

PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES

HON. R. A. WILLIAMS, *Minister*

B. E. MARR, *Associate Deputy Minister
of Water Resources*

REPORT

of the

BRITISH COLUMBIA
WATER RESOURCES
SERVICE

DECEMBER 31

1974



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1975

COVER

The Snow Survey Bulletins published monthly February-June each year by Water Investigations Branch's Hydrology Division serve as a vital indicator of probable summer stream-flows. In 1974 the bulletins reported record snow-packs over southern British Columbia, creating a major flood risk. Snow-level and quality readings are gathered by field staff from 244 snow courses and eight snow-pillow stations. Access to these remote measuring stations is by helicopters, snowmobiles, snowshoes, skis, feet, and sliding posteriors.

THE UNIVERSITY OF CHICAGO
DEPARTMENT OF THE HISTORY OF ARTS
AND ARCHITECTURE

REPORT
ON THE
BRITISH COLUMBIA
WATER RESOURCES
SERVICE

BY
J. H. ...
...
...
...
...

March 25, 1975.

*To Colonel the Honourable WALTER STEWART OWEN, Q.C., LL.D.,
Lieutenant-Governor of the Province of British Columbia.*

MAY IT PLEASE YOUR HONOUR:

Herewith I beg respectfully to submit the Annual Report of the British Columbia Water Resources Service of the Department of Lands, Forests, and Water Resources for the year ended December 31, 1974.

ROBERT A. WILLIAMS
Minister of Lands, Forests, and Water Resources

March 25, 1975.

*The Honourable Robert A. Williams,
Minister of Lands, Forests, and Water Resources,
Victoria, B.C.*

DEAR SIR: I have the honour to submit the Annual Report of the British Columbia Water Resources Service of the Department of Lands, Forests, and Water Resources for the 12 months ended December 31, 1974.

B. E. MARR
Associate Deputy Minister of Water Resources

BRITISH COLUMBIA WATER RESOURCES SERVICE

DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES

December 31, 1974

B. E. MARR, *Associate Deputy Minister*

G. E. SIMMONS, *Assistant Deputy Minister*

WATER RIGHTS BRANCH

H. D. DEBECK, *Comptroller of Water Rights*

A. K. SUTHERLAND, *Deputy Comptroller of Water Rights*

WATER INVESTIGATIONS BRANCH

P. M. BRADY, *Director*

T. A. J. LEACH, *Assistant Director*

POLLUTION CONTROL BRANCH

W. N. VENABLES, *Director*

R. H. FERGUSON, *Assistant Director*

A. J. CHMELAUSKAS, *Assistant Director, January-June*

CHEMISTRY LABORATORY

A. J. LYNCH, *Chief Chemist*

INSPECTOR OF DYKES

W. R. MEIGHEN, *Inspector of Dykes, January-November*

K. J. CHISHOLM, *Inspector of Dykes, December*

W. S. JACKSON, *Assistant Inspector of Dykes*

SOUTHERN OKANAGAN LANDS PROJECT

W. J. STEPHENSON, *Supervisor*

ACCOUNTING DIVISION*

M. B. MACLEAN, *Departmental Comptroller*

PERSONNEL OFFICE*

R. C. WEBBER, *Director of Personnel*

MAIL AND FILE ROOM†

D. S. PRESTON, *in Charge*

PUBLIC INFORMATION OFFICER

J. MCCROSSAN

* Service shared with Lands Service.

† Service shared with Lands Service and Forest Service.



Mica Dam on the Columbia River was completed in 1973. This dam is the world's second highest. Picture shows its vast reservoir—to be named McNaughton Lake—forming behind the dam in 1974.

CONTENTS

	PAGE
British Columbia Water Resources Service—	
Report of the Associate Deputy Minister.....	9
Water Rights Branch—	
Report of the Comptroller of Water Rights.....	15
Water Licensing Division.....	16
Regional Engineers Division.....	19
Power and Major Licences Division.....	25
Improvement Districts Division.....	33
Water Utilities Division.....	36
Water Investigations Branch—	
Report of the Director.....	41
Hydrology Division.....	45
Planning and Surveys Division.....	53
Environmental Studies Division.....	59
Engineering Division.....	63
Record Compilation and Reports.....	75
Pollution Control Board.....	81
Pollution Control Branch—	
Report of the Director.....	85
Industrial Division.....	87
Municipal Division.....	90
Regional Division.....	93
Projects and Research Division.....	98
Chemistry Laboratory.....	105
Inspector of Dykes.....	115
Southern Okanagan Lands Project.....	119
Personnel Services.....	125
Accounting Division.....	129

Dear Mr. [Name],

I have received your letter of the 15th and am glad to hear from you.

The matter is being considered and I will get back to you as soon as possible.

Very truly yours,

[Signature]

[Address]

[Address]

[Address]

[Address]

[Address]

[Address]

[Address]

BRITISH COLUMBIA WATER RESOURCES SERVICE

B. E. Marr, P.Eng.
Associat e
Deputy Minister

The year 1974 was one of change for the Water Resources Service, both in added responsibilities and in organization, bringing new challenges and opportunities for staff to play their part in water resources and environmental management.

Early in the year it became apparent from our snow surveys that we were again facing a potential flood situation, particularly in the southern half of the Province; however, very favourable weather conditions during the snow-melt period, together with early implementation of flood warning and control systems, and the construction of certain emergency works allowed the existing flood protection works to operate satisfactorily with only limited flood damage being sustained in the critical Lower Fraser Valley and Kamloops area. However, many home-owners and small businesses did experience losses and about \$1,500,000 was paid out by the Province to assist those affected.

It is apparent that reliance on structural solutions alone to reduce potential future flood damage is not a satisfactory situation and much more use must be made of nonstructural possibilities including floodplain zoning and floodproofing. A recent amendment to the *Land Registry Act* requires approval by the Water Resources Service for all new subdivisions within the floodplain, and a program of floodplain mapping and the establishment of flood-proofing guidelines is now under way as part of a long-range program to develop sound floodplain management policies.

The Lower Fraser Valley flood control program under the Canada-British Columbia agreement was stepped up during fiscal 1974/75 with anticipated expenditures in the order of \$10,000,000. In addition, some 55 smaller flood-protection projects were completed at various locations throughout the Province in co-operation with local authorities or individual landowners. Following the 1974 run-off period, a number of stream-clearing projects were undertaken to reduce flood-damage potential. The review of storage possibilities on the Upper Fraser River system for flood control and hydro power generation continues under the Canada-British Columbia flood-control agreement with considerable emphasis on the environmental impact and the effect of such development on other resources of the area.

In tune with other natural resource departments, efforts continued toward decentralization of certain functions of the Water Resources Service to provide a larger role for the Regional offices of the Water Rights Branch and Pollution Control Branch, including the establishment of district laboratories under the Water Resources Chemistry Laboratory. As part of this program, the Pollution Control Branch has held a number of site meetings between applicants and objectors under the *Pollution Control Act* where it was felt that clarification of the issues would avoid the need for formal hearings.

Reorganization within the Service has included the strengthening of the Pollution Control Branch's policing, monitoring, and permit-issuing functions as well as continuing involvement in the establishment of Pollution Control Objectives. The Branch is also responsible for the day-to-day administration of the *Litter Act* and SAM program (crushing and removing derelict automobiles throughout the Province), transferred from the Department of Recreation and Conservation and is establishing an advisory service to assist local governments in the operation of municipal waste treatment facilities. The Water Investigations Branch has been expanded by the transfer of the projects and research component of the Pollution Control Branch to form a new Environmental Studies Division. This division will be responsible for environmental and water management studies undertaken by the Service. A major environmental baseline study has been announced for the Kootenay area and the Kalamalka-Wood Lake water management study begun in 1972 is now in final draft stage.

The Pollution Control Branch continues to give priority to bringing under permit all discharges of liquid, solid, and gaseous wastes to the environment and the total of 677 permits and amendments issued this year is the greatest for any single year since the Branch was established. The increased monitoring and policing work load associated with the expanding permit system places a strain on existing staff and the number of routine environmental tests increased to 171,000 from 128,000 in 1973. Fortunately the Branch has operational a sophisticated computer data storage and retrieval system on which is recorded over one-half million test results and other resource data. Recently the system has been extended to assist in the management of the Water Resources Service Chemistry Laboratory as well as provide a water quality information system to the Health Branch and the Water Investigations Branch. As a measure of the effectiveness of pollution control policies, it is interesting to note that for the pulp and paper industry over the period 1973-75, capital expenditures for environmental protection in British Columbia was 53 per cent of the Canada total in contrast to British Columbia's 24 per cent share of total production.

The Pollution Control Board adopted as policy in 1974, the Objectives for the Chemical and Petroleum Industry and has before it the proposed Objectives for the Food-processing, Agriculturally Oriented and Other Miscellaneous Industries and the Objectives for Municipal-type Waste Discharges. This will complete the objectives for major industrial and municipal activities in British Columbia. The Board has been instructed by Government to review and update the Forest Industry Objectives established in 1971, and it is anticipated that this process will be repeated with the other objectives on a five-year rotating basis.

The Service undertook discussions with officials representing the Government of Alberta to assess the environmental effect in the downstream province of the proposed Site 1 hydro power development on the Peace River in British Columbia. As a result of these discussions it was determined that Site One would have no adverse environmental effects in Alberta and this was reported to the two Governments prior to the initiation of site development by B.C. Hydro and Power Authority.

On December 4, 1974, the Southern Okanagan Lands Irrigation District assumed full responsibility for the operation of the district. This officially brings to an end over 50 years' administration of the area by various departments of the Provincial Government, including a close association with the Water Resources Service going back to 1964 when rehabilitation of the irrigation system was initiated under the ARDA program.

The year was marked by the retirement of several long-service employees and special note is made of W. R. (Bill) Meighen, the Inspector of Dykes, who retired after 28 years' service, and Humphrey W. Mellish, who was recently transferred to the Service after 37 years in Government, mainly with the former Public Utilities Commission.

While organizational changes can be unsettling, it is particularly gratifying to report the ready acceptance and, indeed, initiation of changes by senior staff within the Service.

As usual, we are indebted to other departments of the Provincial Government, and to the universities for their co-operation and assistance during the year, sentiments that we believe to be reciprocated.

PROVINCIAL MAJOR DISASTER FUND

Although the 1974 spring thaw did not bring river and lake levels to the heights experienced in 1972, both the snow-melt run-off and early and severe spring rainstorms did cause undue hardship to many people in widely separated areas of British Columbia. In August the Province initiated steps to assist individuals and small businesses hit by damaging snow-melt run-off or severe rainstorms between January and July.

As in 1972 the services of the Canadian Independent Adjusters Conference were obtained to appraise damages and adjust claims. In all, approximately 700 claims were handled by the Conference and processed by the Water Resources Service. Payments totalling just under \$1,500,000 will have been made from the Provincial Major Disaster Fund when all approved claims have been finalized. Unlike 1972, however, there was no Federal participation because the total assistance provided by the Province did not meet the senior Government's requirements for financial support for disaster situations.

WATER RIGHTS BRANCH

The Water Rights Branch is the agency of the Provincial Government which administers the control and use of surface water under the authority of the *Water Act*.

The main principles of the *Water Act* regarding the use of water are:

- (1) The property in and the right to the use and flow of all the water at any time in any stream in the Province are for all purposes vested in the Crown in the Right of the Province. The common law principle of riparian water rights has been abolished.
- (2) Prospective users of water must file applications for water licences. There is a procedure for notifying the Deputy Ministers of Agriculture and Recreation and Conservation and all those whose rights may be affected, all of whom have a right of objection to water applications.
- (3) Licence-holders have a right to the use of water under the terms and conditions of the water licence issued by the Comptroller of Water Rights. Earlier licences have priority over licences issued later.
- (4) Retention of a water licence is dependent upon the beneficial use of the water, payment of the water-licence rentals, and observance of the regulations of the *Water Act*.
- (5) A water licence is generally made appurtenant to a parcel of land, mine, or undertaking, and it will pass with any conveyance or other disposition thereof.
- (6) If it is necessary that a water licensee construct works on another person's land, he can expropriate the land reasonably required if a voluntary agreement cannot be reached. If the works will be on Crown land, the water licensee may acquire a permit to occupy Crown land for such purpose.

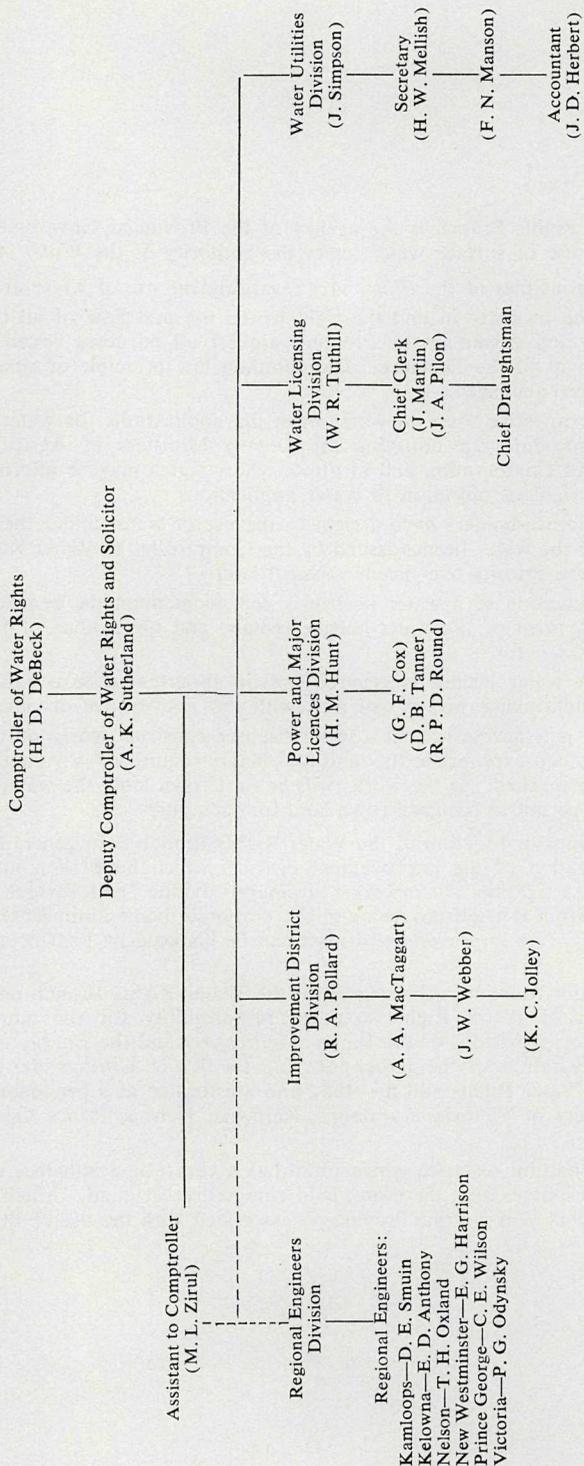
The second major function of the Water Rights Branch is to generally supervise and assist in the administration of the improvement districts which have been incorporated under the *Water Act* for irrigation, waterworks, drainage, dyking, and several other purposes. An improvement district is a self-governing public corporate body administered by elected Trustees. The undertaking of an improvement district can be financed by Provincially guaranteed debenture issues.

A third major function was assigned to the Water Rights Branch on July 15, 1973, when the Comptroller of Water Rights assumed responsibility for the administration of Water Utilities under the provisions of the *Water Utilities Act* and the *Energy Act*.

The administration of the *Water Act* and the *Water Utilities Act* is carried out by the Comptroller of Water Rights and his staff, who are located at a headquarters office in Victoria and district offices at Victoria, Kamloops, Kelowna, Nelson, Prince George, and New Westminster.

Water is a natural resource which often has a controlling influence on economic development of other resources and, therefore, is in competitive demand. Much of the vast industrial expansion of recent years in this Province is associated with the use of British Columbia water.

ORGANIZATION CHART FOR THE WATER RIGHTS BRANCH, YEAR ENDED DECEMBER 1974



WATER RIGHTS BRANCH

H. D. DEBECK, P.ENG.
COMPTROLLER OF WATER RIGHTS

The Water Rights Branch is organized into five divisions as shown on the organization chart included in this Report.

The Licensing Division is responsible for maintaining a complete record of all water licences in effect and for processing applications for new licences or for amendment of existing licences.

The Power and Major Licences Division is responsible to the Comptroller of Water Rights for supervision of the licensing of all power applications and major licences for other purposes. In both cases this becomes a continuing responsibility and includes approval of plans, inspection of the works during construction, assisting with environmental studies, determining annual rentals, and other related duties.

The Improvement Districts Division assists the Comptroller with his responsibilities under the *Water Act* for the administration of improvement districts. It also provides administration and engineering advice to improvement districts and other authorities providing water services to small communities.

The Water Utilities Division provides the staff support for the Comptroller for the regulation of public utilities under the terms of the *Water Utilities Act* and *Energy Act*.

The Regional Engineers Division comprises regional engineers and their staffs at Kamloops, Kelowna, Nelson, New Westminster, Prince George, and Victoria. The function of this division is to provide on-the-spot investigation and determination which has been a guiding principle in the administration of the *Water Act* for many years. In accordance with a general Government program of regionalization of resources management, increased emphasis has been given to the involvement of regional office staff in some phases of the work of all divisions of Water Rights Branch and Water Investigations Branch. Of particular importance is regional liaison with other Government departments through regional resource management committees and other personal contacts. In order to carry out these new functions in addition to the regular responsibilities of *Water Act* administration, it has been necessary to obtain increased staff during 1974 at all regional offices.

The 1974 water-year was a flood-year in the southern half of the Province, but the flood potential which had been indicated by the exceptionally heavy accumulation of snow was fortunately dissipated by a very favourable weather sequence during the snow-melt period. As a result serious flooding occurred only in localized areas in the Okanagan and Kootenay areas. During the flood-threat period, regional and Victoria staff of the Water Rights Branch worked in close liaison with the Hydrology Division of Water Investigations Branch in flood precautions and surveillance work. Water availability for use in 1974 was generally good, although some shortages were experienced in the August to October period.

The number of new applications remained high, but less than the 1973 record year. The total number of water licences in effect as of November 1974 was 28,598. The work load resulting from new applications has greatly increased in recent years, not only because of the increase in the number of applications but also because of the increasing complexity of many of these applications. At the same time there has been a steady increase in the variety and complexity of the other responsibilities of district office staffs resulting from such problems as flooding and erosion, resource-use conflicts, and the greatly increasing scope of the activities of regional districts in which the Regional Engineers participate as members of the technical planning committees. Due to the increased volume of such other work in 1974, the number of water licence applications awaiting adjudication increased slightly to 3,156.

The present water licensing system covers only surface waters but the need to extend this system to include groundwater is becoming increasingly apparent. During 1974 a senior official was assigned to review this situation on a full-time basis, including discussion with other jurisdictions, and the consideration of possible amendments to the *Water Act* and regulations required to put groundwater licensing into effect.

Activity in the Improvement Districts Division continued high during the year. A number of feasibility studies were carried out with regard to proposed new systems, or the rehabilitation of old ones, and final design and supervision of construction were provided for several small projects where special circumstances warranted such assistance. Many proposals prepared by consultants were reviewed with respect to both technical suitability and economic feasibility.

By agreement with the Federal Government, the Province assumes the responsibility for the proper operation and maintenance of all irrigation and farm domestic water systems constructed with Federal and Provincial funds under the ARDA program, in order to assure compliance with the intent of the statutes involved and the agreements made under them. A program of continuing surveillance of these systems was instituted by the Water Rights Branch in 1972. The program is still in an early stage of development and is limited by the availability of manpower, but the need for this kind of follow-up has been clearly demonstrated.

Licences were issued during the year authorizing the construction of hydro power projects at Site One on the Peace River near Hudson's Hope and at the Seven Mile Site on the Pend-d'Oreille River near Trail. The Site One application was uncontested, but a public hearing was required by the Comptroller to hear objections to the Seven Mile Project.

The year under review, 1974, was the first full year of the jurisdiction of the Comptroller over water utilities, formerly the responsibility of the Public Utilities Commission. The main purpose of this administration is the regulation of rates charged for water and standards of service. To ensure continuing satisfactory service for the protection of the public, increasing use has been made of the establishment of trust funds to ensure adequate operation and maintenance and to provide for the replacement of obsolete system components.

The activities of the Water Rights Branch for 1974 are recorded in greater detail in the reports of the individual divisions of the Branch in the pages following.

WATER LICENSING DIVISION

Water licences are issued for domestic, waterworks, irrigation, mining, industrial, power, storage, and other purposes. Licences are required, with few exceptions before any person, company, corporation, community, or Government agency uses water from any surface water source.

As of November 30, 1974, the number of water licences in effect totalled 28,598, each of which authorizes the use of water for one or more purposes. There were 16,837 licences authorizing the use of water for domestic purposes, 1,214 for waterworks; 11,326 for irrigation; 308 for power, and 1,677 for storage purpose. The total quantity authorized to be stored was 95,776,306 acre-feet.

Applications for approvals under section 7 of the *Water Act*, either for the use of water for a period not exceeding six months (the former period of 90 days was amended in 1974) or to authorize changes in and about a stream dropped to 126 from 149 in 1973. Applications for the amendment of existing licences by apportionment, transfer of appurtenancy, or changes of works or purpose have increased over last year's total and there are now 585 amendment applications pending. There are 95 water-users communities incorporated under the *Water Act* compared to 93 in 1973.

The following tables show the staff establishment for the licensing division and the principal activities of the General and Draughting offices in the 12-month period ending November 30, 1974, together with the activity data for the five preceding years:

LICENSING DIVISION

Staff, 30; November 1974

Administrative Officers, 3; Total staff, 31

	General Office	Draughting Office
Administrative Officer 1	1	---
Clerk 6	2	---
Clerk 5	---	1
Clerk 4	3	1
Clerk 3	3	2
Clerk 2	2	---
Clerk 1	2	---
Clerk-Stenographer 3	1	---
Clerk-Stenographer 2	1	---
Clerk-Typist 2	1	---
Technician 2	---	1
Draughtsman 4	---	1
Draughtsman 3	---	2
Draughtsman 2	---	4
Draughtsman 1	---	2
	—	—
	16	14

General Office

	1969	1970	1971	1972	1973	1974
Application for—						
Licences.....	1,503	1,767	1,733	1,515	1,892	1,708
Rights-of-way.....	227	243	263	122	246	303
Apportionments.....	75	60	96	91	103	130
Transfers of appurtenancy.....	119	104	159	137	162	130
Changes of works or extensions of time.....	270	278	243	307	327	452
Approvals.....	50	81	88	91	149	126
Totals.....	2,224	2,533	2,582	2,263	2,879	2,844
Average monthly applications.....	187	211	215	189	240	237
Issues of—						
Conditional licences.....	1,103	1,447	1,343	1,746	1,131	1,544
Final licences.....	444	298	286	359	400	393
Approvals.....	45	75	85	96	132	109
Licence amendments.....	206	164	182	236	168	239
Rights-of-way.....	356	478	474	524	478	389
Changes of works and extensions of time.....	258	271	207	313	315	331
Totals.....	2,412	2,733	2,577	3,274	2,624	3,005
Average monthly issues.....	201	228	215	273	219	250
Changes of address, ownership, etc.....	2,701	2,272	1,796	2,803	2,608	3,534
Licence cancellations and abandonments.....	399	340	338	359	427	356
Objections to applications.....	493	616	359	206	274	262
Annual over-all totals.....	8,249	8,494	7,652	8,905	8,812	10,001
Applications pending at November 30.....	2,400	2,628	2,827	2,522	3,115	3,156

Draughting Office

	1969	1970	1971	1972	1973	1974
New water licence applications cleared and plotted on maps.....	1,448	1,623	1,702	1,400	2,001	1,682
Final and conditional licence plans prepared.....	1,961	1,955	2,106	2,463	2,125	2,017
Regional Engineers' reports processed.....		858	1,326	1,197	1,168	953
New water rights maps compiled and traced.....	51	65	110	107	152	109
Water rights maps revised.....	7	5		5	2	1
New improvement districts described and plans prepared.....	8	3	5	12	7	8
Improvement districts descriptions and plans amended.....	31	46	50	65	48	33
Reference maps renewed.....	48	24	36	19	41	122
Apportionments and transfers of appurtenancy.....	194	164	255	228	265	255
Changes of works and extension of time.....	270	278	243	313	327	452
Approvals.....	50	81	88	95	149	126
Rights-of-way over Crown land.....	356	478	404	528	478	303
Changes of ownership and cancellations.....	3,100	2,612	2,134	3,162	3,035	3,890
Land clearances (purchases, leases, etc.).....	8,623	6,990	5,431	4,362	3,812	3,595
Pollution control permit clearances.....			161	434	716	507
Forest Service clearances (timber sales, etc.).....		358	1,867	1,738	2,338	1,556
Totals.....	16,147	15,540	15,919	16,629	16,664	15,609

REGIONAL ENGINEERS DIVISION

In keeping with their changing role which reflects greater involvement in resource management and allocation decisions and increasing responsibility in management of the water resource under the *Water Act* of the Province, the title of "District Engineer" was changed early in the year to "Regional Engineer." This is also in keeping with plans to establish common regional boundaries and regional centres for the several departments of Government having jurisdiction in the resource field. The title of "Chief of District Engineers Division" was also changed to "Assistant to Comptroller of Water Rights" to reflect the expansion in his responsibilities to include assistance to the Comptroller in administrative matters. Staff increases, including five technicians to assist in duties related to water utilities and 11 technicians and one engineer to assist in normal administrative duties and engineering investigations, will alleviate staff deficiencies of long standing in the regional offices. The new staff positions were still in process of being filled at the end of the year.

Staff of most of the regional offices were involved in flood preparations in co-operation with other municipal and Provincial Government agencies in the early part of the season in anticipation of large-volume water flows indicated by the heavy snow-pack in most areas of the Province. Although flood peaks were not as high as expected, relatively high flows were experienced, particularly in the regions administered by the Nelson and Prince George offices, and considerable stream bank and channel erosion and some flooding occurred. A stream-clearing program authorized by the Minister and aimed at removing log jams and other hazards resulting from the 1974 high water was undertaken and engaged a large percentage of regional office staff time during the fall months.

Normal water licence administrative work was continued at a relatively high level in spite of extraordinary commitments connected with the occurrence of a high-flow year. Action on applications for water licences, however, still did not keep pace with the number of new applications received.

The table below summarizes the work associated with water licence administration. Reports of the six Regional Engineers follow.

Staffing of Regional Engineers Division

	Regional Offices						Totals
	Kamloops	Kelowna	Nelson ¹	New Westminster	Prince George	Victoria	
Engineer 5	1	1	1	---	1	---	4
Engineer 4	---	---	---	1	---	1	2
Engineer 3	3	2	2	1	1	1	10
Technician 3	1	1	1	1	1	---	5
Technician 2	---	1	---	---	---	---	1
Technician 1	4	1	3	1	1	---	10
Engineering Assistant	1	---	2	---	1	1	5
Engineering Aide	2	1	---	2	1	2	8
Clerk-Stenographer	1	1	2	1	1	---	6
Clerk	1	1	---	---	---	---	2
	14	9	11	7	7	5	53

¹ The Technician 3 position, one Technician 1, and one Engineering Assistant position at Nelson office remain not filled at the date of this Report.

Summary of Water Licence Application Report Situation and Reports for Licence Amendments and Related Activities as Reported by Regional Engineer for the Period November 1, 1973, to November 30, 1974.

	District Offices						Total
	Kamloops	Kelowna	Nelson	New West- minster	Prince George	Victoria	
Applications for water licences—							
On hand, November 1, 1973.....	590	104	498	159	240	88	1,679
Received during the year.....	486	249	361	248	237	226	1,807
Inspected and reported on.....	389	158	153	240	117	222	1,279
Cancelled or abandoned.....	86	23	34	39	61	13	256
On hand, November 30, 1974.....	601	172	672	128	299	79	1,951
Applications for approval under <i>Water Act</i> , section 7, reported on.....	18	14	20	26	23	16	117
Reports for final water licences.....	99	20	76	44	110	64	413
Water licence amendment reports—							
Apportionment.....	32	14	26	8	4	20	104
Transfer of appurtenancy.....	30	23	25	13	3	14	108
Change of works.....	44	11	28	15	1	11	111
Extension of time.....	11	4	3	7	73	39	137
Other.....	2	1	16	45	5	2	71
New conditional water licences.....	398	269	293	177	86	237	1,460
New final water licences.....	75	36	41	76	98	83	409

KAMLOOPS REGIONAL OFFICE

Water supply in the region varied during 1974 with most shortages occurring in the Cariboo-Chilcotin area, generally on streams lacking water-storage facilities. Precipitation during the growing season was approximately 65 per cent of normal, resulting in reduced forage crop production. This was in contrast to the serious flood threat which existed over most of the Fraser-Thompson watershed during the early part of the season.

As a result of the serious flood potential indicated within the Thompson River watershed, field staff were diverted from their normal duties to carry out special flood studies and provide technical advice to land owners undertaking to protect their properties from flooding. Assistance was given the City of Kamloops in constructing flood protection works under the *Kamloops Emergency Flood Control Act*.

Administrative effort was directed to the instigation of a regional dam inspection program, commencement of regional administration of water utilities; undertaking of engineering projects with respect to river improvements, and the usual functions with respect to the allocation of water under water licences and administration of the *Water Act*.

A large increase in the number of new applications received resulted in a further increase in the backlog of applications awaiting attention in spite of the number of application reports being up 18 per cent over the previous year.

Title searches numbering 408 were carried out at the Kamloops Land Registry office and 1,327 official plans were obtained for other Water Rights Branch offices, 72 complaints involving field investigations were attended to.

KELOWNA REGIONAL OFFICE

The well-above-average snow-pack raised Kalamalka Lake level to an elevation of 1,286.55 feet on June 8, which is 1.62 feet above the normal operating level and some shoreline damage occurred.

The Similkameen River at Nighthawk peaked at 31,000 cfs on June 17, compared to 45,800 cfs in the 1972 flood year. Minor flooding occurred along the Similkameen River and Keremeos Creek near Cawston and around the shoreline of Osoyoos Lake which is affected by high flows in the Similkameen River.

The inflow to Okanagan Lake from April 1 to June 30 was 618,260 acre-feet compared to 636,400 acre-feet in 1972 and 579,200 acre-feet in 1948. The lake rose to elevation 1,124.11 feet on June 27, which is 0.32 foot above the normal full operating level. Some minor flood damage was reported around the perimeter of Okanagan Lake.

Reports of flooding were investigated at Sicamous, Enderby, Grinrod, Armstrong, Summerland, Kelowna, Princeton, Tulameen, Oliver, and Grand Forks. Damage from flooding during the 1974 freshet season was significantly less than anticipated. Factors which tended to minimize damage from flooding were favourable weather conditions during the melt period, close co-ordination of the Government agencies involved, and the active public information program. Major water-storage reservoirs were inspected prior to snow run-off to indicate and correct any hazards from this source.

