THE EFFECT OF THE PROPOSED MORAN DAM ON AGRICULTURE WITHIN THE MIDDLE FRASER REGION, BRITISH COLUMBIA

by

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We accept this thesis as conforming to the required standard

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In the search for energy many proposals have been made to harness the rivers of British Columbia, but the one for the Moran canyon on the Fraser River has the widest implications. A dam on this site, 800 feet high and 2400 feet wide, could produce initially 4 million horsepower of electricity at low cost. In addition it would hold the key to flood control on the Fraser River and to expansion of navigation, industrial location and agriculture. It would be located on part of the river believed by many to have considerable potential for future salmon runs. While each of these aspects of the dam is important when considered by its proponents, together they indicate a unique possibility of widening the economic base of the province. One aspect, the effect of the dam on agriculture, is the subject of this study.

Moran Dam, it is believed, will affect agriculture in three major ways: (1) It will flood the Fraser Valley for a distance of 172 miles north of Moran to a maximum elevation of 1540 feet; (2) it will provide low cost hydro-electric power for use in pumping irrigation water and for rural electrification; (3) it will provide low cost energy which may act as a factor in the location of electrically-oriented industries, and in turn through an increased work force create larger markets for agricultural products. It is these influences on agriculture related to the land and people of British Columbia that concerns this thesis.
To collect the necessary data four week-long trips were made to the agricultural areas of the Fraser Basin in the fall of 1957. Land-use was mapped and location of farms, ranches and significant landforms upon which agriculture could be undertaken were mapped. Later airphotos and maps were studied.

The reasons for proposing the Moran Dam along with a comparison between this dam and others within the province were reviewed. Next followed a description of the landforms, climate, soils, vegetation and hydrology, the components of the Physical Geography. A consideration of the present value, location and nature of agricultural activity and the extent to which foodstuffs have been imported into the province was made. Another aspect studied was the human geography.

As the Fraser River Basin was found too large to study as a whole a sub-regional breakdown was made within which the various aspects of the problem were discussed. The sub-regions were Lytton to Moran, Moran to Williams Lake River, Williams Lake River to Quesnel and the adjacent areas of the Thompson Valley, Chilcotin and Cariboo plateau.

Flooding was found to be restricted because of the physical nature of the valley with its steep slopes rising from the river to a more or less continuous series of benches 100 to 800 feet above its present bed. Thus only about 3000 acres of arable land, now chiefly utilized for winter grazing would be flooded, while about 45,000 acres could be inten-
sively cultivated with irrigation water pumped from the reservoir. If the adjacent regions were included, where flooding is not a factor, pumping plants utilizing low cost electrical energy could make available an additional 20,000 acres.

Since British Columbia at present imports large quantities of foodstuffs, additional population expected to work in electrically-oriented industries would necessitate importation of even larger quantities of foodstuffs unless some of the 65,000 acres were developed. Many of these are in areas with a relatively long growing season, large accumulated temperatures and low precipitation. Soils are fertile and the prospects for the intensive cultivation of vegetables, fruits and forage crops, plus the establishment of "feed lot" type cattle operations, in place of extensive grazing of cattle, could be expected. The costs of expanding agriculture in this region, however, would have to be competitive with other areas where irrigation agriculture is undertaken.

This expansion of agriculture, desirable to meet the growing deficit in foodstuffs within British Columbia, would be dependent on the advent of large scale pumping irrigation works contingent on the construction of Moran Dam.

No other proposal has been made of comparable import to the diversification of the economic base of the province. The impact of the proposal on agriculture alone is impressive.
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Department of Geography and Geology,
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Date September, 1958
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It is impossible to mention the many people who gave assistance in the preparation of this thesis; some who answered questions, replied to letters and other enquiries, who supplied information or acted as a "sounding board" for the ideas of the author.

Others it is imperative to acknowledge for their assistance. Singled out for particular thanks are: Dr. J.D. Chapman, my advisor, in whose classes I first became interested in Geography and who patiently listened to the plans for this thesis and read parts of the original draft before leaving for England in the spring of 1958; Dr. Harry V. Warren, who sparked my interest in Energy problems in British Columbia and who read the final draft; Mr. Hans Swinton and the Directors of Moran Power Development Company through whose generosity in sponsoring the Moran Power Development Fellowship, the author was financially able to spend a year doing research and writing; Dr. J. Lewis Robinson, who patiently read the first and final drafts after the departure of Dr. Chapman; Dr. R.I. Ruggles who offered considerable professional advice on the cartography; my father, W.H. W. Hardwick who read and edited much of the thesis; and finally my wife, Shirley, who in addition to spending many lonely evenings while the thesis was in preparation did much of the printing on the maps.

Walter G. Hardwick.

September, 1958.
CHAPTER I

INTRODUCTION

Serious proposals to dam the Fraser River in the Moran Canyon have prompted studies on the effect of this dam on the people, economy and landscape in British Columbia. The dam is planned primarily to produce hyro-electricity, but it would have important influences on navigation, flood control, tourism and irrigation agriculture. To date the studies related to this dam have been directed toward the feasibility of constructing the dam, its influence on flood control and its effect on the fishing industry of British Columbia. None of these studies has been exhaustive and all are continuing.

Three areas of investigation have received little more than superficial or speculative attention. These are the effect of the Moran Dam on settlement patterns within the Fraser River valley, on industrial location within the province, and on the agricultural potential of the region.

I. THE PURPOSE AND METHODS OF RESEARCH EMPLOYED

Moran Dam will affect agriculture within the middle Fraser River Valley in at least four ways:
(1) It will raise the level of the river for some 175 miles;
(2) it will provide cheap power for pumping irrigation water;
(3) it will provide local markets for locally produced agricultural products through industrial location; and
(4) it may stimulate the expansion of transportation routes in the area.

It is the purpose of this thesis to examine these and their effects on various sub-regions of the middle Fraser Valley from a geographical point of view. Some attention will be paid to settlement patterns that may change within the region.

Procedure

Information was gathered and processed concerning the technique of irrigation agriculture and the present means for producing and marketing agricultural products. Also, field studies were made of the present and potential location of agricultural land within the Middle Fraser Region. The physical geography of the region was studied as to its landforms, climate, soils, vegetation and hydrography.

Data on the extent of agricultural activity in the Middle Fraser Region, its location and potentialities was examined, through use of maps, air photos and field trips.
Vertical air photographs covering the area from Lytton to Moran and from Spences Bridge to Walhachin on the Thompson were studied, along with oblique air photographs of the Moran to Williams Lake areas.

Four week-long field trips were made by automobile, the first one in mid-August, 1957. They covered the Williams Lake to Quesnel area in detail, and served as a reconnaissance survey for the Lytton-Lillooet and Ashcroft regions enroute.

In early September, 1957, with the aid of air photographs and one inch to one mile base maps, the agricultural use of the area from Lytton to Pavilion on both sides of the Fraser was mapped. An initial trip into the Big Bar Creek Valley was made on this trip. Several weeks later on another trip, the area from Clinton west to Canoe Creek and the Gang Ranch was visited, and agricultural activities in the Canoe Creek, Gang Ranch, Dog Creek and Alkali Lake areas were recorded on maps. A day trip was made south-west from Williams Lake to the Riske Creek area in the Chilcotin and another side trip was made to Soda Creek and Marguerite along a portion of the old Cariboo Road.

Late October, 1957, was the occasion for the last trip, in which the Fraser Basin was entered from the east, through the Okanagan and Thompson Valleys. Land use was mapped in several areas of the Thompson and Big Bar Creek
Valleys. Visits were made for the first time to the Big Bar Mountain ranges, and along the road from Jesmond to Canoe Creek.

The phase of this study, in which the physical and cultural geography of the region was described, and in which the data for the agricultural production was derived, necessitated the study of government reports, documents, and of historical works. Also some correspondence and personal interviews were undertaken.

It was found that the Middle Fraser Region had not been studied as a separate region and all the information for this report had to be selected from a variety of sources.

Plan

This introductory chapter will include an outline of the factors involved in building the dam at Moran. Other sections will include a resume of the primary reasons for planning the dam, a consideration of its relation to other hydro-electric proposals in the province and elsewhere, and a description of the proposed Dam itself.

Part I of this thesis contains chapters delimiting the area which the Moran Dam will affect, and describing the physical and human geography.

Part II provides basic information needed to understand the problems involved in any expansion of irrigation agriculture. The first chapter discusses Agriculture, the second Irrigation in British Columbia.
Part III consists of five chapters dealing with the agricultural potentialities of various sub-divisions of the Moran region in terms of the influences of Moran on agriculture described on page one. It is in these chapters that the bulk of the data collected on field trips and from air photographs and maps is reported.

Two concluding chapters consider problems of the future of agriculture in the region and give a general summary.

II. ENERGY, THE PRIMARY REASON FOR THE MORAN PROPOSAL

Electricity is a means of distributing, for convenient use, energy that has been produced from any one of a number of sources. From early in this century it has been largely produced from coal-powered steam plants and from hydro sources. In recent years, petroleum products, natural gas and nuclear fuels have been utilized to produce it for domestic and industrial consumption.

Exhaustible and Renewable Energy Sources. In producing electricity, coal, petroleum and natural gas are themselves consumed. In other words they are exhaustible, in that they are consumed and cannot be utilized again.

The exhaustible sources of energy suffer from several drawbacks. Usually they are bulky to transport, and sometimes, after they are consumed, residue remains for disposal. In addition, they suffer from increasing costs, for as soon
as nearby sources are utilized, more distant sources must be developed with a resulting increase in transportation costs.

Hydro-electricity and solar power can be termed renewable energy sources, in that they are not consumed in the process of supplying energy. Even after indefinite use, they do not become any less potent suppliers of energy.

Energy as a locating factor for Industry. Energy can be a tool for the use of man and industry, or it can act as a locating factor for various industries. In industrial countries, energy is produced primarily as a tool for the industries of the nation, and the cost of production can be considerable. When energy becomes a determining factor in the location of an industry, the cost of producing the energy becomes important; for only where a nation or region can produce energy so that it can compete in price with the cheapest producers of energy in the world, can it attract those electrically-oriented industries in which the cost of energy is a substantial proportion of the total cost of production. An expanding economy demands an expanding energy source, and when the energy is used only as a tool for industry, the source of energy, thermal or hydro, does not make too much difference because the cost of power as a cost of production for most industries is not significant. The fact that power is available to meet an increasing demand is the significant factor. If, however,
a nation or region is to compete with other regions for the location of industry which demands large blocks of cheap power, a renewable source, with a low unit cost, will usually be imperative. The most frequently found source for cheap power has been water.

Where power costs are substantial proportions of the costs of production, as in the electro-chemical and electro-metallurgical industries, their location depends on the maintenance of low cost power relative to other regions. Although domestic and light industrial users can pay up to 2 to 4 cents per kilowatt hour for electricity, some electro-chemical industries require electricity at a total cost of only 4 mills per kilowatt hour. The large forest industries can afford 6 mills. Bonneville Power Authority which markets Columbia River power in the United States, charges between 2 and 2.5 mills per kilowatt hour. If any region is to attract industries similar to these mentioned, then it is imperative that the electricity be developed at sites which are favorable and at a wholesale price competitive with the cheapest.

1 The cost of power is only significant, when comparing several regions, if other cost factors of production are relatively constant.

2 In several locations thermal plants have produced power at rates competitive with the large hydro-electric sources. The most widely cited plant is the Dow Chemical plant in Texas where gas fired generators produce power at 4 mills per kilowatt hour.

3 G. Griffith, "Inventory of British Columbia's Hydro-Electric Resources," 9th Transactions, British Columbia Natural Resources Conference, (Victoria B.C. 1956) p. 530
Cost Factors in Development of Hydro Sources

Costs of dam construction and transmission of energy are important factors in considering which sites are to be developed and in which order. The cost of building a dam itself is important, because fixed annual costs, resulting from construction borrowings, are one major item to govern the price at which electricity may be sold. The cost of transmitting energy from the dam site to the area of utilization is about 1 mill per kilowatt hour, for every 150 miles. Most electrical utility engineers have believed that, without a great loss of energy, 300 miles was the limit that electric power could be transmitted. However this physical limit may be changed by the announcement by the Soviet Union and inspection by western engineers of the 400kv line, which transmits about 1 million kilowatt hours of electricity from Kuibyshev to Moscow, a distance of 505 miles.\(^4\) The cost of transmission of power, added to the cost of initial generation, limits the effectiveness of any power to act other than as a mere tool for established industries and homes.

Fish Facilities. As many rivers desirable for multi-purpose dams are already utilized as a fisheries resource, provisions for fish protection must be made. Further costs of construction are added to the capital cost

where means of conveying fish over the dam and fingerlings down the dam are needed.

**Other Costs related to Dam Construction** Where expensive relocation of transportation routes or of farms and towns are involved, costs increase. International implications of international rivers, creating problems of downstream damages and benefits, further complicate the cost picture. On the other hand, some of the costs of a dam may be borne by other agencies that will benefit from the construction. Those who can share in the costs of a dam are interested in flood control, irrigation and navigation.

**Load** Finally the question of "load" needs consideration. Energy which is used to 90 per cent of capacity is obviously cheaper to produce than that, given the same capital costs, which is used only to 50 per cent of capacity. The term "load factor" is used in describing the percentage of developed power actually used.

**III. ENERGY IN BRITISH COLUMBIA**

British Columbia has been endowed with many energy producing materials: coal, natural gas, and large rivers on which to produce hydro-electric power. These sources make up the energy reserves of the province, the tools for our present and future economies. Electricity has been the form
in which much energy has been utilized in British Columbia, most of it produced by hydro-electric stations.

**British Columbia's Hydro-Electric Sources**

At the turn of the present century, British Columbia was believed to have unlimited latent sources of hydro-electric power to supply energy to future generations. British Columbia can no longer claim unlimited supplies. For now most of the large watersheds have been studied, at least superficially, and estimates of the energy which it is possible to utilize are now being made. In December 1957, within the province, some 3.7 million horsepower had been developed, accounting for about forty per cent of the energy used. Another 177,000 horsepower was under construction.

Leaders of government and industry have tried to project into the future the energy needs of the province so that provisions can be made to meet those needs. The British Columbia Electric Company expects to need 1,400,000 horsepower by 1961 and 5,600,000 horsepower within 20 years. 5 British Columbia Power Commission will need some 700,000 horsepower by 1961. 6 In its submission to the Gordon Economic Commission, the Government of British Columbia anticipates there will be needed some 12.5 million horsepower. 7

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horsepower of electrical energy within the province by 1975. Whether these estimates are valid or not, they are of significance in that they have prompted an intensive study of the rivers of this province to determine the feasibility of developing hydro-electric sources. It has also prompted a survey of other means of producing electric power, using the other energy reserves of the province.

**Interim Estimates of the Hydro-Electric Potential of British Columbia.** British Columbia has five large and several small water sheds on which hydro-electric developments have taken place or are proposed: the Fraser, draining 89,900 square miles of south-central British Columbia; the Columbia, draining south-eastern British Columbia; the Yukon, draining the far northwestern part of the province; the Peace, draining east-central British Columbia and the Liard in the far north-eastern part of British Columbia. It was reported in 1957 that 3.7 million horsepower was installed or being installed in the province and that another 2.5 million horsepower was possible from the present sites. This represented 2,100 horsepower installed per person in British Columbia. Further, it was

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7 Submission of the Province of British Columbia to the Commission on Canada's Economic Prospects, 1956.

estimated that there is an energy potential of 21.2 million horsepower at undeveloped sites in the province. This total, added to the present and potential energy possible from developed sites, is far from the 8.5 million horsepower estimated five years ago, and no doubt far short of the total potential, as studies in northern rivers are at present fragmentary at best. This is exemplified in that in 1954 it was estimated that 179,000 horsepower was available from the Peace River while in 1957 the British Thompson-Houston Company estimates the potential may be near four million horsepower. In tabular form the potential horsepower for various rivers and regions of the province are listed in Table I on the following page. This list is already outdated, as previously mentioned, in regard to the Peace River.

There appears from this impressive list, a great potential of renewable energy sources, as yet untapped in the form of hydro-electric power. Many of the sources, however, are beyond what was considered the range of economic transmission to markets. Although the cost of high voltage transmission in the western world has not been determined, the Wenner-Gren proposals for the Peace River obviously plan to utilize this method of bringing power to the Vancouver Metropolitan area.

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TABLE I

BRITISH COLUMBIA'S UNDEVELOPED HYDRO-ELECTRIC RESOURCES

<table>
<thead>
<tr>
<th>Drainage Basin</th>
<th>Potential Electrical Horsepower</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fraser</td>
<td>7,100,000</td>
</tr>
<tr>
<td>2. Yukon-Taku</td>
<td>4,900,000</td>
</tr>
<tr>
<td>3. Columbia</td>
<td>3,300,000</td>
</tr>
<tr>
<td>4. Stikine</td>
<td>2,000,000</td>
</tr>
<tr>
<td>5. Thompson</td>
<td>1,531,000</td>
</tr>
<tr>
<td>6. Homathko, Chilko</td>
<td>1,000,000</td>
</tr>
<tr>
<td>7. Nass</td>
<td>353,000</td>
</tr>
<tr>
<td>8. Quesnel</td>
<td>309,000</td>
</tr>
<tr>
<td>9. Skeena-Bulkley</td>
<td>292,000</td>
</tr>
<tr>
<td>10. Vancouver Island</td>
<td>228,000</td>
</tr>
<tr>
<td>11. Peace</td>
<td>179,000</td>
</tr>
<tr>
<td>12. Dean-Klinaklini</td>
<td>166,000</td>
</tr>
<tr>
<td>13. Okanagan-Similkameen</td>
<td>34,000</td>
</tr>
<tr>
<td>14. Liard</td>
<td></td>
</tr>
</tbody>
</table>

IV. MAJOR HYDRO-ELECTRIC PROPOSALS IN BRITISH COLUMBIA

The Fraser and Columbia Rivers have received much attention from hydro-engineers, politicians and industrial leaders as a potential source of hydro-electric power to meet British Columbia's industrial and domestic needs. The location of these rivers in the southern portion of the province, near population concentrations and industrial locations, have prompted studies of their characteristics and of potential sites. In October 1957, proposals were made to develop Peace River. This river is outside what has generally been believed to be the range of economical transmission distance to the markets of the province.

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11 Griffith, op. cit., p. 528
Within the Fraser River Basin, development has taken place along some of the important tributaries. The Nechako River has been diverted through a tunnel in the Coast Mountains to develop some 860,000 of a potential 2.2 million horsepower, at Kemano on tidewater. On the Bridge River, the B.C. Electric has several projects, where 248,000 horsepower out of a potential 620,000 horsepower has been brought into production. Several other smaller rivers have been developed.

Tributaries of the Columbia River system have been developed in Canada by Consolidated Mining and Smelting Company and by the public and private utilities of the area. However, neither the Fraser nor Columbia River has been developed in Canada, and proposals to utilize their potential are being debated at the time of writing.

The Columbia River System

The Columbia River and some of its major tributaries, such as the Kootenay and Okanagan, rise in British Columbia and cross the international boundary enroute to sea level. This fact complicates the development of the river, as storage dams built on these rivers, which have wide seasonal differences in their run off, would automatically create more uniform flow patterns on the lower reaches of the Columbia and allow dams in the United States to generate more power. Alternate plans have been developed to utilize
the full potential of the Columbia within Canada, and these are indicated on Map 1. At present, two dams have been specifically proposed for the Columbia River, one at Mica Creek, just south of the Big Bend of the Columbia, and the second at the lower end of the Arrow Lakes; and several others are planned. The dam at Mica Creek has a reported potential of 830,000 horsepower. Potential dams at Downie Creek and Little Dalles could generate an additional 500,000 and 300,000 horsepower respectively. Additional power could be generated if a dam were built on the Kootenay River at Bull River or Copper Creek, and excess flood waters diverted northward across Canal Flats to the storage lake behind Mica Creek dam.

Canada has claimed in international meetings that by creating additional storage in Canada and by creating benefits in the United States through release of stored water from British Columbia, Canada is contributing a natural resource and should share in any resultant benefits in the form of a percentage of the power so created. To back up this demand, the "McNaughton Plan" has been proposed whereby the excess stored water from Mica Creek would be diverted from either the Downie Creek or Little Dalles Dams into the Thompson River, a tributary of the Fraser, for use entirely within the province of British Columbia.

12 Griffith, op. cit., p. 53.

Cost of construction of dams on the Columbia would be larger than just the cost of the physical plants, for the Columbia River Valley is now settled in many places, and rail lines, roads, farms would have to be re-located and forest cover removed. Production costs at Mica Creek are estimated at 3 to 4 mills per kilowatt hour at 75% load factor.  

Mica Creek and the related power producing dams lie approximately 400 miles from the large markets of Vancouver Island and the lower Fraser Valley, and thus transmission costs would range from 2 to 3 mills per kilowatt hour. 

The power from these sources, if developed, will likely add to the energy base of the province but considering the cost would not act as a locating factor for industry in the settled tidewater locations of this province. The electrical energy, produced at 3 to 4 mills, might attract industry to the Columbia and Kootenay Valleys themselves.

The Fraser River 

The Fraser River system is reported to have the largest potential power reserve of all the watersheds in British Columbia, and as studies progress, the power potential has been uprated several times. In 1956, it was estimated that over 10,000,000 horsepower of electrical energy was available.

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14 T. Ingledow, from notes taken at Hearing of Public Utilities Commission, October, 1957.

Ten Dams Proposal  One proposal put forward is to construct ten dams on the Fraser and Thompson Rivers, which would be supplemented by the excess stored floodwaters from the Columbia, described in the preceding section. The location of these dams is indicated on Map 2. In January 1955, British Columbia Engineering Company and the Department of Northern Affairs and National Resources, proposed four hydro-electric dams on the Fraser River and six on the Thompson. Subsidiary storage dams on Adams, Shuswap, Mabel and Kamloops Lakes, and on Quesnel, Stuart and Babine Lakes, and diversion of Babine Lake from the Skeena into the Fraser watershed were suggested. In addition, the report envisioned 10,000,000 acre feet being diverted from the Columbia River in the seven low flow months each year, October to April. The head developed at each dam listed in Table II would vary from thirty-five to one hundred feet on the Thompson and Fraser. A head of 1136 feet is possible in the diversion from the Columbia. (See Table II following page).

The potential power from the Fraser and Thompson Rivers under this proposal is reported as 2,799,000 kilowatts.
TABLE II
PROPOSED DAM SITES ON THE FRASER AND THOMPSON RIVERS

<table>
<thead>
<tr>
<th>River</th>
<th>Damsite</th>
<th>Head</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraser</td>
<td>Emory Creek</td>
<td>60 feet</td>
</tr>
<tr>
<td>Fraser</td>
<td>Spuzzum Creek</td>
<td>100 &quot;</td>
</tr>
<tr>
<td>Fraser</td>
<td>Anderson Creek</td>
<td>100 &quot;</td>
</tr>
<tr>
<td>Fraser</td>
<td>Cisco</td>
<td>100 &quot;</td>
</tr>
<tr>
<td>Thompson</td>
<td>Gladwin</td>
<td>95 &quot;</td>
</tr>
<tr>
<td>Thompson</td>
<td>Seddel</td>
<td>50 &quot;</td>
</tr>
<tr>
<td>Thompson</td>
<td>Basque</td>
<td>35 &quot;</td>
</tr>
<tr>
<td>Thompson</td>
<td>Ashcroft</td>
<td>35 &quot;</td>
</tr>
<tr>
<td>Thompson</td>
<td>McAbee</td>
<td>35 &quot;</td>
</tr>
<tr>
<td>Thompson</td>
<td>Kamloops Lake</td>
<td>35 &quot;</td>
</tr>
</tbody>
</table>

The Moran Proposal  The second proposal for the Fraser centres around the construction of the Moran Dam in the Moran Canyon, north of Lillooet. This site is one of the major dam sites of the world, with a great storage capacity behind it. This dam would be supplemented by three smaller dams on the Fraser, one at Cottonwood, one in the Grand Canyon, just east of Prince George and one in Raush Valley. Additional storage could be derived from Quesnel Lake, Stuart Lake and Chilko River. Potential diversions of the Parsnip River from the Peace River watershed, with the construction of a 550 foot dam near Finlay Forks, and diversion of Babine Lake into Stuart Lake from the Skeena watershed, could add to the average flow passing this huge dam.

A third proposal is that several smaller dams would be built on Fraser River, the first at Lillooet, a second
small dam at Moran, a third at Soda Creek, a fourth at Cottonwood and a fifth at Fort George Canyon. Each of these could develop power, but no estimate of the potential for this system has been ventured.

Conflicting Interests on the Fraser

All these proposals for development of Fraser and Thompson Rivers and their tributaries involve the displacement of the fisheries on the Fraser River to some degree. The International Pacific Salmon Commission, in November 1955, brought out a report dealing with the possible effect of Fraser-Thompson proposal on the fishing industry, and in 1957 the University of British Columbia, under a grant from the British Columbia Power Corporation, published a second report, dealing with both the Fraser-Thompson and the Moran proposals.  

V. THE MORAN PROPOSAL

Moran Canyon dam site is 226 miles up Fraser River from its mouth, but only 140 miles from tidewater at Squamish.


17 Pretious, Contractor. et al, Fish Protection and Power Development on the Fraser River, University of British Columbia, 1957.
A dam can be built 2400 feet long some 840 feet high, giving an effective head of 732 feet. The drainage basin amounts to some 51,040 square miles, an area which could be reduced by the diversion of Taseko Lakes and Chilko Lake into the Homathko River and Bute Inlet. The capacity of the reservoir is reported as 13,350,000 acre-feet with an elevation of 1,520 feet. The storage exceeds by some 2,000,000 acre-feet the required flood storage on Fraser River.

A description of the dam site is found in several publications of the Fraser River Board, Water Rights Branch and in articles by interested parties. One description of the site, four miles upstream from Pavilion Creek, states: "In this area, the river cuts through a rock-walled gorge about 500 feet deep and 400 feet wide at water level. Above the gorge, benches on either side of the river extend back to the toe of steep-rising valley walls which climb to the Fraser Plateau...." (Figure 1)

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20 Preliminary studies indicate that footings are satisfactory for this dam. At the proposed dam site in the lower of two canyons, the right bank is rock for 1,000 feet up from the river. On the left bank, no rock is visible between water level at elevation 810 feet and elevation 850 feet. Between that latter contour an elevation 1,080 feet bedrock is evident. A further section of visible rock lies between the elevations of 1200 and 1620 feet.
FIGURE 1
THE MORAN DAM SITE, FRASER RIVER
Indicating the axis of the dam. The P.G.E. Railway runs along the right side of the photo. Note the deep channel cut by the Fraser and the absence of agricultural areas near the river.
The nearest gauging station to the damsite is on the Fraser River, 26 miles upstream near Big Bar Creek, where records available, commencing in April 1935, report maximum and minimum discharges of 289,000 cubic feet per second and 4,000 cubic feet per second respectively. The mean annual discharge rate at Big Bar is 50,500 cubic feet per second. 21

At Moran, it is proposed to develop the river for a mean flow of 41,000 cubic feet per second. This amount of water would justify the installation of three million kilowatts at 75 percent load factor. "The site lends itself to low cost power, something below $175 per installed kilowatt including two transmission lines to the Vancouver area." 22 This would develop approximately 4,021,450 horsepower, which could be expanded to over 6 million horsepower with the proposed diversion from the Peace and Skeena River systems and storage of all flood waters above Moran. 23 The lake created behind the dam would be very narrow and long, enclosed within the steep sided banks of the river, and

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21 (This would be somewhat reduced by diversion of Nechako, Chilko and Taseko Systems.)


23 Ibid., p. 22
stretching for 172 miles from Moran Canyon to the vicinity of Narcosli Creek, south of Quesnel.

If detailed drilling supports the preliminary geological and engineering examinations and detailed engineering studies, probably a concrete arch type dam will be constructed. The intakes for power generation will be sunk low in the reservoir and the power houses will be set on either bank. In the process of operation, the reservoir will vary between 66 feet and 75 feet in level, as water is drained off to maintain flows through the winter. The estimated cost of the dam, including two transmission lines to Vancouver area, is between $500 and $600 million.24

Fish Problems

The Fraser and Thompson Rivers and many of their tributaries, indicated on Map 3, are important spawning areas for salmon, the most important single species of fish caught and marketed in British Columbia. It is estimated that a maximum of 750,000 migrating adult salmon per day can be expected to migrate up the Fraser River past Yale, half of which are stated to go up the Thompson. The International Pacific Salmon Commission states that:

The construction of four power dams on the Fraser River and six on the Thompson River would preclude the preservation and extension of all the salmon and steelhead runs to these

24 R. Potter, op. cit., p. 24
rivers beyond the dams. This conclusion is reached both on the basis of the delays in migration caused by the dams, and on the basis of the mortalities to seaward migrants at the series of dams.25

The advocates of the Moran Dam have made proposals to counter these claims,26 but to the knowledge of the writer, no specific reply has been made to their claims. This is mentioned briefly here as one of the problems involved in such an undertaking as Moran Dam.

The Number of Salmon Involved in the Moran Proposal

It is important to note that the Fraser River is just one of the salmon streams of the province,27 and that various species and runs of species spawn in its various tributaries. In the 1951-54 salmon-cycle, the value of salmon that passed Moran averaged $3,000,000 per annum.28 This figure could be misleading if one did not take into account the fact that, prior to the Hell's Gate slide of 1911 the runs to many streams north of Moran were larger, and if restored, would no doubt considerably exceed the present value of salmon.

25 "A report on Fish Facilities..." op. cit. p.4
26 Personal communication with Mr. Russell Potter, Consulting Engineer, Victoria, B.C.
27 The Fraser accounts for 20% of the British Columbia Salmon pack and 31% of the American and Canadian packs attributable to the rivers of British Columbia.
There is evidence that, with concentrated effort, satisfactory solutions to this problem will be devised.  

**Power Costs** As a source for low-cost electric power, the Moran Dam is reported to be one of the most promising sites in the world. In a submission to the Public Utilities Commission of the Province of British Columbia, Mr. Russell Potter, project engineer for Moran Power Development Company, stated that power generated at Moran Dam could be delivered at tidewater for use by electrically-oriented industries for a figure slightly less than four mills per kilowatt hour, and at the damsite for considerably less. The price for electricity to bulk buyers could be one-third less than present British Columbia coastal electric prices. This price would be competitive at the time of completion of the dam, with any other major power site in the world.  

Western Development and Power Limited, which has reportedly made studies of the Moran site, has issued no statement as to what the cost of power would be. President A.E. Grauer of the British Columbia Power Corporation has suggested that the Fraser River power resource offers the most economical source of power available to the people of British Columbia.  

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29 Several articles on this problem are listed in the Bibliography.

30 Public Utilities Hearing, Vancouver November 1957

31 Reported in the Vancouver Sun, March 25, 1958.
Industry Utmost haste appears desirable in the construction of the Moran Dam in order to offer the people of British Columbia a means of expanding the base of their economy. Dominated by the lumber and related wood-working and processing industries, the present economy does not appear to contain any other base with which to correct this imbalance. Neither mining, fishing nor agriculture offers much prospect for large scale expansion.

