PROVINCE OF BRITISH COLUMBIA

REPORT

OF THE

WATER RIGHTS BRANCH

OF THE

DEPARTMENT OF LANDS

HON. T. D. PATTULLO, Minister

E. A. Cleveland, Comptroller

FOR THE YEAR ENDING DECEMBER 31ST

1918

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AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:
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1919.

VICTORIA, B.C., February, 1919.

To His Honour Sir FRANK STILLMAN BARNARD, K.C.M.G..
Lieutenant-Governor of the Province of British Columbia.

MAY IT PLEASE YOUR HONOUR:

Herewith I beg respectfully to submit the Annual Report of the Water Rights Branch of my Department for the year ending December 31st, 1918.

T. D. PATTULLO,
Minister of Lands.

VICTORIA, B.C., February 17th, 1919.

The Hon. T. D. Pattullo,

Minister of Lands, Victoria, B.C.

SIR,—I have the honour to submit the Annual Report of the Water Rights Branch of the Department of Lands for the year ending December 31st, 1918.

I have the honour to be,

Sir,

Your obedient servant,

E. A. CLEVELAND,

Comptroller, Water Rights Branch.

TABLE OF CONTENTS.

	Page.
Board of Investigation Report	7
District Offices Reports	8
General Reports, etc.—	
Head Office General Work	11
Commission investigating Irrigation Companies	12
Irrigation	12
Water-power	17
Waterworks	20
Well-drilling	20
Drainage	21
Datum-planes	22
Meteorological Report	22
Appendices—	
No. 1. Water-powers of British Columbia	31
No. 2. Acquisition of Class "A" and Class "B" Licences	40
No. 3. Measurement of Water	42
No. 4. Self-cleaning Intake and Diversion	45
No. 5. Irrigation Headgate	47
No. 6. Overirrigation	51
No. 7. Useful Water Data	52

REPORT OF THE WATER RIGHTS BRANCH.

BOARD OF INVESTIGATION REPORT.

The work of the Board of Investigation during the year ending December 31st, 1918, included the determination of rights under Acts prior to the "Water Act, 1909," riparian rights, approval of undertakings, extension of time for commencement and completion of works under water records, and Indian rights.

Meetings of the Board of Investigation have now been held in all parts of the Province and preliminary hearings in regard to all of these claims, and approximately 7,500 have been dealt with. During the year, 1,296 formal orders were issued, 569 being directions to issue licences in substitution for records and 687 being cancellations of records. Some 2,500 orders have yet to be issued, of which 600 are for rights claimed by the different Indian Agents.

Section 6 of the "Water Act, 1914, Amendment Act, 1918," extended the time when a riparian proprietor might file a claim to water to June 1st, 1920. Up to date 110 such claims have been filed. The Board will deal with these claims after June 1st, 1920.

Section 79 of the "Water Act, 1914," provides that the Board shall hear the petition for approval of undertaking and report thereon to the Minister. Fifty-nine petitions have been filed, of which thirty-eight have been granted and twenty-one are pending.

A considerable number of applications for extension of time for commencement and completion of works under water records have been made, and extensions have been granted when it could be done without affecting injuriously later licensees who had made beneficial use of the water.

A large number of claims for water rights for the use of Indians have been filed during the past year. Surveys have been made by the Department's Engineers, and the Board is in communication with the Department of Indian Affairs with a view of arranging, as soon as possible, for the hearing of the claims and adjudicating upon the rights.

I have, etc.,

J. F. Armstrong,

Chairman, Board of Investigation.

DISTRICT OFFICES REPORTS.

KAMLOOPS DISTRICT.

The irrigation season of 1918 was probably one of the worst the Department had to deal with since its inception. A late and exceptionally dry spring, in which the snow was largely lost by absorption and evaporation, was the chief source of the trouble. Streams which ordinarily give no trouble were the subject of much contention; on many streams the usual freshet-discharge was non-existent, and as a result many storage-lakes were deprived of their supply and remained almost empty for the whole of the season. With such conditions it was inevitable that difficulties should arise in the division and distribution of water. In many cases it was found necessary to make orders for rotation, automatic division, or to entirely desist from using the water. The enforcement of an order by the ordinary means was impossible in some cases owing to the lack of control due to the unsatisfactory form of headgates. It is hoped that this difficulty will be overcome in the future by the installation of headgates of suitable construction.

Your Engineer travelled close to 3,300 miles by rail, about 2,200 miles by motor, and 100 miles by other means, in the pursuit of his duties during the season.

The season's field investigations were confined mainly to the Ashcroft Water District. Besides numerous small investigations, a survey in connection with a number of applications on Ashcroft or Barnes Creek was made. Of chief interest, perhaps, to the citizens and ranchers of Ashcroft and vicinity was an investigation into the possibilities for the irrigation from the Bonaparte River of certain lands lying north of the Basque Ranch and west of the Bonaparte and Thompson Rivers. The irrigable area was found to be far smaller than estimated, and the feasibility of the scheme appears to be subject to the relinquishment to the Province by the Indian Department of a large portion of the Ashcroft Indian Reserves Nos. 1 and 2.

A new dam was built in the spring on Monte Lake, and another in the fall on Edith Lake. Both dams replace old ones that were a menace to the public, and it is satisfactory to note that it was possible to bring the parties interested to realize the necessity of complying, in their own and the public interest, with our orders.

Storage by Senator H. Bostock in the near future of the freshet-water of Monte Creek is contemplated. The site of the proposed reservoir is located in the Monte Hills Forest Reserve, and from an examination made on the ground and plans on file the project seems feasible. The lands to be irrigated from this proposed supply form a part of the Bostock Ranch at Ducks, and will bring some hundreds of acres of first-class land under cultivation.

Pumping water for irrigation by hydro-electric or gasolene engine appears to have passed the experimental stage. During the season two new electric pumping plants were put into operation—one on the South Thompson River for the Kamloops Industrial School, and the other on the Josephine Ranch on the North Thompson River. Both plants were successful, and it is reasonable to suppose that a still greater advantage will be taken of this form of irrigation in the future.

I have, etc.,
C. VARCOE, A.M.E.I.C.,
District Engineer.

OKANAGAN DISTRICT.

The past year was a very prosperous one in the Okanagan Valley, the crops having been a fair average and prices high. It is estimated that $4,000,000 worth of farm produce was shipped out of the valley last year, which is slightly greater than the total amount of capital spent on irrigation-works in the valley, and the greater part of the produce shipped was grown on irrigated land. Kelowna exported $1,100,000 of farm produce during the past year, every bit of which was grown on irrigated land.

The total capital spent on irrigation-works tributary to Kelowna is approximately $1,605,000. These figures are, I think, a conclusive answer to those pessimists who five years ago advocated the abandonment of all the irrigation systems in the Okanagan Valley and the return of the irrigated lands to their former state of cattle-ranges; especially when it is considered that all the orchards under irrigation are not in full bearing, and that there are many thousands of acres which have not been brought under cultivation.

There was no great additional quantity of land brought under cultivation and irrigation in the Okanagan Valley last year, but for the last five years there has been a small and steady increase in the area under cultivation and irrigation; the cumulative effect of which is now becoming apparent in a considerably increased draught on all the streams and irrigation systems in the valley. Also the majority of the orchards planted are now coming into bearing and require twice the amount of water that they did when first planted out. The combined result of the increase of land under cultivation and the increase in age of the orchards was that with a few exceptions there was a general shortage of water all through the Okanagan Valley last fall. With only three exceptions, the capacity of the reservoirs was not sufficient to meet the requirements of the lands they served, and many of the lands that were irrigated from streams, the flow of which had been supposed to be ample to meet the requirements of all lands adjacent, had insufficient water last fall. If any more land is to be brought under irrigation in the valley, or if even that now under irrigation is to be brought to its maximum state of productiveness, then it is imperative that the reservoir system of the valley must be largely increased, both by the construction of new reservoirs and the enlargement of existing reservoirs wherever possible.

Realizing the necessity of increased storage-reservoirs, the following companies and communities either constructed or started construction of storage-reservoirs:—

The Kelowna Irrigation Company built a crib log dam 22 feet high and 250 feet long at the outlet of South Lake, situated on the South Fork of Mill Creek. This reservoir is capable of holding 800 acre-feet.

The owners of 1,000 acres of land at Ellison, to which the waters of Scotty Creek are appurtenant, started an earth dam at the outlet of Trapper Lake, which drains into Scotty Creek. On account of the shortage of labour they only got the foundation cleared off.

At Naramata, the land-owners having arranged for a loan of $10,000 from the Conservation Fund, started construction of an earth-fill dam at the outlet of what is known as the Big Meadow on Chute Creek. On account of the lateness of the season when the work was started—last week in September—and the difficulty of getting competent labour, little progress was made in building the dam, the work done consisting of the erection of two log cabins, clearing and stumping the site, clearing off the surface dirt from the south half of the site, digging trench for outlet culvert, and laying foundations for outlet culvert. The work closed down on November 4th, there being then 1 foot of snow on the ground and hard frost at nights. The proposed dam will be 18 feet high, 627 feet long, and capable of storing 700 acre-feet of water.

At Peachland, the land-owners under the existing irrigation system having arranged for a loan of $5,000 from the Conservation Fund, started the construction of an earth dam with concrete core wall at the outlet of their present reservoir on the North Fork of Deep or Peachland Creek. The work started on October 8th and closed down on November 17th on account of snow and frost. The site for the dam had been cleared and stumped, the core wall and spillway built, and about one-third of the earth fill made when the work closed down. Three weeks to a month's work should complete this dam in the summer. The height of dam is 8 feet, length 232 feet, and should impound 250 acre-feet additional water.

Messrs. McKinnon *et al.* constructed a small reservoir on Jack Lake, which drains into Powers Creek, for the purpose of irrigating District Lot 3188. This reservoir was formed by digging an outlet drain from the lake 6 feet deep and 450 feet long, and placing a bulkhead and gate to the same, with a small crib dam on top. This reservoir should store 500 acre-feet and is capable of considerable enlargement as requirements warrant it.

D. Gellatley also constructed a small reservoir on a small lake above Jack Lake, and which drains into same, by building up an old beaver-dam and putting a gate in same. This reservoir will store about 60 acre-feet as at present.

The Summerland Municipality, I believe, increased their storage by raising some of the existing reservoir dams, and also, I believe, did a considerable amount of reconstruction-work.

The Municipality of Penticton have during the year laid 1,100 feet of 4-inch wood pipe and 2,250 feet of 6-inch pipe, or a total of 3,350 lineal feet of irrigation-pipe, to withstand a pressure of 100-foot head; replaced 1,400 feet of the old Ellis Creek main flume by a new 3- x 2-foot wooden flume, tongued and grooved, set in concrete footings. They have also replaced the old log intake on Ellis Creek by a solid concrete intake, which cuts off the seepage losses that used to take place through the old crib. Some 30,000 feet B.M. of lumber has also been used in general repair-works on the system.

The Kelowna Irrigation Company had their 32-inch steel siphon across Mill Valley scraped and painted inside last spring, at a cost of $4,450; this was a very necessary repair, as it was becoming badly corroded internally.

The same company's main distribution system supplying the Glenmore and Rutland Valleys being in need of immediate repairs, and the company not having the funds to make same, the land-owners under the two systems arranged for a loan of $20,000 from the Conservation Fund for repair-work. This work started the last week in September and closed down on November 26th on account of snow and an outbreak of Spanish influenza in the Rutland camp. The work consisted of, in Glenmore District: The relining of 1,620 lineal feet of main ditch; new bottoms in 555 lineal feet of main ditch; relining of 1,060 lineal feet of Lateral 1; relining of 510 lineal feet of Lateral 3; new bottom in 60 lineal feet of Lateral 3; or a total of 3,805 lineal feet repaired. This work was necessitated by the cracking and collapsing of the sides of the concrete ditches and the cracking and disintegration of the bottoms.

The cracking of the sides was due to two causes—the expansion of the stiff clay at the back of the concrete lining, due to moisture, also, and principally, to surface water getting behind and under the lining in the early spring during the day and freezing at night. This has completely wrecked a large part of the concrete ditches in Glenmore. Another cause which has contributed to the cracking and destruction of long lengths of ditch was the placing of a board longitudinally underneath the bottom of the ditches for the purpose of forming a cover to a stone drain laid underneath same to carry away seepage-water. This board swelled and burst up the bottom for thousands of feet. Where the ditches were built through a gravelly formation they are in a fairly good condition, though none of them are in the condition that they should be if proper material and care had been used in their construction. The concrete of which the lining of the ditches is composed is of a very porous nature and anything but watertight; on account of this there is a very great seepage loss, not only through the cracks in the ditches, which are many, but also through the concrete itself, the result being that considerable tracts of land all through the valley underneath the ditch system have become water-logged, and the trees, both pine and fruit, are dying. The injurious effects of this seepage-water may be partially overcome by subsoil drains, but the ditches themselves should be relined when badly cracked and coated with a water-proofing material such as pitch or asphaltan.

As a large part of the company's Rutland main ditch system is formed of wooden flumes, which were in a poor state of repair and leaking very badly, but not so badly dilapidated as to necessitate rebuilding, 4,500 lineal feet of flume in this ditch were lined last fall with a layer of tar-felt covered with ½-inch boards. The company's chief bailiff had tried this on several lengths of flume the year before and found it satisfactory. It will stop the great loss of water through leakage and prolong the life of the flume four or five years at least.

The Canyon Creek Irrigation Company replaced 2,960 lineal feet of distribution-flumes by new flumes, strengthened and repaired the dam at their Reservoir A on Canyon Creek, installed measuring-boxes on their distribution system, and did a considerable amount of general repair-work.

I have, etc.,

F. W. GROVES, M.E.I.C.,

District Engineer.

GENERAL REPORTS, ETC.

HEAD OFFICE GENERAL WORK.

Staff.

The number on the staff remains about the same, being twenty in December, 1918, compared with eighteen reported for the previous year. In order to cope with the pressure of field-work during the year the services of four of the men in the draughting-room were utilized for varying lengths of time.

Mention must be made of the death from influenza of H. G. Lawley, Assistant Engineer in the Nelson District, who had rendered for some years faithful and efficient service to the Department.

Applications, etc.

On receipt of an application it is entered on the water-rights map or reference map and a note made of any further information required, on receipt of which the conditional licence or authorization is issued.

The number dealt with during the year is as follows: Applications received, 212; conditional licences issued, 245; final licences issued, 15; authorizations issued, 9; applications withdrawn, lapsed, or cancelled, 188.

In connection with the reallocation of space in the vault, one of the Engineers was deputed to represent this Branch; the files were carefully looked through and rearranged systematically, and about 1,200 that were closed and dealt with matters not likely to be raised again were removed to save time and space in locating current files.

The checking of plans for Class "C" licences, preparation of several reports on power possibilities in various parts of the Province, compiling and revising lists of the rights on special streams, and of all rainfall stations and waterworks in British Columbia, and calculations of discharge of water over weirs, through pipes and openings under different conditions of slope and head, have formed a good part of the year's work.

Revenue for Year ending December 31st, 1918.

Purpose.	Application Fees.	Rentals.	Total.
1. Power	$1,343 50	$ 7,365 05	$ 8,708 55
2. Irrigation	726 59	3,992 38	4,718 97
3. Miscellaneous	56 50	1,107 67	1,164 17
4. Mining	376 85	5,070 20	5,447 05
5. Clearing-streams	.....	400 03	400 03
6. Storage	26 00	544 30	570 30
7. Waterworks	400 35	512 38	912 73
8. Steam	83 65	182 75	266 40
9. Domestic	129 35	214 05	343 40
10. Fluming	25 00	35 15	60 15
11. Lowering-water	5 00	.....	5 00
12. Hydraulicking	.....	.....	.....
13. Conveying	.....	.....	.....
14. Mineral-trading	.....	10 00	10 00
15. Certificates of approval	125 00	.....	125 00
Totals	$3,297 79	$19,433 96	$22,731 75

COMMISSION INVESTIGATING IRRIGATION COMPANIES.

J. S. T. Alexander, E. Davis, and F. H. Kidd, who were appointed as a Commission under the provisions of section 171 of the "Water Act," as amended in 1917 and 1918, report as follows:—

"By Order in Council No. 1300 we were appointed to examine and report upon the financial condition of the Canyon Creek Irrigation Company, Limited, the general condition of its water system, and its ability to fulfil its obligations to persons using water from its works.

"On January 16th, 1918, we proceeded to Kelowna, where we examined the books and inspected the works of the company and took the evidence of numerous water-users and representatives of the company.

"By Order in Council No. 1615, approved on April 9th, 1918, we were appointed to make similar investigations of the affairs of the Kaleden Irrigation and Power Company, Limited. The books of this company were in the custody of its secretary in Vernon, where Mr. Kidd examined them. While he was so engaged Mr. Davis inspected the company's works from the intake on Sheep Creek to the lands at Kaleden where the water is used. On April 19th we all met at Penticton and the next day proceeded to Kaleden, where we heard the evidence of the water-users there. On the 20th, at Penticton, we took the evidence of Mr. Latimer, the engineer who laid out the works and subdivided the lands at Kaleden, and of J. M. Ritchie, the managing director of the Kaleden Irrigation and Power Company, Limited.

"By Orders in Council Nos. 2091 and 2260, approved July 22nd, 1918, and September 6th, respectively, Mr. Davis, Mr. Roberts, and Mr. Alexander were appointed to investigate the affairs of the Kelowna Irrigation Company, Limited; the Central Okanagan Land and Orchard Company, Limited; and the Central Okanagan Lands, Limited, under the section of the 'Water Act' above referred to. On September 18th and 19th, in Kelowna, we met and examined many of those using water from the Glenmore part of the Kelowna Irrigation Company's works, and in the evening of the 20th we went to Rutland school-house, where we secured further information concerning the Irrigation Company's affairs, more particularly with respect to the irrigation of lands in the Rutland Subdivision.

"The Kelowna Irrigation Company and the Central Okanagan Lands, Limited, being in the hands of a receiver whose office is in Vancouver, Mr. Roberts spent some days there and made a thorough examination of their books. He also examined the books of the Central Okanagan Land and Orchard Company which were produced by the officers of that company.

"Reports on all these companies have been compiled by us and submitted to His Honour the Lieutenant-Governor in Council."

IRRIGATION.

VERNON.

In view of the fact that during the past few seasons there was a shortage of water under the White Valley and Coldstream Internal irrigation systems, representations were made to the Department to make an investigation as to what extent the water-supplies could be augmented. It is very evident that if the water-supply is at present deficient for the land under irrigation it will be more so in the future when more land is using water. In view of the fact that the continued operation of the White Valley system is dependent on an increase in its revenue, it is of vital necessity that more water be available.

Accordingly, J. F. Rowlands, A.M.E.I.C., was detailed to undertake the work. His report is as follows:—

"*White Valley Irrigation and Power Co's Water-supply.*

"Work in connection with the above was commenced in September. A general investigation of the headwaters of Jones Creek was made; each branch of the stream was examined for discharge and relative storage value. The time available was not sufficient to complete the field-work, and a number of reservoir-sites are not yet surveyed or cross-sectioned. The figures given are subject to reasonable adjustment upon completion of the surveys. The matter of costs cannot be considered at this stage, and is deferred until the field-work is finished and the whole system and scheme ready for consideration, including the proposed supplementary supply from Harris Creek.

