

**THE 2001 SUMMER WATER
TEMPERATURE AND FLOW
MANAGEMENT PROJECT**

*NECHAKO FISHERIES CONSERVATION PROGRAM
Technical Report No. RM01-1*

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ABSTRACT

The 2001 Nechako River Summer Water Temperature and Flow Management Project (the Project) was undertaken to attempt to prevent mean daily water temperatures in the Nechako River above the Stuart River confluence (at Finmoore) from exceeding 20.0°C (68.0°F) from July 20 to August 20. Water temperatures were managed by regulating Skins Lake Spillway releases to control flows in the Nechako River below Cheslatta Falls and at Vanderhoof. In 2001, mean daily water temperatures in the Nechako River above the Stuart River confluence did not exceed 20.0°C (68.0°F).

Over the duration of the 2001 Summer Water Temperature and Flow Management Project (July 10 to August 20), the total volume of water released was 7,548.9 m³/s-d, (266,587 cfs-d), and the average release during the Project was 179.7 m³/s (6,350 cfs).

INTRODUCTION

Control of the Nechako River water temperature for protection of fish resources is a concern of both government agencies and Alcan. Each summer between 1981 and 1984, Alcan Primary Metal Group (Alcan), Triton Environmental Consultants 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, an independent water temperature and flow management project similar to the one used during the summer of 1984 (Envirocon 1985) was carried out. Since 1988, analogous water temperature and flow management projects (Triton 1995a through 1995h, Triton 1996, Triton 1997, Triton 1998, Triton 1999, Triton 2000) have been carried out under the auspices of the Nechako Fisheries Conservation Program (NFCP).

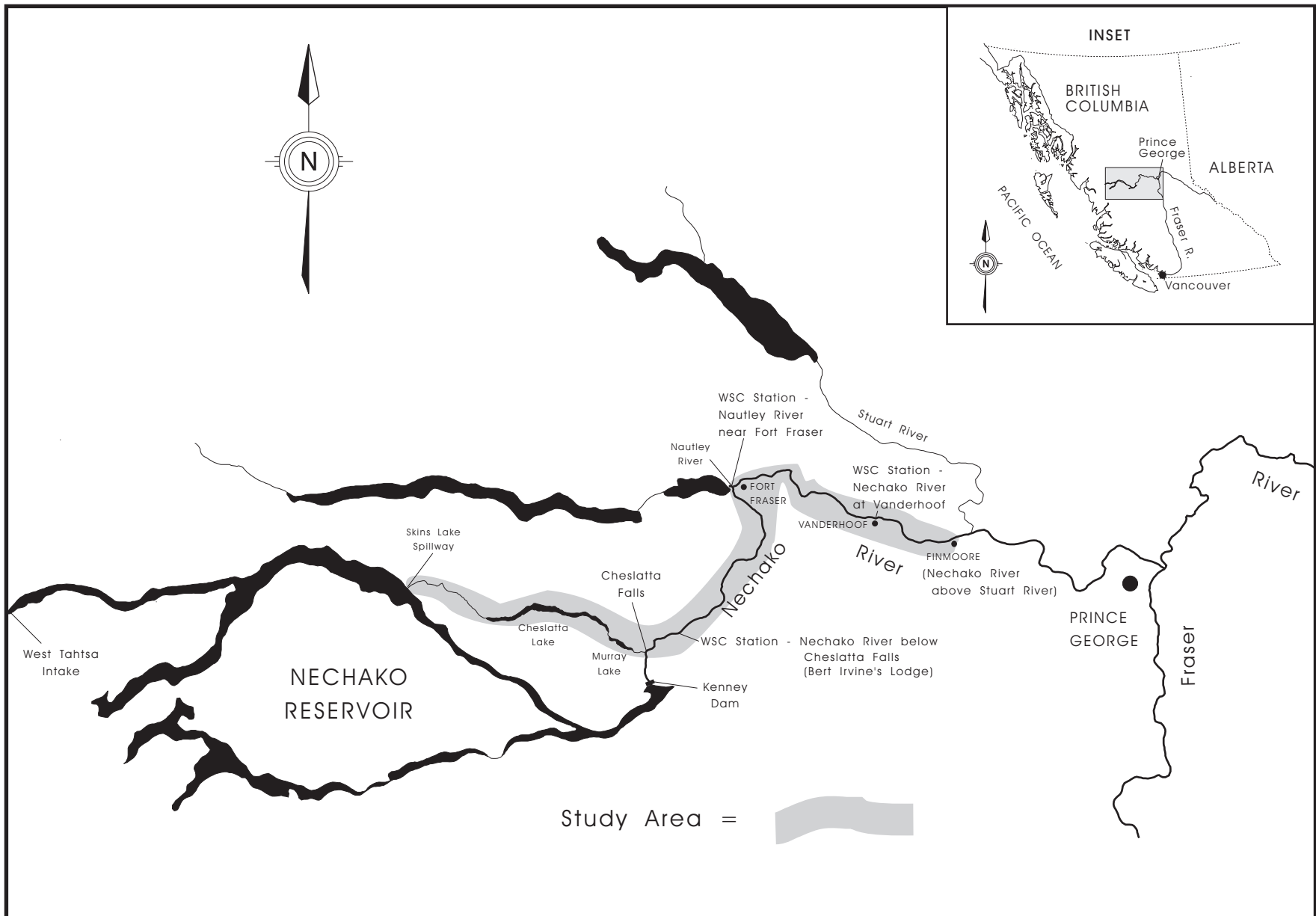
The Nechako River Summer Water Temperature and Flow Management Project (the Project) currently in place was designed and developed in 1982 and has been successfully implemented since 1983. The objective of the Project is to attempt to prevent mean daily water temperatures in the Nechako River above the Stuart River confluence (at Finmoore) from exceeding 20.0°C (68.0°F). This objective is met by regulating releases from the Skins Lake Spillway to control flows in the Nechako River below Cheslatta Falls and at Vanderhoof. The Project operates from July 10 to August 20 (the operational period) with the goal of

managing water temperatures in the Nechako River at Finmoore between July 20 and August 20 (the water temperature control period, hereafter referred to as the control period). Flows in the Nechako River at Cheslatta Falls are also to be reduced to fall spawning flows by early September. These dates may vary as directed by the NFCP in accordance with the timing of sockeye runs in the system. The Project study area is shown in Figure 1. Unless otherwise stated, references to water temperatures, flows (including releases) and meteorological data are mean daily values, and the location of the Nechako River above the Stuart River confluence refers to the Nechako River at Finmoore.

