PRELIMINARY SOIL SURVEY OF THE CLEARWATER RIVER VALLEY IN NORTH-WESTERN SASKATCHEWAN

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Introduction

The agricultural potential of lands surrounding the Metis and Indian settlements of Northern Saskatchewan is of importance to the administrators and officers concerned with the welfare of the native population.

This survey was undertaken at the request of the Deputy Minister, Saskatchewan Department of Agriculture following representation from the Agricultural Representative for Northern Saskatchewan concerning the possibility of finding land suitable for agricultural development in the Clearwater River Valley.

Previous exploratory traverses in the Upper Churchill River Plains and the Ile à La Crosse Lowlands (1,2,3) had indicated a very limited acreage of land suitable for agricultural development in North-Western Saskatchewan. An exploratory soil survey made at West La Loche (4), on Methy Lake, revealed some small areas suitable for cultivation. These are the most extensive areas found in this region to date.

The amount of land suitable for cultivation at West La Loche is small in comparison to the needs of the people in the settlements surrounding Methy Lake, and since the possibility

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of finding suitable areas close to the La Loche settlements appeared unlikely, it was decided to investigate the Clearwater River Valley in this regard.

In the early days the Clearwater River formed a part of the important fur trade route from the east to the North West Territories. Reports of early travellers indicated that there might be some areas along the Clearwater suitable for cultivation. No settlements were ever developed, and at the present time there are no permanent inhabitants in the valley. In the winter months some of the people from the Methy Lake settlements trap small fur-bearing animals in the valley.

Today, the Clearwater River Valley is an isolated region. It may be reached from Buffalo Narrows by road in the winter months, but only by air in the summer. Furthermore, it should be noted that the Clearwater River is a meandering stream set in a narrow and deep valley which makes the landing of larger type aircraft difficult, if not impossible.