"*Jones Creek.*—A high percentage of the total water discharged comes through two branches of the creek, viz.: (1) The East Fork, flowing through Aberdeen Lake; (2) the South Fork, which drains the Grizzly hills.

"The East Fork drains some 14,000 acres behind the dam at Aberdeen Lake and a mean annual discharge of 8,000 acre-feet of water can be developed. Storage accommodation for this amount can be developed by raising the existing dam 5 feet and replacing the present culverts by one at a 2-foot lower level. The dam is in a dangerous condition and in need of considerable repair, including culverts; when the latter are opened up the construction at a lower level should be carried out.

"The South Fork, including Haddo Lake, drains some 15,000 acres and the mean annual discharge is estimated at 8,500 acre-feet of water. A dam at the outlet of Haddo Lake would pen back about 1,500 acre-feet of this; it is not established that the other sites available are large enough to store the remaining volume. There are large swamps about a mile above Haddo Lake that may hold a considerable portion of it, and these are the most important of the unsurveyed sites, having an extensive drainage area behind them.

"*Fish Lakes.*—As reservoirs, these lakes are not suited to the conditions, their areas being too large in proportion to the volume of water available for storage, resulting in a very high percentage of loss through evaporation; also their outlets are unfavourable. There is a suitable site for a dam on Fish Creek situated at the outlet of a large swamp and meadow about three-quarters of a mile from its junction with the main stream. A survey of and capacity of this site is required. It is estimated that 500 acre-feet of water will be available for storage at this point. This will include the Fish Lakes drainage.

"Mud Creek and Summit Creek are small freshet streams discharging together about 500 acre-feet of water annually. There are small swamps on both creeks that will probably hold this amount; the outlets are suitable for dams; these sites are not yet surveyed. The large Summit Lake is not suitable for a reservoir, for the reasons applied to Fish Lakes.

"Referring in general to Jones Creek and its tributaries, an unusually high percentage of the total discharge is available for storage owing to the reservoir-site on each branch being located near its mouth, thus making practically the whole drainage area effective and subject to control. It will be noted that the estimated mean discharge available for storage—viz., 17,500 acre-feet—is high when compared with observations of the total discharge taken at the company's weir and headgates, the seven-year mean of which is 19,000 acre-feet, covering a four-months' recording period annually. From examination of the weir where the records are taken, a high velocity of approach is suspected, which during the high run of the creek would considerably increase the calculated discharge; further, a four-months' period does not approximately represent the total discharge of this stream. In support of this statement it was observed that the two main branches of the creek were discharging a considerable volume of water last September and October.

"*Harris Creek.*—To obtain information upon the feasibility of bringing water from Harris Creek to supplement the Jones Creek supply, a preliminary ditch-location line was run, commencing at the White Valley headgate. The point of diversion on Harris Creek would be approximately eight miles on grade from the headgates on Jones Creek. For about 75 per cent. of this distance the conditions are favourable for ditching; the remaining portion could be flumed.

"The first mile in the Harris Creek Canyon is on a steep rocky side-hill, part rock-slide. Owing to shortness of time available only work of a preliminary nature was attempted; the investigation should be continued in detail and a close location and estimate of cost made. Unfortunately no discharge records of Harris Creek are available, but it appears to be a larger stream than Jones Creek. Nothing is known of the drainage area. An extension of the photo-topographical survey (Surveys Branch) to include Harris Creek would be of great assistance to the Water Branch, as ultimately this stream will figure prominently in irrigation adjustments in this district.

"*Deer Creek.*—Deer Creek is the source of the water-supply for that portion of the Coldstream Estate irrigated from the King Edward ditch. An investigation of its watershed has been made and the maximum storage possibilities ascertained. King Edward Lake is the only storage-site on the stream of any importance. A chain of swamps and a small lake about 15 acres in area, situated within the King Edward Lake catchment, are of no consequence,

inasmuch as the main site fully developed will provide storage for all the water available. The area draining into King Edward Lake is about 1,600 acres. The mean annual run-off from this area is estimated to be 1,000 acre-feet.

"The capacity of the existing reservoir is 860 acre-feet. By drawing the water off at a level 2 feet lower than the present outlet and raising the dam 2 feet the storage capacity is increased to 1,100 acre-feet."

ASHCROFT.

A petition was filed with the Department by a number of land-owners near Ashcroft, requesting that a survey and report be made as to the feasibility and practicability of irrigating certain lands from the Bonaparte River. A. G. Hatton, acting under instructions from District Engineer Varcoe, undertook the surveys required. The substance of the report is as follows:—

"It has been assumed locally that the Semlin Valley could be supplied from the Bonaparte River, but the following figures prove to the contrary:—

Place.	Elevation.
Boston Flat ditch near Cache Creek	0
Bridge over Bonaparte River at Cache Creek	—98
Bridge over Cache Creek to Parke's Ranch	—42
Ground-level, south-west corner of Lot 3, Group 2	+209
Western Canada Ranching Company's ditch from Cache Creek	+256
Ground-level, north-east corner of Sections 20, 21, and 24	+274

"Another local assumption has been that it is possible to divert Hihium Creek directly into a branch of Cache Creek.

"The investigations indicate that it would not be possible to divert water from this source directly into Cache Creek. Hihium Creek is a very sluggish stream and meanders through wild hay meadows, for the first two or three miles of its course having practically no fall, while the country at the east end of the lake falls towards Deadman's Creek, the physical nature of the land being such as to make a diversion from this direction to Cache Creek out of the question.

"It being impracticable to include the Semlin Valley in a project taking water from the Bonaparte River, we directed our attention to a determination of the irrigable area of the lands on the western side of the river. The result of the survey was disappointing, so much so that instead of running a grade-line for a ditch as at first intended, it was decided to obtain some approximate data upon which rough figures as to probable cost might be based. For this purpose a tie for elevation was made on the old Boston Flat ditch; although this ditch was a failure, it actually carried water to a certain point, but in insufficient quantities. The ditch was found to be 66 feet lower than the control-point on the lands under the project, and it was assumed that a ditch to supply the lands would take its point of diversion at least 66 feet higher than the Boston Flat intake plus the additional head for grade. From levels taken above the proposed intake a rise of 77 feet was found in a distance of about three miles, and it indicates that it would be necessary to go from 5 to 6 miles above the said point to obtain the required grade, making the ditch-line, including about six miles of flume, about nineteen miles in length. It is believed that this is a sufficient guide in determining the advisability of further investigations or the contrary."

GRAND FORKS.

During the latter part of 1917 and a short time in 1918 preliminary surveys were made to determine the feasibility and practicability of irrigating certain lands in the vicinity of Grand Forks either by pumping or gravity systems. From the investigations made it would appear that it is not feasible to obtain a gravity supply from the North Fork of the Kettle River, and that it is necessary to make a diversion from the main Kettle River at a point approximately seven miles south of the boundary. Owing to the difficult nature of the ground through which the conduit would pass, further investigations are to be made so that the estimated cost may be determined.

CRESTON.

A petition was filed relative to the construction of an irrigation system near Creston. The late H. G. Lawley, assistant to District Engineer Biker, commenced the surveys for this scheme,

but unfortunately, owing to his contracting Spanish influenza and his subsequent death thereby, the work was not finished. It is the intention to proceed with this work at an early opportunity.

Keremeos.

In view of the fact that there is a large area of bench land near Keremeos which could be irrigated from an extension of the Keremeos Land Company's irrigation system, C. A. E. Shaw was employed to make a report on the feasibility and probable cost. The substance of his report is as follows:—

"A survey was made for an irrigation-ditch from the end of the Keremeos Land Company's ditch at Keremeos to the north boundary of the Similkameen Fruit Land Company's property. From this point, with the exception of a few acres at the north-east corner of the latter company's land which can be irrigated from Barcelo Creek, the water can be taken to any part of the property to be irrigated.

"The ditch would be about three miles and three-quarters in length, and by careful location all but a few hundred feet of this can be made in ditch. A flume would be required at the crossing of Keremeos Creek, one or two short flumes at Stations 151 to 160, and a flume or siphon about 700 feet in length at Stations 167-174. Several other short flumes would also be required.

"A rough estimate of the cost would be about $7,000—say, $4,500 for excavation, $1,500 for rock-work and boulders, and $1,000 for fluming. This is exclusive of the cost of right-of-way, which would probably be expensive up to Station 70, especially if the ditch crosses the road to the north side, as most of the land is planted in orchard, and it might be necessary for this reason to carry the water through part of this distance in underground pipes.

"There are at present about 800 acres under irrigation supplied from the Keremeos Land Company's system, and this system would have to be enlarged, as an additional 800 acres would require water.

"Keremeos Creek cannot be relied upon as a sole source of supply. There are, however, one or two reservoir-sites on the watershed which might be developed to advantage, although there is no definite data at present; this can be obtained by sending out a survey party during the 1919 season.

"Ashnola Creek would have to be relied upon for the major part of the water-supply, and consequently the Keremeos Land Company's system would have to be enlarged to carry this water."

Conservation Fund.

Owing to the shortage of water under a number of irrigation systems in the Okanagan Valley, it has been necessary for the Government to come to the assistance of the water-users. For this purpose a fund called the Conservation Fund has been set aside, and the moneys spent therefrom are to be a first charge against the assets of the companies operating the systems and against the lands which are served by the systems. The works contemplated or being constructed are as follows:—

Project No. 1—Storage-dam at Big Meadow for the system at Naramata.

Project No. 2—Raising the dam at North Fork, Peachland, to increase the storage.

Project No. 3—The drainage of three sloughs in the vicinity of Rutland. Owing to the rise in the water-table of some lands, due to irrigation, this work is very necessary.

Project No. 4—The repairs to the irrigation system of the Kelowna Irrigation Company.

Project No. 5—The construction of a system of flumes at Scotty Creek near Kelowna to replace ditches, thereby conserving the water-supply.

Project No. 6—The repairs to the White Valley Irrigation and Power Company's system at Vernon.

The work on Project No. 1 at Naramata was commenced on September 28th and continued until November 4th, when owing to the frost and snow it was not economical to continue. The storage of water to furnish an adequate supply to the land being served by the Naramata system is an expensive undertaking, as there are no reservoir-sites of any large size available, and what there are require expensive dams. It was suggested that Chute Lake be used as a reservoir, but owing to the location of the grade of the Kettle Valley Railroad it is impossible to store more than 400 acre-feet of water at this site. This alone precluded utilizing same, although the use

of this water would have necessitated a long conduit from Chute Creek to connect to the present system, and, further, it would prevent the lands nearer Chute Creek from being developed.

The site at which the dam is being erected is known locally as Big Meadow. The capacity of the site is as follows:—

Elevation of Contour.	Area of Contour in Acres.	Contents between Contours in Acre-feet.	Accumulated Contents of Contours in Acre-feet.
5,280 feet (0)	32.1	....	....
5,285 „ (5)	40.8	182	182
5,290 „ (10)	56.8	243	425
5,295 „ (15)	69.5	316	741
5,300 „ (20)	79.8	373	1,114
5,305 „ (25)	89.2	422	1,536

The catchment area above the dam-site is approximately 2½ square miles (1,600 acres), and assuming that the average precipitation over this area is 20 inches per annum, there should be a total of 2,660 acre-feet of water fall upon the 1,600 acres. Allowing 25 per cent. of this water as the estimated run-off, there should be approximately 930 acre-feet available for storage. The dam is at present being constructed up to an elevation of 18 feet and should be capable of storing 700 acre-feet of water.

The work on Project No. 2 at Peachland was not commenced until October 8th. It consisted of increasing the height of the existing dam 6 feet. The dam as originally constructed had a concrete core wall; this raised the 6 feet and as completed is 217 feet long. A concrete and stone spillway 20 feet wide was provided at the south end of the wall. An earth fill 8 feet wide on top on each side was brought up to within 2 feet of the top of the wall. It is estimated that 50 per cent. of the earth fill is in place. The channel of the stream below the culvert outlet was cleaned out and deepened for a length of some 200 feet.

This reservoir is situated on what is locally known as the North Fork of Peachland Creek (Deep Creek). The catchment area is four square miles and the capacity of the reservoir before the commencement of the work this past season was 531 acre-feet. This has been increased to 850 acre-feet by the new work. The contents of the site are as follows:—

Elevation of Contour.	Area of Contour in Acres.	Contents between Contours in Acre-feet.	Accumulated Contents of Contours in Acre-feet.
0.00	48.87	.....	Sill of outlet.
5 feet	52.95	254.55	254.55
10 „	60.02	282.40	536.95
15 „	65.87	314.70	851.65
20 „	72.15	345.05	1,196.70

From the data available there should be at least 1,000 acre-feet of water run-off from this watershed above the reservoir-site.

Work in connection with Project No. 3 has only just commenced, owing to the fact that the organization of the Rutland Drainage District was incomplete. As it will take some time before all the requirements of the "Drainage, Dyking, and Development Act" are complete, it was decided that the construction of the main drainage-ditch should be undertaken before the water-table rises, due to the spring run-off, thereby saving considerable extra work. Preparations are now under way to undertake the work.

Work on Project No. 4, being the repairs to the Kelowna irrigation system, was commenced on September 26th and continued until November 26th. During this time a total length of 3,805 feet of concrete ditch was either fully or partially relined in the Glenmore section of the system, while a total of 3,500 feet of wood flume was lined with tar-felt and lumber in the Rutland section of the system.

No work has been undertaken on Project No. 5 up to the present, as the farmers were too busy in the fall to take up the matter of construction or organization of their district. Directly the district is properly incorporated it will be possible to proceed with the works.

The work on Project No. 6 was carried out by the White Valley Irrigation and Power Company, and consisted of making necessary repairs and improvements to the system.

WATER-POWER.

In view of the development of the pulp and paper and other industries, it is very desirable that water-power investigations be carried further, as upon reports of this nature will depend very largely whether capital can be interested or not. The Commission of Conservation had several survey parties in the field a few years ago, but their operations consisted in merely locating a possible power-site, ascertaining the probable head, and making measurements of the stream-flow while in the vicinity. What is now desirable is to follow up these preliminary reports by ascertaining the character and boundaries of the watersheds and establishing stream-gauging stations. The lack of this information has resulted in more failures of power developments than any other cause.

The report of W. Blane on the power possibilities on Queen Charlotte Islands which he carried out during the summer of 1918 is as follows:—

"AIN RIVER.

"*Source.*—The Ain River, flowing into Masset Inlet at Indian Reserve No. 6, about two miles north-east of Buckley Bay sawmill, is the outlet of a chain of lakes on the north side of Masset Inlet. Of these lakes the largest is Ian, having an area of 5,400 acres or 8.4 square miles; it is connected by a channel half a mile in length with Skundale Lake, the area of which is 320 acres or 0.5 square mile. The fall from the large to the smaller lake is less than a foot in the half-mile. From Skundale Lake another channel of about two miles in length, both channels being navigable by canoe or light-draught boat, leads into Ain, the smallest lake of the series, the area of which is about 200 acres. The fall between these two latter lakes is about 4 feet.

"From Ain Lake the Ain River flows in a winding channel in a general south-easterly direction to Masset Inlet; the difference in elevation between mean low water of Ain Lake and mean high-tide level of Masset Inlet being 124 feet.

"*Drainage Area.*—The drainage area covers approximately 98,800 acres or 155 square miles of territory. This is mountainous and heavily wooded over the greater portion, the exceptions being the higher mountain-sides, which are bare, and occasional stretches of open muskeg. There is also in many places a dense undergrowth of salal, whilst spagnum and other mosses abound, making ideal natural conditions for a gradual and economical precipitation run-off.

"The precipitation data used is taken from the Meterological Report for 1916-17 of Masset Station, covering an observation period of seventeen years, with an allowance of 8 inches per year increase, due to local conditions, as the Ian Lake neighbourhood, owing to its mountainous character, is said to average greater annual precipitation than the country in the vicinity of Masset.

"The precipitation at Masset, according to said Meterological Report, is 52 inches, and allowing an increase of 8 for local difference, this would give to Ain Lake and vicinity a precipitation of 60 inches.

"This applied to the drainage area in question will give a total precipitation of 494,000 acre-feet, or sufficient to produce a run-off of 550 feet per second, allowing that 14 per cent. is taken up in evaporation and 6 per cent. in plant-structure.

"*Characteristics of River.*—The river may be said to be divided into two parts—the first beginning at Ain Lake and terminating at the West Fork of the river, and the second beginning at the West Fork and terminating at Masset Inlet.

"The first part, from Ain Lake to the West Fork, covers a distance of a little less than a mile. In this distance occurs 105 feet of the total 124 feet of fall between the low-water level of Ain Lake and mean high tide of Masset Inlet. For this portion of the river the banks are in general high, the bed is of rock of very uneven surface, and low falls are of frequent occurrence.

"The second part of the river, that is from the West Fork to tide-water, although of considerably greater length than the first part, has much less fall, and in consequence a slower flow, whilst the banks have flattened out to a considerable extent.

"The average width of the river throughout is about 60 feet and the average central depth probably 2 feet, but the river-bed is so uneven and full of rock pockets that it is difficult to determine an average uniform depth.

"*Volume.*—Several gaugings made on the river between the proposed dam-site and the entrance to the lake gave a mean of 317 cubic feet per second. This may be regarded as mean low discharge.

"Gaugings were also taken at the same place in August, 1917, by E. A. Cleveland, of Vancouver, who had installed here an automatic water register. The foundation for this instrument he built of such a height as to ensure that the instrument itself would be above the reach of the highest flood. In deciding on this high-water mark he had been guided by local information covering a number of years, and also by erosion and other water-marks along the bank; however, in November, 1917, the waters of the lake rose to an unusual height, completely covering the water register. When this flood stage was at its height a durable mark recording the elevation was made on a tree close to the guaging-station. In August, 1918, at the time of extreme low water in Ain Lake, a measurement was made from extreme low-water mark to this mark on the tree, and the difference was found to be 11 feet.

"Using the same stream velocity as before, also the same cross-section for the bed of the stream, but with the additional 11 feet of water, the flow would be augmented by 3,850 cubic feet per second or a total extreme high-water flow of approximately 4,200 cubic feet per second.

"*Storage.*—The natural storage-basin of Ian Lake, about 10 square miles, will yield a minimum low-water flow of 317 cubic feet per second, or a maximum flow of approximately 4,200 cubic feet per second under exceptionally favourable high-water conditions. This storage area may, however, be increased by the erection of a dam of such a height (maximum height being under 50 feet) as would provide storage for the whole precipitation run-off from the entire catchment-basin, and the flow could be so regulated from the reservoir as to permit of a continuous discharge of 550 cubic feet per second.

"*Dam-site.*—This site is in Ain River at the first falls, about 200 feet from the entrance to the lake. The channel at this point contracts between rock walls and is about 36 feet wide at low water. The bed of the river is also of rock, all basaltic in character. The wall on the east side rises to a height of 50 feet in a horizontal distance of 60 feet; on the west side to a height of 50 feet in a horizontal distance of 80 feet, with in places a surface covering of several feet of moss and earth.

"*Mill-site.*—To procure a suitable mill-site at tide-water where freight and other boats could make a landing it would be necessary to go about three-quarters of a mile from the river's mouth, as a long sand-bar extends past the entrance to the river and in front of the Indian reserve, rendering navigation there impossible, except to small boats. The nearest site of this description obtainable is near the south-east corner of Lot 1437. From here a narrow-gauge railway or motor-truck road-bed could be built on a direct line to the West Fork of the river, from which point there would be a heavy grade to overcome, which might the easier be accomplished if the course from here on followed the windings of the river.