This report reviews the 2001 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 2001 Skins Lake Spillway release recommendations for the period July 10 to September 6 inclusive, and a summary of recorded 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 2001 Summer Water Temperature and Flow Management Project.

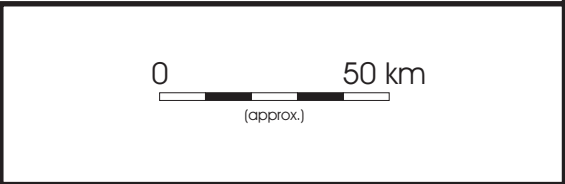
METHODS

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



Nechako Fisheries Conservation Program Map # RM01-1

FIGURE 1. NECHAKO RIVER STUDY AREA



jectives. The Summer Water Temperature and Flow Management uses 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. Numerical modelling of flows and water temperatures in the Nechako River was performed daily during the entire operational period.

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 the Nautley River), in the Nechako River above the Stuart River confluence 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 World Weatherwatch, a sub consultant 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 on the 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. The adjustment provided 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 recorded 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 reported are as requested by Triton. All Nechako River and Nautley River flow

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

The first ten days of the operational period, July 10 to July 19, were utilized for system start up, for initialization of the database required to schedule Skins Lake Spillway releases necessary to meet project water temperature objectives during the control period commencing July 20, and to increase 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 typical approach used to increase the Skins Lake Spillway release from the spring base release to the Summer Water Temperature and Flow Management Project base release was modified this year in response to construction activities immediately downstream of the Skins Lake Spillway. The 2001 Skins Lake Spillway spring base release, as determined by NFCP, was 52.6 m³/s (1,860 cfs). Prior to the start of the operational period, the Skins Lake Spillway release was increased from 52.6 m³/s (1,860 cfs) to 100 m³/s (3,530 cfs) on July 8. The Skins Lake Spillway release was then increased incrementally to 110 m³/s (3,880 cfs), to 120 m³/s (4,240 cfs) and to 255 m³/s (9,000 cfs) on July 10, July 12 and July 14, respectively. The Skins Lake Spillway was subsequently decreased to 198 m³/s (7,000 cfs) and to 170 m³/s (6,000 cfs) on July 18 and July 19, respectively 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). Upon commencement of the operational period on July 10, the recorded flow in the Nechako River below Cheslatta Falls was 56.0 m³/s (1,980 cfs).

Throughout the operational period, water temperatures in the Nechako River were calculated daily for the previous day, the current day and each of the next four days. These calculations were based on recorded and five-day forecast meteorological data, recorded 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 recorded 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 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 recorded mean daily water temperatures measured in the Nechako River above the Stuart River confluence each day (bo and co in Table 1). The difference in recorded water temperatures for the previous two days is extrapolated over the next five days to determine the observed water temperature trend.

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 Recorded Water Temperature @ Date - 1 Day			ao	bo	co					
Current Day's Release @ Date				ra	rb	rc				

observed trend
 predicted trend
 forecast trend

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

-
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 current day and the next two days only are averaged and added to the fifth 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 the Stuart River confluence 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 the Stuart River confluence, 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 the Stuart River confluence 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 the beginning of the control period, and is to be reduced to approximately 31.2 m³/s (1,100 cfs) by September 6.

3. At any time, increase the Skins Lake Spillway release from the current level to 453 m³/s (16,000 cfs) 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 (five days), reduce the Skins Lake Spillway release from the current level to 14.2 m³/s (500 cfs).

RESULTS

Predicted and recorded mean daily water temperatures for the Nechako River above the Stuart River confluence, Skins Lake Spillway releases and changes in Skins Lake Spillway releases over the duration of the Project operational period are summarized in Table 2.

Recorded mean daily water temperatures in the Nechako River above the Stuart River confluence (Figure 2 and Table 3) did not exceed 20.0°C (68.0°F). The respective maximum and minimum mean daily water temperatures recorded during the control period were 19.6°C (67.3°F) on August 15, 16 and 17, and 16.4°C (61.5°F) on August 7. A summary of mean daily water temperatures recorded during the Project in the Nechako River below Cheslatta Falls, near Fort Fraser and above the Stuart River confluence, and in the Nautley River near Fort Fraser is presented in Appendix B.

