

THE 1988 SUMMER WATER TEMPERATURE
AND FLOW MANAGEMENT PROJECT

*NECHAKO FISHERIES CONSERVATION PROGRAM
Technical Report No. RM88-5*

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ABSTRACT

The 1988 Nechako River Summer Water Temperature and Flow Management Project was undertaken to attempt to prevent mean daily water temperatures in the Nechako River above Stuart River (at Finmoore) from exceeding 20.0°C (68.0°F), and to control flows in the Nechako River below Cheslatta Falls and at Vanderhoof during the water temperature control period (July 20 to August 20). In 1988, very mild temperatures were experienced within the area and mean daily water temperatures in the Nechako River above Stuart River did not exceed the temperature criterion throughout the water temperature control period.

Over the duration of the 1988 Summer Water Temperature and Flow Management Project, the total volume of water released was 6,681.4 m³/s-d (235,954 cfs-d). The volume released for cooling purposes was 4,652.8 m³/s-d (164,314 cfs-d). The average flow over the operational period (July 10 to August 20) was 159.1 m³/s (5,619 cfs).

INTRODUCTION

Control of the Nechako River water temperature for protection of fish resources is a concern of both government agencies and Alcan Smelters and Chemicals Ltd. Each summer between 1981 and 1984, Alcan, Triton Environmental Consultants Ltd. (formerly Envirocon Pacific Ltd.), and the Department of Fisheries and Oceans (DFO) undertook a joint water temperature monitoring and control project. In 1985, no water temperature monitoring and control project was implemented as Alcan maintained a constant Skins Lake Spillway release of 283 m³/s (10,000 cfs) providing the maximum allowable flow in the Nechako River below Cheslatta Falls for the entire period of concern. In 1986 and 1987, Triton Environmental Consultants Ltd. (Triton), on behalf of Alcan, carried out an independent water temperature and flow management project similar to the one used during the summer of 1984 (Envirocon 1985). In 1988, Triton carried out an analogous water temperature and flow management project under the auspices of the Nechako Fisheries Conservation Program (NFCP).

The project undertaken in 1988 is referred to as the Nechako River Summer Water Temperature and Flow Management Project. This project was designed and developed by Triton in 1982 and has been successfully implemented by Triton since 1983. The project is comprised of an operational period (July 10 to August 20), a water temperature control period (July 20 to August 20), and a flow control period (July 10 to September 6). The objectives of the Summer Water Temperature and Flow Management Project are to attempt to prevent water temperatures in the Nechako River

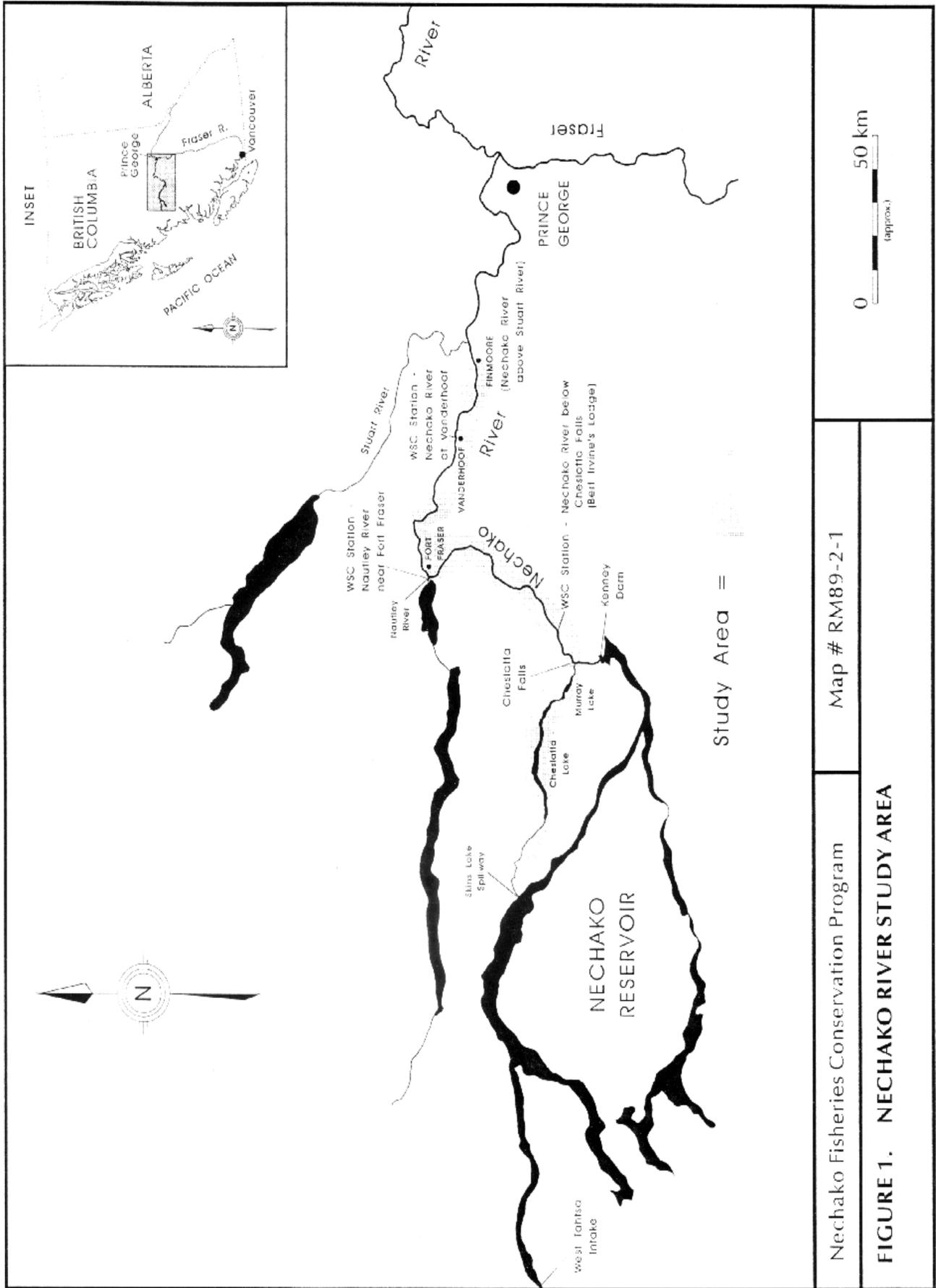
above the Stuart River confluence from exceeding 20.0°C (68.0°F) during the water temperature control period, and to control flows in the Nechako River below Cheslatta Falls and at Vanderhoof during the flow control period. The latter objective includes reducing the flow in the Nechako River below Cheslatta Falls to the chinook salmon spawning flow by September 6.

The study area included in the Summer Water Temperature and Flow Management Project is shown in Figure 1. Unless otherwise stated, the location of the Nechako River above Stuart River refers to the Nechako River at Finmoore.

This report reviews the 1988 Summer Water Temperature and Flow Management Project and includes an outline of Triton's method of determining Skins Lake Spillway releases, a summary of Triton's 1988 Skins Lake Spillway release recommendations for the period July 10 to September 6 inclusive, and a summary of observed flows (July 10 to September 6) and water temperatures (July 10 to August 20) at various locations along the Nechako River. Also discussed is the volume of cooling water used in the 1988 Summer Water Temperature and Flow Management Project.

METHODS

Management of the Nechako River flows and water temperatures was accomplished using water temperature predictions based on five-day meteorological forecasts to determine scheduling of Skins Lake Spillway releases required to meet project objectives. The



Nechako Fisheries Conservation Program

Map # RM89-2-1

FIGURE 1. NECHAKO RIVER STUDY AREA

0 50 km
(approx.)

Summer Water Temperature and Flow Management Project is a computer based project utilizing an unsteady-state flow routing model and an unsteady-state water temperature prediction model designed to compute the conditions in the Nechako River defined by the nature of the meteorological conditions. Mathematical modelling of flows and water temperatures in the Nechako River was performed daily during the period July 10 to August 20, inclusive.

Daily operations followed the protocol defined in the Settlement Agreement (Anon. 1987), and involved collection of water temperature and river stage data from several locations in the study area, and development of five-day meteorological forecasts. Water temperatures were obtained daily from recorders maintained in the Nechako River below Cheslatta Falls (at Bert Irvine's Lodge), in the Nechako River at Fort Fraser (upstream of Nautley River), in the Nechako River above Stuart River and in the Nautley River. River stages were obtained daily from recorders maintained in the Nechako River below Cheslatta Falls, in the Nechako River at Vanderhoof and from a staff gauge in the Nautley River. Five-day meteorological forecasts were obtained from Meteorological and Environmental Planning Ltd. (MEP), a subconsultant to Triton.