"If such a railway were built in order to take in the materials necessary for building a dam, a great part of its cost might be defrayed by bringing out such spruce and other millable timber as might be in proximity to such railway.

"*Power.*—Considering the available head as 124 feet and the continuous flow under reservoir government 550 cubic feet per second, the available horse-power is 6,200 (using an efficiency factor of 80 per cent.).

"AWUN RIVER.

"*Source.*—Awun River is the outlet of Awun Lake and flows north into Awun Bay near the western end of Masset Inlet.

"*Characteristics.*—The river is about one mile in length from the lake to a point where it meets the high tides from the inlet; from this point to the mouth is about a quarter of a mile, or in all a total length of a mile and a quarter. The banks in general are sloping, but in many cases rise abruptly to a height of 10 or 15 feet. The channel has a well-defined low-water bed, but there is every evidence that it has cut for itself auxiliary channels during flood stages.

"The average velocity of the low-water flow is about a mile and a third per hour as found by timing floats in a representative reach of the stream, the average width about 30 feet, and

the average central depth 1¼ feet. Two falls occur, one of about 5 feet at a point about two-thirds of the distance up the river from tide-water; the other about 2½ feet at the point chosen for a dam-site.

"*Volume.*—Gaugings gave a mean of 60 cubic feet per second, which might be considered as slightly more than the low-water discharge. This discharge would not seem to be very constant, as the mountains surrounding the lake rise with a steep incline and in many places are partly denuded of vegetation through the action of slides. The influence of precipitation would therefore be felt quickly and the flow of the river on that account be rendered irregular.

"*Drainage Area.*—The drainage area comprises nearly twenty square miles, of a rugged mountainous character, showing frequent rock-outcrops, but heavily timbered on the lower slopes.

"The precipitation here is assumed to be equal to that of the Ian Lake neighbourhood and taken as 60 inches. Therefore, with an annual precipitation of 60 inches and a drainage area of twenty square miles, there will be a total annual precipitation of 64,000 acre-feet, and allowing loss by evaporation to be 14 per cent. and from other causes 6 per cent., there is available 52,200 acre-feet, or sufficient to produce a continuous flow of 72 cubic feet per second.

"*Levels.*—The elevation of Awun Lake above high-tide levels of Masset Inlet is 48 feet.

"*Power.*—Considering the available head at the dam to be 47 feet and the continuous flow under reservoir control to be 72 cubic feet per second, the available horse-power is 308 (using an efficiency factor of 80 per cent.). The low-water horse-power without reservoir conditions is 256.

"*Storage.*—The natural storage-basin of Awun Lake is slightly in excess of two square miles and will yield a low-water flow of nearly 60 cubic feet per second, which may easily be increased to the maximum of 72 cubic feet per second by the erection of a dam (of a maximum height of 20 feet).

"*Dam-site.*—Several dam-sites are available near the lake, but the one deemed the most suitable is at a point about 600 feet from the lake; here the drainage area divide crosses the river, sloping to the north and west respectively. At this point the river-bed is about 30 feet wide, with a fall over rock of about 2½ feet. The banks on the east side rise on a 1-to-1 slope to about 60 feet; showing frequent rock-outcrops. On the west the slope is more gradual and the banks rise to a greater height, with a considerable thickness of earth over the underlying rock.

"*Mill-site.*—A suitable mill-site could be had at the mouth of the river on the west bank; at low tide the water here is shallow and would necessitate a wharf, exceeding perhaps 600 feet in length to reach the deep water. The bay, however, is sheltered and affords a safe anchorage for small boats.

"*Power.*—The low-water flow of the river is in the neighbourhood of 60 cubic feet per second, and (using an efficiency factor of 80 per cent.) would provide 256 horse-power; but with storage facilities this could be increased to 72 cubic feet per second or 308 horse-power.

"The prospects here throughout seem more suited for a cannery than for any other industrial enterprise.

"*Lands affected by a 20-foot Dam*—

	Acres.
Lot 1088	160
„ 1086	100
„ 1084	160
„ 1082	80
„ 1080	80
„ 1079	50
„ 1081	5
„ 1083	5
„ 1546	10
Approximate total area that would be flooded	650

"MAYER LAKE.

"Mayer Lake is situated about five miles and a half east of Port Clements, Masset Inlet. It lies almost due north and south and is about seven miles and a half long with a greatest width of half a mile, and, lying as it does in a very shallow depression, does not appear to have a great depth in any part. A stream about 20 feet wide enters at the northern end; this stream

has no perceptible current, being more of a slough in character, and drains from the swampy land lying to the north of the lake.

"The outlet, Mayer River, is at the southern end, but has become blocked by an accumulation of drift, fallen trees, and silt, through which the water filters sluggishly to the more open stream-bed below. On account of these obstructions in the river and because of its very low banks, much of the high-water flow, which would otherwise be carried away by this agency, floods out over the low lands to the south, making travel in those parts difficult and cultivation impracticable.

"*Access to Lake.*—Some years ago a road was laid out from the village of Port Clements to the lake. This road runs through Lots 1883, 414, 412, 411, 391, and from thence follows the northerly boundary-line of Lots 384 and 383 to the lake. It is now seldom used, as the pre-emptors whom it was built to serve have abandoned their holdings; some did so prior to the outbreak of the present war; the others since, most of them enlisting.

"*Elevation.*—The elevation of the lake is 60 feet above high-tide water. This occurs in a distance of about nine miles following the course of Mayer River.

"*Storage.*—No natural facilities for the erecting of a reservoir present themselves here, nor would the head available justify any extensive works with a view to developing power from this source."

WATERWORKS.

ELKO.

The Elko waterworks has now been in operation some years, but owing to the town not developing as expected the revenue from the water system under the then existing rates was not enough to meet the operating expenses and the liability against the system. Through the services of the Department a new tariff was established and new officers placed in charge.

NAKUSP.

An attempt is being made to provide a water service to the residents and farmers in the vicinity of Nakusp. Early in the year a preliminary report was made by our District Engineer's office at Nelson as to the practicability and feasibility of the proposed scheme. This report outlined the possibility of providing a water service to eighty-nine taps at a cost of $26,000; allowing for repayment of the capital, depreciation, maintenance, and operation, it would be necessary to charge about $50 per annum for each tap. In view of the scattered positions of the residences, the length of pipe-line between each connection is large and greatly adds to the cost of the scheme. Even if the cost were $75 per annum for each connection it would not be excessive under the circumstances.

SIDNEY.

A reconnaissance survey was made by G. Anderson, M.Inst.C.E., during the season to determine whether it was advisable to make detail surveys as to the augmentation of the water-supply to the Sidney water system. The report discloses that there are some small reservoir-sites available, but it would appear that the cost of utilizing same might be excessive in view of the long distance the water would have to be carried before it could be made available in the existing water system.

WELL-DRILLING.

Well-drilling has again been carried on at two places in the Province during the past year—in the Hazelton Water District near Kitwanga, on the Grand Trunk Pacific Railway, about twenty-five miles west of Hazelton, and at Marysville, in the Cranbrook Water District. As stated in the last annual report, the difficulties encountered in drilling have prevented rapid progress with the operations.

Kitwanga, Prince Rupert District.

This well has been sunk on the first bench on the north side of the Skeena River, at an elevation of 104 feet above the river and 525 feet above sea-level. Owing to the difficulty of getting an experienced driller and also to the difficulty of getting well-casing, it was late in the year before operations commenced. The report of H. C. Fritts, the driller, is as follows:—

"On October 16th drilling operations were commenced and it was found that soft blue clay and sand had filled up 30 feet in the 6-inch pipe. The 6-inch pipe was then driven 3 feet in an endeavour to shut off this caving; this was not successful, and owing to the lateness of the season 4-inch pipe was used, as more rapid time could be made in drilling. At a depth of 309 feet the 4-inch pipe had shut off the caving, and I drilled past the 4-inch pipe to a depth of 350 feet in hard blue clay, where a strata of coarse grey sand was encountered that filled up in the 4-inch pipe to 253 feet from the surface. This sand, I believe, contains a sufficient amount of water for farm use, but is held back by the volume of sand in the 4-inch pipe. At this time drilling operations were discontinued owing to the number of deaths and sickness in vicinity; only for this and the lateness of the year in getting started the well would have been finished this year.

"In continuing the well, I would advise that a 20-foot length of 4-inch galvanized pipe, perforated and wrapped with fine galvanized wire screen and wire, soldered, be used in the bottom of the 4-inch pipe, and that the 6-inch pipe be drawn; also that proper equipment and tools be purchased for drawing 4-inch and 6-inch pipe, which can again be used in different wells at considerably less expense to the farmer and the Government."

The work this season demonstrated that water was available and that very little requires to be done to finish off the well.

Marysville, East Kootenay.

The operations at this point suffered considerably through the inexperience of the drillers. It is impossible to make much progress without thoroughly experienced men, and this season's work at this point more than fully bore out this contention.

DRAINAGE.

Kootenay Flats.

In order to make a closer study of the regimen of the Kootenay River it was necessary to undertake certain surveys during the season. E. P. McKie, A.M.E.I.C., was detailed to undertake this work, and his report on the work done is as follows:—

"The party consisted of two chainmen, a launch engineer, and myself. We left Nelson by launch on September 28th and arrived at Kootenay Landing on Sunday, September 29th; then proceeded about three miles up the river and fixed our first camp.

"A decision was arrived at to take a few soundings at the mouth of the river and soundings across the river at every mile. The distance of Kootenay Landing from the International Boundary at Porthill is about twenty-eight miles, but the least distance that would have to be levelled, including check-levels, cross-sections, and tieing into Dominion bench-marks, is about seventy miles.

"The method of procedure was as follows: The mile points were fixed from positions shown on the plan from what land-marks were available. A tag-line was prepared by using a ⅝-inch Manila rope and inserting tags at every 20 feet. The launch engineer and a chainman then drove in long plugs at the water-level on each bank, marking the water-level with a nail; the tag-line was stretched across the river by means of block and tackle, and the men read the depth of soundings at each tag by means of a light steel sounding-cable. After taking a sounding a trail was cut through the brush on the river-bank to the open flats, the depth of the brush varying from 100 feet to 600 feet. When soundings had been taken at three or four sections the cross-sections were completed by levels tied into the bench-marks. At Mile 18 a line of check-levels was run to Creston.

"The work proceeded in this manner until Porthill was reached on November 19th and the levels tied into the Dominion levels at the International Boundary. Owing to wet weather only about one-half of the time was available for work, and the freeze-up came the day after finishing.

"There is evidently very little difference between the elevation of the water-surface at low water at Porthill and at the lake; this is very important and should be checked, and more time should be available to run the levels than there was last fall."

GLEN LAKE, NEAR COLWOOD, V.I.

The drainage of certain lands in the vicinity of Colwood necessitated investigations as to the possibility of relieving these lands of their excess waters. E. G. Marriott, A.M.E.I.C., has made a short study of this problem, but before coming to any definite conclusion it will be necessary to do a certain amount of levelling. When this is undertaken it will be probable that a drainage district will be incorporated to undertake this work on a proper scale.

DATUM-PLANES.

The establishing of definite figures correlating the various datums in use on the Lower Mainland has made further progress, and we are indebted to A. J. Dalzell, of the City Engineer's Office, Vancouver, for the final figures relating to this important subject. The table given herewith has been submitted to Dr. Dawson at Ottawa for confirmation and may now be taken as correct:—

British Columbia Mainland Datum-planes.

Datum-planes referred to Vancouver Harbour Tide-levels.	O.L.W.		M.S.L.		H.W.L.	
	Plus Feet.	Minus Feet.	Plus Feet.	Minus Feet.	Plus Feet.	Minus Feet.
Admiralty datum (O.L.W.)	Zero.	Zero.	..	8.03	..	13.00
Mean sea-level (M.S.L.)	8.03	..	Zero.	Zero.	..	4.97
High-water level (average of higher high water)	13.00	..	4.97	..	Zero.	Zero.
Datum of Canadian Pacific Railway Co.	..	84.77	..	92.80	..	97.77
Datum, City of Vancouver	..	83.52	..	91.55	..	96.52
Datum, City of New Westminster	16.75	..	8.72	..	3.75	..
Datum, Provincial Water Dept., Fraser River	..	0.70	..	8.73	..	13.70

METEOROLOGICAL REPORT, 1917-18.

Work during the year has been continuous along the lines adopted formerly. The co-operation between the Dominion Meteorological Service and the Provincial Water Rights Branch, which was begun in 1915, has been continued throughout the year. As the result of this, records are now available from 245 stations, of which 160 are Dominion stations.

Complete returns have been received from 165 stations during the year. At 129 stations the precipitation was greater and at twenty-eight it was less than during 1916-17. The records show increases at ninety-three stations and decreases at sixty-eight, compared with the average for same for all years up to and including 1917-18. For all stations maintained ten years and upwards the records show increases at thirty-two and decreases at eight, compared with average for same up to and including 1917-18.

During the year seven minimum and twenty-seven maximum records were established at the stations indicated by *.

Maximum Records.—A new maximum yearly record has been established for all stations by the 301.16 inches registered during the year at Swanson Bay, where the previous highest yearly record for any station was established in 1907-8, when 205.58 inches was registered.

At Lake Buntzen Station, which has been maintained for fifteen years, the precipitation was 123.96 inches, thus establishing a new maximum record for this station. This is the only station out of all the stations maintained for ten years and upwards where a new record was established; the previous maximum record for this station was 123.32 inches in 1904-5.

Monthly maximum records were also established at this station as follows: 88 inches in November, 1917; 146 inches from October 1st to November 30th, 1917; and 206.34 inches in the four months ending January 31st, 1918.

Minimum Records.—With a precipitation of 5.28 inches, Ashcroft has the lowest record for the year. Further, by months, it has also established monthly records as follows: March 1st to April 30th, 0.001 inch; February 1st to April 30th, 0.20 inch; six months ending July 31st, 2.21 inches; and for the eight months ending September 30th, 2.49 inches.

Additional Data.—Particulars of economic value regarding precipitation which have an important bearing on all water-development questions are now given for the first time as follows:—

(*a.*) The annual precipitation table, giving the usual yearly data, has been extended and includes particulars of approximate elevations of 133 stations above mean sea-level. Also maximum and minimum yearly records established for all stations since they have been maintained.

(*b.*) A new table, giving some selected lowest precipitation records, which have been established for long periods at the various stations mentioned.

The tables herewith are compiled from all sources available and for all stations, whether maintained at present or not.

The two years given under records established refer to the water or climatic year, which extends from October 1st to September 30th.

In making use of these tables for average precipitation, reserve should be placed on the figures for a period of less than ten years.

Owing to the war it has been difficult to keep the records unbroken, and although the data for some months are missing, as a whole the Department has to thank the numerous observers for their thought and care during the past season.

PRECIPITATION, 1917-18.

Approx. Elevation above Mean Sea-level.	Station.	No. of Years of Complete Observation.	Average Precipitation.	Precipitation of Year.	Percentage above Average.	Percentage below Average.	Records Established. Minimum.		Records Established. Maximum.	
Feet.			Inches.	Inches.	Per Cent.	Per Cent.	Inches.	Years.	Inches.	Years.
90	Abbotsford	15	60.82	....	....	....	43.08	1889-90	79.56	1893-94
60	Agassiz	29	63.38	76.02	20.0	....	46.38	1889-90	89.41	1912-13
....	Ayansh	4	33.59	37.31	....	....	26.21	1914-15	41.42	1916-17
300	Alberni (Somass River)	20	71.70	....	....	....	64.68	1906-07	87.88	1904-05
....	" (Beaver Creek)	22	68.03	73.25	7.67	....	47.04	1916-17	94.04	1894-95
200	Alert Bay (Mission)	1	40.05	....	....	....	....	.....	....	.....
....	" (Wireless Station)	2	40.84	....	....	....	40.24	1916-17	41.45	1914-15
....	Alkali Lake	6	10.56	10.48	....	....	7.89	1916-17	13.52	1911-12
400	Alouette	7	100.41	109.96	....	....	82.41	1914-15	116.32	1912-13
....	Alvaston	3	11.20	12.09	....	....	8.24	1916-17	13.27	1915-16
....	Anyox (Granby Bay)	2	96.78	115.36	....	....	78.20	1916-17	115.36	1917-18
1,182	Armstrong	6	18.59	17.87	....	....	14.68	1916-17	23.19	1912-13
1,000	Ashcroft	4	7.48	5.28	....	....	5.28	1917-18*	9.12	1914-15
3,450	Aspen Grove	4	11.50	....	....	....	11.50	1916-17	19.54	1915-16
....	Atlin	13	10.75	13.93	29.6	....	6.91	1914-15	14.58	1908-09
2,220	Babine Lake	3	20.54	19.97	....	....	19.68	1909-10	21.97	1908-09
....	Bamfield	2	84.83	....	....	....	51.18	1905-06	118.47	1903-04
4,180	Barkerville	29	35.38	43.61	23.3	....	23.35	1896-97	46.85	1907-08
....	Baynes Creek	1	12.59	....	....	....	....	.....	....	.....
1,490	Bear Creek (Jordan River)	7	102.90	131.39	....	....	83.62	1911-12	131.39	1917-18*
....	Beaver Lake, V.I.	23	35.09	36.36	3.6	....	20.80	1914-15	45.31	1896-97
....	Bella Coola	17	43.72	58.17	33.0	....	29.61	1898-99	60.77	1913-14
....	Bevan, V.I.	4	60.65	58.04	....	....	36.48	1916-17	87.91	1915-16
1,420	Birchbank	5	24.95	21.47	....	....	21.88	1916-17	28.39	1913-14
1,650	Bonnington Falls	5	20.71	24.63	....	....	19.74	1916-17	31.19	1913-14
....	Boswell	3	25.90	22.86	....	....	22.86	1917-18*	28.57	1915-16
1,800	Bridge River	5	19.39	21.63	....	....	14.78	1914-15	21.66	1916-17
Sea level.	Britannia Beach	3	....	....	....	....	56.92	1916-17	85.31	1915-16
2,200	Britannia Mines (Tunnel Camp)	3	88.26	68.65	....	....	68.65	1917-18*	99.47	1915-16
2,600	Briscoe	5	17.19	17.06	....	....	13.59	1916-17	20.83	1915-16
....	Bullion (Quesnel Forks)	..	23.33	....	....	....	15.53	1904-05	29.78	1897-98
400	Buntzen Lake	15	109.69	123.96	13.0	....	80.10	1914-15	123.96	1917-18*
....	Bute Inlet	4	65.68	79.06	....	....	53.66	1916-17	79.06	1917-18*
1,250	Cache Creek	2	7.91	....	....	....	7.24	1915-16	8.58	1914-15
640	Cameron Lake	3	63.66	75.02	....	....	47.85	1916-17	75.02	1917-18*
2,650	Canal Flats	4	16.54	10.95	....	....	10.69	1916-17	22.52	1914-15
1,250	Canoe Point (Shuswap Lake)	7	23.08	....	....	....	18.59	1913-14	25.64	1915-16
....	Cape Scott	9	113.79	....	....	....	89.99	1898-99	146.82	1901-02
....	Capilano Intake	4	117.83	138.99	....	....	94.57	1916-17	138.99	1917-18*
....	Carcross (Yukon)	9	8.76	8.69	....	....	3.93	1914-15	12.42	1913-14
....	Carmanah	9	111.18	....	....	....	92.94	1897-98	136.49	1895-96
2,780	Carmi	5	17.71	15.60	....	....	11.84	1916-17	24.00	1914-15
3,100	Chilcotin (Big Creek)	14	13.01	14.41	10.75	....	8.23	1916-17	21.60	1906-07
21	Chilliwack	21	60.64	69.04	13.8	....	42.93	1914-15	71.98	1906-07
1,300	Chinook Cove	5	16.68	21.23	....	....	13.94	1913-14	21.23	1917-18*
1,460	Christina Lake	5	21.72	19.18	....	....	17.07	1916-17	25.32	1913-14