The Moran proposal offers an important opportunity to re-orientate the economic base of the province. It has unique geographic advantages over schemes for the Columbia, Columbia-Thompson-Fraser, Peace or Chilco-Homathko Rivers. Moran is the most advantageous major site from which to transmit large quantities of power, at a price acceptable to the electrically-oriented industries. The distance from Moran to Vancouver is half that of Mica Creek, one-third the distance of the proposed Peace River Dam, and less than the distances from either the "Ten Dams" or Chilco-Homathko.

The necessity of transmitting this power to tidewater at a low cost becomes meaningful when one realizes that most potential electrically-oriented industries will utilize imported raw materials and will consequently be dependent on ocean transportation. Potential areas available for industrial sites at tidewater, are indicated on Map 45.
Electricity would also be available for any processing of British Columbia raw materials within a radius of two or three hundred miles of the dam.
PART I

Part I of this thesis is devoted to setting the stage upon which a discussion of the effect of the Moran Dam proposal on agriculture within the Middle Fraser Region can take place.

Three chapters are included in this section: one delimiting the region and describing its relation to other areas of British Columbia; a second describing the physical geography in terms of its landforms, climate, hydrography, soils and vegetation; and one describing the Cultural Geography, in terms of the man-made features in the region.
CHAPTER II
THE MIDDLE FRASER REGION

This thesis is concerned with those areas in which the Moran Dam proposal could affect agriculture. As the dam itself is planned for the Moran Canyon on the Fraser River, the areas most directly affected by the proposal will be those within the Fraser River valley itself, - the Middle Fraser Region.

The Middle Fraser Region can be described as that area within the Fraser Valley between the Coast Mountains and Quesnel where much of the land can be used for agriculture.

The Middle Fraser Region is recognized as separate from the Cariboo and Chilcotin regions, although all three form part of the central upland area of British Columbia, generally called the Interior plateau.  

The Cariboo region lies between the Cariboo Mountains, and the poorly defined ridge west of the North Thompson River on the east, the Tranquille plateau on the south and the Marble Mountains and high plateau domes that lie immediately east of the Fraser on the west. The

Daly recognizes many plateau blocks separated by deeply incised streams, and perhaps first recognizes the Chilcotin and Cariboo regions as parts of the Interior Plateau.
Chilcotin Region is an area of similar size which lies north of the Camelsfoot Range, Taseko Mountain and the Chilco Lake area, east of the ranges of the Coast Mountains and south of the water divide between the West Road-Nazko River system and the Chilcotin system.

Between these two regions lies the Middle Fraser Region. This region, outlined on Map 4, is distinct from Lower Fraser Valley, that area of the River west of the Coast Mountains and the Upper Fraser River, where the river flows southward.

The Middle Fraser Region stretches from 50 degrees to 53 degrees North Latitude and between 122 and 123 degrees west longitude. The southern section of the Region is in a similar latitude to the Thompson and north Okanagan Valley in British Columbia, central Germany and the northern Russian steppes in Europe.

Lytton, a town of some 350 persons, at the confluence of the Thompson and Fraser Rivers was chosen as the southern limit of the Middle Fraser Region and the village of Quesnel, with some 5,000 persons, the northern limit. Lytton, situated at the southern limit of agricultural land in the valley, is a major weather recording station and the centre of trade for the southern valley. Quesnel, near the northern end of major agricultural activity in the middle Fraser Valley, has a major weather recording station and is located
just a few miles north of the limit of flooding caused by the proposed Moran dam. It, like Lytton is a marketing centre for the local farm areas.

The boundaries of the region coincide with the boundary of the immediate valley of the Fraser River, plus the drainage basins of the tributaries except where the tributary stream enters the Fraser from an area outside the main basin.

From Lytton the boundary of the region would follow about the 2,000 foot contour along the eastern side of the Coast Mountains, to Seton Creek, one of the Fraser tributaries that enters from outside the basin. Continuing north the valley of the Bridge River would be excluded. The regional boundary would then follow the mountains north to Churn Creek where it would angle west some forty miles so as to include the lands of the Gang Ranch, and then return to the Fraser at the mouth of the Chilcotin River. North of the Chilcotin the border follows the valley rim, and finally a ridge just west of Narcosli Creek to West Quesnel.

The eastern edge of the region follows the divide between the Fraser and Thompson drainage basins as far as Big Bar Creek. North of Big Bar Creek, the tributary valleys where they are cut into the plateau, and the range land on Big Bar Mountain, Dog Creek Dome and north of Alkali Lake are included within the Region. North of Williams Lake the boundary follows the rim of the Fraser
valley north, and includes Cuisson and Dragon Lakes in the Middle Fraser Region.

**The Adjacent Regions**

The Moran Dam proposal would affect two other regions, the Thompson River Valley and the plateau regions. The boundaries of these two regions are described in more detail in two chapters of Part III.
CHAPTER III
THE PHYSICAL GEOGRAPHY

Man does not operate in a vacuum, and any cultural or economic activity which he engages in must by necessity take place within some physical context.

When considering the effect of the Moran Dam proposal on agriculture within the Middle Fraser Region, it becomes obvious that a description of the area upon which the dam is to be constructed and the area over which the agriculture will take place is a necessity.

To draw this picture, on which the rest of the discussion of the effect of Moran Dam on agriculture will be placed, I have undertaken a description of the landforms of the area, along with the processes that were involved in their creation. The climate of the area is considered, both as a factor for the success or failure of agriculture and as an agent in the development of the landforms.

The rivers and streams which modify landforms, act as sources of irrigation water, and as the home of the proposed dam itself, are described in the section on hydrology. Soils, upon which the agriculture is based and the vegetation that must be removed, adapted or used for grazing cattle or other animals are other environmental factors discussed in this chapter on the physical geography.
I. LANDFORMS

Near 54 degrees north latitude, the Fraser River starts a southward flow diagonally across the interior plateau of British Columbia. After a course, nearly due south for over two hundred miles, the river enters a canyon through the Coast Mountains. The Interior Plateau lying between the Coast and Rocky Mountains, is a rolling, hilly upland sloping from a general elevation of 4,000 to 6,000 feet in the south to 2,500 to 3,500 feet in the north, which is deeply incised in places by major streams like the Fraser and Chilcotin Rivers.

Fraser River flows from north to south against the general trend of the plateau, so that in the northern areas it appears as a rather mature stream in a relatively wide valley, while in the southern region it could more easily be described as a rapid flowing youthful stream in a deeply incised valley within the plateau. Where it enters the Canyon through the Coast Mountains it leaves the Interior Plateau.

Physiographic History

Pre-pleistocene The Interior Plateau, in the early part of the Triassic Period had become a nearly uniform plain, through prolonged denudation. The rivers were likely in a mature form and flowed to both the Pacific Ocean and
An uplift of the Coast batholith followed in the Jurassic, which was followed by a long period of calm in which through subsidence and erosion by the many rivers, the area was reduced to near sea level. Later another elevation took place in Pliocene times.

With the building of the Rocky Mountains and the Coast Mountains the rolling plain was elevated and the streams became entrenched due to their increased volume and head. The parts of the Fraser River that may have flowed north and east to the Inland Sea from the vicinity of the Chilcotin River in the mountain building era were captured by the streams flowing westward. As the Coast Mountains were elevated these streams were subsequently forced to take a southerly course along the eastern edge of the mountain mass, to where they finally spilled through the new mountains in the Fraser Canyon.

The excavation of the valleys of the Thompson and Fraser Valleys is believed to have been completed wholly or almost wholly about the close of the Eocene. In the Miocene, the area occupied by the plateau was down warped and lavas poured in. In the Fraser Valley near Soda Creek, intrusions of lava caused extensive damming, as they filled the valley to some 1200 feet. Remnants of this are found near the

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33 An inland sea occupied the present Interior plains region.

mouth of Narcosli Creek and in the gorge near Soda Creek and over much of the Chilcotin area. Other evidence of the river excavation in the Eocene is reported in sedimentary strata found near Spences Bridge on the lower Thompson.\(^35\)

The present Fraser River was completely cut in a form similar to the present before the glacial period. Remnants of Miocene Age Basalts and Sandstones which occur near Leon, Pavilion and Big Bar Creeks, have been cut through by the river and now fringe the edges of the plateau on both sides, 1500 feet above the river are cited as evidence.\(^36\)

**Pleistocene Epoch** During this epoch the middle Fraser Basin was covered with ice, except for some higher peaks of the Coast Mountains. The ice seems to have had its center over the middle Coast Mountains and across the plateau in the Churn Creek area. It is believed that this area received the most continuous supply of moist Pacific air which was in the form of snow and helped accumulate the enormous depth of 8,700 feet. From this center the ice appears to have moved south along the edge of the Coast Mountains in the general trend of the Fraser River, as is evidenced in the scouring of the east face of the Coast

\(^35\) D. Lay, "Fraser River Tertiary Drainage History in Relation to Placer Gold Deposits," *British Columbia Department of Mines Bulletin 3* (Victoria, 1940).

\(^36\) Lay, *op. cit.*
Mountains between Lytton and Lillooet. In the north the ice appears to have moved in a north-easterly direction, across the low plateau, disrupting the established drainage pattern.

There have been two onslaughts of the glaciers, and some unconsolidated material in the Fraser Basin is of this first glacial period. All present landforms were the result of, or were modified considerably by, the last glacial period. Some landforms in higher valleys along Bridge River, Cinquefoil and Fountain Creeks are glacial deposits as are many of the smaller landforms in the Fraser River Valley. It is believed that the glacier melted more rapidly in the interior than on the Coast Mountains, or the northern Nechako plateau. With this excessive supply of meltwater the resulting outwashes and quickly flowing streams cut into the accumulated drift material on the plateau and the rivers quickly regained their old channels. Some tributaries like the Bonaparte and Deadman Creek, now the homes of very small streams were probably large torrents as meltwater channels.

Glacial outwash deposits are abundant along the


Fraser and from the vicinity of Lytton north they form more or less continuous benches. They are some 200 feet thick in the south and reach a maximum thickness of about 900 feet near Pavilion. Some deposits consist of coarse boulder and cobble gravel and locally considerable thicknesses of silt, which were probably built up by an aggrading river that was overloaded with outwash from the glaciers to the west and the north. These sediments eventually accumulated to such a depth that the gradient of the main stream was increased, to a point where it could carry the material supplied by its tributaries, and then the river cut down leaving the terraces. This development is particularly evident near Lillooet.

Other benches are large alluvial fans which have formed at the mouths of many tributary valleys. Excellent examples are evident in the vicinity of Foster Bar and Laluwissin Creeks. These fans are composed of parallel layers, up to six feet thick, of unsorted angular and rounded fragments and minor layers of gravel, sand and clay. Many of them were likely produced under water as the result of mud flows that swept down side valleys onto the outwash plain during the period when streams occupying them were clearing their channels of the glacial debris. Many of these were developed before the present terraces and are

40 S. Duffel, and K.C. McTaggart, op. cit. p. 70
characterized by the smooth convex surfaces. It is quite possible that these fans extended right across the valley and that when the main river started its rapid down cutting it chose the lowest point on the fan for its course.\textsuperscript{41} The subsequent deepening of the river channel has left these fans quite high above the present river, and from the river bottom difficult to distinguish from any other bench.

Damming of the present river occurred probably at various places along the course and glacial lakes of some size existed behind them. One of the last to be removed was at the Fountain gorge states Dawson.\textsuperscript{42} He claims a waterfall may have been still present there in post glacial times.

In the northern part of the region the rounding out of the valleys and the clearing of small tributary valleys is less evident. It is believed that the rather shallow valley of the Fraser River was filled with drift deposits, into which the river has cut. The valleys are much less regular in pattern and in many places stream courses have been disturbed by various glacial phenomena. Bogs and small lakes are common on the poorly drained upland adjacent to the river.


FIGURE 2
HIGH BENCHES ABOVE THE FRASER RIVER SOUTH OF PAVILION
P.G.E. Railway and Highway 12 follow the high benchland
Present Landforms

During most recent times, the Fraser River has regained its comparatively narrow river channel, and in the process of doing so has formed most of the agriculturally significant landforms. These landforms are the benches that are found the whole length of the river, benches of various elevations, sizes, base material and origin.

Travelling within the valley, one loses sight of the plateau, and is conscious only of these smaller landforms although the sides of the river valley give an indication of the surrounding plateau. These landforms within the river valley are basically of three origins; fluvo-glacial benches, fans, and old lake bottoms.

The largest number are benches. These benches may be continuous for several miles, and where they are at a similar elevation, it is usually indicative of a pause in the downcutting of the river.

Some of the present benches are fans, with eroded river faces and having tributary streams cut deeply into their surface. Fans have a sloping surface of about six degrees.

The old lake bottoms are usually identifiable because of the level surface of the bench and the horizontal layers of material that underlie the present soil surface.

In addition to these three landform types, complex varieties are in existence in several locations where fans have developed over all or part of old terraces.

The agriculturally significant landforms of these varieties are found in all sections of the valley. Most of the well developed fans are found in the southern region, whereas old lakes are most evident near Lillooet and Soda Creek.

**The Southern Area**  
Between Lytton and the mouth of Bridge River the valley varies between one and five miles in width. It is bounded on the west by the Lillooet Range of the Coast Mountains which form a complete barrier to the west, broken by the narrow Seton Gap, where Seton Creek enters the Fraser. The mountains are part of the Coast batholith. They rise steeply from fragmented terraces, giving the appearance of glaciated sides of a U-shaped valley. The streams that flow from these mountains are short, and some drop sharply from hanging valleys. The larger valleys were once occupied by glaciers, as indicated by their U-shaped appearance.

On the east the slopes rise rapidly from rather well-developed fans and benches to about 3500 feet, from where the plateau slopes eastward with characteristic rolling surface. This plateau is rather deeply incised and

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44 An excellent account of the Geology and Landforms for this area is found in the Geological Memoir #262, S. Duffel, and K.C.McTaggart., op. cit.
in being so gives a mountainous appearance to areas which are essentially part of the plateau. Many intermittent streams flow down the steep slopes from the plateau and have very little valley development. The valleys that are open were cleared out in the period at the end of the glacial era, and the material washed out forms fans at the valley mouths. The streams that presently occupy the valley have cut deeply into the fan because the Fraser itself has cut down creating a new base level. A cross section at Laluwissin Creek half-way between Lytton and Lillooet indicates this type of terrain, (Map 5.) The high Coast Mountains rise steeply on the west, with fragmentary terraces near their base, while on the east there is a steep rise to the fans, which lie riverward of the plateau mountains. The aerial photo, Figure 3, shows these large fans utilized to a large degree as agricultural land.

The sedimentary rocks that underlie the plateau outcrop from place to place as dome peaks, or as the spectacular limestone Marble Mountains which lie just north of Pavilion. Elsewhere these plateau mountains, unlike the Coast Mountains, are covered with unconsolidated material.

The Middle Area North of the "S" turn of the Fraser

45 There is little published material on this section which may stem from the fact that the area is of little interest to geologists. In addition to the general work of Dawson in the 1870's some information is available from:
FIGURE 3

IRRIGATED FARMS ON OUTWASH FANS NEAR LALUWISSIN CREEK

Note the steep river banks of the Fraser, the gullies and where the tributary creeks have cut deeply into the fans.
at Fountain the plateau mountains are found on both the west and east side of the river. On the west they form high foothills to the Coast Mountains. Between Bridge River and north of French Bar Creek they form a high west wall to the Fraser Valley. The plateau to the east is not as high, and the dome-type mountains common in the southern sections become more widely spaced. In the valley itself, benches are rather continuous on the east bank, relatively wide, made up of riverine deposits, which in the subsequent dropping of the river level have been left as terraces. At the mouths of some tributary streams, for example Watson Bar and Big Bar Creeks, fans and some deltaic formations are found. A cross section of this area, (Map 5), shows 6,000 foot mountains on the west sloping down to several small benches near the river. On the east wider benches lie some 500 feet above the river, from which point the land slopes up to the plateau surface around 3500 feet on Big Bar Mountain. This pattern of the high west bank and lower east bank continues north along the river. Just south of Crow's Bar the height on the west has dropped, and a series of old benches show up at various levels above the river. On the east bank the valley slopes more gradually up to 3500 feet in steps.

The level to which the Moran Dam will cause the valley to flood is indicated by dotted lines on the profile. The importance of the flooding to the wide terrace on the
east bank is evident, for where at present the land could not be served with pumped irrigation water because of its height above the river, after flooding it will lie less than 200 feet above the new reservoir and within easy pumping distance.

At Canoe Creek, the height of the west bank has diminished to approximately the same height as the east bank. The significant landforms present on this cross section, (Map 5) are the large benches on the east bank about 300 feet above the new reservoir level, presently utilized by the B.C. Cattle Company for winter range.

A similar pattern is evident in all the profiles of the southern and middle sections and the relative relief is considerable.

An interesting exception to the pattern in the Middle Fraser Region is the Gang Ranch depression. In this depression on the west side of the river, between Churn Creek and Gaspard Creeks, the height of the plateau is considerably lower than anywhere to the south. A gradual slope for forty miles is required to reach the elevation of 4000 feet. The benches common in other parts of the river valley occur in this section, the first ones about 500 feet above the river. This large upland is the setting of the largest ranch in the Middle Fraser Region. North of Gaspard Creek the western side of the valley is higher than the east, the height being around 3,500 feet. The river is considerably
nearer the level of the plateau by the time the Chilcotin Bridge is reached, and the relative relief is not as great as in the south. A distinct rim to the valley is evident in this area.

**The Northern Region** In the northern section, the general slope of the plateau from the south to north, and the general rise in the level of the river as its headwaters are neared, is indicated in considerably less relative relief. At Soda Creek, (Map 5) the river level is about 1300 feet and the plateau stands between 2500 and 3500 feet. The river was blocked by lava flows, remnants of which still show along the valley sides, filling a large area to some depth with silts and sands which form the basis of a large bench at about the 2000' level. This surface is not smooth like the fans of the south, but is covered in places with glacial drift making a rolling surface in places. Near the river more recent deposits are the location of agricultural land. North of Macalister the river itself is wide and recent bottom lands, including some islands, are important for agriculture. In this region agriculture takes place at about the 2500 foot level, an area covered with glacial deposits. The rivers and streams that are tributary to the Fraser River in this region flow roughly parallel to the river and then turn and enter the river at right angles. These streams, like the Williams Lake-San Jose Rivers,
Narcosli and Cuisson Creeks, were possibly meltwater channels during glacial times. At Quesnel, the northern end of the region, the valley itself is close to river level, and large alluvial areas are found at the confluence of the Quesnel and Fraser.

II. CLIMATE

The climate of an area is one of its inexhaustible resources. It makes up one of the components of the environment and as such becomes a liability or an asset to the inhabitants of an area, and must be studied if one is to comprehend a full picture of the region.

Climate is part of the natural environment of a country. In some regions it imposes hardship on the inhabitants, in others makes life easy. Designs of living adapted to the climate of each region are the result of accumulated experience of generations. They find their foremost expression in clothing, housing and agriculture.

The climate of the Middle Fraser Region is considered here as an aid to evaluating the possible expansion of agriculture. This is done within the severe limitations imposed by few reporting stations and varied topographical conditions.

Controls of Climate

The Middle Fraser Region lies within the Interior

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plateau of British Columbia, an area with a continental climate characterized by hot summers and cold winters. The region is under the influence of Polar Pacific air through most of the year, this air being unstable in winter and stable in summer. In some periods in winter Polar Continental air penetrates the region. The mountain barriers are significant in that they cause these air masses to rise and to be modified before entering the Interior region. The Polar Pacific air, in crossing the Coast Mountains, drops much of its moisture and enters this region relatively dry. The Fraser Basin, lying in the southern sections within the rain shadow of the Coast Mountains, is characterized by warm temperatures, for the descending air warms considerably as it drops into the deep valleys, particularly in summer. Stagnation of the air and absence of cloud in the summer contribute to the hottest temperatures recorded in the province.

In the winter an increase in pressure gradient in the Mackenzie River Valley and in the Yukon causes Polar continental air to push south into the interior plateau, bringing with it the coldest temperatures of the season. These polar outbreaks are most severe in the northern and eastern areas and are moderated in the southern and western sections. 47

Topography is a very important factor in controlling the climate of the region, and several climatically significant landforms can be recognized. These are illustrated on Map 6. The mountain valleys are a route for the penetration of air into some areas of the interior. Slightly modified maritime air often enters the interior at Lytton in winter. On the east and north, mountains act as a more or less effective barrier against polar continental air, and it is only when extreme high pressure systems occur that the passes through the mountains, like Peace, Monkman and Pine Passes, become routes of passage for the arctic air. The lack of continuous mountain barriers in the south allows the occasional entry of warm air from the desert-like intermountain region to the south.

Weather is modified locally by such additional factors as local landforms and exposure. Differences within the climatic records of particular stations are found and are attributable to the moving of the station, perhaps only a few hundred feet. Changes in the location may alter the possibility of air drainage, the exposure to wind and sun, or the heat retention of the soil or vegetation cover.

Weather Stations

Few stations report from within the Middle Fraser Region. Some have only rain gauges or have recorded weather observations for only a very short period. The Weather
BRITISH COLUMBIA
CLIMATICALLY
SIGNIFICANT
LANDFORMS

PM - POLAR MARITIME AIR
PC - POLAR CONTINENTAL AIR (WINTER)
A - PEACE PASS  B - PINE PASS
C - MONKMAN PASS  D - EAGLE PASS
E - KANAGAN DEPRESSION  F - FRASER CANYON
Stations can be classed by: elevation, what type of records that are maintained and the length of time the records have been kept.

Three stations can be classed as low elevation stations, located in the deep southern valley; four can be classed as mid-elevation stations, 1000 to 3000 feet, and two can be classed as high elevation plateau stations. These are located on Map 7 and listed in Table III.

**TABLE III**

WEATHER RECORDING STATIONS BY ELEVATION

<table>
<thead>
<tr>
<th>Under 1000 Feet</th>
<th>1000 to 3000 Feet</th>
<th>Over 3000 Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lytton</td>
<td>Quesnel</td>
<td>Dog Creek</td>
</tr>
<tr>
<td>Laluwissin Creek</td>
<td>Soda Creek</td>
<td>Pavilion</td>
</tr>
<tr>
<td>Lillooet</td>
<td>Williams Lake</td>
<td>Alkali Lake</td>
</tr>
</tbody>
</table>

Several stations outside the middle Fraser Region that will be referred to for comparison fall into each of these categories, (Table IV).

**TABLE IV**

WEATHER RECORDING STATIONS BY ELEVATION IN ADJACENT REGIONS

<table>
<thead>
<tr>
<th>Under 1000 Feet</th>
<th>1000 to 3000 Feet</th>
<th>Over 3000 Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashcroft</td>
<td>Alexis Creek</td>
<td>Big Creek</td>
</tr>
<tr>
<td>Kamloops</td>
<td></td>
<td>Mamitt Lake</td>
</tr>
<tr>
<td>Oliver</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The quantity of weather data recorded is a criterion for a second classification. Quesnel, Dog Creek and Lytton have continuous records from their establishment to the present time. Lillooet, Pavilion and Williams Lake have temperature records and some precipitation records for some periods, but these do not necessarily coincide. Rain gauge data for some years has been recorded at Laluwissin Creek, Alkali Lake and Soda Creek.

Quesnel has continuous weather records for over 60 years, while Lytton and Lillooet have records for over thirty years. Other stations have weather records for much shorter periods. Dog Creek with nine years and Pavilion with two years are examples.

The station at Lillooet has had at least three locations, although the present one at 740 feet has been there for the longest period. For one year, it was located about a mile south of town at 830 feet, and for two years, namely 1945 and 1946, it was not in operation. In 1958 it is reported that the station in the town was closed and that records were now being kept at the Riverland Irrigated farm across the Fraser. One year, records were kept at Fountain, and the station was called Lillooet #3. The Pavilion station has been in operation only two years but another station, of the same name from which a long frost free period is recorded a decade ago, was located at the 15 Mile Ranch near Glen Fraser. The present station is at an
elevation of over 3000 feet while the former was near 1700 feet.

**Classifications of Climate**

As the agricultural possibilities of the Middle Fraser Region are the primary interest of this report, first consideration will be given to those aspects of climate that significantly influence success or failure in farming. These aspects are precipitation and temperature and their interrelation in the Potential Evapo-transpiration. Other climatic phenomena that are of interest in this discussion will be the frost free period, the growing season, snowfall and temperature accumulation. The probability of variations from the mean of precipitation from year to year will be of interest, particularly to the farmer.

The Interior Plateau of British Columbia lies within the humid continental climatic classification of Koeppen. In the deep valleys Chapman recognizes examples of the mid-latitude steppe. The weather station at Quesnel at the extreme north of the region falls into the Dfb, humid continental climatic type, with precipitation all year, a

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49 Letters representing climatic types derived by Koppen. D cold snowy forest climates, average temperature of coldest month less than 26.6° F, average temperature
dry spring with a summer maximum, a January mean of 14 degrees and a July mean of 62 degrees. Lytton falls into the Dsa type climate, with a summer drought, winter maximum precipitation and a warmest month with temperatures of 71 degrees. Some local areas in the deep valleys are classified as Bsk.

Precipitation

While precipitation is low within the Middle Fraser Region, with mean annual precipitation under 20 inches, two general precipitation regimes are recognized. In one, the deep valley locations of the south, low summer precipitation and high winter precipitation are characteristic, while in the northern shallow valley and on the plateau, year-round precipitation with a summer maximum is characteristic. The monthly means plotted in two graphs, Figure 4 and 5, illustrate these two regimes. This characteristic variation is significant in terms of agriculture, for equivalent annual rainfall distributed with a summer maximum offers more useful moisture for agriculture than the same amount of pre-

warmest month more than 30°. f no distinct dry season, b cool summer, average temperature less than 71.6 degrees F. s summer dry -- driest month less than 1.2 inches. a hot summer, average temperature of warmest month over 71.6° F.
Precipitation — Annual Variation in Monthly Means

Valley Stations
Lyttton — Lillooet — Laluvissin — Ashcroft

Plateau and Northern Valley Stations
Quesnel — Williams Lake — Alkali Lake — Dog Creek

Fig. 4

Fig. 5
W.G. Hardwick
cipitation occurring in the winter season. The distribution of annual precipitation through the Middle Fraser Region is mapped on Map 8. Ashcroft on the Thompson, with average annual precipitation of 7.4 inches, is the driest station in British Columbia.

Variability of Precipitation For the farmer, the variability of precipitation is very important, for this "can make or break" him in terms of crop returns. To find this, precipitation for the growing season over thirty year periods for Quesnel and Lillooet were plotted (Figure 6 and 7) and the variations from the mean calculated. Records of eight years at Dog Creek, representing a station on the plateau, were studied. At Quesnel the mean precipitation for the growing season is 9.04 inches, at Lillooet 5.44 inches and at Dog Creek 8.92 inches. During the growing season wide variations from the mean figures take place. Quesnel had its low precipitation in 1926 when 5.15 inches were recorded and a maximum in 1955 of 14.78 inches. At Lillooet had its six month minimum precipitation record in 1929 when 1.44 inches were recorded and a maximum in 1956 of 10.94 inches. A range of from 5.52 inches to 13.45 inches is found at Dog Creek in the eight years recorded.

The question of variability of precipitation has not

50 April to September is taken as an average growing season. While at Quesnel the planting season does not come until late April, at Lillooet ploughing often takes place in March.
been studied fully in this brief summary. In some years, especially at Lillooet, most of the precipitation has fallen in one month, and in fact within a very few days in some cases. For seven of the months in the thirty year period recorded there has been less than .01 inches of precipitation recorded, and in a similar number of months over 2.50 inches had fallen. This indicates the need for further study of precipitation variability, not by years alone, but by months and days.

At Quesnel, 14 of the years summarized had less precipitation than the average and 17 years had more than average precipitation. At Lillooet, the pattern is reversed, and 20 years have experienced less than average precipitation while only 10 years recorded more. At Dog Creek the ratio was 5 years less and 3 more.

Coefficient of Variation Statistically the variation is best expressed in the Coefficient of Variation.

In determining this, the standard deviation of the annual means from the overall mean is calculated. The result is compared as a percentage variation from the mean for Quesnel and Lillooet, stations representing the northern valley and the southern valley respectively. On the basis of 30 years of records, the coefficient of variation for Lillooet is 40% while that for Quesnel is 30.9%.
VARIATION IN PRECIPITATION
DURING THE GROWING SEASON (APRIL-SEPTEMBER)

QUESNEL—MEAN 9.04 INCHES

LILLOOET—MEAN 5.44 INCHES

FIG. 6-7
W.G. HARDWICK
Temperature

Stations recording temperature data are not as wide-spread as those recording precipitation data (see Map 7). Lillooet and Lytton represent the southern valley stations, Williams Lake and Quesnel the high valley stations, and Dog Creek and Pavilion the plateau stations. As one would expect, the southern stations have higher annual temperatures than the northern valley and plateau stations. As indicated on Figure 8, the southern stations have July means 7 to 9 degrees warmer than the northern valley stations, and these in turn are 6 to 7 degrees warmer than the plateau stations. Lytton and Lillooet have July means in excess of 71 degrees, while the mid-valley stations of Williams Lake and Quesnel report July mean temperature of 64 and 62 degrees respectively. Dog Creek reports a 60 degree mean and Pavilion records a 56 degree mean. The pattern of July mean temperatures in the Middle Fraser Region is plotted on Map 9. In January, a 27 degree mean was reported at Lytton while in the north and on the plateau mean temperatures range from 9 to 15 degrees. The pattern of temperatures in January is illustrated on Map 10.

Decreases in monthly mean temperatures are evident both in altitude and in latitude. Pavilion is located on the west-facing side of a rounded mountain, part of the northern upland plateau, at 3500 feet elevation. The
January mean at Pavilion of 15 compares with 27 at Lillooet, and a 56 degree July mean at Pavilion compares with a 71 degree July at Lillooet. July 71 degree mean at Lillooet compares with 64 degrees at Quesnel, only 900 feet higher, but nearly 200 miles further north. In January Quesnel's 14 degree mean compares with a 27 degree mean at Lillooet.

Accumulated Temperature The success of agriculture depends to some degree on the accumulated temperatures in the growing season. Rather than considering monthly means alone this derived climatic element is described to give further information on the potential warmth of various areas. In deriving these figures of accumulated temperature, work by T.G. Northcote in an unpublished paper was consulted. In this paper the "day degree" units are obtained from the monthly mean temperature multiplied by the number of days in the month concerned. The threshold temperature used is 43 degrees. In this paper the Accumulated Temperature is calculated over a twelve-year period, 1944-56.

51 Although the two year record at Pavilion suggests that this comparison may not be too accurate, a similar temperature pattern is found when comparing Ashcroft in the Thompson Valley and Mamit Lake on the plateau, where records have been in existence for a long period.

52 T.G. Northcote, "Accumulated Temperature in British Columbia" typewritten, Department of Geography, University of British Columbia.

53 43 degrees is the temperature at which plants commence to grow. This will be discussed in the section entitled "The Growing Season".
FIG. 8
W. G. HARDWICK

MEAN TEMPERATURE RANGE

10  20  30  40  50  60  70  80  90

JAN.  FEB.  MAR.  APR.  MAY  JUNE  JULY  AUG.  SEPT.  OCT.  NOV.  DEC.

QUESNEL  WILLIAMS LAKE  DOG CREEK  LILLOOET

FIG. 9
W. G. HARDWICK

EXTREME TEMPERATURE RANGE

DEGREES F.