As outlined in the Methods section, Skins Lake Spillway releases required for water temperature control were regulated during the control period to ensure flows in the Nechako River below Cheslatta Falls were

Table 2 (continued)
 Predicted and Recorded Mean Daily Water Temperatures in the Nechako River above the Stuart River Confluence, July 10 to August 20, 2001

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	18.3	18.3	17.7	17.0	17.1	17.9	17.4	17.7	18.8	19.3	19.4	19.9	19.3	19.4	19.4	19.6	19.3	19.4	18.5	18.4
4th Day's Predicted Water Temperature at Date + 3 Days	17.9	18.1	17.2	16.7	17.6	17.0	17.2	18.0	18.6	19.1	19.6	19.4	19.4	19.4	19.8	19.7	19.8	19.4	18.8	18.4
3rd Day's Predicted Water Temperature at Date + 2 Days	18.2	17.7	16.7	17.2	16.9	17.1	17.4	17.6	18.2	18.8	19.2	19.2	19.3	19.9	20.2	20.2	19.8	19.4	18.8	17.5
2nd Day's Predicted Water Temperature at Date + 1 Day	18.2	17.0	17.0	17.1	17.2	17.0	16.9	17.4	17.7	19.1	19.0	19.2	19.8	20.5	20.5	20.1	20.0	19.5	17.8	16.5
Current Day's Predicted Water Temperature at Date	17.7	17.2	17.1	17.4	16.8	16.9	17.0	16.9	18.1	18.8	19.0	19.4	20.2	20.4	20.3	20.3	20.0	18.9	17.1	17.0
Previous Day's Calculated Water Temperature at Date - 1 Day	17.7	17.3	17.3	17.5	16.8	17.0	16.8	17.1	18.0	18.8	19.0	19.5	20.2	20.3	20.2	20.3	19.9	18.7	17.3	
Previous Day's Recorded Water Temperature at Date - 1 Day	17.4	17.0	17.1	16.8	16.7	16.6	16.4	16.5	17.1	18.0	18.4	18.9	19.3	19.4	19.6	19.6	19.6	18.7	17.4	
Current Day's Skins Lake Spillway Release at Date (m ³ /s)	170	170	170	170	170	170	170	453	14.2	170	170	170	453	453	283	283	14.2	14.2	14.2	14.2
								to	to	to			to	to	to					
								453	14.2	170			453	283	14.2					
								@	@	@			@	@	@					
								1700	1700	2000			1700	1700	1700					
								hrs	hrs	hrs			hrs	hrs	hrs					

Table 3
Recorded Mean Daily Water Temperatures in the Nechako River above the Stuart River Confluence, July 10 to August 20, 2001

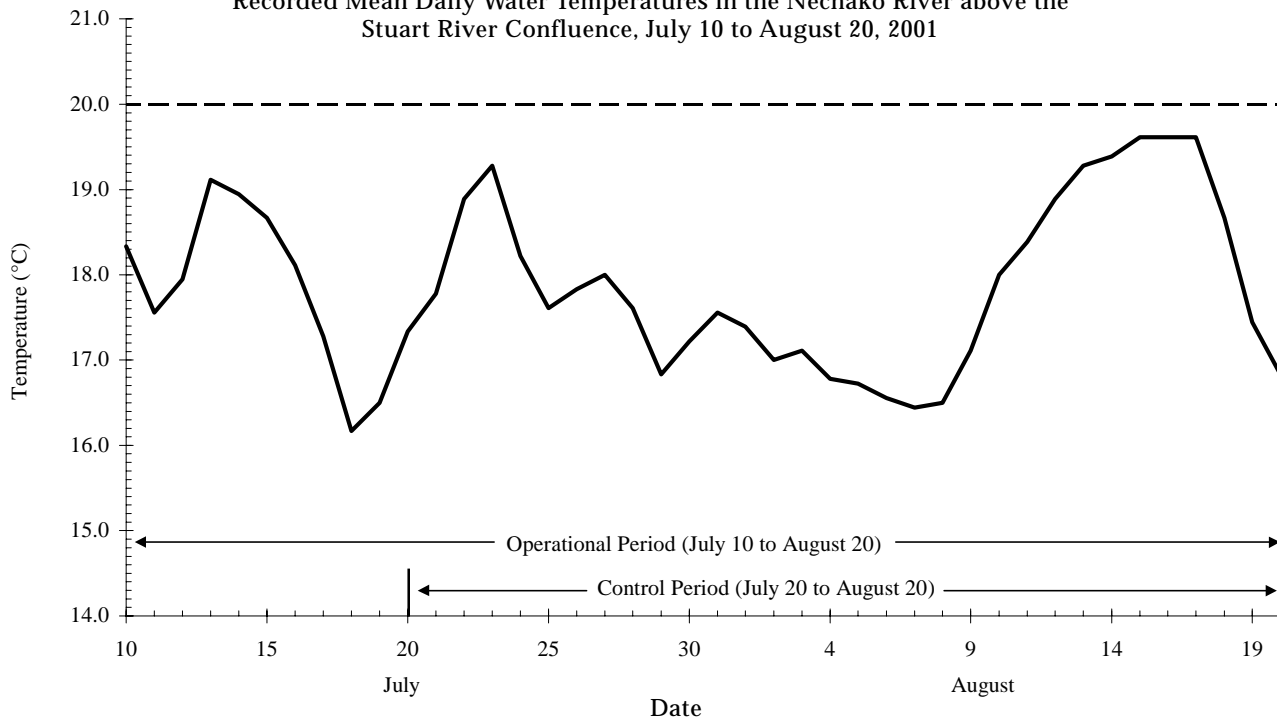


Table 3
Recorded Mean Daily Water Temperatures in the Nechako River above the Stuart River Confluence, July 10 to August 20, 2001

