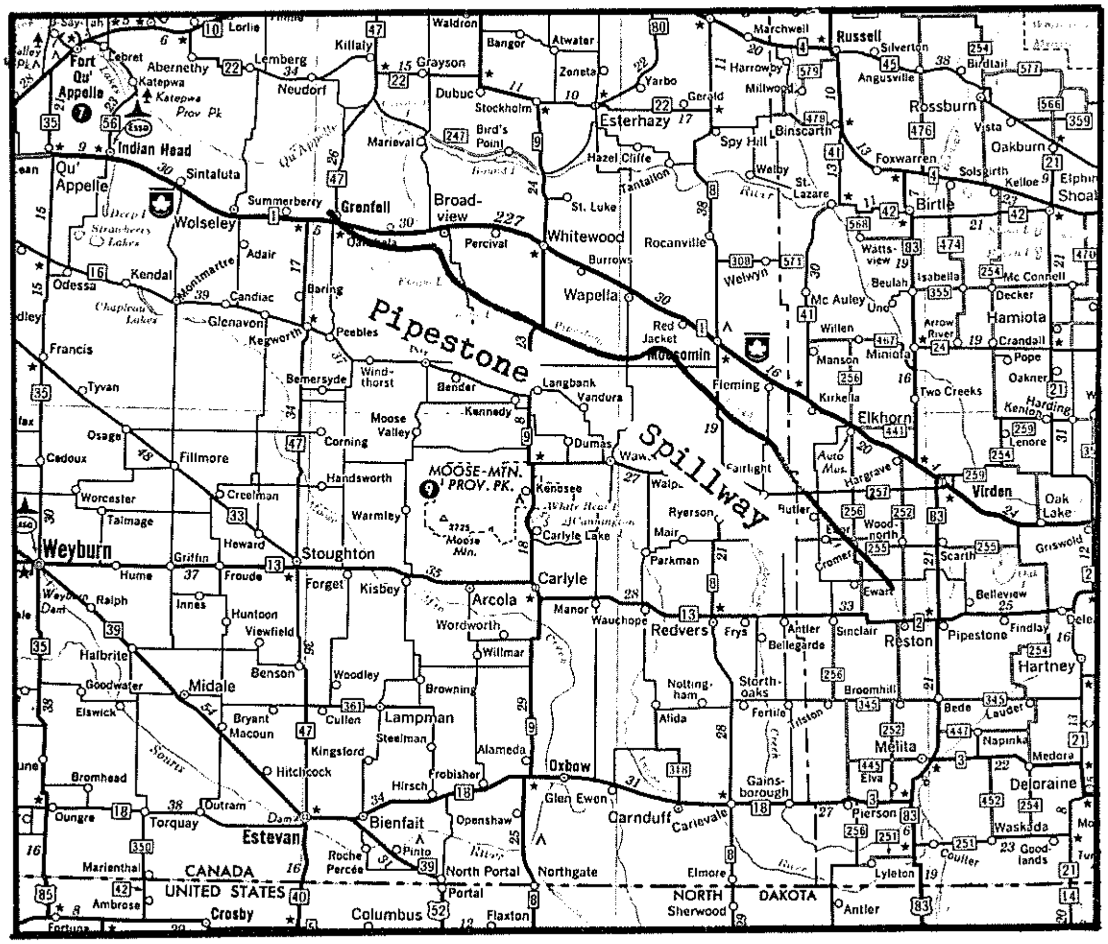
00014-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Pipestone Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length 170 km

Width 500 m

Relief 50 m

Drained meltwater only

Depth of fill m

In drift

In drift & bedrock x

Drained meltwater & runoff x

Other remarks

SCALE OF MILES Lambert Conformal Projection

10 0 10 20 30 40

0 50

Kilometres

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	Pg	Bedrock Exposures	Pp
Ice-thrust Moraine	NP	Springs	Pp
End Moraine	Pg	Alluvial Fans	Pp
Flutings	Pp	Flood Plains	Pg
Eskers	NP	Stream	Pp
Tunnel Valleys	NP	Marshes	Pp
Glacial Lake Basins	Pg	Lakes	Pg
Outwash Plains	Pg	Deltas	Pp
Meltwater Channels	Pg	Beaches	Pp
Landslides	Pg	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	2	No. of towns	0
Km of highways	8	No. of villages	1
Km of railroads	10	No. of resorts	1