LILLOOET  LYTON  PENTICTON  QUESNEL  DOG CR.  WILLIAMS L.  PAVILLION  VANCOUVER  ALEXIO CR.  BIG CR.  KAMLOOPS  ASHERCROFT

32°
MIDDLE FRASER REGION

JULY MEAN TEMPERATURE

- OVER 70° F
- 60°-65° F
- 65°-70° F
- 55°-60° F
- UNDER 55° F

30 MILES TO 1 INCH

MILES
MIDDLE FRASER REGION

JANUARY MEAN TEMPERATURE

- OVER 25°F
- 15°-25°F
- 20°-25°F
- UNDER 15°F

30 MILES TO 1 INCH

MILES
(Perhaps a longer period would be needed to get more exact estimates.) At Lytton, in the low deep valley along the Fraser, 3667 day degrees per annum are accumulated. Lillooet has a similar accumulated temperature. Quesnel at the northern end of the region accumulates 2022 day-degrees per annum, while Dog Creek on the plateau, with an eight-year record shows 1716 day degrees per annum. The accumulated temperature at Lytton is perhaps the largest accumulation in the province and compares well with Kamloops in the Thompson Valley and Oliver in the warm southern area of the Okanagan Trench. (Table V).

**TABLE V**

<table>
<thead>
<tr>
<th>Station</th>
<th>Day Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lytton</td>
<td>3667</td>
</tr>
<tr>
<td>Oliver</td>
<td>3426</td>
</tr>
<tr>
<td>Kamloops</td>
<td>3247</td>
</tr>
</tbody>
</table>

The significance of the high accumulated temperature to farmers at Lytton is great as this allows intensive cultivation of a wide variety of plants that need warm temperatures.

**Frosts**

Freezing temperatures are expected in winter at locations in this latitude, and as they occur in other than the growing season they do not affect agriculture significantly.
Important to agriculture in the Middle Fraser Region are:
(1) the dates at which freezing temperatures begin and;
(2) the occurrence of freezing temperatures in the otherwise open season; (3) the cause of frost conditions. It is usually considered that frost occurs when the low daily temperature drops below 32 degrees Fahrenheit. Some persons interested in agriculture prefer a low of 26 degrees Fahrenheit in the 24-hour period.

Cause of Frost

Frosts are caused by a variety of conditions among them nocturnal radiation, air drainage and the penetration of air masses.

Summer frosts on the plateau and northern valley locations are usually attributable to nocturnal radiation. The clear nights allow the accumulated heat to dissipate so that the 24 hour temperature falls below freezing. In the same period, many valley locations will be so warm that the drop in temperature would not be sufficient from the day time highs to cause freezing temperatures. If the frosts persist on the plateau, drainage of cold air down the valley sides can be expected.

The outpouring of cold air masses is common in the winter but occasional outbursts in the spring and fall bring freezing temperatures to the region. This air normally comes through the mountain passes and moves down the river
valleys. However in spring and fall the lowering of the overall temperatures may sometimes be attributed to Polar Maritime Air. The lower portions of this air in its movement across the Pacific are warmed by its proximity to the ocean, while the upper portions which are first to cross the mountains, remain cold. In the Fraser Region, this air mass crosses the plateau in a south-easterly flow and possibly passes completely over the deep valley areas, bringing cold temperatures to the plateau alone. The arrival of cold air in the interior valleys does not necessarily mean that frost will occur, for the valley bottoms may be filled with warm moist air. When this is the case, the cold air entering the valley causes the formation of clouds which block radiation and keeps temperatures above freezing. If, however, dry air fills the valley and the cold air enters the province clear skies occur, which inevitably results in nocturnal radiation and the lowering of the temperature.

Each particular site will be affected differently by frosts. Terrace sites will benefit from air drainage, an occurrence with drains off the coldest air and leaves the terrace moderately warm. A northern exposure will usually mean that less heat accumulation takes place in the daylight hours and as a result lower temperatures will occur at night, perhaps low enough for frost, while on the southern or western slopes at a similar elevation the temperature remains above freezing.
Vegetation or surface material, with its ability to retain or radiate heat, is significant in the frost situation at some particular sites.

The Length of Frost Free Period (32 degrees F.)
The frost free period is usually the number of days between the occurrence of the last 32 degree temperature in any 24 hour day in the spring and the first day on which it occurs in the autumn. In comparing the frost free period for several stations in the interior of British Columbia, as indicated in Table VI, variations in the average frost free period appear, ranging from 52 days at Big Creek in the Chilcotin to 192 days at Lytton in the south. The number of frost free days vary from year to year. Stations on the plateau and at Quesnel can experience frosts in any month of the year, while valley locations experience long frost free periods. The number of days in each month of the growing season in which frosts occur for some representative stations is indicated on Figure 10. The contrast between the long open season at Lytton and the short one on the plateau stations is evident.

The Frost Free Period (26 degrees F.) Agriculturists believe that most plants that thrive in this region can take up to six degrees of frost before killing takes place.

54 Map 11.
MIDDLE FRASER REGION

FROST FREE PERIOD
(32° F.)

OVER 180 DAYS
100-140 DAYS
140-180 DAYS
UNDER 100 DAYS

30 MILES TO 1 INCH

MILES
<table>
<thead>
<tr>
<th>Station</th>
<th>Mean Free Period</th>
<th>Average Date of Frost</th>
<th>Earliest Date of Frost</th>
<th>Latest Date of Frost</th>
<th>Average Date of First Frost</th>
<th>Earliest Date of First Frost</th>
<th>Latest Date of First Frost</th>
<th>Longest Frost Free Period</th>
<th>Shortest Frost Free Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lillooet</td>
<td>182</td>
<td>Apr. 22</td>
<td>Mar. 20</td>
<td>May 20</td>
<td>Oct. 21</td>
<td>Oct. 3</td>
<td>Oct. 31</td>
<td>223</td>
<td>129</td>
</tr>
<tr>
<td>Williams L.</td>
<td>119</td>
<td>May 21</td>
<td>May 11</td>
<td>June 1</td>
<td>Sep. 17</td>
<td>Sep. 2</td>
<td>Oct. 10</td>
<td>150</td>
<td>93</td>
</tr>
<tr>
<td>Quesnel</td>
<td>103</td>
<td>June 2</td>
<td>May 7</td>
<td>Jul. 11</td>
<td>Sep. 13</td>
<td>Jul. 22</td>
<td>Oct. 18</td>
<td>115</td>
<td>12</td>
</tr>
<tr>
<td>Pavilion</td>
<td>111</td>
<td>May 30</td>
<td>May 16</td>
<td>Jul. 2</td>
<td>Sep. 2</td>
<td>Jul. 26</td>
<td>Sep. 17</td>
<td>124</td>
<td>66</td>
</tr>
<tr>
<td>Dog Creek</td>
<td>95</td>
<td>May 30</td>
<td>May 16</td>
<td>Jul. 2</td>
<td>Sep. 2</td>
<td>Jul. 26</td>
<td>Sep. 17</td>
<td>124</td>
<td>66</td>
</tr>
<tr>
<td>Mammit Lake</td>
<td>81</td>
<td>May 30</td>
<td>May 16</td>
<td>Jul. 2</td>
<td>Sep. 2</td>
<td>Jul. 26</td>
<td>Sep. 17</td>
<td>124</td>
<td>66</td>
</tr>
<tr>
<td>Big Cr.</td>
<td>52</td>
<td>Jun. 27</td>
<td>May 29</td>
<td>Jul. 13</td>
<td>Aug. 18</td>
<td>Jul. 16</td>
<td>Sep. 7</td>
<td>103</td>
<td>3</td>
</tr>
<tr>
<td>Kamloops</td>
<td>166</td>
<td>Apr. 25</td>
<td>May 29</td>
<td>Oct. 8</td>
<td>Sep. 18</td>
<td>Oct. 30</td>
<td>212</td>
<td>137</td>
<td></td>
</tr>
</tbody>
</table>

55 Based on A.J. Connor, "The Frost Free Season in British Columbia," Meteorological Division, Department of Transport, (Toronto, 1949)

and as a result suggest that a Frost Free period based on 26 degrees Fahrenheit should be used. Comparing frost free averages for several stations, listed in Table VII, one finds that the length of period is extended from 20 to 40 days each year.

### TABLE VII

**FROST FREE PERIOD**  
(Mean Period above 26 degrees Fahrenheit)

<table>
<thead>
<tr>
<th>Station</th>
<th>Number of Days</th>
<th>Average Date of the Last Frost of the Season</th>
<th>Average Date of the First Frost of the Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lytton</td>
<td>245</td>
<td>Mar. 20</td>
<td>Nov. 17</td>
</tr>
<tr>
<td>Lillooet</td>
<td>221</td>
<td>Mar. 17</td>
<td>Oct. 31</td>
</tr>
<tr>
<td>Williams Lake</td>
<td>144</td>
<td>May 6</td>
<td>Sep. 26</td>
</tr>
<tr>
<td>Quesnel</td>
<td>135</td>
<td>May 6</td>
<td>Sep. 17</td>
</tr>
<tr>
<td>Big. Cr.</td>
<td>177</td>
<td>May 27</td>
<td>Sep. 19</td>
</tr>
<tr>
<td>Kamloops</td>
<td>221</td>
<td>Mar. 28</td>
<td>Nov. 4</td>
</tr>
</tbody>
</table>

The dates of the last spring frost and the first autumn frosts on the 32 degree and 26 degree criteria plotted on Figure 11 show some striking comparisons. At Big Creek in 1954, where on the 32 degree scale 11 frost-free days were recorded, on the 26 degree scale 110 frost-free days occurred.\(^56\)

Using the low of 32 degrees as a criteria for frosts,

\(^{56}\) Consecutively numbered days 192 to 203 were frost free on the 32 degree scale while days 152 to 272 were frost free on the 26 degree scale.
NUMBER OF DAYS OF FROSTS PER MONTH
IN THE GROWING SEASON – 1953

BIG CREEK ★ DOG CREEK ★ QUESNEL ★ PAVILION ★ LYTTON ★

THE LENGTH OF THE FROST FREE PERIOD
OF 26 AND 32 DEGREES COMPARED

CONSECUTIVELY NUMBERED DAYS

DOG CREEK LYTTON

FIG. II
Map 6 has been prepared, which shows the length of the frost free period over the Middle Fraser Region. It is notable that most of the plateau has a very short frost free period, while the narrow deep valley and the southern part of the region have long dependable frost free periods.

**Growing Season**

The growing season of any station is the number of days on which the mean temperature exceeds 43 degrees. (6.0°C)\(^{57}\) Mean 43 degrees is used as it approximates the temperature at which seeds germinate in the spring and where growing terminates in the fall. This data suggests when a farmer can plant in the spring and should harvest in the fall. The length of the growing season in different parts of the Middle Fraser Region is indicated on Map 12. The mean durations of the growing seasons for several stations are listed in Table VIII.

**TABLE VIII**

<table>
<thead>
<tr>
<th>Station</th>
<th>Days</th>
<th>Station</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quesnel</td>
<td>184</td>
<td>Kamloops</td>
<td>214</td>
</tr>
<tr>
<td>Williams Lake</td>
<td>199</td>
<td>Oliver</td>
<td>225</td>
</tr>
<tr>
<td>Lillooet</td>
<td>230</td>
<td>Prince George</td>
<td>166</td>
</tr>
<tr>
<td>Lytton</td>
<td>234</td>
<td>Vancouver</td>
<td>244</td>
</tr>
</tbody>
</table>

\(^{57}\) Brink, *op. cit.* p.5
MIDDLE FRASER REGION
MEAN
LENGTH OF GROWING SEASON
(DAYS OVER 43° F.)

- DAYS OVER 230
- 170 - 200
- 200 - 230
- 140 - 170
- UNDER 140

30 MILES TO 1 INCH

30 MILES

MAP 12
W. G. HARDWICK
The pattern is similar to the frost free period in many respects. The Lillooet-Lytton area has a very long growing season, longer than others in the Interior, and only slightly shorter than coastal stations such as Vancouver. Just as the frost free period is discussed as extending from a particular day in the spring to a certain day in the fall, so is the growing season. Table IX indicates the dates at which the mean daily temperatures rise and fall below 43 degrees F.

**TABLE IX**

**DATE AT WHICH MEAN DAILY TEMPERATURE RISES AND FALLS BELOW 43° F**

<table>
<thead>
<tr>
<th>Station</th>
<th>Spring</th>
<th>Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lytton</td>
<td>March 16</td>
<td>Nov. 5</td>
</tr>
<tr>
<td>Lillooet</td>
<td>March 19</td>
<td>Nov. 3</td>
</tr>
<tr>
<td>Quesnel</td>
<td>April 15</td>
<td>Oct. 16</td>
</tr>
<tr>
<td>Kamloops</td>
<td>March 28</td>
<td>Oct. 28</td>
</tr>
<tr>
<td>Penticton</td>
<td>March 22</td>
<td>Nov. 3</td>
</tr>
<tr>
<td>Big Creek</td>
<td>May 2</td>
<td>Oct. 3</td>
</tr>
<tr>
<td>Williams Lake</td>
<td>April 9</td>
<td>Oct. 25</td>
</tr>
</tbody>
</table>

Map 13 indicates the approximate dates at which the growing season arrives in different parts of the Middle Fraser Region. The growing season begins in the southern regions in March, a month earlier than in many plateau locations. It is interesting to compare the length of the growing season with the frost free periods based on 32 degrees and 26 degrees as in Table X.
MIDDLE FRASER REGION AVERAGE
DATE AT WHICH TEMPERATURE RISES ABOVE 43° F.

- BEFORE MARCH 20
- MARCH 20-30
- APRIL 1-10
- APRIL 18-20
- APRIL 20-30
- AFTER MAY 1

30 MILES TO 1 INCH

MILES
TABLE X
A COMPARISON BETWEEN THE LENGTHS OF "THE GROWING SEASON" AND THE FROST FREE PERIODS DETERMINED AT 26 AND 32 DEGREES

<table>
<thead>
<tr>
<th>Station</th>
<th>Growing Season</th>
<th>Frost Free Period (32°)</th>
<th>Frost Free Period (26°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lytton</td>
<td>234</td>
<td>192</td>
<td>245</td>
</tr>
<tr>
<td>Lillooet</td>
<td>230</td>
<td>182</td>
<td>221</td>
</tr>
<tr>
<td>Williams L.</td>
<td>190</td>
<td>119</td>
<td>144</td>
</tr>
<tr>
<td>Quesnel</td>
<td>184</td>
<td>103</td>
<td>133</td>
</tr>
<tr>
<td>Kamloops</td>
<td>214</td>
<td>166</td>
<td>221</td>
</tr>
</tbody>
</table>

Extreme Temperatures

In general, extreme temperatures do not significantly influence agriculture. However the absolute minimum temperatures have a "killing effect" on certain crops. The regular occurrence of low minimum temperatures can be a limiting factor in growing some crops, particularly crops demanding a long growing season and high accumulated temperature. Temperatures below 20 degrees Fahrenheit make it impossible to grow peaches successfully. This limits any possible peach orchards to the most sheltered areas in the Middle Fraser Region. At present there are none grown commercially. However, apples are grown successfully in the Lillooet area, indicating that they are not affected by the minimum temperatures in that area. Alfalfa is killed in years when persistent low temperatures occur. Such a loss adds to the cost of farming.

Within the Middle Fraser Region, there are lower
minimum temperatures in the northern areas and on the plateau than in the southern valley. These are indicated on Figure 9. The lowest recorded temperature in the region is -52 degrees Fahrenheit at Quesnel. The maximum temperatures are high in the south and the 112 degree high at Lytton is the hottest temperature officially recorded in the province.

**Potential Evapo-transpiration**

With high accumulated temperatures and small total precipitation recorded in much of the Middle Fraser Region, one would reasonably expect a water deficiency and a need for irrigation if agriculture was to survive. This is the case. Of considerable interest to the farmer is the extent of water deficiency. Thornthwaite\(^{58}\) developed a means of measuring the relationship between moisture available to that needed through potential evapo-transpiration. Water deficiency or surplus at any time in any particular area can be estimated, by comparing the precipitation with the water loss attributable to the evaporation of water and transpiration of plants and different areas can be compared in terms of their water deficiency or water surplus.

The water deficiency and the heat accumulation can be the most important factors in suggesting what type of crops are desirable in an area.

In determining the potential evapo-transpiration, it is assumed that the soil retains a portion of the moisture that falls and the rest runs off. In many of his works, Thornthwaite used the figure of 10 centimetres as the retention capacity of the soil. This figure is accepted as generally satisfactory, although not necessarily so for all areas within the region.\(\text{59}\)

The pattern of water deficiency in the Middle Fraser Region is mapped on Map 14. It generally increases from north to south, and from plateau to valley.

The degree of deficiency of moisture can be tabulated indicating the months of deficiency and months of surplus. The greatest deficiency occurs around Laluwissin Creek where over 71 centimetres per annum of moisture must be added if agriculture is to be practised.\(\text{60}\) Figure 12 illustrates graphically the pattern of water deficiency at Laluwissin Creek and other weather stations in the Region. At Lytton a winter surplus of moisture is accumulated, some of which is retained and aids that area in the early part of the water deficient season. By the first week in May, the surplus has been used and the deficiency starts accumulating

\(\text{59}\) The particular soils in this area have their own retention characteristics, and until the soils are all classified an average figure has to be taken.

\(\text{60}\) No temperature data is available from Laluwissin, but as Lytton and Lillooet have nearly identical temperatures throughout the year an average was taken and applied to the precipitation records of Laluwissin.
WATER DEFICIENCY
IN THE MIDDLE FRASER REGION

LEGEND

ADJUSTED POTENTIAL 
EVAPORATION-TRANSPIRATION

AMOUNT OF 
WATER 
DEFICIENCY

MONTHS

FIGURE 12

W.G. HARDWICK
because the summer has minimum rainfall. The annual water
deficiency for Lytton is 53 cm. Lillooet becomes water
deficient two weeks earlier than Lytton, in April. Because
there is a greater precipitation in the growing season at
Lillooet the deficiency does not become as great as at
Lytton, amounting to 38 centimetres.

Recalling that the northern stations have higher
annual precipitation than the southern stations, and a
summer maximum, one could expect that the water deficiency in
those areas would be less than in the south and would be for
a shorter period. Dog Creek, on the plateau, has a defic-
iency of 16.3 cm. Dog Creek, Figure 12, meets its water
needs until late enough in the season so that surplus water
in the soil is sufficient to meet the plants' needs until
July. As a result some dry farming can take place. At
Williams Lake, only 1 centimetre deficit is recorded by
July first, and even by the end of July, it just totals 5.5
centimetres, a permissive deficiency for the raising of some
grains or dry farming methods.

Quesnel, at the northern end of the region has a
water deficiency of only 9.1 centimetres, and the moisture
needs of the plants are usually met until late July. Pavilion,
the station at 3500 feet thirty miles north of Lillooet, has
only a 9.3 centimetre annual deficit, which does not start
until July. As this record is for two years it can be
questioned as to reliability, but nevertheless it makes an excellent contrast with the valley station at Lillooet where, starting in April, a 38 centimetre average annual deficit accumulates.

**Climatic Areas**

After studying maps of the various elements of climate, a common pattern is noted. In precipitation, there are two regimes, that of the valley and that of the plateau: in temperature, three patterns, those of the southern valley, northern valley and plateau. In heat accumulation, there are wide variations between the south and north, and great variations in the water deficiency between the southern valley, the northern valley and plateau are indicated. In considering the frost free period or the growing season similar patterns are in evidence, a distinct variation from the valley to the plateau. On the basis of this evidence, three climatic divisions are recognized. Although the boundaries cannot be located exactly, they are estimated on Map 15.

The first division is the southern valley, extending from north of Lytton between the Coast Mountains and plateau to just north of Big Bar Creek. This is the area of high temperatures, greatest heat accumulation, long growing season and has the greatest average annual water deficiency. Vegetation and crops are similar at Lytton and Lillooet and at Big Bar, although winter temperatures may be somewhat
more severe at the last station. The 190 day frost-free period, recorded at the 15 Mile Ranch near Pavilion on a two year basis, indicates that the characteristics of this southern division reach further north than has been suggested in the *British Columbia Atlas of Resources*, and by other writers such as Kendrew and Kerr. 61

The second climatic division are those areas over 1500 feet elevation in the south, and lesser elevations in the north, where heat accumulation is less, water deficiency is less and the growing season is shorter than in the southern valley region. Here grass lands can be converted, by irrigation, into excellent cultivated fields. As no stations exist in the south, it is difficult to limit the extent of this division; but in the north, the Canoe Creek, Alkali Lake, Williams Lake and Soda Creek areas have similar climatic characteristics and could be called representative. In the south, this division is indicated by conditions in the Fountain Valley, and lower Bridge River.

The third area is the high forested plateau and northern valley, Marguerite to Quesnel, where there is a relatively low average annual moisture deficiency which usually does not start until July, summer frosts, low winter temperatures and relatively low accumulated temperatures.

Stations from Quesnel to Pavilion, over 150 miles apart, have similar climatic characteristics.

III. HYDROLOGY

As the Middle Fraser Region is an area with a moisture deficit, tributary streams of the Fraser become very important as sources for irrigation water. Some streams are already utilized as sources for irrigation water, some have potential value and some others will not be of use because of their intermittent nature.

Little is known of the actual flow of most of these tributary streams. However, a consideration of their flow in August and September and the size of their watershed will give some indication of their reliability. In addition several streams have lakes in their headwaters which act as natural reservoirs.

The rivers and streams of the Middle Fraser Region can be classified in terms of their importance as potential sources of irrigation water as follows:

I. The trunk river, the Fraser River
II. The major river tributaries: viz. the Bridge, Chilcotin and Quesnel Rivers,
III. The small river tributaries: vis. the Stein River, Seton Creek, Churn Creek, Williams Lake River-San Jose River.

62 Location of rivers and creeks referred to are indicated on Map 16.
IV. The streams, which through adequate watersheds or natural storage in lakes, provide year round supplies of water adequate for irrigation.

(a) Southern section,
Texas Creek, Foster Bar Creek, Laluwissin Creek, Cinquefoil Creek, Fountain Creek, Sallus Creek, Pavilion Creek, Slok Creek, Mackay Creek, Spray, Towinok and Riley Creeks.

(b) Middle section
Leon Creek, Kelley Creek, French Bar Creek, Lone Cabin Creek, Watson Bar Creek, Ward Creek, Big Bar Creek, Grinder-Coster Creek, Canoe Creek, Gaspard Creek, Harpers Creek, Dog Creek, Meason Creek, Alkali Creek, Word Creek, Chimney Creek, and Riske Creek.

(c) Northern section
Meldrum Creek, Makin Creek, Soda Creek, Narcosli Creek, Dragon Creek and Cuisson Creek.

V. The small streams utilized in local farms, usually intermittent in nature, which collectively are important to irrigation agriculture but individually are not important enough to mention.

Flow data is available only for the major rivers, the Fraser, Thompson, Chilcotin and Stein Rivers and Seton Creek. Wide variations are found in the flow throughout the year, a fact that makes construction of run-of-the-river dams without storage impossible.
Fraser River  Stream flow on the Fraser River has wide variations from month to month during the year, reflecting the runoff from melting snow in the spring and summer, and the lack of runoff in winter when precipitation falls as snow and lies for extended periods during cold weather. At Hope, where a gauging station has been in continuous operation for over 44 years, a maximum discharge of 536,000 cubic feet per second has been recorded, and a minimum of 12,000 cubic feet per second. The mean discharge at Hope is 92,300 cubic feet per second. Various other stations are found in all parts of the Fraser Basin, giving similar information for different years. A station with 21 years of record near Big Bar Creek (Jesmond) indicates a maximum flow of 289,000 cubic feet per second, a minimum of 4,000 cubic feet per second and a mean discharge of 54,100. Although records are kept only in the open water season they give an indication for the flow expected at the Moran Dam. These stations are maintained by the Federal Department of Northern Affairs and Natural Resources. In addition to the hydrometric data recorded, meteorological stations and snow gauge stations throughout the basin are maintained from whose records predictions are made as to the runoff expected in any season.

62 "Flood Runoff-Frequency and Magnitude-Design Flood" Appendix D, Interim Report Investigations into Measures for Flood Control in the Fraser River Basin, Fraser River Board (Victoria, 1956), Plate 4.4.3
Thompson River  A hydrometric station near Spences Bridge has records for over 45 years, and gives an indication of the wide fluctuations experienced on that river. A maximum flow of 146,000 cubic feet per second is recorded as compared to a minimum figure of 4,100 and a mean figure of 26,600 cubic feet per second.

Seton Creek near Lillooet records an average flow of 1,240 cubic feet per second, Cayoosh Creek 2,480 cubic feet per second and Chilco River near Redstone 3,210.

Although no flow data is listed, it is indicated that about 600 horsepower, regulated flow, is available from Stein River.63

Reliability of Records  In discussing the runoff from the rivers of the Fraser system, some consideration must be taken of the length of time records have been kept. When averages are involved, one exceptional year can make a short duration station appear to have a greater mean flow than perhaps is justified over the long run. Just as meteorological records are more reliable when available over a long period, so is hydrometric data. Unfortunately most stations within the Fraser Basin have been established since 1948, after the severe flood of that year, and their records are not long enough to illustrate what potential flows are possible. In addition no data is available for some of the

63 Water Powers, British Columbia. Water Rights Branch, op. cit.p. 158
large tributary streams such as Churn Creek, Williams Lake River and Narcosli Creek.

IV. SOILS

Soil Areas Few detailed soil studies have been made within the Fraser Basin, and as a result, attempts to place boundaries around soil classes is difficult. Soil surveys have been made in the last ten years at Quesnel, Alexandria, and Lillooet. There are two divisions of the soils in the region, (1) those associated with the grass and parkland, and (2) those associated with the forests.

The Soil Classes

The Grey-Wooded soils are associated with the forests whereas the Brown, Dark Brown and Thin Black soils are associated with the grass and parkland. Some areas of Degrading Black soil are found in poorly drained sections of the uplands.

The Grey-Wooded Soils The Grey Wooded soils are found in areas of the plateau with moderate rainfall (for the interior) and forest cover. North of Marguerite, the forest cover dominates the valley as well as the plateau and in this section Grey Wooded soils are the dominant soil class. The profile for the soils in this class, Figure 13, shows a thin surface horizon of organic matter underlain by
five to eleven inches of greyish, slightly acid soil. The soil horizons beneath the organic surface may have a high sand and silt content. Below these horizons the soil tends to be more calcareous and free lime is frequently found at depths of 25 to 30 inches. 64

The base material is in most areas glacial drift, but in some localized areas sedimentary rock and lava constitutes the base material.

The Kersley loamy sand, found on the undulating terraces along the Fraser River south of Quesnel, is the most widespread subdivision of the Grey Wooded soils within this region. It is in some places associated with clay and muck, and Degrading Black soils. Where arable these soils may be adapted to a variety of agricultural practices. Because of the low organic matter and fibre content of these soils, leguminous forage crops are recommended in their management. "Provided the soil is properly fertilized and crop rotation is practised, mixed livestock-crop farming is generally recommended." 65

Thin Black Soils The transition zone between the forest and the valley grassland of the "dry belt" of British


SOIL PROFILES

GRASSLAND SOIL

INCHES

A. HUMUS AND NITROGEN
12
B. CALCIUM CARBONATE
24
C. ORGANIC MATTER
36

PARKLAND SOIL

INCHES

A. HUMUS AND NITROGEN
12
B. CALCIUM CARBONATE
24
C. ORGANIC MATTER
36

FOREST SOIL

INCHES

0 - ORGANIC GREY SLIGHTLY ACID
12 - CLAY
24 - CALCIUM CARBONATE
36 - GLACIAL DEPOSITS

DARK BROWN
THIN BLACK
GREY WOODED


Fig. 13. W. G. HARDWICK
Columbia, is labeled the Parkland. Here the Grey Wooded soils become associated with the grassland soils. Within the parkland the Thin Black soils are the common soil type; a soil type associated with low precipitation, under 15 inches, and a 110-120 day frost free season. In the southern section of the Middle Fraser Region these soils are found between 1800 feet and 3000 feet. The Thin Black soil shows a relatively high degree of organic matter in the upper horizons, six to twelve inches in depth, which are dark brown to dark grey in color. The surface is close to neutral in reaction, but the subsoil is alkaline and may show some lime accumulation. With irrigation the Thin Black soils are very productive.

On the plateau itself these soils are associated with the Degrading Black soils, soils which occur in many small watered meadows, and as a group are not significant as agricultural soils. The Thin Black soils cover the greatest area in the Middle Fraser Basin.

**Dark Brown Soils** The Dark Brown soils are found in the valleys of the interior, and are associated with low elevation, low precipitation, plus a frost free period of about 180 days. These soils vary from a very sandy texture where water retention is very low, to nearly a silty loam where a high degree of water retention is reported. The

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66 Profile, Figure 13
Dark Brown soils have a slight content of humus and nitrogen but may be lacking in some other trace elements. It has experienced a minimum of leaching. These soils are neutral to alkaline in reaction and the subsoils contain calcium carbonate. The soil profile, Figure 13, indicates the horizons.

The distribution of these soils is quite extensive, covering many of the lower benches from Lytton to the Chilcotin River. In the south the Dark Brown soils are found to an elevation of about 2300 feet but in the north, they appear only at low elevations, only to about 1400 feet. As a result of this, large areas of Dark Brown soils north of Moran would be unavailable for agriculture because they would be flooded. Hardy fruits, vegetables, forages and other crops thrive when these soils are irrigated.

**Light Brown Soils** The Light Brown soils are associated with very high summer temperatures and a long growing season. They are like the Dark Brown soils but are generally low in humus and nitrogen and as such are light in color. They are found in small patches associated with Dark Brown soils in the Fraser Basin, particularly near Lillooet. In general, due to higher winter precipitation, extensive areas of these soils are not found in the Lillooet-Lytton area, although they are found at similar latitudes near Ashcroft and Kamloops.
Soil Map

The soil map, Map 7, is designed to indicate the approximate distribution of these soil classes, within the Middle Fraser Region and adjacent regions.

V. VEGETATION

Two major divisions of native vegetation comprise the plant cover within the Middle Fraser Region - the grasslands and forests. A factor in the landscape which is most impressive is the large areas of grassland at different elevations from the deep valley to the southern slopes of the high plateau domes over 3,000 feet in elevation. The soils and vegetation are closely linked and the distribution of soils roughly corresponds to the broad types of vegetation.

Spilsbury and Tisdale\(^67\) have recognized the soil plant relationships in the Thompson Valley area and the vertical zonation that takes place. Weir\(^68\) notes that this vertical zonation does not apply too well to the Cariboo-Chilcotin ranchlands, where deep valleys make up a small percentage of the land and where horizontal differences are more easily recognized. Weir's fourfold classification is used here in a modified form, in which the grassland, Cariboo parkland, the forest and natural meadows are the chief classes


of vegetation. A fifth area, the alpine zone must be noted.