27	Clayoquot	18	122.07	127.66	4.6	....	97.84	1910-11	150.92	1900-01
....	Clo-oose	2	78.89	....	....	....	73.74	1914-15	84.05	1912-13
312	Cobble Hill (Boatswain Bank)	5	36.49	39.50	....	....	27.94	1914-15	46.39	1915-16
2,700	Coldspring Ranch (Quilchena)	4	11.82	....	....	....	8.46	1916-17	14.61	1914-15
34	Coquitlam	17	71.57	79.78	11.47	....	53.47	1914-15	81.66	1915-16
540	Coquitlam Lake	15	147.33	146.97	....	0.24	110.48	1916-17	166.87	1903-04
50	Cowichan Bay	4	34.71	35.16	....	....	27.53	1914-15	44.27	1915-16
540	Cowichan Lake	5	78.58	78.57	....	....	57.64	1916-17	94.80	1913-14
2,580	Cranberry Lake	3	17.50	19.25	....	....	13.27	1916-17	19.97	1915-16
3,020	Cranbrook	10	16.18	14.84	....	8.3	11.04	1903-04	25.31	1915-16
3,020	Cranbrook (City)	5	15.46	13.62	....	....	11.74	1916-17	22.49	1915-16
....	Crawford Bay	7	30.95	33.15	....	....	25.13	1913-14	45.97	1915-16
1,990	Creston	6	20.77	20.71	....	....	15.79	1916-17	24.78	1915-16
4.450	Crowsnest	2	16.58	....	....	....	14.22	1914-15	18.95	1915-16
....	Cumberland	2	57.67	....	....	....	56.98	1897-98	58.36	1896-97
....	Dawson	5	11.14	13.10	....	....	9.27	1914-15	13.10	1917-18*
1,400	Deer Park (Lower Arrow Lake)	3	16.18	....	....	....	14.42	1914-15	19.24	1915-16
....	Denman Island	10	49.81	45.72	....	8.2	35.73	1916-17	61.27	1913-14
2,580	Donald	3	23.51	....	....	....	18.97	1895-96	28.86	1897-98
....	Douglas Lake	3	12.47	....	....	....	11.87	1883-84	13.20	1894-95
170	Duncan	23	37.45	39.89	1.12	....	29.04	1894-95	57.21	1904-05
1,400	East Arrow Park	4	29.99	30.95	....	....	27.26	1916-17	33.21	1915-16
3,714	Echo Lake (Telegraph Trail)	4	23.05	22.68	....	....	21.24	1916-17	25.51	1915-16
2,620	Edgewater	2	14.83	....	....	....	13.06	1915-16	16.60	1913-14
3,150	Edith Lake	2	14.59	....	....	....	13.19	1915-16	15.98	1914-15
3,100	Elko	8	21.56	....	....	....	16.01	1913-14	28.46	1906-07
3,100	Elko (Town)	5	20.33	16.63	....	....	14.95	1916-17	26.24	1915-16
1,180	Enderby	14	21.07	22.10	4.9	....	16.12	1895-96	27.86	1898-99
....	Entrance Harbour	2	31.25	....	....	....	30.18	1916-17	32.33	1915-16
....	Estevan Point (Wireless)	1	90.31	....	....	....	....	.....	....	.....
1,000	Fairview	2	5.40	....	....	....	4.30	1909-10	6.51	1910-11
1,780	Fauquier	4	24.78	....	....	....	20.45	1913-14	29.61	1910-11
2,100	Ferguson	10	48.15	50.55	5.0	....	40.08	1914-15	56.58	1912-13
3,305	Fernie	4	40.21	34.74	....	....	31.63	1914-15	52.55	1915-16
2,518	" (Dominion)	3	37.18	34.86	....	....	32.09	1916-17	44.59	1915-16
....	Fifth Cabin (Telegraph Trail)	4	38.69	43.87	....	....	31.29	1916-17	43.87	1917-18*
2,520	Fort Steele	3	17.74	....	....	....	12.75	1916-17	23.45	1915-16
....	French Creek	11	36.53	....	....	....	29.19	1896-97	47.16	1899-00
....	Gillies Bay (Texada Island)	2	40.72	....	....	....	29.25	1917-18	45.68	1913-14
4,072	Glacier	12	64.21	81.98	27.7	....	47.36	1914-15	81.98	1917-18*
1,400	Glenemma	3	24.95	....	....	....	19.50	1915-16	29.94	1916-17
250	Goat River Lodge (Powell River)	4	71.23	80.47	....	....	55.25	1916-17	85.17	1915-16
2,580	Golden	8	19.54	23.92	....	....	15.69	1902-03	23.92	1917-18*
....	Goldstream Lake, V.I.	22	68.60	67.94	....	0.96	41.26	1914-15	78.08	1909-10
980	Gooseneck Camp (Campbell River)	1	50.44	....	....	....	....	.....	....	.....
1,746	Grand Forks	9	16.73	18.16	....	....	15.37	1915-16	20.59	1911-12
1,750	" (City)	5	16.20	13.63	....	....	14.16	1916-17	21.55	1914-15
....	Grande Prairie	1	13.35	....	....	....	....	.....	....	.....
2,470	Greenwood	6	19.08	14.91	....	....	14.62	1912-13	24.87	1916-17
....	Griffin Lake	3	42.01	....	....	....	25.84	1892-93	59.79	1899-00
....	Harpers Camp	4	18.47	16.38	....	....	16.02	1915-16	25.01	1916-17
....	Hartley Bay	1	19.52	....	....	....	....	.....	....	.....
27	Hatzic	1	82.23	....	....	....	....	.....	....	.....
50	Hazelmere	6	52.96	....	....	....	37.44	1895-96	66.11	1893-94
1,030	Hazelton	4	19.30	21.82	....	....	16.99	1915-16	21.82	1917-18*
1,720	Hedley	14	11.83	12.46	5.3	....	7.68	1907-08	15.28	1910-11
4,600	Hedley (Nickel Plate Mine)	12	24.33	....	....	....	16.21	1914-15	47.05	1911-12
....	Holberg	8	122.96	117.48	....	....	98.87	1916-17	147.06	1913-14

* Records established during the year.

PRECIPITATION, 1917-18—*Continued.*

Approx. Elevation above Mean Sea-level.	Station.	No. of Years of Complete Observation.	Average Precipitation.	Precipitation of Year.	Percentage above Average.	Percentage below Average.	Records established. Minimum.		Records established. Maximum.	
Feet.			Inches.	Inches.	Per Cent.	Per Cent.	Inches.	Years.	Inches.	Years.
300	Holt Creek (near Duncan)	1	39.18	....	....	....	....	.....	....	.....
120	Hope	10	52.96	59.36	12.1	....	34.16	1914-15	74.98	1878-79
....	Hornby Island	8	44.77	46.62	....	....	30.28	1908-09	58.58	1913-14
70	Ikeda Head	4	116.26	119.65	....	....	88.58	1914-15	159.96	1913-14
....	Invermere	4	12.70	13.57	....	....	9.20	1916-17	14.88	1914-15
2,900	,, (Experimental Farm)	5	12.86	13.83	....	....	8.43	1916-17	15.48	1915-16
3,340	,, (Comfort Ranch)	5	12.39	11.82	....	....	9.31	1916-17	14.96	1914-15
....	Ioco (Deer Lake)	2	81.52	89.89	....	....	73.15	1916-17	89.89	1917-18*
....	James Island	4	25.68	31.58	....	....	18.34	1914-15	32.23	1915-16
2,000	Jones Lake	8	86.29	102.68	....	....	57.73	1914-15	105.67	1915-16
....	Jordan River, V.I.	10	68.35	79.37	16.15	....	49.90	1914-15	79.65	1915-16
1,150	Kamloops	25	10.40	12.08	16.15	....	6.73	1907-08	16.08	1878-79
1,760	Kaslo	6	22.88	....	....	....	18.90	1914-15	27.64	1912-13
1,200	Kelowna (Town)	19	12.45	13.18	5.94	....	7.90	1916-17	16.65	1906-07
....	,, (Bankhead)	2	11.01	13.30	....	....	8.73	1916-17	13.30	1917-18*
1,870	,, (Rutland)	7	10.78	7.75	....	....	4.77	1916-17	13.39	1911-12
4,120	,, (Hydraulic Summit)	5	20.46	13.77	....	....	19.91	1915-16	24.81	1913-14
1,361	Keremeos (Centre)	5	9.80	7.67	....	....	7.46	1916-17	12.51	1913-14
....	,, (Town)	4	8.98	....	....	....	6.24	1891-92	11.42	1913-14
....	Kingcome	1	75.84	....	....	....	....	.....	....	.....
2,600	Kingsgate	4	26.45	25.23	....	....	21.72	1916-17	32.73	1915-16
....	Kitimat	3	82.50	....	....	....	73.16	1906-07	92.11	1905-06
3,000	Klinaklini	2	14.66	....	....	....	12.53	1915-16	16.80	1914-15
3,000	Knouff Lake	3	16.72	16.80	....	....	15.82	1915-16	17.55	1916-17
1,765	Kootenay Lake (Reclamation Farm)	7	23.11	....	....	....	20.74	1896-97	26.34	1902-03
....	Kuper Island	9	42.94	....	....	....	35.85	1894-95	54.44	1899-00
....	Ladner	18	35.10	37.00	5.4	....	21.12	1914-15	44.54	1880-81
80	Ladysmith	5	49.32	41.28	....	....	41.28	1917-18*	64.75	1915-16
....	Langley	13	54.17	....	....	....	43.39	1887-88	80.31	1899-00
....	Lazo (Wireless Station)	4	44.54	47.27	....	....	36.63	1916-17	48.26	1915-16
....	Lazy "L" Ranch	2	17.51	....	....	....	17.48	1913-14	17.54	1914-15
840	Lillooet	7	13.33	10.05	....	....	9.55	1877-78	22.27	1878-79
....	Little Qualicum	8	36.75	32.75	....	....	26.67	1916-17	50.77	1915-16
....	Lumby	2	17.08	....	....	....	14.94	1913-14	19.22	1914-15
1,900	Lynch Creek	5	21.71	23.15	....	....	19.57	1916-17	23.15	1917-18*
637	Lynn Creek	5	94.13	90.38	....	....	53.59	1914-15	122.78	1915-16
....	Lytton Halfway House	1	....	4.43	....	....	....	.....	....	.....
700	Lytton Town	1	....	15.34	....	....	....	.....	....	.....
1,215	Malakwa	4	28.28	26.04	....	....	24.76	1916-17	32.56	1915-16
3,300	Mamete Lake	3	12.85	....	....	....	10.70	1916-17	18.48	1913-14
....	Mary Island	4	48.42	49.85	....	....	43.70	1916-17	53.18	1915-16
....	Masset	18	52.88	68.78	30.00	....	31.89	1906-07	85.52	1897-98
213	Metchosin	2	44.23	44.44	....	....	44.02	1915-16	44.44	1917-18*
....	McCoy Lake	1	86.49	....	....	....	....	.....	....	.....
....	McClure Lake	4	15.70	15.11	....	....	10.16	1916-17	24.51	1914-15
1,915	Midway	7	12.67	....	....	....	8.29	1901-02	16.55	1898-99

30	Mill Bay (Nass)	5	80.78	97.54	....	....	57.20	1914-15	97.54	1917.18*
....	Moha (Bridge River)	5	13.57	13.53	....	....	10.80	1916-17	18.52	1915-16
....	Monte Creek (Ducks)	9	9.82	8.81	....	....	7.41	1916-17	13.25	1914-15
1,420	Nakusp	6	27.54	28.02	....	....	23.21	1916-17	30.44	1915-16
....	Nanaimo (Bray's)	12	44.90	....	....	....	36.44	1898-99	59.04	1899-00
125	"	16	38.80	34.53	....	11.0	29.49	1916-17	52.57	1904-05
....	" (Biological Station)	5	35.82	34.50	....	....	29.49	1916-17	43.68	1915-16
....	Nanoose Bay	6	31.29	29.18	....	....	25.34	1916-17	38.62	1913-14
1,150	Naramata	4	11.19	11.61	....	....	10.24	1915-16	11.99	1914-15
....	Nass Harbour	18	81.94	79.63	....	2.82	56.63	1914-15	94.95	1905-06
1,780	Nelson	15	26.77	29.09	8.65	....	21.67	1910-11	35.76	1906-07
1,800	New Denver	4	32.32	36.62	....	....	28.99	1914-15	36.62	1917-18*
2,400	Newgate (Yakite Ranch)	3	17.50	....	....	....	15.42	1913-14	20.11	1914-15
330	New Westminster	27	57.65	63.13	9.5	....	43.99	1914-15	75.32	1899-00
3,100	Nicola (Clapperton Creek)	5	15.54	15.61	....	....	12.87	1913-14	18.50	1914-15
2,120	Nicola Lake	37	11.07	....	....	....	6.92	1916-17	16.83	1902-03
....	Ninth Cabin (Telegraph Trail)	1	25.46	....	....	....	....	.....	....	.....
....	Nitinat Lake	4	117.16	121.00	....	....	95.96	1916-17	160.10	1915-16
500	North Bend	3	35.97	38.46	....	....	23.73	1916-17	45.72	1915-16
59	North Nicomen	24	74.56	80.87	8.5	....	52.46	1914-15	106.14	1893.94
....	Observation Bay	3	74.16	72.51	....	....	71.79	1916-17	78.07	1915-16
....	Ocean Falls	4	156.07	152.11	....	....	141.01	1914-15	185.22	1909-10
2,850	105-Mile House	5	12.89	16.10	....	....	9.21	1915-16	16.10	1917-18*
....	Parksville	3	31.88	32.69	....	....	25.74	1916-17	40.20	1915-16
2,600	Pavilion	1	10.77	....	....	....	....	.....	....	.....
1,500	Peachland (Trepanier Creek)	4	15.17	13.49	....	....	11.04	1916-17	18.48	1914-15
700	Pemberton Meadows	6	32.27	41.45	....	....	20.72	1916-17	41.45	1917-18*
....	Pemberton Hatchery	9	37.25	34.45	....	....	22.14	1916-17	38.16	1908-09
1,150	Penticton	11	11.36	9.81	....	13.4	8.56	1916-17	14.48	1914-15
1,730	Perry Siding	5	25.71	26.95	....	....	21.35	1916-17	30.66	1915-16
4,603	Phoenix	5	27.63	24.07	....	....	24.01	1917-18*	31.70	1913-14
1,760	Pilot Bay (Kootenay Lake)	2	39.73	....	....	....	....	.....	....	.....
....	Point Grey	1	44.85	....	....	....	....	.....	....	.....
....	Porcher Island	1	81.06	....	....	....	....	.....	....	.....
....	Port Essington	4	122.86	....	....	....	112.56	1904-05	138.21	1901-02
20	Port Moody	6	66.83	....	....	....	52.03	1914-15	77.75	1890-91
....	Port Simpson	19	89.30	....	....	....	59.48	1902-03	113.43	1894-95
300	Powell Lake (upper end)	4	91.91	88.47	....	....	75.15	1916-17	114.18*	1915-16
....	Powell River	4	38.62	38.07	....	....	33.38	1916-17	49.19	1915-16
1,870	Prince George	4	18.53	18.68	....	....	13.04	1916-17	28.32	1912-13
....	Prince Rupert	9	106.35	100.90	....	....	76.96	1911-12	124.13	1913-14
....	Princeton	20	13.18	13.74	4.25	....	7.61	1894-95	20.40	1902-03
3,515	Princeton Crossing	2	24.58	....	....	....	22.46	1914-15	26.69	1915-16
173	Qualicum Beach	2	31.23	35.24	....	....	27.23	1916-17	35.24	1917-18*
....	Quatsino	15	107.44	104.70	....	2.55	74.86	1916-17	135.29	1905-06
....	Queen Charlotte City (Graham Island)	4	61.25	73.98	....	....	45.25	1914-15	73.98	1917-18*
1,600	Quesnel	18	15.57	21.04	3.32	....	11.16	1915-16	21.40	1906-07
2,900	Quilchena (Dry Farm), Nicola P.O.	5	13.47	14.52	....	....	8.49	1916-17	16.30	1915-16
1,500	Revelstoke	17	41.52	45.59	9.8	....	34.34	1904-05	51.92	1906-07
....	Richlands (near Lumby)	2	21.30	....	....	....	....	.....	....	.....
....	Rivers Inlet	12	112.81	....	....	....	88.32	1897-98	130.15	1899-00
....	Rock Creek	6	15.03	13.43	....	....	11.11	1913-14	19.04	1906-07
3,400	Rossland	12	29.36	25.67	....	12.5	24.60	1905-06	38.04	1906-07
1,170	Salmon Arm (Hobson)	11	18.96	....	....	....	12.84	1895-96	26.34	1906-07
1,170	" (Sharp)	7	19.15	21.15	....	....	16.05	1913-14	22.55	1914-15
....	Saltspring Island	8	39.34	39.96	....	....	31.35	1914-15	50.39	1915-16
....	Sandwick	4	51.59	51.59	....	....	39.93	1916-17	66.37	1915-16
465	Seymour Intake	5	107.84	117.91	....	....	88.80	1916-17	120.17	1915-16

* Records established during the year.