LIST OF REFERENCES ON SPILLWAY

Christiansen, E.A. 1960. Geology and ground-water resources of the Qu'Appelle area, Saskatchewan. Sask. Res. Counc., Geol. Div., Rept. 1, 53 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Pipestone Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km = 10; 200-300 km = 7; <200 km = 4	4
Width (>2000 m = 10; 1000-2000 m = 7; <1000 m = 4)	4
Relief*	2
Drained glacial meltwater only = 5	
Drained glacial meltwater and proglacial runoff = 10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	2	Bedrock Exposures	1
Ice-thrust Moraine	0	Springs	1
End Moraine	2	Alluvial Fans	1
Flutings	1	Flood Plains	1
Eskers	0	Stream	1
Tunnel Valleys	0	Marshes	1
Glacial Lake Basins	2	Lakes	2
Outwash Plains	2	Deltas	1
Meltwater Channels	2	Beaches	1
Landslides	2	Other Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways = 4-(km of highways/length of spillway x 4)	0
Km of railroads = 4-(km of railroads/length of spillway x 4)	0
No. of towns (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	0
No. of villages (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	0
No. of resorts (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	0
Total out of 100	65

** Pg = 2, Pp = 1, and NP = 0.

< 100 m = 2
100-125 m = 4
125-150 m = 6
150-175 m = 8
175-200 m = 10

Pipestone Spillway

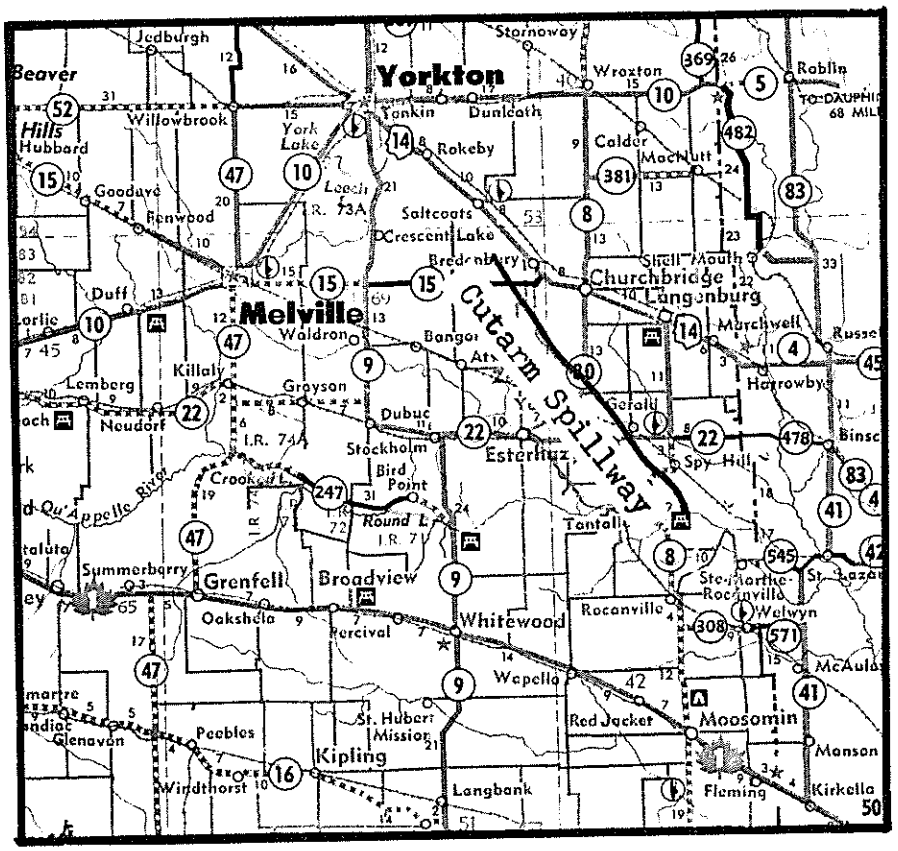
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Cutarm Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	60 km	Depth of fill	m
Width	500 m	In drift	
Relief	105 m	In drift & bedrock	x
Drained meltwater only	x	Drained meltwater & runoff	

Other remarks

Scale in Miles: 10 0 10 20 30

Scale in Kilometres: 10 0 10 20 30 40

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	Pg	Bedrock Exposures	Pp
Ice-thrust Moraine	Pg	Springs	Pp
End Moraine	NP	Alluvial Fans	Pp
Flutings	Pg	Flood Plains	Pp
Eskers	Pg	Stream	Pp
Tunnel Valleys	Pg	Marshes	NP
Glacial Lake Basins	Pg	Lakes	NP
Outwash Plains	Pg	Deltas	NP
Meltwater Channels	Pg	Beaches	NP
Landslides	Pg	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	1	No. of towns	0
Km of highways	4	No. of villages	0
Km of railroads	2	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Christiansen, E.A. 1960. Geology and ground-water resources of the Qu'Appelle area, Saskatchewan. Sask. Res. Counc., Geol. Div., Rept. 1, 53 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Cutarm Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km=10; 200-300 km=7;<200 km=4	4
Width (>2000 m=10; 1000-2000 m=7;<1000 m=4)	4
Relief*	4
Drained glacial meltwater only=5	5
Drained glacial meltwater and proglacial runoff=10	