Grassland The grasslands of British Columbia are an extension of the intermontane grasslands of the northwest United States, an area associated with the Brown and Thin Black soils. They are widespread (see Map 18), in the Thompson Valley and along the benches and terraces of the Fraser. Near the Gang Ranch, Big Bar Mountain, Dog Creek, Alkali Lake and Riske Creek they cover large areas of high land, ranging from 2500 to 3500 feet in elevation, though in most areas the transition to parkland takes place lower than 2500 feet. The grasslands have a vertical zonation, the lower grassland associated with the Brown soils, the middle grasslands found with the Dark Brown soils and the upper grasslands under which lies the Thin Black soils. The lower grassland areas are largely restricted to the Thompson Valley, but some areas in the Lillooet and the China Gulch-Canoe Creek areas have similar characteristics. The middle grassland is found in the Lytton-Lillooet area and as far north perhaps as the mouth of the Chilcotin River at elevations below 2500 feet. The upper grasslands are found in the south over 2500 feet and in the northern areas over 1500 to 1800 feet. In the Chilcotin Valley grassland is found as far as Alexis Creek, although it is largely restricted to the valley at that point. 69

69 Weir, op. cit., p. 21
The lower grassland is characterized by blue, bunch, and wheat grass all highly palatable for cattle and sought after for winter range, plus sage brush, rabbit and antelope brush. Where overgrazing has taken place, the sagebrush becomes the dominant cover.

The middle grassland is found in higher areas of the Thompson Valley, the Lillooet-Williams Lake River areas along Fraser and in the Chilcotin to Hanceville. Blue-bunch wheat-grass and dwarf-blue grass are native to this area, along with spear-grass, which through overgrazing has become dominant plant type in some areas. Downy chess and Russian thistle, both non-nutritional plants have been introduced with overgrazing.

On the upper grassland, an area including most high plateau areas, the valley of the Fraser to north of Soda Creek and the Chilcotin to Alexis Creek is cooler and has a shorter growing season. Spear-grass and Kentucky blue-grass are widespread, plus downy brome-grass and other plants.

The grassland in the Middle Fraser Region, particularly in the south, is broken in places by ponderosa pine, often standing alone, or widely spaced above the grassland cover.

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70 Spilsbury and Tisdale, op. cit. p. 400

71 Weir, op. cit., p. 23
The Cariboo Parkland  
Technically the ponderosa pine infringements into the grassland can be termed parkland in areas between Lillooet and Lytton. Generally the parkland refers to the transition from grass to forest, in many plateau areas. Often this takes the form of fir and aspen arranged in clumps interspersed with grassland areas. In many places these groves will be associated with a valley on the plateau and the rises will be grass covered. These groves provide grazing cattle with shade. The Riske Creek area, around Meadow Lake and valleys of the San Jose River and the area north of Soda Creek, provide many examples of this pleasing landscape.

Forest  
The timbered areas are complementary to the grassland and parkland and are found over some 80% of the Cariboo and Chilcotin plateau areas. Forests are more dense in the northern and higher areas where precipitation is greater. In the northern part of the Middle Fraser Region forests penetrate the valley of the Fraser and as one nears Quesnel, forest cover is found even on the lowest benches.

The dominant trees are conifers in most areas, particularly Douglas fir, lodgepole pine. In higher areas subalpine fir and Englemann spruce are dominant. Willow, alder and birch are found in many well watered areas.

72 Weir, op. cit., p. 23.
Meadows  This type of vegetation is limited to the plateau and is associated with the derangement of drainage by glacial deposition in some plateau regions. The meadows are very important to ranchers as sources of natural hay, and spring and autumn ranges. The meadow may be part of a sluggish stream course, or the result of a high spring water table which recedes in the summer leaving the grasses easy to cut. Spear-grass, brome grass and other grasses are found in these meadows. A third type of meadow is found on the flood plain of small streams, usually between fairly thick groves of willow. Ranches in Hat Creek and Pavilion Creek use meadows of this type.
CHAPTER IV

HUMAN GEOGRAPHY

I. SEQUENT OCCUPANCE

The Middle Fraser Region has a long history of occupance, first as the home of a large native Indian population, and later as the home of the European settlers who followed the explorers into the region. The occupance of the region can be divided into five periods, based not on numbers of people or waves of migration, but on the way the land was used. These are not separate divisions of time in which particular activities started or stopped, but overlapping periods when one activity or another was dominant. They are: (1) The period of fishing and gathering or the period of Native Indian occupance; (2) The period of fur trade, 1793-1857; (3) The period of gold mining and early agriculture; (4) The period of ranching and farming, 1871-1940; (5) The period of forest industries, construction and tourism, associated with the stagnation of agriculture - 1940-present.

The Period of Fishing and Gathering The native Indians who inhabited the Middle Fraser Region and the Thompson River Valley are described as the "up-river fishing tribes" in the Atlas of Resources. These Indians belonged

to the Interior Salish linguistic division and were reported to be semi-nomadic peoples who numbered some 91,000 in 1835. The greatest concentration of Indians was in the Fraser Valley between Pavilion and Boston Bar, a town about 30 miles south of Lytton, although villages were located at Canoe Creek, Dog Creek, Alkali Lake, Williams Lake and in the Chilcotin. Generally their settlements were at the mouths of the reliable streams, where a water supply could be found, and where deciduous trees grew. From the latter roots and fruits were collected. The Indians fished for salmon with primitive nets and spears from the bluffs above the Fraser and in tributary streams such as the Seton River. At Lillooet, native Indians can still be observed catching salmon this way. The population of native Indians was reported halved by a smallpox epidemic in 1862.

The Period of the Fur-Trade, 1793-1858  In 1793, Alexander Mackenzie crossed the continental divide, travelled along the Peace and Parsnip Rivers in search of a route to the Pacific Ocean, and in doing so, brought the European to the Middle Fraser Basin. Simon Fraser, in 1805 built a number of forts on the west side of the Rockies in order to trade for furs, and also to create well stored outposts from which a descent of the Fraser River could be made. In 1808, Fraser descended the river, negotiating the rapids between Fort George and the
mouth of the Thompson with little trouble; then after considerable hardship he continued to the coast. At Lytton, the Indians were friendly, and it is reported that he had to shake the hands of 1200 natives. Fort Alexandria, the first fort in this region, was built in 1820. In 1821, the region was officially taken over by the Hudson's Bay Company. Location of Fort Alexandria is shown on Map 37, page 218.

Although the area was claimed as British territory, the number of Europeans in the region remained very small, and they were generally employees of the Company.

The Period of the Gold Rush The period known as the "Gold Rush" corresponds to the period of effective European settlement of the region. Gold was discovered on the lower Fraser in 1857, but it was not until the bars in the lower Fraser were worked and exhausted that miners moved north along the river into the Middle Fraser Region. In 1860, gold discoveries were made on Williams Creek in the Cariboo, and the great trek to the Barkerville area took place. While 18,000 persons swelled Barkerville, making it the second largest city of the west coast of North America, the bench and valley lands along the Fraser were taken up by farmers. Some men, who had been caught by the "Gold Fever", but who were farmers at heart, recognized the

potential of many of the benches and valleys and established farms. Gold was the basis for the economic development of the area, and agriculture was of limited importance. Barkerville and Stanley made up the large population concentration, while Quesnellemouth, Alexandria, the Mile Houses on the Cariboo Road, Clinton and Lillooet were lesser centres. By 1871, a decline in gold mining was felt in the economy of the region.

The Period of Ranching and Farming. With the decline in mining, the remaining population was primarily occupied in ranching and subsistence farming. Although access to the markets of the coast was difficult, most of the arable land within the Middle Fraser Region was alienated. The economy recovered somewhat after the collapse of the gold rush, and the population slowly increased.

By 1881, the population of 7,550 was distributed in the agricultural areas along the Fraser around small supply centers and along the Cariboo Wagon Road on the plateau.

Typical of the period were little nodes of two or three ranches grouped around a favored watering place or rich pasture. This is well illustrated in the case of the River Trail north. Big Bar Creek, Dog Creek, Alkali Lake, Williams Lake, were, and are to-day centers of settlement because of the natural features of water and open grassland found together. Along the Cariboo Road from Clinton to Lac la Hache,

75 An example of this is the story of Robert Carson, and the establishment of the farm on Pavilion Mountain called "Carson's Kingdom", described by Bruce Hutchison in The Fraser.
where the Trail passes through heavy timber, on the higher upland, settlement clusters were few and far between and this is still the case.  

Ranching was well established as a dominant industry in this period. A general idea of the extent of agricultural activity is found in the following table:

**TABLE XI**

**DISTRIBUTION OF RANCHES, 1887**

<table>
<thead>
<tr>
<th>Area</th>
<th>Number of Ranches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilcotin</td>
<td>40</td>
</tr>
<tr>
<td>Williams Lake-Soda Creek</td>
<td>40</td>
</tr>
<tr>
<td>100 Mile House, Lac la Hache</td>
<td>26</td>
</tr>
<tr>
<td>Clinton</td>
<td>11</td>
</tr>
<tr>
<td>Bonaparte Valley</td>
<td>8</td>
</tr>
<tr>
<td>Cache Creek</td>
<td>10</td>
</tr>
<tr>
<td>Spences Bridge</td>
<td>9</td>
</tr>
<tr>
<td>Lytton</td>
<td>3</td>
</tr>
<tr>
<td>Ashcroft</td>
<td>11</td>
</tr>
</tbody>
</table>

The dominance of agriculture in the Cariboo is best illustrated by the census figures of 1891 in which the census divisions were named after the settlements of importance. All but one of these were in the immediate vicinity of the Fraser River; viz. Alexandria, Alkali Lake, Big Bar Creek, Lillooet, Quesnelle and Williams Lake. Clinton district was located on the plateau. The population and occupied acreage for 1891 in each census subdivision is

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77 B.C. Directory, 1887.
found in Table XII, and the population distribution for 1891 in Map 19.

**TABLE XII**

**POPULATION, OCCUPIED ACREAGE AND NUMBER OF FARMS, 1891**

<table>
<thead>
<tr>
<th>Division</th>
<th>Population</th>
<th>Acreage Occupied</th>
<th>No of Farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexandria</td>
<td>671</td>
<td>23,887</td>
<td>122</td>
</tr>
<tr>
<td>Alkali Lake</td>
<td>534</td>
<td>45,928</td>
<td>30</td>
</tr>
<tr>
<td>Big Bar</td>
<td>234</td>
<td>4,953</td>
<td>24</td>
</tr>
<tr>
<td>Clinton</td>
<td>388</td>
<td>11,232</td>
<td>148</td>
</tr>
<tr>
<td>Lillooet</td>
<td>1088</td>
<td>11,010</td>
<td>33</td>
</tr>
<tr>
<td>Quesnelle</td>
<td>706</td>
<td>4,340</td>
<td>47</td>
</tr>
<tr>
<td>Williams Lake</td>
<td>410</td>
<td>15,776</td>
<td>180</td>
</tr>
</tbody>
</table>

Even with the improvement of transportation facilities in the twentieth century the settlement pattern remained similar, with population settled in greatest numbers in the agricultural areas along the Fraser.

**The Recent Period** The period from about the beginning of World War II to the present can be referred to as the Construction, Forest Industry and Tourism period. The population has increased more rapidly on the plateau and in the forest regions than in the agriculture areas near the Fraser River. The settlements along the Cariboo Road have swelled in numbers with persons engaged in construction and the forest industries and at Quesnel, a largely forest-based economy has been established upon one that was for half a century agriculturally-oriented. In the south,
POPULATION DISTRIBUTION - 1891 -

- REPRESENTS 25 PERSONS
- WAGON ROAD
- CONNECTING ROAD
- SHADED AREA OVER 4000 FEET

SOURCE: Tenth Census of Canada, 1891.

8 MILES TO 1 INCH

MAP 19

W. G. HARDWICK
hydro-electric construction on the Bridge River and Seton Creek, have made jobs for an increased population in the Lillooet sub-division. This change in orientation of the economy can be best illustrated by a comparison between 1921 and 1951 of the farm population as a percentage of the total population. Table XIII indicates that the farm population as a percentage of the total population has dropped by one-half.

**TABLE XIII**

<table>
<thead>
<tr>
<th>Census sub-division</th>
<th>1921</th>
<th>1951</th>
</tr>
</thead>
<tbody>
<tr>
<td>6d South Chilcotin</td>
<td>44%</td>
<td>47%</td>
</tr>
<tr>
<td>6e Clinton</td>
<td>62%</td>
<td>31%</td>
</tr>
<tr>
<td>6f Lillooet</td>
<td>30%</td>
<td>9%</td>
</tr>
<tr>
<td>8c North Chilcotin</td>
<td>50%</td>
<td>21%</td>
</tr>
<tr>
<td>8d Quesnel</td>
<td>40%</td>
<td>20%</td>
</tr>
</tbody>
</table>

The exception is in the South Chilcotin sub-division where the percentage has increased. If the predominantly agricultural areas on the west side of the Fraser, within the Big Bar and Dog Creek enumeration districts were subtracted from the total farm population of the Clinton district, the increase of the non-farm population on the plateau is even more marked.

**Supply Centers**

Concentrations of population are not widespread within
the Middle Fraser Region and many settlements retain essentially the same functions and characteristics that they have had through the past half-century. A few settlements have grown rapidly and now are incorporated villages of some size.

Weir recognizes three classifications of supply centres and settlements in the ranching areas of the southern interior of British Columbia each of which is represented in the Middle Fraser Region. (Map 20).

Type I settlements are ranch centred operations where the Post Office, store and other services are associated with the ranch. Often the store which sells staple goods, confections and perhaps some hardware is part of the ranch building itself. A school is found near some of the Type I settlements. Jesmond, Dog Creek, Alkali Lake, Riske Creek, Hanceville, Big Creek, Meldrum Creek, Macalister and Gang Ranch are settlements of this type. Even within these settlements quite a range of services is found. At Gang Ranch only a Post Office is in existence, and any supplies that are available for purchase come from the Ranch itself whereas at Dog Creek, a full range of goods is available, plus a stage headquarters.

At Type II settlements, in addition to store, gasoline, post office and school, there are some tourist accommodations,

78 Weir, op. cit., p. 66.
CLASSIFICATION OF SETTLEMENTS
IN MIDDLE FRASER REGION, CARIBOO, & THOMPSON VALLEY

LEGEND
- CLASS I  SINGLE SERVICES
- CLASS II  FEW SERVICES
- CLASS III  MULTI-SERVICES

30 MILES TO 1 INCH

MAP 20

W.G. HARDWICK
eating facilities and perhaps a cattle loading corral. Alexandria, Alexis Creek, Pavilion and Spences Bridge are examples.

Type III settlements have multi-services available. Small hospitals, government offices, police headquarters, transportation agencies and some small industries are located in these towns. In the Middle Fraser Region, Lytton and Lillooet in the south, Williams Lake and Quesnel in the north, 100 mile House and Clinton on the plateau and Ashcroft in the Thompson Valley are representatives of this classification.

For most of the period of European settlement this threefold classification has applied to the same centres. However 150 Mile House and Soda Creek, which in 1958 are Type I settlements within the sphere of influence of Williams Lake, in the last century would have been Type II or III centres. One Hundred Mile House was classified as Type II by Weir, but in the last five years, this settlement has grown rapidly becoming a dominant supply centre in its own right.

**Areas Served**

Lytton serves the area near the confluence of the Thompson and Fraser, while Lillooet functions as a major supply centre for the Fraser Valley from Laluwissin to Pavilion area plus the Bridge River district. Clinton serves
Jesmond and Big Bar Creek as well as Canoe Creek and Gang Ranch fifty miles to the west.

Somewhere between Marguerite and Australian, the dominance of Williams Lake is replaced by that of Quesnel.

Ashcroft is the centre of the Thompson Valley, serving the area from Spences Bridge to Walhachin. In addition it has widespread influences in the southern Cariboo, providing headquarters for the South Cariboo School district and for health and welfare operations.

II. TRANSPORTATION

The development of transportation in the Middle Fraser Region has had four distinct phases: (1) the historic period in which waterways were the dominant means of transport; (2) the period of the Lillooet and Cariboo Trails; (3) the Cariboo Wagon Road era, associated with the coming of the railways; (4) the present era of expansion and reconstruction of roads and bridges, the completion of the railroads and the inauguration of air travel.

These phases of development do not coincide in every part of this region, but they do make a framework for discussion of this aspect of human geography.

The Historic Period The native Indians inhabiting the Middle Fraser Region did not travel widely, but are reported to have developed a network of trails along the benches
of the Fraser, particularly in the Lillooet and Lytton areas. In the slow moving areas of the river north of Soda Creek, the Indians had canoes for water transport. Many of the Indians were semi-nomadic, but parkland vegetation and tributary stream valleys made travel easy. The first explorers, Mackenzie and Fraser, travelled by canoe and foot.

The Trails Miners and adventurers entering the Middle Fraser Region in search of gold found convenient the water-level route, up Harrison and Lillooet Lakes, then to Anderson and Seton Lakes and finally to the Fraser River at Lillooet. Boats were employed on the rivers and lakes and a railway was constructed over one portage. This was the Lillooet Trail. From Lillooet, it would north over Pavilion Mountain to Clinton, thence across the plateau past the various Mile Houses. The trail reached the Fraser again west of Williams Lake. After reaching Quesnellemouth, it turned eastward to Stanley and Barkerville. Goods that were transported over this route were packed by the miners or by animal train until the wagon road was constructed. The routes into the interior are shown on Map.21.

With the incorporation of the mainland areas into the Colony of British Columbia in 1858 and the appointment of the Royal Engineers to construct a road into the Cariboo, the

79 These Mile houses incidentally were, and still are, numbered from Lillooet.
entrance into the area shifted from Lillooet area to Yale, the head of navigation of the Fraser. The road was built through the Fraser Canyon to Lytton, thence to Clinton and across the plateau to return to the Fraser at Williams Lake. The route across the plateau was popular even to those who hiked in at the beginning of the gold rush. The "River Route" through the arid Fraser valley, with its few streams, steep slopes and frequent gullies, passed north through Pavilion, Big Bar Creek, across the plateau to Canoe Creek and thence along the river to Dog Creek and Alkali Lake. It was more or less abandoned in favor of the plateau route. Commencing in 1864, passengers travelled on stages of the B.C. Express Company from Yale to Lillooet, to Clinton and eventually Soda Creek, from whence summer steamer service provided accommodation as far as Fort George.

The Road and Rail The Cariboo Wagon Road was improved and extended to Alexandria and Quesnelle. In the 1880's the Canadian Pacific Railway was built and altered the transportation pattern of the region. Instead of transshipment at Yale, goods were transported by rail to Ashcroft, from where the stages left for Clinton and the rest of the Cariboo Road. Lillooet, which had continued to be on the road from Yale, lost all importance as a transportation

80 W.N. Sage, op. cit. p.30
SOUTHERN BRITISH COLUMBIA

ACCESS TRAILS

LEGEND

LILLOOET TRAILS 1858
CARIBOO TRAIL 1862
COMMON ROUTE L & C
STEAMER ROUTE
RIVER ROUTE

37 MILES TO 1 INCH

UPON COMPLETION OF THE C.P.R. IN 1886 ASHcroft BECAME THE TERMINUS OF THE CARIBOO HIGHWAY.
centre and became serviced only by weekly stages from Ashcroft. The B.C. Express Stages travelled from Ashcroft after the starting of rail services.

Trails out to the Fraser via Meadow Lake and Canoe Creek were opened in the late 1860's and were followed by trails south from Chimney Creek to Alkali Lake and from Dog Creek and into the Chilcotin at Alexis Creek. Other trails, wide enough for the passage of wagons hauling hay from natural meadows, were constructed on the west bank of the Fraser to Narcosli, Meldrum and Riske Creek.

In 1912, the government completed a steel bridge at Churn Creek bringing to four the number of crossings of the Fraser in its Middle Region. Others, all still in use today, are at Lillooet, Chimney Creek and Quesnel. Stages from 150 Mile to Dog Creek and to Alexis Creek were instituted at that time.

Before choosing the route through the Thompson Valley the Canadian Pacific Railway had made surveys of routes that would have crossed the northern area of this region, bridging the Fraser at Quesnel, crossing the Chilcotin plateau, cutting through the Coast Mountains and then down Bute Inlet. Although this plan was abandoned, it sparked land speculation in the Quesnel area.

In the early years of this century the Grand Trunk Pacific built a railroad through the upper Fraser and Bulkley and Skeena Valleys to Prince Rupert, a railroad that affected the Middle Fraser Region in that it created demands that a railroad be built through this region to the Pacific at Vancouver. Lillooet wanted an outlet for its agricultural products, and cattlemen hoped for a railway to carry cattle into the Vancouver market. Eventually the Pacific Great Eastern Railway Company was formed. Some 230 miles of rail between Squamish on tidewater and Quesnel were constructed in the early 1920's before the company went bankrupt, and the railway was subsequently taken over by the provincial government.

Expansion of Roads, Rail and Air It is only after World War II that an efficient system of roads and rail has been realized. The highway, #2-97 and railroad parallel each other roughly from Clinton to Quesnel over the old Cariboo Wagon Road route. What was a one-day trip by stage in 1912, is now only little more than a one or two hour trip by car. Much of highway #12, which goes from Lytton to Lillooet and thence to the Cariboo Highway, is paved or improved gravel. Most other roads, established a half century ago as trails, are now fair dirt roads. Ferry crossings of the river are maintained at High Bar, Big Bar Creek, Lytton Alexandria and Soda Creek, and an aerial cable passenger ferry operates near Pavilion.
Regular truck services are maintained on a daily basis on the Cariboo Highway, and at least weekly to those settlements located along the Fraser and in the Chilcotin.

**Rail** The completion of the Pacific Great Eastern Railway to North Vancouver in the south and recently to the Peace River has improved transportation to the Middle Fraser.

**Air Transport** The development of scheduled air transport to the region took place in the period following World War II. Several airports were built, two of which, Quesnel and Dog Creek, are operated by the Federal Government Department of Transport, and three, Williams Lake, 100 Mile House and Clinton, are operated by the local communities. Amphibious landings are possible on many lakes in the plateau region.

III. PRESENT POPULATION DISTRIBUTION

The present population pattern is described on Map 22 on which a dot has been placed for every 25 persons. Larger concentrations in the villages of Lytton, Lillooet, Williams Lake and Quesnel and lesser concentrations around 150 Mile House and Clinton, growing centers on the plateau, as well as the cluster of persons in the tributary valleys of the Fraser, are indicated.

The urban growth in the area has been most spectacular
in the past decade. The rural population has been much more stable. Table XIV indicates the total population increase in the period 1921 to 1956.

**TABLE XIV**

**GROWTH OF TOTAL POPULATION**

<table>
<thead>
<tr>
<th>Census Subdivision</th>
<th>1921</th>
<th>1931</th>
<th>1941</th>
<th>1951</th>
<th>1956</th>
</tr>
</thead>
<tbody>
<tr>
<td>6d South Chilcotin</td>
<td>492</td>
<td>851</td>
<td>498</td>
<td>524</td>
<td>697</td>
</tr>
<tr>
<td>6e Clinton</td>
<td>1417</td>
<td>1350</td>
<td>2041</td>
<td>3180</td>
<td>5929</td>
</tr>
<tr>
<td>6f Lillooet</td>
<td>2116</td>
<td>2794</td>
<td>4107</td>
<td>4693</td>
<td>5677</td>
</tr>
<tr>
<td>8c North Chilcotin</td>
<td>903</td>
<td>1052</td>
<td>1560</td>
<td>3174</td>
<td>3162</td>
</tr>
<tr>
<td>8d Quesnel</td>
<td>3201</td>
<td>2991</td>
<td>5907</td>
<td>7094</td>
<td>12,016</td>
</tr>
</tbody>
</table>

While these census sub-divisions do not correspond to the Middle Fraser Basin, (Map 23) they illustrate trends taking place in the whole Cariboo region.

An important settlement trend is the concentration of persons in urban areas, particularly at Quesnel, where 4,384 persons lived in 1956 compared with 1,587 in 1951. Similar growth in the other centers has been noted.

An interesting contrast is made by comparing the present pattern with those at the close of the nineteenth century. The rapid growth of non-agricultural areas in the Middle Fraser becomes marked.

The distribution of the Indian population is of interest, particularly because of its concentration in

---

82 The boundaries of the village were increased. It is believed that about 800 additional persons should have been counted in 1951.
several fertile valley areas. A dot Map (Map 24) indicates the location of this Indian population.

Perhaps the most startling conclusion that one can reach in studying the population map is the lack of population in so much of the Middle Fraser Region. The fact that not one dot, representing twenty-five persons, can be placed in a large area immediately west of the Fraser, illustrates this.

The human geography of the area is not the dominant geography of the region, for man-made institutions, objects and economies certainly do not feature the landscape.
MIDDLE FRASER REGION
INDIAN POPULATION

LEGEND
ONE DOT REPRESENTS 50 PERSONS
--- BOUNDARY OF AGENCY
(1,002) POPULATION OF AGENCY
SOURCE: CENSUS OF INDIANS, 1954

30 MILES TO 1 INCH

MILES

ALEXANDRIA
SODA CREEK

CHIMNEY CREEK

WILLIAMS LAKE

DOG CREEK

WILLIAMS LAKE AGENCY (2040)

KAMLOOPS AGENCY (1541)

SYNCLINE AGENCY (1002)

LYTTON AGENCY (1966)

MAP 24

W. G. HARDWICK
PART II

Just as a summary of the physical geography of the Middle Fraser Region was necessary to appreciate the effect the Moran Dam proposal may have on the region, so some knowledge of the patterns of agriculture and the patterns and mechanics of irrigation are needed.

This material may be considered as not strictly geographic. However, the Chapter on "Agriculture within British Columbia" is designed, among other things, to show the distribution of agricultural activity throughout the province, and of various crops in areas topographically and climatically suited to their growth. Similarly the chapter on "Irrigation in British Columbia" attempts to show the patterns and locations of irrigation.
CHAPTER V

AGRICULTURE IN BRITISH COLUMBIA

I. EXTENT OF AGRICULTURE

Total farm area in British Columbia is small, accounting for only two percent of the total area, and improved acreage is calculated to be but .5% of the land of the province. Most of the land lies along the benches and valley bottoms of interior valleys, in the Lower Fraser Valley and on south-east Vancouver Island. While 48 percent of production by value is currently centred in the Lower Fraser Valley, secondary centres of agricultural production are located in the Okanagan Valley, accounting for 17 percent of the production value, in the Kootenays, Cariboo, Peace River, Vancouver Island and the north central district.

Of the 18,000 farms and ranches within the province, 55 percent are small-scale farms, that produce less than 8 percent of the total value of production and thus are of little importance to the agricultural picture. The number of persons engaged in agriculture in British Columbia has


84 Ibid., opposite p. 254
declined in recent years. In 1941, 41,000 people or 13 percent of the gainfully occupied were engaged in farming and ranching. In the ensuing decade, there was an absolute decline in the numbers involved to 28,000 and a drop in the percentage of the gainfully occupied to 6 percent. By the census of 1956, 3,000 fewer people were on the farms and ranches than five years before and the percentage of the gainfully occupied had decreased to 5 percent.

British Columbia, a Deficit Region

In 1950, British Columbia was self-sufficient only in tree fruits, small fruits, eggs and fluid milk. Imports from other provinces, the United States and abroad made up the deficit in production of other foodstuffs. Especially in vegetables and meat: British Columbia's needs were beyond her production. In 1950, 42 percent of the beef, 22 percent of the veal, 27 percent of the lamb and mutton and 12 percent of the pork needed in the province were produced in the province. In 1950, the province imported 12,205,000 lbs of canned vegetables. These included varieties which were not grown within the province or were in short supply, or which could successfully compete in matters of price with the British Columbia product. This was equivalent to about 24 percent of the processing of that year.

Except for fluid milk products, even dairy products were imported. These included 28 percent of the province's needs of evaporated milk, 79 percent of the butter and a similar amount of the cheese. A total of 71,449 live cattle came into British Columbia for slaughter at inspected plants in 1956, the bulk of these originating in the province of Alberta. It is estimated that 25,000 cattle were imported in the form of dressed carcasses and beef cuts. Although there is no official record of this movement, it would appear that the equivalent of approximately 100,000 head of cattle, about 2,000 weekly, were moved into British Columbia during the calendar year 1956. 86 Forty-four percent of the beef marketed in Vancouver in 1956 was of British Columbia origin.

These figures indicate the deficit in food stuffs exists at the present time, when the farm population is falling and the cultivated acreage is remaining constant.

Cash income to British Columbia farmers averaged under $2,000 per farm. However, if the 11,236 farms classed as full scale farms are considered alone, sales per farm were $8,915 compared with $1,653 on the 13,512 part time farms. 87

Comparative Agricultural Areas in the Interior Plateau

To illustrate the comparative position of agricultur-
al production in the interior valleys of British Columbia, one may compare the relative value of production in three regions: Okanagan, Kamloops and Cariboo, as shown in Table XV.

**TABLE XV**

<table>
<thead>
<tr>
<th></th>
<th>Cariboo ($',000)</th>
<th>Kamloops ($',000)</th>
<th>Okanagan ($',000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td>5,403</td>
<td>3,685</td>
<td>2,205</td>
</tr>
<tr>
<td>Poultry</td>
<td>725</td>
<td>488</td>
<td>2,326</td>
</tr>
<tr>
<td>Dairy</td>
<td>402</td>
<td>287</td>
<td>2,524</td>
</tr>
<tr>
<td>Vegetables and Pot.</td>
<td>211</td>
<td>275</td>
<td>1,743</td>
</tr>
<tr>
<td>Swine</td>
<td>171</td>
<td>282</td>
<td>377</td>
</tr>
<tr>
<td>Sheep</td>
<td>58</td>
<td>192</td>
<td>114</td>
</tr>
<tr>
<td>Forage*</td>
<td>25</td>
<td>100</td>
<td>95</td>
</tr>
<tr>
<td>Tree Fruit</td>
<td>--</td>
<td>84</td>
<td>7,766</td>
</tr>
<tr>
<td>Small Fruit</td>
<td>--</td>
<td>15</td>
<td>155</td>
</tr>
<tr>
<td>Grain</td>
<td>--</td>
<td>9</td>
<td>500</td>
</tr>
<tr>
<td>Seed</td>
<td>--</td>
<td>4</td>
<td>115</td>
</tr>
<tr>
<td>Special Horticulture</td>
<td>--</td>
<td>-</td>
<td>201</td>
</tr>
</tbody>
</table>

* This is the value sold and does not include the crops produced and used on the farm.

The relative value of the crops in each of these agricultural regions is indicated on Map 25. The Okanagan leads the three regions in value of production of most crops. In beef, however, the Cariboo and Kamloops value of production is considerably larger. Kamloops leads in the value of sheep production and in the value of the forage crop sold.

---

COMPARISON OF VALUES OF AGRICULTURAL PRODUCTS IN CARIBOO, KAMLOOPS AND OKANAGAN AGRICULTURAL DISTRICTS

1956

37 MILES TO 1 INCH

SOURCE: NATURAL RESOURCES CONFERENCE, B.C.

VALUE OF AGRICULTURE PRODUCTION: $18,126,047
TOTAL POPULATION: 82,480
FARM POPULATION: 33.7%
II. AGRICULTURE WITHIN THE FRASER BASIN

Location The Fraser Basin lies within the Department of Agriculture's Cariboo district, except for a small area around Lytton. Table XVI indicates that the predominant farm product in the area is beef cattle, supplemented by poultry, dairy cattle, vegetables, potatoes, swine and sheep.

