

ANNUAL REPORT
to the
GOVERNMENTS
of
THE UNITED STATES and CANADA

COLUMBIA RIVER TREATY
PERMANENT ENGINEERING BOARD
Washington, D.C. Ottawa, Ontario
30 SEPTEMBER 1970



COLUMBIA RIVER TREATY PERMANENT ENGINEERING BOARD

C A N A D A • U N I T E D S T A T E S

CANADIAN SECTION

G. M. MacNABB, Chairman
A. F. PAGET, Member

UNITED STATES SECTION

W. E. JOHNSON, Chairman
M. D. BURROW, Member

31 December 1970

The Honourable William P. Rogers
The Secretary of State
Washington, D.C.

The Honourable J. J. Greene
Minister of Energy, Mines and
Resources
Ottawa, Ontario

Gentlemen:

Reference is made to the Treaty between the United States of America and Canada, relating to co-operative development of the water resources of the Columbia River basin, signed at Washington, D.C., on 17 January 1961.

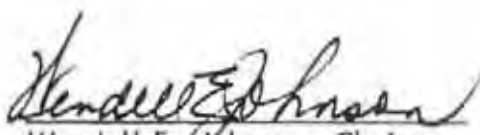
In accordance with the provisions of Article XV paragraph 2(e), there is submitted herewith the sixth Annual Report, dated 30 September 1970, of the Permanent Engineering Board.

The report sets forth results achieved and benefits produced under the Treaty for the period from 1 October 1969 to 30 September 1970.

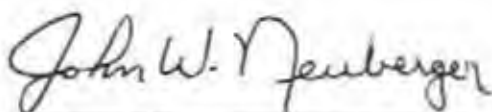
Respectfully submitted:

For the United States

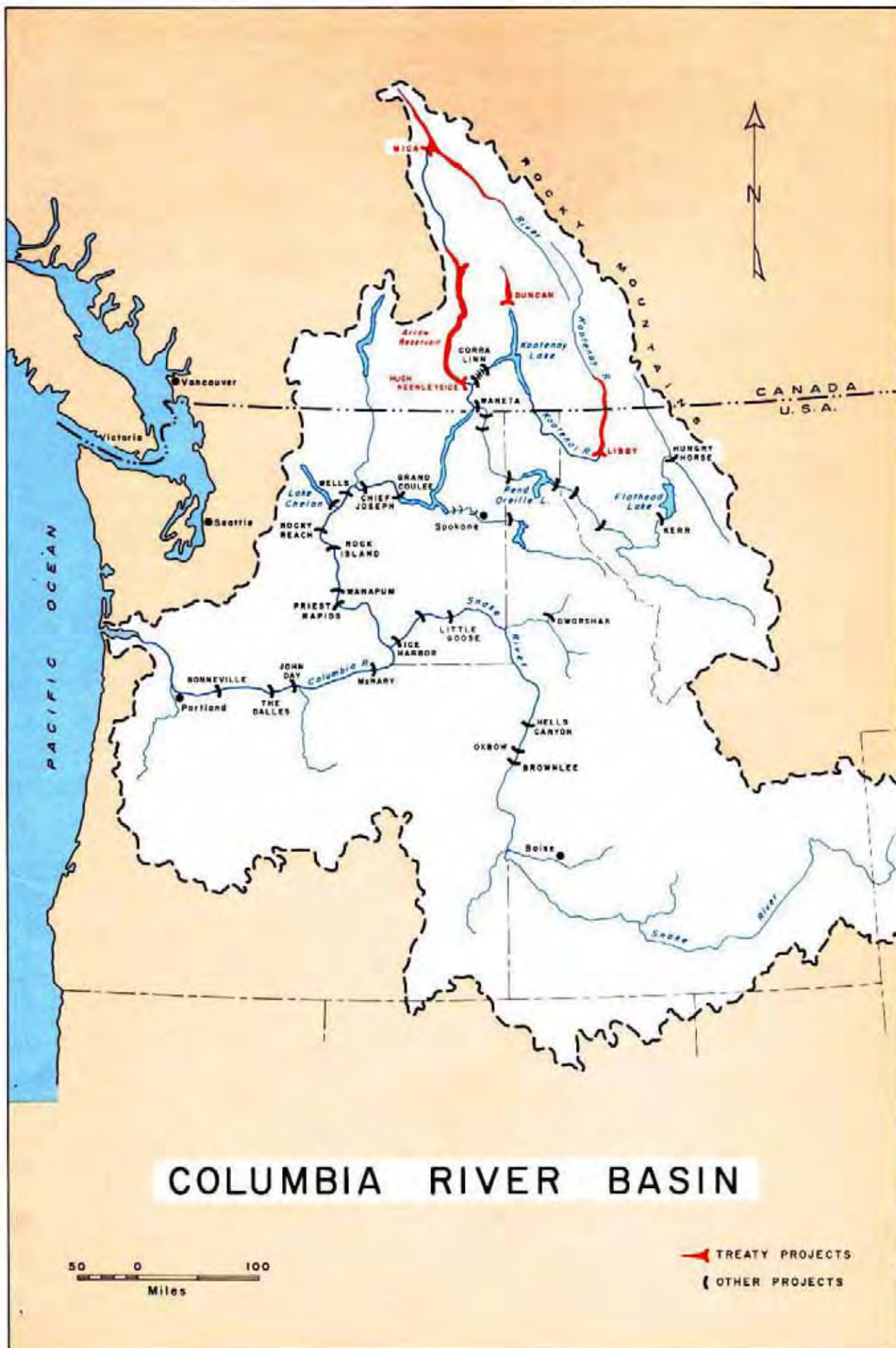
For Canada


Wendell E. Johnson, Chairman


G. M. MacNabb, Chairman


John W. Neuberger


A. F. Paget



COLUMBIA RIVER BASIN

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GOVERNMENTS
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THE UNITED STATES and CANADA**

**COLUMBIA RIVER TREATY
PERMANENT ENGINEERING BOARD**

Washington, D.C.

Ottawa, Canada

30 September 1970

CONTENTS

	<u>Page</u>
Letter of Transmittal	
Frontispiece	
SUMMARY	viii
INTRODUCTION	1
THE COLUMBIA RIVER TREATY	
General	2
Features of the Treaty and Related Documents	4
PERMANENT ENGINEERING BOARD	
General	7
Establishment of the Board	7
Duties and Responsibilities of the Board	8
ENTITIES	
General	10
Establishment of Entities	10
Powers and Duties of the Entities	11

	<u>Page</u>
 ACTIVITIES OF THE BOARD	
Meetings and Field Inspections	14
Reports Received	14
Report to Governments	16
 PROGRESS	
General	17
Construction Progress of the Treaty Projects	
Mica Project	17
Libby Project in the United States	20
Libby Project in Canada	24
Hydrometeorological Network	24
Power Operating Plans	26
Annual Calculation of Downstream Benefits	27
Flood Control Operating Plans	28
Flow Records	29
 OPERATION	
General	30
Power Operation	30
Additional Storage on Arrow Reservoir	34
Flood Control Operation	35

	<u>Page</u>
BENEFITS	
Flood Control Payment	36
Flood Control Provided	36
Power Benefits	38
CONCLUSIONS	39

LIST OF PHOTOGRAPHS

	<u>Page</u>
Artist's Sketch of Libby Dam	3
Duncan Dam	6
Railway Relocation, Libby Project	8
14-yard Loader, Mica Project	9
Reservoir Bridge, Libby Project	11
Hugh Keenleyside Dam	13
Fill Placement, Mica Project	15
Outlet Works, Mica Project	16
Mica Project	18
Spillway, Mica Project	19
Libby Project	21
Diversion Through Libby Dam	22
Reservoir Clearing, Libby Project	25
Power Intake Area, Mica Project	27
Railway Tunnel, Libby Project	28
Diversion Tunnel, Mica Project	29
Construction Activity, Libby Project	31
Gate Sections, Mica Project	34
Penstocks, Libby Project	35

Photographs for the Arrow and Mica Projects were supplied by the British Columbia Hydro and Power Authority.

Photographs for the Libby Project were supplied by the Corps of Engineers, U.S. Army.

HYDROGRAPHS

	<u>Page</u>
Duncan and Arrow Reservoir Levels	32
Observed and Pre-project Flows	37

APPENDICES

Appendix A	—	Names of Board Members, Alternates, and Secretaries	40
Appendix B	—	Names of Members of the Entities	41
Appendix C	—	Record of Flows at the International Boundary	42
Appendix D	—	Exchange of Notes Relating to Hydroelectric Operating Plans for Canadian Storage During the Operating Years 1969-70 through 1974-75	45
Appendix E	—	Plates	78

SUMMARY

The sixth Annual Report of the Permanent Engineering Board is submitted to the Governments of the United States and Canada in compliance with Article XV of the Columbia River Treaty of 17 January 1961. Project construction, progress of Entity studies, operation of the Arrow and Duncan reservoirs, and the resulting benefits are described.

Two Board meetings and one meeting of the Board with the Entities were held during the reporting period. The Board also inspected the Mica, Arrow, and Libby projects during the month of August 1970. Work on the Mica and Libby projects is on schedule.

A payment of \$298,242 in Canadian funds was made to Canada on 7 January 1970 as compensation for providing additional flood control as a result of early completion of the Duncan and Arrow projects.

The Arrow and Duncan reservoirs have been operated in accordance with the objectives of the Treaty, the terms of the detailed operating plans developed by the Entities, and the interim flood control operating plan for Duncan and Arrow reservoirs.

Studies pertaining to development of the hydrometeorological network and power and flood control operating plans are being continued by the Entities to ensure operation of the projects in accordance with the terms of the Treaty. Downstream power benefits were also determined by the Entities as required by the Treaty.

The Board concludes that the objectives of the Treaty are being met.

INTRODUCTION

The Columbia River Treaty, which provides for co-operative development of the water resources of the Columbia River basin, was signed in Washington, D.C. on 17 January 1961 by representatives of the United States and Canada. Article XV of the Treaty established a Permanent Engineering Board and specified that one of its duties would be to "make reports to Canada and the United States of America at least once a year of the results being achieved under the Treaty"

This Annual Report, which covers the period 1 October 1969 to 30 September 1970, describes activities of the Board, progress being achieved by both countries under the terms of the Treaty, operation of the Treaty projects, and the resulting benefits. The report also states that, in the opinion of the Board, the objectives of the Treaty are being met. Summaries of the essential features of the Treaty and of the responsibilities of the Board and of the Entities are included.

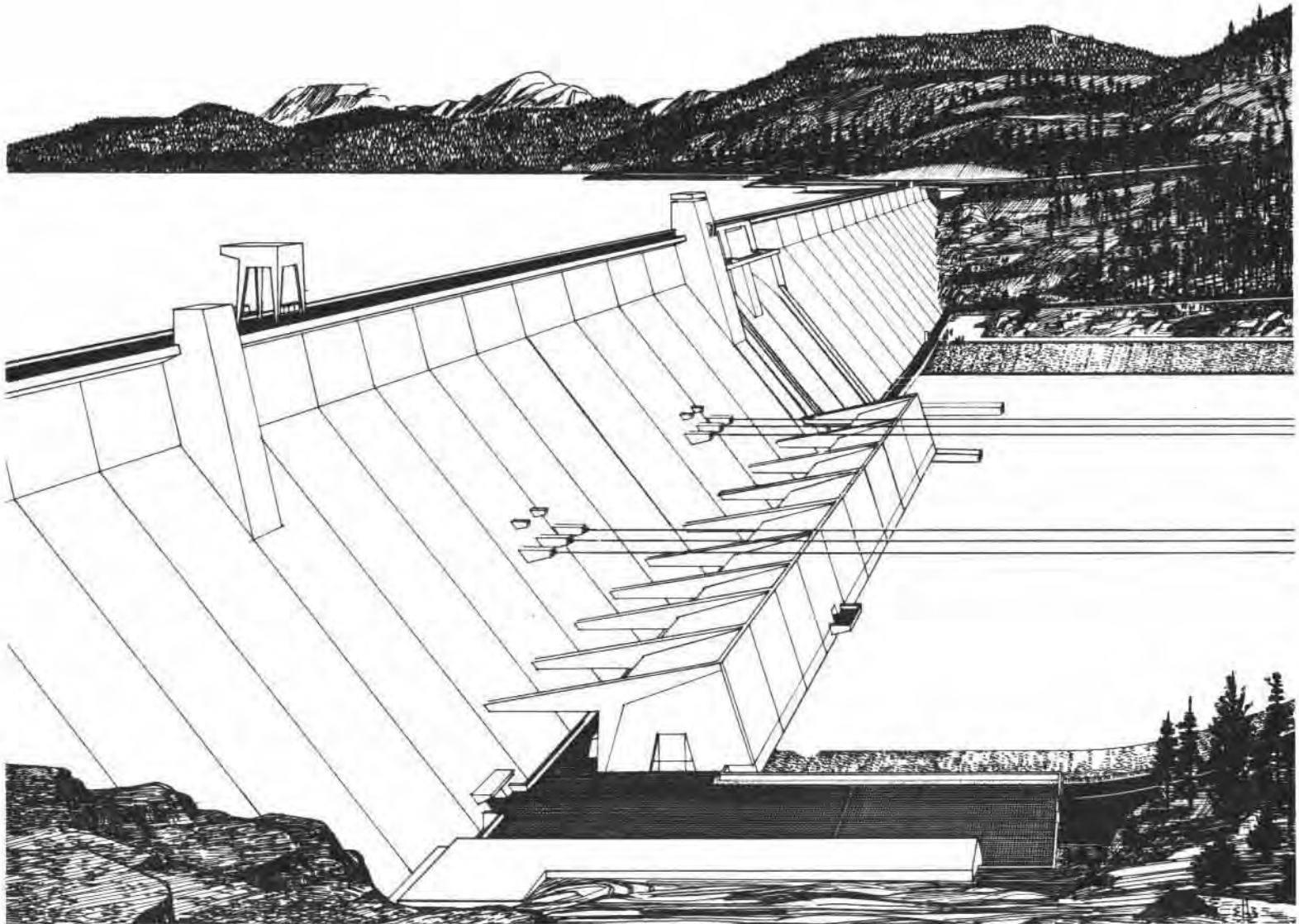
THE COLUMBIA RIVER TREATY

General

The Columbia River Treaty was signed in Washington, D.C. on 17 January 1961 and was ratified by the United States Senate in March of that year. In Canada ratification was delayed. Further negotiations between the two countries resulted in formal agreement by an exchange of notes on 22 January 1964 to a Protocol to the Treaty and to an Attachment Relating to Terms of Sale. The Treaty and related documents were approved by the Canadian Parliament in June 1964.

The Canadian Entitlement Purchase Agreement was signed on 13 August 1964. Under the terms of this agreement Canada's share of downstream power benefits resulting from the first thirty years of scheduled operation of each of the storage projects was sold to a group of electric utilities in the United States known as the Columbia Storage Power Exchange.

On 16 September 1964 the Treaty and Protocol were formally ratified by an exchange of notes between the two governments. The sum of \$253.9 million (U.S. funds) was delivered to the Canadian representatives as payment in advance for the Canadian entitlement to downstream power benefits during the period of the Purchase Agreement. On the same date at a ceremony at the Peace Arch Park on the International Boundary the Treaty and its Protocol were proclaimed by President Johnson, Prime Minister Pearson, and Premier Bennett of British Columbia.



LIBBY PROJECT

Artist's conception of dam and powerhouse.

Kootenai River, Montana

Features of the Treaty and Related Documents

The essential features of the Treaty are as follows:

- (a) Canada will provide 15.5 million acre-feet of usable storage by constructing dams near Mica Creek, the outlet of Arrow Lakes, and Duncan Lake, in British Columbia.
- (b) The United States will maintain and operate hydroelectric power facilities included in the base system and any new main-stem projects to make the most effective use of improved stream flow resulting from operation of the Canadian storage. Canada will operate the storage in accordance with procedures and operating plans specified in the Treaty.
- (c) The United States and Canada will share equally the additional power generated in the United States as a result of river regulation by upstream storage in Canada.
- (d) On commencement of the respective storage operations the United States will make payments to Canada totalling \$64.4 million (U.S. funds) for flood control provided by Canada.
- (e) The United States has the option of constructing a dam on the Kootenai River near Libby, Montana. The Libby reservoir would extend some 42 miles into Canada and Canada would make the necessary Canadian land available for flooding.

- (f) Canada has the option of making specific diversions of the Kootenay River.
- (g) Differences arising under the Treaty which cannot be resolved by the two countries may be referred by either to the International Joint Commission or to arbitration by an appropriate tribunal as specified by the Treaty.
- (h) The Treaty shall remain in force for at least 60 years from its date of ratification, 16 September 1964.

The Protocol of January 1964 amplified and clarified certain terms of the Columbia River Treaty. The Attachment Relating to Terms of Sale signed on the same date established agreement that under certain terms Canada would sell in the United States its entitlement to downstream power benefits for a 30-year period. The Canadian Entitlement Purchase Agreement of 13 August 1964 provided that the Treaty storages would be operative for power purposes on the following dates:

Duncan storage	1 April 1968
Arrow storage	1 April 1969
Mica storage	1 April 1973



DUNCAN DAM

The dam with the reservoir nearly full.

Duncan River, British Columbia

PERMANENT ENGINEERING BOARD

General

Article XV of the Columbia River Treaty established a Permanent Engineering Board consisting of two members to be appointed by Canada and two members by the United States. Appointments to the Board were to be made within three months of the date of ratification. The duties and responsibilities of the Board were also stipulated in the Treaty and related documents.

Establishment of the Board

Pursuant to Executive Order No. 11177 dated 16 September 1964 the Secretary of the Army and the Secretary of the Interior on 7 December 1964 appointed two members and two alternate members to form the United States Section of the Permanent Engineering Board. The members of the Canadian Section of the Board were appointed by Order in Council P.C. 1964-1671 dated 29 October 1964. Each member was authorized to appoint an alternate member. On 11 December 1964 the two governments announced the composition of the Board.

The names of the Board members, alternate members and secretaries are shown in Appendix A. It is noted that Mr. John W. Neuberger has replaced Mr. Morgan D. Dubrow as a member of the United States Section of the Board.



RAILWAY RELOCATION – Libby Project. Head of train carrying rails welded into lengths one-quarter mile long. August 1970.