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	2	Bedrock Exposures	1
Ice-thrust Moraine	2	Springs	1
End Moraine	0	Alluvial Fans	1
Flutings	2	Flood Plains	1
Eskers	2	Stream	1
Tunnel Valleys	2	Marshes	0
Glacial Lake Basins	2	Lakes	0
Outwash Plains	2	Deltas	0
Meltwater Channels	2	Beaches	0
Landslides	2	Other Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways=4-(km of highways/length of spillway x 4)	4
Km of railroads=4-(km of railroads/length of spillway x 4)	4
No. of towns (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
No. of villages (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
No. of resorts (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
Total out of 100	62

** Pg=2, Pp=1, and NP=0.

* <100 m=2
100-125 m=4
125-150 m=6
150-175 m=8
175-200 m=10

Cutarm Spillway

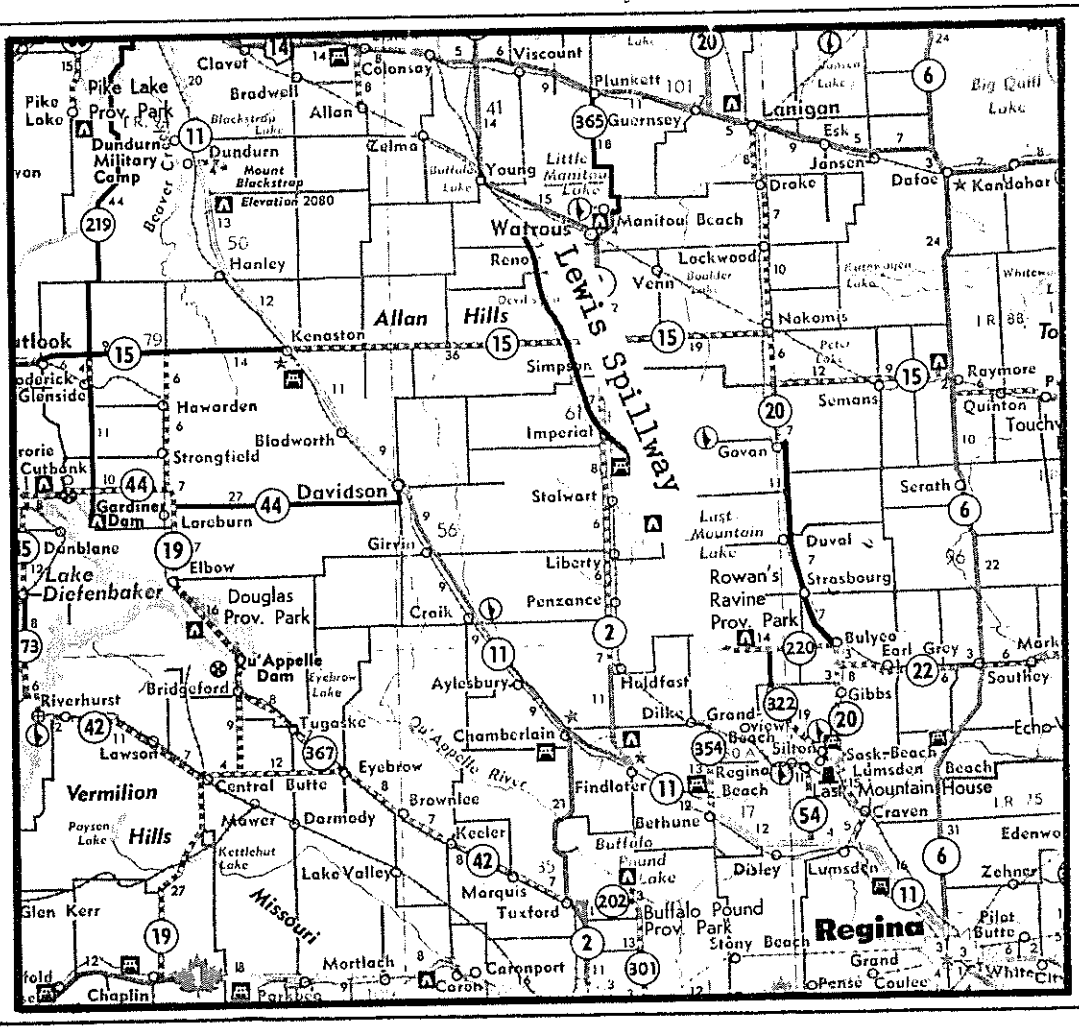
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Lewis Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	40 km	Depth of fill	m
Width	500 m	In drift	x
Relief	40 m	In drift & bedrock	
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	Pg	Bedrock Exposures	NP
Ice-thrust Moraine	NP	Springs	Pp
End Moraine	Pg	Alluvial Fans	Pp
Flutings	NP	Flood Plains	Pp
Eskers	Pg	Stream	Pp
Tunnel Valleys	NP	Marshes	Pp
Glacial Lake Basins	Pg	Lakes	Pg
Outwash Plains	Pg	Deltas	Pp
Meltwater Channels	NP	Beaches	Pp
Landslides	Pp	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	0	No. of towns	0
Km of highways	0	No. of villages	0
Km of railroads	0	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Edmunds, F.H. 1962. Recession of Wisconsinan glacier from central Saskatchewan. Sask. Dep. Min. Res., Rept. 67, 23 p.

