LAND UTILIZATION IN THE LOWLAND AREA OF DELTA MUNICIPALITY

by

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A THESIS SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS
IN THE DEPARTMENT
OF
GEOLOGY AND GEOGRAPHY

*****

THE UNIVERSITY OF BRITISH COLUMBIA

OCTOBER 1950
To the Dean,
Faculty of Arts and Science

Gordon deRupe Taylor
(Name of Candidate in full)

who holds the Degree of B.A. from University of British Columbia University, having satisfied the examiners in Geography and as major and minor subjects respectively, and having presented a thesis in the Department of Geology & Geography on the subject Land Utilization of the Lowland Area of Delta Municipality that fulfils the requirements, is hereby recommended for the Degree of Master of Arts

Head of Department.
LAND UTILIZATION IN THE LOWLAND AREA OF
DELTA MUNICIPALITY

Abstract
of a
thesis
by

Gordon deRupe Taylor
LAND UTILIZATION IN THE LOWLAND AREA OF DELTA MUNICIPALITY

- An Abstract -

The lowland area of Delta Municipality in Southwestern British Columbia comprising some 50 square miles with a population of 4,000 is one of the main suppliers of food to the Vancouver market. Although 10,000 acres classified as peat are unsuited for agricultural purposes, the remaining area has a fertile soil. In addition the area has a mild climate suited to the development of a dairying economy.

Settlement of Delta started in 1868 and proceeded rapidly for several years. It was the wealth of the Fraser River fisheries rather than the agricultural productivity of the land that brought early prosperity to Delta and to Ladner, the municipal centre, in particular. After the decline of the fishing industry following the Hell's Gate disaster in 1913, agriculture became the economic mainstay of the district.

As a result of poor internal transportation and a lack of fresh water in the western half of the municipality early agricultural practises differed in East Delta and in West Delta. Dairying developed in the east whereas cattle ranching became prominent in the west. In both sections similar field crops were grown. The opening of a road network after 1875 and the installation of a municipal water system in 1910
resulted in dairying gradually becoming the principal industry of Delta.

In recent years a diversified agriculture has become the outstanding characteristic of the land use pattern in Delta. The major uses of land are for pasture, hay and oats, with lesser amounts devoted to potatoes, peas, and a variety of other crops. Most of the farm revenue comes from the sale of fluid milk to the Greater Vancouver market.

There is some industrial activity in the area. Prior to 1913 salmon canning was important but declined consequent upon the diminishing of the Fraser River salmon runs. Between 1942 and 1944 two peat processing plants commenced operations upon the peat bog. They have become the largest industrial concerns in Delta. A vegetable canning factory, a grass dehydration plant, and a grist mill are the local industries based upon agriculture.

Ladner is the municipal centre and owes its prosperity to the surrounding farming community. Originally Ladner grew in response to the fishing industry. Summer resorts have grown up at Beach Grove and Boundary Bay. Sunbury is a small fishing community along the river and Tswasssen is an Indian reservation.

Since 1941 an area of 1,100 acres has been used for military purposes.
The conclusions arrived at in the thesis were that the area should remain as agricultural land. Danger from flooding and the limited amount of good agricultural land near the city of Vancouver are two factors which should operate against urbanization of the fertile lowlands of the Fraser Valley. In the event that urban development should come a plan to provide the necessary services and to prevent friction with the farming community has been recommended.
ACKNOWLEDGEMENTS

The preparation of a thesis is not possible without the help and co-operation of many people. It is, therefore, only right and customary that I should at this time attempt to thank those without whose co-operation I could not have succeeded in completing this thesis.

I should like to acknowledge the suggestions and help received from Dr. J. L. Robinson, Dr. J. R. Mackay and Mr. J. Chapman of the Department of Geology and Geography, University of British Columbia; the kindness of Mr. Leon J. Ladner, K.C. in allowing me to examine family paper pertaining to early days on the Delta; to Mr. Edgar C. Dunning and Mr. Linton Eccles of The Ladner Optimist for allowing me access to the complete file of their newspaper; to officials of the Municipality of Delta, Delta Board of Trade, Delta Farmers' Institute, and the Lower Fraser Valley Crossing Improvement Association for allowing me access to their records; and to the many residents of Delta who answered queries that I directed to them.

I should also like to acknowledge the kindness of my father in permitting me the use of his car when I did my field work in 1949, and the forebearance and aid of my wife who at all times stood ready to encourage me past the rough parts of the work.

Gordon D. Taylor
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INTRODUCTION

A geographer in making a land use study is principally interested in the relationships that exist between the pattern of land utilization and the physical geography of the area. He is interested in finding out what factors of the environment, physical and human, control the land use pattern. Beyond the fact of describing the land utilization and pointing out the relationships that exist between it and the physical geography, he is concerned with the problem of suitability of land use. He must be aware of situations which may greatly change the present environment and make necessary a change of land use. In this regard the geographer should be able to recommend how such changes can be made while still maintaining maximum utilization of the land.

These problems would also be met by an agriculturist in making a land utilization study. There is, however, a difference between the problems as they apply to the geographer and to the agriculturist. The geographer is interested in all phases of land utilization while the agriculturist would be interested primarily in the agricultural utilization. It is because of this difference in emphasis that the geographer can make a contribution to the knowledge of an area by undertaking a land use study.

The purpose of this study is to evaluate the land utilization of the lowland area of the Municipality of Delta in the Province of British Columbia. The physical and cultural landscapes of the area will be analysed in so far
as they have a bearing on the land use of the municipality. After this analysis has been made it will be possible to decide if the land is being used in an effective and desirable manner. Should the findings of this thesis be that there is not effective and desirable land use, then recommendations will be made so that improvements may be brought about. On the other hand, should the findings be that the land use is effective and desirable, that fact will be stressed in the conclusions.

The conception, held by the writer, is that the primary function of a land use study should be to determine how the land is being used now. Thorough research should be made into all factors, physical, cultural and historical, which may help to explain the present use. Observations should be made of the land use in neighbouring areas with a similar natural environment. The advantages or limitations given the area by its physical geography should also be investigated. If a similar use exists throughout the adjacent areas and if the physical environment can be shown to have been the primary causal factor in determining land use, then most attention should be directed towards explaining the effect of the natural conditions. The writer also feels that while land survey, field shape and road pattern are of interest, they are of secondary importance in a study of this nature.

In dealing with agricultural land use the major concern should be with what is in the field rather than in the shape of the field. The problem of land use other than
agricultural in a rural area should be approached from the point of view:

(1) has it grown out of the agricultural land use
(2) has it evolved out of a separate cause.

It would seem to the writer that each land use study must be judged on the basis of the area for which it is done. The conditions in that area must be considered, and the end result of the research should be rated in accordance with these conditions rather than against any preconceived notion of what a study should include.

DEFINITION OF THE AREA

The area selected for study in this thesis consists of that portion of Delta Municipality, Province of British Columbia, lying below the 25 foot contour level. Delta Municipality is a part of the Lower Fraser Valley Region of southwestern British Columbia. The district extends westward from the western face of the Surrey Terrace to the Gulf of Georgia, and southward from the South Arm of the Fraser River to Boundary Bay and English Bluff, or the Point Roberts Upland. The municipality has a total area of 58 square miles of which 50 square miles are within the area covered by this research. It has an estimated population of 6,000 of which 4,000 live within the selected area.

The decision to use a topographic rather than a political boundary for the area was based on several factors: (1) within the district selected there is a unity of geologic history and of topography, (2) the soils are of the same
origin - alluvial, (3) the encroachment of urban settlement upon the level land of the Fraser Delta may mean that in a few years the present pattern of land utilization will have been severely disrupted.

It is hoped that this thesis will serve three purposes:

(1) to provide a description and an understanding of the relationships between man and his environment in the area,

(2) to provide an appraisal of the area which may be of use in future regional planning,

(3) to be a contribution to the knowledge of the geography of British Columbia.

OTHER PAPERS ON THE AREA

There have been no publications dealing with the physical conditions of the Delta itself. The geology of the Lower Fraser Valley of which the Delta is a part has been worked out by W. A. Johnston of the Canadian Geological Survey and is presently being redone by Dr. Armstrong of the same service. The soil survey of the Lower Fraser Valley was carried out under the direction of the British Columbia Department of Agriculture. There have been no extensive studies of the economic conditions of the area and the only general history of the area was a paper read by Ellis Ladner to a recent meeting of the British Columbia Historical Society of which only a press report was available at the time of writing.

FIELD WORK

The survey was made during August and September of 1949.
Surveys of local areas such as Ladner and Delta Manor were made earlier in the spring and summer of the same year. In making this study no base map of a size suitable for the purpose was available from known sources. It was necessary, therefore, to construct a map. One drawn at a scale of 6 inches to the mile proved sufficiently large to show all the detail necessary. Extensive use was made of aerial photographs. The area has been completely photographed by the British Columbia Department of Lands and Forests, and copies are easily obtained from that department.

In making the survey the writer covered most of the district by car. Around the more populated areas observations were made more accurately when travelling by foot or on a bicycle. A series of sketch maps were drawn to the same scale as the base map and used on the survey. Detail from these sketch maps was transferred to the large map at the end of each day.
FIGURE NO. 4

ROAD MAP - KEY

1. Ladner Trunk Road
2. Scott Road
3. River Road
4. Crescent Island Road
5. Boundary Bay Road
6. Westham Road
7. Westham Island Road
8. Mason Road
9. G. B. Main Road
10. Goudy Road
11. Benson Road
12. Tasker Road
13. Matthews Road
14. Smith Road
15. Embree Road
16. Oliver Road
17. Kittson Road
18. Peck Road
19. Farrell Road
20. Imperial Road
LAND UTILIZATION OF THE LOWLAND AREA OF DELTA MUNICIPALITY

CHAPTER ONE

THE PHYSICAL BACKGROUND OF THE AREA

1. Geology:

From a structural standpoint the area "... is part of the great structural valley in which lie Puget Sound and the Gulf of Georgia." (1)

The geology of the Lower Fraser Valley of which the Delta forms a part has been traced back at least to the Mesozoic Era. One of the first events that can be placed in the geologic timetable is the intrusion of the Coast Range Batholith during Upper Jurassic time. Although the area now comprising the low lying Delta remained depressed no Jurassic deposits have been found.

At the start of the Cenozoic further uplift of the Coast Range Mountain Region occurred. During Middle Eocene the lowland area was depressed relative to the mountains. Eocene deposits of the Kitsilaino and Burrard Formations were laid down at this time. These deposits which consist of shale, conglomerate, sandstone and coal are the first known ones in the area. Depression of the area continued during this period of deposition, however, uplift occurred at the end of the Eocene. This uplift initiated a period of erosion.

During Miocene the Boundary Bay Formation was laid down. This formation, which is known as a result of drillings

carried on by the Boundary Bay Oil Company, consists of sediments and volcanic ash that are only slightly consolidated and, in places, entirely unconsolidated. The deposits are on top of the Kitsilaino Formation and extend from 2,300 feet below sea level to beyond 3,660 feet below sea level.

The circumstances surrounding the deposition of the Boundary Bay Formation and the age of these sediments is not very clearly known. Evidences of weathering and the presence of lignite has led to the belief that the deposits were laid down in shallow fresh water and partly on land. A lack of fossils has made the determination of the age of the sediments very difficult. Theories have been advanced that they are of Miocene or of Pliocene age, but as uplift of the coastal region occurred in Pliocene time it is, therefore, more reasonable to assume that the sediments are of Miocene age.

The area was downwarped following the deposition of the Boundary Bay Formation. The Cenozoic closed with the area being uplifted higher above sea level than is now the case. As a result of this uplift a period of erosion set in.

Glaciers covered the area twice during the period of Pleistocene glaciation. Mr. E. M. J. Burwash in his "Geology of Vancouver and Vicinity" has estimated the extent of glaciation as follows:

"The Cordilleran ice sheet or ice tongues from it which
crossed the Coast Range formed large piedmont glaciers and filled the Gulf of Georgia with an ice stream which found its outlets through the Queen Charlotte Sound, the Straits of Juan de Fuca, and the Puget Sound Valley." (2)

Pleistocene deposits of till extend downwards at the Boundary Bay drillings from 400 feet below sea level to beyond 2,300 feet below sea level. These deposits are composed, for the most part of clay, sand, gravel, boulders, and interglacial deposits.

"During the final retreat of the ice-sheet, the Fraser Delta was for the most part below sea-level and has since been raised above sea-level." (3)

It has been estimated that from 15,000 to 20,000 years have elapsed since the last glacier of the Ice Age disappeared from the area. (4) At that time the sea stood 650 feet higher than at present. Since that time there has been emergence. (5) W. A. Johnston feels that the recent delta formed while the sea and land held their present relationships.

The recent deltaic deposits which are composed of fine sand, clay, silt, and organic material occur to a depth of 400 feet below the present surface of the land. The material which comprises these deposits has largely been carried down


(4) Ibid, p. 10.

FIGURE NO. 5

DELTA - GEOLOGY

- GLACIAL TILL
- ALLUVIAL DEPOSITS
- PEAT

(After W. A. Johnston)
by the Fraser River, particularly during its freshet stages, although a small part of the material is thought to have been derived from wave erosion of the shoreline of the neighbouring highland areas. The river-borne material comes from three main sources: (a) from glacial drift along the banks of the Fraser River above the Fraser Canyon, (b) from bedrock (granite) within the canyon itself, and (c) from drift deposits in the upper part of the delta. In addition to the inorganic material there is a large amount of vegetal material in the deposits. It was derived from vegetation that occurred locally and was subsequently covered by further deposits of silt, and from driftwood which collected on the shore face of the delta and was buried by the seaward advance of the deposits.

Deposition is continuing in the Lower Fraser Valley and the forward advance of the delta has been estimated to take place at an average rate of 10 feet per year. (6)

The peat bog which is a dominant feature of the district is thought to occupy a depression that was formerly a river channel. The channel, after being abandoned by the river, was not completely filled by deposition from flood waters. These depressions were gradually filled by decaying organic material and in places have been built up above the high tide level. The general outline of the delta had been established prior to the formation of the peat bog.

Most of the delta lies below the level of extreme high

FIGURE NO. 6  View looking southwest across Delta from the Surrey Upland. Note the level nature of the ground surface and Point Roberts Upland in the background.
tides. It has been estimated that these high tides of 15 feet would just cover elevations of 6.3 feet above sea level. The high tides may be increased by one foot as a result of a strong south or southeast wind during the rise of the tide or by the spring freshet. The highest elevations occur in the peat bog with lower elevations being found radially outward.

2. **Topography:**

The area under study is to all intents and purposes flat. The slope of the land is so slight that to the eye it appears nonexistent. The highest part of the Delta is an elevation of 16 feet recorded near the northeast corner of the peat bog. From that point the heights gradually grade down to between 4 and 7 feet in the areas of alluvial soil. There is no definite trend in the direction of the slope away from the peat bog. A cross-section taken at random through any part of the district would show an undulating effect with a slope that is rarely greater than eighteen inches to the mile.

The outstanding topographic feature of the municipality is not a natural one but is man made. On the north, west and southeast margins dykes form an almost continuous ridge. Two breaks occur in the dykes, at Beach Grove and at Boundary Bay where the sea has built up beaches of sufficient height to provide protection for the low lying land. The dykes have an elevation of six feet throughout their length.

In the districts around Beach Grove and Boundary Bay
FIGURE NO. 7  Looking down cliff face of Surrey Upland. Note the steepness of the incline.
the level nature of the countryside is interrupted by several low sand ridges which rise about three feet above the general level of the surrounding land. In most parts of British Columbia ridges of this height would be scarcely noticeable, but on the level Delta they comprise significant features of the topography. These sand ridges mark former beach levels which would be present when Point Roberts was an island during the geologic past. The development of the delta has caused the sea to retreat a short distance and leave the sand ridges as evidence of its former encroachment upon the land.

3. Climate

The climatic readings for the area were made at Ladner, B.C. between the years 1910 and 1934. The reporting station at Ladner had an elevation of 2 feet above sea level. It was situated at 49 degrees 5 minutes North Latitude and 123 degrees 4 minutes West Longitude.

Certain general characteristics of the climate can be ascertained from the geographical position of the district. The location on the west coast of a major continent in the middle latitudes of the Northern Hemisphere will impose a climatic pattern on the area. Variations from the general characteristics will be dependent upon local conditions. The climatic conditions that we would expect to find are a mild climate with abundant precipitation. Such is indeed the case. The effect of local position upon these general characteristics will be seen when we examine the detailed climatic
FIGURE NO. 8  Dykes along the Fraser River.
FIGURE NO. 9

DELTA

- UPLANDS
- BEACHS
- FLOOD BOX
- DYKES
- SLOUGHS
data available for the area.

Mean monthly temperature and mean monthly precipitation for Ladner are shown in Fig. No. 10.

A comparison of this data with Koppen’s Csb (7) climate will show that the climate of the Delta fits within this category. January has the lowest mean monthly temperature (37 degrees). This average fits between the critical temperatures of 26.6 degrees and 64.9 degrees set out by Koppen as the limits for winter temperature. The months from May to September inclusive have monthly average temperatures exceeding 50 degrees. These averages place the mean monthly temperatures well above Koppen’s minimum summer mean for a C climate. December, the wettest month, with an average of 5.33 inches of precipitation has more than three times the precipitation of July, the driest month with 1.12 inches. The July precipitation average is also less than the maximum amount allowed for the driest month of the year. This data places the climate within the limits set out for the dry summer phases “s” of Koppen’s C climate. July and August with mean monthly temperatures of 62 degrees are the warmest months. Average summer temperatures such as these place the area within Koppen’s description of the “b” or cool summer phases of his warm temperate climate.