PRECIPITATION, 1917-18—*Concluded.*

Approx. Elevation above Mean Sea-level.	Station.	No. of Years of Complete Observation.	Average Precipitation.	Precipitation of Year.	Percentage above Average.	Percentage below Average.	Records Established. Minimum.		Records Established. Maximum.	
Feet.			Inches.	Inches.	Per Cent.	Per Cent.	Inches.	Years.	Inches.	Years.
400	Shawnigan Lake	6	40.48	....	....	....	27.15	1914-15	57.02	1915-16
1,690	Soda Creek	4	12.04	13.97	....	....	4.48	1884-85	13.97	1917-18*
25	Sooke Harbour	6	41.86	37.82	....	....	30.44	1914-15	52.98	1915-16
....	Sooke Lake	7	66.87	73.68	....	....	42.46	1914-15	79.49	1915-16
1,180	Sorrento	5	17.99	20.05	....	....	14.01	1913-14	20.60	1914-15
790	Spences Bridge	11	9.44	....	....	....	5.67	1895-96	13.49	1893-94
80	Sproat Lake	1	47.32	....	....	....	....	.....	....	.....
....	Stave River Falls (Ruskin)	9	79.17	91.79	....	....	61.88	1914-15	92.59	1915-16
6	Steveston	22	36.01	32.21	....	10.7	28.95	1914-15	45.99	1904-05
....	Stewart	5	74.26	83.91	....	....	53.44	1914-15	93.72	1916-17
2,200	Stuart Lake	24	16.08	16.14	0.37	....	9.79	1898-99	24.88	1908-09
1,100	Summerland	11	11.02	8.82	....	2.00	8.54	1909-10	14.30	1911-12
....	Surf Inlet	2	185.01	216.89	....	....	153.14	1916-17	216.89	1917-18*
....	Swanson Bay	6	203.28	301.16	....	....	163.38	1911-12	301.16	1917-18
....	Swift River (Cariboo)	1	22.93	....	....	....	....	.....	....	.....
200	Sidney (Experimental Farm)	4	30.22	29.16	....	....	25.21	1914-15	37.12	1915-16
1,158	Tappen	5	21.54	21.31	....	....	18.09	1913-14	25.01	1914-15
220	Terrace	4	41.52	53.34	....	....	35.64	1916-17	53.34	1917-18*
2,400	Tete Jaune Cache	2	14.42	....	....	....	12.93	1915-16	15.90	1914-15
....	Thetis Island	2	36.57	....	....	....	....	.....	....	.....
1,500	Thrums	5	27.52	26.98	....	....	24.57	1916-17	30.23	1913-14
....	Tobacco Plains	6	17.21	....	....	....	13.15	1903-04	19.54	1898.99
....	Tranquille	5	9.32	....	....	....	6.59	1916-17	11.64	1911-12
....	Triangle Island	7	64.19	60.31	....	....	44.59	1914-15	84.44	1910-11
....	Ucluelet	4	103.91	85.79	....	....	85.79	1917-18*	128.48	1915-16
....	Valdes Island	2	58.83	....	....	....	....	.....	....	.....
....	Vancouver	16	58.64	60.48	3.77	....	44.72	1914-15	67.14	1901-02
100	Vancouver (City Hall)	5	58.38	65.28	....	....	45.34	1914-15	65.28	1917-18*
....	,, (Court-house)	1	56.62	....	....	....	....	.....	....	.....
2,093	Vanderhoof	2	17.07	17.57	....	....	16.58	1916-17	17.57	1917-18*
....	Vavenby	5	14.19	14.11	....	....	12.98	1915-16	16.11	1914-15
1,580	Vernon (Coldstream Ranch)	18	14.21	14.41	1.48	....	9.86	1895-96	17.67	1911-12
....	Victoria	44	29.30	30.77	5.0	....	17.18	1914-15	54.42	1893-94
1,358	Waneta	5	28.59	26.11	....	....	26.05	1914-15	33.75	1915-16
....	Westley	3	25.46	25.51	....	....	23.24	1914-15	27.64	1916-17
3,300	Wilmer	8	13.77	15.10	....	....	11.57	1916-17	15.69	1914-15
....	Wycliffe	1	8.96	....	....	....	....	.....	....	.....

* Records estblished during the year.

Selected Lowest Precipitation Records.

(Columns 6 to 12 give the total depths in inches for the number of months duration of each station record.)

West of Coast Range.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Station.	No. of Years of Complete Observation.	Average Precipitation up to & including 1917-18.	Year.	Precipitation of Year.	Length of Record in Months.						
					2.	3.	4.	5.	6.	7.	8.
		Inches.		Inches.			Total	Depth in	Inches.		
Alberni (Beaver Creek)	22	68.03	1895-6	53.71	0.24	0.38	1.41	3.00	...	...	...
Beaver Lake, V.I.	23	35.09	1907-8	35.07	0.46	1.29	1.93	2.54	...	...	...
Coquitlam	17	71.57	1914-15	53.47	1.65	3.12	4.27	...	...	...	...
Coquitlam Lake	15	147.33	1913-14	130.82	1.87	7.13	11.84	...	...	...	...
Duncan	23	39.45	1886-7	44.00	0.03	1.22	...	...	...	...	...
"	23	39.45	1890-1	39.81	0.26	0.86	3.39	...	...	...	...
Denman Island	10	49.81	1914-15	50.09	0.21	0.82	2.27	...	...	...	...
Goldstream	22	68.60	1900-1	73.02	0.33	2.15	...	...	...	...	...
"	22	68.60	1907-8	60.22	0.44	1.62	2.59	...	...	...	...
Langley	13	54.17	1884-5	46.89	0.35	1.42	...	...	...	...	...
Shawnigan	6	40.48	1913-14	43.34	0.21	2.81	...	...	...	...	...
Sooke Lake	6	66.87	1914-15	42.46	0.43	1.82	2.32	...	...	...	...
Victoria	44	29.30	1873-4	15.93	0.30	0.59	1.11	1.84	2.62	...	...
"	44	29.30	1884-5	28.70	0.08	0.33	1.63	2.16	2.48	...	...

Dry Belt.

Aspen Grove	4	11.50	1913-14	14.06	0.00	0.00	1.25	3.25	3.90	...	...
Atlin	13	10.73	1916-17	7.52	0.21	0.34	0.63	1.82	3.10	...	...
Cache Creek	2	7.91	1917-18	...	0.00	0.00	0.00	0.67	2.26	2.26	2.26
Carcross	9	8.76	1914-15	3.93	0.05	0.20	0.52	0.82	0.97	1.52	...
Clinton	5	4.36	1884-5	3.43	0.00	0.07	0.15	1.35	1.55	1.85	...
"	5	4.36	1885-6	2.54	0.00	0.18	0.27	0.73	1.33	1.53	1.73
Fairview	2	5.40	1905-6	...	0.05	0.07	1.19	...	...	...	...
"	2	5.40	1909-10	4.30	0.23	0.42	0.77	1.13	1.36	1.49	...
Kelowna (Rutland)	7	10.78	1917-18	7.75	0.11	0.19	0.38	0.66	0.67	1.09	1.65
Kelowna (Hydraulic Summit)	6	20.46	1917-18	13.77	0.00	0.05	0.20	0.40	1.50	2.55	...
Keremeos	5	9.80	1917-18	7.67	0.00	0.00	0.23	1.03	2.32	...	...
Princeton	20	13.18	1896-7	11.73	0.00	0.00	0.20	1.20	3.09	...	...
Soda Creek	4	12.08	1883-4	4.77	0.00	0.00	0.17	0.65	1.20	1.40	1.90
Spences Bridge	11	9.44	1895-6	5.67	0.01	0.04	0.08	0.34	1.00	1.27	2.22
Stuart Lake	24	16.08	1897-8	9.97	0.00	0.45	0.52	0.82	1.54	2.48	...

SELECTED LOWEST PRECIPITATION RECORDS—*Concluded.*

East of Dry Belt.

Cranbrook	10	16.18	1911-12	12.41	0.38	0.58	1.66	2.70	3.80	...	...
Fort Steele	3	17.74	1914-15	17.04	0.51	1.26	2.21	2.96	...	...	...
Invermere	4	12.70	1916-17	9.20	0.35	0.63	0.78	1.23	1.75	2.36	...
Nelson	15	26.72	1909-10	22.35	0.36	1.91	...	...	...	...	...
Revelstoke	17	41.52	1905-6	37.35	1.91	3.99	...	...	...	...	...
Rossland	12	29.36	1916-17	...	0.34	1.43	...	...	...	...	...
Salmon Arm	7	19.15	1896-7	...	0.00	0.25	0.75	3.40	...	...	...

APPENDICES TO WATER REPORT.

APPENDIX No. 1.

WATER POWERS OF BRITISH COLUMBIA.

In preparing the list a careful analysis was made of all water records, licences, engineers' and surveyors' reports, and 457 sites were indexed. In many instances, however, the information available was scanty and insufficient to check the amount of power given. In the list, wherever the figures are uncertain, note is made under the "Remarks" column.

The 270 power-sites given are divided under the following heads:—

Wholly or partially developed	30
Sites applied for	93
Sites known and unstaked	147

With regard to those power-sites located by the Commission of Conservation, the figures must for the present be taken with reserve. A. V. White, of the Commission, intimates that it is unnecessary to emphasize the paucity of the hydrographic information existent for the northerly part of the Province. With respect to the estimates given, while these were based on such data as were available, it is clear that without explanation the quantities mentioned might be misleading. When the report on the "Water-powers of British Columbia" is published, in connection with the tabular material relating to horse-power, there will be explanatory notes and comments, also description governing the use of the tables.

WATER-POWERS OF 500 HORSE-POWER AND OVER.

No.	Creek.	Tributary of.	H.P.	Applicant or Licensee.	Remarks.	Source of Information.
	ALBERNI WATER DISTRICT—					
1*	Ash River	Stamp and Somas Rivers	11,500			Water Rights Branch, 1913 Report, p. 40.
2†	Beaver Creek	" "	3,000	Alberni Hydro-Elec. Power Co.		Application.
	Drinkwater River—	Great Central Lake.				
3†	Della Falls	875		Big Interior Gold Mines, Ltd.		
4*	Rapids below Lower Canyon	4,300				
5*	Lower Canyon	3,325				
6*	Between Lower and Upper Canyon	1,880				
7*	Between Upper Canyon and Bridge	2,400				
8*	Drinkwater Falls	1,050				
			13,830			1913 Report, p. 40.
10*	Great Central Lake	Stamp and Somas Rivers	21,900		Alternative to development on Upper Stamp River	" p. 40.
11*	McBride Creek	Great Central Lake	800			" p. 40.
12†	Nahmint River	Alberni Canal	2,400	Central Island Power Co., Ltd.		" p. 41.
14†	Sarita River	Barkley Sound	3,350	British Pacific Hydro-Elec. & Tramways, Ltd.		Application.
15†	Sproat River	Somas River	6,400	Vancouver Island Elec. Railways Co., Ltd.		1913 Report, p. 40.
16*	"	"	7,600		Additional to normal power and dependent on Great Central Lake Development (*see* No. 10)	" p. 41.
17†	Stamp River	"	19,000	Ritchie-Agnew Power Co., Ltd.		1913 Report, p. 40, and company's data.
18*	Upper Stamp River	"	3,800			1913 Report, p. 40.
19*	View Lakes	Great Central Lake	1,200			" p. 40.
20†	Gold River	Muchalat Arm	4,000	G. J. Cox		Application.
	ASHCROFT WATER DISTRICT—					
1†	Anderson River	Fraser River	8,500	Imperial Power Co.		Application.
3*	Coquihalla River	"	8,400			1913 Report, p. 44.
4†	Emory Creek	"	3,000	Imperial Power Co.		Application.
7†	Nahatlatch River	"	30,000	"		B.C. Hydrographic Survey Report, 1913, p. 239.
8†	Nicolum River	Coquihalla River	10,000	McKenzie & Mann	Included in figures given for joint scheme (*see* No. 14).	
10†	Silver River	Fraser River	11,500	Silver River Power Co.		Application and B.C. Hydrographic Survey Report, 1913, p. 127.
11†	Siwash Creek	"	4,000	Imperial Power Co.		Application.
12†	Skuzzy Creek	"	5,600	"		"
13†	Spuzzum Creek	"	10,000	"		"
14†	Sumallow River	Skagit River	35,000	McKenzie & Mann	Joint scheme with Nicolum River (*see* No. 8)	Data submitted by company.
15†	Texas Creek	Fraser River	3,000	Imperial Power Co.		Application.
16†	Yale Creek	"	3,600	"		"
	BARKERVILLE DISTRICT—					
18†	Swift River	Cottonwood River	10,000	Quesnel Hydr. Gold Mining Co.	Plant installed, not now in operation.	

	Fernie Water District—					
2†	Bull River	Kootenay River	6,500	Bull River Elec. Power Co.		Water Rights Branch, 1912 Report, p. 95.
3†	Elk River	"	11,600	Crow's Nest Pass Electric Light & Power Co.		Ditto, p. 99.
5*	Phillips Creek	"	750			1913 Report, p. 74.
6†	Wild Horse Creek	"	850	D. F. Basden		Engineer's report.
	Fort Fraser Water District—					
1†	Stellaquo River	Fraser Lake	6,000	Fraser Lake Water & Power Co.		Application.
2*	Stony Creek	Nechako River	1,600			"
	Fort George Water District—					
1*	Beaver River	South Fork, Fraser River	900			Surveyor's estimate.
2*	Boulder Creek	Canoe River			Over 1,000 horse-power per mile	1912 Report, p. 32.
3*	Cottonwood River	South Fork, Fraser River	700			Surveyor's estimate.
4*	Fraser River		5,600		At Lower Falls	*See* No. 8.
5*	"		5,600		At Upper Falls	"
6*	Harvey Creek	Canoe River			Over 2,000 horse-power per mile	1912 Report, p. 32.
7†	Hixon Creek	Government Creek	850	E. Bloomfield		Application.
8†	Moose River	Fraser River	24,000	Yellowhead Pass Light & Power Co.		Data submitted by company.
9*	Raushuswap River	South Fork, Fraser River	2,000			Surveyor's estimate.
11†	Willow River	Fraser River	3,500	Fort George Power Co.		From low-water flow.
	Golden Water District—					
1*	Blaeberry River	Columbia River	2,000			Data uncertain.
2*	Columbia River				Power-site at Surprise Rapids, horse-power unknown.	
3†	"		5,700	Canadian Pacific Rly.		Data submitted by company.
4*	Cummins Creek	Columbia River	3,800			1912 Report, p. 31.
5*	Spillimacheen River	"	3,850			1913 " p. 77.
6*	Wood River	"	5,000			1912 " p. 32.
	Grand Forks Water Dist.—					
3‡	Kettle River	Columbia River	5,000	West Kootenay Light & Power Co.	Site at Cascade; developed.	
4‡	North Fork, Kettle River	"	700	Granby Mining, Smelting & Power Co.	Developed.	
	Hazelton Water District—					
2§	Boulder Creek	Bulkley River	1,000	Grand Trunk B.C. Coal Co., Ltd.		
3§	Bulkley River	Skeena River	40,000		At Hagwilget Canyon.	
3A§	"	"	27,000		At Moricetown Falls.	
4§	Copper River	"	7,500			
6§	Mud Creek	Bulkley River	500			
7§	Skeena River		30,000		Kitsalas Canyon; proximity of railroad may interfere with development.	
8§	Bulkley River	Skeena River	20,000		At Beaumont Canyon.	
9§	"	"	25,000		Canyon 37 miles above Hazelton.	
10§	"	"	6,300		At Telkwa; proximity of railroad may interfere with development.	
12§	Canyon Creek	"	1,500			
14§	Driftwood Creek	"	750			
15§	"	Bulkley River	500			
18§	Gold River	Skeena River	600			
24§	Morice River	Bulkley River	8,000			
27§	Porphory Creek	"	500			
28§	Skeena River		20,000		Canyon just north of Hazelton.	

* Powers available. † Powers staked. ‡ Powers developed and under development. § Powers available, investigated by Conservation Commission of Canada.

WATER-POWERS OF 500 HORSE-POWER AND OVER—*Continued.*

No.	Creek.	Tributary of.	H.P.	Applicant or Licensee.	Remarks.	Source of Information.
	HAZELTON WATER DISTRICT—*Concluded.*					
29§	Skeena River		15,000		20 miles above Babine River.	
30§	,,		10,000		Canyon near 3rd Telegraph Cabin.	
31§	,,		14,000		Canyon 9 miles above 4th Telegraph Cabin.	
32§	Telkwa River	Bulkley River	700			
33§	,,	,,	1,000		Canyon near Pine Creek.	
36§	Big Slide Creek	Skeena River	1,300		Near 3rd Telegraph Cabin.	
	KAMLOOPS WATER DISTRICT—					
1†	Adams River	Shuswap Lake	6,500	B.C. Hydraulic Power Co.		Application.
2‡	Barriere River	North Thompson River	20,000	Kamloops Hydro-Elec. Co.	2,200 horse-power developed.	
6*	Canim Lake	Clearwater River			Horse-power unknown, but must be considerable.	
7†	Clearwater River	North Thompson River	2,000	Imperial Power Co.		Application.
14*	Myrtle River	Clearwater River			Helmcken and Dawson Falls.	
16*	Seymour River	Shuswap Lake	600			Data uncertain.
	KASLO WATER DISTRICT—					
2†	Cedar Creek	Kootenay Lake	1,700	Consolidated Mining & Smelting Co.		Application.
3‡	Coffee Creek	,,	590	Kootenay Air Supply Co.	Developed.	
5†	Kaslo Creek (South Fork)	,,	520	O. T. Stone		Application.
8‡	Tam O'Shanter Creek	,,	520	New Canadian Metal Co.	Developed.	
	LILLOOET WATER DISTRICT—					
1†	Bridge River	Fraser River	147,000	Bridge River Power Co.		Data submitted by company.
2*	Cayoosh Creek	,,	2,000-5,000			1913 Report, p. 51.
4†	Portage Creek	Seton Lake	900	Portage Creek Power & Light Co.		Application.
	NANAIMO WATER DISTRICT—					
2†	Campbell River	Seymour Narrows	85,000	Campbell River Power Co.		Data submitted by company.
4†	Englishman's River	Strait of Georgia	840	British Pacific Hydro-Elec. & Tramways, Ltd.		,, ,,
5*	Little Qualicum River	,,				1913 Report, p. 40.
6‡	Millstone River	,,	1,300	Nanaimo Elec. Light, Power & Heating Co.	Partial development.	
7*	Nanaimo River	,,				
	Site No. 1	,, 5,000				
	Site No. 2	,, 11,200				
	Site No. 3	,, 6,800				
	Site No. 4	,, 3,000				
			26,000			Engineer's report.
9‡	Puntledge River	Comox Harbour	22,500	Canadian Collieries, Ltd.	12,000-horse-power plant in operation.	
10*	,,	,,	4,600		Site below Canadian Collieries development.	1913 Report, p. 40.
	NELSON WATER DISTRICT—					
5‡	Kootenay River	Columbia River	16,300	West Kootenay Light & Power Co.	Lower Bonnington Falls; 4,000 horse-power developed.	
6*	,,	,,	36,000		Bonnington Pool Falls.	1912 Report, p. 34.