Water licence applications processed by this office by year, during the past 10-year period are summarized in the following table:

Summary of Water Licence Applications Processed, 1965 to 1974

Year	Applications Received	Reports Submitted	Cancelled or Abandoned	Total Disposed of
1965	187	145	13	158
1966	196	165	35	200
1967	209	156	27	183
1968	229	209	24	233
1969	230	149	55	204
1970	272	249	30	279
1971	246	301	23	324
1972	199	254	16	270
1973	263	238	17	255
1974	244	147	20	167

The 245 licensed storage dams within the Kelowna region are inspected regularly to ensure that they are being properly operated and maintained. Ninety-seven storage dams were inspected during 1974 and substantial repairs were ordered on 16 structures. Two new dams were constructed, one on Christian Creek near Princeton and one on Greystoke Lake near Kelowna.

A Senior Technician was added to the staff to assist in the responsibility of reporting to the Comptroller on new water utility companies, inspecting installation of new works, and assisting in the administration of existing utility companies. There are 51 existing water utilities in the Kelowna region and 11 new applications currently are being processed.

A "Source Investigation Program" was developed and implemented in the Kelowna Regional office to compile and analyse data on controversial watersheds. This involves the study of hydrology, existing water use, existing and potential storage sites, other agency interests, and possible future water demands in a number of watersheds. The data collected will be used to more effectively manage the water resource within the watersheds.

The regional office was involved in special studies including the reinventory of the forestry resources in the Windermere PSYU, a task force study of the proposed new highway crossing of the Lardeau River at Trout Lake, and examination of the possible impact on various resources of a proposed natural gas pipe-line.

Engineering Investigations and Reports

Project	Description
Glade Improvement District	Prepared engineering feasibility study for rehabilitation of District's water supply system. Provided lay-out and supervision services for construction.
Edgewater Improvement District	Provided supervision for rehabilitation of District's water distribution system. Work was approximately 80 per cent completed and will be continued next season.
Community of "Brandon," near Slocan	Prepared an engineering feasibility report for rehabilitation of the community's domestic water system.
Water Utilities	Field surveys to determine location of works of three water utilities companies were conducted and several utilities were investigated.
Stream-clearing Program	Twenty-two stream-clearing projects related to stream channels damaged during the 1974 freshet, were completed.

NEW WESTMINSTER REGIONAL OFFICE

The serious flood potential existing in the spring of 1974 required considerable involvement of staff with the Lower Fraser Valley Flood Organization preparations. Fortunately, flooding during the freshet period was minimal and conditions returned to normal at an early date. Good stream flows were sustained well into August, but low flows were experienced on some streams as dry weather continued into September and October, resulting in receipt of some complaints of water shortages.

PRINCE GEORGE REGIONAL OFFICE

In anticipation of abnormally high freshet flows a number of gauges were installed at various points on the Skeena River in the Terrace area to record high-water levels as a basis for establishing future floodplain zoning.

Anticipated high-water levels at Prince George and on the main stem of the Fraser River downstream from its confluence with the Nechako River were appreciably modified by manipulation of the Nechako Reservoir and control of outflow through its spillway during the high-water period. Staff of the Prince George office assisted in this control by maintaining continuous surveillance of conditions on the Nechako River and forwarding pertinent information to the Comptroller as required.

The Prince George Regional office set up a system for obtaining data on the magnitude and downstream progress of flood crests on the Nechako and Upper Fraser Rivers and made this information available to Governmental agencies and private organizations concerned with possible flooding.

Severe flooding which resulted from an exceptional rain and hail storm which swept the Peace River district during early July was investigated. Relative to this, the general erosion and siltation problems prevalent in the Peace River district and which are having a damaging effect on established farmlands, were subject of study and a report recommending the establishment of a pilot water and soil conservation project for the Rolla Creek watershed in which conditions are typical.

The Prince George Regional Engineer received instructions to investigate a devastating flash flood on the Skeena River and its tributaries in the Terrace area resulting from mid-October precipitation of unprecedented magnitude. A report was prepared describing the nature and extent of damage which resulted from flooding and measures were recommended to prevent or minimize future damage in the event of a similar occurrence.

Assistance to the Hydrology Division of Water Investigations Branch in its snow-course measurement program continued with new stations being added in the Upper North Thompson area.

The demand for water in the northern Interior has continued to increase with the growth in population. In order to put water allocation on a firm basis, a stream-flow measurement program was instituted and 145 stream measurements made.

Surveys were conducted at Dragon Lake and at Bouchie Lake, near Quesnel, to establish minimum and maximum water levels on the lakes; staff involvement in the Maxan Lake multi-resource use study was continued; emergency work was organized and supervised on the Bowron River to reduce the level of Bowron Lake; construction of dyking and revetment works on the Fraser River in the Village of South Fort George was supervised; an extensive debris removal project was undertaken and completed on the Salmon River north of Prince George in the fall.

VICTORIA REGIONAL OFFICE

In the 1974 water-year winter weather came early with snow falling throughout Vancouver Island on November 13, 1973. Heavy rainfall occurring January 12 to 16, 1974, produced exceptionally high stream flows, with resultant flooding of adjacent lands, in Craigflower Creek, Cowichan River, Chemainus River, Nanaimo River, Diver Lake, Englishman River, and Little River. Periodic rainfall persisted until August, resulting in good growing conditions and a minimum number of complaints of shortages of water. The months of August, September, and October, however, were exceptionally sunny and dry. Rainfall in these three months amounted to 1.1 inches, the lowest since 1904.

Investigations were made, remedial action taken, or report completed on 72 complaints of flooding of residential lands. Many of these complaints recur in the same areas from year to year and are largely a result of the continuing subdivision of low-lying lands subject to flooding. Areas from which complaints are consistently received are Greater Victoria, Lake Cowichan, Cassidy-Cedar, Parksville, including the Errington-Coombs area, Port Alberni, Comox, and Campbell River. Where in past years, instances of flooding requiring investigation were experienced coincident with the winter season, they now occur throughout the year in increasing numbers. New regulations in force, pertaining to the subdivision of lands subject to flooding, will hopefully reduce the incidence of future water damage.

Land erosion problems were inspected on lands adjacent to Robertson River, Chemainus River, Haslam Creek, Chase River, Koksilah River, Waterloo Creek, Stewart Creek, DeMamiel Creek. Twenty-two instances of obstruction of streams were investigated, resulting in 12 orders for removal. Two unauthorized small dams were removed by office staff. Four water-shortage and eight pollution problems were investigated and resolved. Inspections and inventories of licensed and unlicensed use of water were made on nine water sources to determine the availability of unrecorded water for further licensing, to advise applying for licences where indicated and to cancel unused licences.

In the fall of 1974 work was arranged, and supervision provided for emergency stream clearing of log jams and gravel bars on Haslam Creek, Robertson River,

Meade Creek, Koksilah River, and Nanaimo River, the total cost of the work being approximately \$30,000. The entire effort of engineering staff was occupied to the limit on this program during the fall months necessitating postponement of regular work.

POWER AND MAJOR LICENCES DIVISION

POWER LICENCE APPLICATIONS

In addition to the major power applications described below some applications were received to develop smaller power plants.

Seven Mile Project—A conditional water licence was issued to the British Columbia Hydro and Power Authority to develop 700 mw. at the Seven Mile site on the Pend-d'Oreille River, near Trail. The licence was granted following a public hearing, at which environmental and social impact studies and briefs were presented. Special clauses were included in the licence to ensure that the development will proceed with minimum detrimental effects to the natural environment.

Site One—An application to develop a 700-mw. plant at Hudson's Hope on the Peace River was received from the British Columbia Hydro and Power authority and since little objection was expressed to the proposal, a licence was issued without holding a hearing. However, special clauses were inserted in the licence requiring the Authority to take special measures for the protection of the environment.

Environmental Studies

Seven Mile—Although environmental and social impact studies carried out by private consultants and Government agencies indicated that detrimental effects associated with the development were not sufficiently severe to warrant refusal of a water licence, several issues remained unresolved by the end of the year, such as the location of the main access road, wildlife management during and after construction, wildlife mitigation, recreation access and facilities, impact and location of substation and transmission-lines, effect of reservoir operation on water-related recreational activities, and reservoir clearing standards.

Site One—Subsequent to the issuing of a water licence, plans for location of labour camps, site offices, storage areas, construction areas, and borrow-pit locations were received from British Columbia Hydro and approved. A review of proposed recreational facilities and clearing standards is continuing.

Mica—Following completion of Mica Dam early in 1973, a study of the effects of the reservoir on the resources of the Mica Region was commissioned by the Environment and Land Use Committee. The Division's input to this study may occur on the floodplains of the Columbia and the Kicking Horse River which threatens Golden, and the Canoe Hot Springs, south of Valemount, which will be submerged.

Approval of Plans

During 1974, Mica Dam and Kootenay Canal project were visited twice by Divisional staff. In addition to site visits continuing reviews were carried out covering such subjects as reservoir slope surveillance, dam instrumentation, monitoring of seismic activity, reservoir filling program, regional resource studies, and geologic factors as they affect site selection. Visits were also made to several smaller projects either to ensure that construction was proceeding according to approved plans, or that rehabilitation or reconstruction work required was being carried out.

Work is progressing satisfactorily on both the Mica and Kootenay Canal projects. At Mica, project work on the dam and spillway was completed in 1973, and work in 1974 was concentrated in the powerhouse. Excavation work is virtually complete with the exception of a small amount remaining in the tailrace tunnels, and the emphasis has now shifted to concrete placement and machinery installation. The close of 1974 at the Kootenay Canal plant should see the completion of the canal and intake structure; the powerhouse intake headworks and the penstocks should be nearing completion with the main work being carried out on machinery installation in the powerhouse.

A more detailed report on the construction progress of the major projects named above appears in the *Annual Review of Power in British Columbia* produced in July of each year.

Power Rentals

A tabulation of rentals for the past 10 years, together with the percentage change from each previous year, is shown below.

Year	Total Billed \$	Per Cent Change
1964	2,042,612	-----
1965	2,146,805	+5.10
1966	2,135,593	-0.53
1967	2,290,985	+7.27
1968	2,467,329	+7.69
1969	3,207,607	+30.00
1970	3,546,858	+10.57
1971	3,510,014	-1.04
1972	3,978,448	+13.34
1973	4,345,060	+9.21
1974	4,720,432	+8.63
Average annual change	-----	+8.74

FLOOD CONTROL

Operations During the Past Year

Early forecasts of volume of run-off from snow-melt indicated a fairly high probability of damaging floods occurring during the summer. In view of this certain precautions were taken by Provincial authorities, and the Power and Major Licences Division ordered the lowering of reservoirs to take best advantage of the storage available.

In the Fraser Basin the procedures that were earlier developed and applied successfully for the 1972 flood were reinstated. The anticipatory storage in Nechako Reservoir was increased by means of a preflood drawdown, commencing on March 21. In addition, the British Columbia Hydro and Power Authority lowered the Bridge River Reservoirs and undertook to maintain some emergency storage space in the Stave Lake Reservoir.

Cooler than normal spring and summer weather retarded the snow-melt to a considerable extent with the result that flows in the Fraser River itself were not of

a damaging order of magnitude. Tributary flooding did take place in a number of areas and is reported elsewhere.

As in 1972, it was considered that more than adequate storage space was available in the Columbia basin; however, the Division staff monitored daily reservoir levels and discharges throughout the high-run-off season. A full report on flood-control operations appears in the section on the Columbia River Treaty which follows.

Studies in Progress

Lake Williston—Studies have been continuing in co-operation with British Columbia Hydro and Power Authority on a method of operation designed to optimize flood control downstream on the Peace River without jeopardizing the power production.

Maximum Probable Floods—A study evaluating maximum probable floods for all rivers in the Province having significant years of stream-flow records was undertaken. Flood values were derived using the "Hershfield Method" based on mean annual flood peaks and standard deviations, determined by computer programs and tabulated by regions.

Kootenay Lake Board of Control

Kootenay Lake exceeded the maximum allowable elevations on several days in January, caused by an unprecedented inflow to the lake which was about three times higher than any January flow in the 45 years of record. Without Libby and Duncan storage, this inflow would have been even higher.

A meeting of the several international boards having jurisdiction along the British Columbia/United States boundary was held in Seattle on February 14. A tour of inspection of the Kootenay Lake Board of Control's area of jurisdiction was conducted in September. In addition, construction progress at the Mica Creek, Libby, and Kootenay Canal Projects was observed and a tour of the H. L. Keenleyside Dam undertaken.

Ice Studies

Nechako River—Ice jams are an intermittent problem at Prince George and a study was initiated to determine if a cure could be achieved by manipulation of releases from the Nechako Reservoir. Advice was sought from other parts of Canada and the Division is particularly indebted to J. B. Bryce, of Ontario Hydro, D. M. Foulds, of Environment Canada (Ontario Region), and W. Nemanishen, of Water Survey of Canada (Calgary).

Peace River—The Town of Peace River in the Province of Alberta, in most years, has experienced ice-jams at the end of the winter season. At a meeting in Vancouver on March 20, 1974, representatives of Alberta, British Columbia, and British Columbia Hydro and Power Authority established a Joint Task Force to report on measures taken to alleviate ice-jams during the 1974 break-up. By plowing the snow cover, grooving the ice sheet, and dusting the cleared track with sand in late March and early April, the ice sheet was weakened in advance of the break-up and it is believed that this helped considerably in reducing the flood potential. Further protection was provided by the British Columbia Hydro and Power Authority who cut back on power flows from the G. M. Shrum Generating Station during the ice break-up period.

GENERATION AND LOAD GROWTH

Interim Estimate for Past Year

During 1974 the consumption of electricity within the Province rose marginally (1.67 per cent) over the amount used during 1973. Labour problems in the Province accounted for the relatively small increase. Cominco, for instance, was plagued by a very lengthy strike with a considerable drop in production.

It will be noted that the utilities generation is 1723 Gwh. lower than last year; however this is due to a reduction in (net) exports amounting to 2,500 Gwh.

The Division's customary year-end survey is tabulated below. More accurate data will appear in the 1975 *Annual Review of Power in British Columbia*.

	1973	1974	Change
Generation by utilities—	(Gwh.)	(Gwh.)	(Per Cent)
Hydro	22,629	23,590	+4.25
Thermal	3,041	357	-88.3
Subtotal	25,670	23,947	-6.71
Generation by industries—			
Hydro	10,738	10,526	-1.97
Thermal	1,361	1,297	-4.70
Subtotal	12,099	11,823	-2.28
Total generation in British Columbia	37,769	35,770	-5.29
Exports (net)	4,813	2,263	
Total electric load in British Columbia	32,956	33,507	+1.67

NOTES—1 gigawatt-hour (Gwh.)=1,000,000 kilowatt-hours. Hydro-mechanical generation is not included in the above figures.

Long-term Growth

A 10-year analysis of growth in power requirements appeared in the July 1974 *Annual Review of Power in British Columbia*. For the period 1963-1973 the mean annual rates of growth were—total generated, 9.27 per cent; and total required within British Columbia, 7.82 per cent. The difference in the two growth rates is due to the imbalance of imports and exports with 1973 being a year of substantial net export.

Two graphs, one showing peak and average energy requirements and the other the installed capacity, 1930 to date, are included. It will be noted that on the average, while a fairly constant rate of load growth has been maintained since 1955, for a few years installed capacity outstripped the peak requirements.

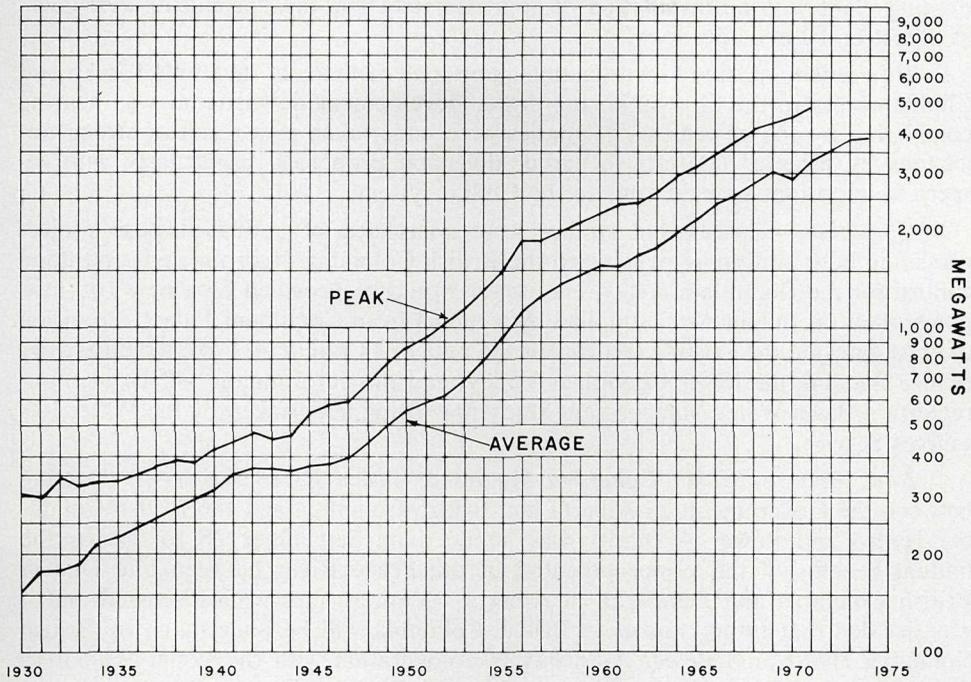
Power Exports

The occurrence of power surpluses in good water years is a characteristic of hydro power systems. During the first half of 1974 exports of power were not substantial. However, during the last six months the rates of flow increased quite markedly as a result of a high volume of run-off which provided a substantial surplus of hydro power. In addition, the strike at Cominco's Trail Smelter made large blocks of power available, some of which has been transmitted as far as San Diego, California.

Project Studies

Brilliant II—A study assessing the cost of additional capacity and energy at Brilliant Dam on the Kootenay River, made available by increased regulation upstream at Libby and Duncan Dams, was completed. The study indicates that the

PEAK AND AVERAGE ENERGY REQUIREMENTS - 1930 to DATE



TOTAL INSTALLED CAPACITY - 1930 to DATE



optimum development would include a surface powerhouse downstream of the existing plant with an installation of approximately 100 mw, producing 430 Gwh. at a cost of 10 mills per kwh.

Homathko—A study investigating alternative methods of diverting Taseko and Chilko waters to the Homathko for power development downstream was nearing completion by end of year. The studies were undertaken as a result of strong objections by fisheries interests to earlier diversion proposals, particularly with respect to important sockeye runs to the Chilko system.

Coquitlam—Cost-benefit studies were completed of a dual-purpose project providing both additional peaking to the British Columbia Hydro system and flood control for the Coquitlam area. The power would be provided by a new 100-mw. powerplant on Indian Arm, supplied by a tunnel from Coquitlam Lake. Provision of crest gates on the existing spillway at the outlet of Coquitlam Lake would greatly reduce flooding the lower Coquitlam Valley, and this information will be incorporated in a Basin Water Management Study now being undertaken by the Water Resources Service.

Joint Alberta/British Columbia Studies of Peace River Power—A meeting between the Governments of Alberta and British Columbia and the British Columbia Hydro and Power Authority was attended on September 26 to discuss the mutual benefits of the power potential of the Peace River between Site One in British Columbia and Dunvegan in Alberta. Various sites were discussed and it was decided that future studies in British Columbia will be undertaken by British Columbia Hydro and Power Authority in co-operation with the Water Resources Service; Alberta's program will be co-ordinated by Alberta Environment in co-operation with Energy Resources Conservation Board.

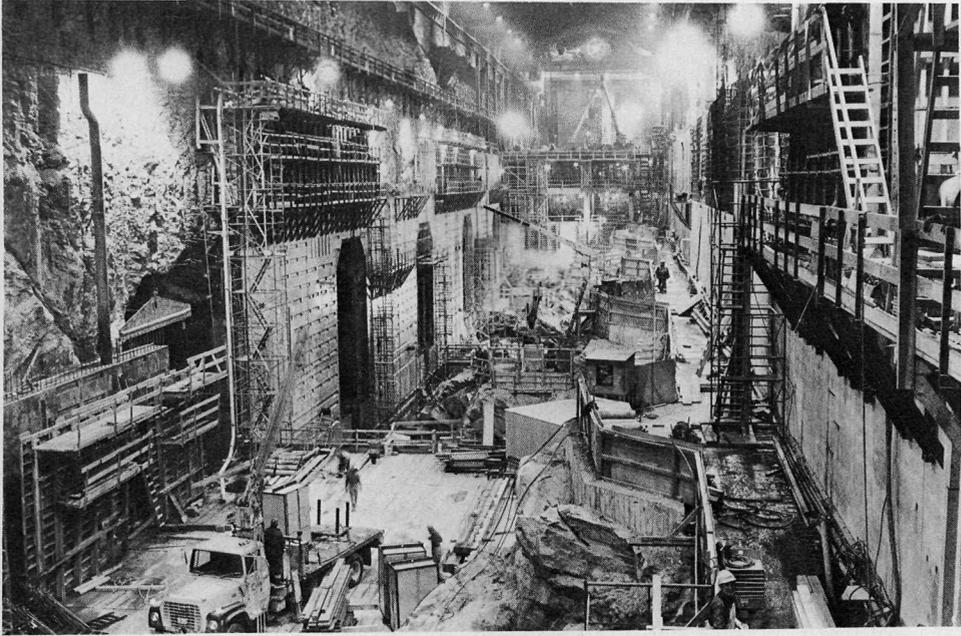
COLUMBIA RIVER TREATY

Mica Reservoir

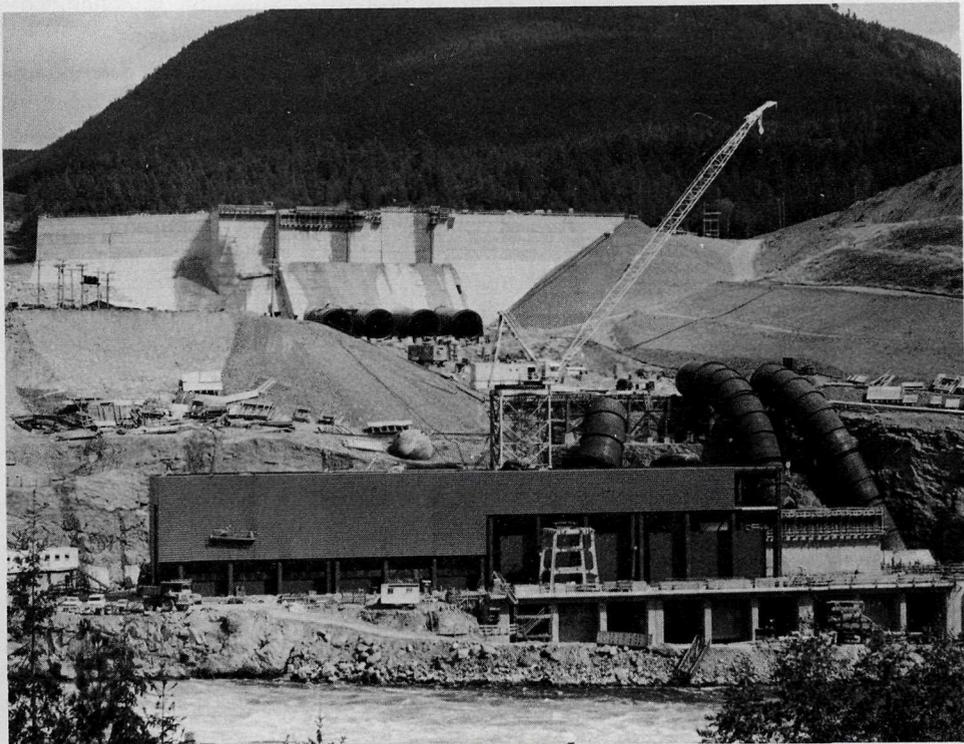
Now in its second year of operation, Mica Dam impounded water to a maximum pool elevation of 2,409 during the summer of 1974. This represents a volume of over 13 million acre-feet, less than 2 million short of the target of 15 million required by the time of first power operation which is scheduled for the fall of 1976. This success is due to an exceptionally high volume of run-off this year. Ultimately, Mica Reservoir will hold up to 20 million acre-feet consisting of—8 million dead storage, 7 million committed for Treaty purposes (but usable for generation in Canada), and 5 million for Canadian use only. The underground powerplant, now being built, will eventually house six units totalling 2,610 mw. Construction is proceeding on schedule.

Benefits in Canada

Kootenay Canal Plant—This project is being built in order to develop the additional generating capability available in Canada by the construction and operation of Libby and Duncan Dams. The project comprises a canal, with its intake at Corra Linn Dam, supplying water to a powerhouse just downstream from South Slocan Dam. In one step this plant will generate more power than is produced by the five existing plants which will be bypassed. Four units of 132-mw. rates capacity each will develop power from the peak flow of 27,000 cfs. through a net head of 245 feet. The first two units will be on-line in the fall of 1975 and the balance in 1976.



The underground powerhouse under construction just below the downstream face of the Mica Dam on the Columbia River.



Penstocks being installed at the Kootenay Canal hydro-electric project. First two generating units come into service during 1975.

Flood of 1974—The Treaty reservoirs were an unqualified success in containing this year's run-off. The combination of Arrow, Duncan, Libby, and Mica held back a flood which was larger than the 1961 flood during which extensive damage occurred, and even approached the magnitude of the 1894 flood. It was determined that, without this regulation, the level of Kootenay Lake would have been nearly 10 feet higher and the level of the Columbia River at Trail would have been 21 feet higher. In the United States, the regulated flow at the Dalles did not exceed 600,000 cfs., the point at which damage commences; without regulation it would have equalled the disastrous flood of 1948, peaking in excess of 1,000,000 cfs.

Libby Reservoir

Lake Koocanusa, which is formed behind Libby Dam on the Kootenai River in Montana, filled for the first time on July 25, 1974, flooding to a maximum depth of 140 feet at the border.

The Government of British Columbia undertook the Canada-British Columbia Agreement of 1963 to prepare the reservoir area in Canada for flooding, and the Water Resources Service was assigned the role of co-ordinating agency. The Division was responsible for maintaining control over field progress, budget expenditure, and liaison between all agencies engaged in the program.

All roads, bridges, and rail relocations were completed earlier and power and telephone services have been disconnected or relocated as necessary. The property acquisition program is nearing completion with four settlements outstanding. The British Columbia Forest Service has cleared all but about 10 acres of the original 9,240 acres of forested land and, as soon as property acquisition is concluded, clearing will be completed.

A meeting was held on September 19, 1974, in Victoria with representatives of the United States Corps of Engineers, the authority responsible for construction of Libby Dam and reservoir preparation in Montana, to discuss progress and items of common interest and concern.

Dam Inspection

The dam inspection program during 1974 was expanded to include the inspection of smaller dams (those over 10 feet in height). This year the small dams on Vancouver Island were inspected as a pilot for a future program to undertake small structure inspections elsewhere in the Province. The scope of the program was also enlarged to include the inspection of all underwater installations by two qualified scuba divers on the Division's staff.

Twenty-eight major dams and 30 smaller structures were inspected as part of the continuing program to ensure that adequate maintenance was being carried out and that no adverse conditions had developed. Several major dams under construction were also visited during the year to ensure compliance with previously approved plans.

A technical report presenting the optimum goals for the dam inspection program was completed and may be initiated in the spring of 1975. It represents an expanded surveillance program and a classification system for dams from which inspection frequency and standards may be derived. Other investigations on aspects of dam safety were undertaken during the year; these included dam-stability studies, flood-handling capability, and reservoir-bank stability.

Metric Conversion

The task of co-ordinating the conversion for Water Rights to the international system of units was assigned to this Division. A tentative schedule covering a two-year period has already been drawn up and is being reviewed.

IMPROVEMENT DISTRICTS DIVISION

There are now 270 improvement districts incorporated under the *Water Act* and administered by the Comptroller of Water Rights. During 1974 the following districts were incorporated and dissolved:

Districts Incorporated

Wolfe Waterworks.
Sutherland Creek Waterworks.
Valhalla Ridge Improvement.
Ptarmigan Flats Drainage.
Tugulnuit Lake Improvement.
Missezula Lake Waterworks.
Nicomen Island Improvement.

Districts Dissolved

Todd Hill Irrigation.
West Nicomen Dyking.
East Nicomen Dyking.
Bluebird Bay Waterworks.
Crozier Waterworks.

Administration of the following improvement districts incorporated under the *Water Act*, lying wholly within the area to be included within the Cities of Prince George and Nanaimo on January 1, 1975, was transferred to the Department of Municipal Affairs:

Districts in Prince George

Airport Hill Improvement.
Blackburn Improvement.
Charella Gardens Waterworks.
Clear Acres Improvement.
College Heights Improvement.
Lafrenier Improvement.
Nechako Improvement.
Parkridge Heights Improvement.
Starlane Waterworks.
Western Acres Improvement.

Districts in Nanaimo

Departure Bay Waterworks.
Harewood Improvement.
Northfield Fire Protection.
North Wellington Waterworks.
Petroglyph Waterworks.

The Letters Patent of 40 other improvement districts were amended in 1974, most changes being boundary amendments.

There are now \$15,704,100 of improvement districts' debentures guaranteed by the Province under the *Improvement Districts Assistance Loan Act*, of which \$4,416,100 are serial debentures and \$11,288,000 term debentures. Sinking funds for redemption of the term debentures are held by the Province in the amount of approximately \$1,051,200. During 1974, debentures of \$2,177,000 were guaranteed.

ENGINEERING SERVICES

During the year both engineering and administrative staff of the Division travelled extensively throughout the Province, meeting with district trustees, municipal officials, organizing committees, and land developers. About 200 visits were made to 101 districts regarding technical and administrative problems.

Reports Prepared and Under Preparation

Community	Subject	Status of Report at End of Year
Avola	Proposed rehabilitation of a domestic-water system	Completed.
Balfour Irrigation District	Additional domestic-water reservoir	Completed.
Beck's Lake	Flooding	Completed.
Blackburn Improvement District	Water consumption	Study continuing.
Braemar Heights Waterworks District and Triangle Mountain Improvement District	Domestic-water-system capacity	Completed.
Coldwater Improvement District	Appraisal of domestic-water system	Completed.
Deep Cove Waterworks District	Hydraulic analysis of domestic-water system	Completed.
Edgewater Improvement District	Rehabilitation of domestic-water system	Completed.
Hillcrest Waterworks District	Alternative sources of domestic-water supply	Completed.
Louis Creek	Proposed rehabilitation of a domestic-water system	Completed.
	Metric conversion	Study continuing.
Village of New Denver	Proposed rehabilitation of a domestic-water system	Completed.
Ootischenia Improvement District	Alternative sources of domestic-water supply	Completed.
Radium Sewerage District	Extension of sewerage system and upgrading of treatment	Completed.
Rutland Waterworks District	Hydraulic analysis of domestic-water system	Completed.
Sorrento Waterworks District	Domestic-water system capacity and proposed extensions	Completed.
Twan Creek	Proposed irrigation system	Completed.
Vananda Waterworks District	Proposed rehabilitation of a domestic-water system	Completed.
All improvement districts	Water charges	Completed.
All small communities	Water supply	Completed.
All communities	Water-use characteristics	Study continuing.
Windermere Improvement District	Appraisal of domestic-water system	Completed.