(7) Csb climate may be defined as follows: C. Warm temperate rainy climate, coldest month below 64.4 degrees, above 29.6 degrees; warmest month over 50 degrees; s. summer dry with at least three times as much rain in the wettest month of winter and in the driest month of summer, and the driest month of summer receives less than 1.2 inches; b. cool summer, average temperature of warmest month under 71.6 degrees.
LADNER B.C.

ANNUAL PRECIPITATION, ANNUAL TEMPERATURE

FIGURE NO. 10
Although the precipitation of the district is considered adequate for agricultural purposes there is a considerable variation in the annual total. Annual precipitation has varied from 23.31 inches to 55.86 inches. This gives a variation of from 13 inches below average to 19 inches above average. In a seventeen year period (1916 to 1934 less 1921 and 1922) precipitation was below average 8 times, above average 8 times, and average once, see Fig. No. 11.

Precipitation for the six summer months averages 9.51 inches with a minimum of 3.24 inches and a maximum of 21.87 inches. This gives a variation of from 6.27 inches below average to 12.36 inches above average. In the same seventeen year period used in the previous comparison the summer precipitation was below average eight times and above average nine times. The years in which the summer precipitation was below average were not always the same years in which the annual precipitation was below average. See Fig. No. 12.

Precipitation that varies as much as this during the growing season will have an effect on agriculture. In some years there will be poor crops as a result of insufficient rainfall, while in others too much rainfall will damage the crops.

The district has an average of from one hundred to one hundred and ten days with measurable rain each year; 63% of these rainy days occurring during the winter six months.

According to Thornthwaite's latest classification of climates (8) the potential evapotranspiration exceeds

ANNUAL PRECIPITATION
Variation from Average

FIGURE NO. 11

SUMMER PRECIPITATION
Variation from Average

FIGURE NO. 12
precipitation for five months of the year - from mid-April to mid-September. However, there is sufficient water storage in the soil to make up the deficiency until the end of June. For the next two and a half months there is a water deficiency in the area. As a result the area is not suited for crops that have a high water requirement during the summer months.

The district has a growing season of 243 days. The critical temperature for the computation of this season is a daily mean of 43 degrees. The average dates for the occurrence of this temperature are March 16th in the spring and November 14th in the fall. (9) If the frost free season is calculated on the basis of at least one degree of frost, there is an average frost free period of 238 days. The first frost of the fall occurs between October 14th and November 14th while the last frost of spring occurs between March 7th and March 17th. If the frost free period is taken from a minimum temperature of 32 degrees the length of the season is 183 days. On this basis the first fall frost may occur from September 3rd to December 24th with the average being October 18th, and the last spring frost will occur from March 17th to June 18th with the average being April 18th. (10)

While climate has a certain interest by itself, it is of primary interest to the geographer in the effect that it has upon the occupation of an area by man and by vegetation. The


(10) Connor, A. J. The Frost Free Season in British Columbia, Department of Transport, Meteorological Division, Toronto, 1941.
This type of graph was devised by Professor Griffith Taylor to portray the suitability of an area for human habitation from a standpoint of comfort. The top side of the graph is too hot, the bottom is too cool, the left is too dry, the right is too wet. The nearer to the centre of the graph that the climatic data for a station can be plotted, the more comfortable the area is for human habitation.

A comparison of Ladner and Vancouver on a graph of this nature shows that Ladner has a much drier, hence pleasanter, winter season than does Vancouver. During the summer conditions are comparable.
This type of graph was devised by Professor Griffith Taylor in an endeavour to show graphically the suitability of an area for human habitation. He selected mean annual temperature, mean annual precipitation, elevation, and coal reserves as the four requirements that are most critical from a standpoint of human habitation.

The line graph above shows the graph of optimum habitability whereas the dotted graph shows the data for Ladner. Because Ladner has no coal reserves the graph is one sided. If the other three criteria were considered alone, however, Ladner is not far from meeting the requirements.
climatic conditions on the Delta allows a greater human comfort than does the climate of neighbouring Vancouver, see Fig. No. 13. For the effect of the climate upon the choice of crops within the area see Table No. 1.

4. Soils:

Soils of the area have been classified in the "Soil Survey of the Lower Fraser Valley" as Ladner Clay and Peat. In addition there is a mixed area, not shown on the soil survey, in the districts around Beach Grove, Boundary Bay and Tswassen. This mixed area is referred to as "Bay Sands" on the accompanying soils map, Fig. No. 15.

The soil survey describes Ladner Clay as follows:

"The soil is recently deposited sediment. Profile development is absent. Where the land has been in permanent pasture a dark coloured surface layer of organic matter, accumulation from 4 to 6 inches thick has developed. This is grey-brown to black clay, granular and heavy. The next 50 inches is grey clay well mottled with iron stains. The structure is massive and tough when wet. When the land is ploughed the grey, mottled parent material is turned to the surface. At about 50 inches a stratum of bluish and micaceous sandy clay in texture is encountered.

"Since the Ladner Clay is comparatively uniform in texture, with smooth topography, the profile varies but little from place to place." (11)

An analysis of the surface of Ladner Clay gives the following content of the soil: (12) see Fig. No. 16.

| Organic Matter | 9%       |
| Very fine sand | 10%      |
| Silt           | 56%      |
| Clay           | 25%      |


With this content the soil would be classified as loam to silt loam on the United States Department of Agriculture system of soil classification. Soils in this category usually have a high percentage of colloids which serve as a source of plant food and as an adhesive agent in the soil itself.

Ladner Clay becomes very heavy and sticky when wet. As a result of heavy winter precipitation it is usually in this condition from October to March of each year. The tendency of the soil to become saturated with water during the winter is aided by the high water table of the area. Consequently it is not possible to work the soil until late March or April when the precipitation decreases in amount and the drainage system has an opportunity to remove excess moisture.

On the other hand, in summer, if a prolonged dry spell develops, the exposed surface of Ladner Clay hardens and cracks. However, the soil never dries out for more than a few inches below the surface.

The gumbo-like quality of Ladner Clay during winter and early spring is a problem to the farmers. It is impossible for him to commence spring ploughing until the soil has dried out sufficiently to allow machinery to operate on the land. An excessively wet spring combined with the nature of the soil can be a real handicap to agriculture in some years. However, the use of tractors for ploughing has mitigated this handicap to a certain extent, by allowing the task to be completed in less time than when horses were used.

Ladner Clay shows a tendency to a low phosphorous and lime content. Application of fertilizers will overcome this
FIGURE NO. 16

SOIL CONTENT

- SILT
- CLAY
- FINE SAND
- ORGANIC MATTER
deficiency and materially increase the fertility of the soil.

Ladner Clay would be classified as Class II land in the classification appearing in a United States Department of the Interior publication. (13) Although the soil has a high fertility, the fact that special practices such as draining and dyking are necessary before cultivation is possible excludes the soil from Class I. (14)

Within the area covered by this thesis there are 2,000 Acres of Ladner Clay on Westham Island and approximately 23,500 acres in the rest of the district. The soil on Westham Island is entirely devoted to agriculture, whereas in the rest of the area acreage is utilized for residential, commercial and recreational purposes as well as agricultural.

The peat of the area is mostly of sphagnum moss origin. There are 10,500 acres of peat within the Delta. Of this total 4,700 acres in the central part of the bog have a peat covering of from 2 to 10 feet in thickness. Included in the bog is a half-bog series which has not been differentiated in the soil survey.

The half-bog series exists mainly towards the outer edges of the Peat Bog. With drainage and cultivation it will leave Ladner Clay exposed. To become as productive as Ladner Clay this soil needs special treatment for some time after reclamation. (15) South and east of Peck Road about 1,000 acres


(14) See Appendix 1.

(15) Dominion of Canada, Department of Agriculture, Soil Survey of the Lower Fraser Valley, Publication 650, Technical Bulletin 20, Ottawa, King's Printer 1939, p. 44.
of this half-bog have been brought under cultivation in the last twenty years. Seven hundred acres of formerly cultivated peat soil lying south of Ladner Trunk Road were taken out of cultivation during the war and devoted to military use.

Soils around Boundary Bay, Beach Grove and Tswassen differ in general characteristics from Ladner Clay. The principal difference lies in the large amount of sand found in this soil type. In many places there is no evidence of any clay being present. A series of very low sand ridges which join the northeast corner of the Point Roberts Upland to Beach Grove provide the boundary between Ladner Clay and Bay Sands.

Bay sands consist of a series of sand ridges alternating with clay depressions. Sandy soil predominates around Beach Grove and Boundary Bay and along the shoreline between them. In the triangular area between the beaches and the eastern flank of Point Roberts. Upland clay predominates although cut in places by sand ridges. Around Tswassen sand is definitely predominant. Along the north face of the Point Roberts Upland there is a narrow strip of sandy soil between the base of the cliff and Ladner Clay. The nature of the sand ridges and their relationship one to another suggests that they represent former beach levels of the Gulf of Georgia and Boundary Bay. There is no comparable sand soil along the western flank of the Surrey Upland. The peat formation abuts sharply upon the base of this highland.

In a land utilization study the adaptability of the soil to agricultural practises is of prime importance. There are certain general characteristics of a soil that will either
encourage or retard the growth of crop plants upon it. These characteristics have been listed as follows:

"(a) suitability for the cultural implements required for most efficient production.
(b) effective resistance to destructive soil erosion and soil depletion under the cropping system involved in profitable management.
(c) adequate moisture storage to meet the water requirements of the crop under normal rainfall or irrigation.
(d) available plant nutrients.
(e) freedom from adverse chemical conditions, or special conditions that favour growth of parasitic organisms." (16)

A comparison of the soil types of Delta with these conditions will aid in determining their suitability for agriculture. There is nothing in the topography of the area which prohibits the use of farm machinery or makes the soil susceptible to soil erosion. As has already been noted when the soil becomes wet it is heavy and sticky and difficult to work. Adequate drainage alleviates this condition. Thus, before the soil of Delta can fulfill requirement "a" it must be thoroughly drained. The level nature of the topography is the best protection that the soils have against erosion. In particular it is protected from sheet or gully erosion. With an efficient crop rotation system the soil will retain its fertility for a long period of time. As a result the soil of Delta fulfills requirement "b".

Soils that fail to meet condition "c" are found in the areas of sand or where there is insufficient natural moisture. The sandy soils around Beach Grove and Boundary Bay do not

Table No. 1

Suitability of Climate and Soil of Delta in regard to cultivation of certain crops.

<table>
<thead>
<tr>
<th>CROP</th>
<th>CLIMATE SUITABLE</th>
<th>SOIL SUITABLE (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>No-summers too cool</td>
<td>Barley - no, too acidic</td>
</tr>
<tr>
<td>Small Grains</td>
<td>Yes</td>
<td>Buckwheat - tolerant of soil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oats - yes, tolerant of low phosphorous and acidic soil</td>
</tr>
<tr>
<td>Hardy Vegetables</td>
<td>Yes, although summer precipitation a bit light.</td>
<td>Wheat - no, requires high phosphorous content and alkaline soils.</td>
</tr>
<tr>
<td>(as cabbage, beets,</td>
<td>Intolerant of mean temperatures over 70 to 75 degrees F.</td>
<td></td>
</tr>
<tr>
<td>spinach, parsnip)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cauliflower,</td>
<td>Yes, although summer precipitation light,</td>
<td>Have a wide tolerance to soil conditions.</td>
</tr>
<tr>
<td>lettuce, peas,</td>
<td>Prefer summer means of 60 to 65 degrees F.</td>
<td></td>
</tr>
<tr>
<td>carrots, celery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potatoes</td>
<td>Yes</td>
<td>Have a wide tolerance to soil conditions.</td>
</tr>
<tr>
<td>Timothy and Alfalfa</td>
<td>Yes</td>
<td>Soils in natural state too acid.</td>
</tr>
<tr>
<td>Red Clover</td>
<td>Yes</td>
<td>Soils in natural state too wet, too low phosphorous content.</td>
</tr>
<tr>
<td>Hardy fruits as</td>
<td>Yes, although high percent of cloud cover keeps from</td>
<td></td>
</tr>
<tr>
<td>Apples, pears,</td>
<td>being ideal.</td>
<td></td>
</tr>
<tr>
<td>cherries, most berries</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) Note: Soils have been considered in their natural state. The application of lime and phosphorous, and drainage has overcome many of the difficulties.
retain moisture during the drier summer months. Except for soils in these two districts, soils of Delta fulfill requirement "c".

Since the soil is lacking in lime and phosphorous this is added in the form of fertilizer. The necessity of fertilization creates an extra charge upon the land which would not be necessary if the nature of the soil measured up to requirement "d". The soil has a tendency to be acidic if not well drained but with adequate drainage and the application of lime this acidity can be largely overcome. Thus before the soil can meet condition "e" it requires a certain amount of special treatment.

The above survey of the suitability of the soil indicates that the soil is not perfect but that it has few serious faults and is generally suited for agricultural use. Besides these general characteristics, each plant has its own adaptability to soils. Various plant requirements have been compared with conditions pertaining to Ladner Clay. The result of this comparison is given in Table 1.

5. Drainage:

Natural drainage of the district was provided by a number of sloughs many of which have since been filled in. A few main sloughs have been retained as the basis of the present drainage system. The original drainage pattern can be reconstructed by looking at the map (Fig. 9) showing the present sloughs. Each of these sloughs had several short tributaries which drained the surrounding area. Natural drainage of the area proved ineffectual. When the river level rose, the water
FIGURE NO. 17  Pumping station used to pump water from ditches into flood boxes.

FIGURE NO. 18  Flood box exit.
in the sloughs backed up onto the land and flooded rather than drained it.

Present drainage consists mainly of underdraining in the fields leading into a primary ditch system. These ditches usually parallel the side roads. The primary ditches lead in turn to a few trunk ditches or the sloughs. Trunk ditches drain into the river or sea by means of controlled outlets through the dykes known as flood boxes. When the water level is high the flood box is closed to prevent water from the river backing up the ditches. Water will lie on the fields in winter and early spring, when, after heavy rain, the ditches cannot be emptied because of high tides. As a result of great improvements that have been made in the drainage system the problem of water lying on the fields is not as great now as it was ten or fifteen years ago. This improvement has been affected by digging more ditches and by keeping existing ones free from any obstruction. Drag-lines working on the ditches are a familiar sight to residents of Delta. Drainage is greatly helped by the fact that the level of the Fraser River is affected by tides in the Gulf of Georgia. As a result there are two periods of lower water every twenty-four hours except during the freshet season when the river level overcomes the tidal influence. During low water the flood boxes can be opened and water from the ditches released.

6. Natural Vegetation and Wildlife:

As the land is nearly all under cultivation little remains of any natural vegetation. Only in the peat bog and in parts of the district near the eastern boundary and around Beach
Grove, Boundary Bay and Tswassen is there any natural vegetation left standing.

Before settlement took place trees were found along the banks of the sloughs, the river and the seacoast where there was better drainage. Grass grew away from the sloughs in the poorly drained areas. A similar situation prevails today in the river marshes. A traveller who passed the area prior to 1860 described it as:

"... great swampy tracts overgrown with coarse grass and rushes, the happy haunt of wildfowl of every description." (17)

A sea captain who visited the area about the same time described the western edge of the Fraser delta as follows:

"From Point Roberts to Burrard Inlet, a distance of 28 miles the coast is low and swampy, the trees appearing to form an unbroken line, when looked at from the Gulf of Georgia ..." (18)

It was this appearance of the western edge that caused Captain George Vancouver to miss the mouth of the Fraser River when he explored the Gulf of Georgia in the eighteenth century.

In the half-bog there is a heavy covering of cedar (thuja plicata), pine (pinus contorta) and bushes. Around Beach Grove and Boundary Bay there are small stands of fir (pseudosugo taxifolia), spruce (picea sitchensis), maple (Acer macrophyllum), and cedar. Parts of these two districts have a grass cover which is characteristically brown in summer.


Trees presently growing in the area are of no commercial value. Their chief use is to provide a haven for wildlife, particularly birds.

The dominant forms of wildlife are birds and small animals. Three classes of birds are found (a) water fowl, (b) upland game birds, and (c) small birds. The most common forms of animal life are rats, mice and moles with a few muskrats along the river's edge.

Water fowl such as seagulls, ducks and loons make their home on river islands and along the coast. During the fall when geese and ducks are migrating southward the water fowl population expands rapidly. The sheltered waters of the river and of Boundary Bay provide a resting place on their southward journey. Small quantities of grain which remain in the fields after harvest are a source of food for the migrating birds. The presence of ducks and geese in the area make it one of the best hunting districts in the Lower Mainland.

Pheasants and quail are the principal upland game birds in Delta. Although they add to the reputation of hunting in the area, they are often a nuisance to the farmers. They feed in the fields and can do considerable damage to young plants.