River stage and minimum and maximum water temperature data were obtained daily by Triton (staff member resident in Vanderhoof) for each location identified except the Nechako River below Cheslatta Falls. Each morning, hourly water temperature and river stage data recorded by the data collection platform located at Nechako River below Cheslatta Falls were obtained via computer link to Water Survey of Canada (WSC), Vancouver. In addition, spot and corresponding recorded water temperatures were collected at each location during these daily site visits and used to adjust the recorded water temperatures. Adjustment was included to provide an ongoing check of each thermograph, and was performed in the following manner. If the spot temperature was higher than the thermograph record, the thermograph record was adjusted to agree with the observed spot temperature for that day. If the thermograph record was higher than the spot temperature, the thermograph record was not adjusted. This procedure was implemented as a conservative measure.

Skins Lake Spillway releases documented in this report are the releases requested by Triton. All Nechako

River and Nautley River flow data documented in this report are preliminary data. The values presented are part of the database utilized in the daily operation of the Summer Water Temperature and Flow Management Project. These data have not been updated as it is the preliminary data that was used in real-time modelling of the Nechako River system. Therefore, values presented in this report may differ slightly from those reported by WSC.

The first 10 days of the operational period, July 10 to July 19, are utilized for system start up, for initialization of the data base required to schedule Skins Lake Spillway releases necessary to meet project water temperature objectives during the control period commencing July 20, and for increase of the flows in the Nechako River from spring flows to the minimum cooling flow of 170 m³/s (6,000 cfs) required below Cheslatta Falls. The 1988 Skins Lake Spillway spring base release as determined by NFCP was 48.3 m³/s (1,706 cfs). Upon commencement of the operational period on July 10, the observed flow in the Nechako River below Cheslatta Falls was unavailable. The observed flow on July 11 was 52.0 m³/s (1,836 cfs). On July 11, 1988, the Skins Lake Spillway release was increased from the spring base release to 227 m³/s (8,000 cfs) to ensure flows in the Nechako River below Cheslatta Falls reached the minimum cooling flow of 170 m³/s (6,000 cfs) by July 20 (the beginning of the water temperature control period).

Throughout the operational period of the project, water temperatures in the Nechako River were calculated daily for the previous day, the current day and each of the next 4 days. These calculations were based on observed and five-day forecast meteorological data, observed water temperature and computed flow data. Forecast water temperature predictions were tabulated and reviewed daily to identify trends in water temperature changes. These trends are the same as those used in the water temperature and flow management projects since 1984 (Envirocon Ltd. 1985), and are best explained through reference to Table 1. Assuming the current day is July 16, entries corresponding to the current day's operation are represented by the letter c. Entries co and cs represent the observed and calculated water temperatures, respectively, for the previous day (July 15). Entries c1 through c5 represent predicted water temperatures computed using the current day's five-day meteorological forecast and an assumed current day's flow regime. The entry rc

Table 1
Daily Operations to Manage Water Temperatures in the Nechako River above Stuart River

Date	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul*	17-Jul	18-Jul	19-Jul	20-Jul
Fifth Day's Predicted Water Temperature @ Date + 4 Days								a5	b5	c5
Fourth Day's Predicted Water Temperature @ Date + 3 Days							a4	b4	c4	
Third Day's Predicted Water Temperature @ Date + 2 Days						a3	b3	c3		
Second Day's Predicted Water Temperature @ Date + 1 Day					a2	b2	c2			
Current Day's Predicted Water Temperature @ Date				a1	b1	c1				
Previous Day's Calculated Water Temperature @ Date - 1 Day			as	bs	cs					
Previous Day's Observed Water Temperature @ Date - 1 Day			ao	bo	co					
Current Day's Release @ Date				ra	rb	rc				

* The current day (e.g., the day of operation) for this example is July 16.

represents the current day Skins Lake Spillway release required to meet project objectives.

The following three trends in water temperature changes were reviewed on a day-by-day basis:

1. Observed trend; developed from observed mean daily water temperatures measured in the Nechako River above Stuart River each day (bo and co in Table 1). The difference in observed water temperatures for the previous two days is extrapolated over the next 5 days to determine the observed water temperature trend.

2. Predicted trend; developed from the predicted water temperatures for the previous day and the following five days (cs,c1,c2,c3,c4,c5, in Table 1). These data represent the predicted trend.
3. Forecast trend; developed from the difference between the current five-day and previous five-day predictions for the same calendar days (c3 and b4, c2 and b3, c1 and b2 in Table 1). Differences between forecasted data on coincident dates for the next 3 days only are averaged and added to the 5th day predicted temperature to determine the trend in forecasted temperatures.

A numerical example of how the trends are calculated is presented in Appendix A.

Each day predicted water temperatures for the five-day forecast period were checked and the three trends were calculated. If two of the three trends indicated that the water temperature in the Nechako River above Stuart River could potentially exceed 19.4°C (67.0°F) then an increase in the Skins Lake Spillway release was required. When this occurred the current day's release was revised and the flow and temperature models were rerun using the modified flow regime. Results of each day's final computer run were subsequently used to initialize water temperatures for the following day's computations. Entries in Table 1 represent each day's final cooling water release and resultant predicted water temperatures.

The following release criteria were used with the three trends identified above to determine the timing and magnitude of Skins Lake Spillway releases:

1. When two of the three trends show an increase in water temperature in the Nechako River above Stuart River, and these trends show that potentially the water temperature could exceed 19.4°C (67.0°F), increase the Skins Lake Spillway release according to criteria 2 and 3 below.
2. Operate Skins Lake Spillway such that flow in the Nechako River below Cheslatta Falls ranges between 170 m³/s (6,000 cfs) and 283 m³/s (10,000 cfs) as required, and flow in the Nechako River above Stuart River does not exceed 340 m³/s (12,000 cfs). It is understood that the flow in the Nechako River below Cheslatta Falls is to be not less than 170 m³/s (6,000 cfs) by July 20, and is to be reduced to approximately 31.2 m³/s (1,100 cfs) by September 6.
3. At any time of release, increase Skins Lake Spillway from the current level to 453 m³/s (16,000 cfs) directly to achieve the flow changes in the Nechako River as fast as possible.
4. During cooling periods when two of three trends in forecasted water temperatures are decreasing and these trends indicate that potentially the water temperature could drop

below 19.4°C (67.0°F) within the forecast period (5 days), reduce the Skins Lake Spillway release from the current level to 14.2 m³/s (500 cfs).

RESULTS

Predicted and observed mean daily water temperatures for the Nechako River above Stuart River, Skins Lake Spillway releases and changes in Skins Lake Spillway releases over the duration of the project operational period (July 10 to August 20) are summarized in Table 2.

Observed mean daily water temperatures in the Nechako River above Stuart River are tabulated in Table 3 and plotted in Figure 2. Note that temperatures are not available for August 17, 18, 19 and 20. The maximum observed mean daily water temperature recorded during the control period (from available data from July 20 to August 20) was recorded as 19.4°C (66.9°F) on July 20. The maximum observed mean daily water temperature recorded during the operational period (from available data from July 10 to August 20) was recorded as 19.8°C (67.6°F) on July 10. The minimum observed mean daily water temperature of 16.5°C (61.7°F) was recorded on July 24. A summary of mean daily water temperatures recorded in the Nechako River below Cheslatta Falls, near Fort Fraser and above Stuart River, and in the Nautley River near Fort Fraser (July 10 to August 20) is presented in Appendix B.

As outlined in *Methods*, during the water temperature control period Skins Lake Spillway releases required for water temperature control were to be such that: flows in the Nechako River below Cheslatta Falls were to range between 170 m³/s (6,000 cfs) and 283 m³/s (10,000 cfs) and flows at Vanderhoof were not to exceed 340 m³/s (12,000 cfs).

Skins Lake Spillway releases and corresponding flows in the Nechako River below Cheslatta Falls and at Vanderhoof are plotted in Figure 3. Daily Skins Lake Spillway releases, Nautley River flows and flows in the Nechako River below Cheslatta Falls and at Vanderhoof are tabulated in Appendix C. A day-by-day record of Triton's Skins Lake Spillway release recommendations and the reasoning behind them is presented in Table 4.

