DOMINION-PROVINCIAL BOARD
FRASER RIVER BASIN

TWEEDSMUIR PARK REPORT

REPORT OF INVESTIGATION

OF TWEEDSMUIR PARK

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Tweedsmuir Park is the largest Provincial park in British Columbia, and is in fact the largest scenic park in Canada or the United States It was created in 1938 and named after the late Lord Tweedsmuir, Governor-General of Canada from 1935 to 1940.

The area was first seen by white men in 1793 when Alexander Mackenzie and his party traversed it on their way to the Pacific Coast. Except for the possibility of fur traders in the area the next white men to see the area were the surveyors looking for a route for the trans-Canada railway between the years 1870 and 1880 Two possible routes through the area were located, but later abandoned for the route down the Fraser Canyon In 1876 G M. Dawson made a trip through the easterly part of the park for the geological survey of Canada Another wellknown name connected with the area is that of Father Morice who travelled and explored much of the north and central part of British Columbia between 1885 and 1904 When Father Morice first saw Eutsuk Lake, the largest of the circle, he described it as "the grandest and most beautiful lake we have ever seen " The area seems to have been little used after 1870 when even the old Indian trails were abandoned The "Grease Trail" ran from Pondosy Bay to Kimsquit over the Sakumta Pass and the "Stick Trail" passed westward from Ulkatcho, an Indian village in the southern part of the park to the Dean River Swannell, the chief surveyor of the area, describes the trails as "disused for a generation, chopped wide with camps everywhere, and the very old choppings done with the axes made after the stone-age pattern--a hoop iron blade lashed at right angles to the shaft like a hoe." Few Indians live in the area now, and there are no white settlements.

The Coast Range summit forms the boundary on the west, extending almost to longitude 128 with the easterly boundary about two miles west of the 125 degree, a distance of over 110 miles. Ootsa River and Lake and the drainage basin of the Tahtsa River and Lake form the northerly boundary, the southerly boundary reaches almost to latitude 52-30, a distance of about 90 miles below Ootsa Lake at this point The total area of the park is 5400 square miles or 3,456,000 acres; Burns Lake on the north and Bella Coola on the south are the gateways to the area.

The park is a great wilderness area, without roads, buildings or other signs of habitation and with very few trails The great natural beauty of the area is enhanced by its wildness and tremendous size The area has not been commercialized in any way J. D Galloway reported in 1916 "There is evidence of widespread mineralization, and at least one

section--Sweeny Mountain--is decidedly promising." Some claims have been staked and the Consolidated Mining and Smelting Co. did some work on the Emerald group on the north side of Tahtsa River, but the very high cost of transportation is said to have caused the work to be stopped. When talking to a man that knows the area very well the statement was made that flooding the area would materially improve the mining possibilities as it would then be possible to reach all parts of the lake system with large boats. Since that time the proposed scheme or development has been altered so that Eutsuk and Tetachuk Lakes will still be isolated as at present.

An interesting note on the park is included in the British Columbia Forest Service Economics Division report P24, printed in 1944, which states "The present number of guides and their equipment and accommodation ..... could not handle more than 200 tourists during a season even with all the trips running on a perfect schedule" The report goes on to state that 800 people is believed the maximum which could be successfully handled without depreciating the wilderness characteristic of the park.

Referring to the map attached showing the park, the circle of lakes may be readily seen. The lower half of the circle is generally at a higher elevation than the upper half, but the difference is slight. Eutsuk Lake head water of the south branch with an area of 96 sq. miles is at elevation 2807' while Tahtsa Lake on the north is at elevation 2783 with an area of 20 sq. miles. The north and south lake systems come together at Natalcuz Lake some 110 miles east. The Nechako River flows from Natalcuz Lake and has a drainage area of 4390 sq. miles at this point, with only occasional flow records, however. The average annual flow of the river at a point one mile above Fraser Lake over a period of almost twenty years is 7270 c.f.s., where the drainage area is 6700 sq. miles. The headwater lakes lie deep into the Coast Range of mountains, and if a tunnel was constructed through to the western slope of the summit, the waters, instead of flowing to the Pacific by way of the Nechako and Fraser rivers, a distance of some 750 miles, could be dropped through penstocks to power-houses, developing most of this great head, and a total of some 1 1/2 million horse-power.