Among the small birds found in the area are robins, sparrows, swallows, crows and blackbirds. In summer the bird population is far greater than in winter, although many of them never migrate with the seasons.
CHAPTER TWO
PERIOD OF EARLY SETTLEMENT

With the exception of the Hudson Bay Company's Post at Fort Langley there was little settlement in the Lower Fraser Valley until after 1860 when unsurveyed country lands were made available for pre-emption. In the decade following, settlement began at Maple Ridge, Langley Prairie and South Westminster in 1860, Chilliwack in 1862, Lulu Island in 1864, Crescent Island in 1865, and Ladner in 1867. The early settlers had a choice of two sharply contrasting environments in which to make their homes - the level, grass-covered, frequently flooded lowlands, or the rolling, tree covered, till uplands. Almost invariably they chose sites in the former. Reasons for this choice will be brought out in the following sections.

1. Original Conditions:

Great problems faced the early settlers who pre-empted land in Delta. In the following paragraphs the geographic environment in which settlement took place will be reconstructed.

T.E. and W.H. Ladner are credited with being the first white men to cross the area. In 1859 they were accidentally landed by canoe at West Point Roberts. From there they walked to Fort Langley. The land they saw was covered by wild grass that stood as high as a grown person. The grass grew thicker in places where it received a greater supply of moisture as a result of flooding. A few Douglas Fir and Cedar existed throughout the area with the largest clump just to the east.
of Chilukthan Slough near what is now Ladner Trunk Road. In other places small groves of cottonwood (Populus trichocarpa) were to be found. The presence of trees indicated land higher or better drained than the surrounding countryside. Many varieties of trees covered the peat bog then as now.

The low lying swampy characteristic of the area provided an almost ideal breeding ground for many types of insects.

"In the months of July and August these insects can only be described as forming a dense, humming cloud, which covers the country to a height of 20 feet above the ground." (19)

An extension of the peat bog across the area in the vicinity of Tasker Road cut the present municipality in two. As a result continuous land transportation across the area from east to west was not possible. This division of the land area played an important role in the subsequent development of Delta.

The only natural water supply in the district was at the site of the present waterworks at the head of Oliver Road. Springs at this place provided a steady supply of water for the eastern half of the municipality. Water in the western half came from the river or from precipitation. The difference in the availability of fresh water also affected the development of the area.

Natural sloughs provided the only drainage system. They were also the only routes for local transportation. For several

years after settlement commenced travel was by boat along these sloughs.

The first settlers found much of the soil covered with a peat layer. Two methods were used to remove it. The first method was to set fire to the land in the fall. It became a common sight to see acres of land on fire in the autumn. In some cases the farmer would burn off too much of the peat and would have only clay left to cultivate. The excessive burning of the land would often do a great deal of harm. An area north of Trunk Road between Benson and Tasker Roads remains unproductive to this day as a result of excessive burning. The usual practise, however, was to mix the ash that remained from the burnt peat with the remaining sub-soil. The farmers found that the mixture of ash and soil produced a good crop.

The other method of bringing the peat covered land into cultivation was much slower but was, at the same time, less dangerous. Cows were pastured on the peat covered sections and over a period of a few years the peat and the clay became mixed.

2. Original Settlement:

The system of pre-empting country land in British Columbia was regulated by an Order-in-Council issued by Governor Douglas in 1860. This ordinance provided two methods of obtaining land. To acquire tracts of land of less than 160 acres, the settler had to decide on the size of the farm and then give a description of the location and boundaries to the
nearest magistrate. He also had to pay a registration fee of 8 shillings. To pre-empt larger areas the settler had to pay an installment of 2 shillings 1 penny per acre until such time as the land was surveyed by the government. After the survey the value at which the land might be assessed - not over 4 shillings 2 pence an acre - became payable. There were restrictions also on the sale or mortgage of pre-empted land to prevent speculation. The ordinance also required that the 'pre-emption' be rectangular in form with the shortest side of the rectangle to be at least two-thirds of the longest.

The settler could have his land surveyed or he could wait for the government survey. In either case, as far as pre-empted land was concerned, the purpose of survey was to confirm the original boundaries. In areas where the survey preceded settlement the following survey system was used:

"The system of survey used in the prairie provinces of Canada and in the western United States - that of ranges and townships - to define farm and timber lands was considered unsuitable for the physiography of British Columbia. The farm land and timber areas in British Columbia occur in the wide valleys, bench lands, and plateaus, these being separated by mountains and ranges.

"With few exceptions the farm lands have been laid out in areas of a mile square, a half, or a quarter and are called land lots, being surveyed by transit and chain (66 feet to a chain) giving sides of 80, 40, or 20 chains. Each land lot has been oriented to true north. These surveys were not laid out in any regular pattern but simply followed the choice pieces of land as they were selected or pre-empted." (20)

That part of Delta, west of Goudy Road and along the river, was surveyed following settlement. As a result the lot lines

are influenced by the configuration of the river bank as each settler tried to obtain land along the river. East Delta was surveyed prior to settlement and by the mile square system. As a result the lot lines are laid out in regular fashion. Where road allowances were not made in the survey, authority was vested in the municipal council to appropriate sufficient land for an adequate road system.

The first claim for land in Delta was made by a Robert Wilson for a site 6 chains east of Chilukthan Slough on July 7, 1860. (21) This claim was later abandoned. It was taken over by T. Harris on March 2, 1865. F. Norman pre-empted land one mile east of Wilson on April 30, 1862, but this claim was also abandoned, being taken over on April 9, 1870 by J. Cooper. Three claims were made in the Ladner area during 1862 but these were likewise abandoned. In 1868, T. E. and W. H. Ladner filed claims for land at the mouth of Chilukthan Slough. The subsequent settlement of these claims marked the first effective utilization of land near the present site of Ladner.

The application of T.E. Ladner was filed in the Registry Office in New Westminster in May 1868 and land was granted in June of the same year - No. 642 at the Land Registry Office. (22) The grant was for 500 acres on the east side of Chilukthan Slough. In the same year W. H. Ladner obtained a similar acreage on the west side of the Slough.

(21) Information used in this section on land grants from, Laing, F. W. Colonial farm settlers on the mainland of British Columbia 1858-1871, Victoria, B. C., 1939, typsecript.

(22) Copy of original land grant now in possession of L. J. Ladner.
FIGURE NO. 19

FIRST LAND GRANTS - FIRST LAND DYKED
In 1869 three more grants (Nos. 680, 696, and 707 New Westminster Land Registry Office) totalling 480 acres were made. Seventeen grants for a total of 2,200 acres were made in 1870, and over 2,000 acres were pre-empted in 1871. Military grants covering 1,200 acres were made on Westham Island in 1870. Thus, four years after settlement commenced on Delta nearly 7,000 acres had been pre-empted. The accompanying map (Fig. No. 19) shows the location of the lands granted to the Ladner Brothers.

3. **Original Problems:**

The original settlers found three difficult problems which had to be solved before the utilization of the land for agricultural purposes could become effective. The first of these problems was flooding, the second was drainage, the third was insect nuisance.

In its natural condition the area under consideration is subject to flooding when the Fraser River reaches its freshet stage. Flooding from winter high tides was common but did not present as serious a problem as did the spring flooding. In the biographies (23) of the early settlers it is common to find reports of the land being under water for as much as six months each year.

To meet the problem of flooding, the farmers began to erect individual dyking systems. The first dykes were built by W. H. Ladner around a few acres that are now included within the village of Ladner. The approximate position of these dykes is shown on the map (Fig. No. 19). Dyking of a

few acres at a time became the pattern for flood protection of the area. Each farmer would dyke a small area and then proceed to cultivate the protected land. This system of dyking proved to be inadequate. An extremely high freshet in May and June of 1894 broke the dykes and completely flooded the area. It became obvious that a more permanent method of dyking was essential if future flooding was to be avoided.

During the flood of 1894 the land was covered by from two to three feet of salty water. Many of the houses had eight inches of water in them, while ten inches or a foot in barns was quite common. It was necessary to store grain in the upper floors of houses to keep it dry. Many of the farmers lost every cow due to tuberculosis resulting from the animals having to stand in water or on wet soil. The land was not specially treated after the flood waters receded but was cropped in the usual way and left to work itself back to normal. Poor crops resulted but in a year or two the salt that had been deposited was washed away by rainfall.

To meet the need of a better dyking system Delta Municipality undertook the construction of dykes around the exposed borders of the area. These dykes have remained until the present. With the exception of a few minor breaks, particularly on Westham Island during the 1930's, they have given almost perfect protection. Following the Fraser Valley Flood of 1948 the dykes were strengthened and heightened under the direction of the provincial government. Although the original dykes held under the strain of the extremely heavy freshet of that year many weak spots were discovered and they have
received the greatest attention.

The second problem of the area was drainage. The very nature of the land makes farming very difficult when the soil is wet. After heavy rain, or as in the early days of the community, after inundation from floods, the area was covered by a gumbo-like substance. In order not to delay spring planting an effective drainage system was essential.

The following quotations will illustrate the difficulties faced by the early settlers in preparing land for cultivation before an adequate drainage system was introduced. In a biography already mentioned, the author, in writing of the late John Honeyman, points out the difficulties he faced in preparing his land in East Delta in 1888:

"In order to cultivate this tract it was necessary to wear rubber boots while the horses were shod with wooden shoes". (24)

Similar difficulties were faced by other early settlers. In writing of the problems faced by A.J. Parmiter the biographer says:

"It was impossible to proceed very rapidly with this part of the work (breaking the land and preparing it for cultivation), as even with the assistance of three or four teams of oxen but little could be accomplished in a day owing to the condition of the soil. The cattle would oftentimes sink to their knees in the mire and it would be necessary to get a team of horses to pull them out. He plowed and planted an acre at a time." (25)

It is to the late Hon. John Oliver that credit is due for introducing an effective drainage system. He was the first


(25) Ibid. p. 564.
farmer to make extensive use of underdraining. This he did on his East Delta farm. The method he used became standard throughout the rest of the area. Cedar planking six inches wide was joined to form a triangular shaped pipe. The pipe was buried three feet beneath the surface of the ground with the apex placed upwards. These drainage pipes were buried in series every two to four rods across the width of the farm. The drains ran outwards towards the dykes. This system proved to be very effective in its primary purpose of reducing the water of the soil. As a secondary effect the underdraining of the soil greatly increased crop yields as the soil moisture content was reduced to a level which provided more optimum growth conditions for plants.

John Oliver's own account of why he underdrained the land is interesting.

"There are the men who scoff at the supernatural, but I am not one of these. I believe that men can still see visions and dream dreams. I know that in those days I used to have dreams night after night in which I saw the grain sprout up in my land only to wither and die, and I saw also that the land was white with salt. Then another night in a kind of trance I had another vision. I saw a great rain descend and dissolve the salt and wash it away. The problem of raising crops on my land was solved there and then.

"I had no money, so I cut ditches with a spade and put in wooden drains at stated intervals. The winter rains came and washed away the salt through these drains, and the following year I had the finest crop of oats I had ever seen. That was the start of underdraining in British Columbia." (26)

The third problem, that of insects, gradually disappeared as improved drainage decreased the number of breeding grounds.

4. **Reasons for Settlement:**

Before human occupation the area was an unfavourable environment. As has been pointed out the land is so low in elevation that it is subject to frequent flooding, the soil becomes heavy and sticky when saturated with water, and insects abounded. However, man occupied the area. He built dykes to keep out the flood waters; he installed a drainage system so that the soil could become dry enough to be farmed. By preventing floods and by draining the land, man also went a long way towards solving the insect problem by removing the swampy areas which they prized as breeding grounds. Thus, before the natural environment of the area could be utilized it was essential that it be modified by man.

If man had to so modify the environment why did he come to this area; why did he not settle somewhere else where flooding and drainage were not such great problems? Two factors would seem to provide the answer to these questions. In the first place the natural vegetation of the area was grass and there was, hence, no problem in clearing the land; in the second place, the higher land in the Fraser Valley was covered by a thick forest growth which was described by many travellers as constituting a veritable jungle. While there are no comparable figures, it would seem that the cost of dyking and draining the clay soils of Delta must have been less than that of clearing the upland soils. It is possible that there is also a psychological reason. The environment of Delta presented a challenge to man's ingenuity and strength. To men like John Oliver this challenge may have been the motivating factor.
CHAPTER THREE
AGRICULTURAL UTILIZATION

1. Historic Utilization:

In order to obtain a fuller understanding of the present agricultural utilization of the land it is necessary to study the historic development of agriculture in the district. In tracing the agricultural development from 1868 to the present there has been a lack of statistics and a lack of uniformity in such statistics as were available. There are, however, sufficient statistics in one form or another to give a representative picture of the development of agricultural land utilization.

The early settlers realized that the moist climate and the fertile soils provided the natural basis for a hay and pasture economy. The division of the municipality into two parts by the southward extension of the peat bog and the lack of an adequate water supply in the western half caused the two parts to develop along different lines during the early years.

In the eastern half, water was available from springs along the base of the Surrey Upland. Dairying became the mainstay of the agricultural economy. Oats, hay and mangles were grown as field crops for this industry. Butter marketed in New Westminster or in Victoria provided the cash income of the farmer.

The lack of fresh water in the western half caused the settlers to make a different adjustment to the environment. Instead of becoming dairy farmers they became cattle ranchers because dairying requires a large supply of fresh water. The
beef cattle were imported into the area from the Great Plains Region of the United States. They were driven overland from the ranching regions to the Pacific Coast. Field crops similar to those in the eastern part were grown for the cattle industry.

It has not been possible to obtain any adequate data for the period from 1868 to 1892. It is known, however, that this was the period of settlement and of bringing the land under cultivation. By 1892 most of the readily-worked land had been brought into use. Dyking was still inadequate and drainage left much to be desired. In spite of the handicaps, a fairly prosperous agricultural community had grown up by 1892.

By this time 111 settlers had taken up land in Delta. Settlement was either along the river, the sloughs, or the shore of Boundary Bay as water still provided the main transportation route. A few settlers had begun to locate farms inland as road communications to New Westminster were opened—the Scott, Peck and River Roads. The central road system of Delta, i.e., the Trunk and its north-south feeder roads, began to take shape in this period. Trunk Road which provided the necessary link across the bog between the west and east of Delta was known locally as "John Oliver's Dyke." To provide a road base across the bog, gravel and tree branches were used. This filling material was piled well above the level of the land, giving it a dyke-like appearance. The road surface was corduroy.

Farm houses in Delta in 1892 looked much as they do to-day. Many of the present farm dwellings were built at this time. Around Ladner each house had a large tank in which to store
rainwater. Transportation between Delta and other points in the Fraser Valley and on Vancouver Island was provided by steamers which ran from Victoria to New Westminster and called at Ladner on each trip. Victoria provided the market for surplus produce from Delta with New Westminster a poor second.

From 1892 on it is possible to obtain a more accurate picture of agricultural growth on Delta. The first reference made to Delta in the Annual Reports, British Columbia Department of Agriculture was in 1892. In that the year the local correspondent wrote of the area:

"Most crops and fruits do well, and it is needless to say that the yield is enormous, and large quantities of wheat, barley, oats, root crops and fruits are grown. It is a district eminently suited for dairying but the industry is not prosecuted, except in a desultory manner." (27)

Table No. 2 shows the breakdown of land utilization in the area under consideration in the years 1892 and 1894.

<table>
<thead>
<tr>
<th>Year</th>
<th>Use</th>
<th>Area (in Acres)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1892</td>
<td>Cultivated</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pasture</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Woodland</td>
<td>10.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marsh</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>1894</td>
<td>Cultivated</td>
<td>10,541 Acres</td>
<td>53.1</td>
</tr>
<tr>
<td></td>
<td>Grain</td>
<td>3,833</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hay</td>
<td>5,146</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Potatoes</td>
<td>241</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other roots</td>
<td>228</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pasture</td>
<td>6,415</td>
<td>32.3</td>
</tr>
<tr>
<td></td>
<td>Woodland</td>
<td>2,545</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Marsh</td>
<td>324</td>
<td>1.6</td>
</tr>
</tbody>
</table>

(27) British Columbia, Department of Agriculture, Annual Report, 1892, p. 789.

(28) Compiled from figures appearing in Annual Reports of British Columbia Department of Agriculture.
In the 1894 figures there is a discrepancy of 1,093 acres between the amount of land listed as cultivated and the land shown in various crops. All the land in cultivation (with the exception of approximately 4% if we disregard the missing 1,093 acres, and approximately 15% if we assume it being used for other purposes) was used for hay and grain.

Production figures for the years 1892 and 1894 appear in Table No. 3.

<table>
<thead>
<tr>
<th>Crop</th>
<th>1892 (in tons)</th>
<th>1894 (in tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain</td>
<td>6,000</td>
<td>2,922</td>
</tr>
<tr>
<td>Hay</td>
<td>10,000</td>
<td>9,177</td>
</tr>
<tr>
<td>Root Crops</td>
<td>12,000</td>
<td>3,293</td>
</tr>
<tr>
<td>Fruit</td>
<td>100</td>
<td>58</td>
</tr>
</tbody>
</table>

These figures indicate the reliance of the farmer on two crops - hay and grain. They also indicate very clearly the effect upon agriculture of the area when heavier than average rains occur in September as happened in 1894. The hay crop which is harvested first was scarcely affected, but the later maturing grains and root crops were hard hit. For this reason the 1892 figures are more representative of the productivity of Delta than are the 1894.

In 1898 direct ferry service between New Westminster and Ladner was inaugurated. With this improvement in transportation with the up-river city, the outlet for Delta produce gradually changed from Victoria to New Westminster. A direct link with Vancouver was not to come until several years later.
The next year for which representative statistics are available is 1911.