Within the Fraser Basin south of Williams Lake, all areas of intensive cultivation are irrigated, except for a few areas on the plateau where water deficiency is not acute. The irrigated areas are small in extent and almost entirely devoted to the growing of forage crops to supplement the range feed for beef cattle. The occupied land in this area is primarily grass and parkland grazing areas. The area in crop expressed as a percentage of the total occupied land, for each of the five census subdivisions which make up the Cariboo agricultural district is shown in Table XVI.

<table>
<thead>
<tr>
<th>TABLE XVI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERCENTAGE OF TOTAL OCCUPIED LAND IN CROP</td>
</tr>
<tr>
<td>South Chilcotin</td>
</tr>
<tr>
<td>Clinton</td>
</tr>
<tr>
<td>Lillooet</td>
</tr>
<tr>
<td>North Chilcotin</td>
</tr>
<tr>
<td>Quesnel</td>
</tr>
</tbody>
</table>

Source: "Canada Census 1951"
Ranching

Most of the land in the Middle Fraser Region is used in some way by ranchers. The small amount that is intensively cultivated is, in most cases, in forage crops which are used as winter feed for cattle. Most of the cattle found in the northern sections of the Interior Plateau are on ranches within the Middle Fraser Region or in the adjacent regions of the Chilcotin, Cariboo and Thompson River Valley. The extensive report by Thomas R. Weir, published as Geographical Memoir 4 in Ottawa, gives the most comprehensive description of ranching in this area of British Columbia.

Distribution of Ranchsteads

A Map (26) showing the distribution of ranchsteads, indicates the concentration of large ranches within the Middle Fraser Region. Often, even when extensive range land is maintained on the plateau, the main ranch is found within the region under discussion. The factors influencing this pattern of distribution are both human and physical. The human factor has operated through history and the chance decisions by early settlers. The physical factors, as described in Chapter III, are more enduring, and have influenced the broad patterns of settlement throughout the historical period. The distribution of grassland, supplemented with

89 T.R. Weir, op. cit.
reliable water sources and moderate climate, set the bounds to which the ranches have more or less adhered. The linear pattern of locations in the valleys of the Fraser, Thompson, San Jose and Chilcotin are evident as well. Ranch sizes are indicated, and in doing so, illustrate the general distribution of cattle.

The Distribution of Cattle by Census Divisions

Most of the cattle in the census sub-divisions, listed in Table XVII are found within the Middle Fraser Region.

<table>
<thead>
<tr>
<th>TABLE XVII</th>
<th>CATTLE BY CENSUS SUB-DIVISIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beef</td>
</tr>
<tr>
<td>South Chilcotin</td>
<td>21,008</td>
</tr>
<tr>
<td>Clinton</td>
<td>22,546</td>
</tr>
<tr>
<td>Lillooet</td>
<td>5,185</td>
</tr>
<tr>
<td>North Chilcotin</td>
<td>13,020</td>
</tr>
<tr>
<td>Quesnel</td>
<td>11,154</td>
</tr>
</tbody>
</table>

One third of the cattle in the South Chilcotin Division belong to the Gang Ranch and are dependent for winter feed or winter range on the irrigated lands of Gang Ranch proper and Big Bar Mountain Range. Other cattle are near centres at Hanceville, Big Creek, Riske Creek, and along the Chilcotin Road. Many of the 22,546 cattle reported in the Clinton sub-division are associated with the plateau meadows.

\* Source: "Canada Census 1951"
and lakes from 100 Mile House to Canim and Chimney Lakes. Over a third, however, are found at the Canoe Creek, Dog Creek and Alkali Lake Ranches, all of which are dependent for winter forage crops on the irrigated lands near the Fraser and the winter pastures on the low Fraser River benches.

In the Lillooet area, the cattle are dependent on the ranches in Big Bar Creek area, on the Pavilion-Sallus Creek-Fountain irrigated alfalfa land and on the small farms south of Lillooet. In North Chilcotin, the Alexis Creek ranching area has a large number of cattle, while the Meldrum Creek-Narcosli Creek area supplies irrigated pasture for cattle feed. In the Quesnel sub-division, the cattle are concentrated in Williams Lake area, near Soda Creek and in the Horsefly area well back on the plateau. The extent to which cattle raising expands will be related to the carrying capacity of the land in the winter season.

Ranches are measured by the carrying capacity of the range rather than the acreage occupied by the ranch. In the forest land and parkland ranges six acres are needed to graze one animal for one month, whereas on the grassland, three to four acres per animal per month are needed. This necessitates large holdings of land either by outright ownership or by grazing leases or grazing permits. In most areas the acreage under lease or permit is about one-fifth of that which is owned, but in the South Chilcotin about one-third of the
land is under permit or lease. The grazing leases are issued by the provincial government and include periods up to 21 years at a rent of four cents to fifty cents per acre per year. The grazing permit is issued annually and allows ranchers to graze limited numbers of cattle on a certain acreage for a stated period.

The exception to the pattern of extensive ranches in the Cariboo and Lillooet areas is the Riverland Irrigated Farms Limited operation at East Lillooet where the "feed lot" method of cattle production is being tried. Rather than grazing the cattle over large areas the ranchers restrict them to pens to which the feed is brought. Similar work has been done at the Experimental Farm near Kamloops where production of cattle per acre has been very high. It is with production methods of this type that it is hoped to expand production markedly in the "dry belt" in future years. The following description of the operation at Riverland gives an interesting insight into the operation:

Green feeding in the feed lot will be a regular practice at Riverland. Cattle will not graze the fields. This system will eliminate trampling of fields, uneven manure distribution and interference with movement of irrigation pipe. No cross fencing will be required and it will not be necessary to move cattle frequently as is essential with well managed rotational grazing. Grain will supplement the green forage. As cattle approach market weights, grain will replace more and more forage for the sake

90 The permit rate was 11¢ per head per month in 1957.
of finish and high quality of beef.

Experience is still limited in the green feeding method but it is expected that yields of forage will exceed those that could be used effectively by grazing. 91

On the four hundred acres planned to be brought under intensive cultivation at Riverland, it is hoped that 1,000 head of cattle per year will be supplied with summer forage and winter silage. The Experimental Farm at Kamloops reports 827 pounds of beef per acre is produced by similar methods. 92

Markets for Cattle

Practically all cattle have been shipped to Greater Vancouver, where the market serves an urban population of more than half a million. Small numbers of cattle have been shipped to Calgary and to the United States when there has been a demand. In 1949, only 907 head went to the United States and 277 went to Calgary. 93 The cattle from interior regions of the province made up just one half the needs of the Vancouver area. Weir suggests that "this would indicate that the populous districts of the west coast will continue to be the destination of most interior cattle shipments."

This is not necessarily the case in 1958, for in the

91 R. Gram, "Riverland Irrigated Farms" (mimeographed) p. 6.


93 Weir, op. cit., p. 76.
ranching areas of Alberta, grain fed cattle are being marketed, and demand for grass fed cattle in the urban areas has decreased. As a result, ranchers have been forced either to import grain to finish their cattle before marketing, or to sell them as feeder cattle to "feed lot" operators for finishing. In the late fall of 1956, Chilco Ranch at Hanceville sent its first large shipment of 700 to 800 two-year-old light steers to Alberta to be finished. The Douglas Lake Cattle Company, located on the Nicola Plateau, shipped twenty cars of calves to Medicine Hat for finishing.  

The future implications of this change in the kind of beef in demand will be discussed further in Chapter XIII.

Value of Cattle The large ranches in the Middle Fraser Region suggest that there are larger numbers of cattle on the average per farm in these areas. This is illustrated in Table XVII where number and value of cattle per farm are indicated.

| TABLE XVIII
<table>
<thead>
<tr>
<th>NUMBER AND VALUE OF CATTLE PER FARM</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Chilcotin</td>
</tr>
<tr>
<td>Clinton</td>
</tr>
<tr>
<td>Lillooet</td>
</tr>
<tr>
<td>North Chilcotin</td>
</tr>
<tr>
<td>Quesnel</td>
</tr>
</tbody>
</table>

Growth of Cattle Production  Cattle ranching had its greatest growth in the "Gold Rush" period, as indicated by figures in Table XIX. By 1881, the cattle population had levelled off at about 9,000 animals. However, after the turn of the century cattle population again expanded. Of the 83,000 cattle listed in the Cariboo and Nicola region, 40,000 were estimated to be in the Cariboo. This nears the 48,000 cattle found in the Cariboo and Chilcotin in 1948.

**TABLE XIX**

**NUMBERS OF CATTLE 1862-69**

<table>
<thead>
<tr>
<th>Year</th>
<th>Number</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1862</td>
<td>1,520</td>
<td>Lillooet-Lytton</td>
</tr>
<tr>
<td>1865</td>
<td>2,905</td>
<td>Quesnel-Cariboo-Lillooet-Lytton</td>
</tr>
<tr>
<td>1866</td>
<td>5,680</td>
<td>Quesnel-Cariboo-Lillooet-Lytton</td>
</tr>
<tr>
<td>1867</td>
<td>8,446</td>
<td>Quesnel-Williams Lake-Lillooet</td>
</tr>
<tr>
<td>1869</td>
<td>10,275</td>
<td>Lillooet-Lytton and Cariboo</td>
</tr>
</tbody>
</table>

Another large increase in the cattle population has taken place in the last decade, when numbers run from 48,000 cattle in 1948 to 59,000 cattle in the 1951 census year. In 1956, 72,000 cattle are reported. This increase was marked in each census subdivision, Table XX with the largest percentage increase in the Lillooet district. This rapid increase in numbers of cattle may be indicative of the "slow" character of the market for grassfed beef rather than an increase in agricultural activity in the region.

95 Annual Report, Department of Agriculture 1869, Victoria, 1871, p. 63.
TABLE XX
NUMBERS OF CATTLE BY CENSUS SUB-DIVISION

<table>
<thead>
<tr>
<th>Sub-division</th>
<th>1956</th>
<th>1951</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Chilcotin</td>
<td>21,008</td>
<td>16,377</td>
</tr>
<tr>
<td>Clinton</td>
<td>22,546</td>
<td>19,616</td>
</tr>
<tr>
<td>Lillooet</td>
<td>5,185</td>
<td>2,995</td>
</tr>
<tr>
<td>North Chilcotin</td>
<td>13,020</td>
<td>9,720</td>
</tr>
<tr>
<td>Quesnel</td>
<td>11,154</td>
<td>10,863</td>
</tr>
</tbody>
</table>

The change in shipment patterns of cattle from British Columbia is indicated in Table XXI, where are indicated a distinct decrease in shipments from the Cariboo, the area most dependent on grass feeding, and a distinct increase in the number of head being shipped to Alberta for finishing.

TABLE XXI
A COMPARISON IN NUMBERS OF CATTLE SHIPPED, 1954 AND 1955

<table>
<thead>
<tr>
<th>Shipments</th>
<th>1955 (head)</th>
<th>1954 (head)</th>
<th>change</th>
</tr>
</thead>
<tbody>
<tr>
<td>To U.S.A.</td>
<td>2,013</td>
<td>3,207</td>
<td>minus 1,194</td>
</tr>
<tr>
<td>From Cariboo</td>
<td>17,061</td>
<td>22,684</td>
<td>minus 5,623</td>
</tr>
<tr>
<td>From Kamloops-Nicola</td>
<td>28,953</td>
<td>29,312</td>
<td>minus 359</td>
</tr>
<tr>
<td>To Prairie</td>
<td>9,920</td>
<td>7,849</td>
<td>plus 2,071</td>
</tr>
</tbody>
</table>

Field Crops

Most of the land devoted to cultivation in the Middle Fraser Region is in cultivated hay or alfalfa. This

is used for winter feed for cattle. In some areas husking corn has been tried as a crop to be used for cattle finishing, but to the present the production is small. The large amount of cultivated land in forage crops is indicated in Table XXII.

**TABLE XXII**

<table>
<thead>
<tr>
<th></th>
<th>Improved Acres</th>
<th>Cultivated Hay</th>
<th>Irrigated Pasture</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Chilcotin</td>
<td>6,824</td>
<td>3,691</td>
<td>2,386</td>
</tr>
<tr>
<td>Clinton</td>
<td>13,789</td>
<td>11,925</td>
<td>3,634</td>
</tr>
<tr>
<td>Lillooet</td>
<td>7,761</td>
<td>3,909</td>
<td>1,959</td>
</tr>
<tr>
<td>North Chilcotin</td>
<td>23,000</td>
<td>3,769</td>
<td>19,912</td>
</tr>
<tr>
<td>Quesnel</td>
<td>27,297</td>
<td>10,776</td>
<td>9,309</td>
</tr>
</tbody>
</table>

The remaining acreage after the hay and pasture acreage are totalled is in other field crops.

Small quantities of grains, particularly oats, are grown in each part of the Middle Fraser Region. Vegetable crops are grown in the Lillooet-Lytton section and in the Quesnel area. In 1956, 310 acres were reported in potatoes in the Lillooet area and 135 acres in the Quesnel region. Lillooet-Lytton Alfalfa Seed Growers Association produced some five tons of seed.

Vegetable crops are grown commercially only in the Lillooet area which in 1951 amounted to some 81 acres on 14 farms. Vegetables grown in other areas were used for local
farm consumption. Some tomatoes and apples are grown in the Lillooet area. Grapes, Mullberry trees and other warm weather crops have been grown in the Lillooet area, but not on a commercial scale.

An Increasing Demand for Agricultural Products

The expansion of production in the Middle Fraser Region, either through improved farming methods or by breaking new land has been necessary in the last few years to meet the increased needs of the urban dwellers in the province. Table XXIII indicates how the consumption of a few products has increased in the last several years.

TABLE XXIII

AVERAGE PER CAPITAL CONSUMPTION (POUNDS)

OF FRUIT AND VEGETABLES IN CANADA

<table>
<thead>
<tr>
<th></th>
<th>1935/39</th>
<th>1946/49</th>
<th>1955</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomatoes</td>
<td>15.4</td>
<td>19.4</td>
<td>21.1</td>
</tr>
<tr>
<td>Fresh Fruit</td>
<td>40.5</td>
<td>52.7</td>
<td>68.9</td>
</tr>
<tr>
<td>Cabbage and greens</td>
<td>16.2</td>
<td>18.6</td>
<td>18.8</td>
</tr>
<tr>
<td>Potatoes</td>
<td>192.9</td>
<td>196.9</td>
<td>145.0</td>
</tr>
</tbody>
</table>

Even though the consumption of potatoes has notably decreased that of the other products has increased. This is the pattern of other commodities cited by R.P. Walrod\textsuperscript{97} in an article on the expanding need for processed food stuffs.

III. SUMMARY

(1) The farm population has decreased in British Columbia in recent years. The reasons for this have been many, but have included better opportunities for farm workers in forestry and construction, attractive opportunities available in urban areas and the consolidation of land into large holdings.

(2) The Province's need for agricultural products has increased and importation of foodstuffs is at an all-time high. Production has increased in some lines. However, the desire of the consumer for standardized grade produce and grain finished beef have contributed to the inability of British Columbia farmers and ranchers to meet the demand.

(3) The dominance of ranching as a form of agriculture in the Middle Fraser Region is evident. The use of the grassland for grazing and the valley areas for irrigating forage crops are important characteristics of this region.

(4) Increases in numbers of cattle on the range have been noted in past years. A further increase in production will depend on the establishment of "feed lot" operations and the importation of grain.
CHAPTER VI

IRRIGATION IN BRITISH COLUMBIA

About one-fifth of the crop land in British Columbia is under irrigation. Most of it, some 200,000 acres, is located in the interior valleys of the province, scattered along old river terraces, valley bottoms and lake shores.

The greatest concentration of irrigation is in the Okanagan Valley where about 70,400 acres are estimated to be presently under irrigation; but a larger acreage, 77,300 acres, is spread over a greater area in the Nicola and Thompson Valleys. 98 The Creston and Grand Forks regions of the eastern part of the province have considerable acreage under irrigation, and additional acreage is found in the agricultural sections of the Fraser River Valley. 99

Forage crops make up the largest percentage of the acreage under irrigation within the province, while tree fruits, small fruits and vegetables make up the largest acreage in certain districts.

Irrigation  Irrigation is the process by which the deficit of moisture in the soil is made up so that plants will have sufficient moisture to grow. In some areas

99 Ker, op. cit., p. 235
irrigation takes place through natural flooding of streams but in most areas irrigation works must be constructed and operated by man. When man operates irrigation works he tries to apply only as much moisture as the soil needs, and to limit the run off. The amount of water applied is usually equal to the amount lost through evaporation, transpiration and run off, and is called "water duty".

I. HISTORICAL DEVELOPMENT OF IRRIGATION

Irrigation works were established simultaneously with the establishment of intensive agriculture in the arid areas of British Columbia. Water was applied to the land around the first fur-trading posts, Fort Alexandria and Fort Kamloops, from their establishment before 1812. Ranches in the Okanagan, Thompson and Nicola Valley were established to make use of the large areas of natural grassland, and cattle and sheep were put to graze. Along the Middle Fraser, many small individual farms were irrigated from tributary streams and farmers began producing grain, fruit and vegetables to supply miners heading north into the Cariboo country.

Extensive grazing and intensive cultivation were the contrasting uses to which the land and irrigation water were put in the early years of settlement in British Columbia. For example, "as late as 1891, the land in the Okanagan Valley
north of the boundary line was owned by ranchers for a
distance of twenty miles ... but in that year orchardists entered the Okanagan Valley, and bid the price of land up so that ranchers had to sell their irrigable acreage and thus started the gradual transition of the irrigated lands from control of the large rancher to the small farmer. In the first decade of the present century this trend spread to the Thompson River Valley.

**Irrigation Projects** The South Okanagan Lands Project, instituted in 1919 by the Provincial Government, resulted in the purchase of 22,000 acres of land for returned service men. About 4810 acres were irrigated.

In other areas of the Okanagan Valley, as permitted by landforms, soil and hydrology, large areas, by British Columbia standards, have been put under irrigation. These areas, listed in Table XXIV, are well separated from each other.

**TABLE XXIV**

<table>
<thead>
<tr>
<th>Location</th>
<th>Irrigated Acreage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vernon</td>
<td>8,697</td>
</tr>
<tr>
<td>Kelowna</td>
<td>10,497</td>
</tr>
<tr>
<td>Westbank</td>
<td>765</td>
</tr>
<tr>
<td>Naramata</td>
<td>916</td>
</tr>
<tr>
<td>Penticton</td>
<td>2,232</td>
</tr>
<tr>
<td>Oyama, Winfield</td>
<td></td>
</tr>
<tr>
<td>Okanagan Center</td>
<td>3,937</td>
</tr>
<tr>
<td>Peachland</td>
<td>455</td>
</tr>
<tr>
<td>Summerland</td>
<td>3,418</td>
</tr>
</tbody>
</table>

100 Margaret Ormsby, "History of Agriculture in British Columbia," *Scientific Agriculture* XX(September 1939) p. 65.

Land was brought under irrigation along the Thompson, near Kamloops, Ashcroft and at Spences Bridge. One large irrigation project, supplying many individual farmers at Walhachin, was started in 1908 on the benches along the north bank of the Thompson River immediately west of Kamloops Lake. Five thousand acres were irrigated with water from Deadman River and Snohoosh Lake reservoir. The scheme was instituted by C.E. Barnes and the Marquis of Anglesey, but failed when most of the British settlers returned to Europe during World War I, and slides and washouts destroyed sections of the irrigation flumes. The failure of this scheme, where thousands of fruit trees had been planted over a seven-year period, seems to have been due to human, rather than any physical factors. In 1957, the whole area was covered with sage brush and grass.

Irrigation regulations Irrigation in British Columbia is administered by the Water Rights Branch of the Department of Lands, Victoria. Within British Columbia, a right to use water is comparable to a property right and it requires registration and protection similar to that of a property right.

Irrigation may be undertaken in several ways. (1) a farmer may procure the water rights to a certain stream or

pond and utilize that water entirely on his own farm. (2) a small group of water licences may operate joint works in what is known as Water-Users Associations. (3) Irrigation Districts may be formed, by public, co-operative or private groups to bring irrigation waters to a number of individual farmers in a particular area.

II. IRRIGATION IN THE FRASER BASIN

At present, most irrigation undertakings in the Middle Fraser Basin are individual farm or ranch enterprises, where one farmer or company maintains the rights to the water of a particular stream. Water Users Communities are located at Dog Creek and near Alexandria.

The number of acres under irrigation in the Fraser Basin is difficult to determine (Map 27). It does not seem possible that it reaches the proportions suggested in the British Columbia Atlas of Resources the acreage estimated there seems to be an estimate of the acreage for which licences have been granted rather than the actual irrigated acreage. The cartographic symbol in the Atlas at Dog Creek, for example, suggests over 1000 acres are under irrigation, while actually 364 acres are reported to be under irrigation.

103 British Columbia Atlas of Resources, p. 46
104 Census, 1951. Agriculture Part II, Vol. VIII
Extent of Irrigation  The census of 1951 reports that in the South Chilcotin census sub-division, 4,018 acres are under irrigation; in the Clinton sub-division, 4,617 acres are irrigated; while in the Lillooet area, 3,942 acres are irrigated, making a total of 12,577 acres for this southern portion of the Cariboo. In the Quesnel area, 5,214 acres are irrigated while in the North Chilcotin sub-division, 7,224 acres are irrigated, for a total of 12,438 acres in the North Cariboo area. Much of the irrigated land is on the plateau surface, and does not lie within the Fraser Basin itself.

The number of irrigated acres on these farms varies widely. If the total number of farms utilizing irrigation in each subdivision is studied one notes in the South Chilcotin only 18 farms use irrigation, while in the Clinton sub-division 44 farms and ranches have some irrigation. Sixty farms in the Lillooet subdivision, 33 farms in the Quesnel subdivision and 27 farms in North Chilcotin subdivision have some irrigation. The largest acreages per farm are found in the Chilcotin while the smallest are in the Lillooet area.

The ranches in Clinton and South Chilcotin census sub-regions have the largest number of cattle per irrigated acre, while those in the Quesnel and North Chilcotin have half as many. To indicate the wide variation in irrigation use, the number of farms in each census sub-division is
equated to one hundred percent, and the percentage of farms with areas irrigated is plotted on a graph, Figure 14.

III. METHODS OF IRRIGATION

Diversions and Pumps Streams, ponds or wells higher than the land to be irrigated normally operate under gravity flow and are the usual sources of water. A small dam often is constructed to store some water and divert the flow into the irrigation system; but sometimes, where water supply is sufficient the year round, a wing dam may be constructed to divert only a portion of the flow.

Water located below the land to be irrigated must either be pumped onto the land or elevated by some water wheel arrangement. There are both cost and physical limitations on how high water may be pumped. In recent years, 250 feet was believed to be the maximum height but recently the Riverland Irrigated Farm at East Lillooet, has been pumping water some 350 feet above the Fraser. One farmer in the Okanagan Valley pumps water over 500 feet to his highest benches, although the average height pumped for his whole operation would be similar to that of the Riverland Project.105 The types of pumps that can be used, their costs and their efficiency are separate topics in themselves and

PERCENT OF FARMS WITH AREA IRRIGATED
BY CENSUS SUB-DIVISION
1951

FIG. 14
W. G. HARDWICK
Conduits Conduits for irrigation are complex and costly and may tax the skill of the most ingenious engineer in facilitating their construction. The traditional means of transporting water in the Middle Fraser has been in earth ditches. In some places, water is diverted into channels of intermittent streams, but both these methods allow serious water loss through seepage and evaporation. Wooden flumes and wooden pipe conduits are common on other farms.

Many of these long-established irrigation systems, utilizing earth ditches, wooden flumes and other open conduits, have an efficiency of only about 20%. Water loss in conduits and in farm application is becoming less through improved irrigation technology and engineering. Steel, concrete and asbestos-cement pipe are replacing open ditches and flumes in conveying water to the farm. Metal conduits, with plastic or asphalt protective coatings, make transporting of water much more efficient. Although these conduits are initially more expensive to build, they have a long life; and their cost amortized over their extended life is no more annually than the more primitive conduits. Reference to Table XXV, comparing costs over

106 "Sprinkler Irrigation in the Fraser Valley," pamphlet, B.C. Electric Farm Service, Vancouver,

107 The irrigation efficiency is the percentage of water diverted or pumped that is maintained in the root zone of the plant.
thirty years in the Okanagan will illustrate the economy of pipe. In addition, these protected pipes allow higher velocity to be maintained, providing more water in any given period to irrigate more acreage. Pipe allows water to be moved across gently rolling country, a feature not possible for traditional open-faced conduits.

**TABLE XXV**

<table>
<thead>
<tr>
<th>Conduit</th>
<th>Cost per Acre</th>
<th>Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underground pipe</td>
<td>$238</td>
<td>17 years</td>
</tr>
<tr>
<td>Galvanized pipe, etc.</td>
<td>113</td>
<td>30 &quot;</td>
</tr>
<tr>
<td>Wooden rectangle</td>
<td>340</td>
<td>12 &quot;</td>
</tr>
<tr>
<td>Wooden &quot;V&quot; etc.</td>
<td>309</td>
<td>10 &quot;</td>
</tr>
</tbody>
</table>

**Application**

Supplanting the traditional methods of applying irrigation water are sprinklers which offer economies attractive to both farmer and rancher. These are summarized in Table XXVI, following page.

For some crops, sprinkler irrigation is less desirable, because the water may wash insecticides from leaves; or because of heavy foliage it may not be spread evenly across the field. To give efficiency and surface irrigation, several plastic pipes have been developed that issue water

at a constant rate through hundreds of pin points in the pipe. This is a form of controlled furrow irrigation.

TABLE XXVI

COMPARATIVE COSTS OF SPRINKLER AND FURROW IRRIGATION
IN THE OKANAGAN VALLEY

<table>
<thead>
<tr>
<th></th>
<th>Furrow</th>
<th>Gravity Sprinkler</th>
<th>Pumped Sprinkler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of orchards</td>
<td>16</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Average size</td>
<td>10.2</td>
<td>13.1</td>
<td>13.8</td>
</tr>
<tr>
<td>Average investment per acre $</td>
<td>114</td>
<td>131</td>
<td>168</td>
</tr>
<tr>
<td>Average annual cost per acre $</td>
<td>30</td>
<td>22</td>
<td>30</td>
</tr>
<tr>
<td>Man labor per acre (hours)</td>
<td>22</td>
<td>11.4</td>
<td>13.3</td>
</tr>
<tr>
<td>Machine use per acre (hours)</td>
<td>1.1</td>
<td>0.5</td>
<td>0.2</td>
</tr>
</tbody>
</table>

The Riverland Irrigated Farm is completely operated by pipe with a very high irrigation efficiency. Similar methods are utilized on the Earlscourt farm at Lytton. Where in 1951, only one farm reported sprinkler irrigation to the census, in 1957, several farmers in the Laluwissin, Lillooet, Dog Creek and Alexandria-Quesnel districts were using it.

Pumping Irrigation Water

Expansion of agriculture within the Middle Fraser Region depends to some degree on the development of pumping systems to bring irrigation water from rivers or streams to

109 Ferries and Wilcox, op. cit, p. 64
the land. Water, combined with a well-planned farming system, can make the desert and grassland bloom. The "L" Ranch at Hanceville and another one north of Soda Creek have pumped irrigation water for several years; but Riverland, at Lillooet is the first to operate in the Fraser Valley solely from pumped irrigation water. Some of the problems to be faced if pumping irrigation water is to expand are summarized in this paragraph.

The Fraser River is violent. It rises and falls 30 feet or more as freshets come and go. It carries a great load of sand and silt that must not get into the pumps...

A pump house was constructed... Steel piling anchored in rock, was used to make a five by twelve foot well casing. It is 40 feet high... Water enters the bottom of the well through perforated steel pipe two feet in diameter extending 60 feet into the river. A filter of crushed rock and gravel placed over the intake pipe screens out sand and much of the Fraser River's silt.

The pumping plant at Riverland consists of two deep well turbine pumps at the river, 100 horsepower and 125 horsepower... The irrigation system delivers water at a rate of 1600 gallons a minute.\footnote{110}

Fraser River water has a high percentage of silt, which causes extreme wear on the pumping machinery, and considerable care and expense must be undertaken to protect it.\footnote{111}

On the other hand, one farmer south of the Damsite expressed the thought that he would like gravity-fed Fraser

\footnote{110} "Riverland Irrigated Farms," \textit{op. cit}, p. 3
\footnote{111} \textit{Ibid}, p. 7
River water because the silt would do much to replenish the top soils, in the tradition of the Nile and Menam.

The efforts which farmers have expended to bring water to the fertile benches of the Fraser Valley have been considerable. One example of these is illustrated in this account of the Anahim Flats ranch near Hanceville on the Chilcotin, established in 1893.

Water is brought 25 miles from Big Creek into Minton Ck. which flows to the south bank of the Chilcotin River and the supply is there caught by dams and led through a flumed ditch to an eight inch pipe suspended on two cables across the river... and is led through the upper part of the ranch.

The ditch on the south bank of the river is three miles in length and the pipe is 2200 feet in length in the form of an inverted siphon; the carrying cables are 7/8 inch wire and the drop is 400 feet rising again to 360 feet on the north bank... The cost of constructing the pipeline was about $4000 and it presented a difficult engineering problem owing to the sagging of the cables at first under strain. It is noteworthy as the first example of a new form of irrigation work in the country.112

This isolated example is cited to indicate the complexity of the operation of transporting the water to the land, and the ingenuity used by ranchers to solve their problems. Other large undertakings could be cited, such as the transfer of water from Gaspard Creek to the Gang Ranch, the use of Pavilion Creek on the old Carson Ranch and the early electric pumping arrangement on the Boston Flats Ranch

112 Boam, op. cit. p. 407
near Ashcroft. This imagination and ingenuity shown by pioneer ranchers in solving conveyance problems, are not in evidence at present, for many of these operations are in disrepair or even have been abandoned. Perhaps present technology, plus the ingenuity and perserverence of the early settlers will both be needed to transform these many remaining benches and valleys into productive agricultural regions.

Considerations in the Expansion of Irrigation Agriculture

Some statements drawn from the reports of the Prairie Farm Rehabilitation Act engineers concerning several studies of the Fraser and Thompson Valleys for the Fraser River Board that are apt in this study of Irrigation in British Columbia. These pertain to the cost of irrigation.

Of course, before any definite costs of construction or annual operating costs could be estimated, surveys of the physical and economic features would be carefully undertaken. But for a rough guide, based on British Columbia costs, the Fraser River Board estimates that capital costs of instituting irrigation run from $175.00 to $300.00 per acre. Present energy costs for pumping irrigation water are $4.00 to $4.50 per horsepower month. Several other economic factors need consideration.


114 Ibid, p. 102
The cost of land must be low if irrigation is to be successful. The combined capital costs of land and irrigation works must be such that payments on capital expenditures may be made and still allow the farmer sufficient returns from the sale of produce to operate the farm and give a margin of profit.

Related to this is the need for reliable markets for the products of the land to ensure reasonable income to pay the fixed costs.

The depth of water applied for optimum profit may be lower than the optimum water requirements, as yields of some crops often increase slowly as increased water depth approach their optimum. These are some of the factors of an economic nature that enter into the irrigation picture.

In Summary

Irrigation is found in many areas in British Columbia. Technical advances have been made in recent years and adopted particularly in the Okanagan. Expansion of irrigation acreage is possible in the Middle Fraser Region, but as suggested in the preceding pages, the problems to overcome are many.