Duties and Responsibilities of the Board

The general duties and responsibilities of the Board to the governments, as set forth in the Treaty and related documents, include:

- (a) assembling records of the flows of the Columbia River and the Kootenay River at the Canada-United States of America boundary;
- (b) reporting to Canada and the United States of America whenever there is substantial deviation from the hydroelectric and flood control operating plans and if appropriate including in the report recommendations for remedial action and compensatory adjustments;
- (c) assisting in reconciling differences concerning technical or operational matters that may arise between the entities;

- (d) making periodic inspections and requiring reports as necessary from the entities with a view to ensuring that the objectives of the Treaty are being met;
- (e) making reports to Canada and the United States of America at least once a year of the results being achieved under the Treaty and making special reports concerning any matter which it considers should be brought to their attention;
- (f) investigating and reporting with respect to any other matter coming within the scope of the Treaty at the request of either Canada or the United States of America;
- (g) consulting with the entities in the establishment and operation of a hydro-meteorological system as required by Annex A of the Treaty.

MICA PROJECT

14 cubic yard
front end loader,
loads 120 ton
haul units.



ENTITIES

General

Article XIV(1) of the Treaty provides for the designation by Canada and the United States of entities which are empowered and charged with the duty of formulating and executing the operating arrangements necessary to implement the Treaty. Provision is made for either government to designate one or more entities. The powers and duties of the entities are specified in the Treaty and related documents.

Establishment of the Entities

Executive Order No. 11177, previously referred to, designated the Administrator of the Bonneville Power Administration, Department of the Interior, and the Division Engineer, North Pacific Division, Corps of Engineers, Department of the Army, as the United States Entity with the Administrator to serve as Chairman. Order in Council P.C. 1964-1407 dated 4 September 1964 designated the British Columbia Hydro and Power Authority as the Canadian Entity for the purposes of the Treaty.

The names of the members of the two entities are shown in Appendix B.

RESERVOIR BRIDGE

nearly complete
across Libby reservoir;
Forest Development Road
in background.
August 1970.



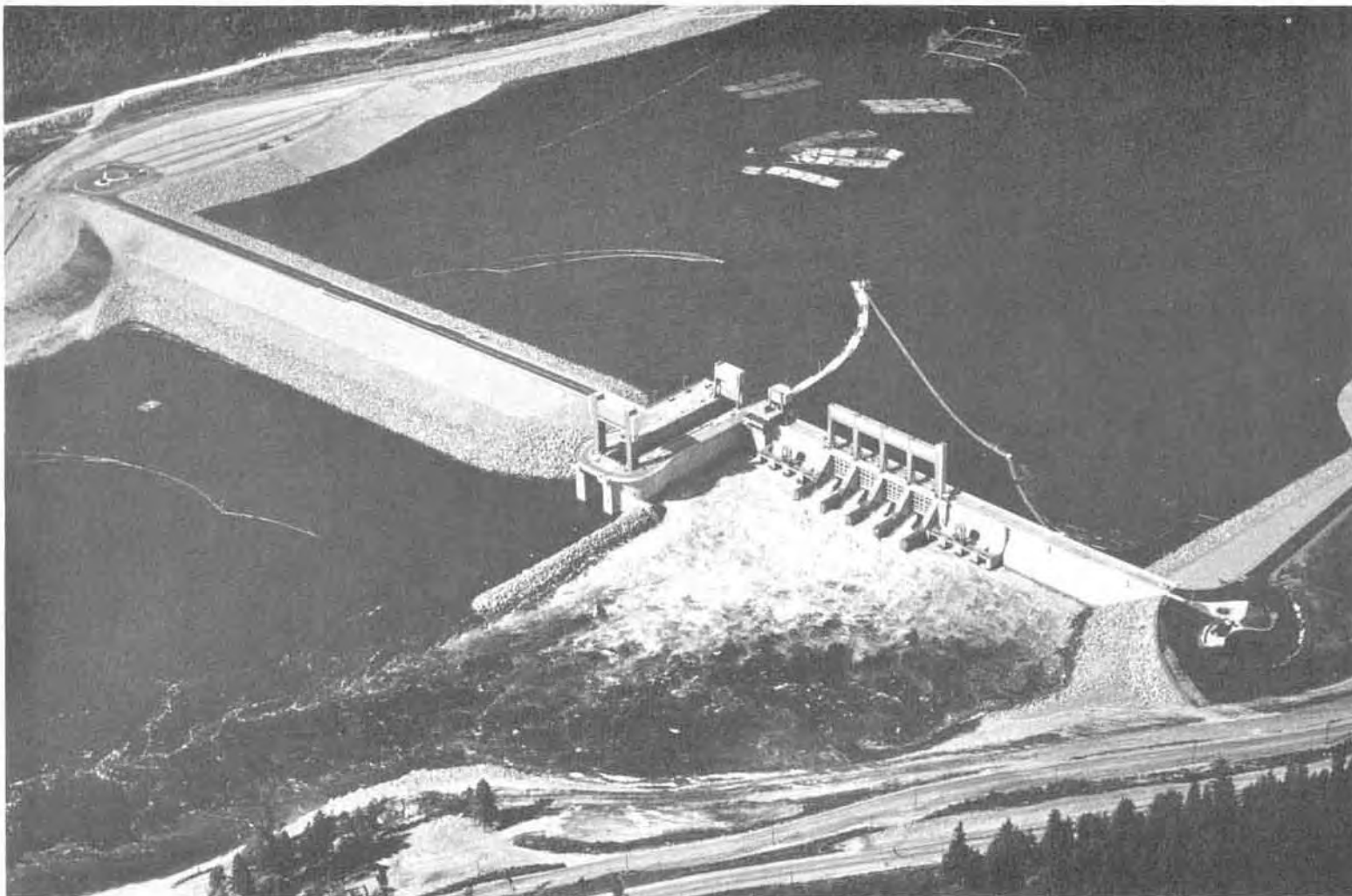
Powers and Duties of the Entities

In addition to the powers and duties specified elsewhere in the Treaty and related documents the Treaty requires that the entities be responsible for:

- (a) co-ordination of plans and exchange of information relating to facilities to be used in producing and obtaining the benefits contemplated by the Treaty,
- (b) calculation of and arrangements for delivery of hydroelectric power to which Canada is entitled for providing flood control,
- (c) calculation of the amounts payable to the United States of America for standby transmission services,

- (d) consultation on requests for variations made pursuant to Articles XII(5) and XIII(6),
- (e) the establishment and operation of a hydrometeorological system as required by Annex A,
- (f) assisting and co-operating with the Permanent Engineering Board in the discharge of its functions,
- (g) periodic calculation of accounts,
- (h) preparation of the hydroelectric operating plans and the flood control operating plans for the Canadian storage together with determination of the downstream power benefits to which Canada is entitled,
- (i) preparation of proposals to implement Article VIII and carrying out any disposal authorized or exchange provided for therein,
- (j) making appropriate arrangements for delivery to Canada of the downstream power benefits to which Canada is entitled including such matters as load factors for delivery, times and points of delivery, and calculation of transmission loss,
- (k) preparation and implementation of detailed operating plans that may produce results more advantageous to both countries than those that would arise from operation under the plans referred to in Annexes A and B.

Article XIV(4) of the Treaty provides that the two governments may, by an exchange of notes, empower or charge the entities with any other matter coming within the scope of the Treaty.



HUGH KEENLEYSIDE DAM

Columbia River, British Columbia

The dam and Arrow reservoir during the freshet.

ACTIVITIES OF THE BOARD

Meetings and Field Inspections

The first meeting of the Board during the report year was held in Seattle, Washington on 17 February 1970 to review progress. A meeting was held with the Entities on the following day to review and discuss Entity studies and general progress under the Treaty. The second meeting of the Board was held in Castlegar, British Columbia, on 24 August 1970 during the course of the Board's field inspection of the Mica, Arrow and Libby projects on 24, 25 and 26 August. The Board also visited the Grand Coulee project during this period.

Reports Received

The Board received semi-annual progress reports from the Entities. These reports included construction progress reports on the Mica and Libby projects, a record of documents approved by the Entities and a general outline of reservoir operations and activities.

Throughout the report year the Canadian Entity provided the Board with weekly reports on operation of the Canadian storage reservoirs and with daily flow forecasts during the freshet season. The Entity also provided reports which reviewed construction of the Duncan and Arrow projects and a copy of the Entities' annual report, "Report of Columbia River Treaty Canadian and United States Entities for the period 1 October 1968 to 30 September 1969".



MICA PROJECT – Fill placement and core contact area on left abutment.

May 1970.

During the report year the Entities also provided the Board with the following documents:

- Columbia River Treaty Detailed Operating Plan for Canadian Storage 1 July 1969 through 31 July 1970, plus a copy of the Entities' agreement on this document
- an Agreement providing an amendment to "Columbia River Treaty Hydro-electric Operating Plans for Canadian Storage, Operating Years 1969-70 through 1974-75"
- Agreement on "Interim Plan for Exchange of Hydrometeorological Data", Recommendation No. 6
- Columbia Board of Review Report No. 16.

Subsequent to the end of the formal report year the Board received the following documents from the Entities with copies of their agreement on each document:

- Columbia River Treaty Hydroelectric Operating Plan for Canadian Storage, Operating Year 1975-76
- Determination of Downstream Power Benefits Resulting from Canadian Storage for Operating Year 1975-76
- Columbia River Treaty Detailed Operating Plan for Canadian Storage 1 July 1970 through 31 July 1971.

During the report year an additional two feet of storage was provided on the Arrow reservoir. Copies of letters pertaining to this storage were provided to the Board by B.C. Hydro and Power Authority and by Bonneville Power Administration. The operation of this additional storage is discussed on page 34.

Report to Governments

The fifth Annual Report of the Board was submitted to the two governments on 31 December 1969.

MICA PROJECT

Outlet works,
tunnel inlet and
form for concreting
mounted on jumbo.
August 1970.



PROGRESS

General

The results achieved under the terms of the Treaty include progress on construction of the Treaty projects and on studies regarding development of the hydrometeorological network, power and flood control operating plans, and the annual calculation of downstream power benefits.

Duncan Dam was placed in operation on 31 July 1967. The Arrow project was declared operational on 10 October 1968 and the dam was named the Hugh Keenleyside Dam on 9 June 1969. Both projects were completed well in advance of Treaty requirements and continued to produce power and flood control benefits during this report year. The Duncan and Hugh Keenleyside Dams are shown in the pictures on pages 6 and 13 and the locations of the Treaty projects on Plate 1.

Construction Progress of the Treaty Projects

Mica Project

Mica dam, the largest of the Treaty projects, is scheduled by the Sales Agreement for initial operation on 1 April 1973.



MICA PROJECT

Columbia River, British Columbia

Downstream face of dam under construction showing location of chute spillway above diversion tunnel outlets. August 1970.

The general arrangement of structures for the Mica project is shown on Plate 2. The main dam will have a nearly vertical impervious core supported between zones of coarser material. The two 45-foot diameter diversion tunnels are located in the left abutment. Spillway facilities and control works to provide regulated discharges from storage are being constructed in the left abutment and power facilities will be located underground in the right abutment.

Construction of the dam is on schedule. During the previous report year the main dam fill was placed to above cofferdam level, excavation of the spillway approach channel was complete, and excavation of the spillway chute was underway. By the end of this report year approximately 21,000,000 cubic yards or nearly 50 percent of the total embankment had been placed. The main dam fill is now 430 feet above the bedrock foundation and when complete will reach a total height of about 800 feet. General progress of the main fill is shown on Plate 3 and in the picture on page 18.

MICA PROJECT

Spillway control works
and rock excavation
for chute.
August 1970.



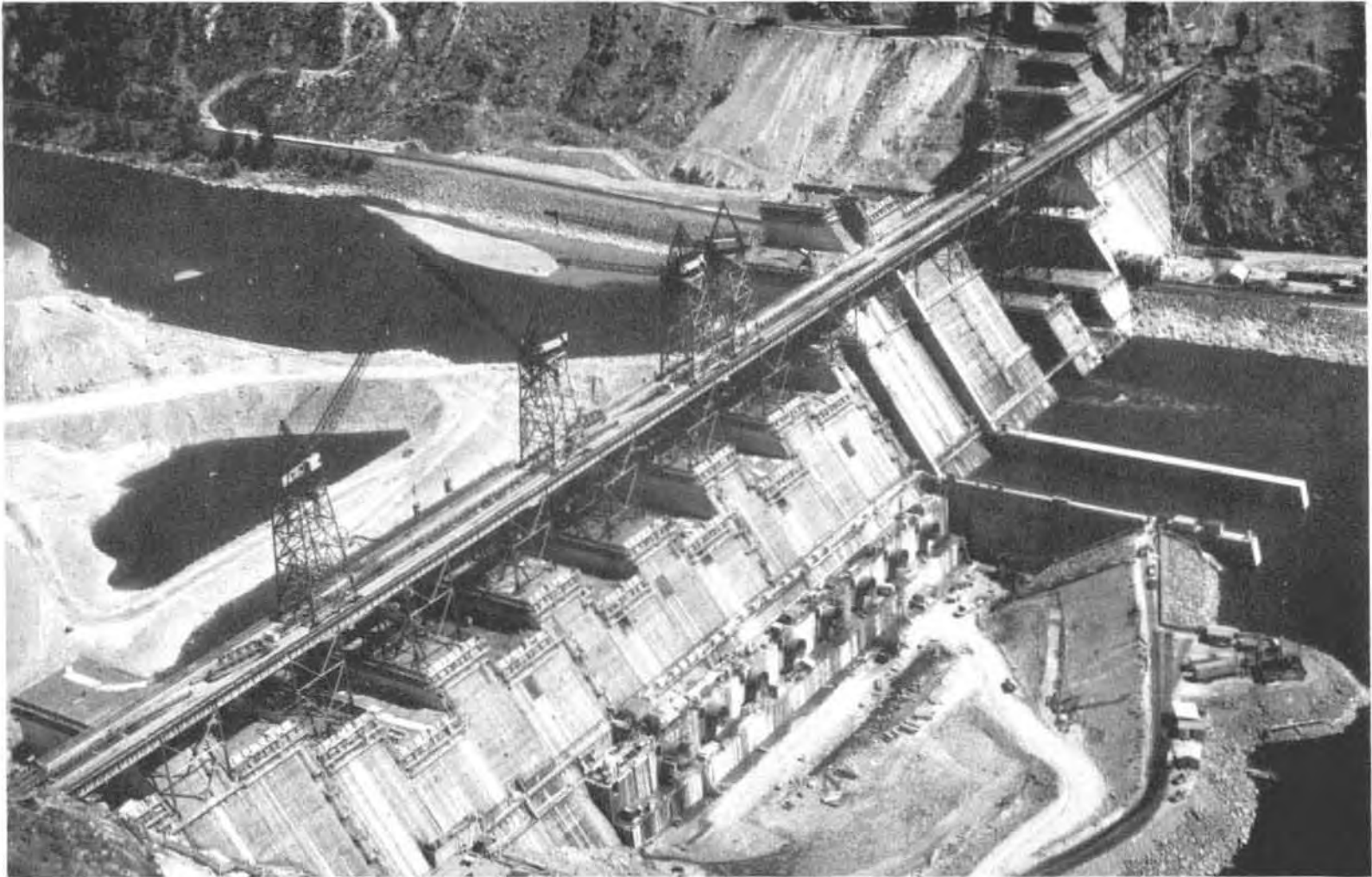
Placing concrete for the spillway structure is well advanced and excavation of the chute is nearly complete. Concrete work has started in the outlet works tunnel and rock excavation for the power tunnel intakes is nearly complete.

The project area is shown on Plate 4. Clearing operations and studies of possible landslide areas around the reservoir and their potential effects on the dam are continuing.

Libby Project in the United States

Libby dam is the fourth and last of the Treaty projects to be placed under construction. Initial phases, including highway and railroad relocations, were commenced in June 1966. In accordance with Article XII of the Treaty the dam is to be operational by 30 June 1973.

The general arrangement of the structures is shown on Plate 5, and the reservoir area and the required highway and railroad relocations are depicted on Plate 6. The concrete gravity dam will be capable of storing water up to elevation 2459 feet, and the reservoir, with a total length of 90 miles, will extend some 42 miles into British Columbia. Procurement and preparation of the land required for the portion of the reservoir in Canada is, in accordance with the terms of the Treaty, the obligation of the Canadian Government. By subsequent agreement between Canada and the Province of British Columbia on 8 July 1963, British Columbia undertook responsibility for these flowage costs in Canada.



LIBBY PROJECT

Downstream face of dam showing penstocks and right bank cofferdams.

Kootenai River, Montana

August 1970.

The dam will consist of non-overflow monoliths, powerhouse intake and spillway monoliths. The spillway monoliths will contain two radial-type crest gates, and the outlet works will be combined into the same section to utilize a common stilling basin. A roadway and sidewalks will be provided over the dam. The powerhouse will provide space for eight generating units for a total installed capacity of 840,000 kw. Initial installation will be 420,000 kw with the first unit of 105,000 kw scheduled for operation in July 1974.

Overall project construction is about 57 percent complete and is on schedule. Initial pool raising, to at least spillway crest elevation of 2405 will begin May 1972, with full storage at elevation 2459 possible during the peak runoff of May and June 1973.



LIBBY PROJECT Upstream face of dam at left bank with diversion through monolith 33, railroad tunnel and ports for low level outlets. August 1970.

The dam construction is 75 percent complete and is on schedule. First stage concrete placement has been completed. The river has been diverted through low monoliths 33 and 35 and concrete placement is progressing within the second stage cofferdam on the right bank.

The supply contract for turbines was awarded in May 1970 and is scheduled for completion in December 1973. The contract for powerhouse construction is scheduled for award in February 1971.

Construction of the detour highway route from Eureka to Libby is scheduled to be completed prior to the May 1972 pool raising. The reservoir bridge, in the vicinity of Rexford, will be essentially complete by November 1970.

Grading contracts and the tunnel contract on the Burlington Northern relocation have been completed. Contracts for the track laying, signals and communications system, tunnel ventilation, and station facilities are to be completed in November 1970. Railroad traffic is scheduled to be moved from the existing reservoir route to the new line in November 1970.

Reservoir clearing continues with all contracts awarded except the clearing contract for the town of Rexford and miscellaneous cleanup. Completion of reservoir clearing is scheduled to meet the partial pool raise to elevation 2405 by May 1972.

Libby Project in Canada

Acquisition of privately-owned property, and clearing of over 9,000 acres of forested land within the pondage area is proceeding on schedule.

The relocation of provincial highway routes involves the construction of 29 miles of roads and 3 bridges. The road approaches to the Wardner highway bridge, one of the two reservoir crossings in Canada shown on Plate 6, are now complete. Designs for relocation of the existing road system on the west side of the reservoir are complete and some sections are under construction. Construction has begun on the Wardner bridge structure and on the Canadian Pacific Railway overpass at Wardner.