Greer, J.E. and Christiansen, E.A. 1963. Geology and groundwater resources of the Wynyard area (72-P), Saskatchewan. Sask. Res. Counc., Geol. Div., Rept. 3, 56 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Lewis Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km=10; 200-300 km=7;<200 km=4	4
Width (>2000 m=10; 1000-2000 m=7;<1000 m=4)	4
Relief*	2
Drained glacial meltwater only=5	
Drained glacial meltwater and proglacial runoff=10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	2	Bedrock Exposures	0
Ice-thrust Moraine	0	Springs	1
End Moraine	2	Alluvial Fans	1
Flutings	0	Flood Plains	1
Eskers	2	Stream	1
Tunnel Valleys	0	Marshes	1
Glacial Lake Basins	2	Lakes	2
Outwash Plains	2	Deltas	1
Meltwater Channels	0	Beaches	1
Landslides	1	Other Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways=4-(km of highways/length of spillway x 4)	4
Km of railroads=4-(km of railroads/length of spillway x 4)	4
No. of towns (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
No. of villages (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
No. of resorts (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
Total out of 100	62

** Pg=2, Pp=1, and NP=0.

* < 100 m = 2
100-125 m = 4
125-150 m = 6
150-175 m = 8
175-200 m = 10

Lewis Spillway

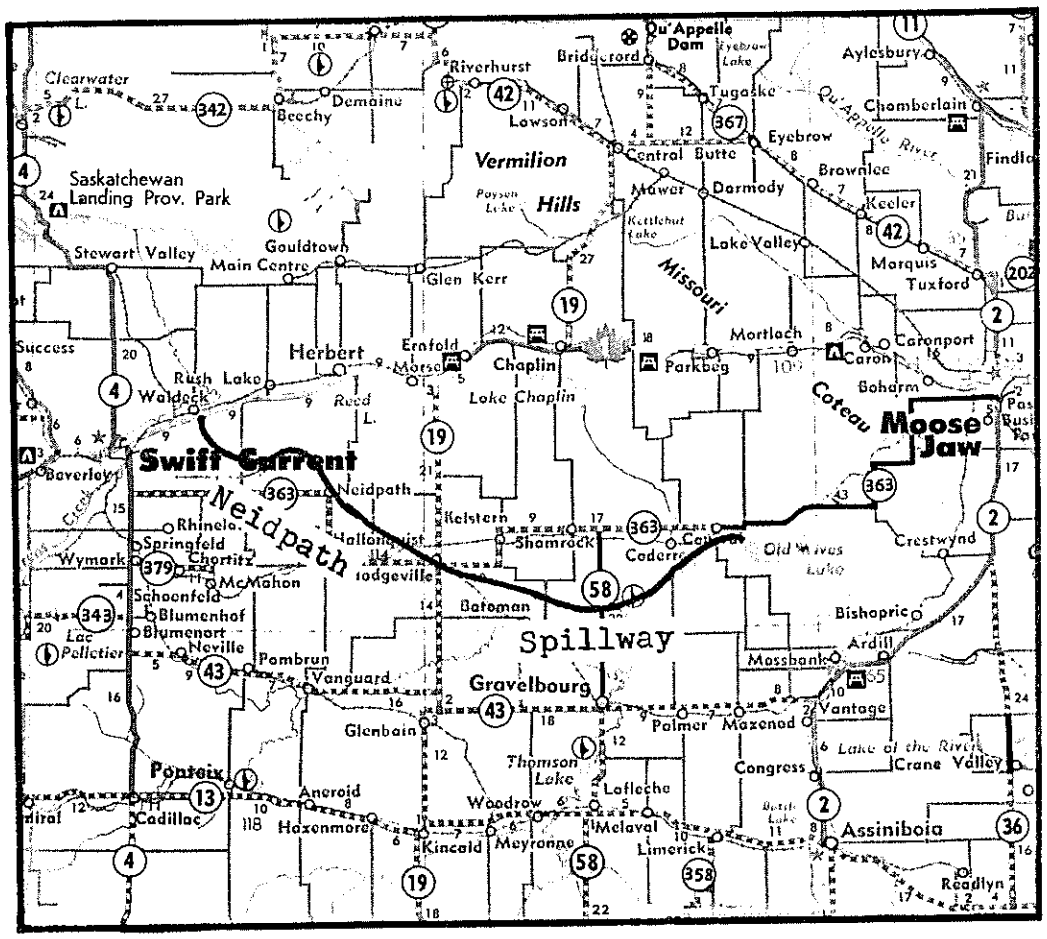
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Neidpath Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	100 km	Depth of fill	m
Width	600 m	In drift	
Relief	115 m	In drift & bedrock	x
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