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PART III

The Middle Fraser Region is too large an area for a detailed discussion of the effects of the Moran Dam proposal on agriculture. It seems desirable to break the Region into smaller sub-regions, within which particular aspects of the problem can be examined.

In the following chapters, the basis upon which the report is sub-divided is discussed, followed by three chapters dealing with sub-divisions of the Middle Fraser Region. Two further chapters deal with the effect of Moran Dam on the adjacent regions.

Two concluding chapters discuss the problems of agricultural expansion and give a summary of the thesis.
CHAPTER VII

EFFECT OF MORAN ON AGRICULTURE IN
VARIOUS AREAS OF THE FRASER BASIN

The ribbon-like distribution of agricultural locations, their north-south orientation and altitudinal range, account for the variations in climate, soils, vegetation and crop type, that we have seen do exist. The human patterns and activities also lack homogeneity. In addition, the Moran proposal will not have uniform effects on the whole Region. This lack of uniformity supplemented by variations in the physical and cultural patterns form the basis for this sub-regional breakdown. (Map 28).

Sub-division I

A major division of the region occurs at the site of the Moran Dam, for south of the dam no flooding will take place, and north of it extensive flooding will occur. Within the area south of the damsite several physical and cultural features have a degree of homogeneity. The climate is characterized by a long, warm growing season with a minimum of precipitation. Dark Brown soils are found in most agricultural regions, which are located on benches of relatively low elevation. Tomatoes, apples and certain vegetable crops are grown only in this sub-region of the Fraser Basin.
MIDDLE FRASER REGION

SUB-REGIONS

I  LYTTON - MORAN

II  MORAN - WILLIAMS LAKE

III  WILLIAMS LAKE - QUESNEL

30 MILES TO 1 INCH

MILES

CHILCOTIN

THOMPSON

MAP 28  W. G. HARDWICK
The marketing of the farm products below Moran dam-site is centralized, and transportation routes which link the towns and farms end near Moran. The highway, which follows the Fraser between Lytton and Pavilion, turns east at Pavilion to the Clinton region on the plateau. The P.G.E. Railway, which enters the region at Lillooet, leaves it again at Kelley Creek near Moran. These physical and cultural factors are the basis for recognizing the Lytton-Moran area as a sub-region of the Middle Fraser.

Sub-division 2 and 3

When the dam at Moran is constructed, the level of the river will rise to form a reservoir 175 miles long with an elevation of approximately 1540 feet.

Flooding north of the dam will change the appearance of the landscape of the area from Moran to Quesnel. However, a look at the physical and cultural patterns of the area will indicate that this area does not have the homogeneity of the area south of Moran, and the recognition of two sub-regions is desirable.

Soda Creek is generally recognized as the northern boundary of the "dry belt" and around this settlement the transition from the grassland to forest cover takes place. The Thin Black soil of the grassland and parkland near Soda Creek blend into the Grey Wooded forest soils of the north.

116 Chapman, op. cit., p. 23.
Near Williams Lake the valley of the Fraser enters the deep valley that characterizes the river as far south as Fountain while above the Williams Lake area, the valley as well as being nearer the surface of the plateau, widens to two to four miles.

Human geographical factors indicate the advisability of dividing the region north of Moran into two sub-regions. The transportation routes that cross the plateau as far as fifty miles east of the Fraser north of Clinton return to the river near the mouth of Williams Lake River. North of here the characteristic ribbon pattern of small farms and villages along the highway and railway that exist south of the Moran damsite are in evidence. This pattern is in contrast to the scattered locations of large ranches and the absence of villages in the Middle Fraser area between Williams Lake and Moran.

Although general flooding will be characteristic from Moran to Quesnel, the physical features and cultural factors, described indicate the advisability of recognizing two sub-divisions. The first of these subdivisions, is from Moran to Williams Lake River, whereas the second sub-division will extend from the Williams Lake River to Quesnel.

Other Regions

While the development of cheap electric power at Moran will be of secondary importance to the regions along
the Fraser, cheap power for pumping irrigation water will be of great significance to two areas outside the Middle Fraser Basin. These are the Thompson River Valley, west of Kamloops Lake, which is within short transmission distances of Moran, and the plateau regions of the Chilcotin and Cariboo. These cannot be included within the physically-defined region, or those regions affected by alterations in the level of the river; but cheap power for pumping agriculture will be nonetheless important in altering the character of these regions. They will be discussed in two sections entitled, "adjacent regions".

Low cost power will make possible the more economic pumping of irrigation water in the North and South Thompson River Valleys, in the Okanagan and to some degree in the Lower Fraser Valley. These areas are noted here, but not discussed in detail as agriculture is at present well developed, and low cost power will permit an expansion of established agricultural patterns.
CHAPTER VIII

SUB-DIVISION #1 - LYTTON TO MORAN

The settlements which occupy the Fraser Valley between the Moran site and the town of Lytton, at the confluence of the Fraser and Thompson Rivers, lie in a deep valley flanked on the west by a division of the Coast Mountains, - the Lillooet Range, and on the east by the high dissected plateau. In this valley, averaging one to five miles in width, terraces and fans form a nearly continuous series of benches on both banks. It is upon these benches, ranging in width from a few feet to about two miles, that intensive agriculture takes place.

I. PHYSICAL GEOGRAPHY OF THE LYTTON MORAN SUB-REGION

Landforms The benches have their origin chiefly as either fans or former glacial lake bottoms. Fans are highly developed and are found on both sides of the valley as benches from two to six hundred feet above the present river level. Tributary streams have cut into the fans creating large gullies, and continued erosion over the centuries has gullied the river-facing cliffs, especially those that are steep and have no vegetation cover.

117 See Map 29.
A glacial lake in the vicinity of Lillooet was in existence in Pleistocene times and parallel layers of silts and gravels were laid down forming the present benches on either side of the river. These benches are characterized by their near-level surface and the horizontal layers of material which are exposed in road cuts and on the cliff along the river.

It is believed that near Fountain a block in the Fraser caused similar depositing of layers of unconsolidated material, which created the benches some 300 to 800 feet above the present river level. However, the clearing out of tributary valleys with the retreat of the glaciers caused fans to cover parts or all of the existing terraces. As a result one can see level benches stretching back from the river for a few hundred feet, then sloping gradually up towards the mouth of a valley in the plateau behind.

**Climate** As this sub-region is located in the rain shadow of the Coast Mountains and is characterized by a long growing season with warm summer temperatures, it is entirely a water deficient region. Irrigation must be undertaken if any intensive agriculture is to take place.

**Soils** Soils are deep in most of this sub-region, ranging from 1 to 4 feet in depth. They are classed as Dark Brown soils; but Thin Black soils are found in some locations. As the average annual rainfall ranges from 7 to 15 inches in
the sub-region, very little leaching has taken place and the soil is very fertile. Some benches have a gravel base for their soils whereas many of the fans have clay and silt bases. As a result considerable differences in the water retention qualities of the soil are found. The porous soils on benches in East Lillooet, have water retention estimated to be about three inches. In other areas in the sub-region, the retention is about four inches. This variation in the water retention ability of the soil is indicated in the distribution of grassland and parkland. The ponderosa pine, the most common tree in the area, grows on lands which retain more water.

II. AGRICULTURE AREAS IN LYTTON-MORAN SUB-REGIONS

Agriculture in this sub-region takes place in a number of locations dependent upon soil and climate plus the availability of sufficient water supplies. The streams that enter the Fraser from the west have adequate year-round flows. Some, such as the Stein River and Texas Creek, have sufficient water to supply more land than is available. On the east, many of the streams from the elevated plateau are intermittent, because the plateau does not receive nor retain sufficient moisture to maintain year-round flow. A few streams have large enough drainage basins and sometimes a small lake reservoir which help maintain a year-round flow. On some streams the construction of small storage dams has allowed a number of farms to exist.
In general, the farms and ranches in this sub-region are grouped as shown in Map 30, due to one or more of the factors described in the previous section, and are separated by non-agricultural areas.

Lytton is located in one of these agricultural areas. Several farms are situated on various benches on both sides of the Fraser and Thompson Rivers. Most are part-time or subsistence farms on Indian Reserves, but a few are commercial farms and ranches. The benches on the east are generally quite high above the water and receive inadequate water supplies from nearby streams. Others, particularly on the west bank, are well-irrigated from streams like the Stein River. More annual rainfall occurs in this area than elsewhere in the sub-region, with the maximum coming in the winter. Winter temperatures are moderated by flows of moist Pacific air up the Fraser Valley. However, summer temperatures are warm, the average for July being over 71 degrees.

A second area of farms and ranches is along the east bank of the Fraser, midway between Lillooet and Lytton. A combination of mile-wide fans and fair-sized tributary streams allowed a number of quarter-section farms to be located here. Foster Bar, Laluwissin and Cinquefoil Creeks are the most important tributaries utilized for irrigation. Considerable acreage in this area remains in grass and ponderosa pine as the water sources are not adequate to irrigate all the available land. The rainfall is perhaps
the lowest in the province. This section will be referred to as "Laluwissin area" in the remaining chapter.

From Foster Bar to near Lillooet, on the west bank of the Fraser, lie a series of broken benches on which considerable agriculture takes place. At the mouth of Texas Creek a fan occurs, but most of the benches seem remnants of larger glacial landforms which crossed the river. Many benches are very narrow, and farmers must utilize terraces at various levels above the river to get adequate arable acreage. Precipitation in this area is more reliable than in the Laluwissin area to the south, and the soils are heavier, in some places being clay loams. Vegetation is dense, and on many of the farms now in existence, considerable clearing was necessary.

East and west Lillooet comprise a fourth area of agriculture. The farming areas are located on level benches at various heights above the Fraser, and in most cases are covered with grass or light pine groves. The East Lillooet area has no year-round streams crossing it and two springs are believed to be the only sources of water available. On the other hand, Seton and Cayoose Creeks cut through the benches on the Lillooet side, and some small streams flow from the Coast Mountains behind the town. This region has a very long growing season (over 180 frost free days) and warm (71 degrees July mean) summer temperatures.
The last section is a complex of fans and benches high above the Fraser between Fountain and Pavilion Ferry. Most of the benches are from 400 to 800 feet above the river, and when fed water from streams like Fountain, Sallus and Pavilion Creeks, they become very productive. Tree cover is absent from most of this area; and summer temperatures are warm. The growing season is long and the precipitation similar to Lillooet.

III. CROPS IN LYTON-MORAN SUB-REGION

The Lytton-Moran region, when prudently farmed, is very productive. Cultivated hay and alfalfa are grown in all five agricultural areas. Most farmers report three crops per year, and one reports that four are possible in the "good" years. The soil is very fertile in the valley and some farmers point to where crops have been removed every year for nearly a century. The first farm, at Lytton, was established in 1859.

Although most acreage is in alfalfa, cultivated hay, grain crops are grown for local use. Cash crops have been few because of transportation and marketing problems, but two in particular stand out: tomatoes and potatoes. Tomatoes are an important crop; yields are high, and the quality is such that premium prices have been paid. Potato yields of from 10 to 15 tons per acre are reported. Apple orchards are maintained in all areas of this sub-region, and apples are
marketed through the Lillooet-Co-operative Growers Association. Peas, seed crops, beans, corn, cucumbers and watermelon are grown, and alfalfa seed in particular is a major source of income for some farms. Peaches and grapes have been grown in the south, but few of the field crops or fruits have been marketed outside the local villages themselves.

Around Lytton, most farms grow cultivated hay and alfalfa or vegetables for local use. Earls court Farm, the first farm established in the area, now owned by the Spencer family, grows excellent crops of alfalfa under a sprinkler-type irrigation system. It was one of the first operations in the region to use sprinklers. Some of the finest show beef in Canada are produced on this Farm. In the Laluwissin Creek area, several ranches raise forage crops, seed, tomatoes and potatoes. South of Lillooet, on the west bank, farms of from 10 to 400 acres in size, most with about one-third of their area under irrigation, produce tomatoes, cucumbers, potatoes and apples, along with hay for cattle, sheep and poultry. At East Lillooet, Riverland Irrigated Farms Limited has about 160 acres in alfalfa and a mixture of grasses to feed cattle kept in pens, in the tradition of "feed lot" operations. A small area is under cultivation south of Seton Creek near the power house, from which energy for the electrically-operated pumps is obtained.
The irrigated pastures near Fountain are mostly maintained by the Indians of the area, and one large old ranch was purchased by the Indian Department for the Indians a few years ago. Unfortunately, much of the area is inefficiently irrigated, and the land does not produce what it could under wise management. North of Sallus Creek, the lands are under the control of Spencer's Diamond "S" Ranch, which raises forage crops for winter feed for the cattle ranged on the main ranch on Pavilion Mountain.

IV. AGRICULTURAL DEVELOPMENT

The whole sub-region has had a more or less "boom or bust" economy based on fluctuations of markets and transportation routes. The first gold bars discovered on the upper river were in this area, and Lillooet became the initial center for gold panning. Much of the land in the area was taken up during this period, and crops produced made up "grub stakes" for miners. With the transfer of the start of the Trail to Yale, Lillooet lost much of its importance, but a road did pass through the valley.

Hope was raised that the railway from the Cariboo to the Coast would enable the area to tap the coast markets. However, when the Pacific Great Eastern Railway was built, it ended in Squamish and the barge service to Vancouver made the trip too long and too expensive for transporting
fruit and vegetables. The railway did, however, allow cattle to be more easily marketed, and drives to the coast through the Lillooet and Harrison valley were no longer needed. Extension to North Vancouver in 1957 improved marketing by inaugurating less than 24 hour service.

During World War II, a number of Japanese were moved into the area. They leased land on the benches in East Lillooet and north of the town, and raised large crops of tomatoes, which they marketed through the cannery established in the town of Lillooet. At the end of the war, the Japanese returned to the coast, and the cannery, through reported mismanagement, was forced to close. Large hydro-electric developments in the area after World War II attracted many men off the farms for good paying construction jobs, and agriculture reached the most depressed state in nearly a century. In the summer and fall of 1957, eight producers were reported marketing their fruit and vegetable crops through the re-organized Lillooet Co-operative Growers Association, a non-profit organization operated by a local resident. Tomatoes sold on the Vancouver market at a premium, and the manager of the Co-op produced invoices showing a price of $2.15¹¹⁸ per case for tomatoes shipped out over the Pacific Great Eastern Railway. Even with premium prices, few acres are under cultivation. Potatoes, apples, cucumbers and vegetables sold in Vancouver and the northern Cariboo towns. Further expansion of the acreage under cultivation is expected even though the only

¹¹⁸ As compared with the Okanagan price of $1.85
dairy farm in the area closed recently. The land seems to produce good crops even where farm methods seem most primitive.

Land in this valley is valued at about $100 per acre if water is available, and very little per acre if no water is available. A number of ranches are for sale; most of the others are by no means in commercial operation. Those ranches that are run efficiently are reported financially sound. Part-time workers from the native Indian population are available for harvesting crops.

V. MORAN DAM AND LYTTON-MORAN SUB-REGION

The construction of Moran Dam would have considerable effect on this region in providing gravity-fed water, cheap power, and a small market for locally grown products. Any industries that located near the dam site to benefit from the cheap power, would of course increase the population of the area, and in addition utilize fresh milk, fruit and vegetables.

In particular, water fed through a gravity irrigation system could irrigate the series of benches from Moran to Sallus Creek, which lie below 1500 feet, and make available the presently utilized streams for irrigating the series of fans behind the benches, which now go unused. In addition, only about one-half the available acreage in this area is
under irrigation, and this additional area could be further utilized. If desirable, the conveyance system could be extended to the Fountain Range, about 15 miles from the dam. In the Pavilion-Sallus Creek area, about 3,000 acres could be utilized along with 700 acres more in the Fountain area. Across the Fraser, a series of terraces that are linked to the second sub-region, could have similar gravity fed water.

Cheap electric power will aid in the establishment of more pumping irrigation water for agriculture in the Lillooet area, as considerable acreage is not presently utilized. For the area south of Lillooet, the Prairie Farm Rehabilitation Act report on pumping agriculture had this to say:

Because of the abundant supply of gravity water in the area between Lillooet and Lytton, and the small area of probable agricultural land available, it would not be particularly a necessity to supplant this cheap water supply for irrigation purposes for any of the lands in this area.\textsuperscript{119}

This is very true for the lands on the western bank of the Fraser, but hardly true for the Laluissin area, where the present agricultural land could be doubled if water were pumped cheaply. However it is too high for the present application of such water, and would likely have to await further technical improvements in pumps. The north Lytton area also would benefit from cheap power for pumping.

\textsuperscript{119} "Fraser River Reconnaissance Survey, Pumping Irrigation Possibilities, Williams Lake to Lytton," Prairie Farm Rehabilitation Act, Water Development Board Report No. I Department of Agriculture, (Ottawa, 1952)
VI. POSITION OF THE REGION WITH RESPECT TO FUTURE DEVELOPMENT

In 1957, the agricultural production of this sub-region was slight, with only a few hundred boxes of tomatoes and apples being sold in Vancouver, a few tons of potatoes being marketed in the Cariboo towns, and only beef from a half dozen ranches adding substantial cash income to farmers and ranchers.

Moran Dam will likely aid in the area by doubling or more than doubling the present acreage available for cultivation, and making existing improved land more productive in the following ways:

(1) The Lytton-Moran sub-region, in terms of climate and soil, is very similar to southern Okanagan Valley, a highly productive, intensive agricultural region. Past and present production by progressive farmers in this sub-region indicates a similar degree of concentration can be maintained on the Fraser as in the Okanagan. Shipments of tomatoes, potatoes, apples and cucumbers to Vancouver in the fall of 1957, over the newly completed P.G.E., although small indicated an expanded business may develop in the near future.

(2) The acreage available in the Lytton-Moran sub-region indicates that each of the five farming areas will correspond in acreage with irrigation districts in the Okanagan. For example, 3418 acres at Summerland compares with 3000 acres in Pavilion-Sallus Creek area. Similarly 860 acres now
irrigated in the Laluwissin area can be compared with 916 acres at Naramata. As the Okanagan areas are large enough in size to support crop marketing agencies, these areas along the Fraser should have similar success.

(3) This sub-region when related to the Vancouver Metropolitan district, as on Map 31, indicates that it is the closest large agricultural area outside the Lower Fraser Valley. By rail, the distance between Lytton and Vancouver is 160 miles, while Lillooet on the P.G.E. is 147 miles by rail from North Vancouver. Paved highways, of Trans-Canada standards, will soon link Vancouver with Lytton, allowing the 167 miles to be travelled in less than five hours. Pave­ment will soon reach Lillooet, 200 road miles from Vancouver, as compared with 250 miles to the south Okanagan. Overnight deliveries of fresh vegetables and fruits to Vancouver area is a distinct possibility.

(4) Urban encroachment on the dairy lands of the Lower Fraser Valley will necessitate an increase in the number of dairy cattle per acre kept in the Lower Valley, and require importation of hay and other forage crops. The Lytton-Moran sub-region could easily produce these crops if farm extension takes place, and be within a 100-mile delivery radius of the Lower Fraser Valley.

(5) The introduction of rural electrification to this area would bring the conveniences of the towns to the
farms, and no doubt attract enterprising farmers to the region.

(6) Electric power could also make possible the establishment of quick freezing plants, where the processing of farm products, not marketed as fresh fruits and vegetables, could take place.

The crops that will be produced will no doubt be those that will bring the greatest return; but field crops, small fruits and vegetables for the growing metropolitan market, appear a fairly probable development. In addition, "feed lot" type cattle farms are a distinct possibility for the region. It appears economical and a good use for the land to raise cattle by "feed lot" methods.

However, regardless of the type of land use, large quantities of capital will be required for the construction and maintenance of irrigation works. It is doubtful if farmers themselves can make such outlays, unless the farmer is a large corporation or a wealthy citizen. This sub-region will only be developed to its ultimate capacity for small-scale farmers with the aid of careful planning.
CHAPTER IX

SUB-REGION #2 - MORAN TO WILLIAMS LAKE RIVER

I. THE PHYSICAL GEOGRAPHY OF THE SUB-REGION

Landforms  Just north of Williams Lake River, the Fraser River enters a deep valley 500 to 2000 feet in depth, which extends south in varying widths to near Pavilion. Terrace formations are found throughout the whole length of this sub-region and at the mouths of tributary valleys, fans have developed. A large basin on the west bank between Churn and Gaspard Creeks, on which are the 2000 to 3000 foot elevation ranges of the Gang Ranch, perhaps was a large meltwater channel. 121

In many places, the rapid down-cutting of the river has left only small benches, and in other regions no benches whatever. Those that are in existence are chiefly on the east bank of the river and lie about 500 feet above it. Above this elevation a rapid rise takes place to the rim of the plateau. Near the confluence of the Fraser and Chilcotin the valley is quite wide. There tier upon tier of "broad sweeping terraces, often assuming fantastic shapes, rise hundreds of feet from the torrent below to the rolling up-

120 See Map 32, Sub-Region #2

land, a thousand or more feet above.\textsuperscript{122}

**Climate** The sub-region is a transition climatic zone. To the south is the deep valley area which, because of its warm summer temperatures, has been classified as a mid-latitude steppe. To the north, humid continental conditions prevail, and within this sub-region these two climatic types merge. Perhaps the difference in elevation between the river and the plateau, 2,000 feet in many places, is particularly significant to the climate of selected valleys and benches.

If a generalization is permissible, one could say that the humid continental climate of the northern sub-region extends far south in this sub-region on the plateau surface, whereas the warm arid climate of the "dry belt" southern sub-region extends far north in the valley locations. The tributary valleys become the transition zones. Unfortunately, few weather records are kept within the sub-region. Dog Creek, (3370 feet) and Pavilion Mountain (3500 feet), have similar mean annual precipitation, precipitation distribution through the year, mean temperatures and frost-free periods. These stations, both on the plateau, are near the northern and southern ends of this sub-region respectively. In the valley itself, no records are kept but from tributary valleys, the rain gauge at Alkali Lake and the weather stations at

\textsuperscript{122} Weir, \textit{op. cit.}, p. 8
Williams Lake provide useful data. Other observations come from verbal reports.

The aridity of the area is apparent by the complete lack of trees within the valley itself, suggesting that the valley is in the rain shadow of the high western Chilcotin plateau. In the deep valley sage brush is in evidence, but on higher benches, grasses are all that grow. Whereas summer frosts are possible on the high plateau, they are unknown in the valley. In the Big Bar Creek area, climatic conditions reportedly approximate those of Lillooet, with very hot summer temperatures. However, lower minimum winter temperatures are experienced than at Lillooet. In the northern part of the sub-region, the elevation of the benches increases, the growing season is shorter, and the mean temperatures lower. The whole sub-region is water deficient, and irrigation must be undertaken if intensive agriculture is to take place. However, on the high plateau dry farming may be successful as more rainfall and lower temperatures cause greater water retention.

Soils The soils on the low benches are Dark Brown, while on the upper benches and tributary valleys they are classified as Thin Black. Many of the soils are silts with the consistency of flour, while others are sandy. In fact, on some benches north of Canoe Creek sand dunes are in evidence. None of the soils in the area retains very much moisture because they are underlain with gravels.
II. DISTRIBUTION OF AGRICULTURAL AREAS

In 1957, the cultivated lands were found chiefly in the valleys tributary to the Fraser, the only places where sufficient water is to be found (Map 33). These streams are not numerous because precipitation on the plateau is light. Only those streams that have their headwaters far west in the Coast Mountains have significant year-round flows. A half dozen streams on the east bank have sufficient water to allow irrigation, a dozen streams on the west could permit irrigation agriculture except that very little land is available.

Several agricultural areas can be recognized. One of significance is that near Big Bar Creek and High Bar. The few hundred acres under cultivation are dependent for water on the Big Bar Creek and by damming intermittent streams on the plateau. The benches at the mouth of the Creek, the valley itself, and a narrow bench stretching south along the Fraser to High Bar, are the locations for agriculture.

Another agricultural area exists on the west bank at the mouths of Watson Bar and Ward Creeks. At Canoe Creek, a third area of intensive agriculture fills the lower reaches of the valley and spills out onto one bench of the Fraser. Across the Fraser, Coster and Grinder Creeks are utilized by the Empire Valley Cattle Company.
The headquarters of the Gang Ranch is located between Churn and Gaspard Creeks and from the latter water is diverted to irrigate considerable acreage on the rolling surface of the basin. Ranches are found in the valleys of Dog Creek, Meason Creek and Alkali Creek. North of Alkali Lake, several small irrigated pastures are related to a larger ranch on the plateau some miles away.

III. AGRICULTURAL ACTIVITIES IN MORAN-WILLIAMS LAKE REGION

Three types of agricultural operations are found in this sub-region. One type is the irrigated pasture of large ranching companies; the other types are subsistence and part-time farm operations. These latter farms are of similar size, but one is operated for a livelihood, while the other is cultivated when the owner is not working on a large nearby ranch or as a guide.

Land under cultivation in the Big Bar Creek area is very productive. Three crops of alfalfa, as well as vegetables, potatoes and small fruits for local use are reported. Mulberry trees have been growing for many years on one ranch. Most acreage is utilized for growing winter feed for the cattle of the two large ranches, the Cromie and O.K., and for several small ranches in the area. The valley has several subsistence and part-time farmers who, according to the voters' list, are ranch hands or guides for big game
hunters west of the Fraser. In 1957, the Cromie Ranch was not under crop, except for a small area reported under lease. One rancher reportedly markets produce and potatoes to residents on the plateau at Jesmond. Products of this agricultural area are not marketed in the towns of the Cariboo or the Lower Fraser Valley because the road from Big Bar to Clinton via Jesmond is considered too long a haul by the local residents. On the west side of the river, the area around Watson Bar and Ward Creeks is under irrigation for alfalfa, vegetables, and reportedly, apples. This farming area is reached by ferry across the river, and is even more inaccessible to markets.

Between Big Bar Creek and Canoe Creek, no stream gives adequate year-round flow except Crow's Bar. The land through this presently non-irrigable area is maintained as winter range by the Gang Ranch and the Canoe Creek Ranch for it has very little snow in winter.

At Canoe Creek, nearly 400 acres are irrigated. Alfalfa is the chief crop averaging over 1 1/2 tons per acre on the first crop maturing in early July, and one ton on the second crop maturing in late August. Potatoes, tomatoes, sweet corn, vegetables, small fruits, and as many as three crops of alfalfa in good years, are grown on the eighty-acre area on a bench of the Fraser about two miles from the main ranch.
The Gang Ranch is the largest ranch in the region. Its proprietors own some 50,000 acres outright and control a million acres under grazing permit and lease. This ranch was established by the Harper Brothers in 1833. Irrigated farm land, where winter feed was grown for up to 11,000 head of cattle, was established. Furrow type irrigation is practised and the water is brought long distances in flumes and channels of intermittent streams.

At Dog Creek, irrigation agriculture has taken place since the early 1860's. In 1912, a ranch of 7500 acres was reported with 600 acres under irrigation. In 1957, some 364 acres of a potential 445 acres were under irrigation producing forage crops. On the plateau above Dog Creek the large Circle "S" Ranch of the Spencer family maintains considerable irrigated hay land.

123 Marketing cattle has been a problem at times. The attempts to meet the problem have been spectacular at times. In one case, Thaddeus Harper, owner of Gang Ranch, was left with a large number of cattle and nowhere to market them in the Cariboo. As a remedy, he decided to drive them to Salt Lake City, the nearest Railway and ship them to Chicago. Arriving in Idaho, he learned that the market had fallen in Chicago, and that it would not be profitable to continue. Turning west he planned to return to the Cariboo when news of a drought in California was reported. So he drove the British Columbia cattle to San Francisco instead where a substantial profit is reported to have been made.


One ranch utilizing Meason Creek, in 1893 controlled 11,000 acres, stretching eight miles along the Fraser. Partial irrigation from pools and springs covered 3,000 acres of this but 300 acres of intensive cultivation was maintained on the warm bottom land. 125

The Alkali Lake Ranch is similar in many ways to the Canoe Creek Ranch in that substantial land in the valley at about 2500 feet is under intensive cultivation while a reported 25,000 acres on the plateau extending some eleven miles along the Fraser, are in fenced natural range.

A few acres at Sword Creek and Doc English Gulch, are or were, irrigated plus small areas along the highway north of Chilcotin Bridge.

IV. MORAN AND SUB-REGION MORAN TO WILLIAMS LAKE RIVER

The Moran Dam will affect this region in two main ways:

(1) The dam will cause the Fraser River to flood all lands that lie below the 1540 foot contour. This will mean the river level will rise about 740 feet at the dam site, over 400 feet at the mouth of the Chilcotin River, and some 200 feet at Soda Creek. 126

(2) The dam will supply electric power which, if transmitted north, would supply cheap power for pumping

125 Boäm, op. cit. p. 401
126 See Map 34 SUB REGION II, AFTER FLOODING
irrigation water from the reservoir to the land.

From a superficial view, the flooding of land would indicate great losses in the arable acreage available for agriculture in the province, but this is only partly true for the banks of the Fraser in this sub-region rise very rapidly. In many areas therefore the flooding will take place only within these steep walls and no land of any present commercial value will be flooded, as indicated on the profiles in Chapter III.

However, in the southern sections particularly the water will rise so high that some fertile terraces will be inundated, particularly irrigated pastures at the mouths of Big Bar and Watson Bar Creeks. This will be a major loss to the existing agricultural acreage both in that Big Bar and Watson Bar Creeks are excellent areas for growing alfalfa, but also in that both are at such an altitude that an expansion of vegetable and fruit crops is possible if transportation were improved. Secondly, several benches used for winter pasture but presently unavailable for intensive agriculture will be flooded. These ranges are in the Deadman Creek and Crow's Bar area south of Canoe Creek, the Churn Creek Bridge area on the east side of the river, around French Bar Creek¹²⁷ and the Gang Ranch on the west. Although this is not presently arable land, it is significant

¹²⁷ A plan to subdivide the old ranch north of French Bar Creek is reported in the Surveyors Report in the 1954 Department of Lands Annual Report, p. CC 53.
MORAN-WILLIAMS LAKE SUB-REGION
AGRICULTURAL AREAS AFTER FLOODING AND SIZE OF MORAN RESERVOIR

MAP 34
W. G. HARDWICK
winter range. It includes over 1000 acres near Deadman Creek and 500 acres each in the other three locations.

On the credit side, there will be large areas, presently only available for grazing, which will be able to make the transition to intensive agriculture with the application of water pumped from the Fraser Reservoir.

One area that will become available is some 2000 acres immediately adjacent to the Moran Dam itself. This high bench, now nearly 900 feet above the river, has long been recognized as an area of potential agriculture; but a most primitive aerial ferry at Pavilion has permitted only the smallest use of the land to be made. The surveyor for the Department of Lands in Victoria in 1917 reported that the "soil is excellent, 18" to 24" deep on a gravel subsoil, capable of producing four crops of alfalfa in one season, excellent beans and other vegetable crops." Although four crops may be exceptional, three are common, according to the residents.

Some higher benches in the Watson Bar and Big Bar Creek areas will be unaffected by the flooding and will no doubt, with a more reliable source of water, increase production.