Design and Engineering Services

Community	Project	Status of Project at End of Year	Estimated Cost
Camp Barnard, Sooke	Domestic-water system for Scout Jam-boree	Completed.	\$ 10,000
Stillwater Waterworks District	New domestic-water system	Completed.	64,000
Walhachin Waterworks District	Rehabilitation of domestic-water supply system	Substantially completed.	39,400
Wolfe Waterworks District	Hydro-pneumatic pumping system	Completed.	10,000

Water Supply, Sewerage, and Other Proposals Reviewed

District	Description of Proposal	Status of Project at End of Year	Estimated Cost
<i>Improvement Districts</i>			\$
Barriere	Reconstruction of domestic-water intake and pumping system	Planning stage.	14,000
Buckhorn	Extension of domestic-water system	Construction completed.	21,000
Clearwater	Extension of domestic-water system	Planning stage.	232,700
Nakusp	Improvements to domestic-water system	Construction completed.	344,000
Nechako	Well, pump, and water main	Under construction.	530,000
Pineview	Domestic-water reservoir	Construction imminent.	180,000

Water Supply, Sewerage, and Other Proposals Reviewed—Continued

District	Description of Proposal	Status of Project at End of Year	Estimated Cost
<i>Waterworks Districts</i>			\$
Brentwood	Domestic-water reservoir	Under construction.	325,000
Copperwill (proposed)	Domestic-water system	Planning stage.	60,000
Cowichan Bay	Domestic-water reservoir	Under construction.	110,000
Eagle Rock	Domestic-water system	Construction completed.	251,725
Heffley Creek	Booster pump and domestic-water reservoir	Construction completed.	30,000
Kemp Lake	Domestic-water reservoir	Construction completed.	19,604
Lighthouse Point	Domestic-water reservoir, supply main, and modification of pumphouse	Construction completed.	35,000
Lower Nicola	Well and pump installation	Construction completed.	15,000
Missezula Lake	Domestic-water system	Under construction.	-----
North Cedar	Extension of domestic-water system	Construction completed.	62,000
Qualicum Bay-Horne Lake	Domestic-water reservoir and extension of system	Under construction.	-----
Rayleigh	Domestic-water reservoir	Under construction.	85,000
Silver Star	Stage 1 rehabilitation of domestic-water system	Construction completed.	40,537
South Pender Harbour	Domestic-water reservoir and extension of distribution system	Preliminary planning.	208,000
<i>Specified Areas</i>			
Mesachie Lake	Rehabilitation of domestic-water system	Preliminary planning.	101,000

ARDA SYSTEM SUPERVISION

In the Federal-Provincial Agricultural and Rural Development Agreement under the *Agricultural Rehabilitation and Development (British Columbia) Act* the Province has responsibility for the proper operation and maintenance of all works constructed under ARDA programs. The ARDA Section, Improvement Districts Division, carries out routine inspections of ARDA systems completed by improvement districts in British Columbia to ensure compliance with the intent of the Act. Section staff advise and assist on technical and administrative problems that arise concerning the ARDA project.

Improvement District Involved in ARDA Program

Districts	Completion Date of Original ARDA Projects	Remarks
Glenmore Irrigation	1964/72	Supplementary project in hand.
Vernon Irrigation	1964/65/73	Supplementary project in hand.
Scotty Creek Irrigation	1964/69	Supplementary project in hand.
Ellison Irrigation	1964/70	Supplementary project in hand.
Heffley Irrigation	1964	
Canyon Waterworks	1965	
South End Kelowna Irrigation	1965	Supplementary project in hand.
Grandview Waterworks	1965/71	
Similkameen Improvement	1965/71	
Oyama Improvement	1966	
Kaleden Irrigation	1966/73	
Westbank Irrigation	1966/73	
Osoyoos Irrigation	1969	
Meadow Valley Irrigation	1969	
Black Sage Irrigation	1969	
Raspberry Irrigation	1969	
Naramata Irrigation	1969/73	
Lakeview Irrigation	1970	
West Bench Irrigation	1970	
Boundary Line Irrigation	1970	

Improvement Districts Involved in ARDA Program—Continued

Districts	Completion Date of Original ARDA Projects	Remarks
Darfield Irrigation.....	1970	
Wood Lake Improvement.....	1970	
Sion Improvement.....	1971	
Winfield and Okanagan Centre Irrigation.....	1971	
Slocan Park Improvement.....	1971	
Peachland Irrigation.....	1972/73	
Otter Lake Waterworks.....	1972/73	
Larkin Waterworks.....	1972	Supplementary project in hand.
Keremeos Irrigation.....	1973	
Okanagan Falls Irrigation.....	1973	
Black Mountain Irrigation.....	1973	
Southern Okanagan Lands Irrigation.....	1974	
Chase Irrigation.....		Project in hand.

Staff limitations have so far prevented the implementing of a consistent routine inspection program and it has been necessary to concentrate on those ARDA Improvement Districts whose developing problems are of an immediately urgent nature.

The following studies were undertaken:

District	Study	Status of Study at End of Year
Naramata Irrigation.....	Proposed extensions of water system.....	Completed.
Okanagan Falls Irrigation.....	Proposed rehabilitation of water system in townsite area.....	In hand.
Kaleden Irrigation.....	Proposed supplementary works to serve residential development.....	In hand.
Sion Improvement.....	Appraisal of water-system capacity.....	In hand.
Grandview Waterworks.....	Proposed supplementary works to serve additional connections.....	Completed.
Oyama Irrigation.....	Proposed booster pump.....	Completed.
West Bench Irrigation.....	Proposed modifications to water system to serve additional connections.....	In hand.
Westbank Irrigation.....	Effect of subdivisions on system capacity.....	In hand.
Boundary Line Irrigation.....	Effect of proposed boundary expansion.....	In hand.
Crozier Waterworks.....	Proposed rehabilitation of domestic-water system.....	Completed.
Larkin Waterworks.....	Amalgamation of Larkin and Crozier Waterworks Districts.....	Completed.
Eagle Rock Waterworks.....	Emergency water-supply interconnection between Larkin and Eagle Rock Waterworks District.....	Completed.
Wood Lake Improvement.....	Intake and sedimentation basin performance.....	In hand.
	Land-use policy.....	Completed.

WATER UTILITIES DIVISION

With the repeal of the *Public Utilities Act* on July 15, 1973, regulation of privately owned and municipally owned water utilities was transferred to the Comptroller of Water Rights under the *Water Utilities Act* and the *Energy Act*. The Water Utilities Division was created within the framework of the Water Rights Branch to assist in the administration of the new Acts. This Report covers the first full year of the Comptroller's jurisdiction.

The staff of the Division, which includes engineers, accountants, administrative officers, and supporting clerical and stenographic staff, was partly decentralized by the recent appointment of senior engineering technicians to regional offices throughout the Province. The technicians are now conducting a wide variety of on-the-spot investigations on behalf of the Division, and are also providing excellent liaison between the Division and the public particularly with regard to complaints by rate-payers' groups and others regarding rates and adequacy of utility service.

The work of the Division continued to expand at a vigorous rate. There are 80 applications before the Comptroller for authorization to create new private

utilities and to extend existing systems to supply additional areas, which indicates a high level of activity when compared with the total figure of 266 utilities presently subject to the Comptroller's supervision. For the most part these applications are by land developers seeking to make water service available at their projects. Prevailing high rates of interest for borrowed capital and rapidly escalating costs for materials and labour resulted in strong pressure by the applicants for approval of their proposals.

An important function of the Division is to ensure that new utility systems are designed and constructed in accordance with acceptable standards of engineering practice. A review was commenced of the standards employed by the Division for this purpose taking into account foreseeable demands for domestic water, and the need for consistency with the standards observed by municipalities, regional districts, improvement districts, and other agencies of Provincial and Local Government.

Boundary extensions by municipalities (e.g., Kamloops) resulted in the assimilation of some privately owned water utilities under municipal management. There are also indications that a few regional districts are taking steps to acquire ownership of water utilities within their boundaries.

Inflationary trends precipitated a large number of applications for substantial increases in rates, there being 26 rate applications remaining to be dealt with at year-end. For example, Elk Creek Waterworks Co. Ltd., which supplies the City of Chilliwack and surrounding area, clearly demonstrated at a recent public hearing held by the Comptroller that an increase in revenue of approximately 40 per cent was required to enable the company to maintain service and to attract capital necessary for improvements.

With the current shortage of funds available for lending and high rates of interest, lending institutions have become most reluctant to lend funds for the purpose of improvements to the works of small utilities. In the result, small utilities are tending to make application for approval of rates sufficient in amount to enable the cost of capital improvement programs to be charged to operating expenses—a practice which is not usually considered to be in the best public interest. In the face of this dilemma and the compelling need for the applicants to improve their systems, the Comptroller approved rates somewhat higher than might otherwise have been justified, but in doing so also required by order that the portion of revenue needed for improvements should be accumulated in a special replacement fund from which disbursements may not be made without the Comptroller's consent.

Taxes applicable to private water utilities works under the *Taxation Act* increased significantly in the last several years due to amendments in the assessing procedures and practices of the Province. A number of new utilities and utilities in early stages of development with very few customers connected reported that their revenues are not sufficient to meet this obligation.

The policy of requiring all new utilities to establish maintenance reserve funds was continued during the year. These funds are held indefinitely to and for the sole discretion of the Comptroller of Water Rights against any unforeseen operating contingency. The total amount on deposit in the various funds now exceeds \$1½ million and may be released in whole or in part by the Comptroller if and when the systems become self-supporting.

A number of public hearings were held by the Comptroller of Water Rights during the year, one of unusual interest being held on an application by Inter-Island Utilities Ltd. to abandon its right to supply water to a residential subdivision of some 117 lots on Mayne Island, which were sold by Surfside Park Estates to lot

purchasers with a promise of water. The applicant utility proposed to continue service to lot purchasers in the subdivisions of its parent company, Gulf Land Corporation Limited.

The application was refused by the Comptroller who declared both Surfside Park Estates and Gulf Land Corporation to be water utilities under the *Water Utilities Act*. An order was subsequently registered as a Judgment of the Comptroller of Water Rights against all the lands owned in the Province by Surfside Park Estates and Gulf Land Corporation Limited. The order was partially complied with at year-end, both parties having until January 15, 1975, to complete their applications.

The major problem confronting new utilities (which usually have few or no customers) continues to be lack of an assured source of revenue, and the main problem facing small older utilities is the virtual impossibility of borrowing funds for essential improvements.

Statistical data relating to the activities of the Water Utilities Division is given below:

Certificates of public convenience and necessity and amendments thereto granted	48
Tariffs and amendments to tariffs accepted for filing	45
Orders requiring maintenance reserve funds and other special funds to be created	44
Orders approving transfer and sale of water utilities to new owners ...	5
Complaints dealt with regarding rates and adequacy of service	42

WATER INVESTIGATIONS BRANCH

The Water Investigations Branch was formed in late 1962 as a consequence of the creation of an independent British Columbia Water Resources Service.

The functions of the Water Investigations Branch, which is headed by the Director, are the evaluation, control, planning, and management of water resources of the Province where these do not directly come under the administration of the *Water Act* and the *Pollution Control Act, 1967*. These functions, carried out by various divisions of the Water Investigations Branch, are briefly summarized below.

(1) Hydrology Division:

(a) Snow surveys and snow-melt run-off forecasting to facilitate flood prevention measures and to guide judicious utilization of water supply.

(b) Hydrologic studies of the Province to compile and evaluate basic hydro-meteorological data for use in planning, engineering studies, and related purposes.

(c) Hydrologic studies as components of interdisciplinary studies pertaining to multi-resource planning and management and environmental protection.

(d) Collection of existing groundwater data and investigation and evaluation of groundwater potential to encourage and guide the future use and conservation of this source of water supply.

(2) Planning and Surveys Division:

(a) Development of floodplain and flood-hazard maps in concert with management planning and control of floodplain development.

(b) Surveys and mapping in connection with water-resource planning, investigations, and construction.

(c) Data collection in connection with water quality, water quantity, and reservoir storage-site investigations.

(3) Environmental Studies Division:

(a) To undertake environmental and management studies for purposes of preserving the quality of the water resource and ensuring its judicious usage.

(b) To carry out limnological and ecological surveys and studies directed toward resolving existing problems and facilitating water-resource planning.

(4) Engineering Division:

(a) Processing of water-project proposals made under the *Agricultural and Rural Development Act*, and investigation, design, and supervision of projects.

(b) Irrigation and domestic water-supply investigations to assist and advise in the development, planning, and management of water-supply projects.

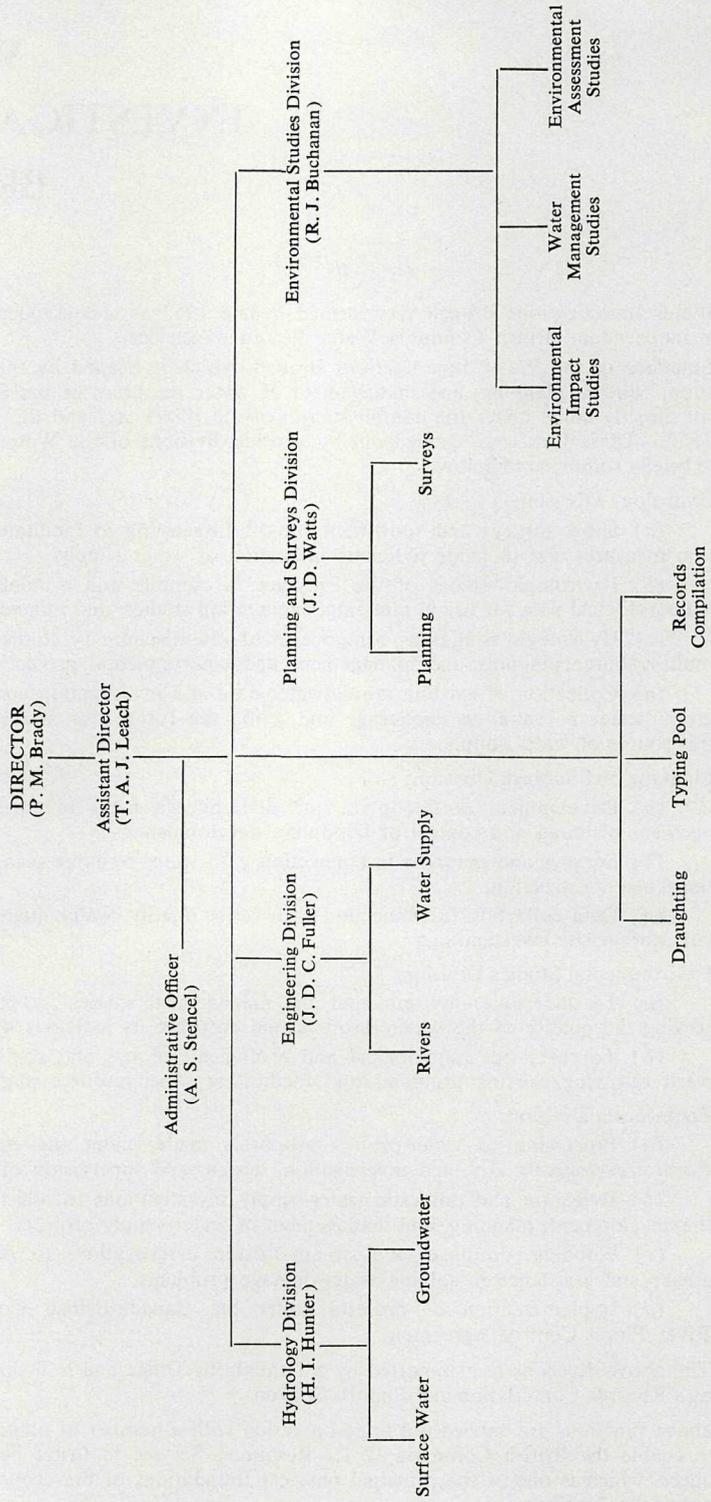
(c) Flooding, drainage, and stream-erosion investigations to give engineering advice and assistance in solving water-damage problems.

(d) Implementation of projects under the Canada-British Columbia Fraser River Flood Control Agreement.

(5) The above divisions are supported by a Draughting Office and a Typing Pool as well as a Records Compilation and Reports Section.

The above functions are carried out in co-operation with a number of other Governmental agencies to enable the British Columbia Water Resources Service to foster better use of the water resource, which is one of the principal physical foundations of the economic and social development of the Province.

WATER INVESTIGATIONS BRANCH



WATER
INVESTIGATIONS
BRANCH

P. M. BRADY, P.ENG.
DIRECTOR

The Branch was reorganized in late 1974 in order to effectively meet changing demands and environmental concerns. Existing personnel, plus 17 staff members, transferred from the Pollution Control Branch were consolidated into four divisions as indicated in the organization chart. The activities under these divisional responsibilities and the administrative and technical support facilities are described in the following pages. A brief overview of Branch activities is presented below.

FLOODING AND FLOOD CONTROL

A major factor affecting Branch activities in 1974 was high run-off and associated problems which occurred over much of the Province.

While flooding problems were caused by heavy rains on Vancouver Island and the west-central area of the Province, the major problems resulted from the high snow-pack which formed over the southern half of the Province. The snow survey network operated by the Branch inventoried this growing pack and through the use of computer models and other methods, prepared long- and short-range forecasts of river flows.

This information was passed to local emergency flood committees through a communication system established for this purpose. The knowledge gained from this information was instrumental in establishing priorities for flood-protection measures undertaken at the local level which, in turn, resulted in protection where most needed and avoided in many cases the construction of unnecessary temporary works.

Large-scale flooding, the potential for which was indicated by the snow-pack, did not materialize because of favourable weather conditions. A weather pattern such as that which occurred in 1948 would have triggered a major disaster.

In anticipation of high run-off, the Branch mobilized all its available resources to provide technical and financial assistance to a number of individuals, groups of farmers and communities in the construction of river protection works of a permanent nature. In addition, the Branch provided the technical input for the construction of some \$850,000 worth of dykes and bank protection at Kamloops pursuant to the *Kamloops Emergency Flood Control Act* passed by the Legislature on May 9, 1974. The majority of these works will remain in place and will form a part of a more adequate flood-protection system for the City of Kamloops which will be constructed in the future.

The heavy snow-pack in the Okanagan necessitated careful operation of the Okanagan Flood Control System. Okanagan Lake was drawn down to 0.3 foot below its minimum operation level prior to peak run-off and filled to 0.3 foot above its maximum operating level. In addition, careful outflow regulation controlled the level of Osoyoos Lake. The reduction in flow at the critical time prevented the lake from peaking approximately 1½ feet higher which would have caused considerable damage.

In recognition of the fact that many areas in the Province are prone to eventual flooding, the Branch expanded its efforts toward structural and nonstructural measures to minimize future flood damage and hardship. The following were undertaken in this regard:

- (a) Acceleration of construction of works under the 1968 Federal-Provincial Agreement covering a plan for flood control in the Fraser Valley. Expenditures under this program will approach \$10 million this fiscal year compared to \$6.1 million and \$2.4 million in fiscal years 1973/74 and 1972/73, respectively. An amount of \$14.6 million has been budgeted for fiscal year 1975/76. The Federal-Provincial Agreement was amended in 1974 to include the Kamloops area and to provide additional funds in the amount of \$30 million in view of rapidly escalating construction costs, inclusion of the Kamloops area, and elimination of local share of capital costs. Projects have been completed or are under way for the District of Kent, Oak Hills area at Kamloops, District of Surrey, Nicomekl-Serpentine Dams, Township of Chilliwack, District of Matsqui, Corporation of Delta, and the Township of Richmond. Engineering and design are at the advanced stage for the Mission City area, City of New Westminster-Queensborough area, and District of Pitt Meadows. Design is well under way in connection with projects for the City of Port Coquitlam and the District of Surrey South Westminster area.
- (b) Expanded program of technical and financial assistance to individuals and communities in the construction of minor river protection works. Many of the projects undertaken were for the protection of agricultural land. In all, 55 projects were constructed having a total construction cost of \$524,000. This compares with 19 projects last year and 12 the year before with the value of construction amounting to \$397,000 and \$161,000, respectively. In addition, flood-protection works costing a total of \$575,000 were completed by the Branch on Trout Creek, near Summerland, and in the Bella Coola Valley.
- (c) In conjunction with the Water Rights Branch, a program of channel clearing was initiated, consisting of removing log jams and gravel bars formed as a result of high run-off and which, if left in place, would cause considerable flooding and erosion problems. The program, which was initiated in the fall of 1974, has resulted so far in the removal of some 31 channel blockages at a total cost of approximately \$115,000.
- (d) Intensification of the floodplain surveys and mapping program to delineate flood-lines and flood-depths necessary for the planning and control of development within our floodplains and for any flood insurance program that may eventually be implemented. During the year, a field survey party, formed specifically for this purpose, went into full operation. Some 1,300 man-days of survey work were completed along some 170 miles of river valleys, 78 miles of lakeshore, and having a total adjacent floodplain area of approximately 280 square miles.
- (e) Passage of the *Land Registry Amendment Act, 1974*, and implementation of its requirements to control subdivisions within flood-

plains and therefore minimizing future hardship and damages. Some 50 subdivision proposals were reviewed and either rejected or agreed to usually subject to conditions designed to minimize damage and the potential for damage claims.

- (f) Review of zoning by-laws to facilitate inclusion of requirements directed toward control of building in areas which could be subject to flood damage. Some 90 zoning by-laws were reviewed and in addition, advice on floodplain planning and flood-prevention measures was provided to local authorities and individuals.

RESOURCE INVENTORY

The major hydrometric network within the Province is operated by the Water Survey of Canada in consultation and with limited financial support from Departmental funds. During 1974, an extensive review of the network was carried out in anticipation of a formal cost-sharing agreement with the Federal Government for the operation of the network.

The Branch operates an independent network of short-term hydrometric stations on small streams and lakes for operational purposes and specific studies. During the year, the number of stations in the network was expanded from 52 to 74.

Groundwater information was collected and monitored throughout the Province and particularly in water-short areas in order to inventory this limited and valuable resource and to assist in its development. A total of 3,109 well-logs was collected, 64 new water-well maps produced, 156 observation wells monitored, and over 200 outside inquiries for groundwater information answered.

HYDROLOGY ASSESSMENTS AND STUDIES

A total of 20 studies on surface water hydrology was undertaken or completed. Of these 20 studies, 11 were for Branch purposes, four were at the request of the Forest Service, three for the Environment and Land Use Committee Secretariat, and two for the Department of Recreation and Conservation.

A total of 18 groundwater studies was undertaken in critical areas throughout the Province. The majority of these were undertaken to fulfil the purposes of the various branches of the Water Resources Service; however, these 18 studies include those requested by the Lands Service, Department of Public Works, Forest Service, Department of Agriculture, Department of Highways, and the Department of Municipal Affairs. In addition, 26 reports submitted to the Water Rights Branch as back-up for applications for a certificate of public necessity and convenience were reviewed.

WATER-SUPPLY PROJECTS

Studies and designs for a total of 21 water-supply projects were under way during the year. Of these, 17 were in connection with ARDA projects, nine of which were at the construction stage. The remaining four studies were for bulk water supply to large areas and for community supplies.

The total expenditure for construction of projects under the ARDA program amounted to approximately \$1.7 million. The Branch is responsible for administering the implementation of these projects.

ENVIRONMENTAL STUDIES

During the year, the Water Resources Service was reorganized to concentrate specific expertise in one division of the Branch in order to undertake studies to preserve the environment of the water resource and facilitate its prudent use.

Studies for this purpose had been undertaken within the Branch prior to the formation of this division. These included the Okanagan Basin Study, the Kalamalka-Wood Lakes Study, and the co-ordination of the environmental impact overview for System E diversion and storages on the Fraser River system for flood-control and power purposes. The reports for the Okanagan and Kalamalka-Wood Lakes studies were completed during the year and a task force, of which the Assistant Director is a member, was formed to prepare an implementation program based on the results of these studies. Considerable progress toward this goal was achieved during the year.

The newly formed Environmental Studies Division will complete certain studies transferred from the Pollution Control Branch and continue research programs such as that investigating the aquatic weed growth problems in the Okanagan Valley lakes. The major emphasis, however, will be on studies where water-use and environmental concerns are greatest.

A major study to assess the air and water environment of the Kootenay area was initiated late in the year. The results of this study will provide information essential for preserving the environment of this area against the adverse effects of existing and future development.

A second major study is being designed to provide a management framework for the control and use of water in the Coquitlam River Basin.

Review of terms of reference and results for environmental impact studies prepared for major developments affecting the air and water resources are being carried out within the new division, and, in addition, environmental impact studies for similar developments will be undertaken.

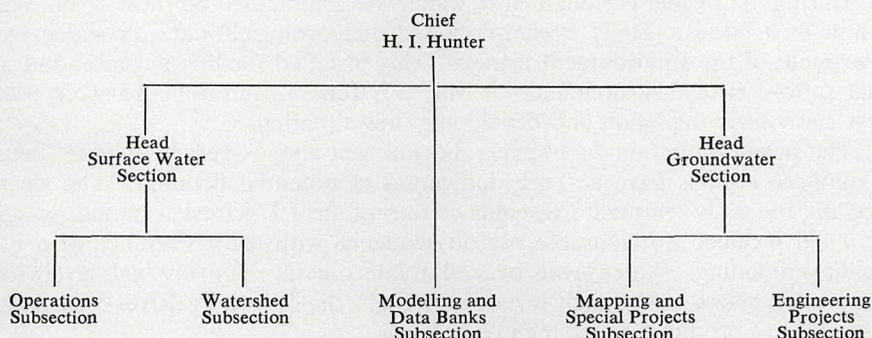
At year-end, the Water Investigations Branch staff consisted of 140 permanent and 20 continuous temporary positions.

Officers of the Water Investigations Branch participated in a number of committees and co-ordinating groups concerned with water-resource matters. These include:

- The National Committee for the International Hydrological Decade.
- The Co-ordinating Committee for Hydrometeorological Networks.
- Fraser River Joint Advisory Board.
- Fraser River Ecology Committee.
- Mines Reclamation Act Advisory Committee.
- Carnation Creek-Study Co-ordinating Committee.
- Babine Lake Watershed Change Committee.
- Environmental Liaison Committee.
- Okanagan Implementation Task Force Working Committee.
- British Columbia Interdepartmental Metric Conversion Committee.
- Interdepartmental Meeting on Surveys and Mapping.
- Engineering Science Lead Committee.
- Ecological Reserves Committee.

HYDROLOGY DIVISION

The Branch reorganization in late 1974 resulted in amalgamation of the former Hydrology Division and Groundwater Division into an enlarged Hydrology Division. The two main sections are Surface Water and Groundwater, with Modelling and Data Bank Section acting as the co-ordinating link. The Division organization is illustrated on the organization chart.



The major responsibilities of the Hydrology Division include operation of snow course, hydrometric and observation well networks, streamflow forecasting, publication of the British Columbia Snow Bulletins, regulation of the Okanagan Flood Control System, special hydrological studies for both design and environmental purposes, and hydrogeological engineering projects associated with the investigation and evaluation of groundwater potential.

SURFACE WATER SECTION

1974 Run-off Conditions

The February 1, March 1, April 1, and May 1 snow surveys indicated a progressively increasing above-average mountain snow-pack throughout the southern half of the Province. In the northern half, the snow-pack remained close to average. The following table lists April 1 seasonal run-off forecasts and the subsequent observed 1974 run-off for key regional streamflow stations.

1974 Volume Run-off—April 1 Forecasts and Observed Run-off

Forecast Station	Forecast Period	Forecast Observed		
		1,000 Acre-feet		Per Cent of Average
Fraser River near Marguerite ¹	Apr.-Sept.	35,080	35,420	123
Fraser River at Hope ¹	Apr.-Sept.	67,650	65,340	118
Thompson River near Spences Bridge.....	Apr.-Sept.	19,170	19,340	120
Nechako Reservoir inflow.....	Apr.-Sept.	4,507	3,900	98
Arrow Lakes inflow ¹	Apr.-Sept.	28,600	28,560	110
Kootenay Lake inflow ¹	Apr.-Sept.	21,830	23,370	128
Duncan Lake inflow.....	Apr.-Sept.	2,480	2,459	111
Okanagan Lake inflow.....	Apr.-July	580	668	201
Similkameen River near Hedley.....	Apr.-July	1,413	1,535	141
Upper Campbell Lake inflow.....	Apr.-July	1,147	1,041	126
Williston Lake inflow.....	Apr.-Sept.	24,590	24,970	107
Skeena River at Usk.....	Apr.-Sept.	19,860	19,530	99

¹ Adjusted for upstream storage and diversion.

The observed seasonal volume run-off ranged from twice average for Okanagan Lake to average for both the Skeena River and Nechako Reservoir.

Volume run-off forecasts are made with the assumption that weather conditions during the forecast period will be close to normal. Total precipitation during the summer of 1974 was generally close to average except for the Upper Fraser, Thompson, and Upper Columbia River basins where precipitation was below normal. Run-off forecasts gave an excellent early indication of spring and summer stream-flow.

During the freshet period, a close watch was maintained on those rivers subject to snow-melt floods. Daily stream-flow and meteorological data, provided by the Department of the Environment using a Telex installed for this purpose, and additional snow-course measurements on May 15, June 1, and June 15 were used to assess snow-pack depletion and developing flow situations.

The heavy mountain snow-pack and the well-above-average volume forecasts for southern regions gave an early indication of potential flooding. The weather, especially the daily temperature sequence during the 1974 freshet period, was such that it did produce a favourable run-off sequence with the occurrence of a minor amount of flooding. Water levels peaked in late June at relatively high levels for all uncontrolled rivers. Although levels were high, the Kootenay River was the only major river to produce record high river levels.

Networks

1. *Snow survey network*—A total of 1,206 snow surveys were made at 233 snow courses by diversion personnel, co-operating agencies, and part-time local employees, and immediately relayed via Telex, telegraph, or telephone to Hydrology Division headquarters in Victoria.

The snow-survey data, along with forecasts, up-to-date written and graphical descriptions of snow-pack, precipitation, temperatures, and run-off, were published in the *British Columbia Snow Survey Bulletin*. The bulletins were issued February 1, March 1, April 1, May 1, May 15, June 1, and June 15 and widely distributed to a mailing list of some 1,000 individuals and agencies with an interest in snow and run-off conditions, flood or drought potential, hydro-power operation, and water management.

The Division's technicians made 85 snow-course visits during the winter to provide at-site instruction in measurement technique and 47 visits during the summer for maintenance purposes.

Five new snow courses were established, one deleted, and one reactivated in 1974.

The snow pillow network will remain unchanged with eight installations operational for the 1974/75 winter. These devices continuously record snow-water equivalent during the build-up and depletion periods.

The 1974 fieldwork totalled 250 man-days, with the section's technicians travelling 23,800 miles by vehicle, 4,200 miles by helicopter, and 130 miles by oversnow machine.