It is this great power scheme that the Aluminum Company of Canada is now surveying, and for which they have made application for a water licence. The value of such a power development to the Province is obvious. A city of many thousands would be required to operate the plants required for the aluminum production alone and there will be many other plants using the excess power, of which there will be considerable available. No resource of the area will be used by the Aluminum Company except the water. The raw products of the aluminum will be brought in and the finished product shipped by water. A short line connecting to the C.N.R. will give the plant rail connection. The capital investment of such a scheme, including the

city and manufacturing plants, is estimated to be from five hundred million dollars upwards. The type of development envisioned, its size and problems would make it, if successfully completed, the most outstanding power development of the world.

The original scheme considered by the Aluminum Company was a dam at the outlet of Natalcuz Lake, high enough to raise the waters in the entire circle of lake, -- Eutsuk, the highest, would have been raised about 29', and the portage to Whitesail would have been almost eliminated.

The land formation at the outlet of Natalcuz did not prove suitable for the dam, and a second scheme shown on the attached "Nechako-Kitimat Project" general plan, may be described as follows:

Stage 1 A dam will be built at the outlet of Tahtsa Lake, raising the elevation only 8 feet from 2782 to 2790. A single tunnel reported to be 19' in diameter and about 10 miles long would be driven westerly through the Coast Range summit to the power site located on the Kemano River. A transmission line would then conduct the current about 45 miles to the head of Kitimat Arm where a suitable location has been found for a town site. This first stage would develop approximately 250,000 kilowatts and would take 4 or 5 years to complete.

Stage 2. Nanika and Kidprice Lakes are in the headwaters of the Skeena system. By building a dam at the outlet of Kidprice Lake approximately 131' high, the flow of these two lakes can be diverted through a tunnel some 3 miles in length into Tahtsa Lake adding approximately the same amount of power which would bring the total to one half million kilowatts.

This second step would require another 4 or 5 years to complete.

Stage 3. When further power is required, the third stage, consisting of a duplicate tunnel from Tahtsa Lake to Kemano will be built and a dam approximately 300' high on the Nechako River just about the head of the canyon and about 20 miles downstream from Natalcuz Lake as well. Here a good site has been located and proven by drilling and a rock-filled dam is proposed, raising the headwater to the 2790 level of Tahtsa Lake.

The various lakes of the system would be affected as follows:

	Present Elev.	New Elev.	Raise.
Natalcuz Lake	2644	2790	146'
Euchu "	2648	"	142'
Chelaslie "	2650	"	140'

(Continued)

	Present Elev	New Elev	Raise
Intata Lake	2650	2790	140'
Ootsa "	2666	"	124'
Sinclair "	2669	"	121'
Whitesail "	2694	"	96'
Tahtsa "	2782	"	8'

Tetachuk Lake is at elevation 2795, at present there is a falls about 15' height in the river. These falls will be reduced to 5', but the lake and Eutsuk Lake above will be unaffected by the development.

The third stages will require five years to build, and it would then take an estimated five years to fill the storage area to the 2790 elevation.

Under this scheme, if construction was commenced immediately, it would be approximately 20 years before the third step could be completed, assuming that each phase was rushed ahead without delay However, with the growing demand for aluminum and the increasing difficulty of obtaining other metals, developments that once seemed highly improbable, today have become commonplace.

The great power scheme is there and some day it will be used; the economics of the development call for its entire construction, so that if started it must be finished, as no part development will pay on the initial capital required

In the discussions of the group which made the trip, two features in particular were outstanding. Firstly the matter of handling the flooding of the area so that it could be retained as a park and useful recreation region; secondly, the effect it would have on the Sockeye salmon runs that use the Nechako River below Fort Fraser, the important runs here being Stuart and Stellako Rivers. There is as well a Spring salmon run which uses the Nechako River between Fort Fraser and the damsite as a spawning ground

There are many millions of board feet of timber and cords of pulp wood in the more than 300 square miles of land to be flooded. There are spruce trees up to 30" diameter and in some places there will be up to 30,000 f.b.m. to the acre.