Location and Physiography of the Area

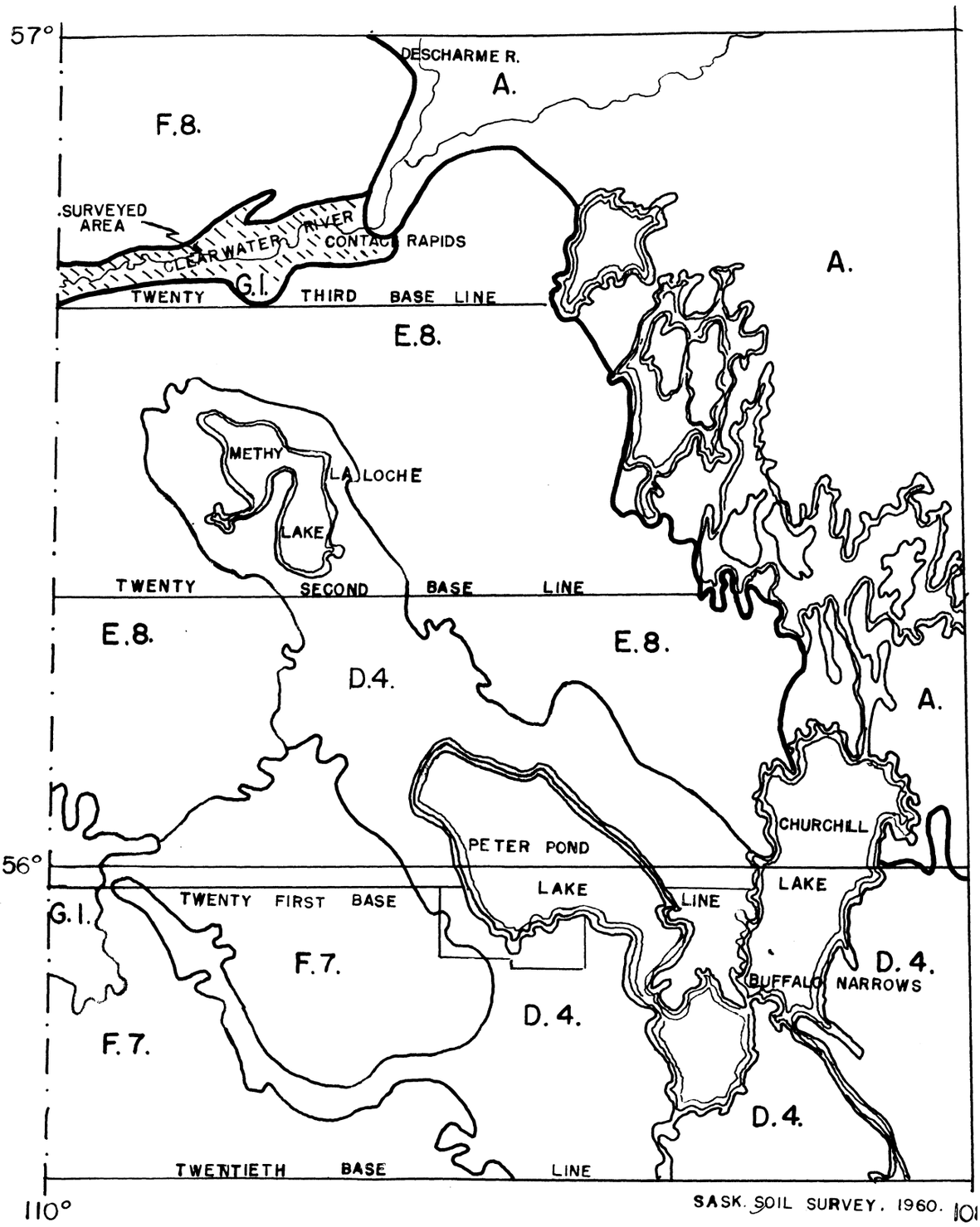
The Clearwater Valley lies within and adjacent to portions of four of the major physiographic divisions of the North American Continent, namely the Central Lowlands, Great Plains, Northern Plains Provinces of the Interior Plains, and the Churchill Province of the Canadian Shield. The accompanying sketch map, Figure 1, indicates the location of the surveyed area with respect to the various physiographic sections. The characteristics of these sections are described in the legend accompanying the Map of the Physiographic Divisions of Saskatchewan as published by the Saskatchewan Research Council (5).

The Clearwater River rises in the Athabasca Plains section of the Canadian Shield. It flows in a general southerly direction through the ice-scoured bedrock of the Churchill River Plains to near Contact Rapids where it turns westward and cuts a

Fig.1. PHYSIOGRAPHIC MAP OF THE CLEARWATER RIVER AND THE SURROUNDING AREA.

Legend.

A. Churchill River Plain.
D.4. Ile-a-la-Crosse Lowland.
E.8. Methy Portage Plain.
F.7. Mostoos Hills Upland.
F.8. Firebag Hills Upland.
G.I. Clearwater River Plains.



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deep valley through the glaciated, Cretaceous Uplands between the Firebag Hills Upland and the Methy Portage Plains before joining the Athabasca River in Alberta. Within this latter area the river has cut to great depth through glacial till and Lower Cretaceous sands exposing dolomites of Devonian age. Most of these bedrock materials are masked by the slumping of glacial material on the valley sides, or by alluvial, sandy deposits in the bottom lands.

The present survey covers that portion of the Clearwater River Valley extending west from Contact Rapids to the Alberta border, a distance of about 20 miles. The area lies north of the twenty-third base line within Townships 89, Ranges 21, 22, and 23, West of the Third Meridian.

The valley varies from three to four miles in width at the top, with steeply sloping valley sides, narrowing at the bottom to a flood plain which is usually less than one mile in width. It is about 700 feet deep on the Alberta border.