2. *Hydrometric network*—During 1974, the Provincial hydrometric network was expanded, with 74 stations operational, a net increase of 22 over the preceding year. Stream-flow is monitored at 51 stations, with the remainder monitoring reservoir or lake levels. Of these stations, 13 have recording devices and 61 have manually read staff gauges.

The network's emphasis is on small streams and lakes where data is required for either operational purposes or for special studies. Most stations are located in the Similkameen, Okanagan, and Shuswap regions.



Sampling on Molson Creek snow course.



Apalmer Creek—Measuring weir and precipitation gauge installed in connection with Salmon Arm Basin Study.

Hydrology Studies

Hydrology studies carried out by the Surface Water Section during 1974 are shown in the following tabulation:

Area	Reason for Study
1. Kalamalka-Wood Lakes Basin	Input to Kalamalka-Wood Lakes Water Resource Management Study.
2. Duteau Creek near Vernon	To determine storage requirements for irrigation, domestic-water supply, and downstream fisheries.
3. Deadman Creek near Kamloops	To determine storage requirements for irrigation and the downstream fishery resource.
4. Nanaimo River	Extreme rainstorm run-off in January 1974.
5. Williston Lake Basin	Continuous update of stream-flow, snow-course, and meteorological data for volume run-off forecasting.
6. Coquitlam River	Input to water management study initiated within the Environmental Studies Division.
7. Salmon Arm Burn area	To determine the effects of forest fire on watershed hydrology.
8. Southwest Mainland B.C.	To determine the magnitude of high flood-flows from available stream-flow data; to derive a method of determining flood-flows of ungauged streams in this region of the Province.
9. Toquart River near Ucluelet	To develop methods of formulating cutting plans to reduce the impact of logging on other resources. Information required for B.C. Forest Service integrated resource studies.
10. Chapman Creek near Sechelt	To assess annual and peak flows based on available data. Information required for B.C. Forest Service integrated resource studies.
11. Nahmint River near Port Alberni	As for Study 9 above: The methods developed in the Toquart Study have been refined and used operationally in the Nahmint Study.
12. Chilliwack Forest area	To assess stream-flow regime based on historical hydrometric data. Information required for B.C. Forest Service integrated resource studies.

In November 1974, work commenced on a study of 38 watersheds in the Vancouver Forest District which require water-resource assessments as input to the integrated resource project approach. These watershed studies will be restricted in scope because of staff limitations, and for the same reason it is doubtful that assessments will be completed for more than a few of the watersheds listed below:

Study Title	Requesting Agency	Details
1. Williston Lake Potentials	ELUC Secretariat	Inflow forecasting and basin hydrological studies as input to an examination of all potential uses of the Williston Reservoir and shoreline areas to determine management procedures for optimizing this resource potential.
2. Springbrook Biophysical Land Classification Project	ELUC Secretariat	Input is to estimate flow of variability and assess snow-pack conditions, present water use, water-quality problems, and effects of various use practices on water quantity and quality.
3. Squamish-Lillooet Outdoor Recreation Study	Parks Branch, Department of Recreation and Conservation	Inventory of available hydrometeorological data in the Squamish, Lillooet, and Seton River watersheds. Information was provided on 200-year flood-levels, flow velocities, lake-level data, water used by hydro-electric power plants, and typical daily hydrographs for average, high, and low run-off years.
4. MacMillan Park Study	Parks Branch, Department of Recreation and Conservation	Total study is to assess the present state of the park forest cover and determine the extent to which it is being influenced by natural phenomena and man's activities within and adjacent to the park. A comprehensive park management plan will be prepared.
5. Salmon River Hydrology Study	Water Rights Branch	In collaboration with Fish and Wildlife Branch, Department of Recreation and Conservation, to define the roles of surface water flow, groundwater flow, licensed water withdrawals and fishery requirements in order to manage the water resource in a manner satisfactory to all users.
6. Grasmere Area Irrigation Potential	Water Resources Service	Study to provide data on the groundwater recharge potential of a series of small basins on west-facing slopes of the Grasmere Valley.
7. Johnson Creek Hydrology Study	Water Resources Service	Run-off estimates for a proposed domestic and irrigation water-supply system for the Sinmax Water Users' Community.
8. Ideal and Fish Hawk Lake Peak Flow Study	Water Resources Service	Estimation of peak outflow and confirmation of spillway capacity for two reservoirs in the Mission Creek headwaters.

GROUNDWATER SECTION

*Collection and Compilation of Basic Data**Water-well Data*

Logs and other information on wells drilled by British Columbia drillers are collected by Groundwater Section Staff or are mailed in by drillers. A total of 3,109 logs was collected for wells drilled in 1973, and part of 1974. Reports on groundwater resource-use and evaluations in the Province were collected from private consultants and Government agencies.

Water-well Maps

A total of 64 new water-well maps was compiled in the early part of the year and preparation of replacement maps for the Saanich Peninsula was initiated.

Observation-well Data

A publication was printed in 1974 entitled *Groundwater Observation Wells of British Columbia*.

As of December 31, 1974, the Groundwater Section was monitoring 156 observation wells, 60 of which comprise a network of continuing observations with 15 having automatic recorders. Ninety-six observation wells are special projects on a short-term basis, 37 of which have automatic recorders. Water-chemistry data were collected at continuing network wells in May and September and those with automatic recorders were inspected and serviced twice in 1974.

Two observation wells of the continuing network were discontinued and three were added.

The special study in Glenmore was completed and the wells abandoned. Four wells for the Kalamalka-Wood Lakes Study were discontinued and nine added for the Salmon River Study. Three wells belonging to Sidney Waterworks are being monitored for salt-water contamination.

At the end of December, the distribution by watershed of observation wells in the continuing network was as follows:

Coastal watershed	11
Fraser watershed and Lower Mainland	30
Okanagan and Similkameen watersheds	12
Columbia watershed	3
Northern watershed	4
	—
Total	60

Present plans are to expand the continuing network coverage in the 1975 program.

Groundwater Chemistry Data

During the 1974 field season, approximately 250 water samples were collected from North and South Pender, Saturna, Hornby, Denman, and Gabriola Islands. The samples were analysed by the Water Resources Laboratory in Vancouver. A computer program developed by the Division was used to process the laboratory data so that it was expressed in a form suitable for plotting on hydrochemical maps.

The results of a chemical analysis of groundwaters obtained from a collection program in the Kootenay district have been processed and a brief report has been prepared, together with hydrochemical information map sheets.

Inquiries

The following is a very approximate percentage breakdown of over 200 recorded routine inquiries handled by the Groundwater personnel over the past year:

Inquiries made by	Per Cent
(a) Provincial Government	27
(b) Municipal governments	7
(c) Consulting firms	23
(d) Private individuals	33
(e) Industry (including water-well contractors)	10

Water Utilities' Well-test Reports

This year, the Groundwater Section undertook a review of all well-test reports submitted to the Water Utilities Division of the Water Rights Branch in support of applications for a certificate of public convenience and necessity. During the year, a total of 26 reports were reviewed in depth, the findings of 23 reports were accepted, two were rejected, and a decision on one was deferred until additional information was made available. At year-end, a pamphlet was being prepared to give applicants details and procedures of pumping-test requirements.

Flowing Artesian Well-location Maps

Work was initiated on a manuscript and 40 flowing artesian well-location maps.

Special Projects

1. *Kalamalka-Wood Lakes Basin Study*—The objective of the groundwater program was to try to determine the role of groundwater in nutrient input to Wood and Ellison Lakes and parts of Kalamalka Lake. The final groundwater report under this study was completed in March.

2. *Salmon River Basin Study of the Shuswap Lakes System*—The objective of the groundwater part of the program is to determine the groundwater component of flow and groundwater return flow from irrigation.

Gulf Islands Groundwater Study

1. *Mayne Island*—An evaluation of the groundwater resources of Mayne Island was completed and records presented in three reports. The study included an investigation of the island's groundwater potential, distribution quality, and quantity. Report 1 outlined the geography and geology of the Island. Report 2 gave a detailed account of the hydrochemistry of Mayne Island and Report 3, an analysis of the 1973 test-well drilling program, pumping test, and down-hole geophysics completed on the Island.

2. *Other Gulf Islands*—During the summer, well inventory and 250 water samples were collected from wells located on Saltspring, Galiano, Hornby, Denman, Gabriola, Saturna, North and South Pender Islands. The hydrochemistry and well-inventory information will provide basic data for further groundwater studies on these islands.

Groundwater Engineering Projects

During 1974, investigations and evaluations of groundwater potential were made for the following:

Area	Comments
1. Whistler Mountain area.....	For municipal water supply in this area.
2. Cherryville.....	Effects of logging operations on groundwater.
3. Vernon Arm of Okanagan Lake.....	Well interference problems.
4. Scotty Creek Irrigation District.....	Groundwater prospects for irrigation wells.
5. Okanagan and Cariboo Fish Hatcheries.....	Information for location of fish hatcheries.
6. Grand Forks.....	Groundwater research project.
7. Scott Point Waterworks District.....	Groundwater supply problems on Saltspring Island.
8. Brentwood Waterworks District.....	Groundwater potential for future development.
9. Alert Bay, Cormorant Island.....	Test drilling for groundwater potential.
10. Marysville Observation Well.....	Drilling to evaluate high water table.
11. Pouce Coupe.....	Test well drilling.
12. Yellow Point, Cedar District.....	Groundwater potential for proposed subdivision.
13. Deep Cove Waterworks District.....	For water supply.
14. Dease Lake Townsite Well.....	Investigation and well development.
15. East Kootenay (Libby Reservoir).....	Possible irrigation from groundwater.



Bail-testing of Cormorant Island well.

MODELLING AND DATA BANK SECTION

Hydrologic Modelling

The record-breaking snow-pack which covered the southern half of the Province in the spring, and the resultant threat of major flooding, meant that the majority of the section's energy in the early months of the year was devoted to developing a package of tools to assist in making short-term forecasts. An analysis of the various models that might be of assistance in forecasting on the Fraser River had been conducted by a British Columbia Hydrometeorological Networks Co-ordinating Committee subcommittee and this had led to the conclusion that the only deterministic model readily available and calibrated for the Fraser River was the University of British Columbia Watershed Model. However, in the time available, it

was not possible to install the model of the Government computer and it was necessary to rely on the Civil Engineering Department at the university to initialize, calibrate, and run the model. Subsequently, the latest version of the model has been received from the university and placed on the Government computer system.

A flow-routing program called "SIMPAK", developed by the Pacific Region of the Inland Waters Directorate and calibrated for the Fraser River system, was adapted to provide one-through-four-day forecasts at Prince George, Quesnel, Kamloops, Hope, and Mission, and was run on the Government computer.

A further one-through-three-day forecasts of flows at Hope and Mission was made by the Water Survey of Canada and made available to this section.

These three forecasts, from the University of British Columbia, SIMPAK, and Water Survey of Canada, were then analysed and assessed and a composite short-term forecast made for flows and levels at Prince George, Quesnel, Kamloops, Hope, and Mission. These were given on a daily basis to the regional offices of the Water Rights Branch.

During the period when the backwater effect of the Similkameen River was causing flooding around Osoyoos Lake, daily forecasts were made of the anticipated change in Osoyoos Lake level in the next 24 hours. These forecasts were relayed to the Okanagan and made available to the public through radio and press releases.

Development of hydrologic modelling techniques is continuing.

Okanagan Lake Operation

The principal storage in the Okanagan Valley and the key to the successful operation of the main stem system is Okanagan Lake. Snowcourse measurements at the beginning of March indicated a very heavy snow-pack and, in anticipation of above-average run-off, a start was immediately made on drawing down the lake to provide as much storage as possible. In fact, Okanagan Lake reached its lowest recorded elevation of about 1,119.5 feet above mean sea-level, or 0.3 foot below its normal lower operating level in the middle of April. Releases from Okanagan Lake were kept at a high level throughout the spring except for a cut-back lasting about 12 days to relieve flooding around Osoyoos Lake. Despite this, as a result of an inflow more than twice the historic average, Okanagan Lake peaked at about 1,124.1 or 0.3 foot above its normal upper operating level. Had it not been necessary to reduce the releases from Okanagan Lake for 12 days to relieve flooding around Osoyoos Lake, it would have been possible to contain the high run-off without Okanagan Lake going above its normal upper limit. It is estimated, however, that this reduction in flow resulted in Osoyoos Lake peaking at about 1½ feet lower than would have been the case had no reduction been made. This extra 1½ feet would have caused considerably increased damage in the Osoyoos Lake area.

Flood Frequency Analyses

Work on the development of computer programs to calculate flood frequency probabilities continued throughout the year. In connection with floodplain definition several requests were received for the values of flows having a return period of 200 years. Rivers analysed or in the process of being analysed include the Courtenay, Vedder, Coquitlam, Squamish, Cheakamus, and Lillooet Rivers as well as Shuswap Lake. Apart from floodplain definition, requests for frequency analysis have arisen from a full hydrologic study of the Coquitlam River Basin currently under way and for the Squamish-Lillooet Outdoor Recreation Study initiated by the Department of Recreation and Conservation.

Data Handling

Routine work on the updating and processing of snow-course, meteorological, and hydrometric measurements continued throughout the year. The major part of this continues to be the snow-course data and the production of the computer output necessary for the *Snow Survey Bulletin* and subsequent summaries.

The preparation of data held by the Groundwater Section for computer-bank storage is a major task facing this section. In preparation, a survey is being undertaken of the various systems developed elsewhere to determine which is the most suited to the needs of the Province. Once a system has been decided upon, the task of transferring the data currently held on well-log cards to computer-readable form will be undertaken.

Miscellaneous Studies

1. *Ocean Falls*—A cut-back in production at the paper mill of the Ocean Falls Corporation due to a shortfall in the water supply occurred at the beginning of the year. A study of this situation was undertaken, and a report prepared.

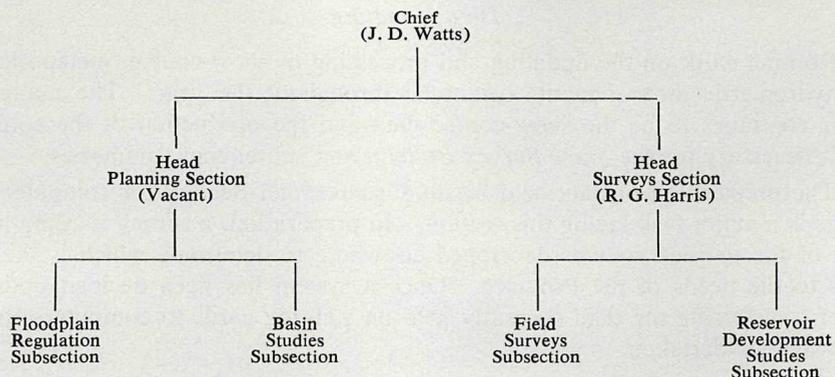
2. *Osoyoos Lake*—A study was completed on the various factors affecting the levels of Osoyoos Lake. Interest in the controls was heightened during the year because of high lake levels caused by large releases from Okanagan Lake, and by flood flows in the Similkameen River. Later in the year the partial failure of a dam in Oroville, Washington, on the Okanagan River just south of Osoyoos Lake resulted in very low lake levels.

Miscellaneous

During 1974, meetings were held with Water Survey of Canada officials to categorize Federally operated hydrometric stations in appropriate responsibility classification listings. These listings will form the basis for a Federal-Provincial cost-sharing agreement which is to commence in the 1975/76 fiscal year.

PLANNING AND SURVEYS DIVISION

This division of the Water Investigations Branch was created in November 1974 by the amalgamation of the former Basin Planning and Power Division and the Water Supply and Investigations Division. These former divisions are now known respectively as the Planning Section and the Surveys Section of the new Division. It is intended that this consolidation will provide more effective co-ordination for mapping the floodplain areas in the Province, which initially is the most important single function of the new division. Each section has additional functions. The Planning Section is responsible for the administration of floodplain regulations, for providing administrative support to the Task Force on Multiple Use of Community Watersheds, and for providing water-resource input to numerous regional studies initiated by the ELUC Secretariat and other agencies. The Surveys Section also provides survey data in support of other divisions; is responsible for a water-storage inventory program; for establishing and maintaining Provincial hydrometric stations for water-yield and research purposes; for river regime and sediment studies; for preliminary dam-site and soil stability investigations in connection with potential storage reservoirs; and for water-supply availability studies.



PLANNING SECTION

The functions of the Planning Section relate to the control of land use in the floodplains of the Province, and to the study of river basins in regard to the protection of community water supplies, and over-all resource management. From these functions arises a large volume of administrative work dealing with flood-control regulations which affect land use, and in regard to applications for the use of Crown land, which may conflict with established reserves for hydro-electric projects or community watersheds.

This section also provides professional staff as members of many study groups or task forces established to undertake studies of a regional and interdisciplinary nature.

The Floodplain Regulation subsection is responsible for the calculation of the 200-year flood profile of rivers and the delineation of the floodplain on suitable mapping; for the preparation of regulations controlling development in floodplains; for the review of zoning by-laws affecting lands in floodplains; and appeals arising from the flood-control provisions in zoning by-laws; and for the review of land subdivision applications which are referred to the Deputy Minister of Water Resources under the *Land Registry Act*.

The Basin Studies Subsection is responsible for providing major support to the Task Force on Multiple Use of Community Watersheds; assistance in regard to the Fraser River Upstream Storage Study; evaluation of potential hydro-electric power developments; water management studies; and provision of water-resource input to regional studies.

FLOODPLAIN REGULATION SUBSECTION

Administration

Following the request in 1973 by the Department of Municipal Affairs to all municipalities and regional districts to introduce flood-control requirements into their zoning by-laws, a considerable effort has been demanded in various aspects of the implementation of these requirements. The subsection has reviewed some 90 zoning by-laws from a flood-control viewpoint under a referral system from the Department of Municipal Affairs. Numerous recommendations on appropriate flood-control provisions were also made on request to municipalities, regional districts, and individuals.

Following the enactment of the *Land Registry Amendment Act, 1974*, some 50 proposed plans of subdivision were reviewed in regard to the flood hazard in

accordance with the new section 93 (3) of the *Land Registry Act*. Appropriate flood-control provisions were recommended in each case to the Deputy Minister of Water Resources as conditions to be incorporated in restrictive covenants running with the land under section 24A of the *Land Registry Act*.

Floodplain Regulation

As part of a program to develop suitable structural and nonstructural flood-control measures throughout the Province, several regions where topographic and bathymetric data existed were selected as areas for which advance floodplain maps could be produced. The bulk of the work was done in 1973, but the final maps were issued in early 1974. River for which floodplain maps have been prepared are as follows:

- (1) Kettle and Granby Rivers near Grand Forks (one inch=400 feet) 7 sheets.
- (2) Lillooet River from Lillooet Lake upstream past Pemberton Meadows (one inch=400 feet) 10 sheets.
- (3) Similkameen River from Princeton downstream to the Canada-U.S. border (one inch=400 feet) 17 sheets.
- (4) Nicola and Coldwater rivers at Merritt (one inch=200 feet) 3 sheets.
- (5) North Thompson River, Kamloops to Vavenby (one inch=500 feet) 31 sheets.

Floodplain definition projects started this year include the following:

- (1) Thompson River, Kamloops Lake to Kamloops.
- (2) South Thompson River, Kamloops to Chase.
- (3) North Thompson River, Kamloops to Vavenby—this is to up-date river conditions from present mapping which was prepared in 1953.
- (4) Lower Fraser Valley—field surveys started which will take several years to complete.
- (5) Coquihalla River, Hope upstream about 10 miles.
- (6) Eagle River, Shuswap Lake upstream 10 miles.
- (7) Osoyoos Lake.
- (8) Courtenay River, near Courtenay.

An additional activity this year was the work required in handling and coordinating air-photo requests for the various rivers as they approached flood peaks. This work was instigated due to the record snow-packs which developed in the spring. The air-photos obtained will be used in floodplain studies as the various rivers are brought under investigation. Coverage on 17 rivers was obtained through the co-operation of the Hydrology Division and the excellent work of the Field Operations Division of the Surveys and Mapping Branch, Lands Service.

Computer program HEC-2, "Water Surface Profiles," developed by the Hydrologic Engineering Centre, U. S. Army Corps of Engineers, has been adapted to the section's requirements and has been placed in the Users' Library at the Provincial Data Processing Centre. A Users' Manual has been prepared and will shortly be available for distribution. This program replaced program WBP001, "Hydraulic Gradients Computation," due to its versatility in handling the effects of hydraulic structures such as bridges, culverts, weirs, and embankments. Also,

the HEC-2 program facilitates simulation of modified channel conditions such as channel-clearing, dyking, and flood bypasses. Over 200 miles of river have been modelled using the HEC-2 program.

Floodproofing Regulations

Following the issuance of the Flood-control Requirements through the Department of Municipal Affairs to regional districts and municipalities throughout British Columbia in 1973, an interdepartmental committee consisting of two members from the Department of Municipal Affairs and two members from the Water Resources Service was set up to prepare floodproofing and floodplain development regulations. Two committee meetings, together with a hearing of floodplain problems in the Osoyoos area, have resulted in the preparation of a set of draft floodplain development guidelines. Pending final checking and final input from concerned Government agencies, together with that from several local agencies, it is anticipated that these guidelines will be available early in 1975.

A second task in conjunction with the development of floodproofing regulations was a study of the flooding and development problems for the Town of Golden. Staff of the Planning Section, Planning and Surveys Division, travelled to Golden in August at the request of the Golden Flood Control Committee, to inspect flooding problems in the town. A brief was subsequently prepared indicating that both structural and planning solutions could be utilized to minimize flood danger.

Floodplain Studies

Four floodplain studies were carried out:

Area	Purpose
1. Village of Pemberton	Review of floodplain regulations and growth pattern for the village.
2. Williston Lake	Determine extent of floodplains that could restrict potential development around the lake and tributaries.
3. Cowichan Lake	Determine 200-year frequency flood level of Cowichan Lake and 200-year flood profile of Cowichan River.
4. Courtenay River floodway	Delineation of floodplain of the Courtenay River.

BASIN STUDIES SUBSECTION

Multiple Use of Community Watersheds

In support of the Task Force on Multiple Use of Watersheds of Community Water Supplies, the subsection continued to carry out various functions during the year as follows:

- (1) Background information was provided for specific watershed areas where multiple-use problems necessitated discussions by interested individuals and organizations.
- (2) A program to classify the community watersheds in the Province was commenced, using available data which includes drainage area size, land status, land use, and topographic information.
- (3) The 28 regional districts throughout the Province were notified of the progress of the task force study, including the establishment and significance of map reserves on community watershed areas. Maps showing the locations of the watersheds and data sheets indicating the water users, population served, and the supply source, were also supplied to each regional district.

- (4) The subsection reviewed approximately 90 land-lease applications referred by the Lands Service, and 50 timber-sale proposals referred by the Forest Service, which involved the proposed use of Crown lands located in community watersheds.

Fraser River Agreement Studies

The following assignments related to the Fraser River Upstream Storage Study were carried out under the Planning Section:

- (a) Preliminary designs and cost estimates for dykes to protect flood-prone lands in the Kamloops, Prince George, and Quesnel areas.
- (b) Possible improvements to the outlet of Kamloops Lake and the effect these would have on reducing flood stages on the Thompson River upstream at the City of Kamloops.
- (c) The feasibility of providing a reduction in flood levels at Kamloops by the development of negative storage (i.e., storage below normal high-water levels) on five major lakes in the Clearwater Basin.

Creston Flats Monitoring Program

The Creston Flats monitoring program was continued in 1974, which was another high-flow year. Data from 71 observation wells were obtained.

Bella Coola Regional Study

A report was prepared detailing water resource parameters in the study area.

Overview of Trout Creek Watershed

During the implementation of the construction of the Trout Creek flood-control program, there was an expression of local concern over the environmental impact of the project, the potential for channel blockage by a landslide and the preservation of the watershed in general. An overview of these matters was initiated with input from other Government agencies as well as local bodies and individuals. At year-end, a draft report for public discussion was being completed.

SURVEYS SECTION

The Surveys Section carries out major surveys required by the Water Investigations Branch for

- (a) mapping of floodplains;
- (b) water supply feasibility studies and construction projects;
- (c) flooding, drainage, and erosion control projects; and
- (d) mapping of major water-storage reservoirs.

Field Surveys Subsection

During the 1974 field season, 33 survey projects were completed. A total of 35 survey projects, including a number carried out prior to 1974, was listed for data processing during the year. All data processing is expected to be completed by the end of March 1975, subject to completion of photogrammetric mapping.

1974 FIELD SURVEYS

Area	Description
<i>Floodplain Mapping Program</i>	
1. North and South Thompson River Valleys	Mapping required from Kamloops Lake to Little Shuswap Lake along the Thompson and South Thompson River valleys, and from Kamloops to Vavenby along the North Thompson River valley. Total distance over 100 miles. All surveys for mapping control completed in 1974. Data now being processed for the North Thompson section. River surveys for computing the 200-year design flood level were carried out along the South Thompson River.
2. Lower Fraser Valley.....	Over 400 square miles of Lower Fraser Valley floodplain, including the Serpentine-Nicomekl area, to be mapped. Surveys in late 1973 covered 60 square miles in the Chilliwack area, and field data was processed in 1974.
3. Coquihalla River Valley.....	Ten miles upstream from Hope cross-sectioned in 1974 for computing the 200-year flood level. Floodplain area was controlled for floodplain mapping.
4. Eagle River Valley.....	Control for photogrammetric mapping completed in 1974 between Sicamous and Perry River (19 miles).
5. Osoyoos Lake.....	Work commenced in 1974 on defining the 200-year flood level (elevation 921 G.S.C. datum) and the 1972 flood level (elevation 916.8 G.S.C. datum) around the shoreline of Osoyoos Lake.
6. Vernon Arm, Okanagan Lake.....	Establishing flood level contours.
7. Kalamalka-Wood Lakes.....	Using existing field information, elevation 1,288 and 1,300 (G.S.C. datum) contours were plotted on air-photo enlargements of the shorelines of these lakes.
<i>Hydrometric Program</i>	
1. Metering existing hydrometric stations.....	Metering was continued on 14 stations in the South East Kelowna Irrigation District, 9 stations in Peachland Irrigation District, 17 stations in the Similkameen River Basin, and 7 stations in the Salmon Arm Burn area.
2. Wood Lake.....	Measuring weirs constructed on Ribbleworth Creek, La Fleche Creek and Trehitt Creek.
3. Salmon Arm Integrated Resource Study.....	A network of 11 stations was established, maintained, and metered.
4. Naramata Irrigation District.....	Established and metered 17 hydrometric stations.
5. Nahmint Integrated Resource Study.....	Two water-level recorders and one chain-operated gauge were established in 1974.
<i>Storage Inventory Program</i>	
1. Vinsulla Irrigation District.....	Bathymetric and topographic surveys for storage capacity and dam-site information at Badger Lake, Hutt Lake, and Martin Meadows.
2. Deadman's Creek and Snohoosh Lake.....	Storage survey to confirm design storage capacity.
3. Major storage sites in Similkameen Basin and Okanagan Basin	Surveys were completed in 1974 on the following lakes: Wolfe, Issitz, Lorne, Otter, Davis, Missezula, Yellow, Nickel Plate, Allison, Lightning, Postill, South, Moore, Garnet, Munro, Maron, Eneas, Farleigh, and Brent Lakes.
<i>General Branch Surveys</i>	
1. Eagle River near Sicamous.....	Cross-sections, longitudinal channel and surface profiles for 23 miles between Shuswap Lake and Kay Falls were surveyed for proposed bank protection work.
2. Fraser River Dyking System.....	Survey of south side bank for 12.5 miles between Matsqui and West Langley was carried out in 1974.
3. Similkameen River.....	Cross-sections were surveyed over 8 miles of the Similkameen River near Keremeos for a flood-protection study of the lower reaches of Keremeos Creek.



Tellurometer Traverse Station for floodplain surveys in North Thompson Valley.

RESERVOIR DEVELOPMENT STUDIES SUBSECTION

The following studies were undertaken by this subsection during 1974:

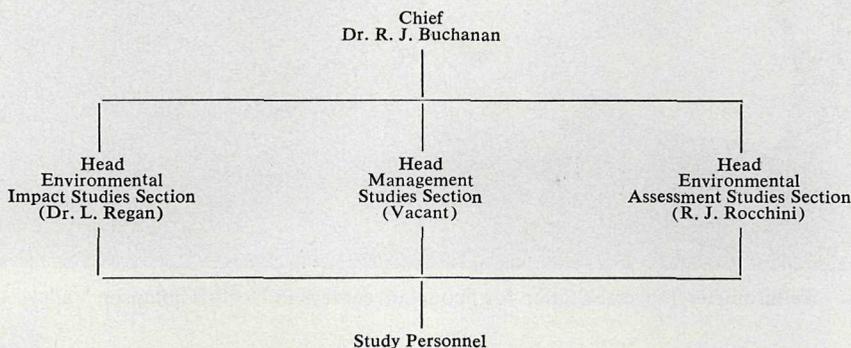
Area	Description
1. Similkameen Basin.....	Assessment of potential storage within the Similkameen Basin for water licensing purposes. Field surveys were completed in 1974 for reservoir mapping, water-quality sampling, dam-site and material investigations, and lake-front property inventory. Study due for completion in 1975.
2. Trepanier area, Municipality of Peachland	Preliminary engineering report of a study of a combined irrigation and water-supply system replacement completed in December 1974.
3. Community of Telegraph Creek.....	Appraisal of improvements to the present water-supply system for Telegraph Creek and possible extension to serve the entire community.
4. Glenrose Area Extension, Westbank Irrigation District	Studies completed in late 1973 and engineering report forwarded to the Westbank Irrigation District in 1974.
5. Peachland Irrigation District.....	Design of dyking system to isolate intake and headpond from the main flow in Peachland Creek and of regulating works for intake screens.
6. Proposed Water Supply for East Kootenay Valley area	Preliminary investigation of feasibility of irrigated forage production on benchland east of the Libby Reservoir.
7. Lake Windermere Control.....	Preliminary report on water-level control for Lake Windermere is nearing completion.

ENVIRONMENTAL STUDIES DIVISION

The Environmental Studies Division was created in September by amalgamation of the Ecology Division with 17 people from the Pollution Control Branch—two from the Industrial Division, and 15 from the former Projects and Research Division. As presently constituted, the Environmental Studies Division includes specialists in hydraulic engineering, chemical engineering, environmental engineering, agricultural engineering, soils, and a diverse range of specialties in fresh-water and marine biology.

The Division will contain three loosely organized sections:

- (1) *Environmental Assessment*—for assembling information on existing conditions and assessing the implications for water-resource preservation and management.
- (2) *Environmental Impact*—for assessing the impact of proposed development projects.
- (3) *Water Management*—for conducting investigations into problems and alternatives and recommending on management strategies.



Projects carried out by the Environmental Studies Division may be initiated in several ways. Studies may be undertaken in response to representations by such nongovernment bodies as citizens' groups, water improvement districts, or other licensed water users. They may also be initiated at the request of local government agencies such as municipal governments and regional districts. Requests for investigations may originate in other Provincial agencies such as the ELUC Secretariat or other Government departments. Many projects are initiated to assist the Comptroller of Water Rights and the Director of Pollution Control in their mandates to administer water use and to regulate waste disposal, respectively.