The new rail crossing of the Kootenay River north of the reservoir at Fort Steele is now virtually complete; removal of the existing bridge at Wardner is well underway and should be finished in 1971. Studies and surveys are underway for the track modifications between Fort Steele and Wardner made necessary by the reservoir.

Studies to evaluate the anticipated effects of the operation of the reservoir on the shoreline are complete for privately-owned land, and are continuing for Crown lands. By establishing a "safe line" these studies aid the Provincial Government in its program of land acquisition.

Hydrometeorological Network

One of the responsibilities assigned to the Entities by the Treaty is the establishment and operation, in consultation with the Permanent Engineering Board, of a hydrometeoro-

logical system to obtain data for detailed programming of flood control and power operation. This system includes snow courses, precipitation stations and streamflow gauges.

In developing the hydrometeorological network the Entities, with the concurrence of the Board, adopted a document which defines the Columbia River Treaty Hydrometeorological System Network and sets forth a method of classifying facilities into those required as part of the Treaty System and those of value as Supporting Facilities. The classification agreed on by the Entities for facilities covered by Hydrometeorological Recommendations 1, 2, 3, 4 and 5 has been provided to the Board. The Entities have also formed a Columbia River Treaty Hydrometeorological Committee to make recommendations on establishing the Treaty Hydrometeorological System.

At the end of the preceding report year the Entities supplied the Board with Recommendation No. 6 which outlines an interim plan for exchange of hydrometeorological data. In this report year the Entities, with the concurrence of the Board, adopted the interim plan.

LIBBY RESERVOIR

Clearing and
Forest Development Road.
Brush piled for burning.
August 1970.



MICA PROJECT

Rock excavation at
power intake site
in right abutment.
August 1970.



Annual Calculation of Downstream Benefits

The general requirements for determination of assured operating plans and downstream power benefits are summarized in the first paragraph of the preceding section.

In the preceding report year the Entities provided the Board with a copy of their agreed document outlining downstream power benefits resulting from Canadian storage for the operating years 1969-70 through 1974-75. The Board has completed its review of this document and concludes that it meets the requirements of the Treaty.

During this report year the Entities completed evaluation of downstream power benefits for the operating year 1975-76. A copy of their agreed document has been provided to the Board and is under review.

Power Operating Plans

The Treaty and related documents provide that before any of the Canadian storage becomes operative the Entities will agree on operating plans and downstream power benefits for each year until the total of 15,500,000 acre-feet of storage in Canada becomes operative. In addition, based on the terms of the Treaty, the Entities are to agree annually on operating plans and on the resulting downstream power benefits for the sixth succeeding year of operation.

In the preceding report year the Entities agreed on hydroelectric operating plans for Canadian storage for the operating years 1969-70 through 1974-75. The operating plans were reviewed by the Board and with a minor amendment have been approved by the two governments through an exchange of notes. The operating plans and the exchange of notes are included as Appendix D.

Early in this report year the Entities completed development of detailed operating plans for Canadian storage for the operating year ending 31 July 1970. A detailed operating plan has been developed for the operating year ending 31 July 1971 and has been forwarded to the Board.

During this report year the Entities also agreed on hydroelectric operating plans for Canadian storage for the operating year 1975-76. Copies of the plan were forwarded to the Board and are under review.

Flood Control Operating Plans

The Treaty provides that Canadian storage reservoirs will be operated by the Canadian Entity in accordance with operating plans designed to minimize flood damage in the United States and Canada.

During the preceding report year the Entities reached agreement on an interim flood control plan for the Duncan and Arrow Reservoirs which will govern flood control operations until the next project under the Treaty becomes operational. The Entities provided the Board with a copy of the plan.

In this report year the Entities continued to study the effects of discharges from the Libby project on the existing International Joint Commission Order for regulation of Kootenay Lake as part of the development of the flood control plan.

RAILWAY TUNNEL

Libby Project.
North portal and
ventilation structures.
August 1970.



Flow Records

Article XV(2) (a) of the Treaty specified that the Permanent Engineering Board shall assemble records of flows of the Columbia and Kootenay Rivers at the Canada-United States of America boundary. Actual recorded flows for the Kootenai River at Porthill, Idaho, and for the Columbia River at Birchbank, British Columbia , (See Plate 1) are tabulated in Appendix C for this report year.

MICA PROJECT

45 foot diameter
diversion tunnel No. 2
dewatered for
maintenance and
silt removal.
March 1970.



OPERATION

General

The Entities previously established a Columbia River Treaty Operating Committee which is responsible for developing operating plans for the Treaty storages and for directing operation of these storages on a continuing basis in accordance with the terms of the Entity agreements.

During the report year the Treaty storage in Canada was operated by the Canadian Entity in accordance with the "Interim Flood Control Operating Plan for Duncan and Arrow Reservoirs", the "Detailed Operating Plan for Canadian Storage 1 July 1969 through 31 July 1970" and the "Detailed Operating Plan for Canadian Storage 1 July 1970 through 31 July 1971". Operations were in accordance with committee directives normally issued on a weekly basis.

Power Operation

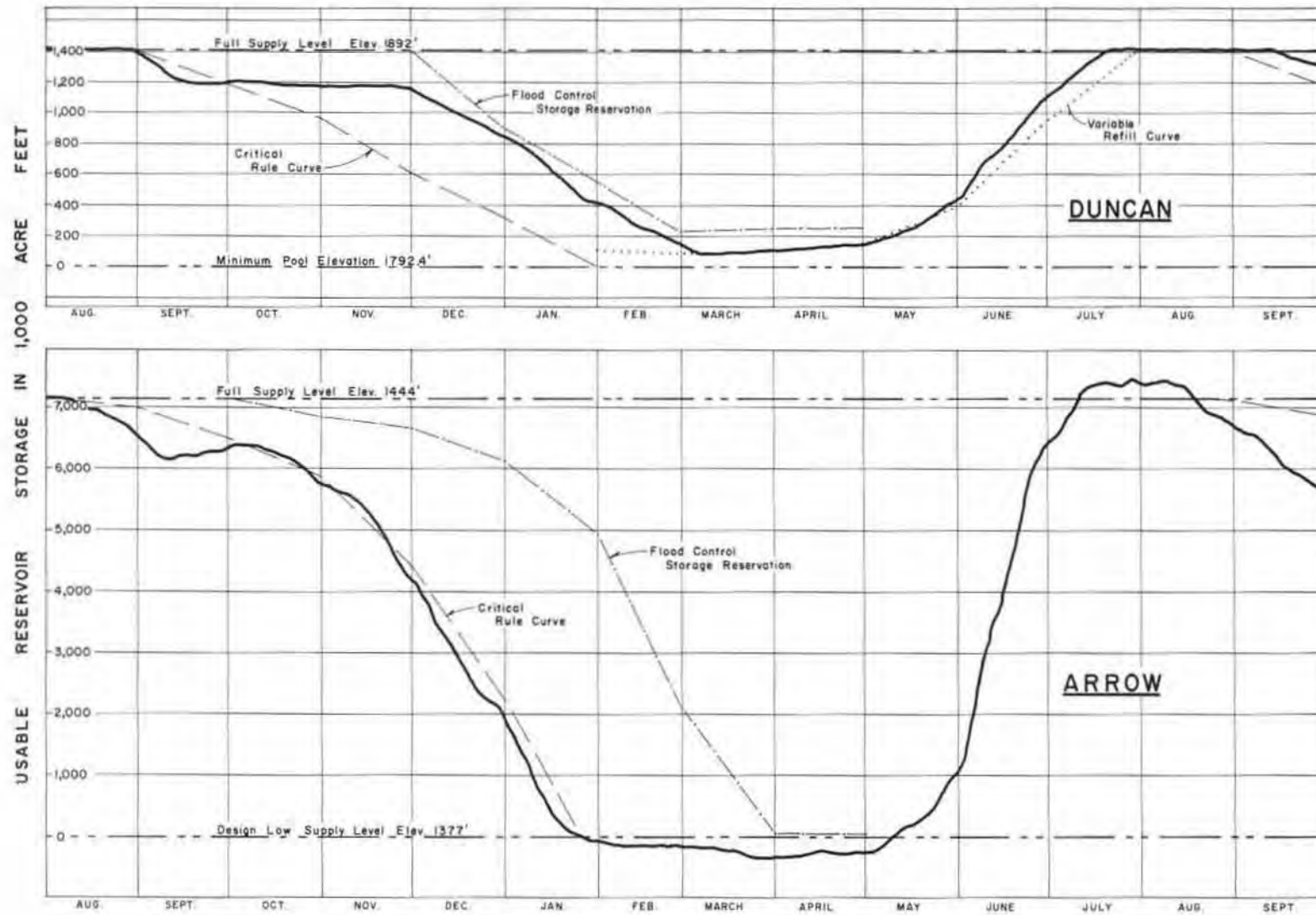
Both the Duncan and Arrow reservoirs were fully operational during the report year and provided reservoir storage to supplement natural streamflow by the end of the storage draft season. Both reservoirs filled completely during the 1969 freshet in a manner consistent with flood control and hydroelectric requirements. As described in the following section an additional two feet of water was stored in the Arrow reservoir above the normal full reservoir level.

LIBBY PROJECT

Monoliths at left bank,
trestle deck with
tracks and
gantry cranes.
August 1970.



Operation of the two reservoirs is illustrated on page 32 by hydrographs which show actual reservoir levels and some of the more important rule curves which govern operation of the Treaty storage. The Flood Control Storage Reservation curve specifies maximum month-end reservoir levels which will permit evacuation of the reservoir to control the forecasted freshet. The Critical Rule Curve shows minimum month-end reservoir levels which should be maintained to enable the anticipated power demands to be met under adverse water supply conditions. The Variable Refill Curve shows reservoir elevations necessary to ensure refilling the reservoir by the end of July with a reasonable degree of confidence. Similar rule curves which apply to operation of the combined storages have also been provided to the Board.



HYDROGRAPHS — Duncan and Arrow Reservoir levels for the 14-month period ending 30 September 1970.

Toward the end of the preceding report year natural inflows were well below average and use of Treaty reservoir storage commenced in the first part of August 1969. As a result the Treaty storage was below critical rule curve until just after the beginning of this report year.

The Duncan reservoir provided about 1.3 million acre-feet of reservoir storage to supplement natural streamflow. During the main storage release period which commenced on 27 November 1969 discharges were limited by agreement to less than 10,000 cfs to minimize spill at the Canadian plants on the lower Kootenay River and to obtain maximum usable generation at these plants. The reservoir filled to elevation 1892 on 26 July 1970 and at the end of this report year was at elevation 1886.15 feet.

Release of storage from the Arrow reservoir continued until late January 1970 when it reached the normal minimum elevation of 1377 feet and had provided about 7.1 million acre-feet of reservoir storage. In the preceding year work in the reservoir had been postponed because of special operating procedures to facilitate construction of the third powerhouse at Grand Coulee. The 1970 Detailed Operating Plan made provision for holding the Arrow reservoir empty through the month of March to allow the reservoir work to be continued. The reservoir was lowered to elevation 1374 feet to facilitate this work and was refilled to its normal full elevation of 1444 feet on 10 July 1970. At the end of the report year the reservoir was at elevation 1431.95 feet and was below the critical rule curve elevation due to low inflow conditions.

Additional Storage on Arrow Reservoir

During the months of July and August 1970 two feet of storage in addition to the storage which Canada is required to supply under the terms of the Treaty was provided on Arrow reservoir. Operation of this storage above the normal full reservoir elevation of 1444 feet is illustrated in the hydrograph on page 32.

Under Article IV(5) of the Treaty the Board has a responsibility to ensure that operation of additional storage does not reduce the flood control and hydroelectric benefits obtainable from operation of the Treaty storage. The Entities informed the Board of the arrangements for provision of the additional storage and that its operation would not conflict with any of the arrangements made in connection with the Treaty. The Board concurs with the Entities in this matter. Accordingly, while operation of the additional storage represents a substantial deviation from the operating plans developed by the Entities the Board does not consider that any further action is necessary.

MICA PROJECT
Spillway gate sections,
July 1970.

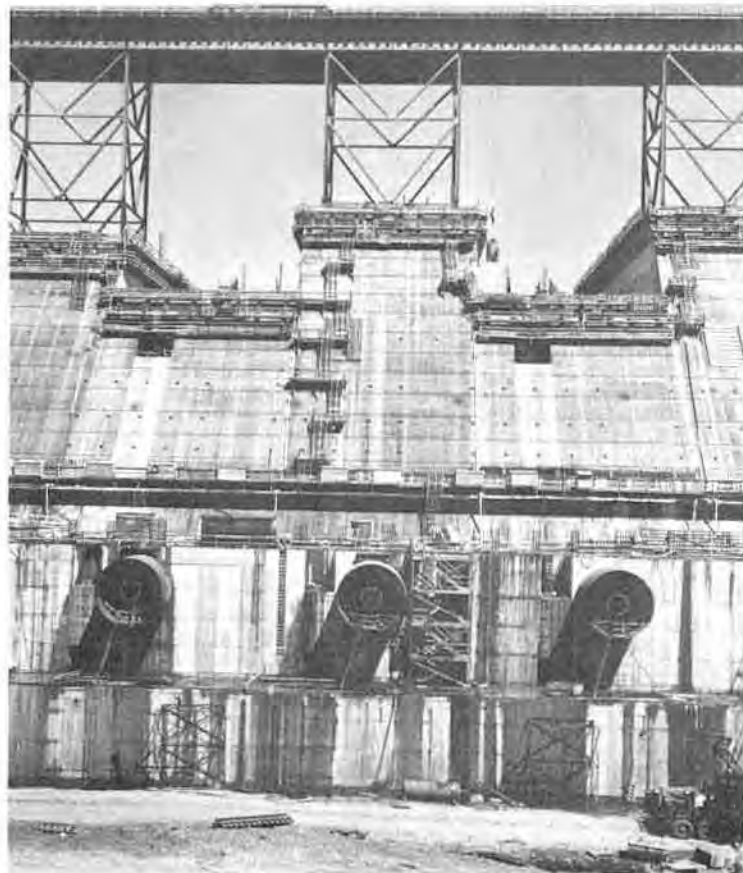


Flood Control Operation

The Entities agreed to operate Treaty storage for flood control during the 1970 freshet in accordance with the objectives of the document "Interim Flood Control Operating Plan for Duncan and Arrow Reservoirs". Both reservoirs were operated in accordance with these procedures. Benefits from flood control operation are described on page 36.

LIBBY PROJECT

Downstream face of dam showing 20-foot diameter penstocks for powerhouse. August 1970.



BENEFITS

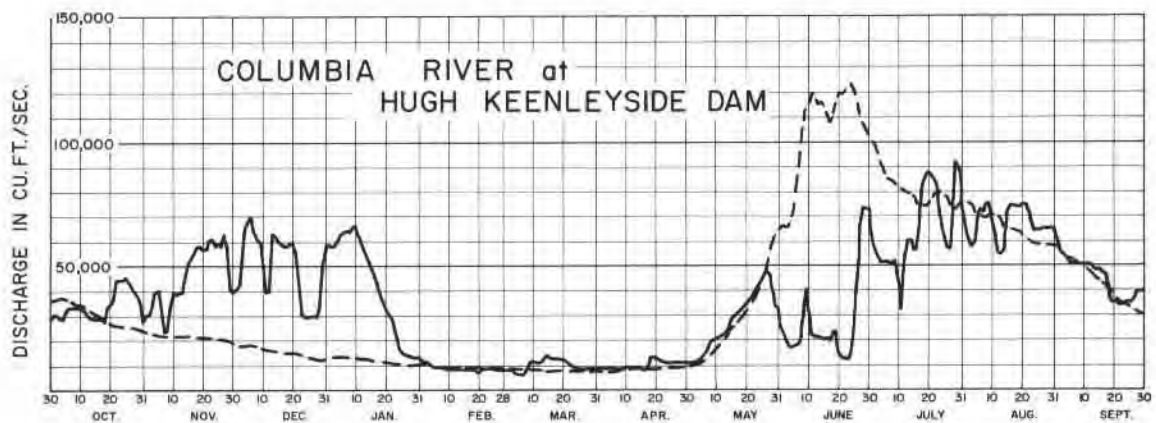
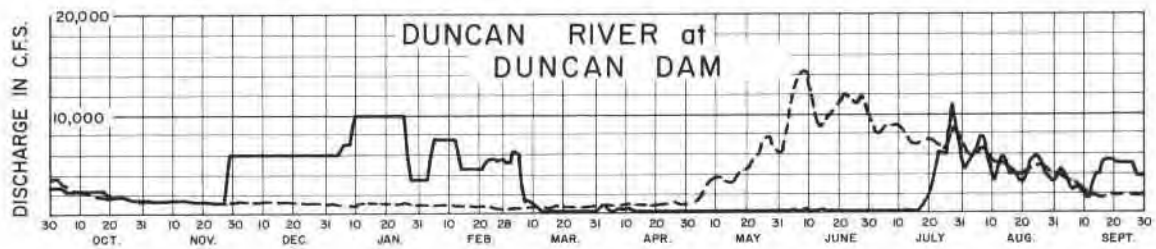
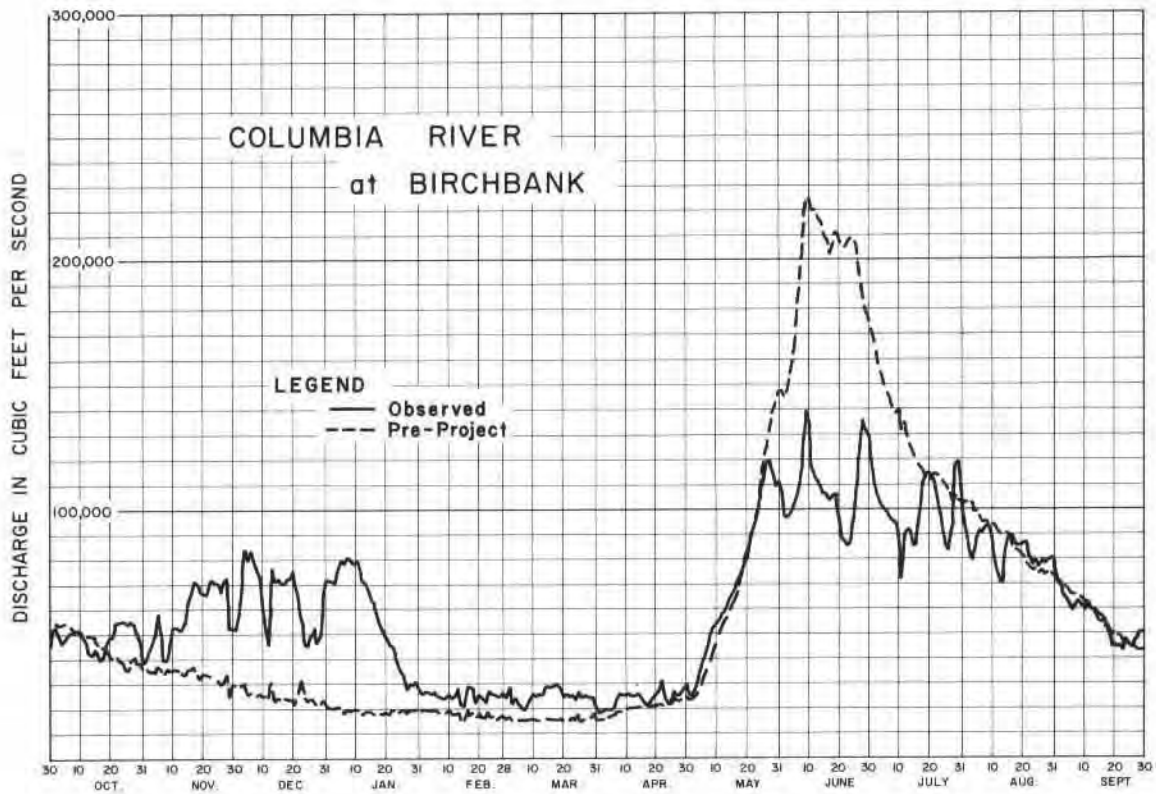
Flood Control Payment

Article IV(6) of the Treaty requires that the Duncan and Arrow storages shall commence full operation by September 1969. As the Duncan and Arrow storages were placed in operation on 31 July 1967 and on 10 October 1968 respectively, both reservoirs have been effective in providing flood control for longer periods than were used in determining the amounts to be paid Canada under Article VI of the Treaty. A payment of \$298,242 in Canadian funds was made to Canada on 7 January 1970 for this additional flood control.