7‡	Kootenay River	Columbia River	6,850	City of Nelson	Upper Bonnington Falls; 4,000 horse-power developed.	
8‡	"	"	23,000	West Kootenay Light & Power Co.	Up. Bonnington Falls; 16,000 horse-power developed.	
9*	"	"			Site at Granite Bridge	1912 Report, p. 34.
10*	"	"	20,000		Canyon near Thrums	" p. 34.
12†	Pend d'Oreille River	"	84,000	Pacific Exploration Co.	Near junction with Columbia	1912 Report, p. 36, and application.
13*	"	"	24,500		9 miles from mouth	1912 Report, p. 36.
14*	"	"	26,000		15 miles from mouth	" p. 36.
15*	"	"	38,000		At junction with Salmon River	" p. 36.
20*	Salmon River	Pend d'Oreille	4,000			" p. 38.
22†	Sheep Creek	Salmon River	800	Motherlode Sheep Crk. Min. Co.		Data submitted by company.
23A†	"	"	640	Amalgamated Gold Mines of Sheep Creek, Ltd.		Application.
23B†	"	"	800	R. H. Leach		"
	New Denver Water Dist.—					
5†	Four-mile Creek	Slocan Lake	1,000	G. H. Aylard		"
	New Westminster District—					
1†	Chehalis River	Harrison River	22,000	Canadian Pacific Rly.	Joint scheme with Statloo River gives 37,000 horse-power	Data submitted by company.
2†	Chilliwack River	Fraser River	70,000-100,000	Vancouver Power Co., Ltd.		" "
3‡	Coquitlam and Buntzen Lakes	Fraser River and North Arm, Burrard Inlet	84,000	" "	Developed.	
4†	Green River	Lillooet Lake and River	16,000	Nairn Falls Power Co.		" "
6†	Jones Lake	Jones Creek	29,000	Vancouver Power Co., Ltd.		" "
7†	Lillooet River	Pitt River	25,000	Burrard Power Company		" "
10†	Pemberton Creek	Lillooet River and Harrison Lake	950	Pacific Great Eastern Development Company	Only small portion of power staked	Application.
11†	Rushton Creek	Pitt Lake	1,000	E. J. Fader		Application and B.C. Hydrographic Survey Report, 1913, p. 123.
13†	Statloo River	Harrison River	15,000	Canadian Pacific Rly.	*See* Chehalis River, No. 1.	
14‡	Stave River	Fraser River	75,000	Western Can. Power Co., Ltd.	50,000 horse-power developed.	
15†	Tamihy Creek	Chilliwack River	8,000	S. Fader		Application.
16‡	Munro Creek	Pitt River	1,200	Gilley Bros., Ltd.	550 horse-power developed.	
	Prince Rupert District—					
1†	Ain River	Masset Inlet	7,800	British Canadian Lumber Corporation		Data submitted by company.
2†	American Creek	Bear River	7,200	R. M. Stewart		Application.
4†	Browns Creek	Ecstall River	8,000	Browns Sawmill Development		"
5†	Cascade Creek	Salmon and Bear Rivers	1,200	Salmon Bear River Mining Co., Ltd.		"
7‡	Falls River	Ecstall River	15,000	Prince Rupert Hydro-Elec. Co., Ltd.		
8†	Glacier Creek	Goose Bay	720	J. L. Parker		"
13†	Khtada River	Skeena River	10,000	Prince Rupert Hydro-Elec. Co., Ltd.		Data submitted by company.
15§	Kitsumgallum River	"	6,000			
16†	Kumeolon Creek	Grenville Channel	2,500	Grenville Development Co., Ltd.		Application.
19†	Madeleine Creek	Ecstall River	3,200	Prince Rupert Hydro-Elec. Co., Ltd.		"
22*	McKnight Creek	"	3,200			"
23†	Meziadin River	Nass River		Canadian North Eastern Power Co., Ltd.		
24*	Mountain River	Rennell Sound	4,800			"
27*	Nass River	Portland Inlet	150,000			Surveyor's estimate.

* Powers available. † Powers staked. ‡ Powers developed and under development. § Powers available, investigated by Conservation Commission of Canada.

WATER-POWERS OF 500 HORSE-POWER AND OVER—*Continued.*

No.	Creek.	Tributary of.	H.P.	Applicant or Licensee.	Remarks.	Source of Information.
	PRINCE RUPERT DISTRICT—*Concluded.*					
28†	Kawon River (Quan)	Masset Harbour	650	British Canadian Lumber Cor., Ltd.		Application.
29*	Raney River	Rennell Sound	2,150			,,
32†	Thulme River	Wark Channel	8,000	Corporation of Prince Rupert		,,
33*	Twin River	Rennell Sound	1,200			,,
36‡	Woodworth Lake	Fern Passage	1,650	City of Prince Rupert	1,650 horse-power developed at present.	
37§	Aaltanhash River	Graham Reach	5,800			
39§	"A" Tributary	Brim River	1,000			
40§	Dome River	Aaltanhash Inlet	2,000			
41§	Inlet Creek	Gardner Canal	800			
42§	Kiltuish River	,,	2,500			
43§	Lizette Creek	Mussel Inlet	4,500			
44§	McAlpine Creek	,,	1,500			
45§	Mussel Creek	,,	3,500			
46§	Poison Cove River	,,	2,000			
47§	Price River	Gardner Canal	500			
48§	See-kwya-kin River	Kemano River	600			
49‡	Swanson Bay River	Graham Reach	1,250	Swanson Bay Forests, Wood, Pulp & Lumber Mills, Ltd.	Developed.	
50§	To-cha-stes Creek	Kemano River	1,600			
51§	Triumph River	Gardner Canal	4,500			
52§	Wachwas Creek	,,	900			
53†	Carter River	Finlayson Channel	5,000	Carter River Power Co.		Application.
54†	Cougar Lake, etc.	Surf Inlet	900	Surf Inlet Power Co., Ltd.		,,
55‡	Falls Creek	Observatory Inlet	7,325	Granby Consolidated Mining & Smelting Co.	7,325-horse-power plant installed.	
	PRINCETON WATER DISTRICT—					
1*	Ashnola River	Similkameen River	2,000			Data uncertain.
2†	Nehumpshan Creek	,,	1,600	South Okanagan Power Co.		Application.
5*	Similkameen River	Okanagan River			Near Junction of Roche and Passayton Rivers.	
6‡	,,	,,	1,600	Daly Reduction Co., Ltd.	Developed.	
7†	,,	,,	2,200	Ashawota Power Co.		Application.
8*	Susap Creek	Similkameen River	650			Data uncertain.
11‡	Twenty-mile Creek	,,	525	Daly Reduction Co.		
	QUESNEL WATER DISTRICT—					
3†	Niagara River	Quesnel Lake	800	Jovian Power Co.		Application.
6†	Spanish Lake, etc.	Quesnel River		L. Muller		,,
7†	Swamp River	,,		Atlas Power Co., Ltd., and Cariboo Power Co., Ltd.		,,
	REVELSTOKE WATER DISTRICT—					
1*	Akolkolex Creek	Columbia River	4,000			B.C. Hydrographic Survey Report, 1913, p. 295; 1914, p. 431.
2*	Gold Creek West	,,			Averages 5,000 horse-power per mile	Water Rights Branch, 1912 Report, p. 32.
3‡	Illecillewaet River	,,	2,300	Revelstoke Power & Light Co.	Developed.	
6*	Smith Creek	,,			Averages 1,400 horse-power per mile	1912 Report, p. 34.
7*	Soard Creek	,,			Averages 2,800 horse-power per mile	,, p. 32.

	Vancouver Water District—					
1*	Ashloo Creek	Squamish River	2,000			Data uncertain.
3†	Brandt Creek	Indian River	1,500	Westminster Power Co.	*See* No. 17.	
5‡	Britannia Creek	Howe Sound	2,275	Britannia Mining & Smelting Co.	Developed (total power on creek).	
6‡	Buntzen Lake	Burrard Inlet	84,000	Vancouver Power Co., Ltd.	Developed (*see* No. 3, New Westminster District joint scheme).	
8†	Cedar Creek	Howe Sound	2,000	G. F. Whalen		Application.
9*	Chapman Creek (Mission Creek)	Gulf of Georgia	800			Engineer's report.
10†	Cheakamus River	Squamish River	34,000	British Columbia Power & Electric Co., Ltd.	There are other power-sites on this river which have not yet been investigated	Data submitted by company.
14†	Furry Creek	Howe Sound	3,000	Howe Sound Power Co.		
15†	Hixon Creek	Indian River	11,000	Westminster Power Co.	*See* No. 17.	" "
16§	Huaskin Lake	Drury Inlet	1,800			
17†	Indian River	Burrard Inlet 9,600		Westminster Power Co. ...	All included in one scheme of development.	
	Brandt Creek	Indian River 1,500		" " ...		
	Hixon Creek	" 11,000		" " ...		
	Norton Creek	" 4,700		" " ...		
	Young Creek	" 4,700		" " ...		
			31,500			
18‡	Jane Creek	Britannia Creek	900	Britannia Creek Mining & Smelting Co., Ltd.	Joint scheme with Marmot Creek (*see* Nos. 5 and 22).	" "
19†	Lloyd Creek	Homfray Channel	2,000	Crescent Sand & Gravel Co.		Application.
20†	Mamquam River	Howe Sound	7,200	Newport Water Co., Ltd.		
21*	"	"	4,500			"
22‡	Marmot Creek	Britannia Creek	900	Britannia Mining & Smg. Co., Ltd.	Joint schemes with Jane Creek (*see* Nos. 18 and 5).	"
23‡	Mill Creek	Howe Sound	2,000	B.C. Sulphite Fibre Co.	Partly developed.	
25†	Monmouth Creek	Squamish River	900	Pacific Great Eastern Development Co.		Data submitted by company.
26§	Necleetsconnay River	North Bentinck Arm	2,500			
27†	Norton Creek	Indian River	4,700	Westminster Power Co.	*See* No. 17.	
28‡	Powell River	Malaspina Strait	32,000	Powell River Pulp Co., Ltd.	24,000 horse-power already developed.	
30†	Sallust Creek	Burrard Inlet	1,170	Consolidated Contractors, Ltd.		Application.
31†	Shannon Creek	Howe Sound	1,700	Newport Brick & Tile Co.		Data submitted by company.
34†	Stafford River	Loughborough Inlet	4,000	Davidson Ward Co.		Application.
35*	Stony Creek	Cheakamus River	5,000			Surveyor's estimate.
36*	Tastsquam River	Bella Coola River	3,000			
39†	Young Creek	Indian River	4,700	Westminster Power Co.	*See* No. 17.	"
40§	Brem River	Toba Inlet	4,000			
41§	Canyon Creek	South Fork, Toba River	17,000			
42§	Chewson Creek	Toba Inlet	5,000			
43§	Dalley River	Rivers Inlet	700		2 sites.	
44§	Dean River	Dean Channel	1,200			
45§	Doos River	Rivers Inlet	6,000			
46§	Eckheimick River	Bute Inlet	4,000			
47§	Falls Creek	North Fork, Toba River	5,000			
48§	Forbes River	Homfray Channel	1,000			
49§	Genesse Creek	Rivers Inlet	2,000			
51§	Hatchery Creek	"	1,000			
52§	Hazel Creek	Toba River	3,500		At Mackenzie Falls.	
53§	Ice River	Bute Inlet	2,500			
54§	Ickna Creek	South Bentinck Arm	4,000			
55§	Indian River	Rivers Inlet	1,400			
56§	Klinaklini River	Knight Inlet	15,000			
58§	Memeky River	Salmon River (Johnstone Strait)	1,550		2 sites.	

* Powers available. † Powers staked. ‡ Powers developed and under development. § Powers available, investigated by Conservation Commission of Canada.

WATER-POWERS OF 500 HORSE-POWER AND OVER—*Concluded.*

No.	Creek.	Tributary of.	H.P.	Applicant or Licensee.	Remarks.	Source of Information.
	VANCOUVER WATER DISTRICT—*Concluded.*					
60§	Moses Creek	Rivers Inlet	600			
62§	Neechantz River	"	1,000			
63§	Noscall River	Dean Channel	7,000			
64§	Nusash River	"	600			
65§	Owens Creek	North Fork, Toba River	2,000			
66§	Rodell Creek	Bute Inlet	3,000			
67§	Salmon River	"	4,500			
68§	"	Johnstone Strait	1,200			
69§	Sandle Lake	Rivers Inlet	3,000	Good Hope Cannery Co.	Partly developed.	
70§	Scow Quiltz River	Dean Channel	4,000			
71§	Seymour River	Seymour Inlet	4,000			
72§	Sheemahantz River	Rivers Inlet	4,500			
73§	Sim Creek	Knight Inlet	6,500			
74§	Slide Creek	"	3,000			
75§	Summit Creek	South Fork, Toba River	1,500			
76§	Tahumming Creek	Toba Inlet	1,000			
77§	Talcomy River	South Bentinck Arm	1,400			
79§	Thomlinson Creek	South Fork, Toba River	5,500			
80§	Toba River (South Fork)	Toba Inlet	4,700			
81§	Little Toba River	"	1,600			
82§	Twenty-two-mile Creek	Bute Inlet	3,000			
84§	Unnamed river	Ellerslie Channel	1,800			
85§	"	"	2,000			
86§	Wah-kash Creek	Knight Inlet	6,000			
88§	White River	Johnstone Strait	5,000			
89‡	Scott-Goldie Creek (Crocker Creek)	North Arm, Burrard Inlet	1,500	Scott-Goldie Quarry Co., Ltd.	Partly developed.	
90‡	Link River	Dean Channel	12,500	Ocean Falls Co., Ltd.	Developed.	
91‡	Granite Falls Creek	Vancouver	.....	Coast Quarries, Ltd.	Partly developed; information incomplete.	
	VERNON WATER DISTRICT—					
2†	Mission Creek	Okanagan Lake	1,000	Belgo-Canadian Fruitlands Co.		Application.
3†	Shuswap River	Mabel Lake	1,200	Couteau Power Co.		Data submitted by company.
4†	"	"	4,150	"		" "
	VICTORIA WATER DISTRICT—					
5‡	Goldstream	Saanich Arm	2,500	B.C. Electric Rly.	Developed.	
6†	Gordon River		.....	British Pacific Hydro-Elec. & Tramways, Ltd.		Application.
8‡	Jordan River		25,000	Vancouver Island Power Co.	Developed.	
10†	Nitinat River	Nitinat Lake	720	Central Island Power Co.		"
11†	Nimpkish River	Broughton Strait	67,000	E. L. Kinman		"
15†	McGoogin Creek	Nitinat River	6,000	J. R. McKinnel and others		"
17§	Amazon Creek	Quatsino Sound	1,100			
18§	Benson River	"	1,000			
19†	Kokish River	Broughton Strait	10,000	White Bros. Lumber Co.		"
20§	Marble Creek	Quatsino Sound	8,200	Colonial Lumber Paper Mills, Ltd. (one site only)	Total for 3 sites.	
23§	Upper Nimpkish River	Broughton Strait	3,500		Camosin Canyon.	
24§	"	"	3,000		Big Falls above Moss River.	
25§	"	"	1,500		Above mouth of Davie Creek.	
26§	Quatze River	Hardy Bay	500			

27§	Raging River	Quatsino Sound	1,500			
28§	Shushartie River	Queen Charlotte Sound	1,200			
29§	Tsi-itka River	Johnstone Strait	500			
	Windermere Water Dist.—					
1*	Findlay Creek	Kootenay River	6,400		Total of several powers of 2,000 horse-power and under	1913 Report, p. 77.
2*	Forster Creek	Columbia River	4,000		Total of 2 sites	,, p. 77.

* Powers available. † Powers staked. ‡ Powers developed and under development. § Powers available, investigated by Conservation Commission of Canada.

APPENDIX No. 2.

HOW TO ACQUIRE A "CLASS A" OR "CLASS B" LICENCE TO TAKE AND USE WATER.

The Province has been divided into thirty-one "Water Recording Districts," the boundaries of which follow as nearly as possible the main watersheds, and a "Local Recorder," in most cases the Government Agent, appointed for each district. The Local Recorder acts as a "Recorder," the active administration in the more important districts being in the hands of a "District Engineer," whose duties are defined by the "Water Act, 1914," and who is subject to the Comptroller of Water Rights, whose office is at Victoria, B.C., and in whom alone is vested the power to approve an application and grant a licence. The printed forms of notice, application, etc., may be obtained on application to the office of any Water Recorder, District Engineer, or to the Comptroller's office.

Licences may be granted for the use of water for any of the following purposes: Domestic, waterworks, mineral-trading, irrigation, mining, steam, fluming, hydraulicking, industrial, power, clearing-streams, storage, conveying, and lowering-water.

As the water may be required in varying quantities, the applications have been classified as follows: "Class A," "Class B," and "Class C," the definitions of these classes being as follows:—

"Class A," in reference to any application or licence, means any application or licence for "domestic," "mineral-trading," or "steam purpose"; or for "mining" or "industrial purpose" where the water is to be used in quantities not exceeding 100,000 gallons per day; or for "irrigation purpose" where the acreage to be irrigated does not exceed 640 acres; or for "power purpose" where the power to be developed does not exceed 100 horse-power and is to be used by the applicant only: Provided that, if in the opinion of the Comptroller the nature of the works intended is such as to require the submission of detail plans, he may place any application which might come within the foregoing classification into "Class B" notwithstanding the foregoing limitations:

"Class B," in reference to any application or licence, means an application or licence for "mining" or "industrial purpose" where the water is to be used in quantities exceeding 100,000 gallons per day; for "irrigation purpose" where the acreage to be irrigated exceeds 640 acres; or for "storage purpose" or "hydraulicking purpose" or "clearing-streams purpose" or "fluming purpose" where the water is to be used by the applicant only; or for "power purpose" where the power to be developed exceeds 100 horse-power and is to be used by the applicant only; or for "lowering-water purpose": Provided that, if in the opinion of the Comptroller the nature of the works is such as not to require the submission of detail plans, he may place any application or licence which might come within the above classification into "Class A" notwithstanding the foregoing limitations:

"Class C," in reference to any application or licence, means a licence by virtue of which water is held in gross, whether by special Statute or otherwise; or an application or licence for "power," "hydraulicking," "clearing-streams," or "fluming purposes" where tolls are to be charged; or for "waterworks" or "conveying purposes."

A licence in respect of a "Class A" or "Class B" application can be obtained by an "owner," "owner" being defined by the Act as:—

(*a.*) Any registered owner in the book of indefeasible or absolute fees in any Land Registry Office in the Province:

(*b.*) Any purchaser or lessee in a registered agreement for purchase or lease:

(*c.*) Any applicant to register his title as owner or his agreement for purchase or lease:

(*d.*) Any pre-emptor, homesteader, or purchaser from the Crown in the right of either the Dominion or the Province, or any applicant to so pre-empt, homestead, or purchase:

(*e.*) Any timber licensee or lessee:

(*f.*) Any other lawful occupant of land or of a mine:

(*g.*) Any legal representative of an owner (as herein defined) who has died, become insolvent, is a minor, is of unsound mind, or is otherwise under disability:

(*h.*) Any receiver or liquidator of a company which is the owner (as herein defined) of land.

A licence in respect of a "Class C" application can only be acquired by a municipality empowered by an Act of the Legislature or to a company authorized by its memorandum of association or by some Act of the Legislature to acquire such licence, and in no case until the undertaking has been approved under the "Water Act, 1914."

The initial procedure to obtain a "Class A" or "Class B" water licence is as follows:—

(1.) Post notices at or near the point of diversion and place of use:

(2.) File the notice in duplicate in the office of the Water Recorder for the district in which the proposed point of diversion is situate:

(3.) At the same time as filing serve the notice upon each owner whose land will be touched or in any way affected by the proposed works:

(4.) Forthwith after posting on the ground, advertise the notice in a local newspaper once a week for four weeks:

(5.) Within ten days after the date of the first publication, file the formal application in duplicate in the Water Recorder's office.

The following is a more detailed summary of the procedure of the requirements of the "Water Act":—

First Step—Posting Notices.

The applicant shall post on the ground at conspicuous points near the proposed point of diversion and proposed place of use a notice of his intention to apply for a licence; although printed forms are supplied, the Act does not require that the notice follow any particular form, but it must give the following particulars:—

(*a.*) The name and address of the applicant:

(*b.*) The Water Recorder's office in which the application is to be filed:

(*c.*) The name or a clear description of the stream the water of which is to be diverted or used:

(*d.*) The quantity of water applied for in acre-feet per annum, cubic feet per second, gallons per day, or miners' inches:

(*e.*) The proposed point or points of diversion:

(*f.*) The purpose for which the water is to be used:

(*g.*) The number of the lot or section (and, if subdivided, the number or description of the subdivision) of the land or mine, and, if a mine, the name of the mine, upon which land or mine the water or power is to be used:

(*h.*) The date when the notice was posted on the ground.

Second Step—Filing and Serving Copies of the Notice.

Forthwith after the posting of the notice on the ground as above, notices to the same effect shall be filed in the office of the Water Recorder for the district in which the proposed point of diversion is situate, and served upon each owner whose land will be touched or in any way affected by the proposed works. Proof of this service is required.