Table No. 4.- Agricultural Production in Delta, 1911

<table>
<thead>
<tr>
<th>Crops</th>
<th>Production (in tons)</th>
<th>Value</th>
<th>Percent of total value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hay</td>
<td>20,000</td>
<td>$400,000.00</td>
<td>36</td>
</tr>
<tr>
<td>Grain</td>
<td>12,500</td>
<td>315,000.00</td>
<td>28.3</td>
</tr>
<tr>
<td>Roots</td>
<td>7,000</td>
<td>150,000.00</td>
<td>13.5</td>
</tr>
<tr>
<td>Milk</td>
<td>60,000 cans</td>
<td>120,000.00</td>
<td>10</td>
</tr>
<tr>
<td>Livestock</td>
<td>150 cars</td>
<td>100,000.00</td>
<td>9</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>25,000.00</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>1,100,000.00</td>
<td>100.00</td>
<td></td>
</tr>
</tbody>
</table>

While no estimate can be given of acreage of land in use in 1911, several facts regarding the type of agriculture practised in Delta can be ascertained from these figures. Hay and grain still provided the basis of the agricultural economy. Potatoes and root crops were still a poor third in the list of important crops. However, sale of fluid milk provided a new factor in the farm economy. Dairying had started to become an integral feature of land utilization.

Two factors were responsible for the appearance of dairying as an important part of the agricultural pattern. In 1903 the Great Northern Railway opened a branch line from Colebrook in Surrey to Port Guichon on the Fraser River two miles west of Ladner. This railway line provided a fast and reliable means of transportation between Delta and the consuming markets of Vancouver and New Westminster. In 1910 Delta Municipality installed a piped water system using the springs at the base of the Surrey Upland as the source of water. A pump lifted the water from the cliff base to a reservoir erected halfway
up the hillside. All parts of Delta were then provided with a sure and adequate supply of fresh water.

As a result of the increasing importance of dairying in Delta, several noticeable changes occurred in the cultural landscape. Large barns were essential to the dairy industry and these began to appear on most farms. Large barrel-like silos were erected beside each barn for the storage of ensilage. By this time the road system of Delta had taken on its present form. The railway and river steamers provided the major transportation connections. Within the Delta, horse and buggy had replaced boats, and there was a small but growing amount of road traffic to New Westminster. This road traffic was heaviest on Friday mornings when the farmer and his family set off in their buggy to market their produce at the Farmer's Market in New Westminster. On Saturday night the farm families would gather in Ladner to purchase their needs, to meet their friends, and to talk. This Saturday night in Ladner became such a tradition that even to-day the stores in Ladner remain open until nine o'clock on a Saturday night.

The next year for which comparable figures are available is 1927.
Table No. 5 - Agricultural Production in Delta, 1927 (29)

<table>
<thead>
<tr>
<th>Crops</th>
<th>Production (in tons)</th>
<th>Value (in $)</th>
<th>Percentage of total value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain</td>
<td>13,000</td>
<td>455,000.00</td>
<td>24.1</td>
</tr>
<tr>
<td>Hay</td>
<td>15,000</td>
<td>240,000.00</td>
<td>13</td>
</tr>
<tr>
<td>Potatoes</td>
<td>8,000</td>
<td>160,000.00</td>
<td>8.7</td>
</tr>
<tr>
<td>Milk</td>
<td></td>
<td>325,000.00</td>
<td>17.6</td>
</tr>
<tr>
<td>Eggs</td>
<td></td>
<td>250,000.00</td>
<td>13.5</td>
</tr>
<tr>
<td>Livestock</td>
<td></td>
<td>210,000.00</td>
<td>11.4</td>
</tr>
<tr>
<td>Fruits &amp; Vegetables</td>
<td></td>
<td>75,000.00</td>
<td>4.0</td>
</tr>
<tr>
<td>Straw</td>
<td></td>
<td>72,000.00</td>
<td>3.8</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td>72,000.00</td>
<td>3.9</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1,787,000.00</strong></td>
<td><strong>100.00</strong></td>
<td></td>
</tr>
</tbody>
</table>

The trend towards dairying which appeared in 1911 was more apparent. Milk had become the second most important item of the farm income. Grain had replaced hay as the most valuable farm product. If we include straw with the grain, however, the relative position of grain to the rest of the farm income had hardly changed since 1911. Value of hay in the farm economy had dropped sharply. As the dairying industry became better developed land formerly devoted to hay had been turned to pasture.

Eggs had appeared as an important item in the economy of the area. In 1926 the 500 acre farm of T. E. Ladner's Estate was subdivided into small holdings of one and two acres. The agency which controlled the subdivision made a concentrated effort to introduce poultry raising as the mainstay of the new settlers. To aid the chicken farmer a demonstration farm was built and placed in operation. Within one year the number

(29) Delta Board of Trade, The Prolific Delta, Ladner, B. C., 1928, (pamphlet)
of laying hens in the district increased from 22,000 to 50,000. In addition there were another 50,000 pullets in Delta in 1927. (30)

The pattern of agriculture in the area was slowly changing. The original agricultural economy based on hay and grain was giving way to a more diversified agriculture. This new economy was based on grain, dairying, poultry and hay. The sale of livestock, potatoes, fruit and vegetables was a minor item in the economy.

With the advent of poultry raising, large chicken houses became a common feature in Delta. They were usually long low buildings, although there were some two story structures. Around each was a large fenced yard which served as a chicken run. Often one end of the chicken house served as living quarters for the owner until he built a house for himself.

Thus, by 1927, the cultural landscape of the farming area of Delta had taken on its present appearance. On the farms large dairy barns dominated the farm yard. About this time the traditional low "V" roofed barn began to give way to a higher, rounded roof barn. Farm life had not been too greatly affected by the advent of the 'gasoline age' although automobiles, trucks, and tractors were beginning to appear prior to 1927. The two characteristics of farming of the day, however, were spring ploughing and fall harvest. The horse still reigned supreme in preparing the land for cultivation. It was indeed a familiar sight in

(30) Delta Board of Trade, The Prolific Delta, Ladner, B. C., 1928, (pamphlet)
spring to see the farmer with two or four horses attached to the farm implements ploughing, disking, or harrowing the land.

In the fall harvest presented a scene never to be forgotten. Crews of men stooked the golden grain after it had been cut by the binder. Then the hay rick drawn by a team of horses would be driven up and the men would stack the wagon high with the grain. From the field the grain moved to the threshing machine. Often as the hay ricks neared the machine they would form a veritable parade - a parade in brilliant yellow. After a hard day's work in the fields there was dinner for the whole crew in the large kitchen of the farm house. Scenes such as these have become uncommon now as the tractor and the combine have brought machine age speed to the countryside.

The latest figures of a comparable nature which are available are for 1945.

Table No. 6. - Agricultural Production in Delta, 1945 (31)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Production</th>
<th>Value</th>
<th>Percentage of total value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>328,500 cwt.</td>
<td>1,067,750.00</td>
<td>35.4</td>
</tr>
<tr>
<td>Potatoes</td>
<td>16,700 tons</td>
<td>678,000.00</td>
<td>22.3</td>
</tr>
<tr>
<td>Livestock</td>
<td>4,000 head</td>
<td>210,000.00</td>
<td>7.</td>
</tr>
<tr>
<td>Peas</td>
<td>3,000 tons</td>
<td>190,000.00</td>
<td>6.3</td>
</tr>
<tr>
<td>Hay</td>
<td>10,500 tons</td>
<td>150,000.00</td>
<td>4.9</td>
</tr>
<tr>
<td>Grain</td>
<td>2,800 tons</td>
<td>98,400.00</td>
<td>3.2</td>
</tr>
<tr>
<td>Field Vegetables</td>
<td></td>
<td>115,000.00</td>
<td>3.8</td>
</tr>
<tr>
<td>Eggs</td>
<td>11,000 cases</td>
<td>80,000.00</td>
<td>2.6</td>
</tr>
<tr>
<td>Small fruit</td>
<td></td>
<td>80,000.00</td>
<td>2.6</td>
</tr>
<tr>
<td>Clover seed</td>
<td></td>
<td>56,000.00</td>
<td>1.5</td>
</tr>
<tr>
<td>Sugar beet seed</td>
<td></td>
<td>44,145.00</td>
<td>1.4</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td>56,000.00</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>2,769,295.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

(31) Figures courtesy Delta Board of Trade.
These figures show the continuation of the trend that had been apparent since 1911. Sale of fluid milk had become the most important source of farm revenue. The position of the dairying industry as the main agricultural occupation can be accounted for by the growth of markets in the metropolitan area of Vancouver and New Westminster. The position occupied by potatoes in the farm economy can be accounted for by one important factor. The formation of the British Columbia Coast Vegetable Marketing Board in 1936 with government control of potato sales brought stability to the potato grower. Prior to the board's formation potato marketing was a gamble for the farmers. Many of them would be unable to market their crop after harvest, a few would be able to sell all they could produce. The Marketing Board assured each farmer a share in the market. With stability in the industry, the cultivation of potatoes could become a reliable occupation.

The drop in the importance of eggs is an example of a local industry affected by national conditions. The poultry industry which had been started in 1926 and had given promise of becoming very important locally was virtually ruined by the depression. The residents of Delta Manor either sold out their holdings or turned to some other source of income, particularly to small fruit production. By 1945 the small fruit industry was equal in importance to the poultry industry.

In 1941 an American investor opened a vegetable canning plant within the district. His plant was located at the corner of Westham and Fairview Roads. The principal canning crop was peas. As a result the importance of peas in the
local farm economy grew, until by 1945 they were the fourth most important crop in the area.

The agricultural pattern of 1945 was one of a well diversified economy. While dairying was by far the most important single industry, the remainder of the agricultural products offered a wide variety of choice. The 1945 figures represent the culmination of a trend which had been apparent since at least 1911. By 1945 Delta farmers no longer relied on one or two crops for their income.

So far we had considered land utilization from the standpoint of financial value of the products. Such a discussion will give the relative importance of each crop within the total agricultural economy. It does not, however, show the actual distribution of land use within the area.

Table No. 7 - Land Utilization in Delta, 1931 and 1941

<table>
<thead>
<tr>
<th></th>
<th>1931</th>
<th>1941</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Crops</td>
<td>16,899 Acres</td>
<td>15,630 Acres</td>
</tr>
<tr>
<td></td>
<td>71%</td>
<td>62.6%</td>
</tr>
<tr>
<td>Oats</td>
<td>45.4%</td>
<td>51.1%</td>
</tr>
<tr>
<td>Hay</td>
<td>42.6%</td>
<td>28.2%</td>
</tr>
<tr>
<td>Potatoes</td>
<td>9.1%</td>
<td>8.7%</td>
</tr>
<tr>
<td>Other Fodder</td>
<td>2.9%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Other</td>
<td>2.2%</td>
<td>9.8%</td>
</tr>
<tr>
<td>Pasture</td>
<td>5,023 Acres</td>
<td>7,110 Acres</td>
</tr>
<tr>
<td></td>
<td>21%</td>
<td>28.5%</td>
</tr>
<tr>
<td>Other</td>
<td>1,871 Acres</td>
<td>1,923 Acres</td>
</tr>
<tr>
<td></td>
<td>8%</td>
<td>8.9%</td>
</tr>
<tr>
<td>TOTAL Cultivated Land</td>
<td>23,793 Acres</td>
<td>24,963 Acres</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source: Compiled from figures appearing in the 7th and 8th Censuses of Canada. (32)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(32) The census figures are for the entire municipality and not just for the portion of it selected for this study. As much of the remainder of the municipality is in woodland, and is not well developed agriculturally, the figures will be reasonably representative for the lowland area.
Table No. 8 - Land Utilization in Delta, 1939, 1942, 1943.

<table>
<thead>
<tr>
<th></th>
<th>1939</th>
<th>1942</th>
<th>1943</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oats</td>
<td>6,500 Acres</td>
<td>6,000 Acres</td>
<td>5,500 Acres</td>
</tr>
<tr>
<td>Hay</td>
<td>5,500</td>
<td>5,100</td>
<td>4,500</td>
</tr>
<tr>
<td>Pasture</td>
<td>5,100</td>
<td>5,100</td>
<td>5,300</td>
</tr>
<tr>
<td>Peas</td>
<td>550</td>
<td>1,200</td>
<td>1,500</td>
</tr>
<tr>
<td>Potatoes</td>
<td>990</td>
<td>825</td>
<td>525</td>
</tr>
<tr>
<td>Other</td>
<td>1,450</td>
<td>1,225</td>
<td>675</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>20,000</strong></td>
<td><strong>19,500</strong></td>
<td><strong>18,400</strong></td>
</tr>
</tbody>
</table>

Source: Delta Farmer's Institute

Figures in Table No. 8 give a more accurate picture of cropland in Delta for the purposes of this thesis as they were compiled for the lowland area only. The sudden drop in total cultivated land in 1943 is a result of the Department of National Defense taking over 1,100 acres for military purposes.

A comparison of percentage of total agricultural income and percentage of crop acreage will give a clear picture of the agricultural economy as it has developed in Delta.

Table No. 9 - Crops by percentage of value and by percentage of acreage:

<table>
<thead>
<tr>
<th></th>
<th>Percentage of Value</th>
<th>Percentage of Acreage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>35.4</td>
<td></td>
</tr>
<tr>
<td>Potatoes</td>
<td>22.3</td>
<td>4.4</td>
</tr>
<tr>
<td>Peas</td>
<td>6.3</td>
<td>8.1</td>
</tr>
<tr>
<td>Hay</td>
<td>4.9</td>
<td>27.1</td>
</tr>
<tr>
<td>Grain</td>
<td>3.2</td>
<td>30.4</td>
</tr>
<tr>
<td>Pasture</td>
<td></td>
<td>28.8</td>
</tr>
</tbody>
</table>

One striking conclusion can be arrived at from a study of these figures. The principal product of the land devoted to
grain, hay and pasture is milk. A well balanced dairy farm, as farmers of Delta have tried to devise it, consists of one that grows sufficient grain and hay to feed the cattle. Any surplus can be sold as a cash crop. The milk is sold to the large dairies in Vancouver and the farmer receives a monthly income from his milk rather than an annual income from his grain and hay.

Potatoes are grown because they give a relatively high return from a small acreage of land. Peas were grown because the canneries offered purchase contracts before the crop was planted. As peas are ready for harvesting in the months of July and August they do not interfere with the harvesting of early potatoes in June or of the grain in late August and September.

Thus we find that the agricultural economy in Delta has developed steadily from one based on grain to one based on dairying. There has not been a relative decline in the amount of land planted to grain. Grain acreage, particularly oats, has retained a proportion of approximately 30% of the total. Grain, while it has remained important as far as acreage is concerned has become relatively unimportant in value. The grain is, however, not marketed as such now but is used as cattle feed and is marketed as milk.

The historic development of cropland utilization has been towards a more diversified crop system. Although there has been this tendency towards diversification, three crops have remained most important as far as acreage is concerned. These
crops are grain, hay and pasture. Possibly the most significant change in the agriculture of Delta has not been so much a change in the crops grown but in the method of marketing these crops.

By 1939 nearly all the land that was available for cultivation was being used for agricultural purposes. In that year total crop acreage reached 20,000 acres. As there are just over 21,100 acres available as farm land, very little suitable land was not being cropped. The land not in crops was used for residential purposes with a very small acreage lying idle. At this time the extension of agricultural land had gone as far as was possible.

2. Present Utilization:

The following table gives the number of acres devoted to each crop and the percentage of total cultivated land that each occupies:

<table>
<thead>
<tr>
<th>Crop Description</th>
<th>Acreage</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oats</td>
<td>5,500</td>
<td>29.8</td>
</tr>
<tr>
<td>Pasture</td>
<td>5,300</td>
<td>28.8</td>
</tr>
<tr>
<td>Hay</td>
<td>4,300</td>
<td>23.3</td>
</tr>
<tr>
<td>Peas</td>
<td>1,000</td>
<td>5.4</td>
</tr>
<tr>
<td>Potatoes</td>
<td>800</td>
<td>4.4</td>
</tr>
<tr>
<td>Other grain</td>
<td>252</td>
<td>1.3</td>
</tr>
<tr>
<td>Sugar beet</td>
<td>225</td>
<td>1.2</td>
</tr>
<tr>
<td>Market garden</td>
<td>220</td>
<td>1.2</td>
</tr>
<tr>
<td>Grass</td>
<td>180</td>
<td>0.9</td>
</tr>
<tr>
<td>Cabbage</td>
<td>77</td>
<td>0.4</td>
</tr>
<tr>
<td>Other</td>
<td>546</td>
<td>3.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>18,400</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Based on field work, August - September 1949*

The general picture of agricultural land utilization has
changed but little in the last few years. The basis of agriculture is still dairying. The three principal crops and uses of farmland are hay, grain and pasture.

The physical geography of Delta provides a suitable environment for the cultivation of certain crops; for others minor adjustments of the environment, by way of fertilization, irrigation or drainage, are necessary before cultivation is possible. From the data presented in Table No. 1. it should be expected that some of the following crops will play a part in the local crop system:

(a) oats, rye, buckwheat, flax
(b) potatoes,
(c) cool region vegetables,
(d) hardy fruits,
(e) timothy, red clover, alfalfa.

If some of these crops are grown it would be safe to assume that the agricultural utilization of the land represents an adequate adjustment to the physical environment as it has been modified by man. The actual selection of crops from those suitable to the area will depend upon economic and human factors.