Flood Control Provided

The effect of storage in the Duncan and Arrow reservoirs on flows at the sites and on flows of the Columbia River at Birchbank is illustrated on page 37 by hydrographs which show actual discharges and pre-project flows that would have occurred if the dams had not been built. It is noted that the pre-project hydrograph for Birchbank has been computed on the assumption that the effects of Duncan and Arrow regulation and of the regulation provided by storage on Kootenay Lake have been removed.

It is estimated that the Duncan project reduced the peak stage by about 1.3 feet on Kootenay Lake and that the Arrow and Duncan projects reduced the peak stage of the Columbia River at Trail, British Columbia by about eight feet.



HYDROGRAPHS — Observed and Pre-Project flows for the year ending 30 September 1970.

The operation of Columbia Basin reservoirs for the system as a whole reduced the peak discharge of the Columbia River near The Dalles, Oregon by approximately 208,000 cfs to 426,000 cfs. The corresponding reduction in peak stage at Vancouver, Washington amounted to about seven feet. The Arrow project contributed about 30 percent of the total effective storage in the Columbia reservoir system during the period of control of the lower Columbia River and the Duncan project about 5 percent.

Power Benefits

Downstream power benefits which arise from operation of the Canadian Treaty Storage were pre-determined and the Canadian share was sold to the United States under the terms of the Canadian Entitlement Purchase Agreement for a 30 year period. No additional downstream power benefits were realized during the year from the operation of Treaty storage, however the British Columbia Hydro and Power Authority received payment for the additional two feet of storage provided in the Arrow reservoir.

CONCLUSIONS

1. The Duncan and Hugh Keenleyside dams are complete. The Mica and Libby projects are proceeding on schedule.
2. Entity studies pertaining to development of the hydrometeorological network, power and flood control operating plans, and the annual calculation of downstream power benefits are proceeding satisfactorily.
3. The Duncan and Arrow projects have been operated in conformity with the provisions of the Treaty, the detailed operating plans developed by the Entities, and the interim flood control operating plan for Duncan and Arrow reservoirs.
4. The operation of additional storage on Arrow reservoir did not adversely affect the benefits obtainable from operation of the Treaty storage.
5. Finally, the Board concludes that the objectives of the Treaty are being met.

COLUMBIA RIVER TREATY PERMANENT ENGINEERING BOARDUnited StatesCanadaMembers

Mr. Wendell E. Johnson, Chairman Chief, Engineering Division, Civil Works Directorate, Office, Chief of Engineers, U.S. Army, Washington, D.C.	(1)	Mr. G.M. MacNabb, Chairman Assistant Deputy Minister, Energy Development, Department of Energy, Mines and Resources, Ottawa, Ontario
Mr. John W. Neuberger Engineering Advisor, Office of the Assistant Secretary for Water & Power Development, Department of the Interior, Washington, D.C.	(2)	Mr. A.F. Paget, Consulting Engineer, Victoria, B.C.

Alternates

Mr. Fred L. Thrall Chief, Water Conservation and Use Branch, Civil Works Directorate, Office, Chief of Engineers, U.S. Army, Washington, D.C.	Mr. E.M. Clark Regional Engineer, Engineering Division, Department of Energy, Mines and Resources, Vancouver, B.C.
Mr. J. Emerson Harper Assistant and Power Engineering Advisor, Office of the Assistant Secretary for Water and Power Development, Department of the Interior, Washington, D.C.	Mr. H.M. Hunt Chief, Power and Major Licences Division, Water Resources Service, Department of Lands, Forests, and Water Resources, Victoria, B.C.

Secretaries

Mr. Verle Farrow Acting Chief, Hydrology and Hydraulics Branch, Civil Works Directorate, Office, Chief of Engineers, U.S. Army, Washington, D.C.	Mr. E.M. Clark Regional Engineer, Engineering Division, Department of Energy, Mines and Resources, Vancouver, B.C.
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- (1) Mr. Johnson retired from the Corps of Engineers on 31 July 1970 and is now a consulting engineer.
- (2) Vice Mr. Morgan D. Dubrow as of 29 August 1970.

COLUMBIA RIVER TREATY ENTITIES

United States

Canada

Mr. H.R. Richmond, Chairman
Administrator, Bonneville
Power Administration,
Department of the Interior,
Portland, Oregon

The Honourable R.G. Williston, Chairman
Minister of Lands, Forests and Water
Resources,
Victoria, B.C.

Brigadier General Roy S. Kelley
Division Engineer, North
Pacific Division,
Corps of Engineers,
U.S. Army,
Portland, Oregon

RECORD OF FLOWS

AT THE

INTERNATIONAL BOUNDARY

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	8,620	5,310	4,270	3,210	4,190	3,910	5,060	7,430	41,000	25,500	11,100	5,900
2	9,780	5,170	4,560	3,140	4,250	3,830	5,090	7,760	40,300	24,900	11,100	5,750
3	10,100	5,300	4,710	3,050	4,310	3,660	5,300	9,680	43,200	23,900	10,900	5,700
4	10,100	5,110	4,890	3,010	4,270	3,740	5,030	13,200	50,900	22,600	10,300	5,900
5	9,450	5,880	4,930	2,900	4,250	3,500	5,160	19,500	59,000	21,300	9,860	6,100
6	8,920	5,900	4,750	2,780	4,260	3,770	5,380	27,400	63,800	20,800	9,380	5,860
7	8,610	5,860	4,820	2,850	4,360	3,850	6,320	33,100	65,800	20,900	9,100	6,140
8	8,160	6,060	4,650	2,800	4,290	4,130	7,500	35,500	64,000	20,300	8,660	6,100
9	8,070	5,930	4,560	2,700	4,320	4,000	7,730	36,300	61,500	19,100	8,810	6,010
10	7,900	5,800	4,450	2,650	4,380	3,910	7,910	35,500	57,600	18,000	8,770	6,010
11	7,960	5,760	4,370	2,740	4,350	3,880	8,920	34,100	52,800	17,500	8,640	6,290
12	7,680	5,640	4,220	2,830	4,400	3,980	8,920	31,600	46,900	17,000	8,350	6,160
13	7,390	5,550	4,420	3,020	4,420	4,010	8,580	28,600	40,300	16,300	7,570	5,850
14	6,970	5,590	4,610	3,410	4,630	4,060	8,360	25,800	35,600	15,700	7,350	5,440
15	6,880	5,550	4,460	3,410	4,570	4,290	7,840	24,100	33,900	14,900	7,350	5,460
16	6,740	5,390	4,540	3,700	4,750	4,460	7,300	24,800	36,600	14,300	7,200	5,280
17	6,440	5,440	4,660	3,520	4,820	4,720	6,910	30,500	40,400	13,600	6,890	5,070
18	6,390	5,480	4,710	3,580	4,940	4,720	6,590	39,800	43,400	13,300	6,720	4,880
19	6,390	5,400	4,520	3,480	4,850	4,660	6,400	45,800	44,200	12,900	6,690	4,910
20	6,310	5,340	4,400	3,590	4,710	4,510	6,730	47,500	42,700	12,600	6,480	4,930
21	6,040	5,310	4,330	3,650	4,660	4,460	6,860	47,900	40,700	12,200	6,440	5,560
22	5,990	5,570	4,140	3,780	4,650	4,580	7,330	48,400	38,500	12,000	6,190	6,340
23	5,940	5,430	4,120	3,840	4,540	4,670	7,660	49,400	36,500	11,600	6,030	6,610
24	5,770	5,240	4,120	3,980	4,360	4,740	7,600	51,700	34,900	11,400	5,910	6,530
25	5,810	5,410	4,090	4,110	4,300	5,360	7,940	53,300	32,600	11,400	6,110	6,570
26	6,000	5,410	3,960	4,150	4,000	5,240	8,290	56,400	30,000	11,100	5,840	6,340
27	5,860	5,040	3,870	4,150	4,020	5,210	8,170	59,300	28,000	10,600	5,960	6,050
28	5,760	4,930	3,660	4,360	3,950	5,120	7,960	62,400	28,200	10,500	5,650	5,810
29	5,560	4,760	3,590	4,310		5,350	7,590	58,700	26,600	10,500	6,220	5,620
30	5,340	4,440	3,430	4,280		5,420	7,300	50,800	26,200	10,700	5,870	5,560
31	5,230		3,280	4,140		5,310		44,600		11,200	5,740	
Mean	7,170	5,430	4,330	3,460	4,420	4,420	7,120	36,800	42,900	15,800	7,650	5,820

KOOTENAI RIVER AT PORTHILL, IDAHO – Daily discharges for the year ending 30 September 1970 in cubic feet per second

EXCHANGE OF NOTES

RELATING TO

HYDROELECTRIC OPERATING PLANS FOR CANADIAN STORAGE

DURING THE OPERATING YEARS 1969-70 THROUGH 1974-75

Washington, D.C.
February 21, 1970

No. 54

Sir,

I have the honour to refer to the Treaty between Canada and the United States of America relating to co-operative development of water resources on the Columbia River basin signed at Washington on January 17, 1961, which entered into force on September 16, 1964.

In accordance with Article IV, Paragraph (1) of the Treaty, I have the honour to propose that the Columbia River Treaty hydroelectric operating plans for Canadian storage during the operating years 1969-70 through 1974-75 dated February 15, 1969, agreed to in an agreement signed on June 6, 1969, by H.L. Keenleyside, Chairman, British Columbia Hydro and Power Authority, Canadian Entity, and on June 2, 1969 by H.R. Richmond, Chairman, United States Entity, as amended by an agreement on hydroelectric operating plans for Canadian storage during the operating years 1969-70 through 1974-75 signed on September 30, 1969, by R.G. Williston, Chairman, Canadian Entity, and on September 23, 1969, by H.R. Richmond, Chairman, United States Entity, copies of which plans and agreements are annexed to this Note, be confirmed and made effective by our two Governments within the meaning of Article IV, Paragraph (1) of the Treaty and that the two Entities be empowered and charged to proceed on the basis herein-before stated.

I should be grateful to know whether this proposal rests with the approval of the Government of the United States of America and whether your Government also confirms the operating plans referred to herein in accordance with Article IV, Paragraph (1) of the Treaty.

Accept, Sir, the renewed assurances of my highest consideration.

"M. Cadieux"

M. Cadieux,
Ambassador.

The Honourable William P. Rogers,
Secretary of State,
Washington, D.C.

COLUMBIA RIVER TREATY

AGREEMENT

on

HYDROELECTRIC OPERATING PLANS FOR CANADIAN STORAGE DURING THE OPERATING YEARS 1969-70 THROUGH 1974-75

The Canadian Entity and the United States Entity signed an agreement on 2 June 1969 and 6 June 1969 on "Columbia River Treaty Hydroelectric Operating Plans for Canadian Storage – Operating Years 1969-70 through 1974-75," dated February 15, 1969.

The Canadian Entity and the United States Entity herewith agree to an amendment of "Columbia River Treaty Hydroelectric Operating Plans for Canadian Storage – Operating Years 1969-70 through 1974-75," dated February 15, 1969, by deletion of Footnote 3 attached to the tables included in that document.

"R.G. Williston"

R.G. Williston
Chairman
Canadian Entity

Sept. 30, 1969

(Date signed)

"H.R. Richmond"

H.R. Richmond
Chairman
United States Entity

Sept. 23, 1969

(Date signed)

These footnotes apply to the following tables.

Notes

- 1/ The rule curves for the individual projects totaled to obtain the composite rule curves for Canadian storage consider only usable storage. The actual allowable volume in Mica in terms of storage space below full pool will be calculated in the actual operating year until such time as initial filling is completed.

- 2/ The Upper Rule Curve is based on the assumption of a transfer of two million acre-feet of flood control storage space from Arrow to Mica. This transfer will be determined each year in accordance with draft of Flood Control Plan dated August 12, 1968, and may not be as assumed in the studies. The composite Upper Rule Curves tabulated herein are for the sole purpose of defining the Operating Rule Curves in instances where the Upper Rule Curve provides for greater draft than the Variable Refill Curve. In the system regulation studies, individual Upper Rule Curves for each Canadian Treaty reservoir were used as an upper limit to reservoir storage content. The tabulated values of the composite Upper Rule Curves for the end of May, June, and July were taken from daily system regulation studies rather than from simulated forecasts and Flood Control Storage Reservation diagrams.

COLUMBIA RIVER TREATY

AGREEMENT

on

HYDROELECTRIC OPERATING PLANS FOR CANADIAN STORAGE DURING THE OPERATING YEARS 1969-70 THROUGH 1974-75

The Columbia River Treaty between the United States and Canada requires that hydroelectric operating plans be agreed in advance by the Entities for the operation of the storages provided in the Treaty. The Canadian Entity and the United States Entity herewith agree that the Canadian storages will be operated in accordance with the attached "Columbia River Treaty Hydroelectric Operating Plans for Canadian Storage – Operating Years 1969-70 through 1974-75," dated February 15, 1969.

"H.L. Keenleyside"

H.L. Keenleyside
Chairman
British Columbia Hydro and
Power Authority
Canadian Entity

"H.R. Richmond"

H.R. Richmond
Chairman
United States Entity

6.VI.1969

(Date signed)

June 2, 1969

(Date signed)

February 15, 1969

COLUMBIA RIVER TREATY
HYDROELECTRIC OPERATING PLANS
FOR
CANADIAN STORAGE

Operating Years
1969-70 through 1974-75

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION	53
ASSURED OPERATING PLANS	54
1. General	54
2. Operating Rule Curve	55
(a) Critical Rule Curve	55
(b) Refill Curve	56
(c) Upper Rule Curve	57
(d) Definition of Operating Rule Curve	57
3. Operating Rules	58
4. Implementation	59

TABLE OF CONTENTS (continued)

TABLES

1. Summary Tabulation of Critical Rule Curves
2. Summary Tabulation of Assured Refill Curves
3. Composite Variable Refill Curve for 1969-70; 1970-71;
and 1971-72 Operating Years
4. Composite Variable Refill Curve for 1972-73 Operating Year
5. Composite Variable Refill Curve for 1973-74 and
1974-75 Operating Years
6. Composite Upper Rule Curve for 1969-70; 1970-71;
and 1971-72 Operating Years
7. Composite Upper Rule Curve for 1972-73 Operating Year
8. Composite Upper Rule Curve for 1973-74 Operating Year
9. Composite Upper Rule Curve for 1974-75 Operating Year
10. Composite Operating Rule Curve for 1969-70 Operating Year
11. Composite Operating Rule Curve for 1970-71 Operating Year
12. Composite Operating Rule Curve for 1971-72 Operating Year
13. Composite Operating Rule Curve for 1972-73 Operating Year
14. Composite Operating Rule Curve for 1973-74 Operating Year
15. Composite Operating Rule Curve for 1974-75 Operating Year

CHARTS

1. Illustration of Derivation of Operating Rule Curve

February 15, 1969

COLUMBIA RIVER TREATY
HYDROELECTRIC OPERATING PLANS
FOR
CANADIAN STORAGE

Operating Years
1969-70 through 1974-75

INTRODUCTION

The Treaty between Canada and the United States of America relating to the cooperative development of the water resources of the Columbia River Basin requires that each year a hydroelectric operating plan be agreed by the entities for the operation of the Columbia River Treaty storage in Canada during the sixth succeeding year. This plan will assure the entities of the manner of operation of the Canadian storage five years in advance, and is referred to herein as an Assured Operating Plan. Once adopted the Assured Operating Plans shall remain unchanged.

It is further required that before the first storage becomes operative an Assured Operating Plan be agreed for each year until the total of 15.5 million acre-feet of Canadian storage becomes operative. The initial Canadian storage was declared fully operative on July 31, 1967, and the total 15.5 million acre-feet is to become operative by April 1, 1973. The operations of the Duncan Project in 1967-68 and the Duncan and Arrow projects in 1968-69 were covered by special operating programs agreed by the entities and approved by exchanges of notes between the United States and Canadian governments.

In accordance with the foregoing, these operating plans have been prepared for the six operating years (July 1 through June 30) 1969-70 through 1974-75 to provide for optimum generation in the United States in accordance with paragraph 6 of Annex A of the Treaty.

Immediately prior to each operating year, a Detailed Operating Plan will be prepared based on the Assured Operating Plan. If it is considered advantageous and is agreed by the entities, the Detailed Operating Plan will reflect the latest load, resource, and other pertinent data. The Detailed Operating Plan will serve as a guide for actual operation of the Canadian storage.

ASSURED OPERATING PLANS

1. General

The Assured Operating Plans contained herein are in keeping with requirements of the Treaty, its Annexes and related documents and provide criteria necessary to produce optimum power generation in accordance with established utility practice. They also take into account the initial filling programs for the Canadian storage projects and the flood control operating plans required by the Treaty.