Table 2
 Predicted and Observed Mean Daily Water Temperatures in the Nechako River above Stuart River, July 10 to August 20, 1988

Date	JULY																					
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
5th Day's Predicted Water Temperature at Date + 4 Days						19.2	16.2	16.6	17.1	16.9	16.3	16.7	17.7	17.8	17.7	18.2	17.6	16.1	16.9	17.2	17.4	17.7
4th Day's Predicted Water Temperature at Date + 3 Days					19.2	15.7	16.3	17.1	16.8	16.3	16.9	18.3	18.6	18.0	18.1	17.6	16.2	16.8	16.9	17.6	17.8	17.6
3rd Day's Predicted Water Temperature at Date + 2 Days				19.0	15.7	16.4	17.1	17.1	16.3	17.0	18.4	19.4	18.9	18.6	17.7	16.3	16.1	16.8	17.9	17.9	17.8	17.1
2nd Day's Predicted Water Temperature at Date + 1 Day			19.0	16.2	17.0	17.2	17.6	16.9	17.2	18.1	19.9	20.3	19.6	18.4	16.8	15.7	16.8	18.1	18.0	18.1	17.3	16.6
Current Day's Predicted Water Temperature at Date		19.4	17.6	17.9	17.3	17.7	17.4	17.5	17.6	19.6	20.6	20.5	19.1	17.7	16.3	16.7	17.6	17.9	18.2	17.7	17.0	17.0
Previous Day's Calculated Water Temperature at Date - 1 Day	16.7	18.8	18.4	17.9	17.4	17.7	17.6	17.3	18.1	19.7	20.7	20.2	19.0	17.6	16.6	16.9	17.7	18.0	18.1	17.7	17.2	17.0
Previous Day's Observed Water Temperature at Date - 1 Day	19.8	19.3	18.3	17.6	17.6	17.3	17.3	17.4	17.9	19.1	19.4	19.3	18.3	17.1	16.5	16.7	16.9	17.6	17.4	17.3	16.7	16.7
Current Day's Skins Lake Spillway Release at Date (m ³ /s)	48.3	48.3 to 227 @ 1600 hrs	227	227	227	227	227	227	227	170	170	170	170	170	170	170	170	170	170	170	170	170

Table 2 (Continued)
 Predicted and Observed Mean Daily Water Temperatures in the Nechako River above Stuart River, July 10 to August 20, 1988

Date	AUGUST																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
5th Day's Predicted Water Temperature at Date + 4 Days	17.5	17.4	17.6	17.6	17.6	17.2	16.7	17.6	17.4	16.6	16.7	17.2	17.2	17.3	16.3	16.3	16.4	16.4	16.1	16.0
4th Day's Predicted Water Temperature at Date + 3 Days	17.1	17.1	17.1	17.6	17.4	16.8	17.2	17.3	17.1	16.4	16.8	17.1	17.4	16.7	16.6	16.3	16.1	15.9	15.7	16.5
3rd Day's Predicted Water Temperature at Date + 2 Days	16.7	16.7	17.3	17.6	17.9	17.4	17.0	17.5	16.8	16.5	16.5	17.3	17.4	17.6	16.7	16.2	15.8	15.4	16.4	
2nd Day's Predicted Water Temperature at Date + 1 Day	16.8	17.1	17.4	18.9	18.4	17.3	17.8	17.7	16.8	16.1	17.0	16.9	18.6	17.7	16.8	16.2	15.8	16.3		
Current Day's Predicted Water Temperature at Date	17.1	17.2	18.6	19.1	18.1	18.3	18.2	17.9	16.7	16.9	17.2	18.2	18.6	17.5	17.1	16.8	16.3			
Previous Day's Calculated Water Temperature at Date - 1 Day	17.2	17.5	18.6	18.7	18.4	18.4	18.4	17.8	17.0	16.9	17.3	18.2	18.4	17.6	17.4	16.9				
Previous Day's Observed Water Temperature at Date - 1 Day	16.6	17.1	18.0	18.4	18.3	17.8	17.8	17.7	16.9	16.7	16.8	17.6	17.8	17.2	17.2	16.6	N/A	N/A	N/A	N/A
Current Day's Skins Lake Spillway Release at Date (m ³ /s)	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	29.7 to 29.7 @ 0800 hrs			

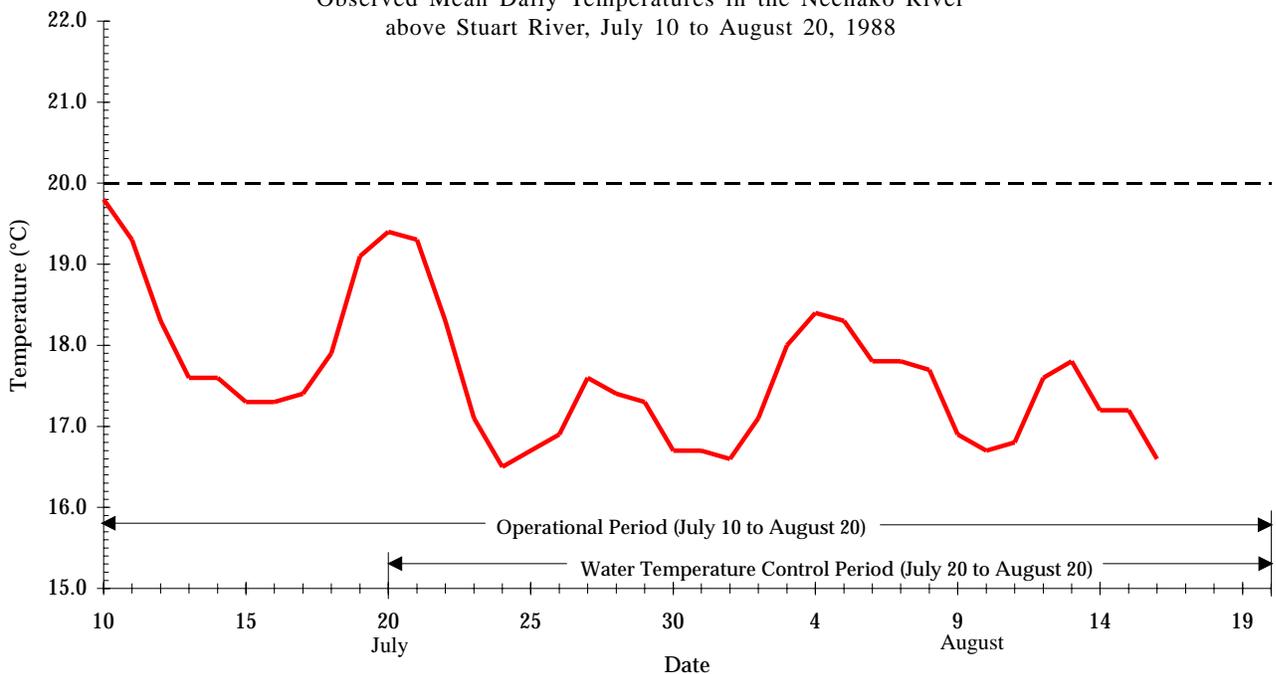
Note: Observed temperatures not available for August 17, 18, 19 and 20

Table 3
Observed Mean Daily Water Temperatures in the Nechako River above Stuart River, July 10 to August 20, 1988

Date	Water Temperature (°C)	Date	Water Temperature (°C)
10-Jul	19.8	1-Aug	16.6
11-Jul	19.3	2-Aug	17.1
12-Jul	18.3	3-Aug	18.0
13-Jul	17.6	4-Aug	18.4
14-Jul	17.6	5-Aug	18.3
15-Jul	17.3	6-Aug	17.8
16-Jul	17.3	7-Aug	17.8
17-Jul	17.4	8-Aug	17.7
18-Jul	17.9	9-Aug	16.9
19-Jul	19.1	10-Aug	16.7
20-Jul	19.4	11-Aug	16.8
21-Jul	19.3	12-Aug	17.6
22-Jul	18.3	13-Aug	17.8
23-Jul	17.1	14-Aug	17.2
24-Jul	16.5	15-Aug	17.2
25-Jul	16.7	16-Aug	16.6
26-Jul	16.9	17-Aug	N/A
27-Jul	17.6	18-Aug	N/A
28-Jul	17.4	19-Aug	N/A
29-Jul	17.3	20-Aug	N/A
30-Jul	16.7		
31-Jul	16.7		