The controlling economic factor in the area is the market. Greater Vancouver with an estimated population of 500,000 is the consuming area where the Delta farmer sells his produce. An agricultural district close to a large consumption area will normally supply those commodities that are bulky and expensive to ship, or those which deteriorate rapidly in shipment. With these facts in mind and with a knowledge of
the crops that can be grown, it is easy to see that the actual crop selection is limited.

Potatoes are a bulky product to ship hence the closer they are produced to the market the better. Delta Municipality supplies one-third of the potatoes consumed in Greater Vancouver. Vegetables and milk cannot be shipped long distances unless there is special equipment, so they are likely to be produced as near to the market as possible. The production of milk will necessitate the growth of pasture and of feed grain for the cattle.

The human factor in the choice of crops is not as easily described as the natural and economic factors. Such elements as habits, history, conservatism and the like will all play a part. However, if the choice of crops throughout an area is similar on each farm, and if we find peoples of varying racial and national backgrounds all growing the same crops, it should be safe to assume that the human factor is at least neutral as far as selection is concerned.

(a) Size of farms:

<table>
<thead>
<tr>
<th>Size of farms</th>
<th>Delta Municipality (1941)</th>
<th>Lowland Area (1949)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 10 Acres</td>
<td>208</td>
<td>62</td>
</tr>
<tr>
<td>11 - 50 &quot;</td>
<td>68</td>
<td>63</td>
</tr>
<tr>
<td>51 - 100</td>
<td>69</td>
<td>73</td>
</tr>
<tr>
<td>101 - 200</td>
<td>74</td>
<td>73</td>
</tr>
<tr>
<td>201 - 299</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>300 - 479</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>480 - 639</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Over 640</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Total over 10 Acres</td>
<td>240</td>
<td>226</td>
</tr>
</tbody>
</table>

(33) Figures for 1941 obtained from 8th Census of Canada, Census of Agriculture, p. 64-65. Figures for 1949 obtained from field-work in area.
The 1941 figures were for the entire municipality and certain corrections were necessary to bring them up to date. Many of the farms from 1 to 10 acres in size belong to the portion of Delta on the Surrey Upland where there has been a large development of small holdings. Between 10 and 15 farms that are included in the 1941 total are found on the Point Roberts Upland in the southwest section of Delta. When the federal government obtained land in 1942 for the Boundary Bay Airport one of the farms were taken over completely. With these observations in mind, the proportion of farms over 11 acres in size will be representative of the lowland area.

(b) Farm population:

Distribution of farm population reflects the road system and the original settlement of the area. There is one main east to west road - Ladner Trunk Road. It is intersected every mile by north-south roads. Another road skirts along the north side of the municipality from Crescent Island Road to Scott Road. This road and the location of the peat bog control the settlement pattern in the northeast section of Delta. Westham Island is served by one main road and three minor ones. Road location is shown on Map No 4.

Original settlement was along the waterways of the area. The effect of this can still be seen by the number of farm houses located near the water. Few farm houses are located far from one of the roads. The location of farm houses in relation to the road system is indicated on the accompanying map (Fig. No. 20). Ladner, Delta Manor, Sunbury and the summer
FIGURE NO. 20

FARM SETTLEMENT
EACH DOT ONE FARM DWELLING
1949

MILES
resorts are not shown on this map.

Farm population was listed as 2,174 in 1931 and 1,755 in 1941. (34) The 1951 census should show the same general decrease in farm population. The reduction in farm population is due entirely to the use of more machines on the farms. The use of tractors, combines, milking machines, potato diggers and trucks has greatly reduced the need for farm labour. The smaller farms can now be handled by the farmer and his family for most of the year with extra help required only during the harvest season. Even the demand for extra harvest labour has been greatly reduced through the use of machines.

Delta farmers have most of those conveniences which are considered necessary for comfortable modern living. While it is true that many of the farm houses were built before the turn of this century they have been successively altered to accommodate each new addition to our present day living. The only remnant from earlier days is the large kitchen so characteristic of older farm houses. These kitchens were built in the days when a large threshing crew was essential at harvest time. Modern machinery has made it possible to complete the harvest without much of this extra hired help. The accompanying photograph (Fig. No. 21) shows one of the older farm houses.

The entire municipality is covered by a rural electrification system. No farm need be without electricity to-day, and indeed, none are. Electricity brings with it the comfort and convenience of the electric light, the radio, the washing

(34) Census of Canada, 8th Census, Vol. 2, p. 54
FIGURE NO. 21    View of older style farmhouse in Delta.
machine, the electric stove, the refrigerator, the milking machine. No farm to-day is without some of these conveniences; some have them all.

Since the inception of a municipal waterworks in 1910 and the system's revitalization during the 1930's all farms in the district with the exception of three have a constant supply of fresh water. These three farms that are without piped water are in the Boundary Bay district and are at present beyond the extent of the municipal water system. They must rely on wells for their water supply. A water system brought with it an efficient system of sewage disposal. All farms to-day have indoor plumbing with septic tanks which is a great change from the original system which used outdoor facilities.

Telephone service extends throughout the entire farm area. In November, 1949, 216 farm homes had telephone connections. As the total number of farms within the area is 226 this means that practically every farm has a telephone. The telephone service is operated by the British Columbia Telephone Company through its Ladner exchange. Telephone service in the area is the result of a farmer's organization which established the first telephone exchange. Control of the telephone system remained on the Delta until 1924 when the present operators purchased the holdings of the local company.

The rural sections of the municipality receive mail by the rural mail service. Rural mail routes from New Westminster serve the northern and eastern districts, while a rural route from Ladner serves the western and southern
### TABLE NO. 12 COMPARATIVE YIELDS

<table>
<thead>
<tr>
<th>AREA</th>
<th>Number of HERDS</th>
<th>Pounds of MILK</th>
<th>Pounds of FAT</th>
<th>% FAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>DELTA</td>
<td>29</td>
<td>9220</td>
<td>402</td>
<td>4.36</td>
</tr>
<tr>
<td>EDMONTON</td>
<td>16</td>
<td>8350</td>
<td>275</td>
<td>3.4</td>
</tr>
<tr>
<td>ALBERTA</td>
<td>20</td>
<td>8595</td>
<td>332.5</td>
<td>3.86</td>
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<tr>
<td>ALBERTA</td>
<td>84</td>
<td>8213</td>
<td>316.1</td>
<td>3.82</td>
</tr>
<tr>
<td>SASKATCHEWAN</td>
<td>191</td>
<td>8887.8</td>
<td>316.5</td>
<td>3.52</td>
</tr>
<tr>
<td>WASHINGTON</td>
<td></td>
<td>4030</td>
<td>158.3</td>
<td>4.05</td>
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<tr>
<td>WISCONSIN</td>
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<td>5100</td>
<td>189</td>
<td>3.7</td>
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</table>

<table>
<thead>
<tr>
<th>AREA</th>
<th>Bushels of OATS</th>
<th>Tons of HAY</th>
<th>Tons of POTATOES</th>
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<tr>
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<td>90</td>
<td>2.5</td>
<td>8</td>
</tr>
<tr>
<td>B. C.</td>
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<td>5.5</td>
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<tr>
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<td>1.3</td>
<td>4.1</td>
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<tr>
<td>SASKATCHEWAN</td>
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<td>1.47</td>
<td>3.2</td>
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<td>MANITOBA</td>
<td>40.2</td>
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<tr>
<td>ONTARIO</td>
<td>33.8</td>
<td>1.59</td>
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<tr>
<td>CANADA</td>
<td>28.2</td>
<td>1.5</td>
<td>4.09</td>
</tr>
<tr>
<td>U. S. A.</td>
<td>29.6</td>
<td>1.32</td>
<td>--</td>
</tr>
</tbody>
</table>

( Source - Various Department of Agriculture Annual Reports )

N.B. As the comparison in the above tables is between a small area and several larger ones, the result is more favourable to Delta than if the areas had been of similar size.
districts. Thus a letter from the eastern part of Delta has to travel via New Westminster and Vancouver to be delivered a few miles away in the western part of the area. The only reason for the split mail service is that it has now become a habit a few of the people serviced by rural routes from New Westminster desire a change of address.

The automobile, the truck, the tractor and the combine are standard equipment on most farms to-day. The extent of farm mechanization can best be shown by the fact that prior to World War I each farm had as many as twenty head of horses, whereas to-day there is only one team of horses working in East Delta. Throughout the area it is almost an oddity to see a team of horses and a wagon on the roads. Trucks or wagons drawn by tractors are a much more usual sight.

The farmer of this area has a comfortable standard of living. The productivity of the soil which he farms has made it possible for him to provide his home with the necessities of modern living. Yields as compared with other parts of Canada are shown in Table No. 12. It will be noted that yields in Delta are considerably higher than the provincial or national average for the selected crops. It would also appear that Delta cows give more and richer milk than do cows in various other places.

(c) **Crop Rotation:**

All farmers practise a system of crop rotation. Each farmer has his own system of rotation depending on the crops he grows. There is, however, a certain basic system of rotation which can be shown diagrammatically as follows:
This system is for a farm of 80 acres with four 20 acres fields. For larger farms where there may be more fields the farmer usually arranges for a field to lie in pasture for an extra year. Field sizes on most farms average from 18 to 25 acres so that the basic system or variations of it will hold true regardless of the size of farm. In cases where a farmer does not grow potatoes, some other crop such as peas would take its place in the rotation sequence.

(d) Dairying:

Dairying provides over one-third of the total farm income in Delta. It is by far the most important part of the agricultural economy. There are two reasons why dairying has developed to such a prominent position, (1) a climate that is ideally suited for the growth of hay and pasture grasses, (2) there is a large urban market for fluid milk in Greater Vancouver.

There is marked similarity among the dairy farms. Four cultural features account for this. It is necessary to keep the cows under shelter at least six months of the year. Large barns are provided not only to house the cattle for this
period but also to store the large amounts of fodder that are required during the winter season. Beside each barn there is a cylindrical tower known as a silo. These silo are used to store ensilage - usually of pea vine - as feed for the cattle. A short distance from each barn is a small milk house. British Columbia law makes it obligatory to separate the place where the milk is strained, cooled and stored from the barn. Beside the road there is always a wooden stand. Each farmer ships his milk by a trucking firm to the large dairies in Vancouver. These roadside stands are the place where the trucker can easily pick up the farmer's milk and return the empty cans.

The cattle are usually turned out to the fields sometime in April or May. Except for the twice daily milking in the barn they remain there until late September or early October. The cows are usually kept in the barn in the spring a week or two longer than might seem necessary. However, farmers have found that by giving the pasture a few days of extra growth in the early spring, it thrives much better during the remainder of the spring and summer.

There is strict government testing of cattle. The area has been classed as free of tuberculosis since about 1925. Continual tests are carried out by government inspectors to keep it that way. Testing is also carried out for the butter-fat content of milk. As a result low producers can be removed from a herd. By this testing and subsequent elimination of poor milk producers the farmer can be sure of obtaining maximum
milk production from the land used for dairying.

There are approximately 5,000 head of milk cattle within the area. Three breeds of cattle make up most of this total. Holstein-Friesian are the most popular variety, followed by Jerseys and Guernseys. Some of the farmers specialize in pure bred stock and have gained recognition for themselves and their district at the Pacific National Exhibition and the Royal Winter Fair.

(e) Oats:

Oats are the principal grain crop. They were planted on 5,500 acres in 1943. Between 1943 and 1949 oat acreage decreased as pea acreage increased. In 1949 when pea acreage was curtailed due to the closure of the cannery most of the acres freed from pea production were planted in oats. This would mean that in 1949 approximately 29.8% of the cultivated area was used for oat cultivation. There is hardly a farm that has not at least one field of oats.

Oats are planted in spring, usually in May, and are harvested in late August or September. Harvesting is done mostly by combine methods, although a few farmers still use the older method of cutting and threshing separately. The yield of oats average from 90 to 100 bushels an acre. In isolated cases yields as high as 150 bushels have been reported.

Oats are used for feed and for seed. Most of the oats for local use are processed by a farmer's co-operative grist mill in Ladner. Sale of certified oat seed on the export market has been a new market that has opened to the farmers
in the last few years.

The chief hazards to the oat crop in Delta are heavy rains and strong winds. Harvesting of the grain becomes difficult if heavy rains occur in August and September. Rains may beat down an unharvested crop, or if the crops has been cut may cause it to rot in the fields. Lodging is the principal danger from strong winds. It makes cutting extremely difficult as binders and combines work best when the grain is standing upright. Excessive precipitation in August and September is not common so that losses due to rainfall are not great. Hardly a year goes by, however, that at least part of the oat crop is not affected by lodging.

(f) Pasture and Hay:

Pasture is the second most important agricultural utilization of the land by area. There are two clearly recognized types of pasture in Delta. Natural pasture is found in areas southeast of the peat bog and in the area west of Boundary Bay. It is generally on land that because of poor drainage or excessive burning of top soil is not suited for the other crops of the district. Natural pasture comprises only a small percentage of the total acreage in pasture.

Cultivated pasture is an integral part of the crop rotation system on most farms. On the smaller farms a field will be in pasture every fourth year whereas on the large farms a field may remain in pasture for several years.

Hay is the third most important utilization of cultivated land on Delta. The popular mixture of fodder crops for hay is red clover and timothy. It is usual to get two cuttings of
hay a year, one in June and one in the fall. If the farmer wishes to sell red clover seed, the seed is threshed from the second cutting. Experience has shown that a second cutting of hay kills the clover for pasture the next year. Hay yields from $2\frac{1}{2}$ to 3 tons an acre.

The chief hazard to the hay crops is rotting from rain after the crop has been cut but before it has been removed from the field. Apparently hay also loses some of its feed value if it becomes sodden with water. Farmers faced the possibility of losing one crop of hay in 1949 when heavy and persistent rains caught tons of cut hay still in the fields. However, as the summer months are usually quite dry in Delta the prospect of losing a hay crop is not one that must be met frequently.

(g) **Peas:**

Peas became important in the agricultural land use of the area after the opening of a vegetable canning factory in Ladner in 1941. Pea acreage increased rapidly until by 1948 it was the fifth most important crop by acreage. In 1948 there were 2,500 acres planted to peas.

In 1949 the acreage was reduced from 2,500 acres to between 1,000 and 1,100 acres when the Ladner Canning Company failed to operate. The remaining acreage was grown for canneries in New Westminster and Vancouver. Most of the acreage formerly planted to peas was seeded to oats in 1949.

Peas are planted in early April and are harvested during July and August. The entire vine is cut in the field and is transported by truck to centrally located pea threshers. The
threshers, or viners, are located in batteries of three or four throughout the district. At the viner the peas are separated from the pods and vine. The latter are returned to the farmer for ensilage while the peas are taken to the cannery. Once the peas have been cut in the fields a great deal of speed is necessary to deliver them to the cannery in good condition. Excessive heat sours the peas rapidly. It is estimated by growers and canners that only from 6 to 8 hours should elapse from the time the peas are cut until they are in the canning process.

The principal damage to the pea crop comes from an aphid which attacks the crop in early June. To prevent serious losses it is essential that the crop be sprayed. The most efficient method of spraying is by aeroplane, flying low over the fields and dusting the crop with a preparation designed to kill the aphids.

All pea acreage in Delta is found west of Benson Road. There seems to be no reason why this should be so, except that East Delta farmers prefer to grow other crops.

(h) Potatoes:

Potatoes represent the fourth most important agricultural land use within the area. As mentioned earlier the potato industry was given stability after the formation of the British Columbia Coast Vegetable Marketing Board in 1936. The potatoes grown in the lowland area of the municipality are of the late varieties, chiefly Netted Gem and Green Mountain. Some early potatoes are grown by Chinese but these cannot complete economically with early potatoes grown in higher
areas where they can usually be harvested by the end of May.

The principal hazard to the potato industry is Late Blight which usually occurs in the first part of September. This blight first attacks the tops of the potato plant and then descends the stem towards the tuber. In order to save the tuber it is necessary to cut the tops off affected plants. However, if the tubers are not fully matured, their quality and size are reduced by early cutting of the tops. The blight generally occurs coincident with the first early morning fogs of September. Although the cause of Late Blight is not definitely known it is thought to be related to the amount of moisture in the air. Blight increases the cost of potato production by the cost of sprays and of cutting the tops.

Blight has been very widespread for the past few years. Agricultural research into blight resistant potatoes would seem to be necessary and is being done. Some farmers have found that by planting early and thus having the crop mature early they can reduce the risk of blight considerably. Most farmers, however, rely on heavy spraying to protect the crop.

The large urban market of Greater Vancouver absorbs most of Delta's potato production. A small percentage of the crop is sold as certified seed. Planting and harvesting of potatoes is done entirely by mechanical means on the larger farms.

(1) Sugar Beet Seed:

The development of a sugar beet seed industry on the Lower Fraser Valley is relatively new. The program started in a small way in 1941 under the auspices of the British
Columbia Sugar Refineries Limited. By 1949 the acreage had grown to from 300 to 400 acres in the Lower Fraser Valley with 225 of these in Delta. The chief natural advantage of the area in the production of sugar beet seed is the fact that winter temperatures allow the crop to winter in the field without serious danger of being frozen. A dry summer season is also an advantage in harvesting of the crop.

In Delta the industry started on two farms, one on Westham Island and one on Crescent Island. It has now grown to 10 farms. There is a yield of from 6 to 10 tons an acre with a sale price of $300.00 per ton.