The Assured Operating Plan for each operating year consists of an Operating Rule Curve for the whole of the Canadian storage, to serve as a guide in operation of the storage and a set of operating rules including flood control requirements, to be observed in operation of the Canadian storage.

Characteristics of the individual Canadian storages, their filling programs and their flood control reservoir regulation schedules, as well as system regulation studies, component curves and procedures for developing inflow forecasts and for developing refill curves for the individual Canadian storages from which these Assured Operating Plans have been derived, are in the files of the entities for reference.

2. Operating Rule Curve

The operation of Canadian storage in each operating year shall be guided by an Operating Rule Curve for the whole of Canadian storage. It is designed to realize the optimum usable energy under any streamflow condition, consistent with refilling the reservoirs to protect the system's ability to carry firm loads of the next operating year. The Operating Rule Curve for the whole of the Canadian storage shall be developed from the curves described below. These curves are the sum of similar curves, in terms of storage content, for the individual Canadian storages. The derivation of the Operating Rule Curve is illustrated on Chart 1.

(a) Critical Rule Curve

The Critical Rule Curve gives the end-of-month storage content of Canadian storage during the critical period. It is designed to protect the ability of the system to serve firm load with the occurrence of flows no worse than those during the most adverse historical streamflow period. A summary tabulation of the Critical Rule Curves for the whole of Canadian storage for each of the operating years is included as Table 1.

(b) Refill Curve

The Refill Curve is a guide to operation of Canadian storage which allows the production of the greatest amount of usable energy consistent with refilling, with an acceptable degree of assurance so as to meet the firm loads of the following year. The end of the refill period for the attached plans is considered to be July 31.

(i) Assured Refill Curve

The Assured Refill Curve gives the end-of-month storage content required to assure refill of Canadian storage based on the second-lowest historical volume of inflow for the whole refill period and as each month of the refill period is passed the second-lowest volume for each remaining portion of the refill period. A summary tabulation of the Assured Refill Curves for the whole of Canadian storage for each of the operating years is included as Table 2.

(ii) Variable Refill Curve

The Variable Refill Curve gives end-of-month storage contents for the period January through July required to refill Canadian storage based on forecast inflow volume during the refill period.

In carrying out the studies for the Assured Operating Plan simulated forecasts, such as would have been made at each date with the information then available, were used to establish the Variable Refill Curves. Similar procedures, using actual forecasts, will be used to establish the Variable Refill Curves for each year's operation. Composite Variable Refill Curves

for the whole of Canadian storage for all 30 years of historical record for the operating years 1969-70 through 1974-75 are included as Tables 3 through 5 to illustrate the probable range of these curves.

(c) Upper Rule Curve

The Upper Rule Curve gives the mandatory end-of-month storage content to which each individual Canadian storage shall be evacuated for flood control and other requirements. The Upper Rule Curves used in the studies were developed from the simulated forecasts mentioned above considering the Flood Control Storage Reservation diagrams and any other limitations. Composite Upper Rule Curves for the whole of Canadian storage for all 30 years of historical record for the operating years 1969-70 through 1974-75 are included as Tables 6 through 9 to illustrate the probable range of these curves.

(d) Definition of Operating Rule Curve

Prior to January 1, the Operating Rule Curve will be defined by the Critical Rule Curve or the Assured Refill Curve, whichever is higher. When the duration of the critical period is more than one year, the Critical Rule Curve for the first year of the critical period will be used in the foregoing determination. Beginning January 1, the Operating Rule Curve shall be defined by first determining the higher of the Critical Rule Curve and the Assured Refill Curve; the Operating Rule Curve shall then be the lower of the above-determined value or the Variable Refill Curve. At no time shall the Operating Rule Curve be higher than the Upper Rule Curve. Composite Operating Rule Curves for the whole of Canadian storage for all 30 years of historical record for the operating years 1969-70

through 1974-75 are included as Tables 10 through 15 to illustrate the probable range of these curves.

3. Operating Rules

The following rules applicable to storage operation have been used in the 30-year system regulation studies summarized herein to illustrate the probable range of storage operation.

- (a) The whole of the Canadian storage may be drafted to its Operating Rule Curve as required to produce optimum generation in accordance with Annex A, Paragraph 6, of the Treaty, subject to project characteristics and operating constraints.
- (b) The whole of the Canadian storage will not be drafted below its Operating Rule Curve unless:
 - (i) Reservoir storage in the United States system has been drafted to its Energy Content Curve; and
 - (ii) Deliveries of secondary energy in the United States are discontinued; and
 - (iii) Committed firm thermal and miscellaneous resources not displaced by surplus firm hydro resources are in operation or other replacement energy has been secured from sources other than those committed.
- (c) When the conditions of (b) above are met, and it is necessary to draft additional storage to produce optimum generation as determined by the applicable Critical Period System Regulation study, the whole of the Canadian storage and reservoir storage in the United States System will be drafted proportionately between its Operating Rule Curve or Energy Content Curve, respectively, and its Critical

Rule Curve. If the system has a critical period in excess of one year, then the proportionate draft will be made first to the first Critical Rule Curve, then between the first and second critical Rule Curve, the second and third Critical Rule Curve, et cetera. When it is necessary to operate the whole of the Canadian storage and the United States reservoir storage below their lowest Critical Rule Curves, each shall be operated proportionately between its lowest Critical Rule Curve and its normal minimum content.

- (d) Each Canadian storage reservoir will be operated on or below the storage content defined by its Upper Rule Curve.
- (e) Canadian reservoirs shall be operated to provide the required flood control regulations. In the event there is a conflict between the flood control requirements and the power requirements, the flood control requirements shall govern.

4. Implementation

These operating plans shall be implemented by the entities as required by the Treaty and in accordance with the Principles and Procedures for the Preparation and Use of Hydroelectric Operating Plans for Canadian Treaty Storage dated July 25, 1967, to which the entities have agreed.

These footnotes apply to the following tables.

Notes

- 1/ The rule curves for the individual projects totaled to obtain the composite rule curves for Canadian storage consider only usable storage. The actual allowable volume in Mica in terms of storage space below full pool will be calculated in the actual operating year until such time as initial filling is completed.
- 2/ The Upper Rule Curve is based on the assumption of a transfer of two million acre-feet of flood control storage space from Arrow to Mica. This transfer will be determined each year in accordance with draft of Flood Control Plan dated August 12, 1968, and may not be as assumed in the studies. The composite Upper Rule Curves tabulated herein are for the sole purpose of defining the Operating Rule Curves in instances where the Upper Rule Curve provides for greater draft than the Variable Refill Curve. In the system regulation studies, individual Upper Rule Curves for each Canadian Treaty reservoir were used as an upper limit to reservoir storage content. The tabulated values of the composite Upper Rule Curves for the end of May, June, and July were taken from daily system regulation studies rather than from simulated forecasts and Flood Control Storage Reservation diagrams.
- 3/ The system regulation studies made for this Operating Plan assume the IJC Order for Kootenay Lake will be modified; however, the studies attempted to minimize conflicts with the existing IJC Order and at the same time optimize power and flood control regulation.

COLUMBIA RIVER TREATY
SUMMARY TABULATION OF COMPOSITE CRITICAL RULE CURVES
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1969-70 THROUGH 1974-75 OPERATING YEARS

	1970	1971	1972	1973 1/	1974 1/	1975 1/							
						1ST YR	2ND YR	3RD YR	4TH YR	1ST YR	2ND YR	3RD YR	4TH YR
JULY	4313.7	4313.7	4313.7	4313.7	7814.6	6530.4	4815.8	2579.4	7814.6	6618.6	5031.4	2285.4	
AUG	4211.4	4169.4	4139.5	4213.0	7674.3	6382.0	4803.6	2636.0	7490.5	5970.9	4712.8	1840.9	
SEP	3996.2	4014.6	3659.0	3846.9	6879.0	5093.9	3993.3	2472.5	6742.3	4797.4	3947.1	1609.7	
OCT	3547.2	3583.9	3348.3	3620.6	6493.9	4172.2	3064.1	1886.9	6389.7	3909.3	3049.2	1042.9	
NOV	2612.1	2651.4	2518.2	3091.7	6513.7	3514.2	2631.2	1376.7	6455.8	3288.6	2656.0	708.8	
DEC	1339.6	1400.9	1327.7	2504.6	5612.3	2553.6	1597.4	697.6	5537.1	2399.4	1600.6	98.3	
JAN	0.0	0.0	0.0	2081.3	3412.3	1374.7	1214.5	113.8	3314.5	1177.8	1150.1	65.6	
FEB	0.0	0.0	0.0	1882.4	2612.5	932.9	460.8	0.0	2457.3	695.6	347.0	0.0	
MAR	0.0	0.0	0.0	1226.4	2066.8	825.3	435.8	0.0	1997.8	579.7	322.0	0.0	
APR	0.0	0.0	0.0	229.3	1114.6	860.9	362.9	0.0	1058.9	615.3	286.5	0.0	
MAY	0.0	0.0	0.0	583.0	2576.6	2191.7	1296.7	0.0	2520.6	2117.3	1282.1	0.0	
JUN	0.0	0.0	0.0	1970.8	5555.9	4001.6	2231.7	0.0	5940.8	4219.8	2345.1	0.0	

Table 1

Note: Duncan and Arrow reservoirs are included in operating years 1969-70 through March 1973. Mica is included beginning April 1973.

COLUMBIA RIVER TREATY
SUMMARY TABULATION OF COMPOSITE ASSURED REFILL CURVES
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1969-70, 1970-71, 1971-72 OPERATING YEARS

JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
0.0	0.0	22.7	68.7	81.3	93.8	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1972-73 OPERATING YEAR <u>1</u> /												
JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR *	MAY	JUN	JUL
0.0	0.0	22.7	358.3	479.3	538.0	630.4	696.5	782.2	971.2	3263.2	5780.0	7814.6
1973-74, 1974-75 OPERATING YEARS <u>1</u> /												
JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
0.0	0.0	142.8	358.3	479.3	538.0	630.4	696.5	782.2	971.2	3243.1	5780.0	7814.6

* Initial operation of Mica project in April 1973

Table 2

COLUMBIA RIVER TREATY
COMPOSITE VARIABLE REFILL CURVE
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1969-70, 1970-71, 1971-72 OPERATING YEARS

FLOW
YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	—	—	—	—	—	—	160.1	225.9	348.0	420.7	1748.3	3245.7	4313.7
1929-30	—	—	—	—	—	—	302.2	365.1	367.7	464.1	1836.2	3253.5	4313.7
1930-31	—	—	—	—	—	—	295.3	231.4	288.7	374.4	1744.1	3253.5	4313.7
1931-32	—	—	—	—	—	—	10.5	10.0	35.9	114.4	1499.6	3127.1	4313.7
1932-33	—	—	—	—	—	—	113.6	19.9	46.3	110.1	1553.8	3136.2	4313.7
1933-34	—	—	—	—	—	—	0.0	0.0	38.4	136.4	1605.3	3218.3	4313.7
1934-35	—	—	—	—	—	—	20.4	0.0	0.0	62.6	1421.5	3026.4	4313.7
1935-36	—	—	—	—	—	—	205.4	168.0	161.8	242.8	1642.4	3251.4	4313.7
1936-37	—	—	—	—	—	—	406.4	353.7	269.0	417.3	1670.2	3214.3	4313.7
1937-38	—	—	—	—	—	—	0.0	0.0	0.0	62.6	1374.4	3040.9	4313.7
1938-39	—	—	—	—	—	—	25.8	0.0	39.9	170.3	1614.9	3224.9	4313.7
1939-40	—	—	—	—	—	—	145.8	231.4	247.2	358.7	1720.1	3253.5	4313.7
1940-41	—	—	—	—	—	—	141.3	159.1	236.9	401.1	1809.1	3253.5	4313.7
1941-42	—	—	—	—	—	—	36.1	129.4	257.6	449.3	1819.5	3222.8	4313.7
1942-43	—	—	—	—	—	—	75.2	50.6	93.7	155.9	1553.0	3125.6	4313.7
1943-44	—	—	—	—	—	—	256.3	248.3	312.9	454.1	1801.3	3253.5	4313.7
1944-45	—	—	—	—	—	—	285.0	246.2	245.8	255.6	1607.2	3147.2	4313.7
1945-46	—	—	—	—	—	—	67.3	20.9	0.0	62.6	1443.2	3123.4	4313.7
1946-47	—	—	—	—	—	—	120.1	37.3	53.2	182.2	1577.0	3200.3	4313.7
1947-48	—	—	—	—	—	—	122.6	100.6	41.8	155.0	1498.5	3111.8	4313.7
1948-49	—	—	—	—	—	—	130.4	205.6	101.1	218.0	1609.9	3208.3	4313.7
1949-50	—	—	—	—	—	—	203.5	138.3	138.6	173.1	1548.8	3125.4	4313.7
1950-51	—	—	—	—	—	—	0.0	0.0	0.0	62.6	1390.2	3062.0	4313.7
1951-52	—	—	—	—	—	—	51.5	0.0	0.0	99.6	1505.1	3123.6	4313.7
1952-53	—	—	—	—	—	—	459.7	284.4	302.1	338.1	1655.1	3190.8	4313.7
1953-54	—	—	—	—	—	—	372.8	98.2	47.3	115.4	1478.0	3091.6	4313.7
1954-55	—	—	—	—	—	—	276.1	282.9	276.4	345.3	1597.1	3107.6	4313.7
1955-56	—	—	—	—	—	—	34.7	0.0	0.0	62.6	1424.6	3101.1	4313.7
1956-57	—	—	—	—	—	—	121.6	82.8	0.0	72.9	1489.6	3169.5	4313.7
1957-58	—	—	—	—	—	—	239.0	207.6	177.2	264.2	1587.1	3236.4	4313.7

Note: Based on variable refill curve for the Duncan project and the assured refill curve for the Arrow project.

Table 3

COLUMBIA RIVER TREATY
COMPOSITE VARIABLE REFILL CURVE
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1972-73 OPERATING YEAR 1/

FLOW
YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	-	-	-	-	-	-	1371.5	2192.4	2525.6	2861.0	4530.1	7167.5	7814.6
1929-30	-	-	-	-	-	-	302.2	890.9	367.7	691.2	3154.8	6211.7	7814.6
1930-31	-	-	-	-	-	-	2085.7	2216.6	2464.0	2795.2	4583.3	7493.3	7814.6
1931-32	-	-	-	-	-	-	10.5	10.0	35.9	51.8	3232.7	6212.6	7814.6
1932-33	-	-	-	-	-	-	113.6	19.9	46.3	47.5	1835.5	5779.2	7814.6
1933-34	-	-	-	-	-	-	0.0	0.0	38.4	73.8	856.3	5699.6	7814.6
1934-35	-	-	-	-	-	-	20.4	0.0	0.0	0.0	967.7	5160.8	7814.6
1935-36	-	-	-	-	-	-	788.8	593.3	455.3	577.3	2898.4	7009.8	7814.6
1936-37	-	-	-	-	-	-	2568.6	3090.8	2558.4	3397.8	4750.9	7098.2	7814.6
1937-38	-	-	-	-	-	-	0.0	0.0	0.0	305.1	2500.3	6361.4	7814.6
1938-39	-	-	-	-	-	-	681.3	508.6	145.6	751.7	3253.9	6822.7	7814.6
1939-40	-	-	-	-	-	-	1388.1	2365.9	2310.6	2803.8	4733.3	7101.0	7814.6
1940-41	-	-	-	-	-	-	868.5	1094.8	1586.0	2291.5	4807.6	6960.0	7814.6
1941-42	-	-	-	-	-	-	200.6	1345.5	2036.2	2572.8	4431.8	6763.7	7814.6
1942-43	-	-	-	-	-	-	509.7	899.6	110.1	1406.9	3501.8	6495.6	7814.6
1943-44	-	-	-	-	-	-	2211.8	2530.1	2805.8	3026.2	4720.7	6977.4	7814.6
1944-45	-	-	-	-	-	-	1762.1	1863.9	1750.8	2015.3	3752.5	6922.9	7814.6
1945-46	-	-	-	-	-	-	542.0	20.9	0.0	0.0	1616.5	6087.0	7814.6
1946-47	-	-	-	-	-	-	345.4	100.9	53.2	283.5	2630.2	6496.4	7814.6
1947-48	-	-	-	-	-	-	1144.5	1551.7	485.4	921.6	2407.6	6362.6	7814.6
1948-49	-	-	-	-	-	-	1276.0	2247.5	1419.8	2171.2	4161.4	7146.4	7814.6
1949-50	-	-	-	-	-	-	1361.9	1235.6	885.1	1205.6	3068.9	6269.4	7814.6
1950-51	-	-	-	-	-	-	63.3	0.0	0.0	0.0	1932.5	5887.3	7814.6
1951-52	-	-	-	-	-	-	635.8	381.9	324.8	946.0	3240.8	6787.3	7814.6
1952-53	-	-	-	-	-	-	3660.1	1441.4	1445.2	1906.0	3516.5	6840.6	7814.6
1953-54	-	-	-	-	-	-	1929.5	1022.6	47.3	457.7	2034.2	5841.0	7814.6
1954-55	-	-	-	-	-	-	1293.0	1738.4	1793.1	1895.8	3472.0	6189.6	7814.6
1955-56	-	-	-	-	-	-	34.7	0.0	0.0	0.0	1770.4	6212.4	7814.6
1956-57	-	-	-	-	-	-	121.6	86.3	0.0	126.4	2586.6	7040.4	7814.6
1957-58	-	-	-	-	-	-	1425.4	1221.7	1134.0	1897.3	3821.6	7238.2	7814.6

Table 4

COLUMBIA RIVER TREATY
COMPOSITE VARIABLE REFILL CURVE
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1973-74, 1974-75 OPERATING YEARS 1/