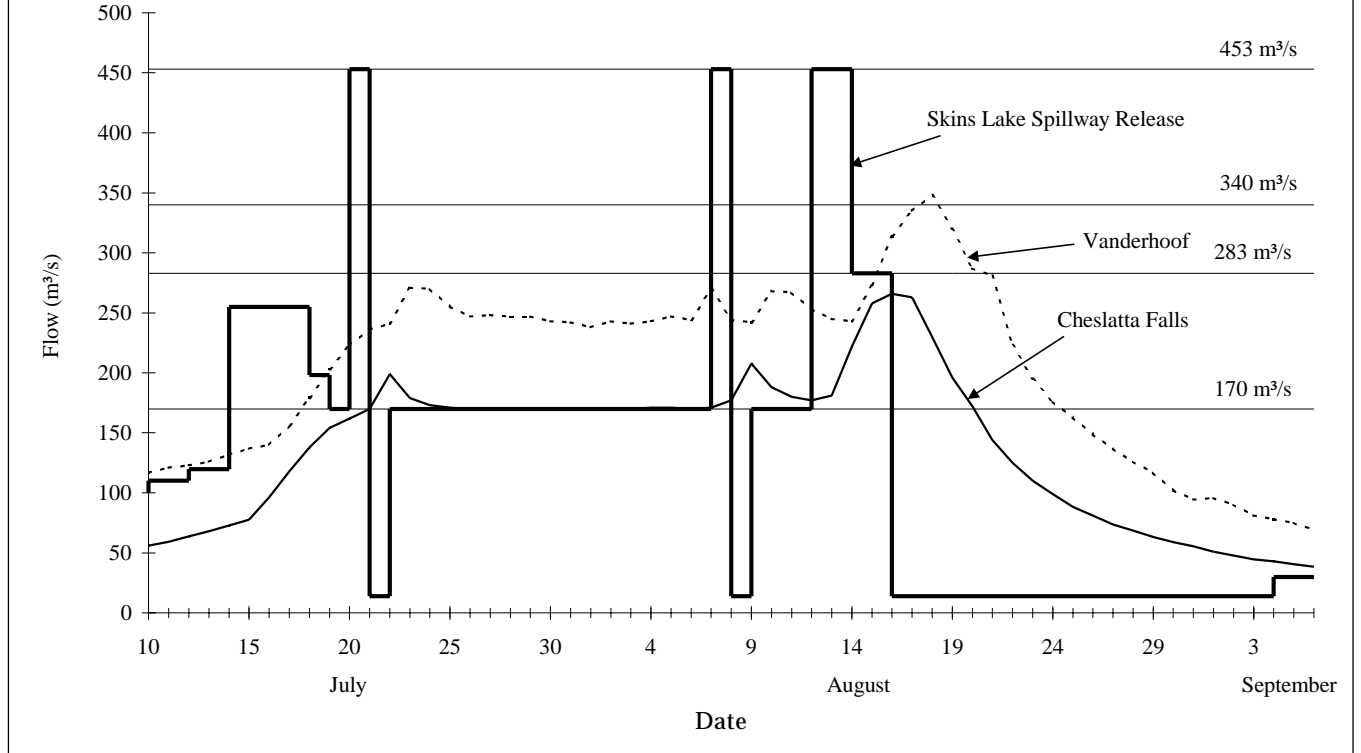
Date	Water Temperature (°C)	Date	Water Temperature (°C)
10-Jul	18.3	01-Aug	17.4
11-Jul	17.6	02-Aug	17.0
12-Jul	17.9	03-Aug	17.1
13-Jul	19.1	04-Aug	16.8
14-Jul	18.9	05-Aug	16.7
15-Jul	18.7	06-Aug	16.6
16-Jul	18.1	07-Aug	16.4
17-Jul	17.3	08-Aug	16.5
18-Jul	16.2	09-Aug	17.1
19-Jul	16.5	10-Aug	18.0
20-Jul	17.3	11-Aug	18.4
21-Jul	17.8	12-Aug	18.9
22-Jul	18.9	13-Aug	19.3
23-Jul	19.3	14-Aug	19.4
24-Jul	18.2	15-Aug	19.6
25-Jul	17.6	16-Aug	19.6
26-Jul	17.8	17-Aug	19.6
27-Jul	18.0	18-Aug	18.7
28-Jul	17.6	19-Aug	17.4
29-Jul	16.8	20-Aug	16.8
30-Jul	17.2		
31-Jul	17.6		

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 their 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 record of Skins Lake Spillway release changes during the Project and the reasoning behind them is presented in Table 4.

During the 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 266 m³/s (9,390 cfs) on August 16 and a minimum of 161 m³/s (5,690 cfs) on July 20. Flows measured in the Nechako River at Vanderhoof ranged between a maximum of 348 m³/s (12,300 cfs) on August 18 and a minimum of 223 m³/s (7,880 cfs) on July 20. Following the control period, the mean daily flow in the Nechako River below Cheslatta Falls was reduced to 38.6 m³/s (1,360 cfs) by September 6.

Figure 3
Skins Lake Spillway Releases and Flows in the Nechako River below Cheslatta Falls
and at Vanderhoof, July 10 to September 6, 2001



DISCUSSION

Decision criteria used to determine Skins Lake Spillway releases during the 2001 Summer Water Temperature and Flow Management Project were identical to those used during summer water temperature and flow management projects since 1984. The discussion of the 2001 Summer Water Temperature and Flow Management Project has been divided into three sections. The first section reviews the collection and use of recorded field data. Variables measured include water temperature, flow, and meteorological data (recorded and forecast). The second section discusses the volume of water used during the 2001 Summer Water Temperature and Flow Management Project. The third section discusses instances when judgment was exercised during the application of the release criteria. This was based on experience gained in previous years' operation of the Summer Water Temperature and Flow Management Project.

Recorded Data

Triton's modelling procedure is based on the premise that the best way to forecast water temperatures is to

initialise computations with recorded 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 also ensures a constant bias throughout the project.