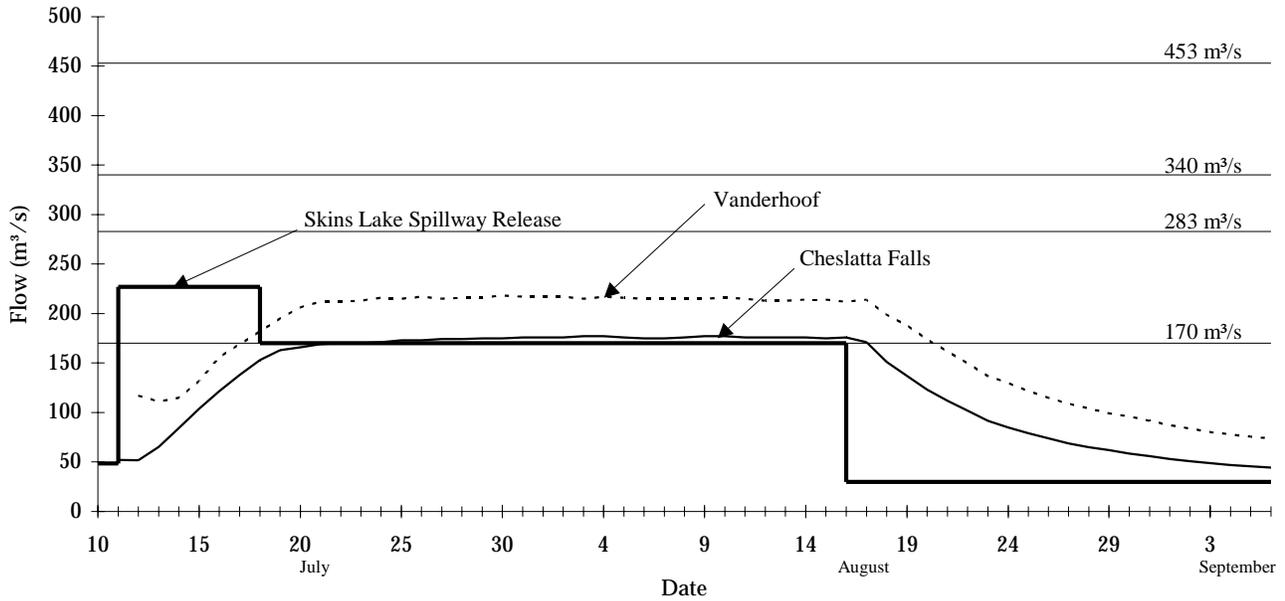
Note: Observed temperatures not available for August 17, 18, 19 and 20

Figure 2
Observed Mean Daily Temperatures in the Nechako River above Stuart River, July 10 to August 20, 1988



Note: Observed temperatures not available for August 17, 18, 19 and 20

Figure 3
Skins Lake Spillway Releases and Flows in the Nechako River below Cheslatta Falls and at Vanderhoof,
July to September 6, 1988



Note: Flows for Nechako River below Cheslatta Falls not available for July 10 and for Nechako River at Vanderhoof not available for July 10 to 11

Table 4
Rationale for Skins Lake Spillway Release Changes, July 10 to September 6, 1988

Date 1988	Old Setting (m ³ /s)	New Setting (m ³ /s)	Time of Change (hrs)	Reason for Changing SLS Release Setting
11-Jul	48.3	227	1600	To ensure base flow of 170 m ³ /s below Cheslatta Falls by July 20
18-Jul	227	170	1600	To maintain base flows of 170 m ³ /s
16-Aug	170	29.7	0800	In response to a predicted cooling trend and to achieve spawning flow in the Nechako River below Cheslatta Falls by September 6.

During the water temperature control period, measured flows in the Nechako River below Cheslatta Falls (based on preliminary WSC data from the WSC data collection platform at Bert Irvine's Lodge) ranged between a maximum of 177 m³/s (6,251 cfs) on August 4, 9 and 10 and a minimum of 123 m³/s (4,344 cfs) on August 20. Flows measured in the Nechako River at Vanderhoof ranged between a maximum of 218 m³/s (7,699 cfs) on July 30 and a minimum of 174 m³/s (6,145 cfs) on August 20. Following the water temperature control period, the mean daily flow in the Nechako River below Cheslatta Falls was reduced to 44.3 m³/s (1,564 cfs) by September 6.

DISCUSSION

Decision criteria used to determine Skins Lake Spillway releases during the 1988 Summer Water Temperature and Flow Management Project were identical to those used during summer water temperature and flow management projects since 1984. Discussion of the 1988 Summer Water Temperature and Flow Management Project has been divided into four sections. The first section reviews the collection and use of observed field data. Types of data include water temperature, flow, and meteorological data (observed and forecast). The second section discusses occurrences of mean daily water temperatures in excess of 20.0°C (68.0°F) in the Nechako River above Stuart River. The third section discusses the volume of water used during the 1988 Summer Water Temperature and Flow Management Project. The fourth section discusses the benefits of exercising judgment (based on experience gained in previous years' operation of the water temperature and flow management projects) during the application of the release criteria.

Observed Data

Triton's modelling procedure is based on the premise that the best way to forecast water temperatures is to initialize computations with observed conditions. For this reason, the quality of the field data used in the modelling process directly affects the accuracy of the computed water temperatures. Therefore, data must be collected accurately and consistently to ensure that random errors are kept to a minimum. Consistency in data collection techniques will ensure any systematic errors maintain a constant bias throughout the project.

In 1988, flow data obtained from gauging stations in the Nechako River below Cheslatta Falls, in the Nechako River at Vanderhoof and in the Nautley River near Fort Fraser appeared to be of a reasonable quality. Changes in flows in the Nechako River below Cheslatta Falls and in the Nechako River at Vanderhoof responded as expected in response to changes in Skins Lake Spillway releases. The Nautley River flow regime was typical for the time of year. The ability to obtain hourly stage data from the gauging station located in the Nechako River below Cheslatta Falls proved very useful in verifying the daily predictions of the flow model and accounting for changes in the local inflow to the Cheslatta/Murray Lakes system.

As stated previously, spot and corresponding recorder (thermograph) water temperatures were collected in the Nechako River at Fort Fraser (upstream of the Nautley River), in the Nechako River above Stuart River and in the Nautley River during each site visit. The thermograph water temperatures were not consistently higher or lower than their associated spot temperatures. These data were used in adjustment of water temperatures and the method applied is that outlined previously.

Observed and forecast meteorological data were obtained daily from MEP, a subconsultant to Triton. Forecast weather data obtained from MEP was developed using observed weather data from the Atmospheric Environmental Service (AES) station at Prince George Airport and from the meteorological monitoring station installed by Triton at Fort Fraser. The observed and forecast weather data received from MEP was used to estimate water temperatures in the Nechako River below Cheslatta Falls and in the Nautley River for the previous day, current day, and following four days. A listing of the observed and forecast meteorological data is provided in Appendix D. The accuracy of the forecast meteorological data has a direct effect on the accuracy of the forecast river water temperatures.

Occurrences of Water Temperatures in the Nechako River above Stuart River Exceeding Water Temperature Criterion

Mean daily water temperatures in the Nechako River above Stuart River did not exceed 20.0°C (68.0°F)

during the water temperature control period of July 20 to August 20. This was primarily due to very mild temperatures experienced within the area which required only the minimum flow of 170 m³/s (6,000 cfs) in the Nechako River below Cheslatta Falls throughout the water temperature control period to control water temperatures in the Nechako River above Stuart River.