The following scheme was discussed and its feasibility is being investigated

A power house and pulp mill are proposed in the Quesnel area This is about 250 miles from Natalcuz Lake and some 375 miles from the tunnel

entrances of the power scheme. It is proposed that clearing of all timber be started when the power scheme is commenced and that it be floated down river. Saw logs would be converted to timber and the remainder made into paper. There may be 20 years supply for a 300 ton mill. This method would ensure complete clearing and might be entirely self-supporting. Mr. Oldham makes interesting recommendations regarding the survey of such a scheme, suggesting that the Fraser River Board supply the $30,000 necessary for the work.

The alternative is logging such areas as are commercial, flooding what will not harm the park, and clearing the shore line to a given depth.

The maximum drawdown of the lake even in a 3-year period of low flows is not expected to be over 6' to 10'.

The Salmon problem is complicated by a minimum of information as to the requirements of the fish. No Sockeye are reported to use the Nechako above Fraser Lake, but the Spring salmon that spawn in the river are said to number 10,000. This may be once in four years. The area is not included in Mr. Whitmore's submission to the Board May 10, 1949.

The principal importance of the Nechako is supplying a large quantity of water for the passage of the fish from the Fraser to the Stuart and the Stellako spawning areas; how the reduction of this flow will affect the fish will require a careful study. The plan shows a spillway and includes gates for allowing water to pass from the storage lake into the river system, but what quantities and how this would be handled is as yet entirely unknown.

The total drainage area of the Nechako River above Prince George is 17900 sq. miles as measured by planimeter on a 15.78 mile per inch map. This includes the Stuart River, the Chilako and the Francois, Stellako areas. The amount of drainage basin cut off by the proposed power scheme and drained to the Pacific is 5146 sq. miles which includes, as well as the 4390 sq. miles above Natalcuz Lake, 756 sq. miles drained by the upper 20 miles of Nechako River. This is 28.8% of the area, but by reference to the precipitation map, plate 8 of the 1949 report of this Board, it can be seen that the westerly part of the eliminated area has the heaviest rainfall, and when the areas are measured and precipitation calculated, it is found that the dam on the Nechako will divert 41 1/2% of the total precipitation in the Nechako basin. The figures presented by the Department of Fisheries of Canada at the Alcan hearing are quoted: "The diversion of all of the water by a dam in the Nechako river below Natalcuz lake would reduce the river flow from below the proposed dam to Fort Fraser by about ninety-five per cent. From Fort Fraser to the confluence of the Stuart, the Nechako river flow will be reduced by about eighty per cent. The combined

flows of the Stuart and Nechako rivers from their confluence to Prince George will be reduced by about fifty-five per cent."

The amount of flow that would be left in the Nechako would seem to be sufficient for transportation of the salmon, the principal run of which go to the Stuart and the Stillako. If the decreased flow would indicate fishways are required at any place in the Nechako run these could be built If additional water may be required it would be possible to pass it out of the main power storage basin or build storage dams for that purpose on Cheslatta, Chesinkut or other lakes that might prove suitable.

Considering the salmon to the Stuart would still have all of the water that the Stuart basin supplies, and that the flow of the Nadina, Endako and Cheslatta Rivers will be unaffected, it would not seem that salmon would have difficulty arriving at Fraser Lake This is of course a matter that would have to be investigated, but it did not appear to be serious or beyond solving.

The study of these two problems should be started now; the clearing or forestry problem could probably be worked out by the Department of Lands and Forests, Forest Service and the Dominion Department of Fisheries could be asked for a report on the other problems

It is almost inconceivable that such a project could be built without having some adverse effect on many things. The construction of a dam on the Nechako River to reverse the flow with the flooding of 300 or more square miles of land or 192,000 acres is in itself a big loss Some of this land is agricultural and some is covered with forest; some has mineral claims on it. The effect of raising the lakes high above their present levels will change their character for fish life; this could be for better or for worse The effect of cutting off the flow of water from the headwaters of the Nechako where the high water is as much as 29,500 sec. ft. or as little as 1860 is a serious problem The entire character of the river below this point will be changed. For any future power plants on the main river, it means a reduction of about 28% of the total flow of water on the annual average, above the Thompson and 14% below it. An advantage in this connection is that the flood waters of the river will be reduced between 5 and 6% lowering the flood height at Hope between 9 and 11 inches on the 1948 scale.