In 2001, 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 accurate. Flows in the Nechako River below Cheslatta Falls and at Vanderhoof responded as expected in response to Skins Lake Spillway releases. The Nautley River flow regime was well below average for the time of year. The ability to obtain hourly stage data from the gauging station located on 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 previously stated, spot and corresponding recorder (thermograph) water temperatures were collected in

Table 4
Rationale for Skins Lake Spillway Release Changes, July 10 to September 6, 2001

Date 2000	Old Setting (m ³ /s)	New Setting (m ³ /s)	Time of Change (hrs)	Reason for Changing SLS Release Setting
10-Jul	100	110	1700	Incremental increase to achieve base flow of 170 m ³ /s in the Nechako River below Cheslatta Falls by July 20
12-Jul	110	120	1700	Incremental increase to achieve base flow of 170 m ³ /s in the Nechako River below Cheslatta Falls by July 20
14-Jul	120	255	1700	Incremental increase to achieve base flow of 170 m ³ /s in the Nechako River below Cheslatta Falls by July 20
18-Jul	255	198	1600	Adjustment to achieve base flow of 170 m ³ /s
19-Jul	198	170	1600	To maintain base flow of 170 m ³ /s
20-Aug	170	453	1600	In response to a predicted warming trend
21-Jul	453	14.2	1500	In response to a predicted cooling trend
22-Jul	14.2	170	2000	To maintain base flow of 170 m ³ /s
07-Aug	170	453	1700	In response to a predicted warming trend
08-Aug	453	14.2	1700	In response to a predicted cooling trend
09-Aug	14.2	170	2000	To maintain base flow of 170 m ³ /s
12-Aug	170	453	1700	In response to a predicted warming trend
14-Aug	453	283	1700	To avoid exceedence of 283 m ³ /s in the Nechako River below Cheslatta Falls
16-Aug	283	14.2	1700	In response to a predicted cooling trend
04-Sep	14.2	30.0	0900	To achieve spawning flow in the Nechako River below Cheslatta Falls by early September

the Nechako River at Fort Fraser (upstream of the Nautley River), in the Nechako River above the Stuart River confluence 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 to adjust water temperatures and the method applied was that outlined in the Methods section of this report.

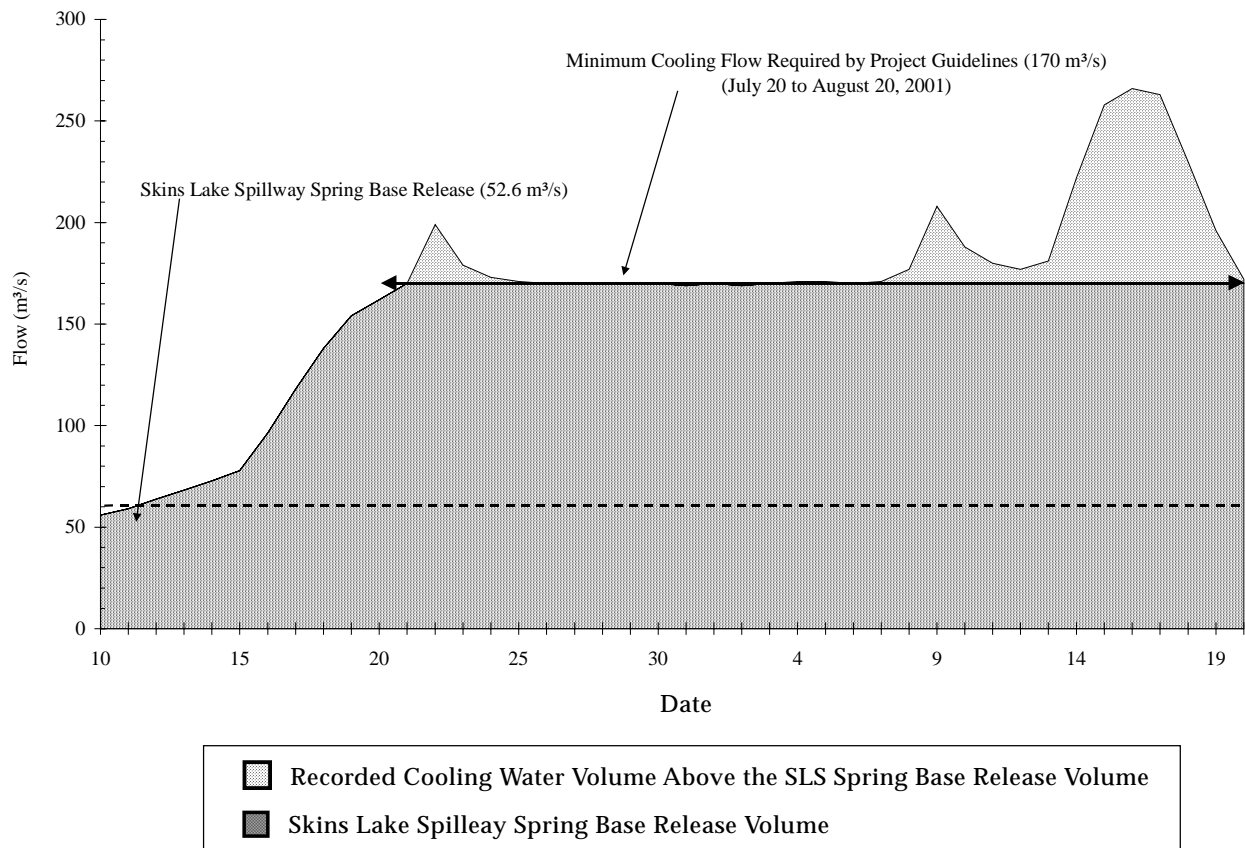
Recorded and forecast meteorological data were obtained daily from World Weatherwatch, a sub consultant to Triton. These forecast weather data were developed using recorded weather data acquired from the Atmospheric Environmental Service (AES) station at Prince George Airport and from the meteorological monitoring station installed by Triton at Fort Fraser. The recorded and forecast weather data were

used to estimate water temperatures in the Nechako River below Cheslatta Falls and in the Nautley River for the current day and following four days. A listing of the recorded and forecast meteorological data is provided in Appendix D.