Soils of the Clearwater River Valley

Vegetation, parent material, and drainage conditions, particularly the last two, are the major factors influencing the types and development of soils in the Clearwater Valley. The vegetative cover is fairly typical of that found on the borders of the Mixedwood and Northern Coniferous Sections of the Boreal Forest Region. The tree cover on imperfectly to well drained sites varies from mature stands of spruce to mixedwoods of spruce - aspen with more local stands of jack pine or mixed aspen and birch. Poorly drained areas are dominated by a marsh-meadow vegetative cover of sedges, meadow grasses and willows with local stands of mixed black spruce and tamarack. Under such vegetation one might expect well developed Podzolic, Gleysolic Meadow, and Organic soil profiles. However, the excessively sandy nature of the parent materials, and the extreme range and variations in drainage conditions, have resulted in a

dominance of weakly developed Regosolic, Podzolic, and Gleysolic profiles.

The soils of the steep valley sides have developed largely on incoherent sandy loams and sands presumably derived by erosion and slumping of sandy till and outwash, or from sandy material of Lower Cretaceous origin. These valley slopes are for the most part excessively drained with numerous eroding slopes and intermittent water courses. Under these conditions the soils are mainly Mor Regosols (weakly developed soils under forest cover), with some weakly developed Podzolic soils found on the more stable slope positions.

The soils of the valley bottom land are mostly developed on loamy sand and incoherent sand deposits. In a few areas there is a thin overlay of finer textured, alluvial materials. The river has entrenched itself into a flood plain, usually less than a mile in width, leaving a series of flat terraces which rise in elevation as they extend back from the river. These terraces and bottom lands receive the accumulated run-off from a much larger area of excessively drained valley slopes and consequently the soils have developed under conditions of very poor to imperfect drainage. The lowest terraces near the river are usually very poorly drained, whereas the higher terraces may exhibit somewhat better drainage conditions. The soils are mostly immature or weakly developed, varying from fibrous peats (Organic soils) to peaty Gleysolic soils developed under meadow vegetation. Local areas of weakly developed Podzolic, or Mor Regosolic soils, occur on the slightly better drained sites, or on sandy ridges with tree cover.

An exploratory map has been prepared of the area in which the soils of the area are divided into four soil mapping units on the basis of differences in textural, vegetative, drainage, and soil profile characteristics. Four land form units are also recognized based on characteristics of topography

and relief. The combinations of soil and land form characteristics constitute the mapping units described in the report and indicated on the accompanying map and legend.

Description of the Soil Mapping Units

Mapping Unit A.

A generalized description of Peaty Gleysols likely to occur on these areas is as follows:

L-H layer - a raw to partially decomposed organic layer varying from two to eight inches in thickness. It is often very wet and mucky.

C - a mottled, reddish brown, incoherent sandy deposit. Occasionally the surface organic horizon may be underlain by a sandy loam or loamy sand horizon which in turn is underlain by the incoherent sands.

These soils occur on the low lying terraces which are subject to flooding either from the river or from run-off from higher areas. Due to their close proximity to the river the water table is near the surface, often within two or three feet. Frequent meander scars and levees tend to hold the water on these terraces, preventing it from flowing back to the river.

The vegetation of these areas consists of sedge, grasses and willows. Jack pine, white poplar and birch are sometimes found on local sandy ridges within these areas giving rise to areas of local Mor Regosols.

Due to the coarse textures, low organic matter content, and poor drainage, these weakly developed soils are not considered to be suitable for cultivation. With clearing of the willows and a minor amount of surface drainage some areas suitable for livestock grazing could be obtained.

Mapping Unit B.

Two soil types were mapped within this unit. The most extensive one is classified as a Mor Regosol; the structure of which is restricted to a layer of raw to partially decomposed organic matter, several inches thick, overlying the sandy parent material.

A weakly developed Podzolic profile also occurs in local areas within this unit. It consists of a layer of raw to partially decomposed organic matter, one to two inches thick, underlain by a light greyish brown, weak platy to granular structured eluvial horizon. The greyish color is usually most evident at the top of this horizon; the color fading with depth and within a few inches cannot be distinguished from the parent material.