Scale in Miles

Scale in Kilometres

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	Pg	Bedrock Exposures	Pp
Ice-thrust Moraine	NP	Springs	Pp
End Moraine	Pg	Alluvial Fans	Pg
Flutings	Pg	Flood Plains	Pg
Eskers	NP	Stream	Pp
Tunnel Valleys	NP	Marshes	Pg
Glacial Lake Basins	Pg	Lakes	Pp
Outwash Plains	NP	Deltas	Pp
Meltwater Channels	NP	Beaches	NP
Landslides	Pp	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	1	No. of towns	0
Km of highways	13	No. of villages	3
Km of railroads	60	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Bretz, J.H. 1943. Keewatin end moraines in Alberta, Canada. Geol. Soc. Am. Bull., v. 54, p. 31-52.

Christiansen, E.A. 1959. Glacial geology of the Swift Current area, Saskatchewan. Sask. Dept. Min. Res., Rept. 32, 62 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Neidpath Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km = 10; 200-300 km = 7; < 200 km = 4	4
Width (>2000 m = 10; 1000-2000 m = 7; < 1000 m = 4)	4
Relief*	4
Drained glacial meltwater only = 5	
Drained glacial meltwater and proglacial runoff = 10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	2	Bedrock Exposures	1
Ice-thrust Moraine	0	Springs	1
End Moraine	2	Alluvial Fans	2
Flutings	2	Flood Plains	2
Eskers	0	Stream	1
Tunnel Valleys	0	Marshes	2
Glacial Lake Basins	2	Lakes	1
Outwash Plains	0	Deltas	1
Meltwater Channels	0	Beaches	0
Landslides	1	Other Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways = 4-(km of highways/length of spillway x 4)	3
Km of railroads = 4-(km of railroads/length of spillway x 4)	2
No. of towns (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of villages (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	2
No. of resorts (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
Total out of 100	59