To study the answers to some of these problems the trip was arranged by the writer to cover the area which would be affected and the different interested departments were asked to send the best authority available. The following men took part:

Dr. D.B. Turner,	Director of Conservation, Department of Lands, Victoria
Mr. H. Richmond,	Dominion Department of Agriculture, Officer-in-Charge Victoria Laboratory, Forest Insect Investigations
Dr Peter Larkin,	Fisheries Biologist, Provincial Game Department, B.C.
Mr. E.G. Oldham,	Forester in Charge, Parks and Recreation Division, Department of Lands and Forests, Victoria.
Mr. R.E. Potter,	Executive Assistant, Dominion-Provincial Board, Fraser River Basin.

The above men have reported to their various departments on the findings of the trip and a short resume of their reports follows

Report of Dr. D B. Turner, Director of Conservation

I. Agriculture A survey of present land use over the north shore of Ootsa Lake will have to be made in the near future. It is true that the agricultural land in question does not figure in the flooded-area picture for at least ten years, or until the final stage is accomplished by building the dam on the Nechako River, but for purposes of satisfaction, to security for, and for the goodwill of the present settlers, plans should be made whereby terms upon which agricultural land that will be flooded shall be acquired can be determined. The survey will also be needed to determine what the losses of unalienated Crown lands suitable for agricultural use will be, necessary knowledge for use in the agreement that will be made between the Province and Alcan.

In the brief reconnaissance made, it can be stated that agricultural land is limited to:

a. A large portion of the north side of Ootsa Lake.
b. Limited areas along the south sides of Ootsa, the lower half of Eutsuk and along Tetachuk.

Terraces of unconsolidated material are quite common. For example, along Ootsa Lake there are many, ranging from 60 to 600 feet above the lake level.

Along the north shore of Ootsa Lake, the arable land is scattered, providing fields for grazing and the growing of hay. Rock outcrops and uneven topography confine agricultural operations to fractions of farms

Most of the soil, through topography, stoniness, and other factors, must be rated below first-class land category.

It is estimated that losses in the field of agriculture, should the Alcan project be implemented, will not be great in comparison with the magnitude of the project. Settlers are few, land under cultivation is limited, production is not high, soils in general have a somewhat low rating, adjacent lands for evacuated farmers are available if re-settlement is requested, and violent dislocations in the present economy will not result from the proposed flooding.

The necessary surveys could be made of the Ootsa area by a small party in probably a two-month field operation.

II. Commercial Fisheries The International Pacific Salmon Fisheries Commission is studying the effects of a dam on the Nechako River as it would concern the migration of Sockeye salmon to Fraser and Stuart lakes. The investigation apparently hinges on the fact that the dam could cut off 2/3 of the water obtained at the junction of the Nechako and Stellako Rivers below Fraser Lake. What effect this would have on the migrating Sockeye salmon is the question to be determined.

This phase of investigation was not included in the terms of reference for the present report.

III. Pulp possibilities require comment

a. There are tremendous acreages of suitable pulp materials, chiefly spruce and lodgepole pine.

b. The pulp material can be taken out cheaply over a period of years. Both prevailing water flow of the lakes and rivers system, body of water flow, and prevailing westerlies can be used to carry the pulpwood to Ootsa Landing, the Nechako River, Prince George, Quesnel, or New Westminster, as found feasible or desirable.

c. I understand that Eastern methods of handling and driving pulpwood can be applied readily to the Tweedsmuir area. Authority for this is A. W. Bentley, who retired to Victoria in 1948 after 25 years as Woods Manager for the Bowater Pulp and Paper Company of Newfoundland, and who is still retained as consultant. Mr G. S. Andrews and Mr. W. Hall of our Air Surveys Division can supply details of how interior pulpwood can be brought to the Coast.

d. In brief, the pulpwood can be cut annually and left to await the expected water level rise. This would eliminate handling, dumping, and other labour efforts. This procedure is followed from year to year as the reservoirs fill up. Each year's cut can be calculated and the necessary number of fallers and buckers put on the job.

e. If this is a practical scheme, it means removal of all debris from the reservoirs that are created and this is an important consideration for obvious reasons. Since costs will be cheap, percentage of wood recovery downstream need not be great to make the operation pay. There is no reason to fear that losses would be excessive, however, since the Fraser River throughout its course is almost fully freed from jams each summer. With pulpwood being small diameter material, it is anticipated that there would be little hang-up in either the Nechako River or the Fraser River.