Perhaps the largest tract that could come under cultivation is located on the benches that stretch along the

east side of the Fraser from China Gulch to the Churn Creek Bridge. It is described by the surveyor as follows:

It is bordered on the east by a vertical precipice about three hundred feet high, of basaltic formation, which makes fencing along this side unnecessary; and on the west by the Fraser River. The whole area is practically treeless and has a steep slope to the river... near the river the slope flattens out into a most remarkable series of benches, which, but for the absence of water, would form an area of enormous productivity. The benches are separated by numerous deep ravines... snow hardly ever lies in winter...

Soil is a foot or more in depth, of a very fine river silt almost the consistency of flour, and underlying this is gravel such as is found in a river bed...

All this area is covered with bunch grass and wormwood and is singularly free from sage brush... owing probably to the fact that it is just at too high an altitude for this plant to survive....

Using a pumping height of 350 feet or more, as demonstrated at the Riverland Irrigated Farm, and a base level of 1500 feet for the water, about 3380 acres south of Canoe Creek and about 3200 acres north of Canoe Creek could be made available to intensive agriculture.

A large tract of land at the mouth of French Bar Creek could be developed if transportation were made available. Significant acreage is available on Gang Ranch property for increased intensive agriculture, but it is believed that waters of Churn and Gaspard Creeks could supply

129 G.M. Downton, Survey Branch Division, Department of Lands Annual Report, (Victoria, Dec 2, 1923).
adequate gravity-fed water. 130

Near Harper, Meason and Word Creeks, areas of some 400 acres each might be brought under intensive cultivation.

There are several other benches that, because of ravines or cliffs, are too small for community water development but which could be exploited by individual farmers with enough capital to instal pipes and pumping apparatus.

Altogether there are over 18,000 acres that could be brought under intensive agriculture with the aid of pumping in this sub-region. In a few places, the land within the tributary valleys could be used more intensely, using gravity fed water no longer needed on the lower terraces. This would be true in Big Bar Creek particularly.

Two problems are recognized as far as flooding and pumping are concerned. One is wave action following the flooding and creation of a large reservoir, could cause considerable erosion in the steep bench sides. Rough water could erode sandy cliffs free of significant vegetation quickly. In addition, water-logging of adjacent shores caused by the raising of the river level would increase the possibility of serious mud slides which could remove altogether some agricultural land.

130 The possible use of tributary streams for irrigation is recognized by the P.F.R.A. Report to the Fraser River Board. A recommendation for future studies into the flow of these streams is included in their 1952 report. op. cit. p. 100.
Secondly, to maintain a constant flow through the dam, the height of the reservoir will be reduced in the winter low-water period and built up in the flood season. Fortunately, the water deficit does not appear until June in most of this sub-region, so it is hoped a level of 1500 feet could be maintained in the growing season for pumping irrigation water. However, in dry years, when irrigable water is particularly needed, the reservoir water level could be conceivably lower and upper pastures therefore left without water.

V. POSITION OF THIS REGION AS TO FUTURE DEVELOPMENT

(1) This sub-region is generally inaccessible to the markets of the province because of distance, poor roads, few bridges and limited scheduled freight or passenger services. Whereas in the 1890's places like Alkali Lake, Dog Creek and Big Bar Creek gave their names to federal census areas, in 1957 they are relatively unknown agriculture areas far to the west of the growing Cariboo. This isolation has given a peculiar character to the residents of the area, perhaps one indicating inertia or apathy to change or even of backwardness; unless this character is changed, little agricultural progress can be expected.

131 See Map 35.
(2) Much of the region is controlled by several large ranching organizations through outright ownership or by grazing land lease. These organizations prosper through extensive use of the land. This problem is characteristic of the region, and was recognized as far back as 1921, when surveyor G.M. Downton wrote,

The state of development at which this area has now arrived is that at which practically no crown land suitable for settlement remains. No subdivision of the crown grants has yet taken place, and there is apparently no move at present in this direction.

There is greater reluctance on the part of any property owner to subdivide or sell at reasonable prices any areas under cultivation.\[132\]

This practice has worsened with the consolidation of many holdings and through purchase of homesteads that were being sold. In 1956, in the southern section of this sub-region, there were only 22 farms or ranches. The extent of alienated land is indicated on Map 36.

(3) Related to these first two problems is the situation where the large ranches are operated by absentee landowners. In 1957, several large ranches are in partial operation. Buildings and irrigation ditches are in disrepair, due to mis-management or lack of interest by the parties concerned.

This is a region with a great potential as an agricultural area for the growing of forage crops, vegetables

\[132\] "Abstracts", op. cit., p. 93
ALIENATED LAND
GENERALIZED FROM PRE-EMPTOR MAPS AND 'BONAPARTE' 4-MILE SHEET

- ONE SQUARE MILE
- 30 MILES TO 1 INCH

MILES

MAP 36

W.G. HARDWICK
and grains. Several statements in the Transactions of the British Columbia Natural Resources Conference, indicate that the number of cattle ranged in the Cariboo is restricted only by the winter feed. With a large potential area of irrigable land available through pumping irrigation, it is expected that it could be increased significantly. The commercial production of vegetables and small fruits has greatest chance of success in the south, for only there would transportation costs be comparable to elsewhere in the Middle Fraser Basin.

(4) The southern part of this sub-region, bordering on the reservoir, may become a desirable summer resort area. The reservoir will be within about 200 miles from Vancouver by road and 185 miles by Pacific Great Eastern Railway. This is comparable with the distance from Vancouver to the Okanagan Valley. The warm summer conditions, a large boating area on the reservoir, and the attraction of the dam itself may make the land desirable for recreation use, and as a result have the effect of inflating the value of the land. As was suggested in the chapter on irrigation, this competitive demand for land could easily make agricultural development of those lands impracticable.

(5) Better roads into the Big Bar-High Bar region might enable this area to expand its production into fruits and vegetables, marketable in the middle Cariboo and even through Lillooet to the Vancouver market. Although, as has been suggested, forage crops produced in the area may very well be needed to feed increased heads of cattle, any surplus could likely be marketed in the Lower Fraser Valley, where a deficiency in dairy cattle feed is expected.

(6) The possible expansion of "feed lot" type cattle operations would be desirable, for much land suited to the cultivation of alfalfa and other clover, grass and hay crops could be put to intensive use. Only in the southern part of the sub-region, within a short distance of the railway or perhaps in the Alkali Lake area not too far from Williams Lake, would it be possible to import grains for finishing cattle.¹³⁴ Ranches in this area would therefore likely have to export cattle to the Peace River, Alberta or the Lytton-Moran sub-region or Thompson Valleys for finishing for market.

(7) In this region also it is evident that large quantities of development capital will be needed to purchase land, build irrigation works, homes and barns and buy equipment. This development capital is not likely to come

¹³⁴ The term finishing refers to the final period of fattening when the texture of the meat is determined. Grain finished cattle is reported more uniform than grass fed cattle.
from private sources, as farmers demand long-term financing at low interest rates. Government assistance seems a necessity if intensive agriculture is to be expanded in this sub-region.
CHAPTER X

SUB-REGION #3 WILLIAMS LAKE RIVER-QUESNEL

I. PHYSICAL GEOGRAPHY

Landforms The height of the Fraser plateau north of Williams Lake River is under 4,000 feet, and many areas lie below three thousand feet. The Fraser River lies within this plateau in a valley two to five miles wide. The plateau is underlain primarily by lava flows which lie in horizontal layers over the region, having been extruded several times in the geological past. Into these layers the river has entrenched itself. To the west of the river, morainic ridges and swell and swale topography, muskeg and swamp are typical surface landforms, indicating the effect of the Pleistocene. Several wide terraces, and the remnants of what may have been an old river plain have been left on each side of the river upon which present settlement is located and agriculture takes place. In the southern part of this sub-region, the Fraser River enters the great deep valley described earlier. The benches are wide and the absence of high mountains or plateau formations in the vicinity gives the whole area much more open appearance than in the southern sub-region. Vegetation covers all the landforms, and as a result the edges of the benches are less
eroded and have a rather even appearance, as compared with the jagged sawtooth appearance of the gullied river front benches in the southern sub-region.

The river is relatively slow-moving in much of this northern sub-region and has created alluvial deposits along its banks, some of which are available for agriculture. A few islands and several sand bars are found in this section as well. The river itself is rather wide and is navigable north of Soda Creek.

The tributary streams are long, less steep in their lower courses and less frequently intermittent than in the southern portion of the Middle Fraser Region. Most of them flow northward through the greater parts of their course, turning and crossing the river benches to enter the river at right angles. Some of the northern tributaries have adequate flows to irrigate considerable land if that is desired, while some in the south have small flows, more like the streams of the middle sub-region.

Climate Soda Creek is recognized as the northern limit of what is generally referred to as the "dry belt". South of Soda Creek, climatic conditions are similar to the northern sections of the Moran-Williams Lake River area, with relatively warm summer conditions, little precipitation and a relatively long growing season. Irrigation is a necessity
for successful intensive cultivation. The similarity in the regions is indicated by comparing precipitation recorded at the two stations of Alkali Lake and Soda Creek. Where records at Alkali Lake indicate a mean annual precipitation of 10.38 inches, they show 11.50 inches at Soda Creek.

North of Soda Creek the climatic conditions are more similar to those on the plateau than the southern valley, with threat of summer frosts, more precipitation (16.74 inches at Quesnel), cooler temperatures and less moisture deficiency being characteristic.

Whereas south of Soda Creek grassland is found in the valley, forest cover becomes more dense as one moves north. Patches of grassland are found on south-facing slopes in the Alexandria area, but north of there forest cover dominates the landscape.

The winters are more severe in this sub-region than in the south and cattle must be fed for up to six months. The growing season commences between the 10th and 20th of April, a full month later than in the Lillooet area. At Quesnel the moisture deficiency does not become acute until mid-July in most years. The water deficiency is generally less than 10 percent in the northern section of this sub-region.

Soils Soils in the northern sub-region are mixed, because the region is a transition zone. In the southern
part the Thin Black soils predominate, associated with Dark Brown soils in some low valley locations and Degrading Black in the higher poorly drained areas. In most of the north Grey Wooded forest soils predominate, intermixed with Thin Black soils where grassland is found. Some of the Grey Wooded soils are rocky and at some high locations are unprofitable to work. On most benches between Alexandria and Quesnel good soils are found in patches. Thus a farm will be large, containing several patches of soil a few acres in size. Near the river some very fertile alluvial soils are found.

II. AGRICULTURE AREAS, WILLIAMS LAKE RIVER-QUESNEL

Five agricultural areas can be recognized in this sub-region. Ranching is carried on in one area between Williams Lake and Marguerite, in similar fashion to the ranching in the southern sub-regions. Although the settlements of Soda Creek and Macalister act as supply centres the whole area is tributary to Williams Lake for most services. Irrigated pasture is maintained, usually by gravity-fed operations. On the Springfield Ranch water is pumped for irrigation purposes.

A second area is near Alexandria, midway between Williams Lake and Quesnel. In this section irrigation is desirable but not imperative. Ranching is the dominant activity but intensive farming is not uncommon. Cuisson
Creek scheme for irrigation is planned for this area.

In the Kersley-Dragon Lake-Quesnel area, in the northern section of the sub-region, a third agricultural area can be recognized. Although a ribbon of farms is found along the highway and railway between Alexandria and Quesnel, this northern section is an area of dairying and vegetable cultivation, rather than a ranching area. The farms are small, and cultivated areas are all cleared from the forest. Cleared land is a major characteristic of the landscape in this section.

On the west bank of Meldrum Creek a large area devoted to ranching is the fourth agricultural section of this sub-region. The first settlers came to this wide grassy valley before 1870. It is surrounded with a high-land containing natural meadows and poorly drained swamps adequate for summer grazing and some hay for winter use. In this area cattle need feed for about five months of the year.

The fifth agricultural area is situated on the east side of the Fraser River, between Alexandria Ferry and the mouth of Narcosli Creek. The farms are generally small, often subsistence type. Natural meadow is utilized along Narcosli Creek for winter feed for a few cattle kept for cash income. The farms are generally located high on benches several miles back from the Fraser River. These areas are indicated on Map 37.
Crops

There are estimated to be more than one hundred farms in the sub-region, most of them lying between the river and 2500 foot contour. About one-third of the farms and ranches use irrigation. In the southern sections most land is in either irrigated pasture or grain, both utilized for cattle feed on the ranches in the area. Some vegetables are grown, dairy cows maintained and poultry kept chiefly for farm use, although small quantities are reportedly marketed in Williams Lake. The Williams Lake-Soda Creek and Meldrum Lake areas are the most important ranching areas in the northern sub-region.

Between Quesnel and Australian, farms are small, often part-time operations. Dairy cows are kept as well as poultry, sheep and hogs. Vegetables are grown commercially in this area and potatoes, particularly, have been important cash crops to some farmers. The dairy products are marketed through Quesnel, where sales to local residents and those in Prince George are handled by Northern Dairies.

Potatoes were grown in considerable quantities in the Dragon Lake and Kersley area after World War II, both for table use and seed. The acreage in potatoes was 551 in 1951. By 1954 the acreage was reduced to 150. Marketing problems and high transportation costs are believed to be factors in the decline in this specialized crop. On some land yields were very high, reportedly up to 20 tons per acre.
Dairying appears to be the dominant source of farm income. The growth of the forest industries around Quesnel has been an important factor in attracting farmers off the land. The short frost free period experienced in this area (50 plus days) limits the growth of many vegetables and grains.

Between Alexandria and Narcosli Creek lie mixed farming areas, where dairying and intensive vegetable cultivation takes place side by side with cattle ranching. Irrigation is practised near Alexandria, water coming from Cuisson Creek. Most farms seem to have some dairy and beef cattle and other crops, but no general category of farm can be readily recognized.

Irrigation expansion is possible in this whole sub-region. Prairie Farm Rehabilitation Act engineers report some 30,000 acres are available for irrigation with the aid of pumped water. Of this, some 5,000 acres are now either in cultivation or natural grass. A scheme to utilize water stored on Cuisson Creek could supply about 2600 acres in the Alexandria area by gravity.

III. MORAN DAM AND SUB-REGION #3

The Moran Dam will have much less effect on this northern sub-region than either of the fore mentioned sub-regions. Distance from the dam, over one hundred miles up...
stream, means that flooding will not be as great as down­stream and that transmission costs for power will be greater.

The land itself, as already suggested, is not in as great need of water as the southern area, for water efficiency is greater.

Moran reservoir will flood some land in this sub-region, (Map 38). The depth of the water above present river levels will range from about 200 feet at Soda Creek to nothing at the mouth of Narcosli Creek. South of Soda Creek the river is in a rather deep valley, in which few branches are cultivated. Between Soda Creek and Alexandria, about 10,000 acres may be flooded. However, reference to maps of the area indicates that, except for small areas near the villages of Soda Creek and Alexandria, no agricultural land is low enough to be flooded. Most farms are found between 1500 and 2000 feet elevation. Many of them that cannot at present benefit from potential pumping of irrigation water will be within the range of pumping if the reservoir is established.

Moran electric power will be reasonably priced in this northern sub-region, but will be higher than in the southern sub-regions.

Detracting from the importance of Moran to this region are the facts that irrigation can be expanded in most areas from existing streams and that some arable land could be irrigated from the river at its present level if power
were available. Other areas are too high even for future pumping.

Narcosli Creek has sufficient discharge to irrigate the bench several miles south of its mouth, although these areas could be irrigated from the Fraser river if pumping were undertaken.

Across from the mouth of Williams Lake River, agriculture could be expanded in the Meldrum Creek area, where a considerable acreage of good land is used for hay and grazing land. A surveyor in 1913 made this report:

... the resident is an old settler with a large family. Only eight acres is cultivated by hand. The system of irrigation used is the carrying of pails of water from the creek to the crop by the large family.  

The water flow of Meldrum Creek would need be more efficiently utilized, for most of the area is too high for pumping from the Fraser itself.

IV. THE POSITION OF THE REGION WITH RESPECT TO FUTURE DEVELOPMENTS

The northern sub-region is quite satisfactory for some types of agriculture, although the threat of summer frosts limits the varieties of vegetables and field crops grown. More severe winter conditions mean that longer

136 An October flow of 60 cfs. is reported by Provincial Government Surveyors.

137 R.W. Haggen, Abstracts, op. cit., p. 54.
winter feed periods for cattle are necessary, making competition with southern ranchers more difficult.

Moran will not stimulate agriculture, for it will not aid in the cost of clearing nor significantly in the cost of pumping water.

Cost of clearing land is an important deterrent to expansion of agriculture. The machine work involved, that is, the services of a bulldozer to clear the trees, averages at present about $40 per acre in this sub-region, depending on the terrain, soil and vegetation density. This does not include burning, root-picking and working down of the soil. Although assistance is given to farmers from the Provincial government through the "Farmers' Land Clearing Assistance Act", this "clearing" factor places this sub-region in a poor competitive position in relation to the grasslands farther south.

The proportions to which this area may grow is exemplified by considering the size of an economic unit needed. In this area, 150 acres of cleared arable land is considered necessary, and usually because of the dispersed nature of the soils this will require the ownership of about 320 acres.

New farmers will find it expensive to acquire land,--

for privately owned land is valued at $15.00 per acre un-cleared, $69.00 per acre cleared and about $100.00 per acre when irrigated.  

Labour costs are high, and the maintenance of reliable workers is a distinct problem in this area. Saw-mills and construction provide jobs for most of the work force, and competition for labour often leaves the farms short-handed. On the other hand, additional income from forestry or construction allows many farms to be operated on a part-time basis. They would likely not be operated at all without this additional source of income.

Although ultimate agricultural development in this sub-region will be restricted by the fragmented nature of holdings, climate and water supply, the future outlook is reasonably encouraging. The increase in population in the sub-region and the areas to the north indicate an increased market for fluid milk, eggs, poultry and vegetables. These may compensate for disadvantages in freight cost to the distant coast markets (Map 39). The expansion of beef cattle raising in this area has been marked during the last decade, and the prominence of the Quesnel Cattle Sale is an indication of this growth.

What is important to this discussion is; cheap power

139 Bulletin, op. cit. p. 50
from Moran would have little influence on pumping irrigation water; markets would not likely be stimulated; and flooding, although covering a considerable area, would not influence settlement or agricultural acreage significantly.
CHAPTER XI

THOMPSON RIVER VALLEY

Expansion of agriculture in the Thompson River Valley is closely related to power development at Moran. This arid valley, 20 to 30 miles east of the Fraser River Valley requires low-cost hydro-electric power for pumping irrigation water. 140

I. THE PHYSICAL GEOGRAPHY OF THE REGION

Landforms There are three types of landforms in this region: the fans, found along the Thompson particularly between Ashcroft and Lytton; the high valleys and terraces such as those at Ashcroft Manor and along Semlin Valley; and terraces along the river from Ashcroft to Kamloops Lake. Related to this area are the two former meltwater channels containing the Bonaparte and Deadman Rivers. A major difference between Lytton-Moran sub-region and the Thompson region is the fact that both sides of the Thompson are bordered by the high plateau; whereas only the east side of the Fraser is so bordered. Consequently both banks of the Thompson are covered by large fans, products of the post-pleistocene. West of Ashcroft lies the Ashcroft Manor area, over 500 feet

140 See Map 40.
above the present level of the Thompson River and running generally parallel to its north-south axis. The land is gently rolling over the upper part of the area, but below the 1500 foot level there are a series of benches that drop gradually to the river. Several large hills protrude from the upland area, separating some of it into valley tracts.

The Semlin Valley just north of Ashcroft, was perhaps an old bed of the Bonaparte River. Many of the present landforms and soils within these valleys and along the Thompson between Ashcroft and Kamloops Lake originated from the outwash in the Pleistocene.

Intermittent streams are the rule in this region. Severe gullying has taken place in many areas where flash floods following exceptional heavy rains have poured down a valley. Generally these valleys are dry during the rest of the season. Several streams have natural reservoirs in the form of lakes, or have been dammed to retain the spring surplus for summer irrigation. Where these exist, individual farmers utilize them fully for irrigation.

**Climate** This region has one of the lowest annual average precipitations in the province, as reported at Ashcroft near the river, and at Ashcroft Manor higher on the benches. The mean summer temperatures are slightly cooler than the region of similar latitude on the Fraser, and the
growing season is slightly shorter. These are relatively unimportant differences, as the growing season is adequately long and warm for producing most crops desired. As the valley has such low precipitation, lying as it does in the rain shadow of the Coast Mountains and the plateau to the west, vegetation is not extensive. A similar degree of water deficiency exists here as in the Moran-Lytton Region, and irrigation is a necessity.

Soil The soils of the region are Dark Brown in the valley, and are classified as Thin Black on the higher benches and tributary valleys. Discussing the feasibility of pumping irrigation water, the Prairie Farm Rehabilitation Act report states: "Generally the soils found in the Thompson Valley were of a silt to sandyloam of varying depth, underlain by a gravelly terrace. In some places, and particularly on the higher benches, angular stones appeared on the ground surface in quantities such that cultivation would be impossible."141

II. AGRICULTURAL AREAS

Several agricultural areas are found in this region, their area governed by one or several of the physical factors

mentioned above (Map 41). One area around Spences Bridge is significantly limited in size by the narrow benches found in the region, and by a lack of water. A second, between Ashcroft Manor and Basque Ranch, is a very large area of grassland, some five miles wide and extending twelve miles along and above the western bank.

Across the river, high on the valley side, several benches are intensively cultivated by utilizing water stored in Barnes Lake. The Bonaparte and Semlin Valleys, meeting at right angles at Cache Creek, compose a fourth area of agriculture. A fifth area, the series of terraces along the Thompson from Ashcroft to Kamloops Lake, are irrigated largely by waters flowing from the plateau. Water supply is the limiting factor in the Ashcroft Manor, Semlin Valley and Thompson bench areas.

III. EXTENT OF AGRICULTURE

Production in the Thompson Valley is fairly large in both vegetables and beef cattle. Cattle raised on the ranches in the valley and tributary valleys are marketed through cattle auctions at Kamloops or are shipped directly from Ashcroft and Lytton and sold to packing houses in Vancouver. Tomatoes raised on the hot benches with aid of irrigation are sold both fresh and for canning. Turkeys, a new and successful means of marketing the products of the
soil, are sold by the farmers directly to the large meat packing firms. Ashcroft potatoes are well known as good quality "dry belt" potatoes and receive a top price on the Coastal market.

Spences Bridge was one of the first areas developed for agriculture in the Thompson Valley. In 1957, some farms were raising forage crops, potatoes, tomatoes and fruit; but "urban sprawl" seemed to be utilizing parts of the best farm lands. About 600 acres are available for cultivation around Spences Bridge.

The ranches of the Ashcroft Manor area are producing crops but in amounts in no way comparable to what was reported produced in the late nineteenth century. In 1957, two large tracts were being operated under lease. On one, 300 acres of oats were planted as partial feed for 35,000 turkeys being raised on the open range. On a second, a large tomato crop was raised. Cattle were being ranged from the Basque Ranch and the other ranches in the area.

Water for these ranches along the western side of the Thompson is limited, most of it coming from Cornwall, Minniberriet, Lone Tree and Oregon Jack Creeks. Only Cornwall Creek has natural lake storage.

The Boston Flats Ranch, just north of Ashcroft Manor, was the grazing land for the B.C. Express Company, the firm which operated the stages on the Cariboo Road. At this ranch
the first electrically operated pumping system was installed in the first decade of this century, to raise the water of the Bonaparte some 300 or more feet to the ranch. In 1957 the system was in ruins.

Fed by water from Barnes Lake, the benches on the east side of the Thompson above Ashcroft, at a similar elevation to Ashcroft Manor, are the location of several rather prosperous farms, where cattle and forage crops now place second to turkeys and grain crops in importance. These farms have some acreage in fruit trees and in tomatoes which are marketed at Ashcroft.

Except for a few acres around Cache Creek, the Bonaparte and Semlin Valleys are under cultivation for hay and alfalfa, which are used as winter feed for the cattle that graze in Hat Creek Valley on the plateau to the north and east, and on the terraces of the Thompson Valley itself. These Bonaparte, Semlin and the Perry Ranches were established in the 1860's and 1870's. The Perry Ranch was part of the land empire established by the Harper Brothers, noted in Chapter 10 in regard to the Gang Ranch. Today it produces breeding stock for the wide holdings of the partnership which controls both ranches. The Semlin and Perry ranches grow


143 Weir, op. cit., p. 85
impressive crops of hay. From time to time, some acreage has been leased to Chinese and white farmers, who cultivate cash crops, usually tomatoes or potatoes. Many people have objected to this practice of leasing land rather than outright sale for "their unfailing practice seems to be to work there until the soil is thoroughly impoverished and then turn it back to the owners.  

Near Cache Creek, cash crops of potatoes and tomatoes are grown by ranchers and native Indians. In the upper Bonaparte Valley, several small ranches irrigate just the alluvial river bottom, and leave the gentle sloping fans on either side of the valley in natural grass for their cattle.

Several benches along the Thompson, from Ashcroft to Walhachin, are under cultivation. The Thompson meanders between elevated terraces in this portion of the valley, terraces that are only a few feet above the river in places. Streams that drop rapidly from the sharp rising cliffs on the south bank irrigate a large acreage devoted to forage crops and tomatoes. Several small orchards are maintained. The large area on the north bank of the river is now covered with sage brush and grass, above which the occasional dead fruit tree stands as a reminder of the large Walhachin irrigation project which once prompted the land to blossom

144 Downton, Abstracts, op. cit., p. 53
145 Weir, loc. cit.
forth some fifty years ago. The abandonment of this irrigation project where 5,000 acres of orchard were planted appears to have been as was explained in Chapter VII, due to human neglect rather than an unsatisfactory physical location.

IV. MORAN AND THE THOMPSON VALLEY

The Moran Dam proposal could have two major influences on agriculture in this region:

(1) Moran would produce cheap power, to be made available (a) for pumping irrigation water, (b) for rural electrification and (c) for quick freeze and other processing plants;

(2) Moran would possibly allow certain waters, now utilized in the Fraser Valley, to be diverted into the Thompson Valley through Hat Creek Valley.

The effect of cheap power for irrigation water pumping would be considerable, for perhaps more land is available at low elevations in this valley than elsewhere in the interior.

It is stated in the Prairie Farm Rehabilitation Act report that an estimated 13,956 acres were available to pumped irrigation water between Kamloops and Lytton, using the conservative figure of 250 feet as the height water could be pumped. Some of the land under this survey is outside

146 Report #4, op. cit.
this region, being around Tranquille and Kamloops at the east end of Kamloops Lake, but the figures are worth recalling. 4356 acres, or 31% of this land was recognized as already under cultivation. 8053 acres, or 58% of the area was in grassland, and the remaining 11% in forest. The land was further classified as to the number of acres at various heights above the river as follows:

<table>
<thead>
<tr>
<th>Height Range</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 50</td>
<td>7210</td>
</tr>
<tr>
<td>50 - 100</td>
<td>2041</td>
</tr>
<tr>
<td>100 - 150</td>
<td>1916</td>
</tr>
<tr>
<td>150 - 200</td>
<td>1446</td>
</tr>
<tr>
<td>200 - 250</td>
<td>1343</td>
</tr>
</tbody>
</table>

Much of the nearly 10,000 acres under 100 feet above the river is the location of the presently cultivated land.

Using just these figures, the possible addition to cultivation is considerable; but if 350 feet were considered as a pumping height, much of the area of the original Walhachin project could be resettled. The half-century old flume, now in ruins, enters the Thompson Valley from the Deadman River Valley at about the fifteen hundred-foot contour. Recalling that the elevation of Kamloops Lake is slightly over 1100 feet, it is evident much of the Walhachin property could be re-irrigated. Through a rebuilding of the Deadman River flumes, water could be utilized on the excellent
benches within the Deadman Creek Indian Reserve.\textsuperscript{147}

The soil and landforms are satisfactory for intensive irrigated agriculture. With the establishment of a reliable source of water through pumping and the convenience of rural electricity, this area could well become an ideal agricultural region.

The Ashcroft Manor-Bonaparte and Semlin Valley will benefit some from cheap power, but the most interesting possibilities for these areas are in diversion of streams to supply water for irrigation. Cache Creek water is completely utilized for irrigation by the Semlin Valley Ranches, but the Bonaparte River has considerable flow now utilized. Most areas outside the Bonaparte valley itself are too high for normal pumping. Additional waters from the Semlin Valley, and more particularly the Boston Flats and Ashcroft Manor area, could be brought from the Bonaparte River by pipe or flume.

This is no new scheme. In 1893, this report was made: "I am not aware of the practicability of bringing water to the higher levels from such sources as the Bonaparte, but from the fact that Captain Parsons gives the altitude of

\textsuperscript{147} The effect of power dams on irrigation within the Thompson Valley could be even more spectacular if the so-called "Ten Dams" proposal of General McNaughton, mentioned in Chapter I was undertaken. Dams at Savona Bridge, MacAbee, Ashcroft and Basque would each raise the level of the river to a height which would lessen the pumping distance necessary to irrigate surrounding benches, and each would provide electric power for pumping at a low cost, as no transmission distance would be involved.
the mouth of Hat Creek which empties into the Bonaparte fourteen miles from Ashcroft, at 1686 feet, I think much of the land on the northern side of the Thompson could be irrigated from that source. A ditch was put in some time ago, but I believe, probably from faulty construction, it proved to be a failure."

As was stated earlier, the general decline of this area to extensive ranching in the present century has precluded any further development of this novel but seemingly practical scheme.

The water available for irrigation from the Bonaparte could be supplemented with water diverted from the Fraser. The possible gravity-fed irrigation of the Pavilion-Sallus Creek area in the Fraser Valley with waters from the Moran dam reservoir, could allow Pavilion Creek and Lake to be dammed and diverted east through the near-level Marble Canyon, 2600 feet in elevation, into Hat Creek, the main tributary of the lower Bonaparte.

An expansion of this scheme was investigated. Recalling that the level of the Fraser reservoir at Moran Dam would be at 1540 feet, the possibility of pumping water 1000 feet up into Pavilion Lake, a total distance of about six miles, for storage and future distribution on the rolling grassland above Ashcroft Manor, looks interesting, and

148 "Abstracts" op. cit., p. 86.
could likely be done if the need for agricultural land in this province were acute. At present, the cost of pumping water six miles and up 1000 feet would be prohibitive but not impossible,¹⁴⁹ as indicated on Map 42.

V. FUTURE AS AN AGRICULTURAL REGION

Like the Lytton-Moran area on the Fraser, this area is climatically suited for intensive irrigated agriculture. Past and present farmers in the region have demonstrated the valuable returns that are possible.

This region is well situated in relation to the urban centers of the lower Fraser Valley and the growing city of Kamloops.¹⁵⁰ Cache Creek in its centre is 220 road miles from Vancouver on the Trans-Canada Highway. Both trans-continental railways travel through the valley.

Walhachin, Semlin Valley and Ashcroft Manor areas are all suited to the development of large irrigation districts, which, properly planned and executed, could provide farmers with successful, economical farms.

The long growing season will allow the cultivation of most vegetable crops, some fruits and most certainly hay and cereal crops. The future development of the area would be planned, no doubt, so that adequate crops of certain types

¹⁴⁹ In a Venezuelan scheme water is pumped up some 3000 feet. "Caracas Water Supply Lifted 3,125 ft. Over Divide," Engineering, XXVI, #12, p. 49.

¹⁵⁰ Map 31, "Moran-Lytton sub-region and other areas"
would be grown to supply packing and quick freezing plants, and other marketing organizations.