Volume of Water Used

Figure 4 presents the recorded flows in the Nechako River below Cheslatta Falls for the 2001 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 52.6 m³/s (1,860 cfs) as determined by the NFCP Technical Committee as part of the “Annual Water Allocation” de-

Figure 4
Flows in the Nechako River below Cheslatta Falls Resulting from Skins Lake Spillway Releases,
July 10 to August 20, 2001



fined in the Settlement Agreement. Skins Lake Spillway releases in excess of 52.6 m³/s (1,860 cfs) are considered releases used for cooling purposes.

The total volume of water released during the 2001 Summer Water Temperature and Flow Management Project operational period was 7,548.9 m³/s-d, (266,587 cfs-d). The volume released for cooling purposes was 5,339.7 m³/s-d (188,570 cfs-d), and is based on an assumed Skins Lake Spillway release of 52.60 m³/s (1,860 cfs) for the period July 10 to August 20, inclusive. The average release during the operational period was 179.7 m³/s (6,350 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 an increase or decrease in temperature occurs over a prolonged period of time (three or four days), inaccurate meteorological forecasts may predict the reversal of the temperature change 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 helped to develop the judgment required to make exceptions to the release criteria during such events, which has proven to be beneficial in the management of downstream water temperatures.

There was one occasion during the operational period when judgement was applied and an exception to the release criteria was made. This exception occurred on August 7, when one of three water temperature trends (predicted trend) indicated that the water temperature could reach 19.4°C (67.0°F) in the Nechako River above the Stuart River confluence within the forecast period (5 days). The remaining two trends showed that the water temperature could either reach 19.3°C (66.7°F) (forecast trend) or 15.7°C (60.3°F) (observed trend). Following the release criteria under these conditions, the release from Skins Lake Spillway should have been maintained at the current release of 170 m³/s (6,000 cfs). However, based on experience in previous summers, downstream water temperatures have increased rapidly under similar conditions. Thus, it was decided to increase the Skins Lake Spillway release to 453 m³/s (16,000 cfs). Conditions on August 8 showed that although the water temperatures were warming, the rate of warming was minimal, and the Skins Lake Spillway release was reduced to 14.2 m³/s (500 cfs). Subsequently, downstream water temperatures continued to warm, and on August 12, the Skins Lake Spillway release was again increased to 453 m³/s (16,000 cfs). Downstream water temperatures reached a maximum of 19.6°C (°F) from August 15 to 17 before cooling rapidly toward the end of the STMP operational period.

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APPENDIX A

Numerical Example of Water Temperature Trend Calculation

Appendix A
Numerical Example of Water Temperature Trend Calculation

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

1. Observed Trend

The observed trend is down by 0.2°C from 18.9°C (J14) to 18.7°C (J15). Take the previous day's recorded temperature 18.7°C (J15) and extrapolate the trend for five days at -0.2°C . The observed trend shows that the water temperature could potentially reach $18.7^{\circ}\text{C} + 5(-0.2^{\circ}\text{C}) = 17.7^{\circ}\text{C}$.

2. Predicted Trend

The predicted trend is the difference between the previous day's calculated water temperature (J15) and the fifth day predicted water temperature (J20). The predicted trend is down from 19.5°C to 17.3°C with the potential to reach 17.3°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	18.2 to 18.8 = up 0.6°C
July 17	17.3 to 18.0 = up 0.7°C
July 18	16.7 to 17.2 = up 0.5°C

Mean of 3 differences = up 0.6°C

This mean of $+0.6^{\circ}\text{C}$ is added to the fifth day predicted water temperature to give $17.3^{\circ}\text{C} + (0.6^{\circ}\text{C}) = 17.9^{\circ}\text{C}$.

The forecast trend is up 0.6°C with the potential to reach 17.9°C .

Appendix A (continued)
Numerical Example of Water Temperature Trend Calculation

A1: Predicted and Recorded Mean Daily Water Temperatures in the
Nechako River Above the Stuart River Confluence

Date	JULY										
	10	11	12	13	14	15	16	17	18	19	20
5th Day's Predicted Water Temperature at Date + 4 Days					19.4	18.4	17.8	16.8	17.4	16.6	17.3
4th Day's Predicted Water Temperature at Date + 3 Days				19.5	18.6	18.4	17.4	17.6	16.7	16.8	
3rd Day's Predicted Water Temperature at Date + 2 Days			19.3	18.8	19.0	18.6	18.3	17.3	17.2		
2nd Day's Predicted Water Temperature at Date + 1 Day		17.6	18.6	19.1	19.7	19.4	18.2	18.0			
Current Day's Predicted Water Temperature at Date	16.9	18.1	18.7	19.7	20.1	19.1	18.8				
Previous Day's Calculated Water Temperature at Date - 1 Day	17.3	18.7	18.9	20.0	20.1	19.5					
Previous Day's Recorded Water Temperature at Date - 1 Day	18.3	17.6	17.9	19.1	18.9	18.7					
Current Day's Skins Lake Spillway Release at Date (m ³ /s)	100 to 110 @ 1700 hrs	110 to 120 @ 1700 hrs	110 to 120 @ 1700 hrs	120 to 255 @ 1700 hrs	120 to 255 @ 1700 hrs	254.9	254.9				