The scheme is recommended for further consideration by those fully qualified to deal with such problems.

Report of Mr. E.G. Oldham, Forester in Charge, Parks & Recreation Division

This report by Mr. Oldham deals largely with timber values in the Park and the effect of the flooding on these values and on the Park generally, for recreation and park uses. His remarks on the different areas are as follows:

Tahtsa Lake

This lake will be raised only 8 feet in elevation and it would therefore appear that little damage to the scenic value of the lake will be involved. However, it must be borne in mind that once Tahtsa Dam is completed there will be practically no water running down Tahtsa River, even though Troitsa Lake does empty into Tahtsa River about eight miles from Tahtsa Lake.

Of all the lakes to be flooded, Tahtsa undoubtedly possesses more rugged beauty than any of the others and this is due to the fact that it lies outside of the inland plateau in the Coast Mountain Range. We can say, however, that Tahtsa Lake and its rugged beauty will be inaccessible from a recreational point of view for a period of twenty years from the time construction starts on Stage 1 of the development.

Tahtsa River

This is a very scenic river, the shores of which offer good browse

for moose Very little merchantable timber is involved over the proposed area to be flooded The timber is all sparse and small and the topography presents no problem from a clearing point of view.

Troitsa Lake

This lake evidently will not be affected by the proposed power development.

Sinclair Lake

This lake will be raised 121 feet, and there is a fair amount of flat land in the vicinity of the present shoreline so that we could look forward to a sea of snags if the area was flooded without being properly cleared. The topography would present no problem from a clearing point of view

Whitesail River

This is a very scenic stream; clear and with a good gravelly bottom undoubtedly suitable for fish spawning. The stream runs through flat land and would again present a sea of snags if proper clearing was not carried out before flooding.

Whitesail Lake

Although it was impossible to see much of the country in the vicinity of Whitesail Lake due to weather conditions, it is evident from information contained in our files that Whitesail Lake rivals Tahtsa Lake as far as beauty is concerned Stage 3 of the development proposes to raise this lake 96 feet, and although the lakeshore for the most part is fairly steep, there will still be many snags above the waterline if proper clearing is not executed on the lakeshores.

Ootsa Lake

This lake is the largest body of water involved and at this time has many lovely sand beaches on its south shore The south shore of this lake also contains the best stand of timber involved The development proposes to raise Ootsa Lake 124 feet, thus of course flooding out most of the farm land on the north shore of the lake as well as most of the timberland on the south shore It will also destroy all of the good moose range However, it would appear that if the lake is raised the moose may then use the range that appears to be available above the timberland and would be made more usable due to the raising of the water. It is felt that this deduction holds true along Whitesail River, Sinclair Lake and Tahtsa River.

Intata, Natalcuz, Chelaslie and Euchu Lakes

All of the above lakes as well as their connecting streams will be affected somewhat similarly due to the raising of the water, and although no great timber values are involved and scenic properties could be maintained by proper clearing, there is no doubt that fish and game populations would suffer.

Tetachuk River

At this time the Tetachuk River offers a great deal in the way of scenery, including Tetachuk Falls, which will no longer be in evidence once the water is raised to the proposed level. However, as a balancing factor here, boat transportation will be made much easier from Euchu Lake and Tetachuk Lake. In fact, it will be quite possible to use a canoe for transportation up this river once the water has been raised as there will only be five feet difference in elevation from the foot of Tetachuk Lake to the head of the flood waters which presumably will come right up to the foot of the Tetachuk rapids. Very little timber value is involved along this river. However, it is felt that clearing of the shoreline is again essential in order to preserve scenic and recreational values.

Nechako River

As can be seen from the accompanying map, a goodly amount of flat-lands are involved here, and although the timber is not of commercial value, again there will be a loss in game populations and probably in fish as well. It is very obvious from the map that the Nechako River area probably will never become an integral part of any recreational programme in Tweedsmuir Park, unless it could be considered as interesting from a power development point of view. Nevertheless, it will be necessary to clear the shoreline in this area as well as all others, otherwise snags are bound to float into the more used waterways of Euchu and Natalcuz Lakes.