Third Step—Advertisement.

A notice giving all the particulars mentioned above, and, in addition, the date of the first publication and stating that objections may be filed with the Comptroller or with the Water Recorder within thirty days from such date, shall forthwith be published once a week for four weeks in a newspaper published in each district affected.

Fourth Step—The Application.

Within ten days from the first appearance of the notice in the local paper, the application, on forms to be supplied, must be filed in duplicate in the office of the Water Recorder where the notice was filed. The sketch on the application form need not be to scale, but must show the point of diversion, the lands crossed or affected, and generally outlining the scheme. The Local Recorder then forwards the application to the Comptroller, who checks the application and advises the applicant of the further requirements and of the amount of fees payable.

FIFTH AND SIXTH STEPS—ADDITIONAL INFORMATION AND FEES.

The further information and the fees must be filed with the Comptroller within fifty days from the first appearance of the notice in the local paper. The fees to be paid in respect of a licence for irrigation purposes are 5 cents per acre-foot of water applied for, and the annual rental is 2 cents per acre-foot of water granted by the licence.

Conditional Licence.—The Comptroller is now in a position to consider the application for the licence. If a "Class A" application, he may issue a conditional licence wherein he sets a time for the commencement and completion of the works and authorizes the use of the water.

SEVENTH STEP—(CLASS "B" APPLICANTS ONLY).

If a "Class B" application, he may issue an authorization to the applicant to proceed to survey and file plans and specifications of his proposed works, setting the time within which they must be completed and the manner in which they are to be made. These plans and specifications are to be submitted in triplicate, one set of plans being tracings and two sets prints, and must be in such detail that the construction of the works could be carried out from them.

EIGHTH STEP—THE TAKING OF LANDS.

Should the applicant require a right-of-way over Crown or private lands, the following procedure must be followed:—

Provincial Crown Lands.—Address a petition and sketch to the Minister of Lands, but file same with the Comptroller of Water Rights, showing:—

(1.) The number and principal terms of the conditional licence:

(2.) The nature of the easement required:

(3.) The length, breadth, and area of the right-of-way and its location.

Dominion Crown Lands.—Address a petition and sketch to the Minister of the Interior, but file same with the Comptroller of Water Rights, showing and setting out the same details as above.

Private Lands.—Obtain if possible the written consent of the owner of the lands over which a right-of-way is desired. If this is withheld it will be necessary for the applicant to furnish security to the amount set by the Comptroller, after which the Comptroller may give the applicant authority to enter on the lands to be used. Following this latter procedure, it is necessary for the applicant to take all steps necessary, as set out in the "Water Act," for the determination, by arbitration, of the amount which is to be paid by way of compensation for the land which is used.

NINTH STEP—FILING PROOF OF COMPLETION.

Within sixty days of the date set for the completion of the works, the licensee shall file proof of such completion, and the Comptroller, when he has satisfied himself by inspection or otherwise that the work has been carried out in a satisfactory manner, will issue a final licence.

While the above is an outline of the procedure to obtain a licence for the use of water, for full particulars of the rights and obligations of licensees interested parties are referred to the "Water Act, 1914," and the rules and regulations thereunder, copies of which, as well as detailed information and forms, may be obtained from the Comptroller of Water Rights, Victoria, B.C.

APPENDIX No. 3.

THE MEASUREMENT OF WATER.

The object in view in the administration of the water of British Columbia is to make the greatest beneficial use of the water, and in order to obtain this end the measurement of the water is of the greatest importance.

On most of the rivers of any size, and on many smaller streams, the measuring of the discharge is in the hands of expert engineers assisted by local observers, but the large body of the work necessary to obtain the greatest beneficial use must be done by the users themselves.

In most cases it is of advantage to know how much water there is, and how much any one is taking, as this leads to a great deal less trouble and friction where the water-supply is limited; it is also admitted that no one can really make a success of irrigation or utilize the important results made public in the reports of Government experimental work unless they know and can control the amounts of water used for different crops. It is hoped that the rather haphazard arrangements adopted by many irrigators will give place to more careful and studied methods.

It should be noted that by the "Water Act, 1914," 1 cubic foot per second (c.f.s.) is fixed as being equal to 1.98 acre-feet per twenty-four hours, so that 1 c.f.s. will approximately cover 1 acre to a depth of 1 inch in 1 hour; this forms an easy basis for calculation, and is used in the table in Appendix 7, which shows the acre-feet given by various discharges in cubic feet per second over a certain time.

The three main measuring-devices for small amounts of water are the "V" notch, the rectangular weir, and the Cippoletti weir. The "V" notch is useful only with very small amounts; the rectangular weir offers certain difficulties in calculation; but the Cippoletti weir overcomes these, it is simple to measure with, and is therefore adopted as being most suitable for the purpose in view.

How to make and place a Cippoletti Weir.

There are certain fundamental features in the construction and use of a Cippoletti weir that must be understood in order to obtain satisfactory results. It must be made correctly, placed correctly, and kept in good order.

Reference to the illustration will show that the sides of the opening are sloped 1 to 4; that is, for every 4 inches above the crest 1 inch is set off to the right or left.

The weir should be bevelled to a sharp edge on the up-stream face, so that the water passes freely over it and allows room for a small amount of air between the discharged water and the weir; sometimes a sheet of metal is used, and the weir cut out of that, or the wooden edge may be covered by a metal strip to prevent its being damaged and so losing its shape.

The following points should be carefully observed:—

(1.) The weir should be set at right angles to the stream, should be perpendicular, and the crest exactly horizontal.

(2.) The width from the edge of the slope to the bank should not be less than three times the depth of water flowing over the crest, so that if the weir is designed for a maximum discharge of 12 inches of water, there should be at least 3 feet clear to the bank each side.

(3.) The depth of water below the crest on the up-stream side should also be at least three times the depth of water passing over the crest, and arrangements should be made by a sluice-gate or otherwise to keep this depth clear.

(4.) There must be a free fall on the down-stream side.

(5.) It is important that as far as possible the water should approach the weir slowly, and without eddies or cross-currents. To obtain this, the weir should be placed in a straight length of channel where possible, and at such a height that a considerable pool is formed behind it.

How to measure the Discharge.

It will be noticed that where the water passes over the crest there is a slight curve in the upper surface, so to measure the correct depth it is necessary to place a peg from 6 to 10 feet from the weir, with the top exactly level with the crest, and to measure the water from the top of the peg; this depth is also called the head of water.

On referring to the table given, the head expressed in inches is shown on the left hand, and opposite this is given the discharge over a 1-foot weir. The discharge varies directly as the width of the crest, so for a 5-foot weir the figure given would be multiplied by 5, and similarly in any other case.

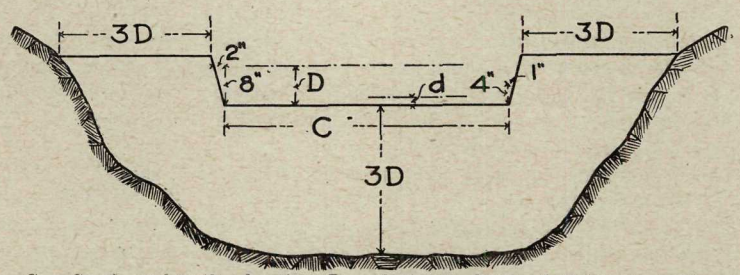
What Size to make the Weir.

To obtain good results from the use of Cippoletti weirs it is also necessary to keep the depth of water flowing over the weir within certain limits; this is obtained by varying the width to suit the particular requirements in each case. The depth of water should not be less than 2 inches, nor more than one-third of the length of crest; so within these limits a—

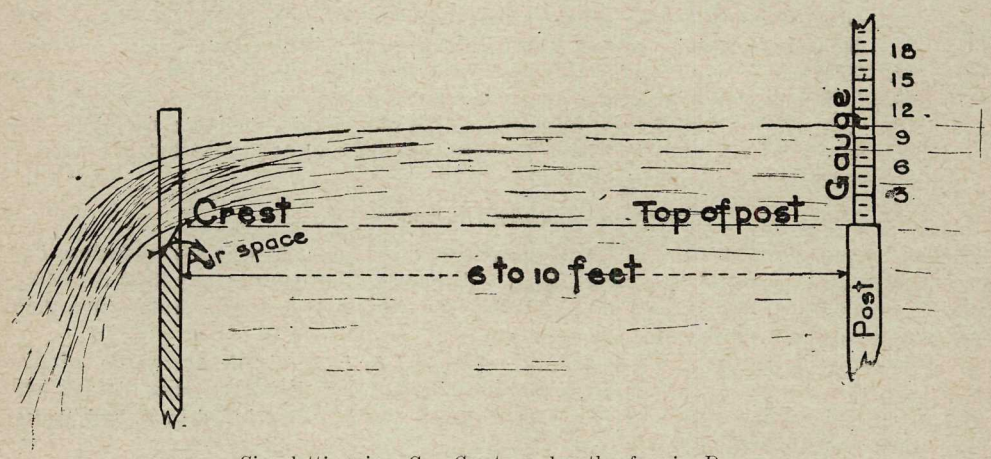
1-foot weir can be used for discharges from ¼ to 1 c.f.s.
2-foot weir can be used for discharges from ½ to 3½ c.f.s.
3-foot weir can be used for discharges from ¾ to 10 c.f.c.
4-foot weir can be used for discharges from 1 to 20 c.f.s.
5-foot weir can be used for discharges from 1¼ to 35 c.f.s.
6-foot weir can be used for discharges from 1½ to 55 c.f.s.
7-foot weir can be used for discharges from 1¾ to 80 c.f.s.
8-foot weir can be used for discharges from 2 to 115 c.f.s.
9-foot weir can be used for discharges from 2¼ to 155 c.f.s.
10-foot weir (with 2 to 36 inches depth of water) can be used for discharges from 2½ to 175 c.f.s.
15-foot weir (with 2 to 36 inches depth of water) can be used for discharges from 3½ to 260 c.f.s.
20-foot weir (with 2 to 36 inches depth of water) can be used for discharges from 4¾ to 350 c.f.s.

It will be seen there may be a considerable choice as to size, but it is best to select the one that will give the most correct measurements at the lowest discharge. The width of the watercourse and the grade will also influence the size of weir-crest.

Any inquiries as to the width most suitable in any particular case should be addressed to the Comptroller of Water Rights, giving full particulars as to width of channel, height and nature of banks, grade of watercourse, and the range of discharge required to be measured.



Cippoletti weir. C = Crest, or length of weir. D = Maximum depth of water on crest = one-third length of crest, but not more than 3 feet. d = Minimum depth of water on crest = 2 inches.



Cippoletti weir. C = Crest, or length of weir. D =

Table of Discharges in Cubic Feet per Second over a Cippoletti Weir One Foot wide.

Head in Inches.	Discharge in C.F.S.	Head in Inches.	Discharge in C.F.S.	Head in Inches.	Discharge in C.F.S.
1	0.08	4⅝	0.81	10½	2.75
1⅛	0.10	4¾	0.84	10¾	2.85
1¼	0.11	4⅞	0.87	11	2.95
1⅜	0.13	5	0.91	11¼	3.05
1½	0.15	5⅛	0.94	11½	3.15
1⅝	0.17	5¼	0.97	11¾	3.26
1¾	0.19	5⅜	1.01	12	3.37
1⅞	0.21	5½	1.04	12¼	3.47
2	0.23	5⅝	1.08	12½	3.57
2⅛	0.25	5¾	1.12	12¾	3.68
2¼	0.27	5⅞	1.15	13	3.79
2⅜	0.30	6	1.19	13¼	3.90
2½	0.32	6¼	1.26	13½	4.02
2⅝	0.34	6½	1.34	13¾	4.13
2¾	0.37	6¾	1.42	14	4.24
2⅞	0.40	7	1.50	14¼	4.35
3	0.42	7¼	1.58	14½	4.47
3⅛	0.45	7½	1.66	14¾	4.58
3¼	0.47	7¾	1.75	15	4.70
3⅜	0.50	8	1.83	15¼	4.82
3½	0.53	8¼	1.92	15½	4.94
3⅝	0.56	8½	2.01	15¾	5.06
3¾	0.59	8¾	2.10	16	5.18
3⅞	0.62	9	2.19	16¼	5.30
4	0.65	9¼	2.28	16½	5.42
4⅛	0.68	9½	2.37	16¾	5.55
4¼	0.71	9¾	2.46	17	5.68
4⅜	0.74	10	2.56	17¼	5.80
4½	0.77	10¼	2.66	17½	5.93
...	...	...	...	17¾	6.06
...	...	...	...	18	6.18

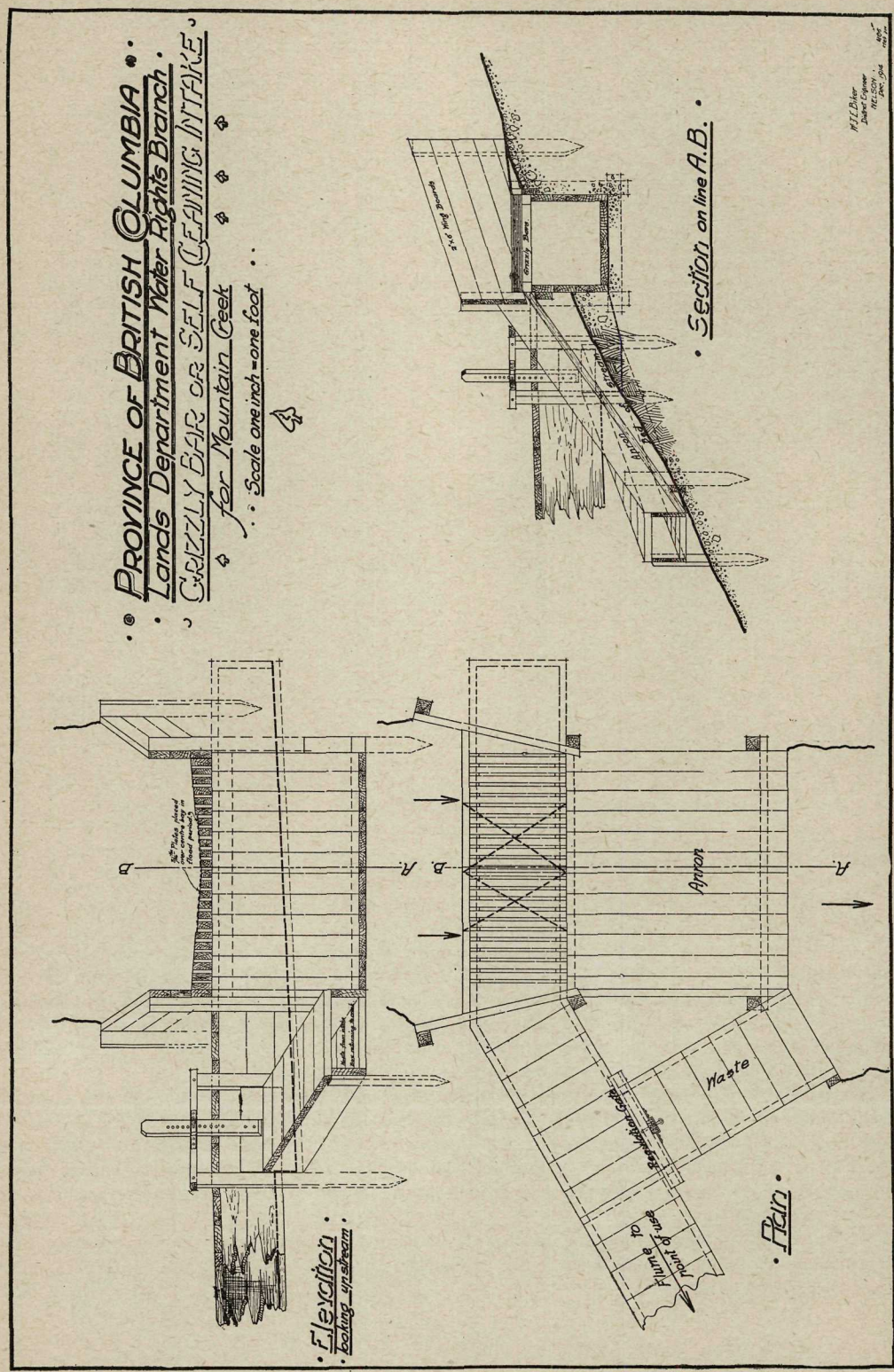
APPENDIX No. 4.

GRIZZLY BAR, OR SELF-CLEANING INTAKE AND DIVERSION.

Specification.—The box, which should be constructed of not less than 2-inch lumber, to be set in a trench cut across the creek, the top of box being flush with creek-bed. Box to be 2 feet wide by 1 foot 6 inches deep at shallow end, sloping to 2 feet deep where it terminates at the sluice-gate, at the connection to the flume. The length to be determined by local conditions, but should be only sufficiently long so that the sluice-gate and flume thereto can be conveniently located. Wing-boards and aprons of substantial size, depending on the particular site where the box is installed, to be provided, great care being exercised that the foot-steps are sunk sufficiently deep to avoid the possibility of the water getting underneath the box.

Grizzly bars to be fixed across top of box, the sides of the box being so shaped that the bars in the centre of the stream will be lower than those at the side. The middle 3 feet of bars to be sunk 1 inch lower than the sides in order that two pieces of ⅛-inch sheet iron or steel, each 2 feet by 1 foot 6 inches, may be set therein. These plates to be set prior to the spring floods, so that the greater quantity of water and gravel passing down the creek may be carried over the box and so prevent it choking.

A sluice-gate to be provided and fixed on the side of the lower end of the box, in order that all gravel and sand may be automatically discharged through a flume to the creek at a point below the grizzly bars.