** Pg = 2, Pp = 1, and NP = 0.

* < 100 m = 2
100-125 m = 4
125-150 m = 6
150-175 m = 8
175-200 m = 10

Neidpath Spillway

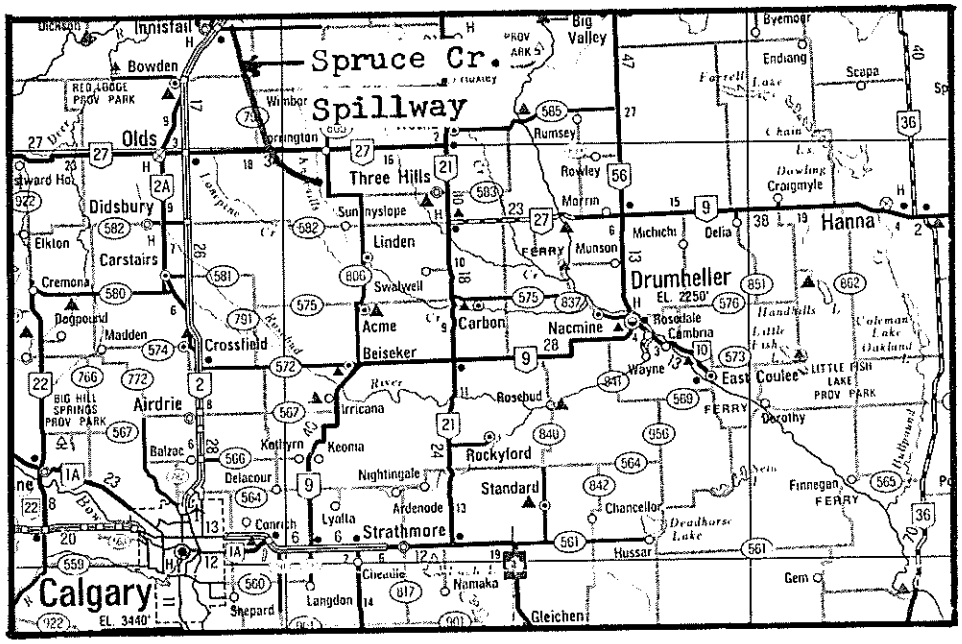
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Spruce Creek Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	30 km	Depth of fill	m
Width	500 m	In drift	
Relief	60 m	In drift & bedrock	x
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	NP	Bedrock Exposures	Pp
Ice-thrust Moraine	NP	Springs	Pp
End Moraine	NP	Alluvial Fans	Pg
Flutings	NP	Flood Plains	Pp
Eskers	Pg	Stream	Pp
Tunnel Valleys	NP	Marshes	NP
Glacial Lake Basins	Pg	Lakes	NP
Outwash Plains	Pg	Deltas	NP
Meltwater Channels	Pg	Beaches	NP
Landslides	Pg	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	0	No. of towns	0
Km of highways	2	No. of villages	0
Km of railroads	0	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Stalker, A.M. 1973. Surficial geology of the Drumheller area, Alberta. Geol. Surv. Can., Mem. 370, 122 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Spruce Creek Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km = 10; 200-300 km = 7; <200 km = 4	4
Width (>2000 m = 10; 1000-2000 m = 7; <1000 m = 4)	4
Relief*	2
Drained glacial meltwater only = 5	
Drained glacial meltwater and proglacial runoff = 10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	0	Bedrock Exposures	1
Ice-thrust Moraine	0	Springs	1
End Moraine	0	Alluvial Fans	2
Flutings	0	Flood Plains	1
Eskers	2	Stream	1
Tunnel Valleys	0	Marshes	0
Glacial Lake Basins	2	Lakes	0
Outwash Plains	2	Deltas	0
Meltwater Channels	2	Beaches	0
Landslides	2	Other — Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways = 4-(km of highways/length of spillway x 4)	4
Km of railroads = 4-(km of railroads/length of spillway x 4)	4
No. of towns (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of villages (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of resorts (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
Total out of 100	58