Since most of the work carried out by division staff during 1974 was done prior to reorganization, the following account includes projects under their previous organizational headings.

ECOLOGY DIVISION (WATER INVESTIGATIONS BRANCH)

Project	Description
1. Serpentine-Nicomekl Watersheds.....	Design of a program to evaluate water quality and ecological implications of a proposal to use these rivers as water sources for intensive agriculture.
2. Williston Reservoir Potentials Study.....	Limnological aspects of the multi-agency study of Williston Reservoir potentials initiated and co-ordinated by the Environment and Land Use Committee Secretariat.
3. Salmon Arm Burn Study.....	Water-quality aspects of joint study to determine the nature and extent of the effects of the "Eden" forest fire of September 1973 on the water resource. Sampling, stream-gauging, and analysis will continue until results indicate that the watersheds have returned to "normal."
4. Studies on Aquatic Weeds.....	Continuing studies in weed biology and control. Participation in an interagency experiment on control of nuisance weeds at Kin Beach on Vernon Arm of Okanagan Lake by harvesting and use of chemical herbicides. Computer programming necessary to establish a data file for sediment and biological data, and statistical analysis of compiled data.

ECOLOGY DIVISION (WATER INVESTIGATIONS BRANCH)—*Continued*

Project	Description
5. Studies on Algæ in the Kalamalka-Wood Lakes Basin	Studies carried out in co-operation with the B.C. Research Council for the Kalamalka-Wood Lakes Basin Management Study.
6. Heavy Metals in Langford Lake.....	Study resulting from reports of high lead content in fish in Langford Lake.
7. Lillian Lake Water Quality.....	Study of present condition of Lillian Lake near Invermere and development of recommended means to prevent deterioration, with special regard to domestic waste disposal.
8. Nahmint Watershed Study.....	Field investigations for the interagency study.
9. Land and Stream Quality Monitor Studies	Study of various means of sampling, and data analysis, and use of various kinds of organisms for water-quality monitoring purposes. Various monitoring and conventional limnological sampling in 14 widely scattered lakes having diverse conditions of climate, size, shape, hydraulics, history, and biology.
10. Arrow Lakes Water Quality.....	Review of available data to describe the present condition of the water and make a prognosis for the future, to assist in appraisal of water-supply options for the lower Columbia area between Castlegar and Trail.

ENVIRONMENTAL STUDIES DIVISION

Project	Description
1. Environmental Effects of Electric Generating Stations	Development of impact-study guidelines for power stations, for the ELUC Secretariat. Includes all aspects of hydro-electric plants, air emission aspects of thermal plants, and effects on water by coal and nuclear-fired thermal plants.
2. Steel Mill Feasibility Study.....	Study co-ordinated by the ELUC Secretariat and the Department of Economic Development. Consideration of water supply, drainage, and various aspects of atmospheric and aquatic environment affected by a steel-mill development in several potential sites.
3. Oil Refinery Feasibility Study.....	Consideration of effects of transportation facilities, water supply, and atmospheric and aquatic discharges. Multi-agency investigations co-ordinated by the ELUC Secretariat.
4. Environmental Impacts of Northern Highway Construction	Review of environmental implications of highway from Fort Nelson, British Columbia to Fort Simpson, Northwest Territories, particularly in connection with drainage, erosion, and water quality. Co-ordinated by ELUC Secretariat.
5. Kootenay Regional Environmental Quality Assessment Study	Study of impacts on air and water of major industrial waste discharges in the region. Development of recommendation for correcting environmental damage and planning long-range environmental management.
6. Coquitlam River Basin Water Management Study	Assessment of present and future water demands within the Coquitlam River Basin and environmental implications.

PROJECTS AND RESEARCH DIVISION (POLLUTION CONTROL BRANCH)

Project	Description
1. Thompson River Study.....	Investigation of cause of colour, foam, and algal proliferation in the Thompson River and Kamloops Lake. A Federal-Provincial Study.
2. Naramata Watershed Study.....	Follow-up to 1971 Pollution Control Branch Study of effects of cattle on quality of Naramata water supply, to determine the effectiveness of livestock control measures that were implemented.
3. Canadian Cellulose Company Effluent Evaluation, Prince Rupert	Evaluation of effluent from pulp-mill and zone-of-influence conditions concurrent with effluent upgrading measures, including changes in intertidal biota.
4. Prince George Sludge Disposal Study.....	Determination of the impact of sewage sludge on soils, vegetation, and water. Development of guidelines for sludge disposal on land in British Columbia.
5. Health Aspects of Land Disposal of Sewage Effluents and Sludges	An interagency study with the Department of Health and Agriculture.
6. Pollution Control Objectives.....	Preparation of 13 background reports and Pollution Control Branch reports on effluence objectives for the food processing, agricultural, and miscellaneous industries.

Other Major Projects

1. *Kalamalka-Wood Lakes Basin Water Resource Management Study*—The Environmental Studies Division also participated in the 2½-year Water Investigations Branch study of the water resources of the Kalamalka-Wood Lakes Basin. The study was directed primarily toward water-quality problems, but the work included other aspects of the total water system, including biology, limnology, hydrology, water use, geology, recreation, engineering, and economics. A public involvement program was initiated in the autumn of 1973 to assure that the study recommendations reflected the wishes and concerns of the residents of the basin.

2. *Fraser River Upstream Storage Studies*—The Division has been involved in a review of the program of upstream storage set out in the 1963 Final Report of the Fraser River Board. Updated construction cost estimates were developed for each project. Benefits and disbenefits were evaluated in both qualitative and quantitative terms for various combinations of storage and diversion projects, and weighed against their potential for flow regulation and flood control.

The Review Report required under the terms of the 1968 Federal-Provincial Fraser River Flood Control Agreement was compiled under the direction of a four-member committee with equal representation from Environment Canada and the Water Investigations Branch. Work was carried out by agencies of both senior Governments and several consulting firms.

A special subcommittee was formed to evaluate the ecological and other consequences of the proposed upstream storage developments, and 13 separate reports documenting the ecological impact were prepared. A summary of these background reports was prepared by the Water Investigations Branch.

Consultative Services

Staff of the Environmental Studies Division has provided advice on a wide variety of subjects to the public and to other Government agencies. Some subjects dealt with are:

- (1) The use of aquatic vegetation to stabilize peaty dredge spoil in Burnaby Lake.
- (2) Aspects of sewage disposal related to algæ and aquatic weeds, and protection of lakes.
- (3) Ecological effects of lowering Ikt Lake by the Forest Service, to aid road construction.
- (4) Sediment nutrient control in Coldstream Creek and storm drainage from Coldstream Municipality.
- (5) Implications of using chemical, bacteriological, and viral agents to control forest pests.
- (6) Means of controlling aquatic weeds.
- (7) Means to maximize the fishery potential of hydro-electric pondages.
- (8) Water-quality information on various water bodies, and interpretation of its meaning.
- (9) Ecological implications of various residential and industrial developments.
- (10) Diving inspection of Vernon City water intake in Kalamalka Lake, regarding obstruction by algæ.

ENGINEERING DIVISION

Under the November 1974 reorganization, the former ARDA Division and Projects Division were amalgamated to form the Engineering Division of the Branch, thus bringing together engineering functions concerning water supply, drainage, and river works into a new Water Supply Section and a Rivers Section. (See Table 1 for organization.)

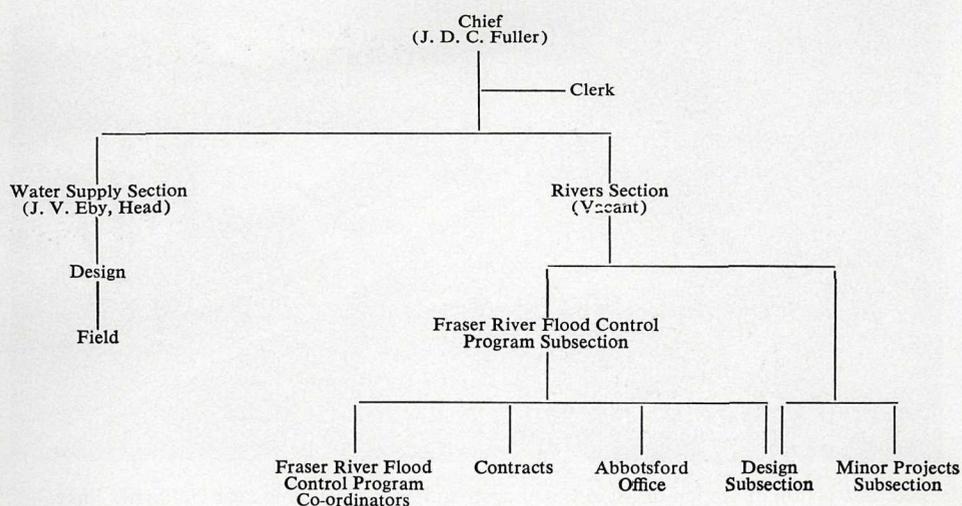
WATER SUPPLY SECTION

The main work of this section during 1974 has involved investigation and implementation of water-supply and drainage projects under the third Federal-Provincial *Agricultural and Rural Development Act* (ARDA) program, which covers the period 1970 to 1975.

The majority of ARDA water projects have been concerned with the rehabilitation of irrigation systems and storage works, the majority of which are located in the Okanagan Valley. Recently, investigations or projects involving drainage and other similar reclamation-type projects, particularly in the Lower Fraser Valley, have been undertaken. Work carried out by the Water Supply Section includes design and construction supervision of certain projects as well as processing of claims and maintenance of records relating to ARDA water projects. Since the start of the ARDA water-projects program in British Columbia in 1963, a total expenditure of \$44,011,000 has been authorized, and \$35,560,000 actually expended on approved projects. In addition, approximately \$270,000 has been expended on projects for which final approval is awaited. Fifty-eight projects have been completed under the program, and 13 additional projects have been approved and are under various stages of design or construction. Two new projects are currently awaiting final approval, and several other projects are under study prior to a possible proposal submission.

Project descriptions following will be given only for those which are actively under study or where significant changes have taken place during 1974.

TABLE 1—ORGANIZATION OF ENGINEERING DIVISION



Approved ARDA Projects Under Construction or Study

District	ARDA Project Numbers	Cost	Notes
South Okanagan Lands Irrigation District	10010 29041(S) 29051 89043	\$ 3,552,300	Rehabilitation of system serving 5,400 acres of agricultural land and 600 farm domestic users. Design for all works completed. Construction will be finished in 1975 to complete rehabilitation.
South East Kelowna Irrigation District	29053 89031	4,720,000	Rehabilitation of system serving 4,336 acres of agricultural land and 660 farm domestic users is essentially complete at the end of 1974.
Corporation of District of Summerland	89044	5,138,183 estimated total	Project approved in June 1974. First contract for 36,000 feet of pipe at cost of about \$350,000 was awarded in November 1974.
Black Mountain Irrigation District	89042	1,600,000	Project approved October 1973 for rehabilitation of upstream storage works. New 64-foot-high dam complete at Graystoke Lake; Belgo Lake dams and diversion ditches near completion at end of 1974.
Black Mountain Irrigation District	89049	101,000	Project approved in September 1974 for installation of mechanical screens at intake.
Grand Forks Irrigation District	89047	135,000	Research project to determine groundwater potential approved in August 1974. Data required to check feasibility of irrigating farms from groundwater.
Glenmore and Ellison Irrigation Districts	89046	855,411	Project approved in August 1974. Includes rehabilitation of shared diversion works with new mechanical screening, replacement of Glenmore main transmission flume with pipe, and installation of two laterals. Construction planned mainly for 1975.
Chase Irrigation District	89039	82,500	Rehabilitation of main line, intake, and storage works approved November 1973. Main line and intake works completed in 1974. Pillar Lake dam construction scheduled for fall 1975.
Deadman Creek Irrigation District	89021	126,000 estimated	Project approved in August 1973 for construction of storage dam on Snohoosh Lake for both irrigation and fisheries purposes. Preliminary investigations and design indicate further studies are needed and an over-all review is under way which will likely result in a revised project submission.
Township of Chilliwack (Castleman Road area)	89025	195,000	Drainage improvement scheme for approximately 300 acres of agricultural land was approved in August 1974. Final design is under way and construction scheduled for summer 1975.



Reconstruction of section of Main Canal upstream of No. 1 Flume near Gallagher Lake, South Okanagan Lands Irrigation District.



Graystoke Dam and Spillway, Black Mountain Irrigation District.



Construction of intake works on Chase Creek, Chase Irrigation District.

Projects Under Study for Possible ARDA Proposal

During the year, the Water Supply Section carried out feasibility studies on several possible projects. The majority of these studies resulted from requests or inquiries regarding possible projects under the ARDA program. The project descriptions following cover the more detailed studies carried out for both water-supply and drainage improvement projects.

District	Description
1. Sinmax Creek Water Users' Community.....	Feasibility study and report completed on proposed upstream storage and pressure pipe-line distribution system. Report recommendations not acted on as anticipated costs to local residents appeared excessive.
2. Fairview Heights Irrigation District.....	The District requested ARDA assistance for rehabilitating its existing distribution system, and utilizing groundwater as a supply instead of the Similkameen River. Feasibility study and report will be completed in 1975.
3. Grand Forks Irrigation District.....	Economic feasibility report prepared on rehabilitation of a large portion of the District's system utilizing groundwater as the source of supply. It indicated that a system could be installed to serve some 1,200 acres for about \$27 per acre per year. Adequacy of groundwater supplies needs to be determined, and an ARDA research project was approved for this purpose.
4. McCoy Lake Drainage.....	Assistance requested for reducing flood damage in low-lying area adjacent to McCoy Lake near Alberni. Preliminary remedial measures and environmental concerns are under consideration.
5. Oregon Jack and Upper Hat Creek.....	Engineering study under preparation on the feasibility of supplying irrigation water to up to 2,000 acres of Thompson River benchlands near Ashcroft. The project would involve diversion of water from Upper Hat Creek and development of storage on Langley Lake for release into Oregon Jack Creek and delivery to the irrigated lands.
6. Coldstream Creek.....	A study was commenced of erosion problems along Coldstream Creek within the Municipality of Coldstream, with a view to obtaining ARDA assistance.
7. Saar Creek, District of Abbotsford.....	Engineering study of possible drainage project for about 1,500 acres of farmland was continued in 1974.
8. District of Surrey.....	Continued study of possible drainage and irrigation schemes for the floodplains of the Nicomekl and Serpentine Rivers, and the effects these might have on fisheries, recreation, and other resource interests. A monitoring program was established during 1974.

Other Studies

Area	Description
1. Lower Columbia.....	Preliminary study of regional water supply for the area between Keenleyside Dam and the City of Trail was completed. The study determined the cost of supplying bulk domestic water to all communities in the area, utilizing either the Lower Arrow Lake or the Columbia River immediately downstream of the Keenleyside Dam.
2. Mission Creek near Kelowna.....	Assessment of Mission Creek channel capacity and dyke system and recommendations for improvements to increase the factor of safety against failure to contain peak flows and to minimize annual maintenance costs.
3. Vernon Creek.....	Studies were commenced in 1974 on erosion problems along Vernon Creek, between Kalamalka and Okanagan Lakes.
4. West Osoyoos Bench.....	A study of seepage problems in about 100 acres of agricultural lands was started in 1974, with a view to recommending drainage works.

RIVERS SECTION

The Rivers Section functions to investigate, review, and implement flood-control, land-reclamation, and erosion-control projects. The principal activities of this section during 1974 comprised the following:

- (1) Continued implementation of design and construction under the 1968 Federal-Provincial Lower Fraser Valley Flood Control Agreement.
- (2) Investigation and construction concerning other major flooding and erosion projects.
- (3) Investigation and construction concerning minor flooding and erosion projects.
- (4) Technical advice to different agencies concerning flooding and erosion aspects of different projects.

An exceptionally high 1974 spring snow-pack resulted in an unusually large number of requests for assistance; however, cool weather resulted in a gradual run-off with no widespread flooding problems.

Details of principal activities during 1974 follow.

Lower Fraser Flood Control Program

While the target expenditure of \$12.6 million for 1974 was not achieved, good progress on program design and construction was made during the year. To date, applications for assistance with flood-control works under the program have been received from the following municipalities or local authorities:

Local Authority	Date of Application	
1. District of Kent.....	March	1969 (C*)
2. District of Pitt Meadows.....	March	1969 (R)
3. Township of Richmond.....	March	1969 (C)
4. District of Matsqui.....	May	1969 (C)
5. Township of Chilliwack.....	August	1969 (C)
6. Corporation of Delta.....	August	1969 (C)
7. District of Mission.....	August	1969 (R)
8. District of Sumas (Abbotsford).....	May	1969 (C) (part)
9. Harrison Hot Springs.....	February	1969 (D)
10. District of Surrey.....	May	1969 (C) (part)
11. New Westminster, Queensborough.....	December	1970 (R)
12. District of Burnaby.....	November	1970
13. District of Langley.....	March	1972
14. City of Port Coquitlam.....	April	1970 (D)
15. District of Maple Ridge.....	October	1969
16. Department of Public Works, Colony Farm.....	August	1970
17. Department of Indian Affairs, Seabird Island.....	October	1971 (C) (part)
18. South Dewdney.....	April	1973
19. Nicomen Island Improvement District.....	February	1974
20. City of Kamloops, Oak Hills.....	October	1973 (C*)
21. Glen Valley Dyking District.....	February	1974

(C*) Project essentially complete.

(C) Project under construction.

(R) Project report complete.

(D) Preliminary designs under way.

Principal design activity centred around the Chilliwack, Delta, Richmond, and Queensborough projects. A start was also made on design for the Coquitlam and Surrey (South Westminster) projects.

Construction work took place mainly at the Chilliwack, Delta, Richmond, and Surrey (Nicomekl-Serpentine dams) project.

With total approved funds amounting to \$61 million, shared 50-50 Federal-Provincial, total program expenditure for the year was \$8.9 million, bringing the total program expenditure to \$20.5 million by the end of 1974.

During 1974, contracts totalling \$8.5 million were awarded (\$4.9 million in 1973) and contract payments totalling \$7.5 million (\$2.6 million in 1973) were processed under the program. Design costs amounted to \$854,000 (\$550,000 in 1973) with site supervision and miscellaneous costs amounting to \$540,000.

Due to unforeseen high escalation in construction costs, the final costs of these projects were forecast to equal, if not exceed, the \$61 million in funds approved. At the end of 1974, work was awaited from the Federal Government regarding approval of further projects which would involve a commitment of funds in excess of those authorized. The construction of further projects, including Pitt Meadows, South Westminster (Queensborough), and Mission City, may therefore be delayed.

The following descriptions are given for projects on which significant activity occurred during 1974:

District	Description
1. District of Kent.....	Project approved in December 1969 at a cost of \$2,003,825. To cover rising costs and additional work, \$553,382.50 has since been authorized. Construction of a landside gravel berm to counteract seepage was completed just prior to the 1974 freshet. Other small items needed to complete the project will be done in 1975. Expenditure in 1974 was \$250,000.
2. District of Pitt Meadows.....	Final design recommenced in July 1974 after being stopped in 1970 upon confirmation that the local authority wished to proceed under the revised cost-sharing agreement. Main features of the project will be reconstruction of 21 miles of dyke, four pump stations (two with floodboxes, two without), a new pump station with a floodbox and upgrading of main drains to protect 9,300 acres of floodplain within the Maple Ridge Dyking District and the Pitt Meadows No. 2 dyked area.
3. Township of Richmond.....	The Local-Provincial Agreement for Richmond was concluded in October 1973, and funds totalling \$11,290,000 were approved for construction in April 1974. Escalation is expected to increase the cost of this project substantially. Main features are—rehabilitation of 40 miles of dyke on Lulu Island, reconstruction and repair of 3 miles of riverbank protection, and internal drainage works comprising construction of 14 new drainage discharge structures and repair to 8 other drainage structures at the dyke. Construction commenced in June, and by the end of 1974, four contracts had been awarded to a total value of \$4,048,827. Expenditure on the project in 1974 was about \$950,000.
4. District of Matsqui.....	Project approved in June 1971 at a construction cost of \$2,284,600. Main features comprise rehabilitation of 7 miles of dyke, 0.5 of riverbank protection, reconstruction of two drainage pump station floodbox structures, and upgrading of main drains. Dyke and pump station contracts were completed in 1974. Expenditure was approximately \$3,280,000 to the end of 1974, with final cost expected at approximately \$4 million.

District	Description
5. Township of Chilliwack.....	Project approved in December 1971 at a construction cost of \$5,315,850, and an agreement between the local authority and the Province was signed in February 1973. Main features are rehabilitation of some 20 miles of dyke, 8.7 miles of bank protection works, including the Greyell Slough flow control, and internal drainage comprising the construction of three pump stations (two combined with floodboxes), the upgrading of a fourth pump station, and improvements to main drains. Project expenditures in 1974 were approximately \$3.3 million.
6. Corporation of Delta.....	Project approved in August 1973 at a construction cost of \$10,523,700. Agreement between local authority and the Province signed in September 1973. Escalation is expected to increase the cost of this project substantially. Main features are rehabilitation of some 40 miles of dyke, 4.5 miles of bank protection and internal drainage, including the rehabilitation or reconstruction of 11 pumping facilities, 25 floodboxes, and upgrading of main drains. During 1974, six contracts were awarded at a total contract value of \$2,379,605. Project expenditures amounted to \$1,443,000.
7. District of Surrey.....	Application to upgrade the dykes of the South Westminster Dyking District, the Serpentine and Nicomekl River dykes, including the dams at the mouths of the two rivers and the flood-protection and wave-protection works at Mud Bay was submitted to the Province in May 1969. Rehabilitation of the Serpentine and Nicomekl Dams was approved in November 1973 at a construction cost of \$1,095,000. Construction was completed in 1974 with expenditure during the year of \$1,149,000. Final design for South Westminster was commenced in October 1974, the project to comprise rehabilitation of 4 miles of dyke, reconstruction of four pump stations and improvements to main drains. Expected cost is \$3.5 million. Clarification regarding dyking requirements at the lower end of the Serpentine-Nicomekl Valley is being sought before a decision on reconstruction of the Mud Bay sea dykes is made. Reconstruction of the Serpentine and Nicomekl River dykes, which generally protect valley-bottom farm and pasture land from flooding by winter rains, was not found to be economic and no further work to these dykes is proposed under the 1968 Federal-Provincial Agreement.
8. City of Port Coquitlam and District of Port Coquitlam	Final design was started on a project to reconstruct 8 miles of dyke, four pump stations, and main drains of the Coquitlam Dyking District (which lies within city and district boundaries). Expected cost is about \$8.6 million.
9. City of Kamloops, Oak Hills.....	The Oak Hills subdivision, about 4 miles north of Kamloops City centre, was inundated by high-water of the North Thompson River on June 2, 1972. In 1973 and 1974, 6,000 lineal feet of dyke was reconstructed, and foundation seepage works and a permanent pump station were installed. The requirements for additional pumping at higher river levels has been assessed and pumps are to be purchased for delivery before the 1975 freshet to assist in drawing down the groundwater table during higher river levels. On April 26, 1974, this project was approved for inclusion under the Fraser River Flood Control 1968 Agreement at a cost of \$1,116,000. To date, \$1 million has been spent on the project, \$409,000 of this amount being spent during 1974.
10. Emergency Bank Protection, Nicomen Island	Prior to the 1974 freshet, emergency bank protection was constructed at Nicomen Island, with \$100,000 of rock riprap protection at two sections where serious erosion was taking place, and an additional \$50,000 was spent on stockpiling rock riprap for future emergency bank protection work. Funds for this work were approved on May 27, 1974.
11. Emergency Bank Protection, District of Pitt Meadows	Emergency bank protection work costing \$40,000 was constructed by the District of Pitt Meadows prior to the 1974 freshet. There were two locations of serious erosion, on the bank of the Fraser River and on the bank of the Alouette River.



Project 3—Township of Richmond, Contract 1: Sea Dyke Improvement.



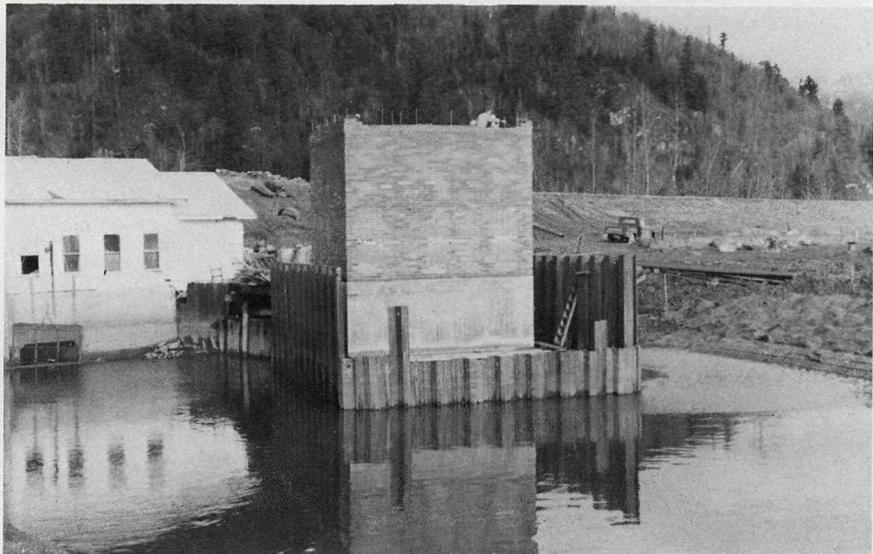
Emergency bank protection at Pitt Meadows.



Reconstructed dyke and control structure at entrance to Greyell Slough.



Drilling of wells for underseepage treatment under Vedder Canal Dyke.



McGillivray pump station under construction.

Major Flooding and Erosion Projects

Area	Description
1. Lower Squamish Valley.....	Upon representation by the District of Squamish, \$500,000 was authorized for construction of 10,000 lineal feet of dykes and bank protection to extend earlier flood protection and bank stabilization works along the Squamish and Mamquam Rivers into the Brackendale area.
2. Bella Coola Valley.....	As a result of heavy rainfall in late 1973, training works and bank protection were constructed on Thorsen Creek, Nooklikonnik Creek, and on a section of the Bella Coola River at a total cost of \$195,000. A report on flooding and erosion by the Lower Bella Coola River and sidestreams has been completed. Recommendations concerning a course change in the Bella Coola River near Firvale, 20 miles upstream, which caused damage to a farm and threatened the highway were forwarded to the Department of Highways.
3. Cowichan River.....	Late in 1973 and early in 1974, heavy rainfalls combined with high tides produced extensive flooding in the lower Cowichan and Koksilah Rivers delta. A private dyke was breached, flooding many acres of farmland. The dyke was repaired in co-operation with the Department of Highways at a cost of \$12,000. Log jams again caused the accumulation of gravels in the lower Cowichan River. The log jams and gravels were removed under direction of Engineering Division staff with the co-operation of the Cowichan Indian Co-operative Association. The Association also constructed some dykes on the Indian Reserve. The cost of this work was \$47,000.
4. Keremeos Creek.....	Some channel-clearing was carried out in the lower reaches of Keremeos Creek on a cost-sharing basis with the regional district, in view of the heavy 1974 snow-pack which threatened to cause extensive flooding in the Cawston area. The cost of the work was \$4,000. During the year, a report giving possible solution to the flooding along the lower Keremeos Creek was completed and submitted to the regional district.
5. Kamloops.....	A record snow-pack in the Thompson River drainage area gave cause for concern that the City of Kamloops might experience extreme high-water during during the spring run-off in 1974. The City was unable to take appropriate action due to a labour dispute, and the Provincial Government passed the <i>Kamloops Emergency Flood Control Act</i> under which the strengthening and raising of dykes was undertaken. The work was carried out by the Department of Highways, with technical assistance provided by the Division, at a total cost of \$850,000.
6. Grand Forks.....	Flood profile and dyke alignment studies of the flood-control scheme on the right bank of the Granby River at Grand Forks were completed during 1974 and construction of Phase 2 of the scheme is expected to commence during 1975.
7. Trout Creek.....	Dyking, channel improvements and erosion protection initiated in 1973 was completed at cost of approximately \$380,000.
8. Slocan Valley, Lemon Creek.....	Arrangements were made for a consultant's review of the flooding and erosion problems in the Slocan Valley related to the formation of the Lemon Creek fan. The draft report was submitted in December 1974.

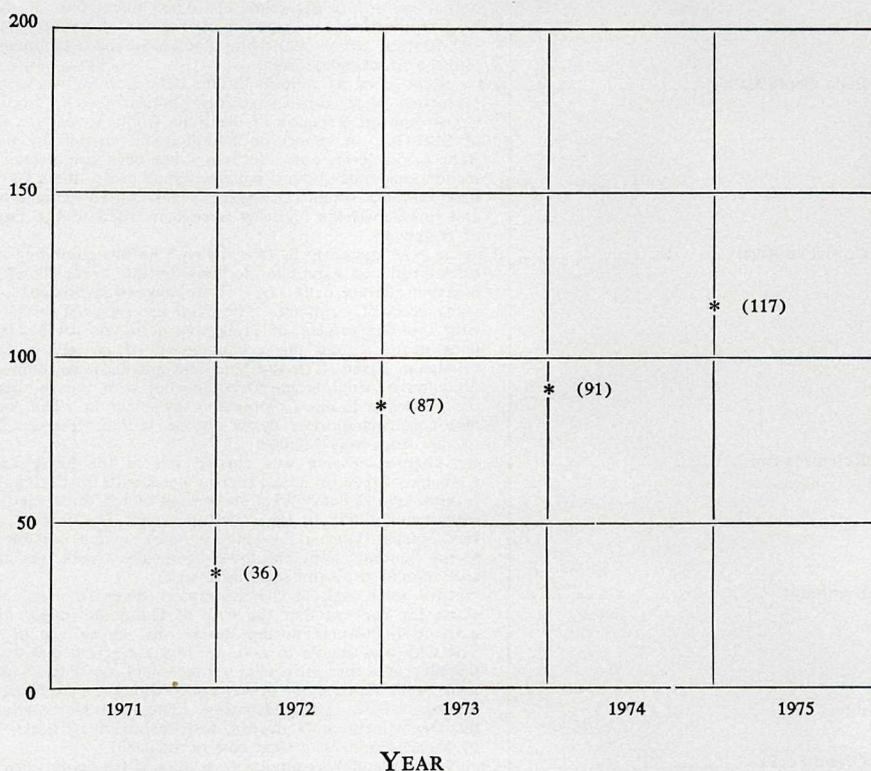
Minor Flooding and Erosion Projects

During the spring and early summer, many communities, organizations, and industries throughout the Province were bracing themselves for possible major floods on account of the record snow-packs reported in many areas. This threat resulted in a very large number of requests being received for dyking and erosion-control works during the early part of the year.