PROVINCE OF BRITISH COLUMBIA
Lands Department Water Rights Branch
GRIZZLY BEAR CREEK SELF CLEANING INTAKE
for Mountain Creek
Scale one inch = one foot
Section on line A.B.
Elevation
looking upstream
Apron
Waste
Flume to
Plan

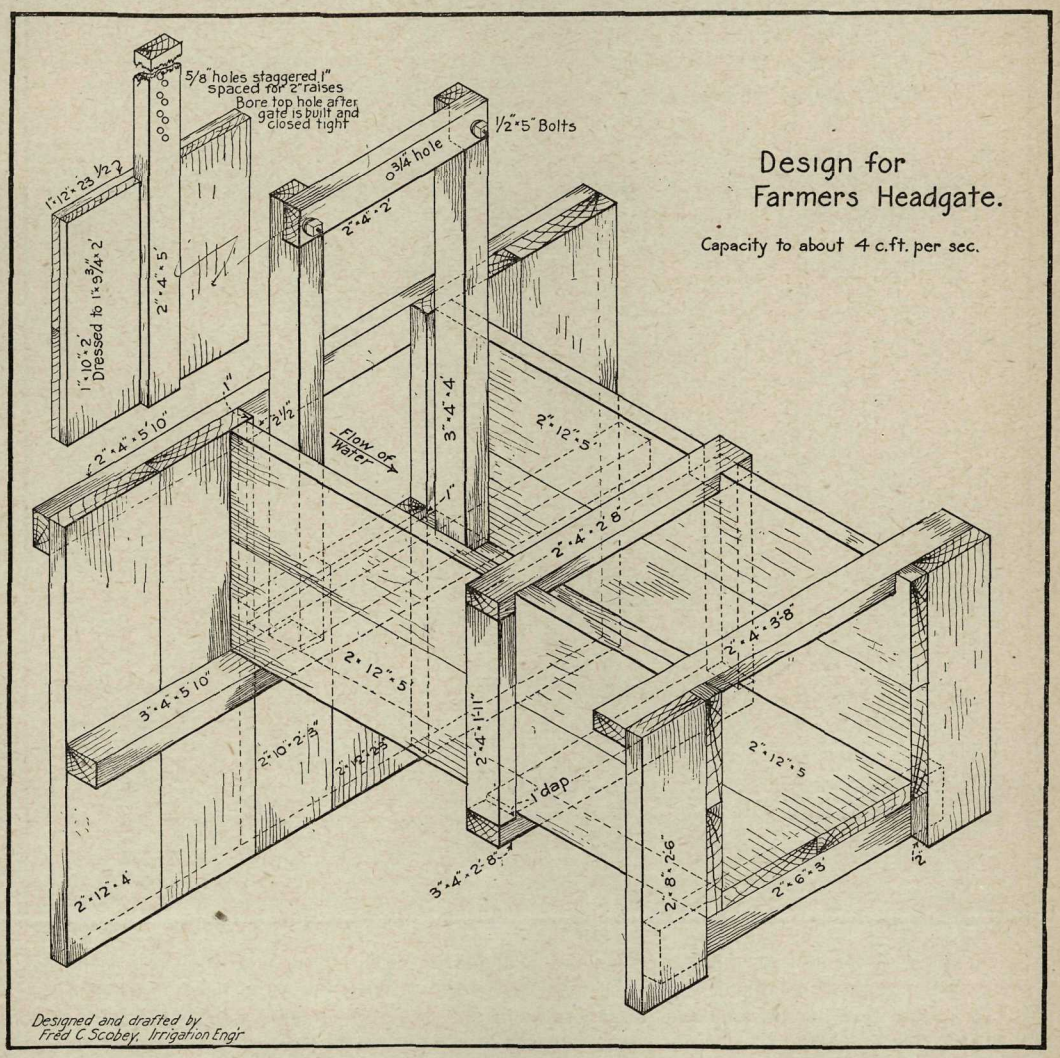
APPENDIX No. 5.

IRRIGATION HEADGATES.

Farmer's Headgate.

The farmer's small headgate shown in Fig. 1 will deliver up to 4 second-feet in the ditch below under favourable conditions of grade and size, assuming the gate-box can be kept full of water.

It will be noticed that the two inner planks of the front wings extend 1 inch beyond the inner face of the side-walls, thus forming front guides. The extension of the two planks in the front cut-off wall above the floor-boards by an inch makes a tighter gate; the gate fits down behind them.



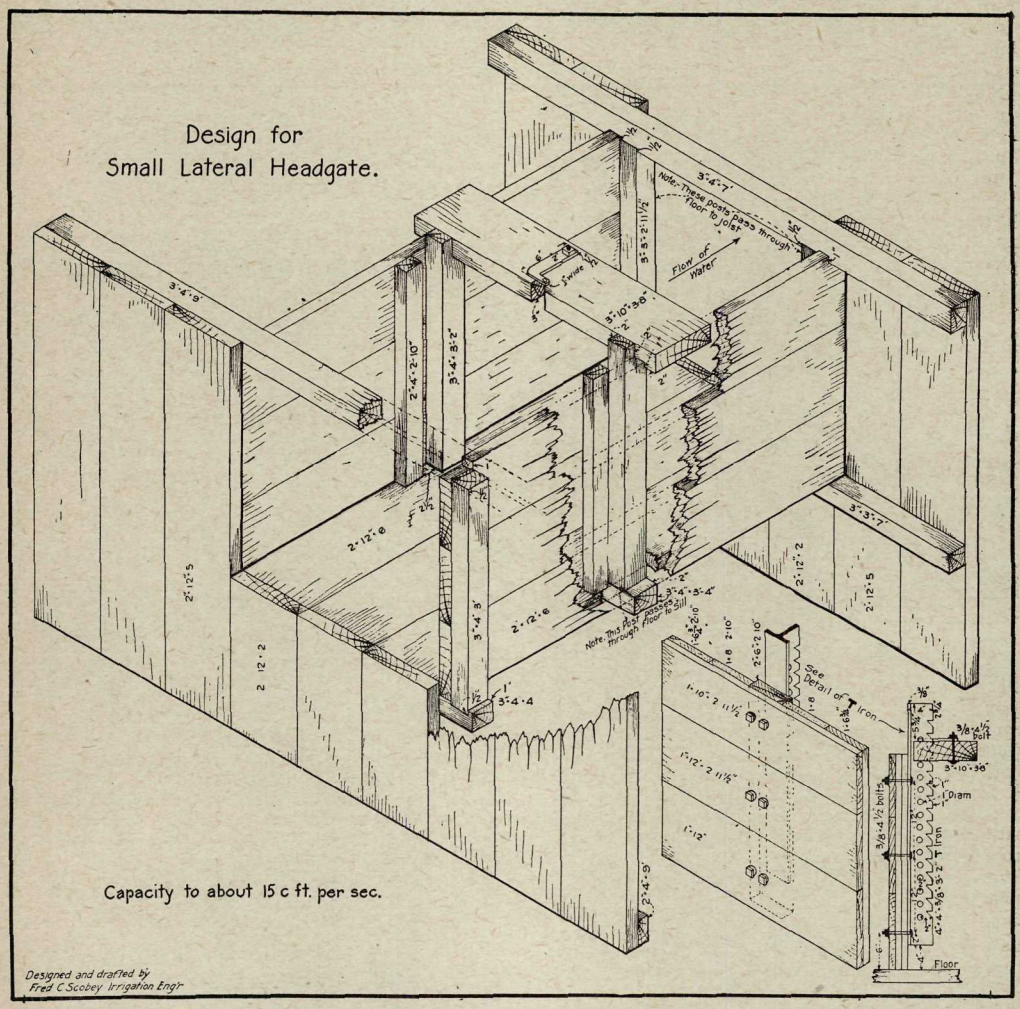
If possible, the stem of the gate should be hardwood and the holes bored therein staggered as shown; ⅝-inch holes will take a ½-inch pin, which could have an iron ring at one end and a small slot at the other to receive the tongue of a thin padlock.

The dimensions of lumber are suited to a structure of the size indicated; a considerable increase in size would need other dimensions and a rearrangement of struts and braces.

The depth of the wing and front walls must be determined by the nature of the soil; one of sand would require greater depth than those shown. Whatever depth be decided on, the dirt excavated must be well puddled round the walls, thoroughly tamped down with a rammer, previously having been worked to the consistency of stiff mortar. If the dirt be replaced in a dry state, carelessly shovelled in, there is every likelihood of a washout.

SMALL LATERAL HEADGATE.

The small lateral headgate shown in Fig. 2 is 3 feet high and 3 feet wide, with a capacity of about 15 second-feet under favourable conditions.



Should it be preferred, angle-iron can be used instead of a T-iron as a stem; it costs less. The gate is raised by means of a short crowbar inserted in the notches and used as a lever.

The same care should be taken to carefully install this type of gate as the farmer's small headgate; if necessary, the vertical planks of the wing-wall can be driven down with a wooden mallet, and cut to length after.

Timber should be notched and fitted as shown in the drawings; whilst this entails slightly more labour at the time, it adds a great deal to the strength and stiffness of the structures.

Bills of material for both types of gates are appended; the lateral type has quantities for three sizes.

FARMER'S HEADGATE. CAPACITY UP TO ABOUT 4 SECOND-FEET (DEPENDING ON GRADE AND CONDITION OF THE DITCH BELOW THE GATE).

Bill of Lumber.

Use.	Pieces.	Dimensions.	Feet, B.M.
Side boards	4	2″ x 12″ x 5′	40
Floor	2	2″ x 12″ x 5′	20
Front wings	4	2″ x 12″ x 4′	32
Front cut-off wall	1	2″ x 12″ x 2′ 3″	5
,, ,, ,,	1	2″ x 10″ x 2′ 3″	4
Cap	1	2″ x 4″ x 5′ 10″	4
Joist	1	3″ x 4″ x 5′ 10″	6
Gate-posts	2	3″ x 4″ x 4′	8
Cap for gate-posts	1	2″ x 4″ x 2′	1
Sill	1	3″ x 4″ x 2′ 8″	3
Cap	1	2″ x 4″ x 2′ 8″	2
Posts	2	2″ x 4″ x 1′ 11″	3
Lower wings	2	2″ x 12″ x 2′ 6″	10
Cut-off sill	1	2″ x 6″ x 3′	3
Cap	1	2″ x 4″ x 3′ 8″	3
Bolts	2	½″ x 6″	..
Gate-stem	1	2″ x 4″ x 5′	3
Gate-boards	2	1″ x 12″ x 23½″	4
,,	2	1″ x 10″ x 2′	4
		Total feet, B.M.	155

Two bolts ½″ x 5″, with washers for each end.

HEADGATE FOR SMALL LATERAL. CAPACITY UP TO ABOUT 15 SECOND-FEET (DEPENDING ON GRADE AND CONDITION OF THE LATERAL BELOW GATE).

(As per Plans in Drawing. Bottom, 3 feet wide; sides, 3 feet high.)

Bill of Lumber.

Use.	Pieces.	Dimensions.	Feet, B.M.
Side boards	6	2″ x 12″ x 6′	72
Floor	3	2″ x 12″ x 6′	36
Front wings	6	2″ x 12″ x 5′	60
Front cut-off wall	3	2″ x 12″ x 2′	12
Joist	1	2″ x 4″ x 9′	6
Sill	1	3″ x 4″ x 4′	4
,,	1	3″ x 4″ x 3′ 4″	4
Posts	2	3″ x 4″ x 3′	6
Cap (front wings)	1	3″ x 4″ x 9′	9
Lower wings	4	2″ x 12″ x 5′	40
Lower cut-off wall	3	2″ x 12″ x 2′	12
Joist	1	3″ x 3″ x 7′	5
Posts	2	3″ x 3″ x 2′ 11½″	5
Cap	1	3″ x 4″ x 7′	7
Front guides	2	2″ x 4″ x 2′ 10″	4
Rear guides	2	3″ x 4″ x 3′ 2″	6
Foot-plank	1	3″ x 10″ x 3′ 8″	10
Gate-boards	1	1″ x 10″ x 2′ 11½″	3
,,	2	1″ x 12″ x 2′ 11½″	6
,,	2	1″ x 8″ x 2′ 10″	4
,,	2	1″ x 6¾″ x 2′ 10″	4
,,	1	2″ x 6″ x 2′ 10″	3
		Total feet, B.M.	318

T-iron—One piece 4″ x 4″ x ⅜″ x 3′ 2″, bored as per detail.
Bolts—Seven ⅜″ x 4½″, with washers for each end.

HEADGATE FOR SMALL LATERAL. CAPACITY UP TO ABOUT 20 SECOND-FEET (DEPENDING ON GRADE AND CONDITION OF THE LATERAL BELOW GATE).

(As per Plans in Drawing, except 4 feet wide instead of 3 feet wide.)

Bill of Lumber.

Use.	Pieces.	Dimensions.	Feet, B.M.
Side boards	6	2″ x 12″ x 6′	72
Floor	4	2″ x 12″ x 6′	48
Front wings	6	2″ x 12″ x 5′	60
Front cut-off wall	4	2″ x 12″ x 2′	16
Joist	1	2″ x 4″ x 10′	7
Sill	1	3″ x 4″ x 5′	5
,,	1	3″ x 4″ x 4′ 4″	5
Posts	2	3″ x 4″ x 3′	6
Cap (front wings)	1	3″ x 4″ x 10′	10
Lower wings	4	2″ x 12″ x 5′	40
Lower cut-off wall	4	2″ x 12″ x 2′	16
Joist	1	3″ x 3″ x 8′	6
Posts	2	3″ x 3″ x 2′ 11½″	5
Cap (lower wings)	1	3″ x 4″ x 8′	8
Front guides	2	2″ x 4″ x 2′ 10″	4
Rear guides	2	3″ x 4″ x 3′ 2″	6
Foot-plank	1	3″ x 10″ x 4′ 8″	13
Gate-boards (front)	1	1″ x 10″ x 3′ 11½″	4
,, ,,	2	1″ x 12″ x 3′ 11½″	8
,, (back)	2	1″ x 10″ x 2′ 10″	5
,, ,,	2	1″ x 10¾″ x 2′ 10″	5
,, ,,	1	2″ x 6″ x 2′ 10″	3
		Total feet, B.M.	352

T-iron—One piece 4″ x 4″ x ⅜″ x 3′ 2″, bored as per detail.
Bolts—Seven ⅜″ x 4½″, with washers for each end.

HEADGATE FOR LATERAL. CAPACITY UP TO ABOUT 28 SECOND-FEET (DEPENDING ON GRADE AND CONDITION OF LATERAL BELOW GATE).

(As per Plans in Drawing, except 4 feet wide and 4 feet high instead of 3 feet wide and 3 feet high. Cut-off and wing-walls 1 foot deeper.)

Bill of Lumber.

Use.	Pieces.	Dimensions.	Feet, B.M.
Side boards	8	2″ x 12″ x 6′	96
Floor	4	2″ x 12″ x 6′	48
Front wings	6	2″ x 12″ x 7′	84
Front cut-off wall	4	2″ x 12″ x 3′	24
Joist	1	2″ x 4″ x 10′	7
Sill	1	3″ x 4″ x 5′	5
,,	1	3″ x 4″ x 4′ 4″	5
Posts	2	3″ x 4″ x 4′	8
Cap (front wings)	1	3″ x 4″ x 10′	10
Lower wings	4	2″ x 12″ x 7′	56
Lower cut-off wall	4	2″ x 12″ x 3′	24
Joist	1	3″ x 3″ x 8′	6
Posts	2	3″ x 3″ x 3′ 11½″	7
Cap (lower wings)	1	3″ x 4″ x 8′	8
Front guides	2	2″ x 4″ x 3′ 10″	5
Rear guides	2	3″ x 4″ x 4′ 2″	8
Foot-plank	1	3″ x 10″ x 4′ 8″	13
Gate-boards (front)	1	1″ x 10″ x 3′ 11½″	4
,, ,,	3	1″ x 12″ x 3′ 11½″	12
,, (back)	2	1″ x 10″ x 3′ 10″	7
,, ,,	2	1″ x 10¾″ x 3′ 10″	7
,, ,,	1	2″ x 6″ x 3′ 10″	4
		Total feet, B.M.	448

T-iron—One piece 4″ x 4″ x ⅜″ x 4′ 2″, bored as per detail (for additional foot).
Bolts—Seven ⅜″ x 4½″, with washers for each end.

APPENDIX No. 6.

OVERIRRIGATION.

Overirrigation:—

(1.) Causes smaller crop yields per unit of water:
(2.) Encourages water-logging and alkali trouble on heavy or low-lying land:
(3.) Leaches out plant-food from coarse soils:
(4.) Causes more plant-food to be used by the plant for each pound of crop produced:
(5.) Causes the quality of crops to be reduced:
(6.) Produces straw at the expense of grain:
(7.) Deprives other lands of irrigation-water:
(8.) Soil air is excluded and unfavourably low soil temperatures are caused by excessive irrigation:
(9.) The community spirit is lower wherever water is wastefully used:
(10.) Overirrigation is the greatest menace to permanently profitable irrigation agriculture:

Proper irrigation makes it possible to build up and keep the soil in a higher state of fertility than is possible by other types of farming.

APPENDIX No. 7.

USEFUL DATA.

1 mile = 1,760 yards = 5,280 feet = 80 chains.
1 chain = 100 links = 66 feet = 4 rods.
1 square mile = 640 acres.
1 acre = 43,560 square feet = 10 square chains.
1 acre equals approximately a square 209 x 209 feet.
1 foot per second = 0.68 mile per hour.
1 mile per hour = 1.467 feet per second.

WATER UNITS.

1 cubic foot of water = 6.23 gallons.
1 cubic foot of water weighs 62.4 lb.
1 cubic foot per second = 6.23 gallons per second.
= 373.9 gallons per minute.
= 538,453 gallons per day of 24 hours.
= 35.71 B.C. miners' inches.
= 1.98 acre-feet per day of 24 hours.
1 miner's inch = 0.028 cubic foot per second.
= 10.47 gallons per minute.
= 15,076.8 gallons per day.
= 0.0555 acre-foot per day.
= 1 acre-foot in 18 days of 24 hours.
1 acre-foot = 43,560 cubic feet.
= 271,472 gallons.
= 1 cubic foot per second for 12.12 hours.
= 1 miner's inch for 432.86 hours.
1 gallon = 277.274 cubic inches.
= 0.16046 cubic foot.
= 1.2 U.S. gallons.
= 10 lb.
1,000,000 gallons = 160,460 cubic feet.
= 3.68 acre-feet.
= 1.86 cubic feet per second for 1 day.
= 66.3 miners' inches for 1 day.
1 horse-power = 550 foot-pounds per second.
= 1 cubic foot of water falling 8.8 feet in 1 second.
= 746 watts.
= 0.746 kilowatt.

To calculate horse-power at 70 per cent. efficiency, multiply the amount of flow of water expressed in cubic feet per second by the available head in feet by the factor 0.08.

To convert head in feet into pounds pressure per square inch, multiply by 0.434.

To convert pounds pressure per square inch into head in feet, multiply by 2.31.

DUTY OF WATER.

From 1 to 3 acre-feet of water, depending upon the kind of crop and the rainfall in the particular locality, is usually considered sufficient to properly irrigate 1 acre of land. One acre-foot of water properly distributed over an acre of land is equal to 12 inches of rainfall.

The majority of water licences in the Dry Belt of British Columbia, where the precipitation is less than 20 inches per annum, allow the use of 2½ acre-feet of water to each acre of land.

From 3 to 5 acre-inches is generally considered sufficient for each irrigation, depending on the kind of crops and the method employed in irrigating. This would allow (when using 2½ acre-feet per acre) six to ten irrigations during the season.

NOTE.—The gallons referred to above are Imperial gallons. Care should be taken when figuring on pump capacities to note whether Imperial or U.S. gallons are referred to, as a U.S. gallon is only 0.833 of an Imperial gallon. The cubic foot per second is the unit of measurement for flowing water, while the acre-foot is used for the measurement of water in bulk, such as capacity of reservoirs, the total quantity of water which may be used during the irrigation season, etc. The miner's inch referred to above *was* the legal unit of measurement in British Columbia prior to the year 1909.

TABLE SHOWING ACRE-FEET GIVEN BY VARIOUS DISCHARGES OVER A CERTAIN TIME.

Discharges in Acre-feet for Various Flows for given Time Periods.

	6 Hours.	12 Hours.	1 Day.	1½ Days.	2 Days.	2½ Days.	3 Days.	3½ Days.
½ c.f.s.	¼	½	1	1½	2	2½	3	3½
1 „	½	1	2	3	4	5	6	7
2 „	1	2	4	6	8	10	12	14
3 „	1½	3	6	9	12	15	18	21
4 „	2	4	8	12	16	20	24	28
5 „	2½	5	10	15	20	25	30	35
6 „	3	6	12	18	24	30	36	42
7 „	3½	7	14	21	28	35	42	49
8 „	4	8	16	24	32	40	48	56
9 „	4½	9	18	27	36	45	54	63
10 „	5	10	20	30	40	50	60	70

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