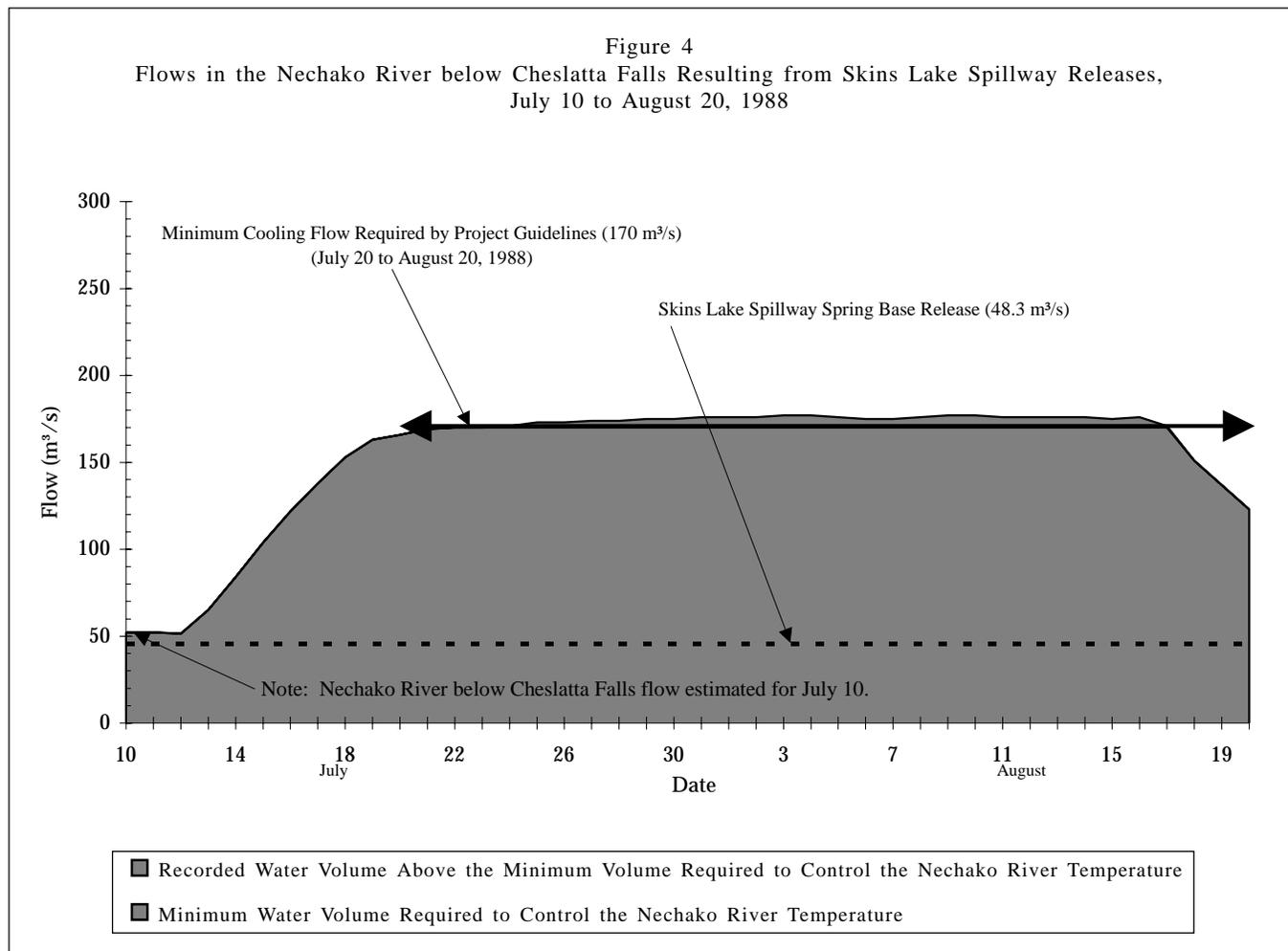
Volume of Water Used

Figure 4 illustrates the observed flows in the Nechako River below Cheslatta Falls for the 1988 Summer Water Temperature and Flow Management Project. Also indicated is the minimum cooling flow of 170 m³/s (6,000 cfs) in the Nechako River below Cheslatta Falls, and the Skins Lake Spillway release of 48.3 m³/s (1,706 cfs) required as part of the “Annual Water Allocation” defined in the Settlement Agreement. Skins Lake Spillway releases in excess of 48.3 m³/s (1,706 cfs) are considered releases used for cooling purposes.

The total volume of water released during the 1988 Summer Water Temperature and Flow Management Project was 6,681.4 m³/s-d (235,954 cfs-d). The volume released for cooling purposes was 4,625.8 m³/s-d (164,314 cfs-d). The average release over the operational period was 159.1 m³/s (5,619 cfs). Volume calculations are presented in Appendix E.

Application of the Summer Water Temperature and Flow Management Project Release Criteria

The Summer Water Temperature and Flow Management Project is very sensitive to the accuracy of meteorological forecasting. If a change in temperature direction occurs over a prolonged period of time (3 or 4 days), inaccurate meteorological forecasts may predict the reversal of the temperature direction prematurely. In these instances, it may be required to exercise judgment when applying the Summer Water Temperature and Flow Management Project release criteria used with the three water temperature trends.



Experience gained in the operation of the Summer Water Temperature and Flow Management Project since 1984 has assisted in developing the judgment required to make exceptions to the release criteria during such events, which has proven to be beneficial in terms of managing downstream water temperatures.

In 1988, flows in the Nechako River below Cheslatta Falls were held constant at approximately 170 m³/s (6,000 cfs) throughout the water temperature control period. As water temperatures were maintained at well below the water temperature criteria of 20.0°C (68.0°F), no exceptions to the release criteria were required.

REFERENCES

Anon. 1987. Settlement Agreement 1987.

Envirocon Limited. 1985. Review of the 1984 Nechako River Hydrothermal Monitoring and Control Program. Technical Memorandum 1941/C. Chapter 2.0, Methods. Prepared for Alcan Smelters and Chemicals Ltd.

APPENDIX A

Numerical Example of Water Temperature Trend Calculation

Appendix A
Numerical Example of Water Temperatures Trend Calculation

From data for July 16 date of operation (Table A1).

1. Observed Trend

The observed trend is down by 0.3 °C from 17.6°C (J14) to 17.3°C (J15). Take the previous day's observed temperature 17.3°C (J15) and extrapolate the trend for 5 days at -0.3°C. The observed trend shows that the water temperature could potentially reach $17.3^{\circ}\text{C} + 5(-0.3^{\circ}\text{C}) = 18.8^{\circ}\text{C}$.

2. Predicted Trend

The predicted trend is the difference between the previous day's computed water temperature (J15) and the fifth day predicted water temperature (J20). The predicted trend is down from 17.7°C to 16.3°C with the potential to reach 16.3°C.

3. Forecast Trend

The forecast trend for the current day of July 16 is based on the first, second and third day forecasts.

July 16	17.4 - 17.6 =	down 0.2°C
July 17	16.9 - 17.1 =	down 0.2°C
July 18	16.3 - 16.8 =	down 0.5°C
Mean of 3 differences	=	down 0.3°C

This mean of -0.3°C is added to the fifth day predicted water temperature to give $16.3^{\circ}\text{C} + (-0.3^{\circ}\text{C}) = 16.0^{\circ}\text{C}$.

The forecast trend is down 0.3°C with the potential to reach 16.0°C.

Table A1
 Predicted and Observed Mean Daily Water Temperatures in the Nechako River above Stuart River, 1988

Date	JULY												
	10	11	12	13	14	15	16	17	18	19	20	21	22
5th Day's Predicted Water Temperature at Date + 4 Days						19.2	16.2	16.6	17.1	16.9	16.3		
4th Day's Predicted Water Temperature at Date + 3 Days					19.2	15.7	16.3	17.1	16.8	16.3			
3rd Day's Predicted Water Temperature at Date + 2 Days				19.0	15.7	16.4	17.1	17.1	16.3				
2nd Day's Predicted Water Temperature at Date + 1 Day			19.0	16.2	17.0	17.2	17.6	16.9					
Current Day's Predicted Water Temperature at Date		19.4	17.6	17.9	17.3	17.7	17.4						
Previous Day's Calculated Water Temperature at Date - 1 Day	16.7	18.8	18.4	17.9	17.4	17.7							
Previous Day's Observed Water Temperature at Date - 1 Day	19.8	19.3	18.3	17.6	17.6	17.3							
Current Day's Skins Lake Spillway Release at Date (m ³ /s)	48.3	48.3 to 227 @ 1600 hrs	227	227	227	227	227						