The crop is sown in summer, usually in July or August. It winters in the field and the next spring is heavily fertilized. Harvest takes place about the middle of August. The land then lies fallow until the next spring or is planted to a fall crop. On farms where sugar beet seed is grown the seeding is so arranged that a crop is harvested each year.

To ensure proper cultivation the crop must be given a great deal of care. The preparation of the seed bed and the control of weeds are especially important. A wet harvest is the chief danger. As July and August are usually fairly dry months there is little hazard from excess precipitation in a normal year. If there should be a heavy August rain, as in 1947, large dryers are used to dry the seed after it has been harvested. The seed would rot if allowed to remain wet.

Farmers who have undertaken to grow sugar beets for seed find that they can usually look after the crops themselves. As the crop has a high yield value per acre, the farmer can
make a profit on a relatively small field. As farm labour has become increasingly expensive, a farmer can reduce his expenses by devoting part of his acreage to sugar beets.

(i) Market gardening:

Market gardening on a commercial basis has been another recent development within Delta. This type of farming is largely in the hands of Chinese. Until the last two years market gardening was devoted primarily to early potatoes and cabbage. The Chinese, and two or three whites, rented small plots of land wherever possible. They first planted early potatoes. Then when the potatoes were nearly ready for digging, seedling cabbage was planted between the rows of potatoes. As a result it was necessary to harvest the potatoes by hand. The cabbage was left in the fields to mature after the potatoes had been harvested. As cabbage can withstand freezing temperatures while it is in the field, it can be planted quite late in the year. Gardening of this nature was confined to Ladner and Delta Manor.

In 1948 Chinese interests purchased 60 acres of land along Westham Road. In the same year other Chinese acquired 160 acres at the intersection of Trunk and Tasker Roads. Those on Westham Road found that by intensive cultivation and by the use of a sprinkler system of irrigation they could raise most temperate vegetables, such as tomatoes, vegetable marrow, sweet corn, lettuce and carrots. Another Chinese, with property nearer Ladner, has used the same method of cultivation for a number of years.

Irrigation water is lifted from a drainage ditch by means
of a small gasoline-driven pump, then carried to where it is needed in the field by means of 1-1\frac{1}{2} inch lead pipe buried in the ground. It is fed to the plants by sprinklers that resemble the usual lawn sprinkler. The acreage on Tasker Road has not been used since 1947. It is at present the largest single area of land capable of cultivation in Delta that is not being used, as the new owners are fixing farm buildings before starting their market garden operations.

(k) Grass:

In 1946 a plant for dehydrating grass was established in Delta. Unsuccessful attempts were made to operate the plant in 1946 and 1947. Fire destroyed the plant in 1947. John Nott-ingham purchased the remains of the plant and rebuilt it on his farm on Crescent Island. In 1949 he had 180 acres planted to grass for dehydration. At present only rye grass and clover are grown although ledino clover and orchard grass could be grown as well. The grass is cut first in April and every three weeks thereafter. During 1948 and 1949 eight cuttings were possible each year.

The 180 acres of grass are enclosed in one large field. To facilitate the cutting of grass all fences on the area planted to grass have been removed. The 180 acres accounted for approximately 1\% of the cultivated land in use.

(1) Other Crops:

Grains, other than oats, are of little importance in the area. Small quantities of spring wheat, barley, fall rye and corn are cultivated. The soils of the area are not particularly suited for the cultivation of a wheat crop since they
lack phosphorous and are slightly acidic. Wheat has a high level requirement for phosphorous and favors neutral to slightly alkaline soils. There were, however, 95 acres planted to wheat on 5 farms. Barley, which is not a popular crop in the Lower Fraser Valley, was planted on 38 acres on 4 farms. Corn to be used for fodder was grown on 11 farms and totalled 98 acres. There was also one 10 acre field of rye. In all, 252 acres of other grains were grown in Delta, constituting just over 1% of the cultivated land in use.

Certain other crops such as field cabbage, raspberries, strawberries, black and red currants, carrots, mangles, and turnips are grown on small acreages throughout Delta. These crops, along with the area utilized for farm buildings and farm gardens, account for 623 acres of land.

(m) Experimental Utilization of the Land

The Dominion Experimental Station at Agassiz obtained a plot of 20 acres on the army camp property in 1948. As the land had not been in use since 1940 a heavy turf cover had developed. In view of this only 2 acres could be readied for use in 1949. Under direction of the Experimental Station two types of tests involving potatoes and cereals were carried out in the Delta area.

The potato tests were carried out along two lines. One test experimented with new potato varieties. These varieties were checked for their resistance to blight and scab and for their yield of dry matter and their cooking quality. The agricultural scientists hope to obtain a blight resistant potato with a high cooking quality which would be of great
help to local farmers. The second test was concerned with the fertilization of potato crops. Results of previous tests carried out in the area from 1938 to 1940 were as follows:

"1. Nitrogen was of little benefit other than to aid in the assimilation of phosphorous and potash.
2. Phosphorous was needed at the rate of 120 to 180 pounds per acre (12% at 1,000 to 1,500 lbs.)
3. Potash applied up to 120 pounds per acres on all but Ladner Clay soils increased yields. On Ladner Clay potash reduced yields below plots having no potash.
4. Manure was needed in all cases." (35)

The cereal tests started at the station in 1949 were not satisfactory due to severe pheasant damage, to areas of couch grass and to burnt-over areas. The thick network of roots developed by couch grass, and the loss of fertility due to excessive burning in the period of early settlement make successful cultivation very difficult. Similar tests to those attempted at the substation were carried out on various farms in Delta. Experiments with oats, barley and as oats-barley mixture were undertaken. A further test was made to determine the most effective seeding rate for oats in the district. It is hoped to achieve a seeding rate which will combine maximum soil productivity with minimum seeding.

Tests were also made with varieties of ensilage corn, sunflowers, and soy beans. The ensilage corn tests were to determine the most suitable varieties for the area. The test with sunflowers was to determine the feasibility of cultivating them on a commercial basis for production of oil from the

LAND USE EXCERPT MAPS

The following three maps are excerpts from the large land utilization map prepared by the writer in compiling the data for this thesis. The location of the areas covered by the excerpt maps is as follows:

Excerpt No. 1 - between Boundary Bay and Imperial Roads south of Farrell Road.
Excerpt No. 2 - Crescent Island.
Excerpt No. 3 - East Delta between Smith and Embree Roads.

KEY

C               Clover
Ca              Carrots
Co              Corn
F               Fallow
O               Oats
P               Pasture
Po              Potatoes
Ps              Peas
R               Roots
S               Sunflower
V               Mixed Vegetables
W               Wheat

Farm House and Farm Buildings
Church
Community Hall
School

Scale: 1:10,560
seeds. The tests did not give encouraging results however, as pheasants played havoc with the crop. The conclusion reached by the testing scientist was as follows:

"From the results of the test it would seem that sunflowers are not a promising crop for the area." (36)

The soy bean test turned out to be a complete failure as pheasants ate the bean shoots as fast as they appeared above the ground.

These tests which will be carried on in coming years will most likely indicate better varieties of present crops for cultivation within the area. While the development of better crop varieties will not likely materially alter the present agricultural land utilization pattern, it will probably result in greater productivity from the land.

(n) **Summary of Present Agricultural Land Use:**

Three crops dominate the land use pattern on the agricultural area of Delta. Over 80% of all cultivated land is devoted to oats, pasture and hay. These crops form the basis of the present agriculture of the district.

In the spring and early summer before the grain begins to mature, Delta is one vast field of green. This broad expanse of varying greens is broken only by farm buildings, roads and fences. In late summer as oats become a golden color and red clover matures there is a beautiful blending of greens, golds and reds. Even during the other seasons of the year green is the dominant colour, although in early spring the

panorama of green is broken by expanses of black as the farmer ploughs his fields in preparation for spring planting. Agriculture is not only the chief source of income to the district but is also the reason for the area's beauty.
CHAPTER FOUR

INDUSTRIAL UTILIZATION

Industrial utilization of the land is fairly unimportant. Prior to World War I there was some industrial development in Delta but it dwindled away in the inter-war years. Since 1940 there has been a slight revival of industry. The location of industries is shown in (Fig. No. 25).

Salmon canning provided the historic basis of industry. For the first 30 years of settlement in Delta (1868-1898) salmon canneries were the only industries. For the next 24 years (1898-1922) they were the leading industry, reaching their peak after 1910. The salmon canning industry of the Fraser River reached a high point in 1913 with a pack of 1,1357,700 cases of sockeye. As a result of a rock slide at Hell's Gate during construction of the Grand Trunk Pacific Railway in that year the escape of salmon to the spawning grounds was practically obliterated. By 1929 the salmon pack had been reduced to 172,300 cases. The decline of the importance of salmon canning in Delta followed as a natural consequence of the decline of the whole industry. Re-establishment of salmon canning during the 1930's was concentrated at Steveston on Lulu Island. Better transportation facilities gave this site an advantage over Delta. The following table shows the number of canneries operating in Delta from 1880 to 1949, and illustrates the decline of the

FIGURE NO. 25

INDUSTRY MAP - KEY

A. Nelson Brothers Cannery
B. Industrial Peat Company Limited
C. Delta Water Works
D. British Columbia Packers (Oyster Plant)
E. Atkins and Durbrow Limited
F. Dehydrated Grass Limited
G. F. V. Delta Co-operative Association
H. Ladner Canning Company
industry after the Hell's Gate Slide.

Table No. 13- Salmon Canneries in Delta 1880 to 1949

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<th>Year</th>
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<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Compiled from various directories and guides.

The one operating fish cannery in the area now is located on the eastern edge of Sunbury where the Great Northern Railway crosses River Road.

All that remains of a once important industry are a few buildings, for the most part derelict, along the river front. A few of these ex-cannery buildings are used as net houses by local fishermen. For the most part, however, they merely serve as reminders of a more industrial past.

A sawmill operated in the area from 1910 to 1929 about three-quarters of a mile west of Ladner on Westham Road. The logs for the mill were brought up the river in booms. No local timber was used. The depression of the 1930's forced the mill to close down. The buildings formerly used by the sawmill have been removed and all that remains of the industry are a few concrete slabs. For several years before the war the unoccupied sawmill was a familiar landmark in Delta.

In 1919 the Boundary Bay Oil Company was formed. It commenced drilling operations in East Delta near the southern end of Matthews Road in 1919. By 1922 four wells had been
drilled but the operators had found no commercial quantities of gas or oil. Spasmodic drilling efforts since then have met with no success. The derrick which was a familiar sight to people travelling along Trunk Road was dismantled during World War II.

The development of peat processing brought two new industries to the area during World War II. The industrial Peat Company established its plant in 1942, and the B. C. Peat Company, now known as Atkins and Durbrow Limited, opened a plant in 1944. These two plants, one located on the west side of the peat bog and the other on the east side, are the most important non-agricultural industries in the district.

A survey of the peat bog made in 1927 by the Canadian Geological Survey disclosed that there was sufficient peat available for 3,412,000 tons of processed peat containing 20% moisture. (38) The standard procedure for the preparation of peat was described at that time as follows:

"..... to dig the peat either by hand or machine, to allow the resulting bricks of peat to dry in the open until the moisture content falls to about 20%, pass the air-dried peat through disintegrating machines and over screens to separate the peat litter from the finer products of peat mull, and finally to compress the resulting material into bales of about 180 pounds weight of peat litter or peat mull." (39)

Peat is usually dug in the fall and winter, allowed to dry and processed during the summer.

(38) Anrep, A., Peat bogs for the manufacture of peat litter and peat mull in Southwest British Columbia, Summary Report, Part A., 1927, p. 60A.

Atkins and Durbrow have developed a hydraulic method of processing peat. Their plant is the only one of its kind in Canada, and except for a state-subsidized operation near Duluth Minnesota, the only one in North America.\(^{(40)}\) Because of the uniqueness of this plant its operations will be described in some detail.

The plant equipment is housed in a line of fire proof buildings located in the bog. The initial stage in processing the peat starts half a mile away in the bog. Powerful hoses fed by water piped from the Fraser River washes the peat loose and floats it to one of a number of ditches. It floats along these ditches to a sump where any foreign matter such as roots are removed. It is then pumped into the plant where it is refined, rolled, dried and baled. The machines used in processing peat are similar to those used in converting pulp to paper. This type of equipment enables the plant to operate on a year-round basis. Hydraulic processing of peat allows peat to a depth of eight feet to be utilized, whereas by hand digging only three feet are used.

Most of the peat is sold in the United States and in Western Canada where it is used as poultry litter, as a physical medium for plant growth, for binding sandy soil, and for aerating heavy clay soils. Atkins and Durbrow have a research department which has already developed a new product 'Peatblene'. This product which is a mixture of chemical fertilizer and peat moss has been well received on the British Columbia market. Experiments into the possibility \(^{(40)}\) As of March 1950.
of utilizing peat moss as insulating material, linoleum filler, deodorant pads, surgical dressings and as packing material are being carried out.

Both companies operating in the peat bog estimate that they have sufficient reserves for another 35 years at present production rates.

<table>
<thead>
<tr>
<th>Company</th>
<th>Annual Production</th>
<th>Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atkins and Durbrow</td>
<td>300,000 bales</td>
<td>60 to 70</td>
</tr>
<tr>
<td>Industrial Peat</td>
<td>250,000 bales</td>
<td>175</td>
</tr>
</tbody>
</table>

The presence of these two industries in Delta has a stabilizing effect on local economy. They provide permanent employment in an area where seasonal labour is general. Atkins and Durbrow have a greater effect on the economy of the area as most of their employees live in Ladner, whereas the employees for Industrial Peat Company are drawn from the upland eastern section of the municipality.

The latest industry to be developed in the area is a grass dehydrating plant. It has been in operation at its present location on Crescent Island since June, 1948. A previous attempt to establish this industry ended in failure when the plant burned down in 1947. Dehydrated grass is used for chicken and other poultry feed. The market is at present local but the owner hopes to be able to establish an export market in the near future. He intends attempting experiments
with 'Canure' - dehydrated manure, and with poultry manure mixed with straw, sawdust or peat.

In 1920 the Fraser Valley Delta Co-operative Association was formed with the purpose of operating a grist mill where local farmers could have their grain processed for feed. As well as processing grain the 'Co-op' sells seeds, commercial feed, fertilizer and other farm needs. The plant was enlarged in 1948 when the facilities were modernized and more storage space was provided. The aluminium coated tower - similar to a prairie grain elevator - of the 'Co-op' is by far the tallest structure in Delta.

British Columbia Packers Limited maintain a small building on Boundary Bay at the foot of Oliver Road. This building serves as a storage shed where supplies in connection with an oyster farm near Crescent Beach are kept. The building is located outside the dyked area of the municipality.

A creamery operated in Delta during the period 1897 to 1918. The development of the Great Northern Railway branch line and the subsequent opportunity for farmers to ship their milk as fluid milk brought about the end of the creamery.

The Pacific Milk Company operated a milk condensing plant at the corner of Fairview and Westham Roads from 1918 to 1925. In the latter year it was purchased by the Fraser Valley Milk Producers Association who operated it until 1928. The industry was then moved to Sumas where it still is. Two factors accounted for the removal of the industry from the Delta. The growth of the fluid milk market in Vancouver meant that is became more profitable to ship milk from Delta to Vancouver and to process
milk from farming districts further from Vancouver. The milk from Delta has a low calcium content which makes it sensitive to heat. (41) As other areas of the Fraser Valley are not so affected, it was more economical to move the factory to an area where suitable milk could be obtained.

The building formerly occupied by the condensing plant was unoccupied until 1941. In that year the Ladner Canning Company was organized and the building was renovated as a vegetable cannery. The basis of the vegetable canning industry was to be the local pea crop. The cannery closed down after the 1948 canning season when it became impossible to sell the canned product. World trade and the dollar situation have been blamed for the failure of the cannery. The effect that the closing had on agricultural utilization of the land has already been discussed.

Prior to the closure of the cannery plans had been made to install quick freezing equipment so that part of the pea crop could be marketed frozen. In 1949 the cannery was purchased by the Hall Packing Company and plans were made to reopen the plant in 1950. The new owners planned to process more varieties than was formerly the case. The effect of this on the agricultural utilization is difficult to estimate. As crops are grown for the cannery on a contract basis, the type of crop planted and the number of acres of each crop is controlled by the canning company. If the cannery re-opens,

the requirements need not be the same as existed previously. It is likely that some of the acreage presently planted to oats would be transferred to vegetables for the cannery.

The cannery did not employ a large permanent staff. From 5 to 10 people were engaged in clerical work, labelling, and maintenance. It did, however, provide summer employment to nearly 100 people. In this way it provided employment for most of the Delta high school and university students who wanted work of this nature. When it did not operate in 1949 the students who had relied upon it for summer employment had difficulty in obtaining other positions.
CHAPTER FIVE

RESIDENTIAL UTILIZATION

There are five distinct areas in Delta where the principal utilization of land is for residential purposes. Each of these areas has a different origin and a different pattern of utilization. In view of this fact each area will be discussed as a separate unit. The five residential areas are Ladner, Delta Manor, Beach Grove and Grauer's Beach, Boundary Bay and Sunbury. There is, in addition, an Indian Reservation at Tswassen.