These soils occupy the eroding, steeply sloping valley sides and some of the well drained, ridged, river terraces. The vegetation is composed of mixed softwood and hardwood.

These areas are considered to be non-arable due to their rough topography and coarse textured parent material.

Mapping Unit C.

Soils of this type are characterized by a medium to fine-textured layer of variable thickness overlying the sandy parent materials. These soils occur as local patches within soils of Mapping Unit A.

A description of a Gleyed Mor Regosol of this unit occurring under a grass-sedge vegetation is as follows:

L-F - raw to partially decomposed organic horizon varying from four to six inches thick.

F-C - partially decomposed organic matter intermixed with some mineral materials. This horizon extends down to about ten inches below the surface. The textures range from loam to clay loam which is significantly

heavier than the underlying sandy horizons. Lime carbonates and alkali salts are absent.

II C - reddish brown sands. There may be some mottling and iron staining indicating imperfect drainage. Lime carbonates and salts are absent.

Under heavy stands of mixedwood vegetation weakly developed, Gleyed, Podzolic soils are formed. They have a thin, raw, organic layer overlying a thin, slightly platy to granular, greyish-brown eluvial horizon. Beneath this eluvial horizon is a dark grey granular to massive B horizon which is the finest textured horizon in the profile. At a depth of ten to twelve inches a sharp break to a very sandy II C horizon usually occurs.

These soils occur on both the low and high terrace levels. They are for the most part imperfectly drained, but some well drained profile types are also present.

The major portion of the soils of this mapping unit occur under a mature spruce cover. The other vegetative types consist of thin scattered stands of poplar mixed with small areas of sedges and grasses.

These soils represent the most suitable types for cultivation of any of the soils in the valley, but their fertility is somewhat limited. Laboratory analyses for two profiles sampled in this mapping unit are shown in Table 1. They indicate that although the soils are acid in reaction throughout, the base exchange capacity of the finer textured layers is moderately high and dominated by calcium. The most undesirable feature is the limited thickness of these finer textured layers and the occurrence of poorly drained infertile sands within twelve inches of the surface. Such soils may eventually require the application of lime to maintain fertility. The organic matter content of the surface soils is reasonably adequate, however, if these are cultivated the incorporation of all partially decomposed leaf litter would be highly desirable.

Mapping Unit D.

Only one area of soils of this type was observed in this study. It is located about 3 miles east of the Alberta-Saskatchewan boundary.

A sedge peat is the dominant soil type of this area. A small part of the area is covered by 8-12 inches of compact, well decomposed peat but the remainder is covered by a wetter open sedge peat several feet thick, but much looser than the former type. The organic layer is underlain by at least several feet of fine-textured, impervious, shaly clays.

These soils lie on a low terrace which is five to ten feet above the river level, and on a gently sloping area extending from this terrace up to the steeply sloping valley sides. Seepage waters from the valley sides keep these two lower levels continually wet.

The whole area could probably be drained by a ditch at the top of the upper level, or the lower terrace alone could be drained by a ditch at the base of the gently sloping area.

The total acreage of soils of this type in the valley is approximately 40 acres.

This area is believed to be the one referred to in early reports indicating "prairie" in the Clearwater Valley.

Agricultural Potential

The agricultural potential of the Saskatchewan portion of the Clearwater River Valley west of Contact Rapids is very limited. Any potential agricultural development would be necessarily restricted to the terraces in the valley bottom which, if fully developed, would not comprise more than 6,500 acres in total area.

About 5,000 acres of the soils in the alluvial terraces are developed on sands, (Map Units A and B). Slightly over half is imperfectly to poorly drained, (Map Unit A). The soils within these areas are subject to periodic flooding from rises in the

water level of the river, and also from run-off waters from the valley sides which are trapped locally on these terraces by many meander scars and ridges. This latter condition could conceivably be alleviated by draining these low terraces but the former condition could only be remedied by flood control measures on the river. The water table would remain near the surface which would probably limit production of tame grasses in such areas. These areas presently support local patches of sedge grasses. The extent of this type of vegetation could be increased by clearing off the willows and slightly improving the surface drainage. Potential production from such areas would likely be limited to low quality pasture or hay crops.