APPENDIX B

Mean Daily Water Temperatures in the
Nechako and Nautley Rivers, 1988

Appendix B
Mean Daily Water Temperatures in the Nechako and Nautley Rivers, 1988

Date	Nechako River			Nautley	Date	Nechako River			Nautley
	Cheslatta Falls (°C)	Fort Fraser (°C)	above Stuart River (°C)	Fort Fraser (°C)		Cheslatta Falls (°C)	Fort Fraser (°C)	above Stuart River (°C)	Fort Fraser (°C)
10-Jul	16.1	18.7	19.8	16.7	1-Aug	15.3	16.1	16.6	16.3
11-Jul	15.9	17.7	19.3	16.9	2-Aug	15.7	16.8	17.1	16.8
12-Jul	15.6	16.5	18.3	15.6	3-Aug	16.2	17.8	18.0	17.7
13-Jul	15.6	16.5	17.6	16.1	4-Aug	16.0	18.1	18.4	17.5
14-Jul	15.2	16.8	17.6	16.3	5-Aug	15.9	17.0	18.3	17.1
15-Jul	15.1	16.4	17.3	15.6	6-Aug	16.0	17.2	17.8	17.6
16-Jul	15.1	16.0	17.3	15.6	7-Aug	15.9	17.2	17.8	17.5
17-Jul	15.3	16.7	17.4	15.8	8-Aug	15.8	16.2	17.7	17.3
18-Jul	15.6	17.2	17.9	16.3	9-Aug	15.8	16.3	16.9	17.0
19-Jul	15.7	18.3	19.1	17.7	10-Aug	15.7	16.4	16.7	16.6
20-Jul	15.9	18.9	19.4	16.7	11-Aug	15.7	17.3	16.8	17.9
21-Jul	16.4	18.2	19.3	17.1	12-Aug	15.9	16.8	17.6	18.0
22-Jul	15.9	17.8	18.3	15.6	13-Aug	16.2	17.0	17.8	17.7
23-Jul	15.4	16.8	17.1	16.4	14-Aug	15.7	16.8	17.2	17.3
24-Jul	15.6	16.7	16.5	16.6	15-Aug	15.6	16.3	17.2	16.9
25-Jul	15.6	N/A	16.7	16.9	16-Aug	15.5	15.8	16.6	18.0
26-Jul	15.5	N/A	16.9	16.3	17-Aug	N/A	N/A	N/A	N/A
27-Jul	15.6	16.5	17.6	16.8	18-Aug	N/A	N/A	N/A	N/A
28-Jul	15.4	17.0	17.4	17.0	19-Aug	N/A	N/A	N/A	N/A
29-Jul	15.3	16.2	17.3	16.7	20-Aug	N/A	N/A	N/A	N/A
30-Jul	15.4	15.8	16.7	16.5					
31-Jul	15.5	16.8	16.7	15.7					

N/A - Temperatures not available.

APPENDIX C

Mean Daily Skins Lake Spillway Releases and Flows
in the Nechako and Nautley Rivers, 1988

Appendix C
Mean Daily Skins Lake Spillway Release and Flows in the Nechako and Nautley River, 1988

Date	Skins Lake Spillway Release (m ³ /s)	Nechako River		Nautley Fort Fraser (m ³ /s)
		Cheslatta Falls (m ³ /s)	At Vanderhoof (m ³ /s)	
10-Jul	48.3	N/A	N/A	N/A
11-Jul	48.3 to 227 @1600 hrs	52.0	N/A	44.3
12-Jul	227	51.4	117	42.3
13-Jul	227	65.0	111	41.4
14-Jul	227	84.2	115	40.4
15-Jul	227	104	132	39.5
16-Jul	227	122	157	39.8
17-Jul	227	138	169	39.3
18-Jul	227 to 170 @1600 hrs	153	182	38.4
19-Jul	170	163	195	37.5
20-Jul	170	166	206	35.0
21-Jul	170	169	212	35.3
22-Jul	170	170	212	34.9
23-Jul	170	170	213	32.8
24-Jul	170	171	216	33.2
25-Jul	170	173	215	32.8
26-Jul	170	173	217	31.9
27-Jul	170	174	215	31.1
28-Jul	170	174	216	30.3
29-Jul	170	175	216	29.8
30-Jul	170	175	218	29.4
31-Jul	170	176	217	28.7
1-Aug	170	176	217	27.9
2-Aug	170	176	217	27.6
3-Aug	170	176	215	26.8
4-Aug	170	177	217	26.8
5-Aug	170	176	216	26.2
6-Aug	170	175	215	25.2
7-Aug	170	175	215	25.2
8-Aug	170	176	215	24.9
9-Aug	170	177	215	24.6
10-Aug	170	177	216	24.6
11-Aug	170	176	215	23.3
12-Aug	170	176	213	22.9
13-Aug	170	176	213	22.9
14-Aug	170	176	214	22.6
15-Aug	170	175	214	22.3
16-Aug	170 to 29.7 @ 0800 hrs	176	212	21.6
17-Aug	29.7	171	214	21.6
18-Aug	29.7	151	199	23.1
19-Aug	29.7	137	188	23.1
20-Aug	29.7	123	174	22.9

Appendix C (Continued)
 Mean Daily Skins Lake Spillway Release and Flows in the Nechako and Nautley River, 1988

Date	Skins Lake Spillway Release (m ³ /s)	Nechako River		Nautley Fort Fraser (m ³ /s)
		Cheslatta Falls (m ³ /s)	At Vanderhoof (m ³ /s)	
21-Aug	29.7	112	162	22.3
22-Aug	29.7	102	150	21.4
23-Aug	29.7	91.5	137	21.4
24-Aug	29.7	85.0	130	21.1
25-Aug	29.7	79.1	122	20.8
26-Aug	29.7	73.9	115	20.5
27-Aug	29.7	68.8	109	20.3
28-Aug	29.7	65.0	104	20.1
29-Aug	29.7	62.2	99.2	20.9
30-Aug	29.7	58.3	96.0	20.1
31-Aug	29.7	55.9	91.5	19.1
1-Sep	29.7	53.1	87.4	18.6
2-Sep	29.7	50.8	83.9	18.2
3-Sep	29.7	48.8	80.3	18.0
4-Sep	29.7	47.1	77.9	17.5
5-Sep	29.7	45.7	75.7	17.7
6-Sep	29.7	44.3	73.9	17.9

N/A - Flows not available.

APPENDIX D
Observed and Forecast Meteorological Data

Appendix D
Observed and Forecast Meteorological Data

17.60	470.00	0.65	10.10	9.50	93.00	63.00	10 7 88
14.00	287.00	1.00	11.00	6.00	92.50	82.00	11 7 88
15.00	446.00	0.88	10.00	10.00	92.90	72.00	
16.00	490.00	0.75	10.00	6.00	93.50	68.00	
17.50	509.00	0.65	10.00	8.00	93.50	61.00	
16.00	414.00	0.65	10.00	10.00	93.50	68.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 11/88							

13.00	111.00	1.00	12.00	6.30	92.50	92.00	11 7 88
13.00	210.00	0.95	7.00	17.00	92.80	67.00	12 7 88
13.00	356.00	0.95	10.00	10.00	93.20	79.00	
13.00	195.00	0.90	10.00	10.00	93.40	82.00	
13.50	405.00	0.75	9.00	13.00	93.60	74.00	
15.00	475.00	0.65	7.00	13.00	93.70	59.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 12/88							

12.30	579.00	0.83	6.50	17.80	92.60	70.10	12 7 88
13.70	458.00	0.80	7.00	16.00	92.80	64.00	13 7 88
13.50	377.00	0.80	7.00	18.00	93.30	65.00	
13.50	506.00	0.70	6.00	17.00	93.70	60.00	
14.50	527.00	0.65	6.00	15.00	93.80	57.00	
14.50	529.00	0.65	5.00	15.00	93.90	53.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 13/88							

12.30	415.00	0.76	7.80	12.00	92.80	75.30	13 7 88
12.80	514.00	0.70	5.00	10.00	93.30	59.00	14 7 88
13.50	539.00	0.65	4.00	12.00	93.60	53.00	
14.00	480.00	0.65	6.00	8.00	93.60	59.00	
14.50	530.00	0.50	5.00	8.00	93.60	53.00	
14.00	430.00	0.70	7.50	10.00	93.60	65.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 14/88							

12.20	514.00	0.56	6.00	10.30	93.90	67.70	14 7 88
12.00	560.00	0.30	5.20	10.50	93.70	63.00	15 7 88
12.50	535.00	0.45	5.00	10.00	93.60	60.00	
13.00	535.00	0.40	5.00	10.00	93.70	58.00	
13.50	550.00	0.35	6.00	10.00	93.90	60.00	
14.00	510.00	0.40	6.50	8.00	93.90	61.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 15/88							

Appendix D (Continued)
Observed and Forecast Meteorological Data

12.00	638.70	0.33	4.70	14.20	93.70	64.20	15 7 88
12.50	530.00	0.40	5.00	13.00	94.30	60.00	16 7 88
12.00	505.00	0.45	6.00	14.00	94.20	67.00	
13.00	550.00	0.35	5.00	11.00	94.40	58.00	
14.00	500.00	0.45	6.00	9.00	94.00	59.00	
12.00	470.00	0.55	6.50	14.00	93.60	69.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 16/88							

12.90	599.60	0.37	4.30	10.90	94.20	59.00	16 7 88
13.00	530.00	0.40	4.50	8.50	94.60	56.00	17 7 88
13.50	575.00	0.30	4.00	7.00	94.40	53.00	
14.00	545.00	0.35	5.00	6.50	94.10	55.00	
13.00	470.00	0.70	6.50	8.50	93.80	65.00	
11.00	470.00	0.65	6.00	11.00	93.40	71.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 17/88							

12.20	357.50	0.58	5.00	7.50	94.60	63.20	17 7 88
14.00	670.00	0.10	6.00	3.00	64.90	59.00	18 7 88
15.50	662.00	0.10	7.00	3.00	64.50	57.00	
16.50	620.00	0.40	7.00	7.00	93.90	53.00	
14.00	470.00	0.70	8.00	10.00	93.40	67.00	
12.00	531.00	0.65	7.00	13.00	93.40	71.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 18/88							