In most areas of the Province, with the exception of the East Kootenay region where floods reached record levels, prolonged high flows were experienced, with little resultant damage to protective works. Approximately 117 new requests for assistance under the 75-per-cent Provincial 25-per-cent landowner cost-sharing program were received during the year which as may be seen in Table 2 represents a steady

increase in the demand which is being made on this program. Of the projects on hand at year's end, 30 have reached report stage, 19 require further investigation, and 38 remain to be inspected.

Table 2—Requests for River Improvement Assistance



Offers of assistance were made in 63 cases. Fifty-four construction projects were completed at a total cost of \$520,000.

The distribution of expenditure throughout the Province, listed in general by watersheds, was as follows, the number of separate projects being indicated by brackets:

	\$
Boundary Creek	4,000 (2)
Fraser River	59,000 (3)
Lillooet River	15,000 (1)
North Thompson River	56,000 (5)
Shuswap Drainage Basin	30,000 (3)
Vancouver Island	164,000 (15)
Columbia River	22,000 (3)
Kettle River	44,000 (3)
Okanagan Valley	50,000 (7)
Similkameen River	76,000 (12)

Channel-clearing Program

Heavy fall and winter rains and high summer freshet flows created channel blockages in watercourses throughout the Province. This blockage, in many cases,

would, if not removed, cause relatively serious flooding and erosion problems. In the fall of this year, a Province-wide program was initiated to remove jams in instances where the cost of works is justified by the damage potential. At the end of the year, 31 projects had been completed at an estimated cost of \$115,000.

Other Activities

During 1974, technical assistance and advice were provided to Provincial Government and other agencies in connection with road, railway, and bridge construction, sale of land, and other developments within or near floodplains.



Closing of break in dyke along Koksilah River.

RECORDS COMPILATION AND REPORTS SECTION

REPORTS LIBRARY

During the year, 171 new engineering reports were received by the Library for registration. In addition to the new reports, over 700 other copies of reports were prepared and distributed.

Set out below is a numerical and percentage summary of reports written during 10-year periods:

Periods (Years)	Number of Reports Available	Percentage of Total Available
1911-20.....	36	1.6
1921-30.....	190	8.4
1931-40.....	30	1.3
1941-50.....	156	6.9
1951-60.....	583	25.9
1961-70.....	788	35.0
1970-74.....	472	20.9
Totals.....	2,255	100.0

Of the present total of 2,255 reports in the Library, 1,313 reports have been prepared by the Water Resources Service staff. The main fields which they cover are as follows—water power, water supply, flooding, drainage, dyking, groundwater, and hydrology.

Throughout 1974, the Reports Library responded to over 650 requests for report loans and copies of other publications.

GENERAL OFFICE

In order to meet the 1974 Branch requirements, over 400 requisitions covering purchases and (or) repairs of equipment, furniture, machinery, and supplies were prepared, and over 2,300 invoices from suppliers processed for payment.

The General Office staff assisted in the processing of claims for various construction and survey projects and in the collection, compilation, and maintenance of technical, cost, and inventory records.

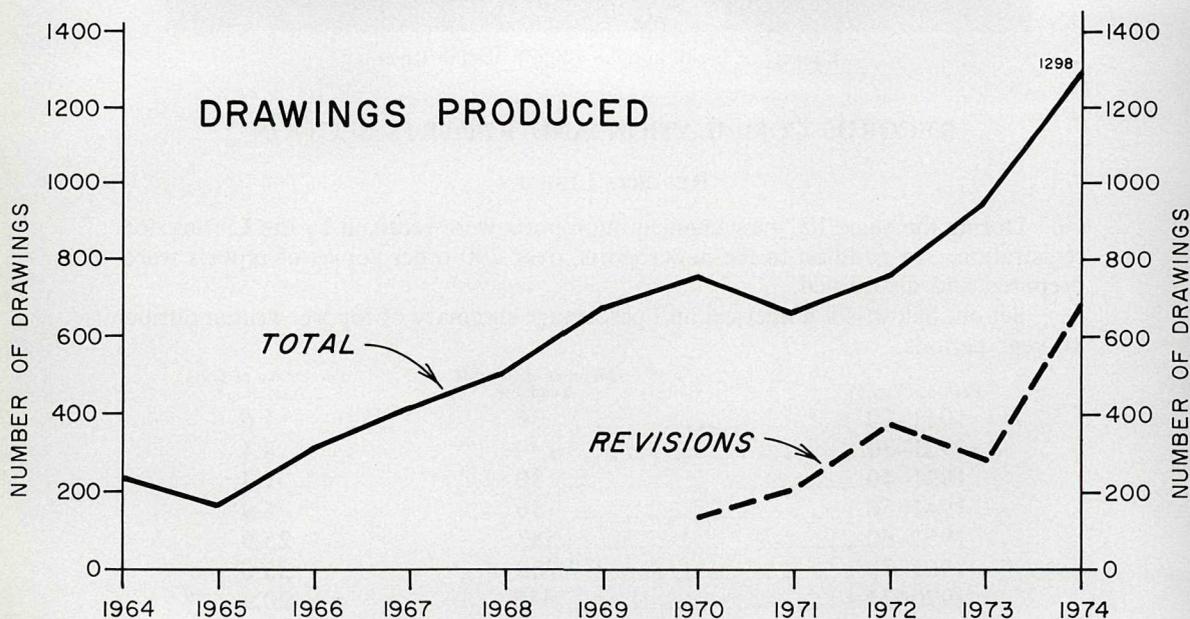
In addition, the General Office provided a central service for mail, messenger and shipping functions, and operated the Branch motor-vehicle pool. During the past 12 months, Branch units travelled over 450,000 miles.

The Accident Prevention Division of the Public Service Commission again conducted the Defensive Driving Course and in 1974, 13 Water Investigations Branch employees successfully completed it. This brings the total of Branch employees who have taken the course since its inception to 20.

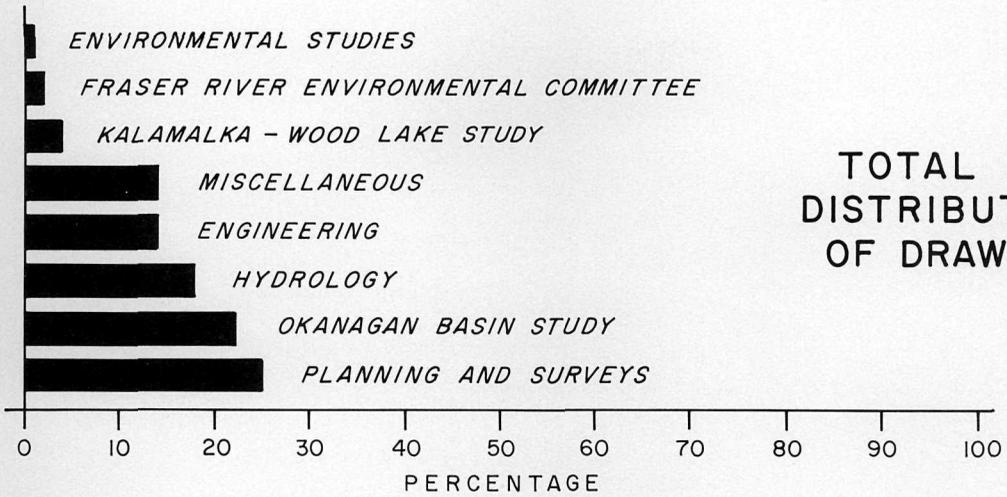
The Administrative Officer attended meetings of the Interdepartmental Safety Committee, the Resources Building Steering Committee, and served as a member of other interbranch and interdepartmental study groups.

DRAUGHTING ROOM

The Draughting Room serves all divisions as illustrated below.



TOTAL 1974
DISTRIBUTION
OF DRAWINGS



STATE OF
DISTRIBUTION
OF DRAWINGS

POLLUTION
CONTROL
BOARD

REVOLUTION

CONSTITUTION

1789

**POLLUTION
CONTROL
BOARD**

B. E. MARR, CHAIRMAN

The Pollution Control Board, as set up under section 3 of the *Pollution Control Act*, consists of a Chairman and eight members representing Government, university, and private interest.

The main functions of the Board are to act in an advisory capacity to the Government, to set standards for controlling pollution, to act as an appeal tribunal when an order of the Director of the Pollution Control Branch is appealed. The Pollution Control Board also hears appeals from the decisions of the Director of Pollution Control (Air) of the Greater Vancouver Regional District. This agency assumed responsibility in 1972 for issuance of air emission permits within the boundaries of the Greater Vancouver Regional District.

The Pollution Control Board was enlarged in 1974 to include two new members. The membership of the Board is as follows:

B. E. MARR, Chairman.

B. D. CAINE,
Assistant Director of Environmental Engineering,
Department of Health, Victoria.

HOWARD ENGLISH, retired farmer and conservationist.

Dr. C. J. G. MACKENZIE,
Head, Department of Health Care and Epidemiology,
Faculty of Medicine,
University of British Columbia, Vancouver.

Dr. J. E. MCINERNEY,
Department of Biology,
University of Victoria, Victoria.

R. J. MILLER,
Director, Special Services,
Department of Agriculture, Victoria.

J. W. PECK,
Chief Inspector of Mines,
Department of Mines and Petroleum Resources, Victoria.

J. S. STOKES,
Deputy Minister of Forests, Victoria.

E. H. VERNON,
Associate Deputy Minister,
Department of Recreation and Conservation, Victoria.

During 1974, the Pollution Control Board heard 12 appeals from the decision of the Director of Pollution Control, including one from the decision of the Director of Pollution Control of the Greater Vancouver Regional District relating to the issuance of an air emission permit.

Where public interest warranted it, the Board held the hearings in the communities concerned—Campbell River, Ganges, and Burnaby. This practice will continue as public concern and participation increase in matters bearing on the protection of the environment.

The Pollution Control Board upheld the decision of the Director of Pollution Control on eight of the appeals; allowed or allowed in part three of the appeals; and reserved judgment on one appeal pending further information.

Two decisions by the Pollution Control Board were appealed to the Supreme Court of British Columbia, one of which was later withdrawn. Two rulings of the Pollution Control Board were appealed to the Lieutenant-Governor in Council (Cabinet) which resulted in one decision of the Board being reversed and the other, to do with interpretation, being upheld.

The Pollution Control Board received and reviewed the chemical and petroleum objectives, as recommended by the Director of Pollution Control following a public inquiry in May of 1972. After some revision, the objectives were adopted by the Board and now constitute Board policy for pollution control in British Columbia's chemical and petroleum industries.

POLLUTION
CONTROL
BRANCH

COLLIER

COLLIER

COLLIER

**POLLUTION
CONTROL
BRANCH**

W. N. VENABLES
DIRECTOR

DIRECTOR'S REPORT

As of April 1, 1974, the Branch took over the administration of the *Litter Act* and the Environmental Conservation (Project SAM) activities of crushing and removing derelict automobiles throughout the Province.

In 1974, the major thrust of Branch efforts continued toward bringing under formal control all discharges of liquid, solid, and gaseous wastes to the water, land, or air environment of British Columbia. In order to aid both applicants for pollution control permits and the Director in resolving the requirements to be imposed on waste discharges to the environment, the Branch continued with its program leading to the establishment of objectives for wastes from the major industrial activities as well as municipal activities within the Province. In this respect, the Director completed the public inquiry into Pollution Control Objectives for Municipal-type Waste Discharges in British Columbia, and has put recommendations before the Pollution Control Board on these objectives for the Board's ratification. The Director also referred to the Board his recommendations regarding the Pollution Control Objectives for Food-processing, Agriculturally Oriented, and Other Miscellaneous Industries of British Columbia. Staff of the Branch commenced applying the Pollution Control Objectives for the Chemical and Petroleum Industries of British Columbia upon their acceptance by the Pollution Control Board on March 19, 1974.

The productivity of the Branch for 1974 is illustrated by the following statistics:

Permit applications received	776
Permit applications refused	16
Permit applications withdrawn	96
Permits issued ¹	582
Amendments to permits ¹	95
Approvals issued	91
Certificates requested	499
Certificates issued	402
Prosecutions initiated	14

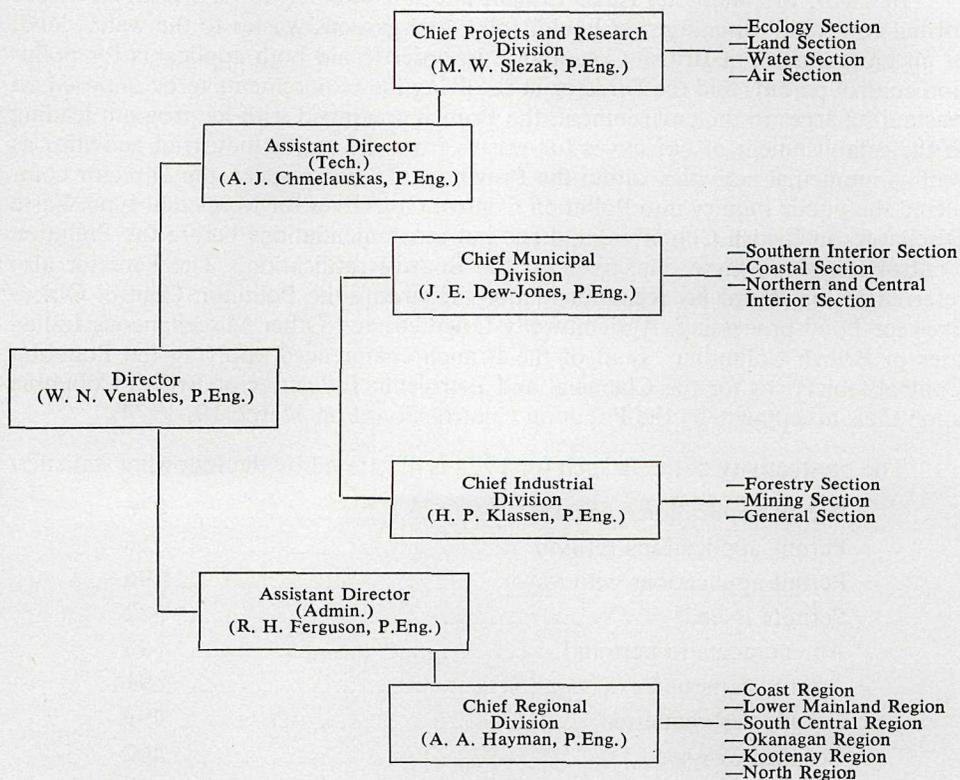
¹ The total of 677 permits and amendments issued in 1974 covers 1,132 discharges.

The Director's office in 1974 held two public hearings related to applications for pollution control permits and three appeal hearings from orders issued by the Regional Managers of the Branch. In turn, 14 appeals from decisions made by the Director of Pollution Control were registered with the Pollution Control Board. As during 1973, the majority of the appeals were from the recipients of permits or orders.

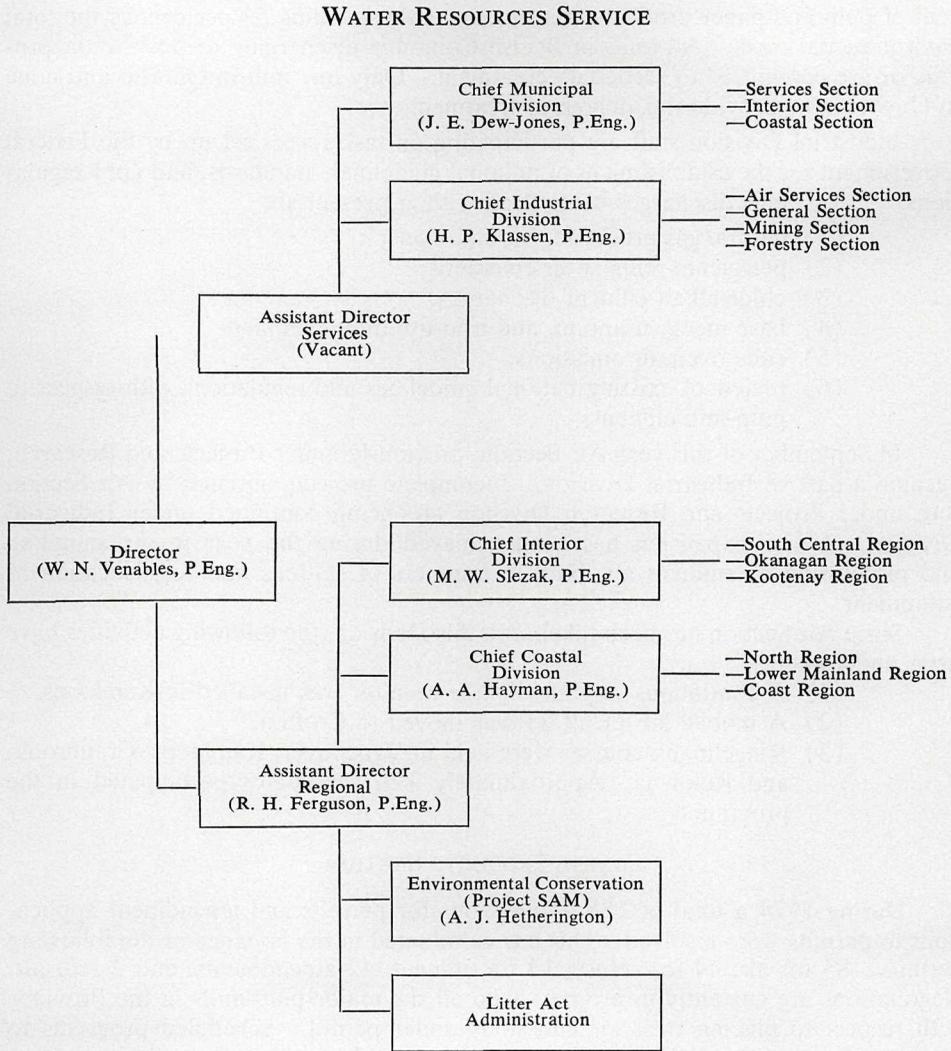
During 1974 the Branch devoted considerable attention toward decentralizing authority for day-to-day administration of the *Pollution Control Act, 1967*, to its staff in Regional offices. In order to aid in the decentralization and to provide for the consolidation, within the Water Resources Service, of all staff engaged in special investigations of an environmental nature the reorganization of the Branch was effected.

ORGANIZATION STRUCTURE (PRIOR TO SEPTEMBER 1974)
POLLUTION CONTROL BRANCH

WATER RESOURCES SERVICE



ORGANIZATION STRUCTURE (AFTER SEPTEMBER 1974)
POLLUTION CONTROL BRANCH



INDUSTRIAL DIVISION

During 1974, some 543 applications for pollution control permits were resolved resulting in the issuing of 414 new permits, 63 amendments to permits, 10 refusals, and 56 withdrawals. It is worthy to note that a permit may cover numerous discharges or emissions. In addition Branch staff made in excess of 95 field inspections and held 250 meetings pursuant to applications.

It is most significant that the British Columbia Pulp and Paper Industry has surpassed the industry in the rest of Canada in its pollution control effort. In the period 1973 to 1975, the capital expenditures for environmental protection works are estimated at \$94,692,000 of which 60 per cent is for effluent improvement and

40 per cent for air emission control. In contrast Ontario in that same period has an estimated cost of \$27,873,000, Quebec \$44,240,000, and all Canada \$179,115,700. It must be noted that British Columbia mills produce only 24 per cent of pulp and paper products, but are currently spending 53 per cent of the total environmental costs. All mills in British Columbia discharging to fresh water provide or are committed to secondary treatment. Only one mill in Ontario and none in Quebec now provide this degree of treatment.

Industrial Division staff are participating on task forces set up by the Federal Government for the establishment of national guidelines, standards, and (or) regulations. The specific discharges being dealt with at present are

- (1) natural gas processing air emissions;
- (2) petroleum refinery air emissions;
- (3) chlor-alkali effluent discharges;
- (4) base metal, uranium, and iron-ore mining effluent;
- (5) coke oven air emissions;
- (6) review of existing national guidelines and regulations with respect to pulp-mill effluent.

In September of this year Air Section, previously under Projects and Research, became a part of Industrial Division. Incomplete projects initiated by Air Section staff under Projects and Research Division are being continued under Industrial Division. Major expansion has been achieved during the year in the sampling and monitoring of ambient air, both in numbers of stations and sophistication of equipment.

Since Air Section has been taken into this Division, the following activities have been undertaken:

- (1) A continuous sulphur dioxide monitor was installed in Kamloops.
- (2) A mobile lab (Unit 3) was moved to Crofton.
- (3) Ringelmann courses were held in Vancouver, Kamloops, Cranbrook, and Kelowna. Approximately 120 candidates participated in the program.

FOREST PRODUCTS SECTION

During 1974 a total of 188 applications for permits and amendment applications to permits were resolved. This has culminated in the issuance of the following permits—85 for air, 44 for refuse, 14 for effluent, 42 amendments, and 3 refusals. Negotiations are currently in progress with all the major pulp-mills in the Province with respect to placing their air emissions under permit. Scheduled programs to improve the quality of the emissions consistent with meeting the objectives have been received and are now in their final stages of review.

Three pulp-mills in the Prince George area have requested amendments to their effluent permits to meet the Level A objectives. In order to meet these objectives, modifications entailing a total expenditure of approximately \$9,000,000 are scheduled for completion by the end of 1976. In addition, upgrading programs are planned for improving emission quality to meet Level B by 1976 at a cost of approximately \$3,000,000. Finlay Forest Products at Mackenzie is expanding their effluent treatment facilities in line with the mill expansion. Crestbrook Forest Products is currently in the process of carrying out the instructions embodied in the Director's order of August 12, 1971, part of which entails upgrading the quality of the mill effluent to Level A by August 12, 1975.

B.C.F.P., Victoria Plywood Mill, have been ordered to install secondary air-control equipment to provide for the removal of 80 per cent of all particulate matter

larger than 0.3 microns in size. An electrostatic precipitator at an estimated cost of \$2,000,000 has been purchased and is to be in operation by December 31, 1975.

The older Coastal mills such as CanCel, Ocean Falls, Gold River Pulp, Rayonier Woodfibre, C.F.P. Port Mellon, C. Z. Elk Falls, B.C.F.P. Crofton, and MacMillan Bloedel Mills at Port Alberni, Harmac, Powell River all have scheduled programs to upgrade the quality of their respective mill effluents to Level B by 1978. The programs entail in-plant recovery systems for recovery of chemical and fibre, removal of suspended solids through clarification systems and submerged outfalls, and diffuser systems for dispersion of effluent. The total costs to the above mills is estimated to be in the order of \$50,000,000. The sulphite mill of Rayonier Canada, Port Alice Division, has embarked on a \$32,000,000 program which entails the installation of a chemical recovery system by mid-1976. This should reduce the pollution load by approximately 65–70 per cent to Neroutsos Inlet. During the interim period during the summer months, barging of the red liquor with discharge of effluent to open seas is carried out. This should permit them to meet permit conditions with a minimum of production curtailment.

The three paper product mills in the Lower Mainland area have submitted programs which should enable them to meet Level A requirements for effluent by 1977.

A fibre-moulding mill in the Victoria area has installed a wood-dust collecting and wood-waste incineration system utilizing the generated heat for drying of their products in the mould drying kilns, at an estimated cost of \$400,000. The quality of the emission discharges will be upgraded to the Level A.

Scheduled programs for improvement to emission discharges from the Coastal and Interior pulp-mills are currently under review. These programs involve improvements for control of operations, primary dust collectors, secondary chemical precipitators, installation of weak and strong black liquor oxidation systems—new recovery chemical and hog fuel boilers, and associated dust collection systems, and incineration of malodorous gases. Estimated expenditures undertaken for the above are in the order of \$60,000,000. Due to the energy situation and the high cost of fossil fuels the pulp-mills are directing their attention to better and maximum utilization of hog fuel as a source of steam and power.

MINING AND MINERAL PRODUCTS SECTION

Eighty-two permits and four amendments to permits were issued by the Mining Section during 1974. These included eight permits and amendments for effluent, twelve permits and amendments for emissions, and six refuse permits, all to mining companies. Eleven effluent permits were issued to placer operators. Twenty-nine effluent and 20 air permits were issued to gravel plants and ready mix operations.

Placer mining represented the area of greatest activity in mining during the year. It is estimated that there are over 500 placer claims upon which some exploration or mining was done. These operations are being examined as rapidly as possible to ensure that pollution control measures are incorporated where required.

Serious contamination of Wolfe Creek below the Similkameen tailing impoundment was prevented by the installation of a groundwater interceptor and pumping system located downstream of the east tailing dam.

The completion of the recycle system at the Kimberley Fertilizer Plant has been delayed for a year due to the four-month strike which occurred during the construction season. A problem with high groundwater in Marysville forced a

modification to the iron roaster plant calcine effluent treatment system which reduces the total quantity of water discharged.

The assessment of pollution control measures employed by the Trail smelter complex has been completed. As part of the on-going program at Trail major pollution control works on the main stacks, scheduled for installation by 1977, are expected to improve concentrations of sulphur dioxide and particulate matter in the atmosphere around the City of Trail.

The section participated in three joint Federal-Provincial Task Forces charged with setting National Pollution Control Objectives. The task forces covered effluent objectives for base metal, uranium and iron ore mines, emission objectives for the coke industry, and emission objectives for the asbestos industry.

The setting of pollution control objectives for the British Columbia-Japanese integrated iron and steel complex has been assigned to the section as part of a three-phase feasibility study to be completed by October 31, 1975.

GENERAL SECTION

The General Section completed the processing of approximately 248 applications in 1974, resulting in 189 permits, and 11 permit amendments with 7 applications being refused. In addition, 41 applications were withdrawn as a result of the discharges being eliminated or connected to a municipal sewerage system. The permits issued were equally distributed among the oil and gas industries, food and agriculturally oriented industries, and a large variety of miscellaneous industries. Approximately half of the permits were for emissions to the air.

Applications for almost all registered discharges have been or are being processed. The remainder represent a number of minor emissions which in the future may be covered by regulations rather than by permits.

The Pollution Control Board adopted objectives for the chemical and petroleum industries. As a result, negotiations were started with various petroleum and natural gas companies to upgrade air emissions to meet the new requirements.

Discussions were held with industry representatives and consultants with respect to requirements for discharges from three proposed new petroleum refineries.

One application for a permit amendment which was refused resulted in an appeal by the applicant to the Pollution Control Board which upheld the Director's decision.

General Section personnel participated in three Government/Industry Task Forces established by the Federal Government. These task forces are involved in establishing regulations and (or) guidelines relative to effluents from the alkali and related products industries, air emissions from the natural gas processing industry, and air emissions from the petroleum refining industry.

MUNICIPAL DIVISION

Since the introduction of the Act in 1967, over \$200 million has been spent by municipalities in provision of sewers, sewage treatment, and refuse disposal facilities, or about \$100 for every man, woman, and child in the Province. In particular, during 1974, over 200 applications were processed, resulting in 168 new permits being issued. Sixty-eight of them were for effluent discharges, mostly entailing secondary treatment, and 90 for refuse, entailing sanitary landfills, the remainder imposing controls on discharges to the air. Thirty-two applications were for amendments to existing permits, usually to increase quantity or improve quality. Six applications were refused and 40 were withdrawn. Four hundred and two cer-

tificates to construct sewers were processed, compared with 468 in the previous year. In addition to the above, preparatory work was carried out for two public hearings arising from objections to applications and evidence provided in regard to eight appeals to the Pollution Control Board against Director's decisions. Two-thirds of the registered discharges are now resolved, the remainder having to await finalization of "objectives" following the Public Inquiry into Municipal-type Waste Discharges. Many of these registered discharges have been resolved by requiring cessation of the discharge rather than by issuance of permits.

A new "Services Section" has been founded to remedy shortcomings indicated from past experience. Firstly, this service has introduced a pollution control assistance team to help municipalities who find difficulty in meeting permit requirements and, in particular, to report on problems arising from poor operator techniques or inadequate facilities. Secondly, it is intended to make a start in providing technical information and environmental news to keep the public informed of work regarding pollution control. Thirdly, an environmental chemist for the Branch has been assigned to the Service Section and additionally has major responsibilities regarding input and output of monitoring data to the computer. Fourthly, information and advice regarding recycling of refuse or other waste management techniques will be made available. It is anticipated this Section's work will broaden to encompass reports on particular problems and act as liaison with such agencies as the ELUC for municipal waste matters.

There is much interest in spray-irrigating of sewage effluent accompanied by a growing realization that this technique has limitations and may be expensive.

Refuse disposal is a particular problem in the Metropolitan area of Vancouver and studies are under way under the auspices of the various municipal governments. One Vancouver Island community elected to build a new refuse incinerator principally because there were no suitable landfill sites available within a reasonable haul distance. Many refuse permits were issued for small quantities in remote areas for such operations as logging camps.

During the year the first permits were issued for a large modern incinerator and also for an incinerator specially designed for disposal of sewage. Dechlorination of chlorinated effluents was required for the first time, affecting three discharges. A major sewerage feasibility study was undertaken for the first time for another Government agency.

While it is not practical to itemize all the matters attended to during the year, the following reports from the Sections itemize their involvement in items of particular interest.

COASTAL SECTION

One Capital Regional District and the Municipalities of Tahsis, Ucluelet, Tofino, Lake Cowichan, Porty Hardy, Sechelt, and Fort Nelson are currently engaged in work involving new sewage collection and treatment facilities or in upgrading their existing facilities. This work in many cases is aimed at consolidating and treating a number of existing unsatisfactory sewage outfalls.

Several stages of the large West Vancouver collection system have received recent approval. Certificates have been issued to the City of Vancouver authorizing separation of sanitary sewage from roof and road drainage in existing combined sewers. This is part of a program encompassing the West End and Downtown Vancouver costing some \$25 million.

The City of Vancouver is presently installing a sanitary system throughout the industrial area on False Creek Flats east of Main Street to eliminate unsatisfactory

discharges. They are also constructing a separate sewer system to serve the city's new subdivision on the south side of False Creek between Granville Island and the Cambie Street Bridge.

The Municipality of Delta recently commissioned a comprehensive study of the impact of discharges from proposed sewage facilities on the local environment and are proposing to construct a new treatment plant with discharge to the mouth of the Fraser. This is the last major component in a clean-up program for the Metropolitan Vancouver area which started with the adoption of the original Rawn Report in 1953.

The Imperial Oil Company has agreed to install a one-half-mile outfall to Boundary Creek from their facilities at Goodlow near Fort St. John to eliminate discharge to an open ditch.

The Village of Clinton was authorized to dispose of its sewage effluent by spray-irrigation with the option of continuing discharge to a creek as previously authorized. The village council was interested in utilizing the water in a productive way that would otherwise be wasted.

A number of Interior regional districts have undertaken to provide refuse disposal services to outlying areas. For example, Thompson-Nicola were issued eight permits in the last year. Refuse disposal sites were authorized for Kamloops, Gold River, and Alberni, while Kitimat is seeking a permit for a similar operation.

The Regional District of Cowichan Valley has been issued a permit for a modern incinerator to dispose of municipal refuse at a total cost of about \$200,000.

A permit was issued to a private company for an incinerator for the destruction of sewage. This was in conjunction with a European concept in sewage collection in which sewage is transported by vacuum through relatively small plastic pipes. This system largely negates the normal stringent grade requirements and results in much smaller treatment volumes.