FLOW
YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	-	-	-	-	-	-	1371.5	2192.4	2525.7	2861.0	4530.1	7167.5	7814.6
1929-30	-	-	-	-	-	-	799.7	1017.5	621.6	691.2	3154.8	6211.7	7814.6
1930-31	-	-	-	-	-	-	2085.7	2216.6	2463.9	2795.2	4583.3	7493.3	7814.6
1931-32	-	-	-	-	-	-	440.9	333.6	35.9	51.8	3232.7	6212.6	7814.6
1932-33	-	-	-	-	-	-	309.8	30.0	46.3	47.5	1835.5	5779.2	7814.6
1933-34	-	-	-	-	-	-	0.0	0.0	38.4	73.8	856.3	5699.6	7814.6
1934-35	-	-	-	-	-	-	20.4	0.0	0.0	0.0	967.7	5160.8	7814.6
1935-36	-	-	-	-	-	-	989.1	786.7	1211.1	577.3	2898.4	7009.8	7814.6
1936-37	-	-	-	-	-	-	2568.6	3090.8	2558.4	3397.8	4750.9	7098.2	7814.6
1937-38	-	-	-	-	-	-	0.0	0.0	0.0	305.1	2500.3	6361.4	7814.6
1938-39	-	-	-	-	-	-	681.3	508.6	145.6	751.7	3253.9	6822.7	7814.6
1939-40	-	-	-	-	-	-	1388.1	2365.9	2310.7	2803.8	4733.3	7101.0	7814.6
1940-41	-	-	-	-	-	-	868.5	1094.8	1586.0	2291.5	4807.6	6960.0	7814.6
1941-42	-	-	-	-	-	-	200.6	1345.4	2036.2	2572.8	4431.8	6763.7	7814.6
1942-43	-	-	-	-	-	-	509.7	899.6	1100.0	1406.9	3501.8	6495.6	7814.6
1943-44	-	-	-	-	-	-	2211.8	2530.1	2805.8	3026.2	4720.7	6977.4	7814.6
1944-45	-	-	-	-	-	-	1762.1	1863.9	1750.8	2015.3	3752.5	6922.9	7814.6
1945-46	-	-	-	-	-	-	542.0	20.9	0.0	0.0	1616.5	6087.0	7814.6
1946-47	-	-	-	-	-	-	345.4	100.9	53.2	283.5	2630.2	6496.4	7814.6
1947-48	-	-	-	-	-	-	1144.5	1551.7	485.3	921.6	2407.6	6362.6	7814.6
1948-49	-	-	-	-	-	-	1276.0	2247.5	1419.8	2171.2	4161.4	7146.4	7814.6
1949-50	-	-	-	-	-	-	1361.9	1235.6	885.2	1205.6	3068.9	6269.4	7814.6
1950-51	-	-	-	-	-	-	173.9	0.0	0.0	0.0	1932.5	5887.3	7814.6
1951-52	-	-	-	-	-	-	635.8	381.9	324.8	946.0	3240.8	6787.3	7814.6
1952-53	-	-	-	-	-	-	3660.1	1441.4	1445.2	1906.0	3516.5	6840.6	7814.6
1953-54	-	-	-	-	-	-	1929.5	1022.6	47.3	457.7	2034.2	5841.0	7814.6
1954-55	-	-	-	-	-	-	1293.1	1738.4	1793.1	1895.8	3472.0	6189.6	7814.6
1955-56	-	-	-	-	-	-	34.7	0.0	0.0	0.0	1770.4	6212.4	7814.6
1956-57	-	-	-	-	-	-	121.6	86.3	0.0	126.4	2586.6	7040.4	7814.6
1957-58	-	-	-	-	-	-	1425.4	1221.7	1134.0	1897.3	3821.6	7238.2	7814.6

Table 5

COLUMBIA RIVER TREATY
COMPOSITE UPPER RULE CURVE
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1969-1970, 1970-71, 1971-72 OPERATING YEARS

FLOW
YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	4313.7	4313.7	4313.7	4212.9	4086.8	3557.4	2927.2	2776.0	3456.6	3431.4	3620.5	3809.5	4313.7
1929-30	=	=	=	=	=	=	2539.0	2387.8	1263.5	1228.2	3628.0	3809.5	4313.7
1930-31	=	=	=	=	=	=	3194.5	3330.6	3381.0	3365.9	3587.7	3809.5	4313.7
1931-32	=	=	=	=	=	=	2297.0	1107.2	98.9	98.9	2095.4	3809.5	4313.7
1932-33	=	=	=	=	=	=	2297.0	1107.2	98.9	98.9	2095.4	3607.9	4313.7
1933-34	=	=	=	=	=	=	2297.0	1107.2	98.9	98.9	3325.5	3809.5	4313.7
1934-35	=	=	=	=	=	=	2297.0	1107.2	98.9	98.9	2259.2	3809.5	4313.7
1935-36	=	=	=	=	=	=	3345.7	2498.7	179.5	179.5	2355.0	3809.5	4313.7
1936-37	=	=	=	=	=	=	3497.0	3426.4	2382.7	2892.0	3522.2	3809.5	4313.7
1937-38	=	=	=	=	=	=	2297.0	1107.2	98.9	98.9	1515.6	3809.5	4313.7
1938-39	=	=	=	=	=	=	2297.0	1107.2	98.9	98.9	2357.5	3809.5	4313.7
1939-40	=	=	=	=	=	=	2423.1	2468.5	219.9	351.0	2408.0	3809.5	4313.7
1940-41	=	=	=	=	=	=	2297.0	1208.0	219.9	2967.6	3592.7	3733.9	4313.7
1941-42	=	=	=	=	=	=	2297.0	1107.2	1621.5	2932.3	3597.8	3809.5	4313.7
1942-43	=	=	=	=	=	=	2297.0	1107.2	98.9	98.9	1187.9	3809.5	4313.7
1943-44	=	=	=	=	=	=	3063.4	3295.3	3365.9	3365.9	3587.7	3809.5	4313.7
1944-45	=	=	=	=	=	=	3093.6	2866.7	2166.0	1006.4	1840.8	3809.5	4313.7
1945-46	=	=	=	=	=	=	2297.0	1107.2	98.9	98.9	2155.9	3809.5	4313.7
1946-47	=	=	=	=	=	=	2297.0	1107.2	98.9	124.1	1924.0	3809.5	4313.7
1947-48	=	=	=	=	=	=	2297.0	1107.2	98.9	98.9	2123.1	3809.5	4313.7
1948-49	=	=	=	=	=	=	2297.0	1208.0	98.9	103.9	2902.0	3809.5	4313.7
1949-50	=	=	=	=	=	=	2297.0	1107.2	98.9	98.9	1200.5	3577.6	4313.7
1950-51	=	=	=	=	=	=	2297.0	1107.2	98.9	98.9	2609.5	3809.5	4314.7
1952-52	=	=	=	=	=	=	2297.0	1107.2	98.9	98.9	3050.8	3809.5	4313.7
1952-53	=	=	=	=	=	=	3481.8	1218.1	179.5	179.5	1261.0	3809.5	4313.7
1953-54	=	=	=	=	=	=	2357.5	1107.2	98.9	98.9	2599.5	3809.5	4313.7
1954-55	=	=	=	=	=	=	2639.9	2881.9	2478.5	1203.0	1936.6	3683.5	4313.7
1955-56	=	=	=	=	=	=	2297.0	1107.2	98.9	98.9	1956.7	3809.5	4313.7
1956-57	=	=	=	=	=	=	2297.0	1107.2	98.9	109.0	3249.9	3809.5	4313.7
1957-58	=	=	=	=	=	=	2337.4	1177.8	129.1	129.1	2483.6	3809.5	4313.7

TABLE 6

COLUMBIA RIVER TREATY
COMPOSITE UPPER RULE CURVE
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1972-73 OPERATING YEAR 1/ 2/

FLOW
YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	4313.7	4313.7	4313.7	4313.7	4313.7	3557.4	3078.5	3179.3	3456.6	6932.3	7121.4	7814.6	7814.6
1929-30	"	"	"	"	"	"	2841.5	2791.1	1994.5	6644.9	7128.9	7814.6	7814.6
1930-31	"	"	"	"	"	"	3295.3	3330.6	3381.0	6866.8	7088.6	7814.6	7814.6
1931-32	"	"	"	"	"	"	2650.0	1813.0	1107.2	4608.1	5596.3	7814.6	7814.6
1932-33	"	"	"	"	"	"	2650.0	1813.0	1107.2	4608.1	5596.3	7612.9	7814.6
1933-34	"	"	"	"	"	"	2650.0	880.3	880.3	5087.0	6826.4	7814.6	7814.6
1934-35	"	"	"	"	"	"	2650.0	1813.0	1107.2	4608.1	5740.1	7814.6	7814.6
1935-36	"	"	"	"	"	"	3396.1	2397.9	1187.9	4688.8	5855.9	7814.6	7814.6
1936-37	"	"	"	"	"	"	3497.0	3426.4	2886.9	6846.6	7023.0	7814.6	7814.6
1937-38	"	"	"	"	"	"	2650.0	1813.0	1107.2	4608.1	5016.5	7814.6	7814.6
1938-39	"	"	"	"	"	"	2650.0	1813.0	1107.2	4608.1	5858.4	7814.6	7814.6
1939-40	"	"	"	"	"	"	2700.4	2771.0	1228.2	4759.3	5908.8	7814.6	7814.6
1940-41	"	"	"	"	"	"	2650.0	1913.9	1228.2	6871.8	7093.6	7739.0	7814.6
1941-42	"	"	"	"	"	"	2650.0	1813.0	1218.1	6735.7	7098.7	7814.6	7814.6
1942-43	"	"	"	"	"	"	2650.0	1813.0	1107.2	4608.1	4688.8	7814.6	7814.6
1943-44	"	"	"	"	"	"	3164.2	3295.3	3365.9	6866.8	7088.6	7562.5	7814.6
1944-45	"	"	"	"	"	"	3194.5	3018.0	2771.0	5263.5	5341.6	7814.6	7814.6
1945-46	"	"	"	"	"	"	2650.0	1813.0	1107.2	4608.1	5656.8	7814.6	7814.6
1946-47	"	"	"	"	"	"	2650.0	1813.0	1107.2	4633.3	5424.8	7814.6	7814.6
1947-48	"	"	"	"	"	"	2650.0	1813.0	1107.2	4608.1	5624.0	7814.6	7814.6
1948-49	"	"	"	"	"	"	2650.0	1913.9	1107.2	4613.1	6402.9	7814.6	7814.6
1949-50	"	"	"	"	"	"	2650.0	1813.0	1107.2	4608.1	4701.4	7078.5	7814.6
1950-51	"	"	"	"	"	"	2650.0	880.3	.5	3501.4	6110.5	7814.6	7814.6
1951-52	"	"	"	"	"	"	2650.0	880.3	880.3	4381.2	6551.6	7814.6	7814.6
1952-53	"	"	"	"	"	"	3481.8	1924.0	1187.9	4688.8	4761.9	7814.6	7814.6
1953-54	"	"	"	"	"	"	2710.5	1813.0	1107.2	4608.1	6100.4	7814.6	7814.6
1954-55	"	"	"	"	"	"	2942.4	3134.0	2932.3	5409.7	5437.4	7688.5	7814.6
1955-56	"	"	"	"	"	"	2650.0	880.3	.5	3501.4	5457.6	7310.4	7814.6
1956-57	"	"	"	"	"	"	2650.0	1813.0	1107.2	4618.2	6750.8	7814.6	7814.6
1957-58	"	"	"	"	"	"	2690.3	1883.6	1137.5	4638.3	5984.5	7814.6	7814.6

TABLE 7

COLUMBIA RIVER TREATY
COMPOSITE UPPER RULE CURVE
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1973-74 OPERATING YEAR 1/ 2/

FLOW
YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	7814.6	7814.6	7814.6	7814.6	7814.6	7058.3	6579.4	6680.2	6957.5	6932.3	7121.4	7814.6	7814.6
1929-30	"	"	"	"	"	"	6342.4	6292.0	5495.4	6644.9	7128.9	7814.6	7814.6
1930-31	"	"	"	"	"	"	6796.2	6831.5	6881.9	6866.8	7088.6	7814.6	7814.6
1931-32	"	"	"	"	"	"	6150.8	5313.9	4608.1	4608.1	5596.3	7814.6	7814.6
1932-33	"	"	"	"	"	"	6150.8	5313.9	4608.1	4608.1	5596.3	7612.9	7814.6
1933-34	"	"	"	"	"	"	6150.8	4381.2	4381.2	5087.0	6826.4	7814.6	7814.6
1934-35	"	"	"	"	"	"	6150.8	5313.9	4608.1	4608.1	5760.1	7814.6	7814.6
1935-36	"	"	"	"	"	"	6897.0	5898.8	4688.8	4688.8	5855.9	7814.6	7814.6
1936-37	"	"	"	"	"	"	6997.8	6927.3	6387.8	6846.6	7023.0	7814.6	7814.6
1937-38	"	"	"	"	"	"	6150.8	5313.9	4608.1	4608.1	5016.5	7814.6	7814.6
1938-39	"	"	"	"	"	"	6150.8	5313.9	4608.1	4608.1	5858.4	7814.6	7814.6
1939-40	"	"	"	"	"	"	6201.3	6271.8	4729.1	4759.3	5908.8	7814.6	7814.6
1940-41	"	"	"	"	"	"	6150.8	5414.8	4729.1	6871.8	7093.6	7739.0	7814.6
1941-42	"	"	"	"	"	"	6150.8	5313.9	4719.0	6735.7	7098.7	7814.6	7814.6
1942-43	"	"	"	"	"	"	6150.8	5313.9	4608.1	4608.1	4688.8	7814.6	7814.6
1943-44	"	"	"	"	"	"	6665.1	6796.2	6866.8	6866.8	7088.6	7562.5	7814.6
1944-45	"	"	"	"	"	"	6695.3	6518.9	6271.8	5263.5	5341.6	7814.6	7814.6
1945-46	"	"	"	"	"	"	6150.8	5313.9	4608.1	4608.1	5656.8	7814.6	7814.6
1946-47	"	"	"	"	"	"	6150.8	5313.9	4608.1	4633.3	5424.8	7814.6	7814.6
1947-48	"	"	"	"	"	"	6150.8	5313.9	4608.1	4608.1	5624.0	7814.6	7814.6
1948-49	"	"	"	"	"	"	6150.8	5414.8	4608.1	4613.1	6402.9	7814.6	7814.6
1949-50	"	"	"	"	"	"	6150.8	5313.9	4608.1	4608.1	4701.4	7078.5	7814.6
1950-51	"	"	"	"	"	"	6150.8	4381.2	3501.4	3501.4	6110.5	7814.6	7814.6
1951-52	"	"	"	"	"	"	6150.8	4381.2	4381.2	4381.2	6551.6	7814.6	7814.6
1952-53	"	"	"	"	"	"	6982.7	5424.8	4688.8	4688.8	4761.9	7814.6	7814.6
1953-54	"	"	"	"	"	"	6211.3	5313.9	4608.1	4608.1	6100.4	7814.6	7814.6
1954-55	"	"	"	"	"	"	6443.3	6634.8	6433.2	5409.7	5437.4	7688.5	7814.6
1955-56	"	"	"	"	"	"	6150.8	4381.2	3501.4	3501.4	5457.6	7310.4	7814.6
1956-57	"	"	"	"	"	"	6150.8	5313.9	4608.1	4618.2	6750.8	7814.6	7814.6
1957-58	"	"	"	"	"	"	6191.2	5384.5	4638.3	4638.3	5984.5	7814.6	7814.6

TABLE 8

COLUMBIA RIVER TREATY
COMPOSITE UPPER RULE CURVE
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1974-75 OPERATING YEAR 1/ 2/

FLOW
YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	7814.6	7814.6	7814.6	7814.6	7814.6	7058.3	6579.4	6680.2	6957.5	6932.3	7121.4	7814.6	7814.6
1929-30	=	=	=	=	=	=	6342.4	6292.0	5495.4	6644.9	7128.9	7814.6	7814.6
1930-31	=	=	=	=	=	=	6796.2	6831.5	6881.9	6866.8	7088.6	7814.6	7814.6
1931-32	=	=	=	=	=	=	6150.8	5313.9	4608.1	4608.1	5596.3	7814.6	7814.6
1932-33	=	=	=	=	=	=	6150.8	5313.9	4608.1	4608.1	5596.3	7612.9	7814.6
1933-34	=	=	=	=	=	=	6150.8	4381.2	4381.2	5087.0	6826.4	7814.6	7814.6
1934-35	=	=	=	=	=	=	6150.8	5313.9	4608.1	4608.1	5760.1	7814.6	7814.6
1935-36	=	=	=	=	=	=	6897.0	5898.8	4688.8	4688.8	5855.9	7814.6	7814.6
1936-37	=	=	=	=	=	=	6997.8	6927.3	6387.8	6846.6	7023.0	7814.6	7814.6
1937-38	=	=	=	=	=	=	6150.8	5313.9	4608.1	4608.1	5016.5	7814.6	7814.6
1938-39	=	=	=	=	=	=	6150.8	5313.9	4608.1	4608.1	5858.4	7814.6	7814.6
1939-40	=	=	=	=	=	=	6201.3	6271.8	4729.1	4759.3	5908.8	7814.6	7814.6
1940-41	=	=	=	=	=	=	6150.8	5414.8	4729.1	6871.8	7093.6	7739.0	7814.6
1941-42	=	=	=	=	=	=	6150.8	5313.9	4719.0	6735.7	7098.7	7814.6	7814.6
1942-43	=	=	=	=	=	=	6150.8	5313.9	4608.1	4608.1	4688.8	7814.6	7814.6
1943-44	=	=	=	=	=	=	6665.1	6796.2	6866.8	6866.8	7088.6	7562.5	7814.6
1944-45	=	=	=	=	=	=	6695.3	6518.9	6271.8	5263.5	5341.6	7814.6	7814.6
1945-46	=	=	=	=	=	=	6150.8	5313.9	4608.1	4608.1	5656.8	7814.6	7814.6
1946-47	=	=	=	=	=	=	6150.8	5313.9	4608.1	4633.3	5424.8	7814.6	7814.6
1947-48	=	=	=	=	=	=	6150.8	5313.9	4608.1	4608.1	5624.0	7814.7	7814.6
1948-49	=	=	=	=	=	=	6150.8	5414.8	4608.1	4613.1	6402.9	7814.6	7814.6
1949-50	=	=	=	=	=	=	6150.8	5313.9	4608.1	4608.1	4701.4	7078.5	7814.6
1950-51	=	=	=	=	=	=	6150.8	4381.2	3052.3	2497.7	5863.1	7814.6	7814.6
1951-52	=	=	=	=	=	=	6150.8	4381.2	4381.2	4381.2	6551.6	7814.6	7814.6
1952-53	=	=	=	=	=	=	6982.7	5424.8	4688.8	4688.8	4761.9	7814.6	7814.6
1953-54	=	=	=	=	=	=	6211.3	5313.9	4608.1	4608.1	6100.4	7814.6	7814.6
1954-55	=	=	=	=	=	=	6443.3	6634.8	6433.2	5409.7	5437.4	7688.5	7814.6
1955-56	=	=	=	=	=	=	6150.8	4381.2	3052.3	2497.7	5457.6	7310.4	7814.6
1956-57	=	=	=	=	=	=	6150.8	5313.9	4608.1	4618.2	6750.8	7814.6	7814.6
1957-58	=	=	=	=	=	=	6191.2	5384.5	4638.3	4638.3	5984.5	7814.6	7814.6