** Pg = 2, Pp = 1, and NP = 0.

* ≤100 m = 2
100-125 m = 4
125-150 m = 6
150-175 m = 8
175-200 m = 10

Spruce Creek Spillway

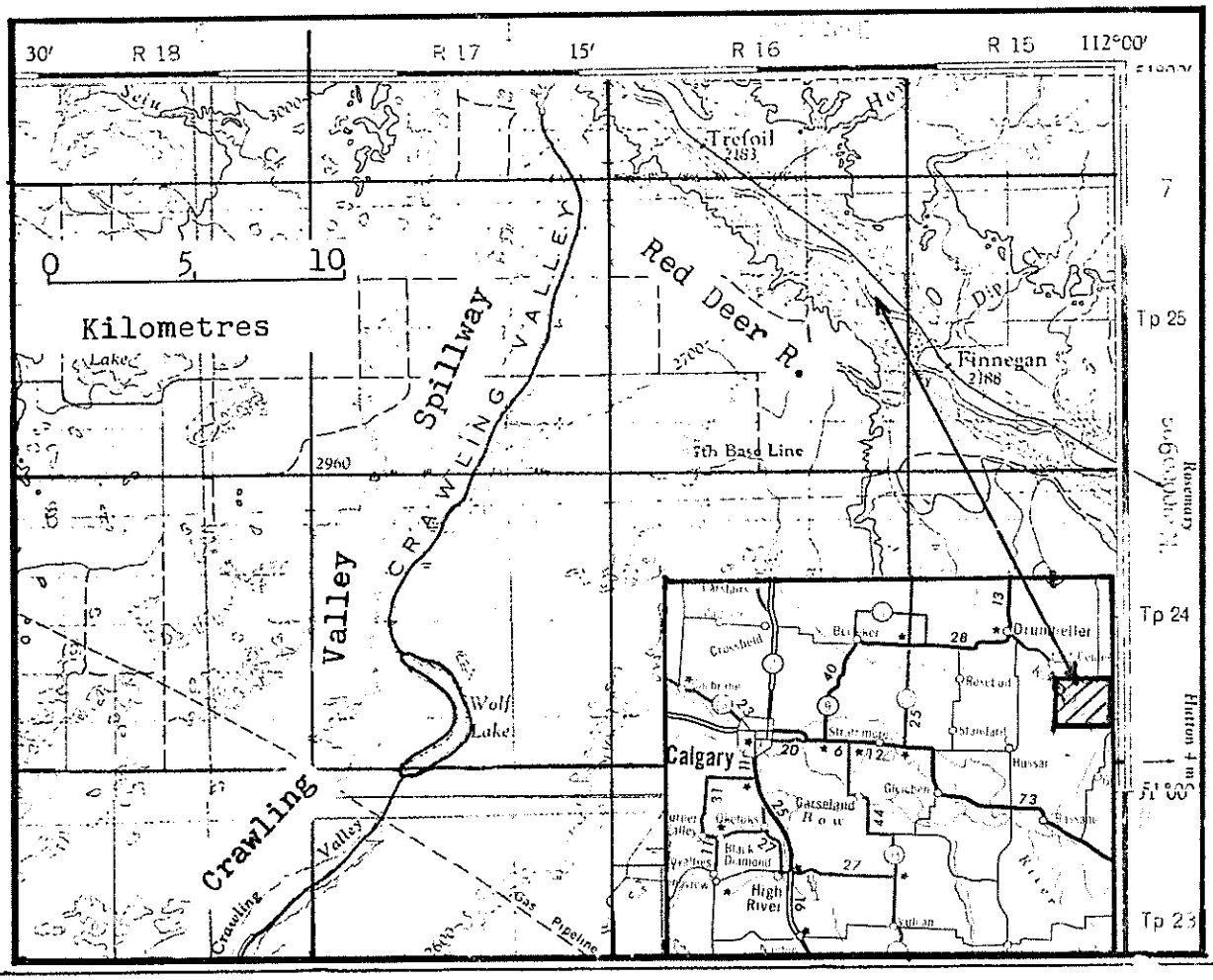
0004-002

E. A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Crawling Valley Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	55 km	Depth of fill	m
Width	600 m	In drift	
Relief	45 m	In drift & bedrock	x
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

0004-002

E. A. Christiansen Consulting Ltd.

NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	NP	Bedrock Exposures	Pp
Ice-thrust Moraine	NP	Springs	Pp
End Moraine	NP	Alluvial Fans	Pg
Flutings	NP	Flood Plains	Pg
Eskers	NP	Stream	Pp
Tunnel Valleys	NP	Marshes	Pp
Glacial Lake Basins	Pg	Lakes	Pp
Outwash Plains	Pg	Deltas	Pp
Meltwater Channels	NP	Beaches	Pp
Landslides	Pp	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	2	No. of towns	0
Km of highways	0	No. of villages	0
Km of railroads	0	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

Stalker, A.M. 1973. Surficial geology of the Drumheller area, Geol. Surv. Can. Mem. 370, 122 p.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Crawling Valley Spillway

E. A. Christiansen Consulting Ltd.

EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km=10; 200-300 km=7; <200 km=4	4
Width (>2000 m=10; 1000-2000 m=7; <1000 m=4)	4
Relief*	2
Drained glacial meltwater only=5	
Drained glacial meltwater and proglacial runoff=10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	0	Bedrock Exposures	1
Ice-thrust Moraine	0	Springs	1
End Moraine	0	Alluvial Fans	2
Flutings	0	Flood Plains	2
Eskers	0	Stream	1
Tunnel Valleys	0	Marshes	1
Glacial Lake Basins	2	Lakes	1
Outwash Plains	2	Deltas	1
Meltwater Channels	0	Beaches	1
Landslides	1	Other Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways=4-(km of highways/length of spillway x 4)	4
Km of railroads=4-(km of railroads/length of spillway x 4)	4
No. of towns (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
No. of villages (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
No. of resorts (0 or 1=4, 2=3, 3=2, 4 or more=0)	4
Total out of 100	58