CONCLUSIONS

If the proper clearing practice is carried out in the development of this power project, and although recreational and scenic values would be lost in some instances, it is also true that the whole of Tweedsmuir Park would be made more accessible. However, practically the whole of the north-western part of the park would be lost for recreational purposes if the project did not include shoreline clearing before flooding.

RECOMMENDATIONS

1) A survey be initiated immediately in order to obtain accurate information on timber values involved, and that the Fraser River Basin

Board pay for the cost of producing the base maps, estimated at $ 30, 000 It would appear the base maps could not be produced until the summer of 1951

2). Upon completion of the above survey, a programme of disposing of all merchantable timber involved be investigated with the possibility that special consideration be given in the drawing up of the timber sale so that shoreline clearing would be carried out over the whole proposed flooded area, which might involve the following:

(a) Very reduced stumpage and royalty, or (b) subsidization taking into consideration timber values, so that all shorelines would be cleared in accordance with specifications to be drawn up.

3). Since there is evidently many cords of Lodgepole Pine involved, it would be well to investigate the possibility of a kraft pulp mill, probably at Quesnel where power will evidently be available for such purposes

4). Upon completion of No. 1, it is felt that a correlator must be appointed in order that a final proposal can be made.

Excerpt from report of H. A. Richmond, Officer-in-Charge Victoria Laboratory, Forest Insect Investigations

Bark beetles normally find conditions most favourable in dying or weakened timber but when numerous attack and kill healthy timber. Green timber infested with bark beetles dies usually within 12 months and after the emergence of the young brood is no longer subject to bark beetle attack. Once the inner bark and sapwood lose its green sappy condition from drying, the attractiveness to beetles diminishes. Dead trees are not subject to attack. Trees that have been influenced adversely by drought, exposure, attack by defoliating insects or that have reached a decadent condition are most subject to bark beetle attack.

It is from the standpoint of attack in dying or weakened timber that these insects assume the role of a hazard in connection with the flooding of timber stands. This is accentuated in instances of prolonged flooding where there is annually a fresh supply of dying timber. While the initial attack might be generally light, a build-up in population could conceivably result in an extremely heavy attack on dying timber in subsequent years, followed by a general infestation through the neighbouring stands beyond the confines of the flooded area. In this respect flooding of timber over a period of years might be compared to the accumulation of breeding material through logging. In appraising the significance

of flooded timber to bark beetle attack, several factors appear to be fundamental and on which there is unfortunately very little data. These may be summarised as follows:

(1) Over what period of time are drowned trees subject to bark beetle attack? A felled tree is suitable only while the inner bark and sap wood is in a green sappy condition. This in the case of pine and spruce is normally about one season. A wind-thrown tree partially rooted in the ground retains its attractiveness over a much longer period. If its attractiveness persists for two years or more the value of the tree as a breeding ground for bark beetles is doubled.

(2) What portion of the bole is preferred for attack? The lower portion might be unsuitable due to excessive moisture while the higher stem might be entirely satisfactory. In such an instance a survey of standing drowned timber might be entirely erroneous unless such timber was felled and completely examined. This is an important consideration in examining previously drowned areas.

(3) What effect on the development of progeny might result from drowning of the tree? It is possible that excessive moisture might prove detrimental to the survival of the young breed even though the tree is suitable for attack by the adult beetles In this regard such conclusions must take into account trees standing in water and those killed along the shore line.

(4) Species of bark beetles concerned--It is evident therefore that considerable study is necessary before general conclusions can be derived. To this end three areas have been investigated: Whatshan Lakes adjacent to the Lower Arrow Lake, Sugar Lake on the Shuswap development, and Campbell Lake on Vancouver Island. The latter constitutes the best study area of the three and an intensive project will be undertaken in October 1950, when the water level is lowered and drowned timber felled.

Excerpts from the report of Dr. P. A Larkin, Provincial Fisheries Biologist

"Ootsa River is a good trout spawning stream."

"Intata River is a good spawning stream."

"Nechako River from Natalcuz to the Grand Canyon twenty miles below is swift, broad and deep, and probably supports a substantial resident fish population Excellent catches of kamloops trout can be made in the large back eddies of the river "

"Euchu River which joins Euchu and Natalcuz Lakes is an excellent spawning stream, one mile long 150 feet wide, and from 2 to 5' deep."