INTERIOR SECTION

The Municipalities of Hope, Lumby, Salmo, Invermere, and Revelstoke are currently engaged in work involving new sewage collection and treatment facilities or in upgrading their existing facilities. Langley has applied to divert the Aldergrove effluent from Bertrand Creek to the Fraser River in the interests of fishery protection.

The District of Coldstream have assumed the responsibility for operation and maintenance of the sewer system and treatment plant previously operated by the developer of a small subdivision at Lisheen Estates.

The Village of Keremeos have submitted an application to sewer the village and construct a treatment plant with an outfall to the Similkameen River. Following various objections to the principle of the river outfall, Section staff have spent time with the village in consideration of alternative methods of disposal.

The possibility of ground disposal of treated effluent has been raised by a number of municipalities, including Salmon Arm, Kelowna, and Cranbrook. The Okanagan Study and the Municipal Inquiry revealed that ground disposal may on occasion be an optimum solution but will not necessarily prevent lake eutrophication in every case and costs may be high. Detail site-specific studies are therefore being undertaken.

Various applications have been processed for discharge of septic tank clean-out waste.

The Municipality of Nelson, Fernie, Kimberley, and others are having difficulty in substantiating application quantities because of groundwater infiltration which may entail costly remedial measures.

Section staff were involved in a feasibility study for a community sewerage system for the Whistler Mountain area and an environmental study in the Queen Charlottes.

Following issuance of a permit to Tamarisk Development Ltd. for a condominium development in the Whistler area, Section staff produced evidence at a subsequent appeal.

An application by Hemlock Valley Recreations Limited for a ski resort development, including tertiary treatment is under investigation, being the first such proposal in the Province for such a small discharge volume.

Under the auspices of the Regional District of East Kootenay a mobile crew and equipment are providing a very satisfactory covering program for small municipal landfill operations throughout its district. Others are being encouraged to follow this example of economical pollution control.

SERVICES SECTION

Further progress in development of the computer data storage and retrieval system was made in co-operation with the Computer and Consulting Services of the Department of Transport and Communications and with the Chemistry Laboratory. This system now handles permit and descriptive data together with monitoring data for all applications and permits for both the Pollution Control Branch and Water Investigations Branch. Approximately half-a-million monitoring result values in addition to other data are being added annually, which is a measure of the extent of the monitoring being undertaken to meet Branch requirements.

Staff participated in various tasks, including the following:

The ELUC Sewage Disposal Task Group investigating septic-tank problems arising from subdivision of land.

The International Nitrogen Task Group examining the effect of supersaturation below power dams on fish.

Work is near finalization on development of a computer model to simulate waste-treatment plant performance to assist the Pollution Control Assistance Team in optimizing plant performance. This team is proceeding with work at plants for the City of Kelowna and the Town of Merritt and other municipalities are awaiting this service.

A study to determine use of certain metal-industry wastes for removal of nutrients is being undertaken at the City of Penticton's treatment plant.

Work is in hand on preparation of information bulletins on aspects of pollution control in the Province for release to the public.

REGIONAL DIVISION

The Pollution Control Branch's decentralization program was advanced during 1974 by the transfer of six technical positions from the headquarters establishment in Victoria to the Regional Division. These positions were being filled in various locations at year-end and this has enabled the regional offices to take on the responsibility for processing permit applications at the local level. At year-end the regional offices were processing a total of 36 applications for permit.

To ensure that the Pollution Control Branch service is accessible throughout the Province, the Regional Division has six established regional offices together with seven field offices, the newest of which was opened at Revelstoke late this year. During the past year the regional staff were able to increase their service to the public by assisting local municipal authorities in locating and advising on suitable waste-disposal sites and facilities and they have accepted membership on technical planning committees of regional districts and special study committees established by the Environment and Land Use Committee Secretariat in various areas of the Province.

During 1974 the Regional Division processed and made recommendations to the Director for the issuance of 91 approvals for temporary discharges under section 5 (c) of the *Pollution Control Act, 1967*.

By year-end, there was a total of 1,626 discharge permits being administered by the divisions. Enforcement of permit conditions and necessary measures to abate problems involved the issuance of 44 orders and the initiation of 14 prosecutions, 7 of which were successful, and 6 which were subjudice at year-end.

In the latter part of the year, efforts were initiated to decentralize authority to regional staff. In order to facilitate the decentralization program, the Division was reorganized into two groups with the Lower Mainland Region, the North Region, and the Coast Region making up the Coastal Division, and the South Central Region, the Okanagan Region, and the Kootenay Region comprising the Interior Division.

OKANAGAN REGION

A comparative summary of the Okanagan Region work load is shown by the statistics in the following table:

	1970	1971	1972	1973	1974
Permits administered—					
Effluent discharges.....	50	57	68	99	129
Refuse discharges.....	.....	5	16	24	33
Air emissions.....	.....	.....	3	17	55
Permit and permit amendment applications received.....	.....	35	45	168	89
Approvals issued.....	.....	.....	11	15	28
Approval applications received.....	.....	.....	18	25	41
Orders served.....	.....	3	3	5	7
Prosecutions.....	.....	1	3	0	0
Pollution complaints investigated.....	.....	27	85	156	89
Certificates administered.....	8	22	32	40	55
Pollution monitoring—					
Outfalls sampled:					
Permitted.....	69	72	202	181	273
Nonpermitted.....	163	305	318	137	68
Stream stations sampled:					
Chemical analysis.....	193	276	444	356	780
Biological analysis.....	.....	.....	11	17	79
Lake stations sampled:					
Chemical analysis.....	55	16	48	78	52
Biological analysis.....	.....	9	48	78	52
Groundwater stations sampled.....	.....	4	2	40	83
Dustfall stations operated.....	.....	19	41	17	20
Hi-vol stations operated.....	.....	2	6	7	7
Smoketape stations operated.....	.....	1	3	4	4
Stack-sampling surveys conducted.....	.....	.....	.....	1	4

In addition to the above work, the Okanagan regional staff conducted a smoke opacity measurement training course in Kelowna.

COAST REGION

The increasing work load in the Coast Region is indicated by the following statistics:

	1972	1973	1974
Permits administered	112	160	270
Permit inspections	203	377	450
Permits sampled	112	183	245
Background sites sampled	175	377	397
Complaints investigated	100	86	102
Approvals issued	4	10	20
Orders issued	2	13	7
Court actions	-----	1	4

A program of sampling and testing fish from certain lakes for heavy metals was continued during the year. In addition, some preliminary sampling and testing of conditions in Ucluelet Harbour was carried out by the biological staff.

The processing of permit applications was undertaken during 1974. To date, one permit has been issued, and five are at various intermediate stages.

LOWER MAINLAND REGION

The following statistics refer to permits in force and applications outstanding in the Lower Mainland Region and reflect the work load related to this responsibility.

	1970	1971	1972	1973	1974
Effluent permits	112	121	137	195	271
Refuse permits	1	4	13	38	58
Air permits	-----	-----	5	20	47
Effluent applications	20	43	60	130	122
Refuse applications	2	7	20	25	29
Air applications	-----	3	7	22	20
Approvals granted current year	-----	-----	-----	-----	10
Orders of Regional Manager current year	-----	-----	-----	-----	25

Site investigations and subsequent reports related to applications continues to comprise a substantial portion of the District work load. The regular program of sampling and (or) inspection of all discharges on a quarterly basis continued and areas of noncompliance with permit conditions were noted and brought to the attention of the permittee. Legal action has been initiated where flagrant violation of permit conditions continues. The surveillance program includes zone of influence sampling in areas where discharges might affect changes in the receiving media.

A general surface water-quality program covering major lakes and streams and some salt-water inlets was expanded to include approximately 142 sampling stations. Frequency of sampling varies with 28 stations sampled two times per year, 64 stations four times, and 45 stations six times per year. The biological program has expanded to cover specific monitoring of six lakes, some areas in Howe Sound, and selected streams.

The air-quality trailer at Squamish was moved out of the Region in May 1974 and two satellite stations supporting the trailer have been shut down. The Branch has recently installed more specific instrumentation to record chlorine and mercury levels in the Squamish area.

Investigation of coal dust from rail transport in the Fraser Valley was carried out during the summer and is to be continued in the summer of 1975. As a result of experimental dust-control techniques some improvement of this problem has been realized.

Fifteen air-quality stations continue to be serviced by this office to provide data on one or more of the standard air-quality parameters. (Dustfall, suspended particulate, soiling index, sulphur compounds.)

KOOTENAY REGION

In mid-1974 the administrative headquarters for the Kootenay Region was transferred from Cranbrook to the new Government building in Nelson in accordance with the Government decision to consolidate regional resource agencies in common locations. Of the fifteen staff in this Region, seven were retained in the Cranbrook office to continue programs of surveillance, enforcement, and other day-to-day functions of the Branch in the area east of Kootenay Lake.

During 1974 the number of permits issued by the Branch for discharges in the Kootenay Region increased by 114 to bring the total number of permits administered by the Region to 258. In addition to inspection and sampling of waste-treatment facilities under permit, stream, lake, and groundwater samples were collected at 177 locations and air samples were taken at 45 locations.

Staff of the Kootenay Region also evaluated and made recommendations regarding 25 requests for short-term discharge approvals. Some of the more interesting activities involving the Kootenay Region staff were a forest industry sawmill survey in the Nelson Forest District to determine the quantity of woodwaste generated, continuation of the program of monitoring and data analyses of the Libby reservoir post impoundment study, and the continuation of the operation of the mobile air monitoring laboratory located in the City of Trail.

In the latter part of the year, the Region became involved in the Kootenay Study by Water Investigations Branch which will continue through 1975.

NORTH REGION

During 1974, 103 new permits and 17 amendments to permits were issued, bringing the total number of permits in the North Region to 320. One hundred and eighteen site investigations reports were submitted to the Industrial and Municipal Divisions in Victoria. Six charges were laid as a result of contraventions of orders made under the Act. Ten approvals were issued.

In line with the Pollution Control Branch policy of decentralizing Branch functions, the North Region commenced processing eight permits through the Prince George office.

In addition to inspection and sampling of waste-treatment facilities under permit, the following environmental monitoring programs were initiated and (or) continued from previous years:

Monitoring Program	Number of Stations	Number of Parameters	Frequency (Times per Year)	Year Initiated
A. River Studies—				
1. Fraser River.....	21	34	4	1971
2. Peace River.....	8	33	3	1972
3. Skeena River.....	19	33	3	1974
B. Lake Studies—				
1. Lakelse Lake.....	8	18	6	1973
2. Tabor Lake.....	6	18	6	1973
3. Burns Lake.....	11	18	6	1974
4. Decker Lake.....	6	18	6	1974
5. Charlie Lake.....	10	18	6	1974
C. Ambient Air Studies—				
1. Village of Taylor.....	6	5	Continuous	1972
2. District of Terrace.....	6	5	Continuous	1974
3. Otway.....	3	1	Continuous	1973
4. Bear Lake.....	3	1	Continuous	1973

The North Region was called upon to provide a consultative service for the Prince George Zone Emergency Program Co-ordinator in regard to a number of accidental oil and chemical spills.



Field sampling is all in the day's work for Pollution Control Branch regional staff. This technician is measuring the flow over a V-notch weir in the North Region.

SOUTH CENTRAL REGION

The Regional office is responsible for the administration of approximately 185 permits. A regular program of sampling and inspection of all discharges was carried out in 1974. The surveillance program was expanded to include zone of influence studies of seven streams where it was considered that discharges may deleteriously affect the receiving environment. Legal action was initiated where flagrant violation of permit conditions was suspected.

In 1974, approximately 120 applications for permits were received and in excess of 160 site inspections carried out. A total of nine approvals were issued and several permits processed.

The general surface water-quality monitoring program of major lakes and streams was expanded to approximately 33 lake stations and 155 stream stations. Several intensive studies on sensitive water courses were initiated and included assessment of both chemical and biological conditions.

The Federal-Provincial interagency study of the Thompson River system continued throughout 1974. The Regional office staff was involved in co-ordination and sampling for the study. In addition, the Regional office staff undertook a survey of litter along the highways in the Interior of the Province.

The ambient air-monitoring program was increased to include approximately 37 stations. Several special short-term air-monitoring studies relating to specific problems were carried out as was an investigation of the meteorological conditions within the Region.

The Regional office staff responded to numerous requests for interpretation of application and permit requirements. Over 70 complaints concerning pollution matters were handled and several accidental oil and chemical spills were investigated.

PROJECTS AND RESEARCH DIVISION

As part of the reorganization movement within the Water Resources Service, the Projects and Research Division was disbanded in September of 1974 with the activities of the Division Chief for the remainder of the year devoted to completion of projects in hand. Twelve personnel were allocated to the Environmental Studies Division in the Water Investigations Branch; five to the Municipal Division; and the Air Section, in total, was absorbed by the Industrial Division.

A total of approximately 80 projects was undertaken by the Projects and Research Division during 1974, some of which are listed below:

AIR SECTION

(1) *Ambient Air-monitoring Programs—*

Stationary Stations:

Expansion of the monitoring program in Kimberley by the addition of two continuous SO₂ analysers and an impinger train for ammonia.

Established monitoring stations in Cassiar to determine the asbestos particulate in the ambient air.

During 1974, two continuous sulphur dioxide analysers were allocated to Trail in addition to the analyser contained in the Unit 2 Mobile Lab. One of these analysers was installed at the Butler Park site where monitoring for heavy metals, arsenic, and fluorides has been carried on for a number of years. The second analyser plus additional equipment for monitoring heavy metals, arsenic, and fluorides were installed on Duncan Flats. A continuous chlorine analyser was purchased during 1974 and has been installed in Squamish to monitor the air quality in the vicinity of the chlor-alkali plant there. Should this analyser prove satisfactory, it is planned to install additional analysers of this type in other areas of the Province where these plants are operating.

Expansion of the monitoring program in Taylor by the addition of one continuous SO₂ analyser.

Mobile Laboratories:

Unit 1 operated in Squamish until May 1974, measuring sulphur dioxide, chlorine, suspended particulate, and wind speed and direction. Subsequently, it was moved to Kamloops but is not operational due to equipment malfunctions. It is expected to be operational in January 1975, and will measure wind speed and direction, total sulphur, sulphur dioxide, and hydrogen sulphide.

Unit 2 operated in Trail throughout 1974, measuring sulphur dioxide, total oxidants, nitric oxide, carbon monoxide, total hydrocarbons, particulate, and wind speed and direction.

Unit 3 was delivered in February 1974, and was checked out in Victoria. In May, the unit was sent to the Taylor gas plant area where it operated for six weeks. The unit then returned to Victoria for further evaluation of the equipment and the establishment of operating procedures.



Stack gas sampling and analysis is a regular part of Pollution Control Branch's continuous monitoring of air emissions.

(2) *Pollution Control Objectives*—

Objectives for Municipal-type Wastes and Food-processing and Miscellaneous Industries:

These projects have been continuing since 1972 and the proposed objectives were placed before the Pollution Control Board in December, 1974.

Following the public inquiry on municipal waste discharges, technical assistance was provided to the Municipal Division in developing the Pollution Control Objectives for the discharge of contaminants to the atmosphere from municipal waste treatment processes.

(3) *Lower Mainland Study*—Air Services Section provided the Technical Co-ordinator for the Lower Mainland Study undertaken by B.C. Hydro. The purpose of the study was to determine the quality of the ambient air under varying meteorological conditions.

(4) *Ringelmann Training Program*—Ringelmann number is used to monitor modified wood-waste burners. The Ringelmann number observation provided a technique to visually determine the quality of an emission discharged to the atmosphere. In order to provide the necessary training to observe Ringelmann number, courses were held in Victoria, Vancouver, Agassiz, Kamloops, Prince George, Williams Lake, and Kelowna during the spring of 1974. Approximately 200 candidates received this training and were certified as Ringelmann number observers.

LAND AND WATER SECTION

(1) *Pollution Control Objectives*—The report on objectives for the food processing, agriculturally orientated, and miscellaneous industries was prepared.

(2) *Heavy metals discharged in the Lower Fraser River*—Sources of heavy metals such as copper, aluminum, mercury, nickel, and zinc, within the Greater Vancouver Regional District were investigated. Metal-plating operations were investigated. Metal-plating operations were estimated to be a significant source of heavy metals to the sewer system. Soluble metal ions are absorbed by suspended organic material, and this process assists the removal of heavy metals from raw sewage by primary sedimentation.

(3) *Use of coal to treat wastewaters*—A study on the use of coal to treat wastewaters was concluded. Results showed that coal may have an application in the removal of heavy metals at relatively high concentrations. There was no evidence that coal possesses any special properties for the removal of organics or nutrients from wastewaters.

(4) *Guidelines for land disposal of septic tank pumpage*—A report was issued jointly by the Pollution Control Branch and the Environmental Engineering Division of the Health Branch. Site selection, preparation, operation, and maintenance guidelines were presented.

(5) *Health aspects of effluent irrigation*—A review of the risks to public health associated with effluent irrigation was initiated through Projects and Research Division of the Pollution Control Branch in 1973. A multidisciplinary approach involving the Provincial Departments of Lands, Forests, and Water Resources, Agriculture, and Health was required to assess and integrate the public health, agricultural, and engineering aspects of land-disposal systems. Federal Department of Agriculture personnel in the Okanagan are participating as well. A report should be finalized early in 1975 as a result of the review by the committee representing the participating agencies.

(6) *Phosphorus removal studies at Penticton*—The City of Penticton Engineering Department has been undertaking phosphorus removal studies with the financial and technical assistance of the Pollution Control Branch. These studies commenced in August 1973 under the over-all direction and supervision of the Projects and Research Division of the Pollution Control Branch. Various chemical coagulants such as lime, alum, ferric chloride have been used with considerable success. Operational problems have been encountered with sedimentation of the coagulated solids fraction, sludge handling, and digestion. Efforts to resolve some of these operational problems are continuing into 1975 through the combined efforts of staff from the Pollution Control Branch and the City of Penticton.

(7) *Naramata Watershed Study*—This study was initiated in 1971 to determine the effects of cattle grazing on the water quality of the Naramata Water Supply. No definitive conclusions could be drawn as to the impact of cattle on the quality of water in the watershed. Subsequently as a result of discussions on the report by concerned agencies and interested organizations, certain livestock-control measures were implemented. A follow-up study was undertaken in September 1973 to determine the effectiveness of these control measures in enhancing water quality. Sampling for this secondary phase was completed in October 1974, and it is expected that report will be finalized early in 1975.

(8) *Thompson River Study*—The Thompson River study was initiated in the spring of 1973 to investigate the source of colour, foam, and algal growth in Kamloops Lake and the Thompson River. Both the Federal and Provincial Governments are participating. A preliminary report was prepared in May 1973. Since that time a data collection program has been under way and will continue until April 1975. Co-ordination of Provincial Government input is through the Pollution Control Branch. All major point-source discharges have been determined and evaluated. Studies continue to be undertaken to determine the nutrient(s) which are essential to primary productivity and algal growth in the system. This information is necessary before recommendations can be made on improvements. Biological and water chemistry data, as it is collected by the various agencies, will be forwarded to Pollution Control for assessment. A progress report will be prepared during the early part of 1975 followed by the production of a final report during the summer of 1975.

(9) *Federal Task Force on Revising Pulp and Paper Effluent Regulations*—In June 1974 a staff member of the Projects and Research Division was appointed on behalf of the Provincial Government to participate on a Federal-Provincial Task Force to review and draft effluent regulations for the pulp and paper industry. Work is currently continuing on this program.

(10) *Prince George Sludge Disposal Study*—A study was initiated in the spring of 1974 by the Projects and Research Division to assess the effect of sludge disposal to land in relation to soils, vegetation, and water quality and is continuing.

ECOLOGY SECTION

(1) *Comox and Prince Rupert Harbour Studies*—The Provincial Interagency Evaluations of water quality of Comox Harbour and Prince Rupert Harbour were completed in September 1974. The evaluations involved task reports of the Department of Health, Fish and Wildlife Branch, Department of Agriculture, Forest Service, Lands Branch, and the Projects and Research Division. Tasks concerning water quality and beach biota were undertaken by the Ecology Section.

(2) *Joint Canadian Cellulose-Pollution Control Branch Study*—The 1974 beach-biota sampling program was completed for the joint Canadian Cellulose-

Pollution Control Branch evaluation of effluent upgrading at the Prince Rupert pulp-mills. A beach-biota report for 1974 is pending contract approval for the analysis of samples.

(3) *Objectives for Food-processing, Agriculturally Orientated, and Other Miscellaneous Industries*—Participation provided in the drafting of the Panel Report to the Director, concerning Pollution Control Objectives for Food-processing, Agriculturally Orientated, and Other Miscellaneous Industries of British Columbia.

This section was also responsible for the production of the following works:

A Guide to Some Biological Sampling Methods.

A Report on Results of a Monitoring Program for Dissolved Gases in Selected Waters of British Columbia, 1972/73.

Annotated Extracts of Some Papers Dealing With the Measurement and Solubility of Dissolved Atmospheric Gases, With Nitrogen Gas Supersaturation, and With Gas Bubble Disease in Fish.

Reports were prepared for the Air Section on the following topics:

Vegetation and Air Pollution for the Greater Vancouver Airshed Study.

Effect of Gas Emissions on Vegetation at Taylor, B.C.

Vegetation Damage in Relation to Sulphur Dioxide Emissions at Cominco Kimberley Operations.

Additional work was involved in preparation and design of the Kootenay Study of the Water Resources Service and in continued development of the data storage system for permit and monitoring data.

ENVIRONMENTAL CONSERVATION

(Project SAM)

Project SAM continued its environmental conservation efforts of removing abandoned and derelict motor-vehicles and other scrap-metal materials from roadsides, recreational, and industrial areas throughout the Province and providing for their reuse in the metal industry.

Two new tractor units were purchased as replacements to haul compacted hulks to shredding facilities. A separate office-shop was leased as a headquarters area and to provide space for servicing and repair of vehicles and heavy equipment.

During 1974, emphasis was placed on removing crushed hulks which had been stored at various depots throughout the Province. Utilizing B.C. Rail, private haulers, and Project SAM transport facilities, a total of 14,934 tons of crushed metal goods were hauled to a shredding plant in Vancouver. It is anticipated that for the first time since its inception in 1971, the Project SAM operation may yield sufficient revenue to offset its operating costs. In the same period the two crushing crews compacted 18,226 automobile hulks, plus innumerable old stoves, fridges, freezers, water tanks, washers, dryers, etc. This service was performed at 86 depots in 52 communities within 20 regional districts throughout the Province.

CHEMISTRY
LABORATORY

CHRISTIANITY

CHRISTIANITY

CHEMISTRY LABORATORY

A. J. LYNCH, CHIEF CHEMIST

In 1974 the total number of routine environmental tests performed by the Laboratory increased to 171,000 from 128,000 in 1973, an increase of 34 per cent. Figure 2 shows the increase in Chemistry Laboratory work load for the period 1971 to 1974. This type of growth in output is expected to continue for another five years as additional environmental monitoring programs are implemented.

Planning for new laboratory facilities was initiated in 1974. The Chemistry Laboratory is presently occupying space in the B.C. Research Building in Vancouver. This space, which has been leased on a short-term basis, will be required by B.C. Research in 1976. The Department of Public Works engaged consultants to develop a functional program design for new facilities. This stage of planning was completed in December 1974.

In December, installation of a terminal to the computer facilities of the Data Processing Centre, Department of Transport and Communications in Victoria was completed. The laboratory result files and reporting procedures have been redesigned to be operated by this computer facility. This is the first time in Canada that an environmental laboratory has used computer facilities for complete record-keeping and reporting functions. The laboratory results are also stored on an environmental data storage and retrieval system operated by the Data Processing Centre.

WATER QUALITY DIVISION

In 1974 the Water Quality Division performed 160,000 tests, an increase of 36 per cent over 1973. As there was no increase in the number of permanent staff for the Chemistry Laboratory in 1974, 15 temporary positions were approved in September to cope with the increased work load. Ten of these positions were designated to the Water Quality Division.

Throughout the year, the staff of the Data Centre in Victoria and the staff of the Water Quality Division worked in close association in documenting the requirements for the computer facility. For the Water Quality Division the computer programs provide the following:

- (1) Efficient system of record-keeping.
- (2) Routine quality control checks on test results.
- (3) Printing of final Water Quality Reports.
- (4) Weekly statistics.

The introduction of these programs has facilitated prompt reporting of results to the submitting agencies.

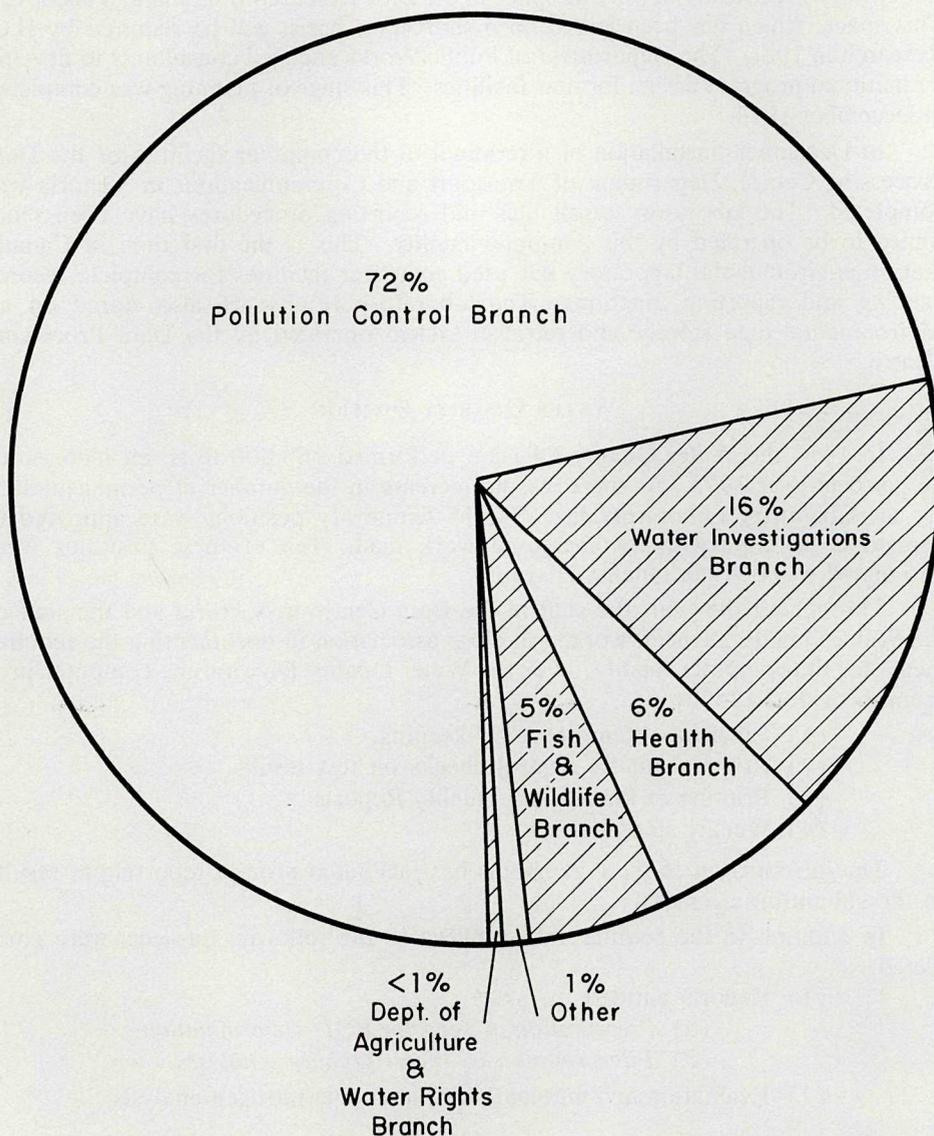
In addition to the routine analytical work, the following projects were completed:

- (1) Reports entitled
 - (a) *Preservation of Seed for BOD Determination.*
 - (b) *Interpretation of Water Quality Analyses.*
- (2) Evaluation and automation of ammonia nitrogen analysis.

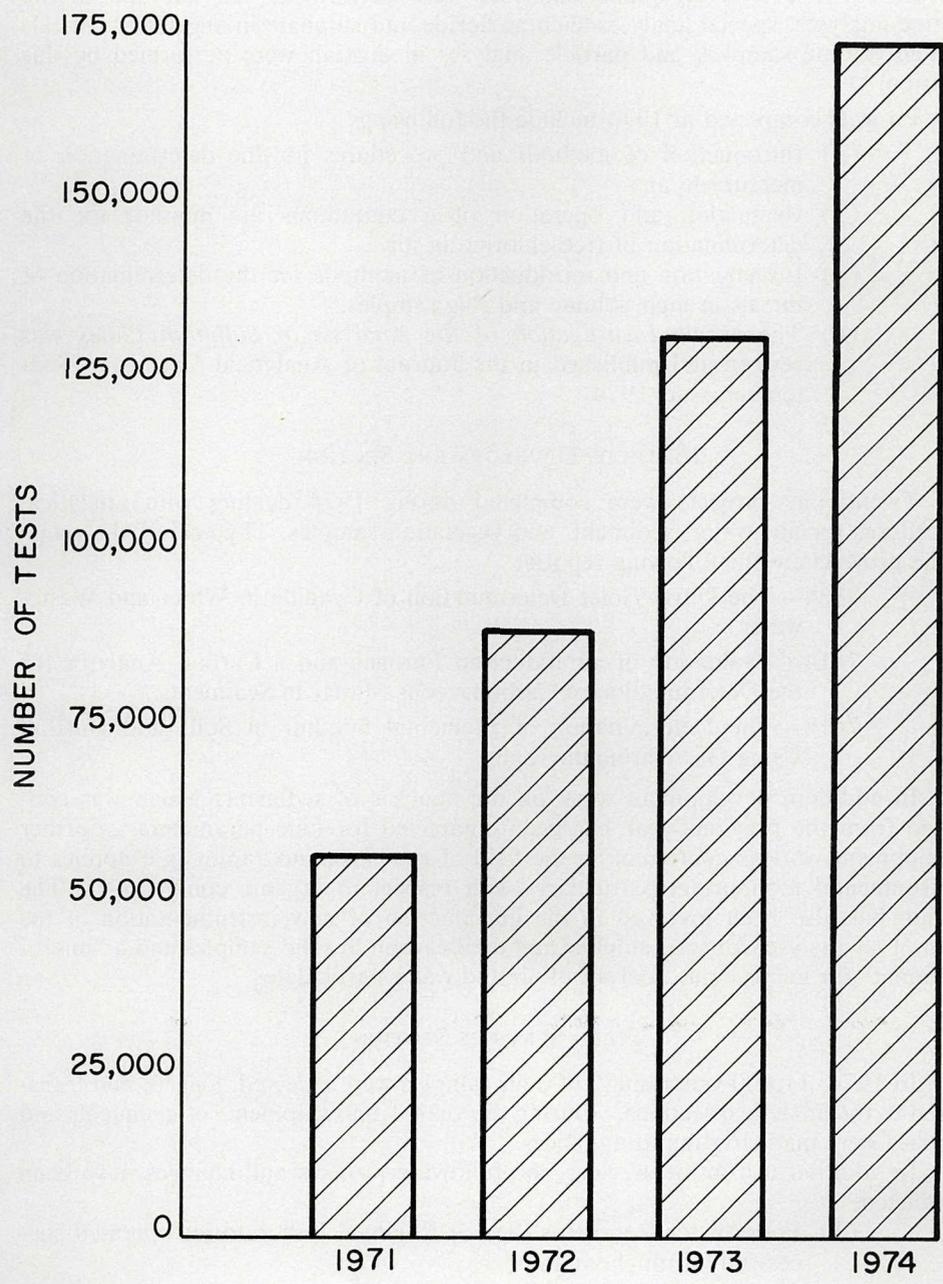
- (3) Compilation of the second edition of *A Laboratory Manual for the Chemical Analysis of Waters, Wastewaters, Sediments and Biological Materials*.