The expansion of vegetable crops seems highly probable to supply the Vancouver metropolitan market. The surplus apple production in the Okanagan Valley and the curtailment of Canadian export markets, precludes an increase in horticulture in the province at least for the present.

Along with vegetables, the raising of poultry and livestock seems particularly suited to this area. As has been mentioned, turkeys have proven a most satisfactory farm product; no pens or other shelters are needed as in the damp coastal region. With sufficient feed available, thousands of birds could be produced. Hogs do well in the area east of Kamloops, and are reported to do well in this valley because of the dry air, and because proper feed crops grow exceptionally well. The extensive use of the land in cattle raising seems wasteful on an area so potentially productive. Perhaps the "feed lot" type of cattle operation will be instituted where local hay crops and imported grains are utilized for finishing the cattle for market.

Electrification will no doubt make it a more desirable rural living area.

There are many factors operating which will tend to prevent this area from being fully developed. These include
the apathy of many of the present inhabitants, the existence of the large ranches covering several thousand acres, and the difficulty of securing capital to purchase land and equipment. A new generation of farmers will likely be needed if the area is to expand. The break-up of ranches is only possible if the price of the land is bid up to a point where ranchers find it to their advantage to sell. A number of individual farmers cannot go into the region, divert a selected stream, or pump water along the river front, for this can result only in a peripheral patchwork development of the area. It seems that the Thompson region should be developed as an integrated irrigation district where fullest development at the least average acreage cost would be possible. A problem arising in 1957 is the reported acquisition of land for speculative purposes by a number of large corporations and individuals. These interests hope that the "Ten Dams" of the Fraser and Thompson may be developed. The result could be an increase in land cost that could hinder valley-wide agricultural development. Lastly, the tenant farmer has done much to ruin some tracts of land and their revitalization will no doubt be costly.

Over 20,000 acres could be developed at a cost. They are acres well located to meet the future needs of growing Lower Mainland and south-central interior markets. Imaginative planning on a valley-wide basis will be necessary.
CHAPTER XII

THE CHILCOTIN PLATEAU AND THE CARIBOO

Two areas where the Moran Proposal will influence agriculture to lesser degrees than either the Middle Fraser Region or the Thompson Valley are the plateau areas to the east and west of the Fraser River. These areas are plateau lands, lying over 3,000 feet in elevation. Only small settlements whose residents are dependent on forestry, transportation and cattle-raising for a livelihood are located there.

I. PHYSICAL GEOGRAPHY

Landforms The plateau is a comparatively level plain, broken only in a few places by low rolling hills or an occasional sharp volcanic cone. In general the relief is not more than 500 feet on the surface itself, except where the deeply incised river valleys break the plateau into large blocks. The gentle relief is referred to as "undulating and rolling" and is directly related to two elements of its origin; the extensive lava beds which cover much of the region, and the deposits of glacial drift which in filling former stream channels and creating ground moraines have resulted in the derangement of the drainage. The resulting

151 Map 43.
lakes and swamp meadows are widely used by ranchers. Large stretches of stony ground caused by glacial deposits makes intensive cultivation impossible.

**Climate** The climate of the plateau regions has been described in Chapter III, in sections dealing with the weather recording stations of Dog Creek, Big Creek and Pavilion.

Long cold winters and relatively short cool summers, characteristics of a humid continental climatic classification, are typical of this area. Precipitation is not abundant at any time of the year, but as temperatures also are low, the moisture retention is such that dry farming can be undertaken in favorable areas. Frosts can occur in any month of the year; and at Big Creek, in one year only three days separated the last frost of the spring and the first frost of the fall. Although the frost free period is short, the growing season is much longer, numbering from 50 to 150 days at various plateau locations. Except for protected areas, the plateau area is not generally suited to intensive cultivation. Some valleys have little precipitation and considerable heat accumulation in the summer, and in these, cultivation of hay and some grains is undertaken with the air of irrigation.

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152 See Chapter III
Soils  The characteristic soils of the plateau are Thin Black in the parkland, Grey Wooded in the forested areas, and Degrading Black in the poorly-drained meadows and swamps.

II. EXTENT OF PRESENT AGRICULTURE

Ranching is the dominant agricultural activity on the plateau, and in the Chilcotin it is the chief economic activity. On the east side of the Fraser, ranching places second in value to forestry and construction as economic activities of importance. Ranches on the plateau were established later than those of the deep valleys and as far as the headquarters of ranches were concerned, most were located in the small plateau valleys, viz. The San Jose River, Bridge Creek and the Chasm near Clinton. Many ranches were established in a linear fashion along the Cariboo and Chilcotin Roads; and it was not until the present century that the pattern was broken and ranches spread east of 100 Mile House to the Buffalo Lake, Canim Lake and Lone Butte areas. The opening of these marginal ranching areas followed the construction of the Pacific Great Eastern Railway.

Most ranches are of moderate size, none running more than 1000 head except the Exeter Ranch at 100 Mile House and the Chilco Ranch at Hanceville. Ranches on the plateau
do not generally have large areas available for irrigated pasture and hay, and as a result must harvest their winter feed from natural meadows and small valley flood plains. Cattle are usually ranged over a wide area on spring, summer and fall ranges at various elevations and returned to the home ranch for wintering or marketing. The report of T.R. Weir explains in detail the complex ranching practices engaged upon by the plateau-located ranchers. 153

Cattle from this area are marketed through the Cariboo Cattleman's Association at Williams Lake, or by direct shipment to the coast from railway stations at Lone Butte, for the 100 Mile House area, and Chasm for the Clinton area.

III. THE MORAN PROPOSAL IN RESPECT TO THE PLATEAU REGIONS

The Moran Proposal will not influence the plateau region to any appreciable degree as it would the Middle Fraser Region.

Small areas of the lower Chilcotin River Valley would be flooded, areas generally not at present used by the ranchers. To the other areas, Moran will be of importance in two ways:
(1) by providing cheap power, for pumping irrigation water and perhaps more important for rural electrification, and

(2) by stimulating the economy in the adjacent Middle Fraser Region. Cattle-raising on more compact farms with "feed lot" methods in the valley, will leave the grazing lands on the plateau, now used for summer grazing by the valley ranches for the sole use of the ranches on the plateau.

The Chilcotin River Valley could support some intensive cultivation of hay, grains and vegetables. Rural electrification and power for pumping irrigation water would no doubt aid in stimulating these activities.

IV. FUTURE PROSPECTS OF THE PLATEAU REGIONS

(1) The Cariboo plateau areas are not particularly well suited for agriculture. As was explained in an earlier chapter, the population of this area grew very slowly, taking second place in importance to the agricultural areas associated with the Fraser. After World War II, a great expansion of population associated with forestry, construction and transportation took place. Settlements like Clinton and 100 Mile House have doubled their population in the last decade. In this last decade cattle raising has at best maintained itself and it is unlikely that it will expand. Increased yields of cultivated hay or alfalfa for winter feed are unlikely because of the limited area of useful land, (that is, where expensive clearing is not needed,) the elevation and adverse climatic conditions.
(2) The Chilcotin River Valley and the Chilcotin plateau have better prospects as far as agricultural activity is concerned. The expansion of cattle-raising is a distinct possibility as is the advent of intensive cultivation of hardy grains, hay and vegetables. Irrigation in the Chilcotin Valley could provide moisture for the cultivation of crops in areas now used exclusively for extensive grazing. The area is very isolated. Only the fact that the cattle can be driven to market in Williams Lake or Quesnel, has allowed even as much development in the area as has taken place. Consolidation of ranches into larger operations has taken place in recent years.

When the province needs new sources of food or new frontiers for agriculture, the Chilcotin cannot be discounted. Although the area is marginal in so many ways, a demand for food, rural electrification, power for pumping irrigation water where needed and accessible roads, cannot but aid in encouraging this development.
The chapters dealing with agriculture in British Columbia and with the various sub-regions of the Middle Fraser Basin indicate two things: (1) that British Columbia is a deficit region as far as many foodstuffs are concerned, and (2) that the Middle Fraser Region and Thompson Valley aided by the construction of Moran Dam and related irrigation works could produce much more foodstuffs than at present, particularly in terms of vegetables and livestock.

I COMPETITIVE AGRICULTURAL AREAS

The markets for food products in southwestern British Columbia are large and according to various sources will increase during the next 15 years.\textsuperscript{154} This optimistic picture of expanded intensive agriculture in these regions supplying the growing metropolitan areas of southwest British Columbia assumes that the products of the soil can be produced, transported and marketed at a price competitive with foodstuffs produced elsewhere. This problem is not new, nor one yet to be experienced in the future. It is a serious problem in British Columbia at present, as recognized in the

\textsuperscript{154} The Commission on Canada's Economic Prospects suggests the Vancouver metropolitan area may have 1.5 million by 1975.
Agricultural development in British Columbia to be successful, and healthy, must of course be able to compete with similar production from our neighbouring provinces and the Northern United States. There is no incentive for our farmers to go ahead and develop new land unless reasonable assurance is present that by good and efficient farming practice, it will be possible to sell the farm produce at an adequate profit.

Competition in this regard is keen because of large and small scale reclamation developments in Alberta and in northern United States, many of which have been brought into being by federal financial assistance.¹⁵⁵

**Competitive Irrigation Areas** Three areas of irrigation agriculture, two of which have in recent years had increasing effect on the existing economy of agriculture in British Columbia, and one projected scheme, may seriously compete with products grown in the Middle Fraser Region and Thompson Valleys.¹⁵⁶ These are the Columbia Basin project in Washington state, the St. Mary's River project in southern Alberta, both now in operation, and the South Saskatchewan project, now planned.

The Columbia River area covers some 2.5 million acres, half of which is suitable for irrigation. The St. Mary's

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¹⁵⁵ *British Columbia Government News*, November, 1956

¹⁵⁶ One area in British Columbia which will offer considerable competition to the new irrigation areas of the Thompson and Fraser is the Okanagan Valley, where as marketing of tree fruits has become more difficult farmers have been switching to vegetable production and livestock as cash crops.
project in southern Alberta in 1954 covered approximately 241,000 acres of a potential 500,000 acres. The construction of the South Saskatchewan project once looked remote, but in 1958, this project covering eventually 500,000 acres has been approved by Parliament.\footnote{157}

As each of these areas is a longer distance from the large markets of southwestern British Columbia than the 200 miles of the Middle Fraser and Thompson Valleys, one would expect that producers in those areas could compete successfully with these more distant producers. This unfortunately is not necessarily the case. A statement from the submission to the Gordon Commission on Canada's Economic prospects expresses adequately the competitive disadvantage in which British Columbia is presently and is likely to remain for some time.

Cheap electric power is available for irrigation pumping from the Federally financed and constructed Grand Coolee power plant. Roosevelt Lake created by Grand Coolee dam provides a source of water for the land. Reclamation of the land, construction of irrigation canals and facilities have also been carried out by the United States Government and the land sold to settlers on such terms as to make it possible for the farmer to become established without the heavy burden of annual costs which has been the death knell of many of our farming enterprises in British Columbia. The land is sold on a long term basis with low initial rates. Irrigation charges are deferred for a ten year period which allows the farmer to equip his farm and become firmly established. Thereafter, repayment of the construction costs of irrigation facilities are made over a long period, free of interest.
This is a large development, close to the urban centers of British Columbia and a strong competitor for the sale of agricultural produce within our province.\textsuperscript{158}

The St. Mary's project in southern Alberta was undertaken jointly by the Federal government and the government of Alberta and there, as in the Columbia scheme, the land was sold to the settlers on long term financial arrangements with relatively low annual charges. In addition many farms were established before this project was instituted, and thus the fixed annual charges for the land were not added to the costs of production. Many crops produced in the St. Mary's development, particularly vegetables and potatoes, were in 1957 competing strongly with crops grown within British Columbia, partly because of the advantageous financing which is enjoyed by the Albertans.

II. PROBLEMS OF EXPANDING PRODUCTION

The problem facing the expansion of agriculture within the Middle Fraser Region and Thompson Valley appears to be primarily one of competing with other areas, both within the province and without. The Government of the United States has aided farmers to solve the financial problems involved in reclaiming agricultural land and have taken the necessary steps to assure the best likelihood of

success for such farming enterprises. The federal and provincial governments have taken no part in such schemes as far as British Columbia is concerned. For some years in the post-war period, an office of the Prairie Farm Rehabilitation Act engineers was maintained at Kamloops, but it has closed. Fixed annual costs are an important cost factor in the economy of any farm, and the lower they remain, the cheaper the produce may be marketed and still maintain a reasonable profit.

A second general problem that will put the Middle Fraser Region at a disadvantage over these other areas is in the nature of the area itself. Where the Alberta and Saskatchewan schemes are located around a nodal supply and marketing center, allowing short distances to market, the British Columbia scheme is lineal in orientation and in addition the largest areas do not exceed 5,000 acres. Most areas occupy 300 to 1000 acres and are separated from the neighbouring plots by hills, gullies and streams. This orientation means that transportation of produce to the marketing center will be more costly than on the prairies where large acreages in particular crops are grown within a short distance of the marketing center. The scale of production of any crop on the prairie is such that it can be produced at a lower cost per unit than in B.C. and processed in large factories at similar savings. British
Columbia farmers would have to be willing to accept the direction of the processors in terms of what crops to produce and in what quantities to compete.

British Columbia has a problem of securing farmers to work the land - farmers who have the ingenuity and training to operate irrigated farms to their greatest advantage. The Middle Fraser Region, as suggested in earlier chapters, is now occupied by part-time farms, large ranches often operated by absentee owners, and farms inefficiently operated by "old timers" whose methods have not changed with the times. This is in contrast with the southern Alberta region where farmers abounded and with Saskatchewan, where farmers, desiring to produce other crops than wheat and grains, are patiently awaiting the water to go into operation on an efficient grand scale.

III. MORAN DAM AND LIVESTOCK PRODUCTION

Livestock production in British Columbia will likely increase markedly if the Moran proposal is adopted and supplementary irrigation works are constructed. Larger crops of alfalfa and cultivated hay will be available either to feed cattle grazed in the summer on the plateau parkland or maintained in feed lots on the river terraces.

The problem that British Columbia ranchers faced in 1957 and will likely continue to face arises from the price
discrimination between grass-fed and grain-fed steers and heifers. Packers pay premium prices for cattle that are grain-fed or at least grain finished; Southern Alberta and Saskatchewan are well located for raising cattle on grain or by importing grass-fed calves or yearlings and finishing them for market on surplus grains. It was the practise in 1957 for some British Columbia producers to ship their cattle to Alberta for finishing.

There is little prospect for the expansion of grain production in the Middle Fraser Region, and it is expensive at present to import grains into the region for finishing cattle. Unlike Alberta farmers who sell one to another British Columbia ranchers have to buy through the Canada Wheat Board. Some ranchers have trucked grain into the region from the Peace River district where grain can be purchased at lower cost without going through the Canada Wheat Board. With the completion of the Pacific Great Eastern Railway to the Peace River in 1958, it was believed by many that grain would be imported into the region to finish the cattle raised on natural grass and forage. This will be possible on ranches along the railway. However in the fall of 1957, it seemed likely that most cattle would be shipped from the Middle Fraser Region to the Peace River area for finishing, and then returned to the markets on the coast. Cattle from the Thompson region and the Nicola plateau seem
destined to continue to go to southern Alberta for finishing, maintaining the present pattern, unless changes take place in the activities of the Canada Wheat Board.

Even with the increased production of cattle in British Columbia made possible with the construction of the Moran Dam, it will be necessary to compete with the cattle producers of southern Alberta, and likely in addition to

159 "There is a general trend in cattle production in the interior to convert to a cow and calf operation, and the trend is manifested to a greater degree in the Cariboo plateau region. The markets of to-day in demanding "red" and "blues" brand beef place the Cariboo cattle especially in a very unfavorable position price-wise, unless they have been on a short feed period or on very good grass. The latter is rapidly being depleted to the point that in order to market 2-year-old steer at the highest prices it has become necessary to spend $25 to $35 in supplementary feeds...

The fall sales have clearly pointed out that since a 400 pound weaner calf sells for the same price or better than the 2-year-old steer, there is an economic loss sustained in keeping the latter over two years just to gain weight.

To establish this cow-calf operation, needed is (1) finishing area not too distant from the calf producing ranges (2) a direct short haul back to Vancouver, (3) the finishing area should be well supplied with fattening feeds, grains, summer grass and hay.

Unless subsidies from the Federal Freight Assistance Policy should be made to apply to the Peace River feed grains for consumption in the Cariboo, it would seem, in the light of some cost accounting done by M.J. Walsh, District Agriculturist, Williams Lake and the writer, that young cattle can be advantageously shipped and finished in the Peace River Area."

those of the South Saskatchewan region. This will be so even with a disappearance of huge grain stocks, for the demand for grain-fed cattle is established in the cities. British Columbia ranchers seem to be penalized or put at a competitive disadvantage because the province is not a grain producing area.

In 1957, it was apparent that hogs utilizing imported grains and corn grown in the area could be produced in the Middle Fraser Region cheaper than they could be imported into the province. Turkeys were thriving under a similar condition where local oats and imported feed grains were mixed. However the success of the 1957 crop can also be attributed to the raising of the tariff on birds coming from the United States.

It is indicated that British Columbia farmers are now at some disadvantage in their attempt to compete successfully against products grown in other areas. It is obvious that construction of such large irrigation works, as the Moran Dam would make possible, must have some guarantee that the produce can be sold at a price high enough to make the whole scheme a financial success. Failure of individual farms could do much to undermine the financing of irrigation works, processing plants and marketing agencies.

It is apparent that for British Columbia growers to compete successfully, even within our province, with produce from such projects as those mentioned above, some sort of assistance must be provided,
particularly with regard to the development of new land and the rehabilitation of existing reclamation systems. Federal and provincial assistance in the planning and financing of such developments in British Columbia would seem desirable. Much could be accomplished to place present and future agricultural enterprises within the province on a solid footing by the use of long term financing with low interest rates.160

Pessimism is held by many authorities on the future of the region without the institution of a new factor, viz. the construction of Moran Dam. This is indicated in two statements concerning the present:

As areas of open grassland and abundant upland meadow have been settled to their practical limits since World War I, the basis for establishing new commercial ranch units no longer exists and no expansion can be expected in the future.

On the other hand, expansion of cattle numbers is within the practical limits of realization by increasing the total available forage and by fattening young stock on feed lots. The problem of increasing forage is related directly to more efficient use of water resources.161

and

Because of the geographical features of this area the land does not lend itself economically to the development of its lands by pump irrigation from the Fraser River.162

The new factor, Moran Dam, would make possible many changes. If the additional acreage in each subdivision available for intensive cultivation were totalled, some 65,000 acres would be added.

160 G.L.Landon, B.C.Submission to the Gordon Commission, op. cit. p.260
161 Weir, op. cit., p. 109
162 P.F.R.A. Summary, Dominion-Provincial Board, Fraser River Basin op. cit., p. 100
South of Moran are 5,000 potential acres, five times the present cultivated acreage in that area. Some 18,000 acres, six times the present irrigated acreage, are in the Williams Lake River-Moran area; and some 20,000 acres are in the northern sub-region. In addition, 20,000 acres in the Thompson Valley would be available if cheap power were produced to pump water.

Bringing some 65,000 acres under cultivation would be costly. Assuming $200 per acre as an average cost of irrigation equipment, as suggested in Chapter V, the cost would reach about $13,000,000.

IV. FISH AND AGRICULTURAL RESOURCES COMPARED

Proponents of the Moran Dam have suggested that the agricultural potential of the Fraser River Basin, if expanded with the aid of irrigation water would be more than comparable in food and monetary value with the salmon that pass the Moran site enroute to spawn. This comparison is rather hypothetical for there are so many variables involved. For example, the possibility of all the land available being irrigated and being devoted to "feed lot" type cattle is highly unlikely.

The salmon pack that is attributed to runs that pass Moran Dam are valued at about $5 to $6 million.163

annually and weigh an estimated 6-10 million pounds. In the Middle Fraser Region, about 45,000 acres will be available for intensive cultivation for forage crops along with an additional 20,000 acres in the Thompson Valley. Five hundred pounds of beef per acre, a figure now surpassed by the Kamloops Experimental Farm, could be estimated as the potential of each of the 65,000 acres of land. Thus 32,500,000 pounds of beef could be produced in addition to the current 40,000,000 pounds. The 32,500,000 pounds multiplied by the farmers' selling price of between $15 and $20 per hundredweight, would give a value of $5-$6,000,000. The total present and projected beef produce would weigh 72,500,000 pounds and be valued at $11,000,000 to $14,000,000 to the ranchers. Thus the ratio between the increase in beef production and the present fish resource would be 32,500,000 (lbs) to 6,000,000 to 10,000,000 (lbs).

In comparing the food values of the two protein foods, fish and beef, the beef production would be considerably more. The method of comparing these was to consult the Table of Food Values Recommended For Use in Canada, where one pound of the edible portion of salmon is listed as giving 1,012 calories. While one pound of the edible portion of beef

164 The number of fish involved in the Moran Proposal is derived from the 'spawning count' of the International Pacific Salmon Commission and the estimation that about 50% of the escapement is caught.

165 The price of beef is on the basis of the Calgary Livestock Market, in the summer of 1958. Since the value of
as producing 1,241 calories. The value of the post-Moran beef production would be 40,332,500,000 calories compared to 10,120,000,000 calories for the salmon. If the present production of cattle were maintained the beef food value could reach 89,932,500,000 calories. Similarly if the salmon runs were to return to their pre-1913 figures their food value would be much higher, but the value of increase is difficult to determine.

Perhaps the apt conclusion to this discussion is a recognition of what a large food potential there is in the Middle Fraser Region if the Moran Dam is built and if the fish runs are maintained!

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the fish is the wholesale pack price, its comparison with beef is difficult. Perhaps the beef price should be more correctly the value of beef leaving the processing plant after dressing or the fish price should be on the basis of that paid to the fisherman; whichever modification was made the comparative position of the beef would be indicated.

166 *Table of Food Values Recommended for Canada*, Nutrition Division Department of Health and Welfare, Ottawa 1951, p. 218.

167 *Ibid*, p. 22
CHAPTER XIV

SUMMARY

The Moran Dam is multi-purpose and benefits could be derived by a large segment of the economy of British Columbia. A possible loss to the fishing industry remains the only adverse effect of the proposed dam. Some favorable aspects of the proposal are:

Moran Dam would allow the storage of more water than is necessary to control flooding in the Lower Fraser Valley and delta. A steady year round volume of water entering the navigable areas of the Lower Fraser would permit construction and easy maintenance of deep-sea shipping facilities twice as far inland as is possible at the present time. A large, long lake-reservoir would afford excellent sites for resorts in an area climatically suited for summer outdoor activities. As a source of low cost electrical power, the Moran Dam is reported to be one of the most promising sites in the world. In its relation to the potential tidewater industrial areas in southwestern British Columbia, the Moran Dam generators could produce lower cost power than any other site in the province. (Map 44). The economic benefits would be of considerable significance in expanding the economy basis of the province now dominated by the lumber industry.
FROM PEACE RIVER

AS NO SITE ON THE PEACE RIVER HAS BEEN SELECTED THE TRANSMISSION DISTANCE IS APPROXIMATE

MORA
"TEN DAMS"

FROM CHILCO-HOMATHCO

ALTERSTATE ROUTE TO THE PEACE VALLEY

SOUTHERN BRITISH COLUMBIA
SHOWING MAJOR POWER SITES AND DISTANCES FROM VANCOUVER

LEGEND

POWERSITE
220 MILES TRANSMISSION DISTANCE

37 MILES TO 1 INCH

MILES
I. THE EFFECT ON AGRICULTURE OF THE MORAN DAM PROPOSAL

The effect of the Moran Dam proposal on agricultural production will be fourfold. (1) construction of the dam will cause flooding of valley areas behind the dam to an elevation of 1540 feet; (2) the dam will provide low cost electric power for the pumping of irrigation water and rural electrification; (3) the location of electrically-oriented industries subsequent to the construction of the dam will increase markets for agricultural production; and (4) transportation to and within the region should improve.

Flooding and Agriculture

Between Moran and Narcosli Creek near Quesnel flooding will occur. The depth of the water will vary from about 800 feet at Moran to 400 feet at the confluence of the Chilcotin River and 200 feet at Soda Creek. Because the river is so deeply incised through so much of its length, flooding of arable land will not be great. Present intensively cultivated land will be flooded in three areas: at Big Bar and Watson Bar Creeks a few miles north of the dam, near Soda Creek and near Alexandria. The total acreage is small, likely not exceeding 600 acres. Some land used for grazing will be flooded, particularly prize winter rangeland on the east bank between Big Bar and Canoe Creeks. Near
Churn Creek Bridge and the Chilcotin River other valuable tracts will be flooded. More marginal land in the northern sub-region will be flooded. Since it is mostly tree covered its loss as grazing land will not be serious. It must be suggested that some of this land could be developed if clearing were to be undertaken. The significant grazing land that will be lost totals about 3000 acres, in the Moran to Quesnel areas.

Irrigated land that may be flooded likely does not exceed 250 acres.

Low Cost Power and Agriculture

The advent of low cost electricity for use to pump irrigation water could be of great significance in the expansion of agriculture in the Middle Fraser Basin. Most potentially arable land between Moran and Williams Lake River lies on high benches 300 to 800 feet above the present river level, much too high for pumping. The raising of the river to the 1540 foot level will allow many of these benches to be irrigated. About 18,000 acres in the Moran-Williams Lake area and 20,000 acres between Williams Lake and Quesnel could be irrigated. Some large areas by British Columbia standards that will become available are Deadman Creek-China Gulch area south of Canoe Creek, Churn Creek Bridge area and the benches along the river side of Gang Ranch. Each of these areas would be over 3000 acres in
extent and thus be comparable in size to the Summerland area of the Okanagan Valley.

The Thompson Valley, unaffected by flooding, would benefit from low cost power for pumping irrigation water. Twenty thousand acres in the Thompson Valley could be brought under intensive cultivation.

Over 3,000 acres immediately below the dam could be irrigated by a gravity fed system.

The importance of these areas to British Columbia could be more easily recognized if the potential value of production of crops produced by cultivation could be compared with those produced by the present extensive use of the land.

Some of the benches in the Middle Fraser Region do not necessarily need to await Moran and can be developed through diversion of tributary streams.

**Increased Markets and Agriculture**

As British Columbia is a deficit area at present for most agricultural commodities, an increase in population in the Vancouver metropolitan area will increase this deficit. The Moran proposal could stimulate the development of some 65,000 acres to meet this demand.

Three types of agricultural products will be produced. These are vegetables and small fruits, livestock and forage crops.
Expansion of agriculture in Williams Lake River Quesnel sub-region will be related to an expansion of markets in the Prince George and Quesnel districts.

**Vegetables and Small Fruits** The Lytton-Moran sub-region and Thompson Valley with their hot dry climate and proximity (less than 200 miles distant) to the Vancouver metropolitan area could produce large quantities of field vegetables, small fruits and potatoes on intensively cultivated irrigated farms.

**Livestock** Beef cattle production which cannot now be increased without new feed sources could be expanded with the introduction of "feed lot" type ranches. Alfalfa and natural hay supplemented by locally grown or imported grains can produce 600 to 800 pounds of beef per acre. Expansion of this type of operation seems probable in the Thompson Valley and on locations near the railway in the Middle Fraser Region. Ranchers in many inaccessible areas will produce more beef per acre but will likely sell their cattle as feeder calves or yearlings for finishing in those areas where grains are available at reasonable costs.

Turkeys and other poultry can be grown successfully in the southern sub-regions.

**Forage Crops** The anticipated encroachment on agricultural land of the Lower Fraser valley by urban residences
will increase the dependence of dairy farms on imported hay for supplementary feed. Surplus forage crops are possible, particularly in the Moran Williams Lake sub-region where distances from rail lines and more severe climate preclude the 'finishing' of the beef cattle or large scale production of vegetables.

**Improved Transportation and Agriculture**

The completion of the Pacific Great Eastern Railway to North Vancouver has already stimulated the production of some vegetable crops in the Lillooet area; and the improvement of highways to the Lytton-Moran and Thompson Valleys promises to improve their position in relation to the urban coastal markets.

However the Moran-Williams lake sub-region will have to await the construction of the Moran Dam to stimulate the growth of adequate transportation routes.

**The Competitive Position**

The expansion of agricultural production to meet the growing demand from urban areas will be contingent on costs of development being such that the Region can compete with other areas of irrigation agriculture. The development cannot be random if it is to be successful. Some degree of planning will have to be undertaken. Further, large quantities of developmental capital will be needed for capital
expenditures on irrigation works, livestock and buildings, and these funds will not likely come from private sources.

Agriculture in British Columbia is perhaps at its lowest ebb in several decades, and expansion seems contingent on the intervention of a new factor. The expansion of production is needed to meet the growing deficit British Columbia has in agricultural production. However, this will require in the arid areas of the province with their low population, the advent of large scale pumping irrigation works. These will be dependent to a large degree on the construction of the Moran Dam.
MAP 45

W.G. HARDWICK
The Lytton-Moran Sub-Region near Laluwissin Creek

"In this valley averaging one to five miles in width terraces and fans form a continuous series of benches on both banks ... two to six hundred feet above the present river level. It is upon these benches that intensive agriculture takes place."

Irrigated Benches, East Lillooet

"Electrically operated pumps (center left) supply irrigation water to 160 acres on level benches 100, 200 and 250 feet above the Fraser ... on the Riverland Irrigated Farms."
Fraser River Near the Moran Damsite

The canyon just north of where this picture was taken would hold the dam 2400 feet long and nearly 800 feet high. The absence of benches within the valley indicates why only small arable acreage will be lost through flooding.

Big Bar Creek Valley Irrigated Pasture

These irrigated areas lie above the range of flooding. Note small buildings and fence in centre. The near field is irrigated from an earth ditch running along the edges and drained off to a lower field down the centre.
In early September the second crop of alfalfa is being harvested. An Indian village from which labor is secured is located at the far edge of the fields. Note the abrupt rise to the surface of the plateau, characteristic of the ranges along the Fraser in the Moran-Williams Lake sub-region.

A large saucer-like area between Churn and Gaspard Creeks is the headquarters for the widespread holdings of the Gang Ranch. It is over twenty miles back to the plateau. Large irrigated fields growing winter feed for up to 11,000 head are found here. This view is from the east rim above the Fraser, looking west across the river. Camera elevation is about 3000 feet.
Benches Near Churn Creek

Sage and grass covered benches used for winter grazing land. The centre benches would be flooded by the Moran reservoir but the higher benches would be available for cultivation.

Near Australian Williams Lake-Quesnel Sub-region

Much less relief is evident in this sub-region. Farms are usually found on high ground above the river as shown in the location of the farm in the foreground and a second one several miles away on the west bank. Farms are located in a linear fashion along the transportation route.
The Thompson Valley

20,000 acres of arable land could be intensively cultivated in this region if low cost electric power was available for pumping irrigation water. This view is looking east from near the Perry Ranch. Sage brush covers much of the Thompson Valley.

Meadow Lake

About half way between the Cariboo Highway and the Fraser on the Plateau. Parkland in background stretches back to the Marble Mountains. Rocky soil and characteristic grasses are in the foreground while hay from around the lake is baled and piled in front of bared bluff, left of centre.
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