TABLE 9

COLUMBIA RIVER TREATY
COMPOSITE OPERATING RULE CURVE FOR 1969-70 OPERATING YEAR
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD

FLOW YEAR	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	4313.7	4211.4	3996.2	3547.2	2612.1	1339.6	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1929-30	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1930-31	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1931-32	=	=	=	=	=	=	10.5	10.0	35.9	74.6	1499.6	3071.5	4313.7
1932-33	=	=	=	=	=	=	102.6	19.9	46.3	70.2	1502.3	3051.8	4313.7
1933-34	=	=	=	=	=	=	0.0	0.0	38.4	96.5	1472.1	3071.5	4313.7
1934-35	=	=	=	=	=	=	20.4	0.0	0.0	22.7	1414.1	3026.4	4313.7
1935-36	=	=	=	=	=	=	102.6	108.7	117.8	179.5	1509.9	3071.5	4313.7
1936-37	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1937-38	=	=	=	=	=	=	0.0	0.0	0.0	22.7	1374.4	3040.9	4313.7
1938-39	=	=	=	=	=	=	25.8	0.0	39.9	98.9	1512.4	3071.5	4313.7
1939-40	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1940-41	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1941-42	=	=	=	=	=	=	36.1	76.1	117.8	224.2	1561.0	3071.5	4313.7
1942-43	=	=	=	=	=	=	75.2	50.6	76.1	98.9	1187.9	3071.5	4313.7
1943-44	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1944-45	=	=	=	=	=	=	102.6	108.7	117.8	189.2	1449.4	3071.5	4313.7
1945-46	=	=	=	=	=	=	67.3	20.9	0.0	22.7	1443.2	3071.5	4313.7
1946-47	=	=	=	=	=	=	102.6	37.3	53.2	124.1	1561.0	3071.5	4313.6
1947-48	=	=	=	=	=	=	102.6	76.1	41.8	98.9	1498.5	3071.5	4313.7
1948-49	=	=	=	=	=	=	102.6	108.7	76.1	103.9	1552.7	3071.5	4313.7
1949-50	=	=	=	=	=	=	102.6	76.1	76.1	98.9	1200.5	3021.6	4313.7
1950-51	=	=	=	=	=	=	0.0	0.0	0.0	22.7	1390.2	3062.0	4313.7
1951-52	=	=	=	=	=	=	51.5	0.0	0.0	59.7	1449.4	3071.5	4313.7
1952-53	=	=	=	=	=	=	102.6	108.7	117.8	179.5	1261.0	3071.5	4313.7
1953-54	=	=	=	=	=	=	102.6	76.1	47.3	75.5	1478.0	3071.5	4313.7
1954-55	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1444.3	3071.5	4313.7
1955-56	=	=	=	=	=	=	34.7	0.0	0.0	22.7	1424.6	3071.5	4313.7
1956-57	=	=	=	=	=	=	102.6	76.1	0.0	33.0	1489.6	3071.5	4313.7
1957-58	=	=	=	=	=	=	102.6	108.7	106.4	129.1	1561.0	3071.5	4313.7

Table 10

COLUMBIA RIVER TREATY
COMPOSITE OPERATING RULE CURVE FOR 1970-71 OPERATING YEAR
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD

FLOW
YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	4313.7	4169.4	4014.6	3583.9	2651.4	1400.9	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1929-30	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1930-31	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1931-32	=	=	=	=	=	=	10.5	10.0	35.9	74.6	1499.6	3071.5	4313.7
1932-33	=	=	=	=	=	=	102.6	19.9	46.3	70.2	1502.3	3051.8	4313.7
1933-34	=	=	=	=	=	=	0.0	0.0	38.4	96.5	1472.1	3071.5	4313.7
1934-35	=	=	=	=	=	=	20.4	0.0	0.0	22.7	1414.1	3026.4	4313.7
1935-36	=	=	=	=	=	=	102.6	108.7	117.8	179.5	1509.9	3071.5	4313.7
1936-37	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1937-38	=	=	=	=	=	=	0.0	0.0	0.0	22.7	1374.4	3040.9	4313.7
1938-39	=	=	=	=	=	=	25.8	0.0	39.9	98.9	1512.4	3071.5	4313.7
1939-40	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1940-41	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1941-42	=	=	=	=	=	=	36.1	76.1	117.8	224.2	1561.0	3071.5	4313.7
1942-43	=	=	=	=	=	=	75.2	50.6	76.1	98.9	1187.9	3071.5	4313.7
1943-44	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1944-45	=	=	=	=	=	=	102.6	108.7	117.8	189.2	1449.4	3071.5	4313.7
1945-46	=	=	=	=	=	=	67.3	20.9	0.0	22.7	1443.2	3071.5	4313.7
1946-47	=	=	=	=	=	=	102.6	37.3	53.2	124.1	1561.0	3071.5	4313.7
1947-48	=	=	=	=	=	=	102.6	76.1	41.8	98.9	1498.5	3071.5	4313.7
1948-49	=	=	=	=	=	=	102.6	108.7	76.1	103.9	1552.7	3071.5	4313.7
1949-50	=	=	=	=	=	=	102.6	76.1	76.1	98.9	1220.5	3021.6	4313.7
1950-51	=	=	=	=	=	=	0.0	0.0	0.0	22.7	1390.2	3062.0	4313.7
1951-52	=	=	=	=	=	=	51.5	0.0	0.0	59.7	1449.4	3071.5	4313.7
1952-53	=	=	=	=	=	=	102.6	108.7	117.8	179.5	1261.0	3071.5	4313.7
1953-54	=	=	=	=	=	=	102.6	76.1	47.3	75.5	1478.0	3071.5	4313.7
1954-55	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1444.3	3071.5	4313.7
1955-56	=	=	=	=	=	=	34.7	0.0	0.0	22.7	1424.6	3071.5	4313.7
1956-57	=	=	=	=	=	=	102.6	76.1	0.0	33.0	1489.6	3071.5	4313.7
1957-58	=	=	=	=	=	=	102.6	108.7	106.4	129.1	1561.0	3071.5	4313.7

TABLE 11

COLUMBIA RIVER TREATY
COMPOSITE OPERATING RULE CURVE FOR 1971-72 OPERATING YEAR
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD

FLOW
YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	4313.7	4139.5	3659.0	3348.3	2518.2	1327.7	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1929-30	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1930-31	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1931-32	=	=	=	=	=	=	10.5	10.0	35.9	74.6	1499.6	3071.5	4313.7
1932-33	=	=	=	=	=	=	102.6	19.9	46.3	70.2	1502.3	3051.8	4313.7
1933-34	=	=	=	=	=	=	0.0	0.0	38.4	96.5	1472.1	3071.5	4313.7
1934-35	=	=	=	=	=	=	20.4	0.0	0.0	22.7	1414.1	3026.4	4313.7
1935-36	=	=	=	=	=	=	102.6	108.7	117.8	179.5	1509.9	3071.5	4313.7
1936-37	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1937-38	=	=	=	=	=	=	0.0	0.0	0.0	22.7	1374.4	3040.9	4313.7
1938-39	=	=	=	=	=	=	25.8	0.0	39.9	98.9	1512.4	3071.5	4313.7
1939-40	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1940-41	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1941-42	=	=	=	=	=	=	36.1	76.1	117.8	224.2	1561.0	3071.5	4313.7
1942-43	=	=	=	=	=	=	75.2	50.6	76.1	98.9	1187.9	3071.5	4313.7
1943-44	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1561.0	3071.5	4313.7
1944-45	=	=	=	=	=	=	102.6	108.7	117.8	189.2	1449.4	3071.5	4313.7
1945-46	=	=	=	=	=	=	67.3	20.9	0.0	22.7	1443.2	3071.5	4313.7
1946-47	=	=	=	=	=	=	102.6	37.3	53.2	124.1	1561.0	3071.5	4313.7
1947-48	=	=	=	=	=	=	102.6	76.1	41.8	98.9	1498.5	3071.5	4313.7
1948-49	=	=	=	=	=	=	102.6	108.7	76.1	103.9	1552.7	3071.5	4313.7
1949-50	=	=	=	=	=	=	102.6	76.1	76.1	98.9	1200.5	3021.6	4313.7
1950-51	=	=	=	=	=	=	0.0	0.0	0.0	22.7	1390.2	3062.0	4313.7
1951-52	=	=	=	=	=	=	51.5	0.0	0.0	59.7	1449.4	3071.5	4313.7
1952-53	=	=	=	=	=	=	102.6	108.7	117.8	179.5	1261.0	3071.5	4313.7
1953-54	=	=	=	=	=	=	102.6	76.1	47.3	75.5	1478.0	3071.5	4313.7
1954-55	=	=	=	=	=	=	102.6	108.7	117.8	224.2	1444.3	3071.5	4313.7
1955-56	=	=	=	=	=	=	34.7	0.0	0.0	22.7	1424.6	3071.5	4313.7
1956-57	=	=	=	=	=	=	102.6	76.1	0.0	33.0	1489.6	3071.5	4313.7
1957-58	=	=	=	=	=	=	102.6	108.7	106.4	129.1	1561.0	3071.5	4313.7

TABLE 12

COLUMBIA RIVER TREATY
COMPOSITE OPERATING RULE CURVE FOR 1972-73 OPERATING YEAR 1/
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD

FLOW YEAR	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	4313.7	4213.0	3846.9	3620.6	3091.7	2504.6	1371.5	1882.4	1226.4	971.2	3243.2	5780.0	7814.6
1929-30	"	"	"	"	"	"	232.4	722.9	197.1	451.3	2832.8	5780.0	7814.6
1930-31	"	"	"	"	"	"	2022.9	1882.4	1226.4	971.2	3243.2	5780.0	7814.6
1931-32	"	"	"	"	"	"	10.5	10.0	35.9	51.8	2620.6	5740.9	7814.6
1932-33	"	"	"	"	"	"	113.6	19.9	46.3	47.5	1784.0	5694.9	7814.6
1933-34	"	"	"	"	"	"	0.0	0.0	.5	.5	723.1	5552.7	7814.6
1934-35	"	"	"	"	"	"	20.4	0.0	0.0	0.0	960.3	5160.8	7814.6
1935-36	"	"	"	"	"	"	788.8	582.1	450.3	554.0	2709.4	5780.0	7814.6
1936-37	"	"	"	"	"	"	2081.3	1882.4	1226.4	971.2	3243.2	5780.0	7814.6
1937-38	"	"	"	"	"	"	0.0	0.0	0.0	305.1	1807.2	5592.6	7814.6
1938-39	"	"	"	"	"	"	681.3	508.6	145.6	405.2	2837.7	5780.0	7814.6
1939-40	"	"	"	"	"	"	1388.1	1862.2	1226.4	971.2	3243.2	5780.0	7814.6
1940-41	"	"	"	"	"	"	868.5	1094.8	1226.4	737.2	3243.2	5780.0	7814.6
1941-42	"	"	"	"	"	"	200.6	1292.2	1216.4	965.1	3243.2	5780.0	7814.6
1942-43	"	"	"	"	"	"	509.7	899.6	1082.5	503.0	2131.2	5780.0	7814.6
1943-44	"	"	"	"	"	"	2081.3	1882.4	1226.4	971.2	3243.2	5780.0	7814.6
1944-45	"	"	"	"	"	"	1709.5	1814.7	1226.4	936.2	2949.9	5780.0	7814.6
1945-46	"	"	"	"	"	"	542.0	20.9	0.0	0.0	1616.5	5706.7	7814.6
1946-47	"	"	"	"	"	"	345.4	100.9	53.2	265.3	2607.9	5780.0	7814.6
1947-48	"	"	"	"	"	"	1144.5	1527.2	485.4	670.9	2407.6	5780.0	7814.6
1948-49	"	"	"	"	"	"	1276.0	1862.2	1105.4	890.8	3234.9	5780.0	7814.6
1949-50	"	"	"	"	"	"	1361.9	1173.4	822.6	649.8	2115.1	5699.0	7814.6
1950-51	"	"	"	"	"	"	63.3	0.0	0.0	0.0	1932.5	5600.4	7814.6
1951-52	"	"	"	"	"	"	635.8	381.9	324.8	494.1	3009.7	5780.0	7814.6
1952-53	"	"	"	"	"	"	2081.3	1344.0	1186.1	966.4	2364.3	5780.0	7814.6
1953-54	"	"	"	"	"	"	1789.1	1000.5	47.3	381.9	2034.2	5565.9	7814.6
1954-55	"	"	"	"	"	"	1249.4	1642.6	1216.4	971.2	3045.7	5757.0	7814.6
1955-56	"	"	"	"	"	"	34.7	0.0	0.0	0.0	1770.4	5780.0	7814.6
1956-57	"	"	"	"	"	"	121.6	79.7	0.0	126.4	2586.6	5780.0	7814.6
1957-58	"	"	"	"	"	"	1418.8	1160.8	1063.2	875.4	3243.2	5780.0	7814.6

TABLE 13

COLUMBIA RIVER TREATY
COMPOSITE OPERATING RULE CURVE FOR 1973-74 OPERATING YEAR 1/
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD

FLOW
YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	7814.6	7674.3	6879.0	6493.9	6513.7	5612.3	1371.5	2166.5	1977.5	1360.5	3243.1	5780.0	7814.6
1929-30	=	=	=	=	=	=	697.5	852.4	457.3	451.3	2832.7	5780.0	7814.6
1930-31	=	=	=	=	=	=	1990.5	2185.2	1962.7	1360.5	3243.1	5780.0	7814.6
1931-32	=	=	=	=	=	=	440.9	333.6	35.9	51.8	2620.6	5740.9	7814.6
1932-33	=	=	=	=	=	=	309.8	30.0	46.3	47.5	1784.0	5694.9	7814.6
1933-34	=	=	=	=	=	=	0.0	0.0	.5	.5	723.1	5552.7	7814.6
1934-35	=	=	=	=	=	=	20.4	0.0	0.0	0.0	960.3	5160.8	7814.6
1935-36	=	=	=	=	=	=	983.6	775.5	1090.1	554.0	2709.3	5780.0	7814.6
1936-37	=	=	=	=	=	=	1875.6	2007.9	1793.9	1360.5	3243.1	5780.0	7814.6
1937-38	=	=	=	=	=	=	0.0	0.0	0.0	305.1	1807.2	5592.6	7814.6
1938-39	=	=	=	=	=	=	681.3	508.6	145.6	720.2	2837.7	5780.0	7814.6
1939-40	=	=	=	=	=	=	1308.4	1585.8	1597.1	1360.5	3243.1	5780.0	7814.6
1940-41	=	=	=	=	=	=	868.5	1059.1	1269.9	1126.5	3243.1	5780.0	7814.6
1941-42	=	=	=	=	=	=	200.6	1148.1	1558.4	1354.4	3263.1	5780.0	7814.6
1942-43	=	=	=	=	=	=	509.7	899.6	1059.6	892.3	2131.2	5780.0	7814.6
1943-44	=	=	=	=	=	=	1815.9	1738.1	1873.3	1360.5	3243.1	5780.0	7814.6
1944-45	=	=	=	=	=	=	1677.1	1817.7	1708.5	1325.5	2949.8	5780.0	7814.6
1945-46	=	=	=	=	=	=	542.0	20.9	0.0	0.0	1616.5	5706.7	7814.6
1946-47	=	=	=	=	=	=	345.4	100.9	53.2	265.3	2607.9	5780.0	7814.6
1947-48	=	=	=	=	=	=	1144.5	1527.2	485.3	905.4	2407.6	5780.0	7814.6
1948-49	=	=	=	=	=	=	1276.0	1876.0	1394.8	1280.1	3234.8	5780.0	7814.6
1949-50	=	=	=	=	=	=	1358.4	1173.4	822.6	1039.1	2115.1	5699.0	7814.6
1950-51	=	=	=	=	=	=	173.9	0.0	0.0	0.0	1932.5	5600.4	7814.6
1951-52	=	=	=	=	=	=	635.8	381.9	324.8	883.4	3009.7	5780.0	7814.6
1952-53	=	=	=	=	=	=	2784.7	1344.0	1299.9	1355.7	2364.3	5780.0	7814.6
1953-54	=	=	=	=	=	=	1756.7	1000.5	47.3	457.7	2034.2	5565.9	7814.6
1954-55	=	=	=	=	=	=	1217.0	1642.6	1703.8	1360.5	3045.6	5757.0	7814.6
1955-56	=	=	=	=	=	=	34.7	0.0	0.0	0.0	1770.4	5780.0	7814.6
1956-57	=	=	=	=	=	=	121.6	79.7	0.0	126.4	2586.6	5780.0	7814.6
1957-58	=	=	=	=	=	=	1386.4	1160.8	1063.2	1264.7	3243.1	5780.0	7814.6

TABLE 14

COLUMBIA RIVER TREATY
COMPOSITE OPERATING RULE CURVE FOR 1974-75 OPERATING YEAR 1/
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD

FLOW
YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	7814.6	7490.5	6742.3	6389.7	6455.8	5537.1	1371.5	2166.5	1938.6	1304.8	3243.1	6105.0	7814.6
1929-30	"	"	"	"	"	"	697.5	852.4	453.9	451.3	2832.7	5934.2	7814.6
1930-31	"	"	"	"	"	"	1990.5	2185.2	1923.7	1304.8	3243.1	6105.0	7814.6
1931-32	"	"	"	"	"	"	440.9	333.6	35.9	51.8	2620.6	6065.9	7814.6
1932-33	"	"	"	"	"	"	309.8	30.0	46.3	47.5	1784.0	5694.9	7814.6
1933-34	"	"	"	"	"	"	0.0	0.0	.5	.5	723.1	5552.7	7814.6
1934-35	"	"	"	"	"	"	20.4	0.0	0.0	0.0	960.3	5160.8	7814.6
1935-36	"	"	"	"	"	"	983.6	775.5	1054.6	554.0	2709.3	6105.0	7814.6
1936-37	"	"	"	"	"	"	1875.6	2007.9	1760.4	1304.8	3243.1	6105.0	7814.6
1937-38	"	"	"	"	"	"	0.0	0.0	0.0	305.1	1807.2	5917.6	7814.6
1938-39	"	"	"	"	"	"	681.3	508.6	145.6	720.2	2837.7	6105.0	7814.6
1939-40	"	"	"	"	"	"	1308.4	1585.8	1567.1	1304.8	3243.1	6105.0	7814.6
1940-41	"	"	"	"	"	"	868.5	1059.1	1239.9	1070.7	3243.1	6105.0	7814.6
1941-42	"	"	"	"	"	"	200.6	1148.1	1528.4	1298.7	3243.1	6105.0	7814.6
1942-43	"	"	"	"	"	"	509.7	899.6	1029.6	836.6	2131.2	6105.0	7814.6
1943-44	"	"	"	"	"	"	1815.9	1738.1	1839.9	1304.8	3243.1	6105.0	7814.6
1944-45	"	"	"	"	"	"	1677.1	1817.7	1705.0	1269.7	2949.8	6105.0	7814.6
1945-46	"	"	"	"	"	"	542.0	20.9	0.0	0.0	1616.5	6031.6	7814.6
1946-47	"	"	"	"	"	"	345.4	100.9	53.2	265.3	2607.9	6105.0	7814.6
1947-48	"	"	"	"	"	"	1144.5	1527.2	485.3	905.4	2407.6	6105.0	7814.6
1948-49	"	"	"	"	"	"	1276.0	1976.0	1394.8	1224.4	3234.8	6105.0	7814.6
1949-50	"	"	"	"	"	"	1358.4	1173.4	822.6	983.4	2115.1	5963.6	7814.6
1950-51	"	"	"	"	"	"	173.9	0.0	0.0	0.0	1932.5	5887.3	7814.6
1951-52	"	"	"	"	"	"	635.8	381.9	324.8	827.6	3009.7	6105.0	7814.6
1952-53	"	"	"	"	"	"	2784.7	1344.0	1299.9	1300.0	2364.3	6105.0	7814.6
1953-54	"	"	"	"	"	"	1756.7	1000.5	47.3	457.7	2034.2	5820.9	7814.6
1954-55	"	"	"	"	"	"	1217.0	1642.6	1703.8	1304.8	3045.6	6082.0	7814.6
1955-56	"	"	"	"	"	"	34.7	0.0	0.0	0.0	1770.4	6044.6	7814.6
1956-57	"	"	"	"	"	"	121.6	79.7	0.0	126.4	2586.6	6105.0	7814.6
1957-58	"	"	"	"	"	"	1386.4	1160.8	1063.2	1208.9	3243.1	6105.0	7814.6

TABLE 15

ILLUSTRATION OF DERIVATION OF
OPERATING RULE CURVE
FOR THE WHOLE OF CANADIAN TREATY STORAGE

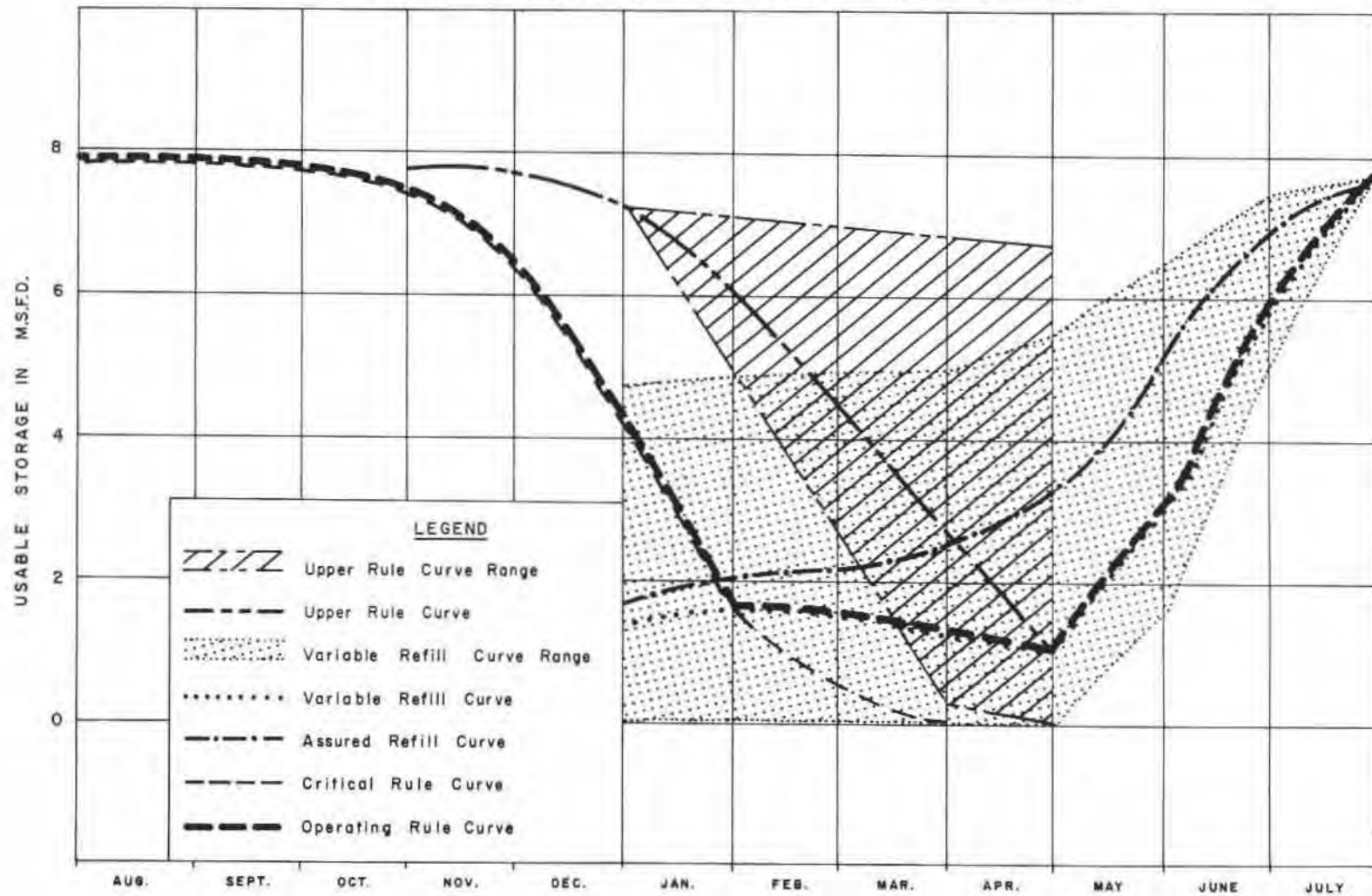


CHART 1

Washington, D.C.
March 30, 1970

Excellency:

I have the honor to refer to your Note No. 54, dated February 21, 1970, together with the attachments thereto regarding the hydroelectric operating plans for Canadian storage during the operating years 1969-70 through 1974-75 dated February 15, 1969 under Article IV, Paragraph (1) of the Treaty between Canada and the United States of America relating to co-operative development of the water resources of the Columbia River basin signed at Washington on January 17, 1961 which entered into force on September 16, 1964.

I wish to advise you that the proposal contained in your note with the attachments thereto meets with the approval of the Government of the United States of America and that your note together with this reply constitutes confirmation of the operating plans referred to in your note by our two Governments within the meaning of Article IV, Paragraph (1) of the Treaty, thus empowering and charging the two Entities to proceed on the basis set out in the enclosures to your note.

Accept, Excellency, the renewed assurances of my highest consideration.

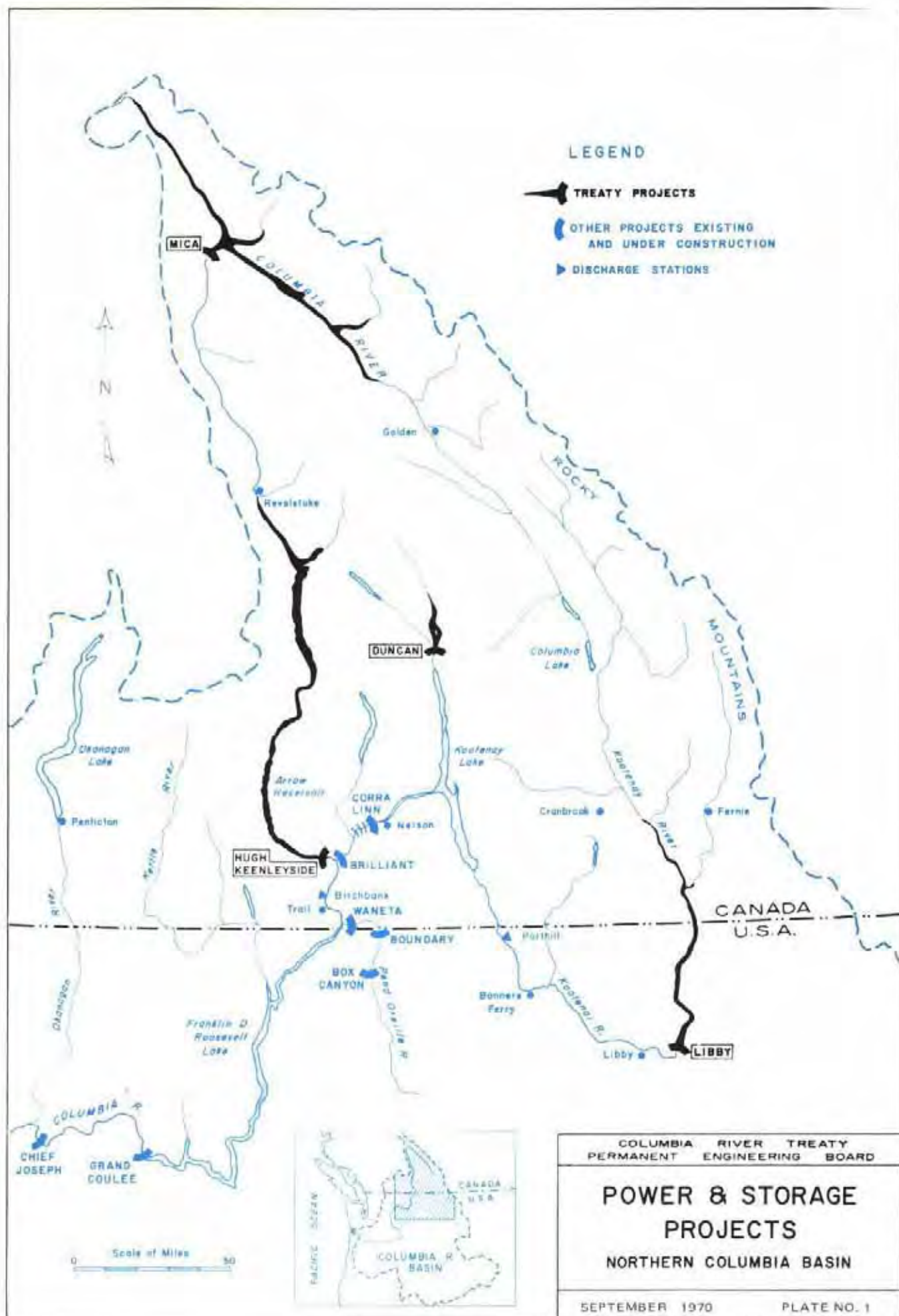
For the secretary of State:

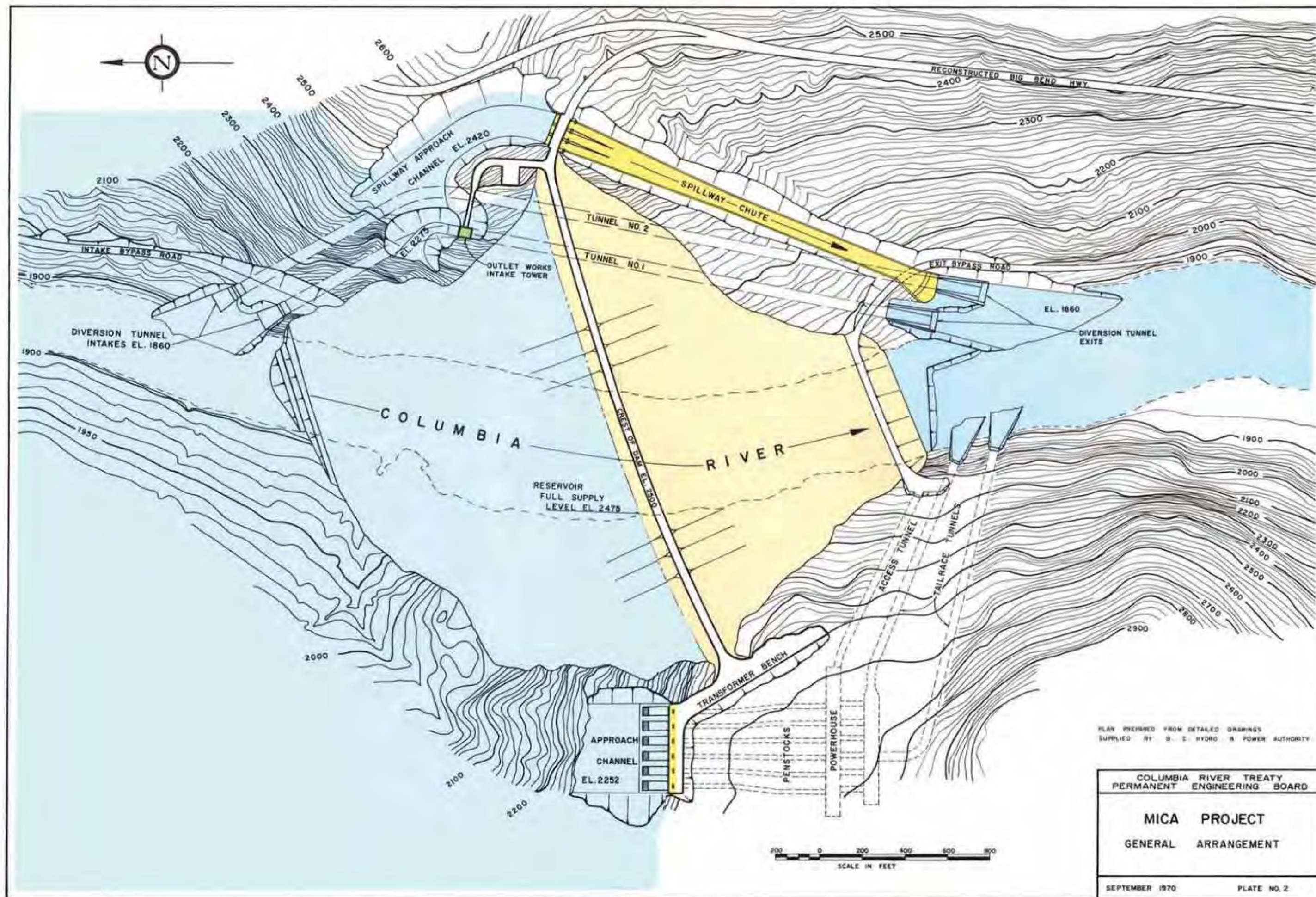
"Martin J. Hillenbrand"

His Excellency
M. Cadieux,
Ambassador of Canada.

LIST OF PLATES

	<u>Plate No.</u>
Power and Storage Projects Northern Columbia Basin	1
Mica Project General Arrangement	2
Mica Project Progress Chart of Dam	3
Mica Project General Project Area	4
Libby Project General Arrangement	5
Libby Project Reservoir Area	6





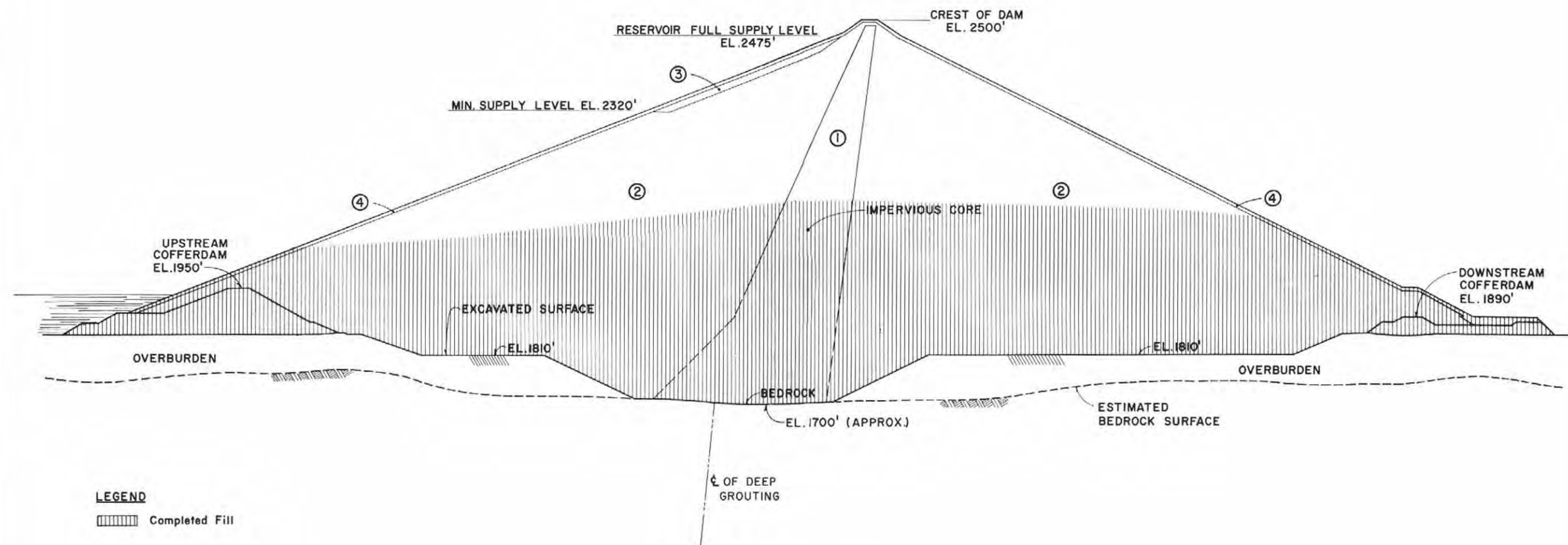
PLAN PREPARED FROM DETAILED DRAWINGS
SUPPLIED BY B. C. HYDRO & POWER AUTHORITY

COLUMBIA RIVER TREATY
PERMANENT ENGINEERING BOARD

MICA PROJECT
GENERAL ARRANGEMENT

SEPTEMBER 1970

PLATE NO. 2

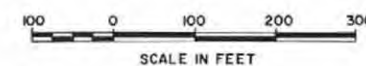


LEGEND

Completed Fill

ZONE	MATERIAL
①	IMPERVIOUS FILL
②	PERVIOUS FILL
③	FILTER
④	RIP RAP

EMBANKMENT SECTION



PLAN PREPARED FROM DETAILED DRAWINGS
SUPPLIED BY B.C. HYDRO & POWER AUTHORITY.

COLUMBIA RIVER TREATY
PERMANENT ENGINEERING BOARD

MICA PROJECT PROGRESS CHART OF DAM

SEPTEMBER 1970

PLATE NO. 3