1. Ladner

Ladner is not incorporated and has no definite boundaries. Throughout the text however, it will be referred to as a village or a town in a descriptive rather than a political sense. There are, however, certain locally accepted limits of Ladner which may be described as follows:

- from the intersection of Chilukthan Slough and the Fraser River, southward along Chilukthan Slough to the intersection of the abandoned railway line, thence in a westerly direction along the abandoned railway line to the Fraser River, then northeasterly along the river to the starting point.

While this boundary may include a little more than is Ladner it will serve as a convenient boundary in that nothing that is properly Ladner is outside the defined limits. As defined, Ladner comprises an area of 322 acres.
**FIGURE NO. 26**

**ROAD MAP - KEY**

1. Trunk Road
2. Ferry Road
3. Westminster Avenue
4. Boundary Bay Road
5. Westham Road
6. Fairview Road
7. Elliott Street
8. Delta Street
9. Georgia Street
10. Bridge Street
11. Westham Street
12. Stanley Street
13. Victoria Street
14. Hotham Street
15. King Edward Street
16. Ontario Street
17. Central Avenue
18. Maple Avenue
19. Linden Drive
20. Green Road
Table No. 15 - Land Utilization, Ladner, B. C.

<table>
<thead>
<tr>
<th>Use</th>
<th>Area in Acres</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivated</td>
<td>153.4</td>
<td>46</td>
</tr>
<tr>
<td>Residential</td>
<td>125.5</td>
<td>38</td>
</tr>
<tr>
<td>Commercial</td>
<td>31.5</td>
<td>9.8</td>
</tr>
<tr>
<td>School &amp; Park</td>
<td>10.6</td>
<td>3</td>
</tr>
<tr>
<td>Waste</td>
<td>11</td>
<td>3.2</td>
</tr>
</tbody>
</table>

The site for the village was selected by William Ladner. Two considerations governed his selection; first, the possibility of escape via the river should the local Indian population prove warlike, and second, the junction of Chilukthan Slough and the river provided a landing place for river boats bringing supplies and passengers to the area.

The settlement grew up in response to the profitable fishing industry on the Fraser River. The first cannery in the area was located at the junction of Chilukthan Slough and the river, on the east side of the slough. This cannery was followed by other canneries and a lumber mill. The mill was erected about a quarter of a mile up the slough from its mouth. After the establishment of the canneries, the first store opened in the settlement and then a post office. At this time the village was known as Ladner's Landing. All that remains of the first cannery to-day are a few rotting piles. They are used by fishermen as a mooring place for boats.

As no building supplies existed locally all material for construction had to be imported by boat or by ox team.
from New Westminster. As a result of the cost and inconvenience of importing building supplies the size of buildings was kept to a minimum. No fresh water existed locally so the early settlers had to place barrels under the eaves in order that rain water might be stored.

One of the first homes built in the area has been described as consisting of four rooms constructed of split logs and green timbers. When the green timbers dried they shrunk and left many cracks in the walls. The cracks were filled with cheesecloth and caulking. These houses provided little of the comfort of a modern dwelling.

After the incorporation of Delta Municipality in 1879 Ladner became the seat of local government. Thus there are three factors which influence the areal development of the town, (a) a suitable site for the first settlers, (b) as a centre for fish canning, (c) as the municipal centre. As the agricultural area around Ladner became settled the village also served as the supply centre for the farming population.

Until 1910 however, Ladner grew and prospered as a fish canning town. When the fish canneries closed down after 1913 the town went into a decline. The future of Ladner then became closely tied to the prosperity of the farming industry. After the closure of the canning industry the principal business of the village was as a supply centre. Nearly all the residents of Ladner were connected in one way or another with this function.

Ladner remained almost static between the two World Wars. During the 1930's only four new businesses opened in the town
while three closed down. World War II brought a period of revitalization. An R.C.A.F. station opened three miles east of Ladner in 1942 and brought with it a sudden influx of population which strained the capacity of Ladner to accommodate them. There was little construction during the war years but once the war ended there was a period expansion of the commercial facilities of the town. Since 1945 eleven new buildings have been erected with accommodation for five offices, ten stores, one theatre, two service stations and a bowling alley. In addition to the new construction six other buildings were renovated or enlarged. Since the war two stores have closed down. Both belonged to larger chains and activities with the company as a whole rather than local conditions were responsible for the closure. Both of the premises have since been occupied by new businesses.

A general pattern of land utilization can be defined within Ladner. The commercial section is in the northeast, the residential district extends in a semi-circle around it, and beyond the residential area are cultivated fields. Although this pattern holds true in a general way there are several exceptions to it. Land utilization within Ladner is shown on (Fig. No. 32).

A detailed examination of the area will show the actual pattern of land utilization. The main business streets are Westham Street from Chilukthan Slough to the intersection with Bridge Street; Delta Street from Westham Street to the river, and Elliott Street from Westham Street to the river. Residential and cultivated lots are found within the main-
commercial district. Delta Street could be described as the main street but recent business construction has been taking place along Westham Street. If the present tendency continues it seems likely that the commercial centre may shift from Delta Street to Westham Street. Such a shift would provide local authorities with a traffic problem. Delta Street is the wider street and has ample room for angle parking whereas Westham Street is not, although angle parking is allowed. As a result traffic congestion occurs. It would seem that planning is necessary either to control the selection of sites for new business development or to widen narrow streets before development takes place.

The business section of Ladner is a study in contrasts. The two periods of growth of the town - at the turn of the century and since World War II - are reflected in the types of building. The older buildings are rather unattractive, wooden frame structures that present a square front to the street. Some of these older buildings have been modernized and blend in harmoniously with the newer stores. Those that still retain all their original features, however, clearly testify to the time of their construction. The newer buildings are of wood or cement block construction usually finished in stucco or tile. They are much lower than the older buildings and present a more pleasing picture to the eye. The accompanying photographs (Figs. 27 & 28) taken of buildings on Delta Street illustrate the contrast between the old and the new.

The residential areas spread out around the central
FIGURE NO. 27  Commercial district, Delta Street, Ladner, B. C.

FIGURE NO. 28  Commercial district, Delta Street, Ladner, B. C.
commercial district. Generally speaking the older residences are nearer to the centre with the newer ones towards the periphery. The most recent residential construction has taken place along Ontario, Hotham and King Edward Streets. These streets now are the last ones within Ladner that have available building lots, and water, light and telephone services.

There is, in the residential districts, the same contrast between old and new that was found in the commercial area. The older houses are large two storey buildings while the more modern houses are of the bungalow type. The older buildings have an exterior finish of paint whereas the new houses are finished with stucco or patent shingles. Both types will be found interspersed along the same street as the accompanying photograph (Fig. No. 30) will illustrate. It has not been possible to grade the residential districts into first, second or third class. Any criteria which might be used for such a classification - type of house, value of house, age of house, occupation of owner or tenant - would fail to provide any clear cut division between one block and another.

The residential districts of Ladner reflect a certain small town charm that is rarely found in cities. The building lots are large, ranging from one-half to one acre in size. Most houses have their lawn, shade trees and flower beds. In summer the flowers provide a delightful panorama of colour against a background of varying greens. Orchards are common throughout the residential districts and add to the charm of the area. In spring the blossoms with their delightful appearance and odours; in the fall the fruit with
FIGURE NO. 29  Residential Street,
Ladner, B. C.

FIGURE NO. 30  Older style residences,
Ladner, B. C.
FIGURE NO. 31  Bungalow style residences, Ladner, B. C.
all its varying colours help to clothe the area in natural beauty. Against this background there are, of course, the houses and the lots that are not kept up and, as in other settlements, detract from the general appearance of the whole.

The residential area along Westham Road to the western limit of Ladner is a fishing village. This settlement stretches in line along the river, as a 'strassendorf' type of settlement. Houses on the south side of the street are built on municipal land, and contrast with those on the north side on the dyke. The dwellings on the dyke are often little more than shacks with equipment sheds and net houses interspersed amongst them. Those on the south side of the street are substantial, one and two story structures. This section of Ladner is entirely dependent on the fishing industry. All of the people that live in the settlement are either fishermen or retired fishermen. This area, which has no commercial district, is dependent on Ladner for its business needs.

Area of cultivated land are found beyond the residential section. Some of the land is included within Ladner merely for the sake of a convenient boundary. There is, however, some cultivated land enclosed by the residential section. Some of this land is suitable for housing construction now, but the development of most of it will have to await road construction. With land available along existing roads however, it seems unlikely that any further road construction in Ladner would be necessary for the present. The pattern of urban utilization within Ladner is therefore unlikely
to change in the near future.

One other separate section called "Chinatown", is worthy of note. Now much reduced from what it originally was, Chinatown consists of a few unkempt buildings along the dyke from the end of Westham Street and a few more respectable buildings at the end of the street. The Chinese settlement which began to decline with the end of the fish canning in Delta, was virtually wiped out by a fire in 1928. The fish canneries had provided employment to a large number of the Chinese. A triangular piece of land between the dyke and Westham Road is possibly the most intensely cultivated section in the delta area. Under cultivation by a Chinese truck gardener, the land produces two or three crops a year.

2. Delta Manor:

Delta Manor extends one mile east of Ladner and between the river on the north and a line linking Green Road with Chilukthan Slough on the south. It was originally the land granted to T. E. Ladner in 1868. This farm of 500 acres remained with the family until 1926. At that time the farm was subdivided into small holdings of one and two acres. The area was provided with roads, electric light, water and telephone. Settlers for the new subdivision came mostly from the Prairie Provinces although some came from as far away as England. Poultry raising was to provide economic stability to the settlement. With the decline of the poultry industry, the settlers turned to the cultivation of small fruits. They became the mainstay of the settlers by acreage and by
value of production. The residents concentrated on the production of raspberries although lesser areas were given over to black currants, red currants, strawberries and loganberries.

Five types of land use have been recognized in Delta Manor.

Table No. 16. - Land Utilization, Delta Manor

<table>
<thead>
<tr>
<th>Use</th>
<th>Area in Acres</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small holdings</td>
<td>345</td>
<td>69</td>
</tr>
<tr>
<td>Residential</td>
<td>84</td>
<td>16.9</td>
</tr>
<tr>
<td>Cultivated</td>
<td>55.6</td>
<td>10.9</td>
</tr>
<tr>
<td>Commercial</td>
<td>2.7</td>
<td>1.6</td>
</tr>
<tr>
<td>Not used</td>
<td>12.8</td>
<td>2.6</td>
</tr>
</tbody>
</table>

The areal distribution of this land use is shown on Map No ...

In distinguishing between small holdings and residential land a test of size and of use was applied. Small holdings were recognized as being over an acre in size and land from which the owner derives some revenue other than in the form of rent from buildings. Residential land was recognized as being less that an acre in area and from which the owner does not receive revenue from produce. While this test cannot be applied too rigidly it will hold for most of the cases concerned.

In distinguishing between small holdings and cultivated land the following test was used. Cultivated land was taken to be land that is entirely used for commercial cultivation while a small holding usually combines the function of residence, garden and commercial cultivation.
The pattern of distribution of residential and small holdings is fairly clear. With a few exceptions, the residential land is found along the two main roads through the subdivision - Westminster Avenue and Trunk Road, whereas small holdings cover most of the rest of Delta Manor. The remaining areas are spread with little pattern.

It would be difficult to describe a typical small holding because there is so much variety. Small fruits are common on nearly all holdings. Cultivation of asparagus, flowers, potatoes, and the raising of chickens are all part of the land use pattern on a small holding. In most cases the selection of crop seems to reflect the whim of the owner more than an area specialty. Of the hundred small holdings in Delta Manor it would be difficult to find two that were exactly alike as to crops.

The use of the cultivated land presents an example of fragmentary agriculture. One man may work several discontinuous plots of land. He does not, as a rule, own the land but rents it on a yearly basis from the owner who for reasons of health, age, or personal preference may not care to work the land himself. The limited land available and the discontinuous nature of the plots is not conducive to a profitable type of agriculture. The cultivation of land fragments is of declining importance as it is upon this land that the demand for residential building lots is falling.

Commercial development within Delta Manor is very limited. The three business enterprises that are in operation - a bakery, a cold storage locker and a gasoline station - are
FIGURE NO. 33  
Family home of T. E. Ladner,

FIGURE NO. 34  
Westminster Avenue.
supplementary to the businesses in Ladner and serve the combined districts. For most of its commercial needs Delta Manor relied upon Ladner.

The well-kept bungalows built along Westminster Avenue since 1945 have made it one of the most modern residential streets in Delta. Each house is surrounded by a lawn and garden and has several fruit and ornamental trees that add to the picture of a pleasing residential street.

3. Beach Grove and Grauer's Beach

Beach Grove consists of that part of Delta lying west of Boundary Bay, east of Point Roberts Road, south of Herd Road and north of Boundary Bay Road. It lies partly on the Point Roberts Upland and partly on the lowland area. It has a total area of 171 acres of which 146 are on the lowland. Of the 146 acres on the lowland 60 acres have been utilized as a golf course whereas the remainder have been subdivided into 50 by 125 feet lots. Grauer's Beach consists of 30 acres lying immediately north of Beach Grove. This part of the resort is crossed by 5 north south roads with forty two 50 by 125 feet lots lying between each road. The two resorts will be discussed together as there is no natural boundary between them. The only distinction between the two is that they were subdivided by different agencies.
Table No. 17 - Land Utilization Beach Grove and Grauer's Beach

<table>
<thead>
<tr>
<th>Use</th>
<th>Area in Acres</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beach Grove</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Golf Course</td>
<td>60</td>
<td>41</td>
</tr>
<tr>
<td>Residential</td>
<td>60</td>
<td>41</td>
</tr>
<tr>
<td>Recreational</td>
<td>6</td>
<td>4.2</td>
</tr>
<tr>
<td>Not Occupied</td>
<td>20</td>
<td>13.8</td>
</tr>
<tr>
<td>Grauer's Beach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>18.3</td>
<td>61</td>
</tr>
<tr>
<td>Not Occupied</td>
<td>11.7</td>
<td>39</td>
</tr>
</tbody>
</table>

The pattern of settlement in each has been similar. The lots along the waterfront were occupied first with later settlement taking place in steps away from the water. The only variant to this has been along Herd Road where settlement along a main road preceded settlement away from the beach. Settlement further west in each area is at present handicapped by a lack of water facilities in Beach Grove beyond present settlement and by the poor condition of the north-south roads in Grauer's Beach. These roads are being opened up so that the latter handicap is only a temporary one.

The water problem in Beach Grove presents the greatest barrier to further settlement. Water mains have not been laid beyond the westerly limit of present occupancy. The water supply is adequate for the present inhabitants but it would not serve a further increase in population. A complete revamping of the present water system would be needed before there could be a further increase in settlement. At present water for Beach Grove is purchased from the Delta Water Works.
FIGURE NO. 35  Waterfront, Beach Grove.

FIGURE NO. 36  Main Road, Beach Grove.
by the Beach Grove Water Works and then sold to the residents. All water must come through a master meter and then be distributed throughout the area. The supply of water is limited by the amount of water that can pass through the master meter. To supply more water would require a new meter and new piping throughout Beach Grove. There is little likelihood that such action will be taken by the present Beach Grove Water Works as they have indicated a desire to cease functioning. There exists a possibility that should the Beach Grove Water Works become defunct the resort will be added to the present municipal system.

These two districts have been utilized as resorts for many years. Many of Delta's early settlers had summer homes at Beach Grove before the turn of the century. Extensive development of the resorts did not come until 1927 when subdivision took place. Subdivision was followed by an active campaign to sell the land. Since 1927 there has been a steady increase in the number of summer homes in the area. At present all lots that can be serviced by water in Beach Grove and by roads in Grauer's Beach have been sold. When these services have been extended there will be 177 lots available in Beach Grove and 82 in Grauer's Beach. Experience has shown that these lots will be sold as soon as they can be made available to the public.

Although these two areas were originally intended to be resorts a trend towards permanent settlement has been noticeable since 1939. In that year there were no permanent residents in either area. By 1949 there were 60 permanent
residents in Beach Grove and 25 in Grauer's Beach. The permanent residents fit into four categories: (a) retired people, (b) people who work in Vancouver and who commute daily between the city and their homes in Delta, (c) people who work in Ladner, (d) people who work in the area. The great increase in permanent settlement has come since 1945.

The resorts have certain advantages over Ladner as a residential area and suffer several disadvantages. The great impetus to settlement came during the war when families of servicemen required housing in Delta. The resorts were the only places that had housing available. They have a somewhat more attractive setting than Ladner in that the houses are located in an area of coniferous trees, and the houses along the waterfront look out onto an lovely embayment of the Gulf of Georgia. The resorts are linked to Ladner with a good road and are only about 15 minutes by car from that village. People who live at the resorts claim that there is less rain and fog there than in Ladner. There is no weather station to prove or disprove the contention, however, and personal observations are unreliable in support of an argument of this nature.

Among the disadvantages is the fact that there is only one store to serve the two resorts so that permanent residents must either do their shopping there or in Ladner in person or by telephone. In either case it is somewhat inconvenient. Parts of the resorts are poorly drained as they do not come under the municipal drainage scheme. While the lack of
drainage does not affect them as resorts, it does offer a drawback to permanent settlement. It is likely that they will remain primarily as resorts.

4. Boundary Bay

Boundary Bay is a summer resort in the southeast corner of the municipality. The southern boundary of Delta is the 49th parallel although the resort continues in the United States of America. Within Canada the resort has an area of 161 acres.