Appendix B
Mean Daily Water Temperatures in the Nechako
and Nautley Rivers, 2001

Appendix B
Mean Daily Water Temperatures in the Nechako and Nautley Rivers, 2001

Date	Nechako River			Nautley	Date	Nechako River			Nautley
	Cheslatta Falls (°C)	Fort Fraser (°C)	above the Stuart River (°C)	Fort Fraser (°C)		Cheslatta Falls (°C)	Fort Fraser (°C)	above Stuart River (°C)	Fort Fraser (°C)
10-Jul	15.6	16.6	18.3	16.3	01-Aug	15.9	16.9	17.4	17.7
11-Jul	15.8	16.7	17.6	17.1	02-Aug	15.8	16.7	17.0	17.3
12-Jul	16.2	17.8	17.9	17.7	03-Aug	15.9	17.2	17.1	17.2
13-Jul	16.3	18.0	19.1	18.3	04-Aug	16.0	16.0	16.8	17.1
14-Jul	16.4	17.8	18.9	16.9	05-Aug	15.8	16.2	16.7	17.3
15-Jul	16.0	17.3	18.7	16.4	06-Aug	15.6	16.2	16.6	17.2
16-Jul	15.4	16.3	18.1	16.2	07-Aug	15.6	15.6	16.4	16.6
17-Jul	15.6	16.2	17.3	15.8	08-Aug	15.8	16.8	16.5	17.7
18-Jul	15.5	16.1	16.2	15.4	09-Aug	15.8	17.3	17.1	18.3
19-Jul	15.3	16.4	16.5	16.3	10-Aug	16.1	17.5	18.0	18.6
20-Jul	15.4	16.9	17.3	16.3	11-Aug	16.6	17.6	18.4	19.4
21-Jul	15.3	17.1	17.8	17.2	12-Aug	17.1	18.2	18.9	19.8
22-Jul	15.9	17.4	18.9	18.0	13-Aug	17.4	18.6	19.3	19.8
23-Jul	16.3	17.3	19.3	18.0	14-Aug	17.5	18.8	19.4	19.8
24-Jul	15.8	16.8	18.2	16.9	15-Aug	17.6	18.9	19.6	20.4
25-Jul	15.9	16.6	17.6	17.6	16-Aug	18.6	18.8	19.6	21.1
26-Jul	16.2	17.7	17.8	17.8	17-Aug	17.7	18.3	19.6	20.2
27-Jul	15.9	16.8	18.0	17.4	18-Aug	17.4	17.3	18.7	18.9
28-Jul	15.7	16.0	17.6	16.8	19-Aug	17.1	17.0	17.4	18.4
29-Jul	15.7	16.8	16.8	17.0	20-Aug	17.1	17.2	16.8	18.2
30-Jul	15.7	16.7	17.2	17.4					
31-Jul	15.7	16.3	17.6	17.3					

Appendix C
Mean Daily Skins Lake Spillway Releases and Flows
in the Nechako and Nautley Rivers, 2001

Appendix C
Mean Daily Skins Lake Spillway Releases and Flows
in the Nechako and Nautley Rivers, 2001

Date	Skins Lake Spillway Release (m ³ /s)	Nechako River		Nautley River
		Cheslatta Falls (m ³ /s)	At Vanderhoof (m ³ /s)	Fort Fraser (m ³ /s)
10-Jul	100 to 110 @ 1700 hrs	56.0	117.0	41.4
11-Jul	110	59.1	121.0	42.3
12-Jul	110 to 120 @ 1703 hrs	63.8	123.0	41.4
13-Jul	120	68.1	126.0	40.4
14-Jul	120 to 255 @ 1700 hrs	72.8	132.0	40.4
15-Jul	255	77.8	136.9	38.6
16-Jul	255	96.4	140.0	38.6
17-Jul	255	118.0	156.0	37.9
18-Jul	255 to 198 @ 1600 hrs	138.0	179.0	41.4
19-Jul	198 to 170 @ 1600 hrs	154.0	203.0	36.1
20-Jul	170 to 453 @ 1600 hrs	161.0	223.0	35.4
21-Jul	453 to 14.2 @ 1445 hrs	170.0	236.0	35.2
22-Jul	14.2 to 170 @ 2000 hrs	199.0	241.0	34.5
23-Jul	170	179.0	271.0	34.1
24-Jul	170	173.0	270.0	34.6
25-Jul	170	171.0	255.0	32.7
26-Jul	170	170.0	247.0	32.2
27-Jul	170	170.0	248.0	31.7
28-Jul	170	170.0	247.0	31.5
29-Jul	170	170.0	247.0	31.3
30-Jul	170	170.0	243.0	29.6
31-Jul	170	169.0	242.0	29.0
01-Aug	170	170.0	238.0	28.2
02-Aug	170	169.0	243.0	28.1
03-Aug	170	170.0	241.0	28.1
04-Aug	170	171.0	243.0	28.7
05-Aug	170	171.0	247.0	27.6
06-Aug	170	170.0	244.0	27.3
07-Aug	170 to 453 @ 1700 hrs	171.0	270.0	26.9

Appendix C (continued)
Mean Daily Skins Lake Spillway Releases and Flows
in the Nechako and Nautley Rivers, 2001

Date	Skins Lake Spillway Release (m ³ /s)	Nechako River		Nautley River
		Cheslatta Falls (m ³ /s)	At Vanderhoof (m ³ /s)	Fort Fraser (m ³ /s)
08-Aug	453 to 14.2 @ 1700 hrs	177.0	244.0	26.3
09-Aug	14.2 to 170 @ 2000 hrs	208.0	242.0	25.6
10-Aug	170	188.0	268.0	25.3
11-Aug	170	180.0	267.0	25.0
12-Aug	170 to 453 @ 1700 hrs	177.0	253.0	28.4
13-Aug	453	181.0	245.0	24.3
14-Aug	453 to 283 @ 1700 hrs	222.0	243.0	23.8
15-Aug	283	258.0	273.0	23.1
16-Aug	283 to 14.2 @ 1700 hrs	266.0	314.0	22.5
17-Aug	14.2	263.0	335.0	22.7
18-Aug	14.2	230.0	348.0	22.3
19-Aug	14.2	196.0	320.0	21.6
20-Aug	14.2	172.0	283.0	21.2
21-Aug	14.2			
22-Aug	14.2			
23-Aug	14.2			
24-Aug	14.2			
25-Aug	14.2			
26-Aug	14.2			
27-Aug	14.2			
28-Aug	14.2			
29-Aug	14.2			
30-Aug	14.2			
31-Aug	14.2			
01-Sep	14.2			
02-Sep	14.2			
03-Sep	14.2			
04-Sep	14.2 to 30.0 @ 0830 hrs			
05-Sep	30.0			
06-Sep	30.0			

n/a - data not available

Appendix D
Recorded and Forecast Meteorological Data

Appendix D
Recorded and Forecast Meteorological Data

16.50	500.00	0.49	9.10	3.50	93.70	63.90	9 07 01
16.30	440.00	0.64	10.10	7.00	93.45	67.00	10 07 01
15.80	560.00	0.43	5.70	5.50	93.61	51.00	
17.30	620.00	0.48	6.30	3.50	93.74	48.00	
17.70	390.00	0.75	9.80	9.00	93.65	60.00	
16.90	350.00	0.85	11.00	8.00	93.68	58.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 10/01