** Pg=2, Pp=1, and NP=0.

* <100 m=2
100-125 m=4
125-150 m=6
150-175 m=8
175-200 m=10

Crawling Valley Spillway

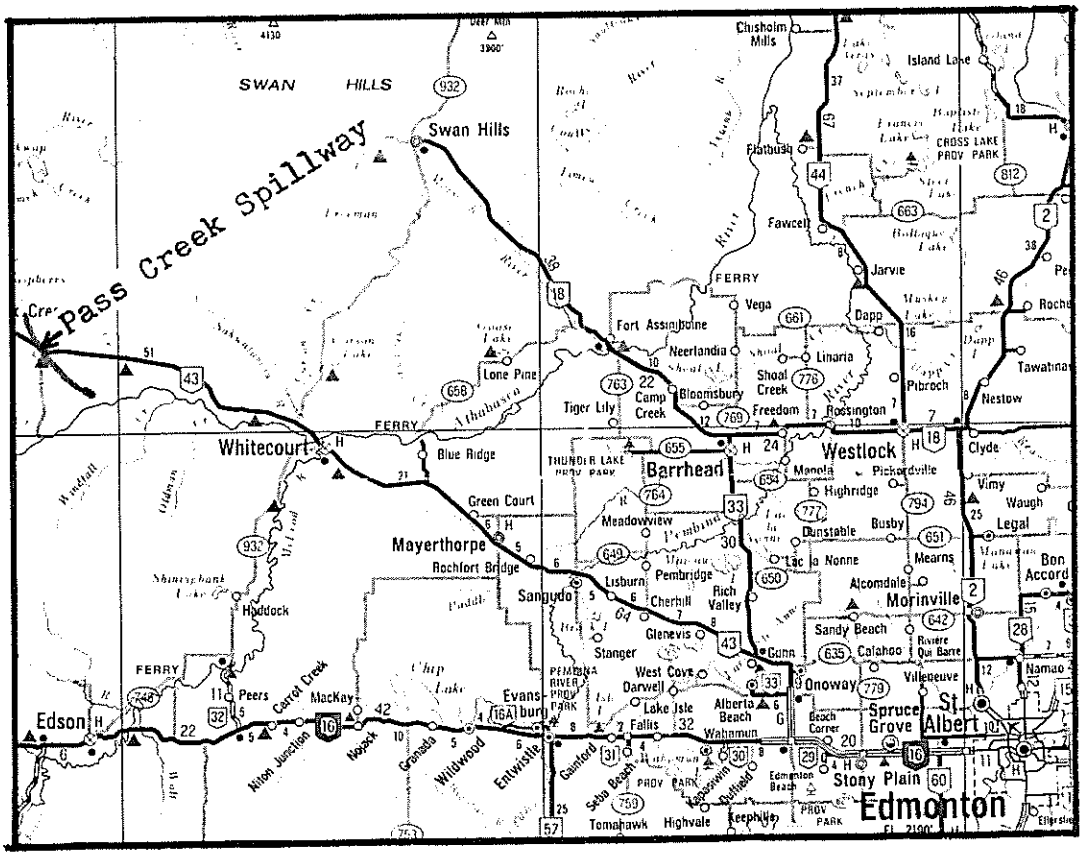
0004-002

E.A. Christiansen Consulting Ltd.

INVENTORY OF GLACIAL SPILLWAYS

NAME OF SPILLWAY Pass Creek Spillway

LOCATION OF SPILLWAY



DESCRIPTION OF SPILLWAY

Length	35 km	Depth of fill	m
Width	600 m	In drift	x
Relief	60 m	In drift & bedrock	
Drained meltwater only		Drained meltwater & runoff	x

Other remarks

0004-002

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NATURAL VALUES ASSOCIATED WITH SPILLWAY *

Ridged Moraine	NP	Bedrock Exposures	NP
Ice-thrust Moraine	NP	Springs	Pp
End Moraine	NP	Alluvial Fans	Pg
Flutings	NP	Flood Plains	Pp
Eskers	NP	Stream	Pp
Tunnel Valleys	NP	Marshes	NP
Glacial Lake Basins	Pg	Lakes	NP
Outwash Plains	Pg	Deltas	NP
Meltwater Channels	NP	Beaches	NP
Landslides	Pp	Other Terraces	Pg

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

No. of dams	0	No. of towns	0
Km of highways	0	No. of villages	0
Km of railroads	0	No. of resorts	0

LIST OF REFERENCES ON SPILLWAY

The surficial geology of this area has not been published.
The interprretation is based on a study of maps and photo-mosaics.

* Within 20 km of spillway. Pg=good; Pp = poor; and NP= not present.

0004-002

Pass Creek Spillway

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EVALUATION OF SPILLWAY

DESCRIPTION OF SPILLWAY

Length (>300 km = 10; 200-300 km = 7; < 200 km = 4	4
Width (>2000 m = 10; 1000-2000 m = 7; < 1000 m = 4)	4
Relief*	2
Drained glacial meltwater only = 5	
Drained glacial meltwater and proglacial runoff = 10	10

NATURAL VALUES ASSOCIATED WITH SPILLWAY **

Ridged Moraine	0	Bedrock Exposures	0
Ice-thrust Moraine	0	Springs	1
End Moraine	0	Alluvial Fans	2
Flutings	0	Flood Plains	1
Eskers	0	Stream	1
Tunnel Valleys	0	Marshes	0
Glacial Lake Basins	2	Lakes	0
Outwash Plains	2	Deltas	0
Meltwater Channels	0	Beaches	0
Landslides	1	Other ---- Terraces	2

SIGNIFICANT HUMAN IMPACT ON SPILLWAY

Km of highways = 4-(km of highways/length of spillway x 4)	4
Km of railroads = 4-(km of railroads/length of spillway x 4)	4
No. of towns (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of villages (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
No. of resorts (0 or 1 = 4, 2 = 3, 3 = 2, 4 or more = 0)	4
Total out of 100	52

** Pg = 2, Pp = 1, and NP = 0.

* < 100 m = 2
100-125 m = 4
125-150 m = 6
150-175 m = 8
175-200 m = 10

Pass Creek Spillway

0004-002

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