15.00	711.00	0.09	6.50	2.30	94.80	61.30	18 7 88
17.10	660.00	0.10	8.00	2.00	94.50	55.00	19 7 88
19.00	620.00	0.35	9.50	6.00	93.90	54.00	
15.00	515.00	0.65	8.00	12.00	93.60	63.00	
13.00	532.00	0.60	7.00	13.00	93.30	67.00	
12.50	529.00	0.60	7.00	10.00	93.30	69.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 19/88							

17.40	704.00	0.10	8.00	3.30	94.40	59.60	19 7 88
20.00	620.00	0.30	9.00	7.00	93.80	50.00	20 7 88
17.50	526.00	0.40	8.50	13.00	94.00	56.00	
14.50	483.00	0.30	7.50	3.00	94.00	3.00	
13.00	527.00	0.60	7.00	10.00	94.00	67.00	
13.50	550.00	0.40	6.00	8.00	94.30	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 20/88							

Appendix D (Continued)
Observed and Forecast Meteorological Data

19.90	711.00	0.28	8.00	5.40	93.70	51.00	20 7 88
19.80	620.00	0.27	6.00	13.50	93.80	41.00	21 7 88
16.50	560.00	0.50	5.50	13.00	94.10	48.00	
14.00	580.00	0.50	5.00	9.00	94.00	55.00	
14.50	640.00	0.20	5.00	8.00	94.30	53.00	
14.50	620.00	0.35	5.00	6.00	94.20	53.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 21/88							

18.90	617.00	0.46	4.70	12.10	93.80	42.00	21 7 88
15.50	551.00	0.60	2.00	14.00	94.00	40.00	22 7 88
14.00	551.00	0.60	4.00	8.00	94.00	51.00	
14.50	484.00	0.65	5.00	12.00	94.00	53.00	
14.50	556.00	0.60	4.00	10.00	93.80	49.00	
15.00	505.00	0.65	5.00	12.00	93.80	51.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 22/88							

15.30	699.00	0.45	1.80	15.70	94.10	41.10	22 7 88
12.00	350.00	0.65	4.00	10.00	94.00	56.00	23 7 88
15.00	510.00	0.60	5.50	12.00	93.80	50.00	
14.00	350.00	0.70	6.00	11.00	93.60	55.00	
14.00	410.00	0.65	6.00	12.00	93.50	57.00	
14.00	410.00	0.65	6.00	11.00	93.50	57.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 23/88							

10.80	280.00	0.74	6.30	7.70	93.90	75.00	23 7 88
13.00	150.00	0.98	11.00	7.00	93.70	88.00	24 7 88
14.00	398.00	0.85	9.00	7.00	93.70	72.00	
15.00	479.00	0.65	6.00	9.00	93.70	55.00	
15.00	476.00	0.65	6.00	10.00	93.70	55.00	
15.00	473.00	0.65	6.00	10.00	93.80	55.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 24/88							

14.40	157.00	1.00	12.40	10.20	93.80	88.00	24 7 88
16.00	250.00	0.90	11.00	10.00	94.20	71.00	25 7 88
15.50	345.00	0.80	9.00	10.00	93.40	65.00	
14.00	495.00	0.65	7.00	10.00	93.40	63.00	
14.00	490.00	0.65	7.00	9.00	93.70	63.00	
15.00	500.00	0.60	6.00	8.00	94.00	55.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 25/88							

Appendix D (Continued)
Observed and Forecast Meteorological Data

16.90	258.00	0.89	12.50	9.20	94.00	76.00	25 7 88
18.50	495.00	0.65	7.80	10.00	93.70	50.00	26 7 88
17.00	480.00	0.60	7.50	7.00	93.50	55.00	
15.00	450.00	0.80	7.00	8.00	93.80	60.00	
15.00	470.00	0.60	6.50	8.00	94.00	57.00	
15.00	470.00	0.60	6.50	8.00	94.10	57.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 26/88							

18.50	594.00	0.62	7.30	10.00	N/A	N/A	26 7 88
15.00	550.00	0.40	7.00	5.00	N/A	N/A	27 7 88
14.50	500.00	0.70	7.50	5.00	N/A	N/A	
14.00	495.00	0.75	7.50	8.00	N/A	N/A	
15.00	520.00	0.60	6.50	8.00	N/A	N/A	
15.00	540.00	0.40	6.00	10.00	N/A	N/A	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 27/88							

14.80	672.00	0.42	5.70	5.40	93.50	58.00	27 7 88
15.00	550.00	0.65	6.50	5.00	93.80	57.00	28 7 88
15.00	505.00	0.65	6.00	7.00	94.00	55.00	
14.50	525.00	0.50	5.80	8.00	94.00	53.00	
15.00	545.00	0.50	5.00	10.00	94.20	51.00	
15.00	542.00	0.50	5.00	10.00	94.20	51.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 28/88							

14.20	472.00	0.69	6.50	2.80	93.60	63.10	28 7 88
14.40	382.00	0.80	9.00	6.00	93.90	70.00	29 7 88
14.50	530.00	0.50	6.00	8.00	94.00	57.00	
14.00	442.00	0.60	5.50	6.00	94.00	57.00	
15.00	530.00	0.50	5.00	6.00	94.20	51.00	
16.00	630.00	0.30	4.00	3.00	94.40	45.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 29/88							

13.50	273.00	0.79	10.00	4.20	93.90	80.80	29 7 88
12.80	530.00	0.40	5.80	6.50	94.00	65.00	30 7 88
13.00	445.00	0.75	7.00	6.00	93.80	65.00	
12.70	510.00	0.55	6.00	6.00	93.80	60.00	
14.50	625.00	0.30	4.50	5.00	94.20	50.00	
15.00	620.00	0.30	4.00	4.00	93.80	45.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 30/88							

Appendix D (Continued)
Observed and Forecast Meteorological Data

13.30	572.00	0.53	5.10	5.90	94.00	60.20	30 7 88
14.00	410.00	0.82	7.00	4.00	93.60	70.00	31 7 88
12.00	320.00	0.90	10.00	10.00	93.40	85.00	
13.00	570.00	0.50	6.00	6.00	94.20	60.00	
13.50	630.00	0.30	5.00	5.00	93.90	55.00	
13.50	620.00	0.30	5.00	4.00	93.80	55.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED JUL 31/88							

13.30	448.00	0.65	5.90	6.80	93.80	63.00	31 7 88
11.50	570.00	0.30	5.00	5.50	94.10	65.00	1 8 88
12.50	620.00	0.20	5.00	5.00	94.00	60.00	
13.00	610.00	0.20	6.00	4.00	93.80	65.00	
13.50	580.00	0.30	7.00	6.00	93.70	70.00	
12.50	480.00	0.60	8.00	7.00	93.50	75.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 1/88							

13.30	599.00	0.26	5.80	7.70	94.10	64.40	1 8 88
14.50	550.00	0.16	6.00	2.00	94.10	57.00	2 8 88
16.00	530.00	0.30	7.00	4.00	93.60	55.00	
14.50	490.00	0.60	7.00	6.00	93.30	61.00	
13.50	500.00	0.55	6.00	10.00	93.30	60.00	
13.00	590.00	0.25	5.50	8.00	93.30	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 2/88							

16.00	620.00	0.35	6.40	5.40	94.00	59.00	2 8 88
20.80	590.00	0.47	10.50	7.50	93.70	52.00	3 8 88
15.00	344.00	0.80	9.00	10.00	93.20	67.00	
13.50	370.00	0.75	8.00	10.00	92.90	69.00	
13.50	350.00	0.70	8.00	10.00	93.10	69.00	
14.50	590.00	0.30	6.00	8.00	93.50	57.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 3/88							

20.90	580.00	0.48	9.90	9.50	93.70	52.00	3 8 88
15.50	340.00	0.95	9.60	9.50	93.20	68.00	4 8 88
14.00	340.00	0.90	8.00	8.00	92.80	67.00	
14.00	360.00	0.70	8.00	7.00	93.10	67.00	
15.00	550.00	0.40	6.50	8.00	93.50	57.00	
15.50	530.00	0.50	6.00	10.00	93.60	53.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 4/88							