"The Chelaslie River above Chelaslie Lake is heavily stained, but it would nevertheless appear to be a good spawning area for it is moderately swift, shallow and has many bars of fine to large gravel."

"The Whitesail River which joins Whitesail Lake and Ootsa Lake is seven miles long and is an excellent spawning stream: swift, clear and with numerous shallow bars."

"The effects of flooding. The group of lakes mentioned above, with the exception of Tahtsa and Whitesail, share many features in common. They are all of shallow to moderate depth, all lie in valleys that have relatively gentle slopes and all have excellent spawning facilities in their tributary streams. All of these lakes have a moderately low production of plankton and bottom fauna, which reflects the recent formation of the lake basins, the general large size of the lakes and their relatively low altitude and relatively northern latitude. They are potentially substantial producers of kamloops trout, kokanee and lake trout in their present condition. The introduction of Mysis, Pontoporeia and possibly other elements of the Eastern North American fauna would probably increase their productivity Each of these lakes and their tributary streams will be flooded to depths of over one hundred feet and marked changes in the ecology of the area will result. The rivers joining the lakes will become very broad, deep, slow-moving channels with no value as spawning areas for the most valuable sports fish--the kamloops trout and the kokanee. The lakes will be a continuous body of water well over one hundred miles long, in many places four to five miles across and of considerable depth (maximum approximately 450 feet).

The single large lake resulting would probably be an excellent area for a limited commercial fishery for whitefish (Coregonus) and lake trout (Cristivomer) if the necessary supplements to the bottom fauna were made. The introduction of Mysis and Pontoporeia might be made immediately to provide a substantial stock in twenty years time. The lake might not be a satisfactory producer of kamloops trout because of the inadequacy of spawning grounds. The Entiako River might provide limited spawning facilities for the new lake, but it is quite probable that many of the fish would not enter the river at the spawning season because of its relatively small flow and position in the drainage system. The Tahtsa River immediately below Tahtsa Lake would be from ten to fifteen feet deep and would be a very broad channel, probably of great value as a spawning area, but some improvements might be necessary The Chelaslie River might support small runs of fish, and a small portion of the Tetachuk River immediately below Tetachuk Lake might be developed into a spawning area.

It is possible that movement of fish from Euchu Lake to Tetachuk would be possible in which case the Eutsuk River might also be included as a spawning area However, the problem of providing adequate spawning facilities for such a large lake as would be formed is serious and it is tentatively suggested that the grounds provided would be inadequate.

The changes in the direction of flow in the drainage system are regarded as improvements because the length of a drainage system affects water temperature and dissolved solids content, and in the proposed development the flow from Eutsuk would pass around the full circle before being lost to the system. A further contributing factor may be flow in the direction of decreased solubility of sediments rather than the present reversed condition, i.e. the greatest rate of solution of materials probably occurs in the more heavily drift-covered eastern portion.

Increase in the depths of the lakes would lower their per unit area productivity but this would be more than compensated by the greater area of the new water system.

SUMMARY AND RECOMMENDATIONS

The findings of the present survey can be summarized as follows:

1) The series of lakes which will be affected by the Aluminum Company project are, in their present condition, substantial producers of the sport fishes--kamloops trout, kokanee and lake trout

2) With the proposed development there will be--

   (a) A loss of spawning grounds which will be only partially replaced by the formation of new spawning areas and fragments of present ones.

   (b) A decrease in per unit area productivity which will be more than compensated by an increase in the area of the drainage system.

   (c) An increase in productivity from changes in the direction of flow in the system.

It is recommended that the Game Department consider an extensive field survey of the lakes in the circle route to establish these findings and to explore the possibility and expense of developing the proposed system into a satisfactory sport fishing area or a commercial fishing area of equal value. An appendix outlining the cost of such a survey for one season is attached to this report.

APPENDIX

The estimated cost of a two-man field survey of lakes in the Tweedsmuir area to be affected by the proposed Aluminum Company Development is as follows:

Transportation, food, guide services for 2 months	$2,500.00
Equipment	1,000.00
Salaries	650.00
Transportation to and from area	100.00
Miscellaneous	400.00
	$4,650.00