During the year the Water Quality Division continued to receive samples for possible legal action. In cases where legal action was taken, the legal scientist was required to give evidence pertaining to sample security, analytical results, and methodology.

PERCENTAGE OF CHEMISTRY LABORATORY WORK LOAD
BY SAMPLING AGENCY



CHEMISTRY LABORATORY WORK LOAD
1971 TO 1974



AIR QUALITY DIVISION

In 1974, 11,000 air-quality analyses were performed. In addition to the routine analyses, special analyses such as fluoride and sulphate in vegetation, metals in high-volume samples, and particle analyses in dustfall were performed by this Division.

Projects completed in 1974 include the following:

- (1) Introduction of methods and procedures for the determination of mercury in air.
- (2) Evaluation and operation of a continuous air monitor for the determination of free chlorine in air.
- (3) Investigation and introduction of methods for the determination of metals in high volume and slag samples.
- (4) The article *Investigation of the Analysis of Sulfation Plates* was revised and published in the Journal of Analytical Chemistry, September issue, 1974.

METHODS DEVELOPMENT SECTION

Twenty-one projects were completed during 1974 dealing with analytical procedures for air, water, sediment, and vegetation samples. Typical of the scope of the projects are the following reports:

- 7334—The Ultra-Violet Determination of Cyanide in Water and Wastewater.
- 7414—Evaluation of an Induction Furnace and a Carbon Analyser for the Determination of Carbonaceous Matter in Sediments.
- 7418—The Determination of Elemental Sulphur in Soils and Dustfall Using Gas Chromatography.

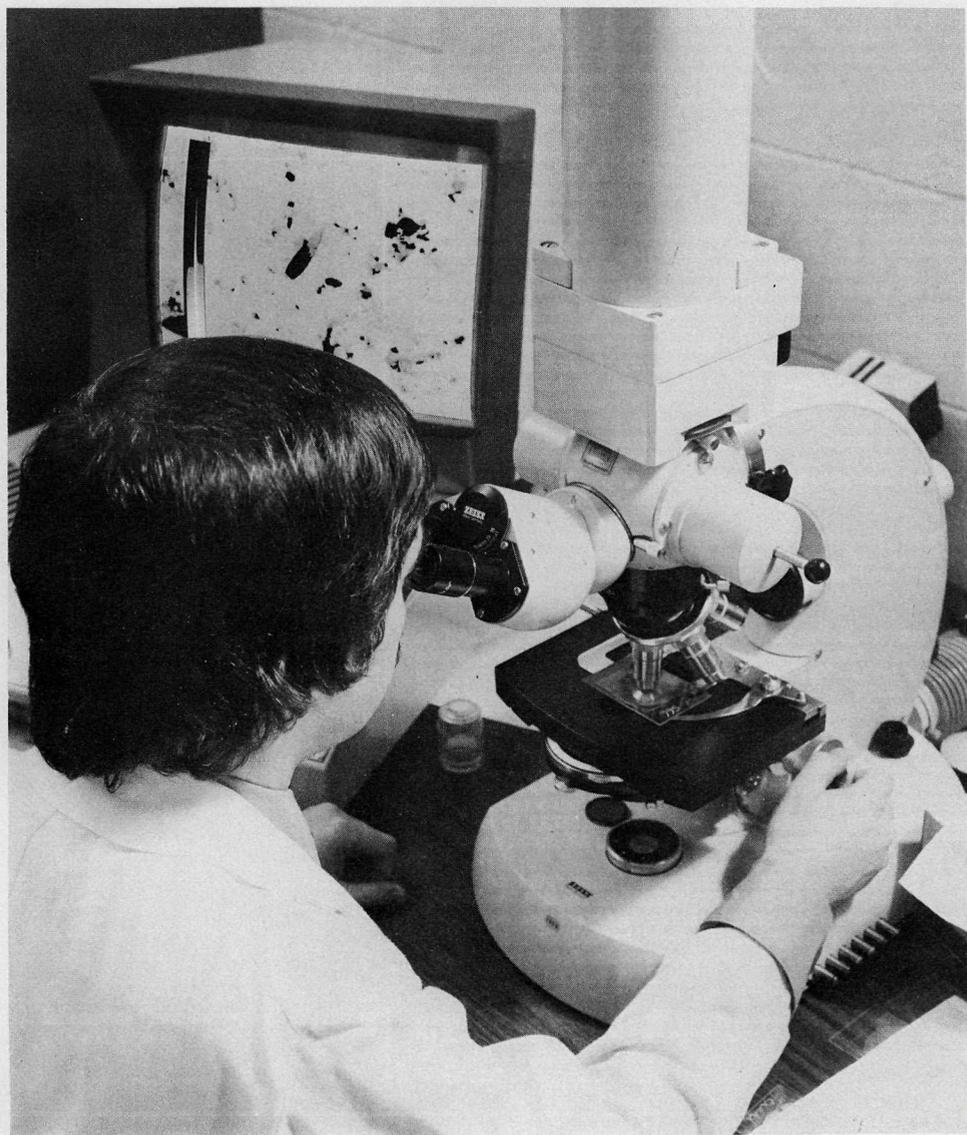
In addition, development work on the analysis of sediments which was continued from the previous year has been completed for nine parameters. Further development work is continuing in the field of gas chromatography as it applies to environmental monitoring, particularly with respect to organic compounds. The section has also been involved in the introduction of new instrumentation in the form of an analyser for total sulphur and total carbon in solid samples and a "microvideomat" for microscopic analysis of air and water particulates.

FIELD SERVICES SECTION

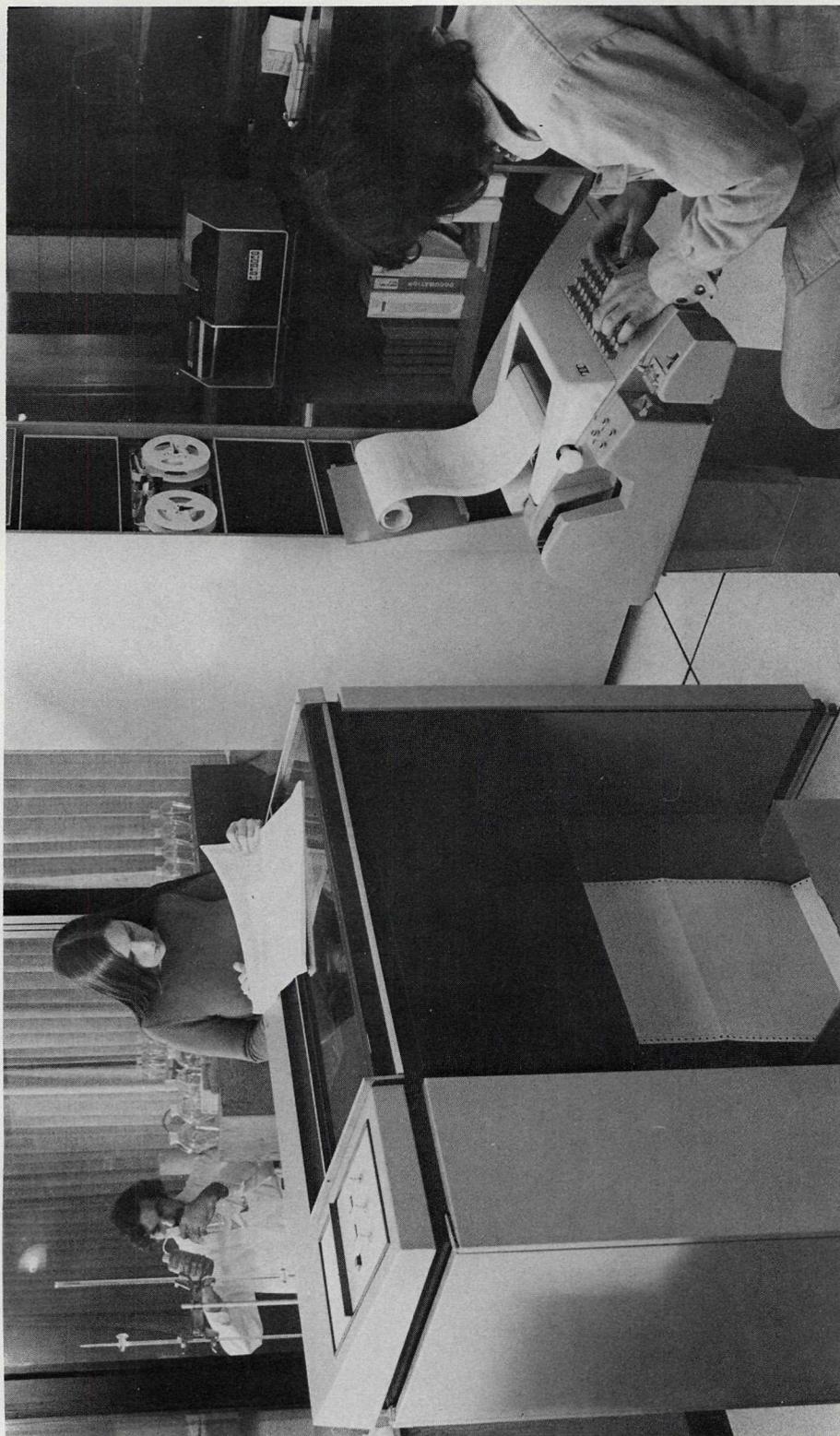
In 1974, 11,800 water and 2,000 air samples were received, logged, and transferred to the analytical sections. During the year, 1,050 shipments of chemicals and supplies were made to submitting offices.

In addition to routine services, the following projects and changes have been completed:

- (1) Four Water Resources Service Regional Laboratories operated successfully throughout 1974:
 - (a) One thousand seven hundred water samples processed and tested.
 - (b) Senior laboratory technicians relocated and confirmed for the Regional Laboratories in Kamloops, Prince George, Victoria, and Vernon.
 - (c) New quarters obtained and renovations designed to alleviate overcrowding in Kamloops and Prince George Laboratories.



Microscopic identification of dustfall particles at the Chemistry Laboratory.
Note the TV monitor.



Chemistry Laboratory's computer terminal linked to the Provincial Government's Data Centre in Victoria.

- (2) A complete revision of the sample handling system in conjunction with Data Centre staff has been developed and implemented.
- (3) A system of stock control has been introduced to supply chemicals and equipment to all Provincial agencies. Any office with occasional requirements for equipment for its own use may order and receive the equipment quickly from the Chemistry Laboratory without reference to chemical catalogues and suppliers.

In 1974 the Instrumentation Services Section calibrated and serviced 425 instruments and performed 150 routine services. The work load of the Section has increased by approximately 20 per cent due to the additional Chemistry Laboratory equipment and the purchase of complex air monitoring equipment by the Pollution Control Branch. During 1974 the Instrumentation Services Section acquired additional electronic test equipment and air-monitoring calibration equipment.

In addition to the above work load time was spent on the following projects:

- (1) Annual preventive maintenance programs for Regional Laboratories.
- (2) Investigation of methods for calibration of environmental instrumentation.
- (3) Development of an instrument maintenance manual for all Pollution Control Branch and Chemistry Laboratory equipment.
- (4) Major servicing of out-of-town air-monitoring stations.
- (5) Instrument work related to the Lower Mainland air study.
- (6) Installation and start-up of air-monitoring equipment in a Kootenay air study.

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INSPECTOR
OF
DYKES

REPORT
OF
THE

**INSPECTOR
OF
DYKES**

K. J. CHISHOLM, P.ENG.
INSPECTOR OF DYKES

During the year, the process of consolidation and transfer continued with the following changes in management or operation of dyking areas:

- (a) East and West Nicomen were dissolved and consolidated as Nicomen Island Improvement District under the *Water Act*.
- (b) North Nicomen reverted from an Improvement District under the *Water Act* in voluntary receivership administered by the Inspector of Dykes to an Improvement District under the *Water Act* administered by its own trustees.

Negotiations continued with a view to having Dewdney, Albion, Nicomen Island, and Trethewey Edge Improvement Districts assume responsibility for their own administration and this responsibility will be passed over to these districts in January 1975.

Negotiations were also continued with the municipalities concerned for the transfer to municipal control of Sumas and Coquitlam Dyking Districts.

In August, W. R. Meighen retired from the position of Inspector of Dykes and was replaced by K. J. Chisholm in December. W. S. Jackson acted as Inspector of Dykes in the intervening period.

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SOUTHERN
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PROJECT

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**SOUTHERN
OKANAGAN
LANDS
PROJECT**

W. J. STEPHENSON
SUPERVISOR

HISTORY

The Southern Okanagan Lands Project was formed in 1919 with the purchase by the Provincial Government of some 22,000 acres of land located in the southern end of the Okanagan Valley. The object of the purchase was the rehabilitation, under the *Soldiers' Land Act*, of veterans of the First Great War. The Project lands are located in the only intrusion into Canada of the Upper Sonoran Faunal Area in the Upper Austral Zone. This area supports several unique species of flora and fauna which have survival limits established primarily by the climate. Summer temperatures in excess of 100° Fahrenheit or 38° Celsius, combined with very low amounts of precipitation create an arid, semi-desert environment.

Water was diverted from the Okanagan River downstream of Vaseaux Lake into a concrete canal which was constructed with a hydraulic gradient of 1:4000 over a distance of 22.3 miles. Water finally reached the southern extremity of the Project lands at the United States Border in 1925.

During construction, the Government operated its own sawmill 12 miles east of Oliver to produce timber needed in the flume sections of the canal. The Government also operated its own pipe plant to manufacture approximately 42 miles of concrete pipe varying from 4 to 24 inches in diameter.

In the mid-1920's large tobacco plantings were developed. The Government built four large tobacco drying sheds with the hope of establishing a stable industry. Unfortunately, the quality of the tobacco was not good and by 1929 this industry was abandoned. Cantaloups, tomatoes, and zucca melons were grown successfully in the 1930's and Oliver was once referred to as the "Cantaloup Capital of Canada." However, as more and more land was being planted in tree fruits it was impractical to grow field crops between the rows of trees.

Mining was also carried out over the years in the area. Gold was retrieved from the Fairview Mines located west of Oliver and from Camp McKinney to the east. An open pit mine located just north of Oliver has been producing silica rock for a number of years. Many Crown-granted mineral claims still dot maps of the area.

Construction of the Okanagan Flood Control channel, which was completed in 1957, changed the topography of the bottom lands and lowered the water table several feet. As a result, a considerable acreage which originally consisted of waterlogged sloughs has now been rendered arable.

In 1964 the Southern Okanagan Lands Irrigation District (SOLID) was formed as an Improvement District under the *Water Act* for the purpose of transferring the irrigation works to local autonomy. Rehabilitation of the irrigation

system was then commenced under the *Agricultural Rehabilitation and Development (British Columbia) Act*. With the virtual completion in 1974 of the rehabilitated irrigation system under ARDA, the Southern Okanagan Lands Irrigation District assumed full responsibility for the irrigation works. The transfer agreement was formally ratified by His Honour the Lieutenant-Governor by Order in Council dated December 4, 1974.

The District will be responsible for the distribution of irrigation water to approximately 5,500 acres of heavily cultivated land, 4,800 acres of which receive pressurized water directly from District pipe-lines. The canal, which now extends only to the north end of Osoyoos Lake, is still the main source of water for the system. However, water is also pumped from numerous wells and directly from Osoyoos Lake. Total pumping capacity is approximately 4,500 U.S. gallons per minute, and over 3,000 horsepower is required to lift this water to the highest cultivated lands. In addition, the District has assumed responsibility for providing chlorinated domestic water to more than 600 residents within its boundaries.

The dominant crop within the District is tree fruits, although production of grapes and field crops has increased markedly in recent years. In 1974, this relatively small farming community produced 62 million pounds of apples, 22 million pounds of peaches (out of a Province-wide total of 27 million pounds), 4.5 million pounds of pears, 4 million pounds of prunes, 4 million pounds of cherries, and 1.5 million pounds of apricots. The gross value of this crop to the farmer is estimated to be over \$9,500,000. It is difficult to estimate the value of this crop to the economy of the region. However, it can be conservatively estimated that the revenue from service industries, packing plants, wineries, canneries, etc., would increase the value by three-fold, or to over \$33,000,000.

OPERATION

While final terms of the takeover were being negotiated, it was deemed advisable for the District to accept responsibility for operation and maintenance of the irrigation system. To achieve this end all Project personnel except office and survey staff were transferred to the Southern Okanagan Lands Irrigation District. This transfer was accomplished prior to the start of the irrigation season so that the District could gain the maximum possible experience from their new responsibilities.

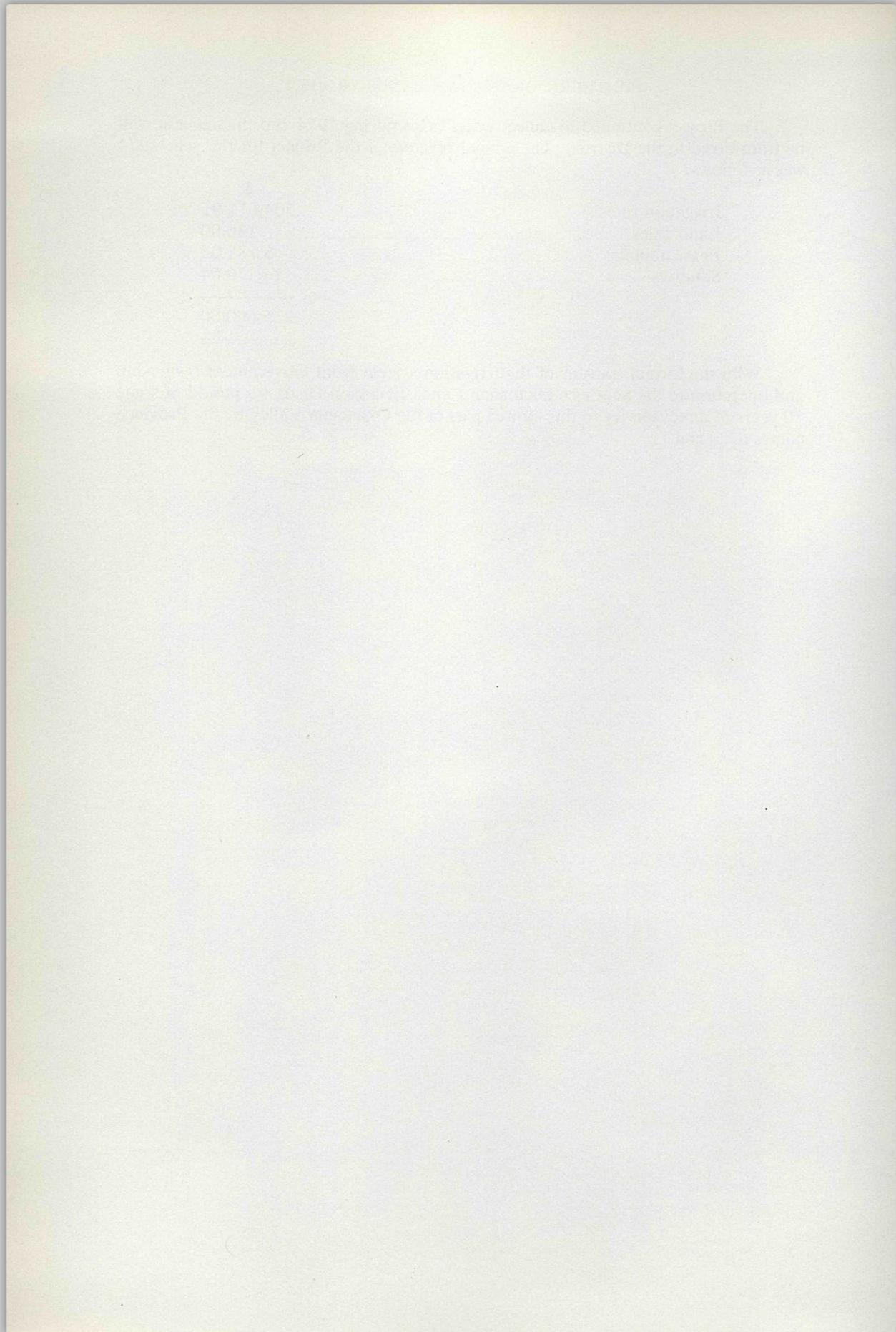
Under the ARDA program work was completed on the interconnection of Irrigation Systems 2 and 6. Construction was commenced on the relocated Pump-house No. 5 late in the year. Because of delays in the delivery of materials this pumphouse is not expected to be in use until the 1976 irrigation season. Tenders have been invited for the lining of approximately 1,800 feet of canal. The construction of the above works will use the remaining funds authorized under ARDA Project 89043.

From the start of the spring run-off, the Project office was plagued with complaints regarding the flooding of orchard land and several reports were received concerning loss of crops and trees due to the high water table. The run-off was the most protracted and extensive on record, presumably as a result of the heavy snowfall reported the previous winter. Those orchards located below the Strawberry Creek watershed received the most damage and several emergency measures were undertaken to relieve flooding problems in this area. An engineering study has been undertaken by the Department to find a satisfactory long-range solution for this particular problem area and a report on the matter will be available early in 1975.

The Project continued to collect water taxes during 1974 and this revenue will be transferred to the District. The annual revenue of the Project for the year 1974 was as follows:

	\$
Irrigation rates	204,611.91
Land sales	130.00
Lease rentals	5,188.05
Sundries	15,730.04
	<hr/>
	225,660.00
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With the formal transfer of the irrigation system from Government ownership and operation to the Southern Okanagan Lands Irrigation District a period of some 50 years of direct service to this limited part of the Okanagan Valley by the Province comes to an end.



PERSONNEL
SERVICES
AND
ACCOUNTING
DIVISIONS

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PERSONNEL

SERVICES

R. C. WEBBER
DIRECTOR

Activities of the Personnel Office have increased considerably during the year, which started off by moving into new quarters in Harbour Towers. The advent of collective bargaining, with two master agreements and 11 component agreements, has meant that a great deal of time and effort has been demanded of this office at meetings and bargaining sessions, as well as in the everyday interpretation of policies and contracts to Departmental staff. Reorganization of the Water Investigations Branch and the Pollution Control Branch and regionalization studies for Pollution Control Branch have also required this office's services. A major classification review of the Pollution Control Branch Engineering Technician series is nearing completion.

The following table summarized the principal Water Resources Service activities of this office in 1974, and provides a comparison with the previous three years:

	1971	1972	1973	1974
Recruitments for continuous staff	84	141	80	84
Reclassifications.....	55	40	45	42
Promotions.....	14	44	36	26
Internal transfers.....	2	4	5	22
Promotions and transfers to other departments.....	9	7	18	26
Promotions and transfers from other departments.....	27	14	31	12
Terminations of continuous staff.....	21	40	65	55
Retirements.....	2	3	1	4
Short-term appointments.....	56	77	69	151

LABOUR RELATIONS

Two of the three bargaining units established under the *Public Service Labour Relations Act* have a major influence on the Water Resources Service's staff. The first of these to get under way was the British Columbia Government Employees Union which signed a master agreement on June 28, 1974. This office was involved to a limited extent with management's input into the master agreement, but became fully involved with several of the eight component agreements, particularly the Engineering Technical and Inspectional; the Environment, Resource and Conservation; and the Educational and Scientific Services components. Other British Columbia Government Employee Union Components affecting the Service are Hospital and Allied Services, Operational Services, Administrative Fiscal and Regulatory, and Administrative Support.

Additionally, the British Columbia Government Professional Employees' Association started negotiating its master agreement in July and at year-end the first contract had not yet been signed. As the British Columbia Government Professional Employees' Association agreement covers a high percentage of the Service's employees, namely engineers, senior accountants, agriculturists, and geologists, many hours of the Director's time were spent in providing management input into these negotiations.

RECRUITMENT AND SELECTION

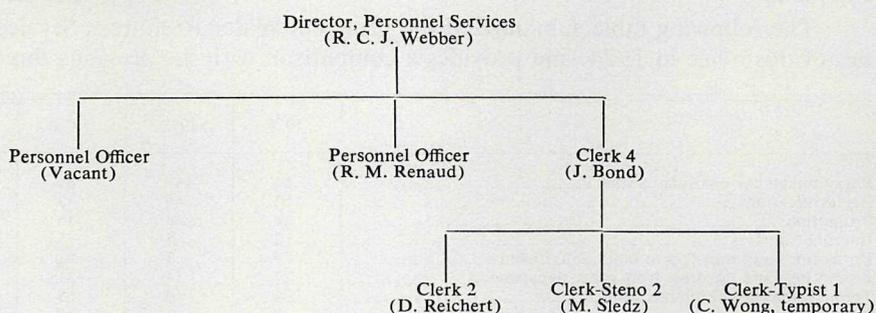
Recruitment of continuous staff increased slightly; however, short-term appointments of temporary and summer staff greatly increased (118.8 per cent) over 1973. The increase was largely due to the Department of Labour's Careers '74 and Experience '74 Programs which provided funds to take on summer help in addition to that which had been budgeted by the Service.

Difficulties were encountered in recruiting for some professional and technical positions such as engineers, accountants, economists, and technicians experienced in pollution control. The major reason for this difficulty was the large differential that existed between external and Provincial salaries brought about by protracted negotiations prior to the signing of the various collective agreements.

Nevertheless, many hard-to-recruit positions were filled by advertising across Canada and in professional journals and bulletins.

NEW POSITIONS ESTABLISHED

The Personnel office:



WATER RESOURCES INCREASE IN ESTABLISHMENT

Water Rights Branch—Twelve new positions were established (One Engineer 3, 11 Technician 1's) as a result of a Public Service Commission Study of Regional Office organization and staff requirements.

Water Investigations Branch—The establishment of the Water Investigations Branch was increased by three Senior Officer 2 positions as a result of a reorganization, which decreased the number of divisions from seven to four, each now headed by a Senior Officer 2.

Pollution Control Branch—Ten positions were transferred from the Department of Recreation and Conservation for Project SAM. One Clerk-Typist position was also established.

Current Service Establishment

	Professional	Technical	Clerical	Operational Services
Number of permanent employees	178	192	108	15
Number of auxiliary employees	2	18	3	---
Number of vacancies	35	22	6	---
	<hr/>	<hr/>	<hr/>	<hr/>
Total	215	232	117	15

Total service establishment, 579 positions.

Turnover Rate by Classification Category

	1972	1973	1974
Professional	7.3	13.1	7.0
Technical	11.7	13.9	15.4
Clerical	24.8	15.5	24.6
Operational services	8.3	8.7	26.7 ¹
Water Resources average	12.5	14.3	15.0
Government-wide average	16.3	17.2	(²)

¹ The percentage does not reflect the transfer of seven employees with the Southern Okanagan Lands Project (SOLP), as a result of the project takeover by the regional district.

² No percentage available.

RECLASSIFICATIONS

There was no significant change in the number of reclassifications over 1973. A Pollution Control Branch Engineering Technician series review is nearing completion and this office has had input into a major Government-wide Draughtsman series review and other major organization and classification reviews.

STAFF TRAINING

Executive Development Training Plan—One employee graduated from this course in 1974. Seven employees are currently taking the course, two of whom are in the third and final year.

Correspondence Course in Public Administration—One employee graduated from this course in 1974, and three are currently taking the course.

Defensive Driving Course—This course is available to all Provincial Government employees whose work involves a significant amount of driving. Although the number of classes held in 1974 was less than in previous years, 20 Water Resources employees took the course, thereby bringing the total since its inception in 1972 to 60 Water Resources employees.

STAFF TRAINING ASSISTANCE

In June 1973, staff training funds were made available through the Public Service Commission's Staff Training Division. Approximately 60 employees had their tuition fees reimbursed for courses taken in 1974.

SICK LEAVE

The average number of days sick leave taken by Water Resources employees increased slightly over the 1973 rate. The average is also slightly higher than the Government-wide average for 1973.

Sick Leave in Days per Employee

	1971	1972	1973	1974
Water Resources Service	4.2	4.3	5.0	5.3
Government-wide average	6.2	6.7	5.1	(¹)

¹ Not available.

SAFETY

The Water Resources Service was awarded the Premier's Safety Trophy "On Target Award" for larger departments, for having less than five time-loss accidents per million man-hours in the preceding 12 months. This is the second year in succession that the Water Resources Service has received this award.

RETIREMENTS

Four Water Resources Service employees retired during the year.

TWENTY-FIVE- AND THIRTY-FIVE-YEAR SERVICE AWARDS

Service Awards were presented to the following employees at a dinner in Government House:

25-year Service Awards

- A. O. Ferguson, Administrative Officer, Water Rights Branch.
- S. J. Hives, Administrative Officer, Pollution Control Branch.
- Mrs. G. M. MacNutt, Clerk, Pollution Control Branch.
- P. G. Odynsky, Engineer, Water Rights Branch.

35-year Service Awards

- L. F. Macrae, Draughtsman, Water Investigations Branch.
- H. W. Mellish, Administrative Officer, Water Rights Branch.
- B. Varcoe, Technician, Water Investigations Branch.
- D. White, Clerk, Water Rights Branch.

ACCOUNTING

DIVISION

M. B. MACLEAN
DEPARTMENTAL COMPTROLLER

The enlarged Data Processing system implemented in 1972 has the licence record on magnetic tape, which is the single master record for the system. It provides for the calculation of yearly rentals; the printing of annual statements for the majority of the licences, and for the programmed calculation of yearly rentals after the entry of adjustments from the annual returns from improvement districts, municipalities, towns, and villages.

There has been a noticeable increase in the demand for statistical data by the Licencing Branch, other Government Departments and Federal Agencies. This demand has been met by the implementation of additional programs. A continuing function is the constant up-dating of existing records and the collection and coding of data for new records.

Following is a statement of Water Rights revenue for 1974 by major purpose and also a statement of comparative revenue for the past 10-year period.

	\$
Domestic, incidental use, and fees	569,742
Waterworks	195,426
Irrigation	18,394
Power	5,170,179
Funds received on application	333,401
	<hr/>
Total	6,287,142
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Comparison of Revenue for 10-year Period, 1965-74, Inclusive

	\$		\$
1965	2,251,025	1970	3,716,932
1966	2,285,932	1971	4,076,598
1967	2,431,010	1972	4,923,346
1968	2,749,848	1973	5,404,106
1969	3,364,577	1974	6,287,142

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