In contrast to the imperfectly to poorly drained sandy soils in Map Unit A, the soils of Map Unit B within the valley bottom are developed on relatively well drained sands. They are situated on slightly higher terraces than the soils in Map Unit A and on ridges within this latter Map Unit itself. If the nutrient level of these soils was raised they may be suitable for some garden crops, but large additions of organic matter and continual applications of fertilizers would be necessary to build up and maintain a suitable productivity level. The fact that much of the area of soils mapped within this particular Map Unit occur on small, moderately steep ridges situated within poorly drained areas must also be considered as an adverse factor.

Soils mapped within Map Unit C are similar to those mapped in Map Unit A in that they occur primarily on imperfectly drained terraces. They differ from this latter Map Unit in that they have a thin, fine textured deposit overlying the sands. There are about 1,300 acres of soils mapped within this Map Unit over half of which are presently supporting a heavy cover of trees. This would restrict immediate agricultural development to three or four patches in the central portion of the surveyed area which would only require a moderate amount of clearing and possibly some drainage. It should be pointed out that

thorough traverses of these terraces was not possible, and as a result the entire areas delineated on the map may not be entirely composed of soils possessing the fine-textured surface layers. Once cultivated, these soils would probably be suitable for some types of garden crops and would almost certainly be suitable for forage crop production.

There is one area in this region which has a much higher potential than any of the areas mentioned so far. It is a small area near the Alberta border mapped as Map Unit D. This area with an extensive drainage program could secure about 40 acres of soils capable of high productivity levels for any crops climatically suited to this northern region.

It must be remembered that due to the tremendous run-off from the valley sides that the erosion potential is great. On clearing, this may lead to complete removal of the finer textured overlays and continual losses of added nutrients through erosion.

It is apparent that there is no sizeable acreage of soils in the Clearwater Valley that are suitable for agricultural development. Areas suitable for development would be restricted to Map Units C and D, a total of approximately 1,300 acres. It should be pointed out that the production of cultivated crops would likely require subsurface drainage and flood control measures. The scattered pattern of occurrence of these soils, together with the inaccessibility of the valley itself also present serious handicaps to development.

TABLE 1 - Some Analyses of Soils from the Clearwater River Valley

	Horizon	Depth	Texture*	pH	Nitrogen	Organic Carbon	Total Ex. Capacity	Ex. Ca	Ex. Mg	Ex. Na	Ex. K
Profile 1 - Weak podzolic (Map Unit C)	L-F	0-3"		5.6	1.19	22.88	79.2	63.1	19.1	0.0	0.2
	Bt	3-9"	clay loam	5.1	0.24	4.06	32.8	14.0	1.9	0.0	0.1
	II Cg	9"+	fine sandy loam	5.2	0.06	1.02	12.5	7.5	1.9	0.0	0.1
Profile 2 - Gleyed Mor Regosol (Map Unit C)	L-H	0-2"		5.7	0.61	9.63	47.6	28.0	19.2	0.0	0.1
	F-C	2-8"	loam	5.1	0.35	4.88	31.6	13.8	20.3	0.0	0.1
	II Cg	8"+	sand	5.5	0.13	2.06	13.6	7.8	2.8	0.0	0.1

*Hand texture on mineral and organic-mineral horizons.

References

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2. "A Preliminary Study of Soils of the Churchill River Basin of Northern Saskatchewan", H. C. Moss. 1949. Department of Agriculture, Regina.

3. "Report of the Soils of the Beauval Area", J. G. Ellis and A. K. Ballantyne. 1956. Department of Agriculture, Regina.

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5. "Physiographic Divisions of Saskatchewan". Map No. 1. Saskatchewan Research Council, University of Saskatchewan.