Appendix D (Continued)
Observed and Forecast Meteorological Data

14.50	227.00	0.92	10.80	10.30	93.40	79.50	4 8 88
13.00	332.00	0.75	9.00	8.00	93.20	77.00	5 8 88
14.00	401.00	0.70	9.00	8.00	93.20	72.00	
14.50	484.00	0.70	8.00	8.00	93.30	65.00	
15.50	428.00	0.75	8.00	12.00	93.30	61.00	
14.50	419.00	0.75	9.00	10.00	93.30	70.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 5/88							

13.30	466.00	0.56	7.80	5.30	93.10	75.00	5 8 88
15.00	425.00	0.68	8.50	5.50	92.80	68.00	6 8 88
15.50	500.00	0.40	7.50	7.00	93.40	59.00	
15.00	385.00	0.65	8.50	6.00	93.60	65.00	
14.50	300.00	0.75	8.50	8.00	93.50	70.00	
14.00	350.00	0.65	8.00	8.00	93.40	68.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 6/88							

13.40	467.00	0.64	9.00	4.30	93.10	76.60	6 8 88
14.00	510.00	0.40	8.20	8.50	93.40	68.00	7 8 88
13.50	270.00	0.90	9.00	9.00	93.30	75.00	
13.50	300.00	0.85	9.00	10.00	93.10	75.00	
13.50	410.00	0.65	8.50	8.00	93.30	72.00	
14.00	480.00	0.45	8.00	7.00	93.50	66.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 7/88							

15.30	590.00	0.48	8.00	9.60	93.40	66.60	7 8 88
13.60	230.00	0.95	12.00	17.00	93.20	90.00	8 8 88
13.50	333.00	0.85	10.00	12.00	93.20	79.00	
14.00	419.00	0.65	8.00	19.00	93.30	67.00	
14.00	485.00	0.45	7.00	7.00	93.50	63.00	
15.00	515.00	0.40	7.00	7.00	93.70	59.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 8/88							

13.50	143.00	0.99	13.00	18.80	93.20	96.50	8 8 88
13.10	273.00	0.89	10.00	12.00	93.30	81.00	9 8 88
14.00	421.00	0.65	7.50	6.00	93.40	65.00	
14.50	485.00	0.45	7.00	8.00	93.40	61.00	
15.00	515.00	0.40	6.50	8.00	93.30	57.00	
14.00	409.00	0.75	8.00	11.00	93.30	67.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 9/88							

Appendix D (Continued)
Observed and Forecast Meteorological Data

13.90	416.00	0.75	8.90	12.70	N/A	N/A	9 8 88
14.00	425.00	0.50	7.00	11.00	N/A	N/A	10 8 88
15.50	510.00	0.45	6.50	8.00	N/A	N/A	
16.00	525.00	0.40	6.50	8.00	N/A	N/A	
14.50	409.00	0.75	8.00	11.00	N/A	N/A	
14.50	485.00	0.45	7.00	8.00	N/A	N/A	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 10/88							

12.80	388.00	0.55	8.10	7.30	93.50	74.10	10 8 88
14.80	480.00	0.60	9.00	3.50	93.50	68.00	11 8 88
16.50	525.00	0.40	8.00	7.00	93.20	57.00	
14.50	265.00	0.80	10.00	11.00	93.00	74.00	
13.00	383.00	0.65	8.00	10.00	93.30	72.00	
12.80	461.00	0.45	7.00	8.00	93.50	68.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 11/88							

14.30	560.00	0.48	9.20	3.40	93.40	75.60	11 8 88
16.00	565.00	0.10	8.00	5.00	93.10	59.00	12 8 88
14.00	458.00	0.70	10.00	10.00	92.90	72.00	
13.50	261.00	0.70	9.00	12.00	93.30	74.00	
12.80	459.00	0.50	7.50	10.00	93.50	70.00	
13.50	375.00	0.65	8.00	8.00	93.50	69.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 12/88							

15.80	608.70	0.14	8.20	6.10	93.00	66.50	12 8 88
15.00	416.00	0.40	9.00	9.00	92.80	67.00	13 8 88
13.00	327.00	0.70	11.00	12.00	93.10	88.00	
12.50	294.00	0.70	11.00	11.00	93.40	91.00	
13.50	406.00	0.30	8.00	10.00	93.60	69.00	
15.00	453.00	0.20	7.00	7.00	93.50	59.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 13/88							

13.50	340.90	0.34	8.00	6.50	93.00	66.90	13 8 88
11.50	386.00	0.65	9.00	7.50	93.30	85.00	14 8 88
11.00	328.00	0.70	9.50	6.00	93.40	90.00	
11.50	294.00	0.80	10.00	5.50	93.60	90.00	
13.50	402.00	0.45	8.00	6.50	93.80	69.00	
15.00	445.00	0.20	7.50	6.00	93.90	61.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 14/88							

Appendix D (Continued)
Observed and Forecast Meteorological Data

12.90	362.00	0.67	7.20	7.60	93.30	69.60	14 8 88
12.20	231.00	0.98	9.00	6.50	93.30	81.00	15 8 88
13.00	245.00	0.98	10.00	6.50	93.30	82.00	
13.00	316.00	0.70	9.00	5.00	93.50	77.00	
13.50	412.00	0.55	5.50	7.00	93.60	65.00	
13.50	347.00	0.80	8.00	10.00	93.60	69.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 15/88							

13.30	367.00	0.83	9.50	4.90	93.20	79.00	15 8 88
13.00	170.00	0.90	9.75	8.00	93.30	81.00	16 8 88
13.00	250.00	0.80	9.00	10.00	93.50	72.00	
13.00	360.00	0.65	8.00	10.00	93.60	72.00	
13.00	408.00	0.70	7.00	10.00	93.50	69.00	
13.00	403.00	0.70	7.00	10.00	93.50	69.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 16/88							

13.00	221.00	0.94	10.50	7.50	93.20	86.00	16 8 88
13.50	340.00	0.80	10.50	5.00	93.50	85.00	17 8 88
13.00	330.00	0.85	10.00	10.00	93.50	85.00	
13.00	410.00	0.65	9.00	7.00	93.60	70.00	
13.00	430.00	0.65	7.00	9.00	93.50	68.00	
13.00	340.00	0.80	8.00	10.00	92.90	80.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 17/88							

14.00	479.00	0.65	10.10	7.30	93.40	80.20	17 8 88
13.00	350.00	0.90	9.00	15.00	93.60	75.00	18 8 88
13.00	400.00	0.65	9.00	8.00	93.50	75.00	
13.00	320.00	0.85	10.00	8.00	92.70	80.00	
13.00	370.00	0.65	9.00	11.00	93.40	75.00	
13.00	390.00	0.55	8.00	10.00	93.50	70.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 18/88							

13.00	255.50	0.88	10.00	11.30	93.60	82.50	18 8 88
12.50	250.00	0.90	10.00	6.00	93.30	90.00	19 8 88
13.00	320.00	0.85	10.00	10.00	93.10	85.00	
13.00	375.00	0.70	9.00	10.00	93.60	75.00	
13.00	440.00	0.50	8.00	6.00	93.80	70.00	
13.00	440.00	0.50	8.00	8.00	93.60	70.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
MEP FORECAST ISSUED AUG 19/88							

N/A - Data not available.

APPENDIX E

Summer Water Temperature and Flow Management Project Reservoir
Release Volume Calculations for July 10 to August 20, 1988

Appendix E
 Summer Water Temperature and Flow Management Project Reservoir Release Volume Calculations
 for July 10 to August 20, 1988

Skins Lake Spillway base release for the period July 10 (192) to August 20 (233) = 48.3 m³/s (1,706 cfs)
 Therefore, Summer Water Temperature and Flow Management Project Base Volume = (233 - 191) * 48.3
 = 2,028.6 m³/s-days

Time period (Julian Day)	Time (hrs)	Flow Rate (m ³ /s)	Volume (m ³ /s-hrs)
July 10 (192) @ 0000 hrs to July 11 (193) @ 1600 hrs	40	48.3	1,932
July 11 (193) @ 1600 hrs to July 18 (200) @ 1600 hrs	168	227	38,136
July 18 (200) @ 1600 hrs to August 16 (229) @ 0800 hrs	688	170	116,960
August 16 (229) @ 0800 hrs to August 20 (233) @ 2400 hrs	112	29.7	3,326
Total	1008 (42 days)		160,354
Total Release Volume		= 160,354 m³/s-hrs = 6,681.4 m³/s-days	
Therefore, Volume Released for Cooling Purposes		= Total Volume - Base Volume = 6,681.4 - 2,028.6 = 4,652.8 m³/s-days	
Average Flow over Summer Management Period (July 10 to August 20, 1988)		= 4,652.8 m³/s-days / 42 days = 110.8 m³/s = 3,859 cfs	