Table No. 18 - Land Utilization, Boundary Bay

<table>
<thead>
<tr>
<th>Use</th>
<th>Area in Acres</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>83.7</td>
<td>51.9</td>
</tr>
<tr>
<td>Wooded</td>
<td>54.6</td>
<td>33.9</td>
</tr>
<tr>
<td>Commercial</td>
<td>4.6</td>
<td>3.0</td>
</tr>
<tr>
<td>Not Used</td>
<td>23.1</td>
<td>11.2</td>
</tr>
</tbody>
</table>

The areal distribution of uses is shown on (Fig. No. 37).

The resort developed originally under impetus from Delta residents. Popularization of the automobile made it possible for summer visitors from Vancouver and New Westminster to come to Boundary Bay. The Canadian section of the resort was for many years completely dependent on the American section for stores and amusement. The international boundary meant little to the summer residents at Boundary Bay. Within the last ten years, however, and largely as a result of enforcement of wartime regulations governing the export of Canadian currency, there has been some commercial development on the Canadian side. To-day the commercial enterprises on
the north side of the boundary consist of three general stores, two restaurants, a dance hall and a novelty store.

The growth of settlement has been westward from the shoreline and northwards from the boundary. The western side of the resort is a fir and cedar forest covering nearly 55 acres. This wooded area is gradually being diminished as land is cleared for new settlement. The unused portion is in the centre of the resort and it consists of marsh or sand covered with a scrub growth.

The principal drawback to settlement at Boundary Bay at present is a lack of fresh water. The area is not part of the municipal water system, and must rely on springs and wells for its water supply. Springs occur on the eastern slope of the Point Roberts Upland at elevations of 25 to 30 feet. The few wells that exist cannot be used too extensively for fear that salt water may filter into them.

During the summer of 1949 Delta Municipality employed a firm of geologists to survey the area and to estimate the local water supply. They reported to the municipal authorities as follows:

"The writer is of the opinion that a supply of ground water suitable for a waterworks system covering this entire area is not available. The catchment area of 1,400 acres is too small to provide sufficient recharge from rainfall, which is the direct source of water from the springs and wells. In periods of little or no rainfall, it is reported that the flow of springs is reduced. The formation supplying water to the Whalen well at 275 feet is very fine sand and silty and would not allow the movement of a large quantity of water through it.

"It is therefore our recommendation that some source of supply other than ground water be considered if the entire area is to be serviced." (42)

Until such times as adequate fresh water is available to the residents, Boundary Bay will have little future development.

The development of permanent settlement at Boundary Bay has paralleled that at Beach Grove. Stimulus to permanent settlement came during the war when there was a sharp rise in Delta's population as a result of the establishment of the airport. Summer cottages at the resorts were the only available places for the new residents to live. Although the number of permanent residents has decreased since the war, there are about 30 families in year-round residence.

5. **Sunbury**

Sunbury is a fishing settlement in the northeast section of Delta. Settlement is in a narrow strip between the river and the bog with all houses being along River Road. Each holding stretches back from the road and is bounded on the south by the bog. The pattern of land holding would be similar to that along the St. Lawrence River in Quebec. There is no definite western boundary for Sunbury. There is a gradual gradation from small holdings to farms and as a result the boundary selected on the utilization map is an arbitrary one. The eastern boundary has been taken as the Great Northern right of way.

Between the dyke and the river a small ledge of land has been built up. During most of the year this ledge is land but when there is high water in the river it may be covered by as much as two feet of water. Several houses
and the four stores which make up Sunbury's commercial centre are built on this ledge outside the dyke. To protect the buildings from high water, they are either upon floats or upon piles.

The settlement exists entirely as a home for fishermen. Its location is governed by the fact that the only cannery presently operating in Delta is located at the eastern edge of the settlement. There is a small commercial centre, but for most of the needs of the residents, New Westminster is the supply centre as it is closer to Sunbury than is Ladner, Nearly all of the 345 acres which have been included within Sunbury are in use for building lots and gardens.

6. Tswassen:

There is an Indian Reservation called Tswassen in the southwest corner of the lowland area, bordering the Gulf of Georgia. It lies athwart the division between Ladner Clay and Bay Sands and continues southward on the Point Roberts Upland. Tswassen is connected to the road system of Delta by a sand road along the shore. Settlement is laid out on the east side of this road with a large expanse of marsh on the seaward side. Houses for the most part are unpainted and lack the surrounding lawns and gardens of the rest of Delta.

The two soils types found are used quite differently. Settlement is on the Bay Sands while farming is carried out on the clay soils. The only vegetation on the sand is a sparse grass and a few bushes.

The Indians of the reservation are of the Salish Tribe.
Their numbers have remained almost constant since the beginning of this century with a population of 56 being listed by the Indian Affairs Branch in 1944. The present population will be somewhat less as two of the younger families have moved away since that time. Of the eight families on the reservation half are engaged in farming and the other half in fishing. In both occupations the Indians use the methods of the neighbouring white men.
CHAPTER SIX

MILITARY UTILIZATION

In 1942 the Department of National Defense purchased 1,100 acres of land east of Tasker Road and south of Trunk Road. This land which came to be known as the Boundary Bay Airport was utilized by the Royal Canadian Air Force first as an Elementary Flying Training School and later as an Operational Training Unit. Following the conclusion of the war the airport was used as a discharge centre and then as a base for the War Assets Corporation. In 1948 the site was taken over by the Canadian Army and has been developed as a permanent army camp. A residential section of fifty houses has been completed for married personnel and a further expansion is planned for 1950.

Other smaller tracts of land at the junction of Crescent Island Road and Trunk Road, Crescent Island Road and MacDonald Road, and on Westham Island were obtained by the Department of National Defense during the war. Since the war, with the exception of a small acreage on Westham Island, this land has reverted to farm use.

With the establishment of a permanent army camp at the Boundary Bay Airport it seems that military utilization has become a lasting feature of land use of Delta Municipality.

As Ladner is the nearest shopping centre to the army camp the merchants of that town will benefit as they will be called upon to cater to the needs of the army personnel. Thus the army camp will undoubtedly bring greater stability to the
economic life of Delta.
CHAPTER SEVEN
SUMMARY OF LAND USE

Land use has been discussed under the headings of agricultural, industrial, residential and military. The agricultural land utilization is shown on the utilization map (Fig. No. 38) as cultivated land and permanent pasture. No mention has been made of the industrial land use on the map as industries are few and insignificant spatially. They have been located on an "Industrial Map". Residential land appears on the map without subdivision. Special sample district maps have been prepared to show the utilization within the residential areas. The small areas of waste land and trees have been omitted from the summary although they have been shown on the district maps. As they occupy very little land they would appear of no consequence in the total picture. The peat bog has been considered separately. Rather than classify it as an area of waste land, it has been classified as peat.

Table No. 19 - Land Utilization, Lowland Area of Delta Municipality

<table>
<thead>
<tr>
<th>Use</th>
<th>Area in Acres</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural</td>
<td>18,400</td>
<td>58.1</td>
</tr>
<tr>
<td>Peat</td>
<td>10,500</td>
<td>33.2</td>
</tr>
<tr>
<td>Residential</td>
<td>1,675</td>
<td>5.2</td>
</tr>
<tr>
<td>Military</td>
<td>1,100</td>
<td>3.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>31,675</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER EIGHT

CONCLUSIONS

There is one inescapable fact in the physical environment of Delta. The area has but two natural resources - its soil and its peat. Of these nearly all the areal extent of the soil is being utilized whereas until a few years ago the peat contributed nothing to the local economy. With the start of peat processing, however, the bog has been utilized in the most satisfactory manner known at present. The pattern of agricultural utilization that has been evolved is the most efficient for the area at the present time. Climate, soil and market conditions have all contributed to encourage the development of a dairying economy.

In reviewing the geography of Delta, it seems that man has made a satisfactory adjustment to his natural environment. The problem that must now be faced is whether or not the present situation will be allowed to remain. While the natural environment changes slowly, the cultural environment is much less stable. It is the product of man; and what man makes, he can change. Changes may occur in the cultural environment that could radically alter the present land use pattern of Delta.

For the past few years there has been increasing local agitation for a tunnel or a bridge between Ladner and Woodward's Landing to replace the present ferry. Should a tunnel or bridge be constructed travel time between Ladner and Vancouver would be reduced by about one-third and become
more reliable than it is at present. The first effect of a more permanent means of crossing the Fraser River would be a rapid expansion of the population of the Delta. Greater Vancouver's population is now spreading over Sea Island, Lulu Island and the northern part of Surrey Municipality. There seems to be no reason why this spread of population would not continue onto Delta after the construction of a bridge or tunnel. 

There are certain grave considerations which must be kept in mind if urban settlement on the lowland area of Delta is to be encouraged. Two facts would seem to indicate that it is not in the best interests of either any future residents or the Province of British Columbia to encourage extensive residential development in this area.

In the first place, the land of Delta is beneath the high water level of the Fraser River and is, as a result, subject to flooding. While it is true that there have been no floods for over 50 years, it is likely that the area escaped damage in 1948 only because dykes further up the valley held before the river's onslaught. While it is also true that the dykes held again in 1950, there is no assurance that they will hold again in 1950, there is no assurance that they will hold again in 1950.

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Winnipeg, Manitoba, in 1950, should serve to illustrate the danger. In the Lower Fraser Valley there is no need for residential settlement on lowlands. There is much unused land on the Surrey Upland available for this purpose.

Another fact that should be kept in mind is that the amount of good arable land in British Columbia is very limited. Nothing should be done that will in any way decrease the amount of agricultural land. In countries such as Great Britain with a far longer history of settlement than has Canada, the use of agricultural land for other purposes is now having serious effects. While the day when there will be a shortage of farm land in North America may be a long way off, we should profit by the experiences of European countries and plan now to keep our agricultural land in agricultural production.

Although a strong case can be made against urban settlement, a geographer must realize that it is a definite possibility. In such circumstances he should point out some of the difficulties which may be encountered and suggest remedies for them.

The first problem that would have to be solved in this regard is what land to subdivide for residential settlement. Should the process of subdivision be allowed to run free or should it be controlled. If the increase in population comes, the municipal authorities of the day will have to answer that question. If the situation is handled incorrectly there is liable to be wastage of natural resources.

The first step that could be taken to handle an increase
in the residential population of the Delta is to ensure that the present settled areas have adequate roads, drainage, sewage disposal facilities, and water supply for a heavier density of population than at present. Ladner, Delta Manor, Beach Grove and Boundary Bay could all be developed to provide land for more residents.

The development of small holdings on the peat bog of Lulu Island provides an interesting parallel for the planning of future settlement on the Delta. As the Delta bog and the Lulu Island bog are similar, if roads, drainage, and water, were provided in the Delta bog a large scale settlement could take place. In this way the bog could be brought into a satisfactory utilization and the farm land could remain in the production of food.

In order to prevent friction between the farming community and the residential community it would be advisable to incorporate the latter into a town or village. A residential district would require a level of public utilities that is not essential in a farming community. The local authorities would be responsible for the provision of these utilities. As the largest part of local revenue is derived from land taxes, a disproportionate part of the tax burden would, in all likelihood, fall on the farmers. Farmers, as a body, resist higher taxes. Thus they would be opposed to increased levies to provide public utilities for a residential community. To prevent political friction between the two communities, incorporation of the residential district would be necessary.
Incorporation of the residential community would not only prevent friction between the two communities but would also provide a system whereby the residential settlement could take place without unnecessary encroachment upon farm land. If the boundaries of the proposed town were marked out in advance of any large scale settlement, the growth might be confined within desired bounds.

A knowledge of the geographic factors of the Delta would be a great help in determining the proposed boundaries. Ladner and Delta Manor are now residential areas and would be included within the new town. Between Green Road and Goundy Road and from the Crescent Island Slough to the abandoned railway line there is a partial small holding development. This area could be included in the new town without any great infringement on farm land. The area south of the present boundaries of Ladner between Chilukthan Slough and Fairview Road and south to Nelson Road consists mostly of small farms and a few residences. This area could also be included in the new town with little encroachment upon farm land. In order to include part of the Peat Bog within the town it would be necessary to take over a tract of farm land. The least farm land possible would be included if Trunk Road be chosen as the southern boundary east of Goudy Road. The eastern boundary could be provided by a northward extension of the Tasker Road. Crescent Island Slough until it crosses MacDonald Road would make a convenient northern boundary. From the intersection of Crescent Island Slough and MacDonald Road, the northern boundary could be a new road constructed to meet Tasker Road.
FIGURE NO. 39

PROPOSED TOWNSITE
in the bog. A town of this area would include about 2,600 acres available for settlement. One half of these acres would be in the Peat Bog. Such a town would be large enough to give living room for around 5,000 families. This should provide sufficient room for any population growth in the near future.

The chief merit of this plan is that it provides a large amount of land for residential lots with a sacrifice of less than 1,300 acres of present cultivated land, and it is in the area nearest to the proposed bridge or tunnel. The incorporation of a residential community as a separate political unit would prevent the tax load from becoming too heavy on the remaining farm land. By planning for a residential development in advance it would be possible to prevent the spread of scattered subdivisions.

Two choices face the authorities responsible for the future of Delta. There is a choice between retaining the present agricultural economy or attempting to meld rural and urban development within one area. The latter course is fraught with difficulties and dangers. Any authority that encourages urban settlement on the flood plain of the Fraser River is courting disaster. It is the view of the writer that the first choice is the one that will prove most satisfactory is the long run. As long as land unsuited for agriculture and free from flooding remains available, the present agricultural community of Delta should be disturbed as little as possible.
APPENDIX 1.

CLASSIFICATION OF LAND ON A USABILITY BASIS

Class I Land:
(a) Land suitable for cultivation
(b) Land that can be cultivated safely and permanently without special practises for control of erosion
(c) Land that retains and supplies enough moisture and contains sufficient plant nutrients for the maintenance of those physical, chemical and biological conditions of the soil that favor continual production of moderate to high yields of farm crops.

Class II Land:
Land for which special practises such as tile draining are required.

Class III Land:
Land that requires complex or intensive measures in order that it may be safely cultivated.

Class IV Land:
Land suitable for other uses which may involve short periods of cultivation.

Class V Land:
Land that is unsuited for cultivation.

(Classification based on Dale, Tom and Ross, W. A. Conserving Farm Lands, published by the United States Department of the Interior in 1939.)
BIBLIOGRAPHY

Books


Burwash, E. M. J. The geology of Vancouver and vicinity, Chicago, University of Chicago Press, 1918.


Connor, A. J. The frost free season in British Columbia, Toronto, Department of Transport, Meteorological Division, 1941.


Halliday, W. E. D. A forest classification for Canada, Ottawa, King's Printer, 1937.


Johnston, W. A. Sedimentation of the Fraser River Delta, Canadian Geological Survey, Memoir 125, Ottawa, King's Printer, 1921.

Johnson, W. A. Geology of the Fraser River Delta map area, Canadian Geological Survey, King's Printer, 1923.

Laing, F. W. Colonial farm settlers on the mainland of British Columbia, 1858-1871, Victoria, 1939. (unpublished manuscript in Howie-Reid Collection, Library, University of British Columbia).

Massey, N. G. Why the Lower Fraser River Crossing Improvement was formed, Ladner, B. C., 1948.


Merton, James, *Honest John Oliver*, J. M. Dent and Sons Ltd., Vancouver, 1933.

Periodical Articles:


Government Publications

(a) Dominion of Canada


Department of Customs, Annual Reports 1917 to 1929, Ottawa, King's Printer.

Department of Fisheries, Monthly Record of Meteorological Observations in Canada and Newfoundland (1925 to 1929).

Department of Marine, Monthly Record of Meteorological Observation in Canada and Newfoundland (1930 to 1934).

Department of Mines and Resources, Indian Affairs Branch, Census of Indians in Canada 1939, Ottawa, King's Printer 1940.

Department of Mines and Resources, Indian Affairs Branch, Census of Indians in Canada 1944, Ottawa, King's Printer 1945.

Department of Mines, Indian Affairs Branch, Annual Report, 1905, King's Printer, Ottawa, 1906.

Department of Mines, Indian Affairs Branch, Annual Report, 1910, King's Printer, Ottawa, 1911.

(b) Province of British Columbia:

Department of Agriculture, Annual Report 1892, Victoria, King's Printer, 1893.

Department of Agriculture, Annual Report 1892, Victoria, King's Printer, 1894.
Department of Agriculture, Annual Report 1894, Victoria, King's Printer, 1895.


Department of Agriculture, Climate of British Columbia, Victoria, King's Printer, 1948.

Department of Trade and Industry, Regional Development Division, Regional Industrial Index of British Columbia, Victoria, King's Printer, 1948.

Department of Trade and Industry, Regional Development Division, Regional Industrial Index of British Columbia, Victoria, King's Printer, 1949.

c United States of America


Newspapers


Miscellaneous Publications:

Delta Board of Trade, The Prolific Delta, Ladner, B.C., 1927.

Various British Columbia Directories 1890 to 1948.


Interviews:

Armstrong, Dr. J. E.  
Cooper, C. E.  
Cory, S. C.  
Davie, M.  
Dunning, E. C.  
Kirkland, L. J.  
Gowen, E. R.  

Kittson, R.E.  
Ladner, L. J.  
Massey, N. G.  
Nottingham, J.  
Smith, J. P.  
Wainwright, F. R.
Letters:

Carncross, E. E. - Managing Director, Industrial Peat Limited, Cooper, C. E., Municipal Engineer, Corporation of Delta, Ireland, W. E., Provincial Librarian and Archivist.