13.8	500	0.76	10.6	6	93.4	82.3	10 07 01
15	540	0.38	5.5	6.5	93.75	53	11 07 01
17	570	0.46	5.8	4	93.96	48	
17.6	410	0.7	9.4	8	93.56	59	
16.2	350	0.85	10.8	9.5	93.31	70	
15.8	450	0.68	6.8	9.5	93.05	55	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 11/01

13.4	748	0.26	4.8	5.9	93.7	61	11 07 01
15	620	0.4	5.6	5	93.85	53	12 07 01
16.8	390	0.75	9.8	7	93.5	63	
15.8	300	0.9	11	8.5	93.23	73	
15.3	400	0.74	7.8	8	93.11	61	
14.8	350	0.65	6.8	5	92.83	59	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 12/01

15.00	721.00	0.23	4.50	6.60	93.80	55.60	12 07 01
16.00	500.00	0.39	6.10	5.80	93.60	57.00	13 07 01
15.00	400.00	0.60	7.50	6.00	93.30	65.00	
14.00	300.00	0.80	8.00	9.00	92.90	73.00	
13.50	300.00	0.70	7.50	6.00	92.90	72.00	
14.00	400.00	0.60	6.00	8.00	93.10	64.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 13/01

17.00	652.00	0.36	5.90	8.20	93.60	52.60	13 07 01
14.20	380.00	0.82	8.30	8.00	93.30	72.00	14 07 01
14.50	370.00	0.80	8.00	5.00	92.70	69.00	
14.00	320.00	0.70	8.50	4.00	92.40	75.00	
14.30	350.00	0.60	8.40	3.00	92.70	73.00	
14.50	400.00	0.56	8.70	4.00	92.90	73.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 14/01

Appendix D (continued)
Recorded and Forecast Meteorological Data

14.00	508.10	0.87	8.80	7.30	93.50	72.30	14 07 01
13.90	400.00	0.75	7.30	6.00	92.80	68.00	15 07 01
13.60	320.00	0.80	7.20	6.00	92.60	71.00	
13.80	320.00	0.75	7.40	7.00	92.50	70.00	
14.00	350.00	0.65	7.60	8.00	92.80	70.00	
14.50	400.00	0.65	7.20	9.00	93.10	67.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 15/01

14.70	593.00	0.80	6.60	4.70	92.90	60.30	15 07 01
12.60	320.00	0.90	7.70	4.00	92.90	78.00	16 07 01
14.00	380.00	0.73	7.80	6.00	93.10	71.00	
13.50	320.00	0.90	8.00	10.00	92.90	75.00	
15.00	450.00	0.65	7.00	10.00	93.10	64.00	
16.00	650.00	0.30	6.00	6.00	93.70	55.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 16/01

13.90	311.10	0.84	8.50	2.70	92.90	71.00	16 07 01
15.20	340.00	0.86	10.80	6.00	92.80	79.00	17 07 01
14.80	320.00	0.90	11.00	10.00	92.70	83.00	
16.00	400.00	0.70	10.00	10.00	92.90	73.00	
16.50	480.00	0.60	9.00	8.00	93.10	66.00	
17.00	650.00	0.30	8.00	6.00	93.30	59.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 17/01

13.90	396.20	0.95	11.50	5.40	92.90	86.30	17 07 01
13.50	260.00	0.95	10.50	15.00	92.88	82.00	18 07 01
15.00	350.00	0.75	10.00	9.00	93.13	72.00	
17.00	400.00	0.75	9.50	7.00	93.35	61.00	
17.50	580.00	0.50	8.00	6.00	93.26	54.00	
17.50	500.00	0.65	7.70	6.00	93.29	53.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 18/01

13.20	177.00	0.95	11.20	11.60	92.90	88.00	18 07 01
15.30	200.00	0.95	12.00	10.50	93.00	90.00	19 07 01
15.50	350.00	0.85	10.70	9.00	93.10	80.00	
17.30	540.00	0.65	9.00	8.00	93.20	65.00	
18.00	585.00	0.50	8.00	7.00	93.10	60.00	
17.00	530.00	0.60	8.50	7.00	92.90	70.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 19/01

Appendix D (continued)
Recorded and Forecast Meteorological Data

14.10	134.00	0.97	12.50	8.00	93.30	91.00	19 07 01
15.60	275.00	0.90	13.90	8.00	93.20	92.00	20 07 01
17.30	500.00	0.70	10.00	7.00	93.20	80.00	
18.00	580.00	0.50	8.00	6.00	93.10	60.00	
17.70	600.00	0.45	8.00	7.00	93.30	55.00	
18.30	600.00	0.55	8.50	6.00	93.00	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 20/01							

15.80	266.00	0.96	14.00	5.00	93.30	90.00	20 07 01
17.00	480.00	0.65	10.50	4.00	93.40	78.00	21 07 01
18.20	580.00	0.55	8.50	5.00	93.50	60.00	
18.30	600.00	0.45	8.00	6.00	93.60	55.00	
17.00	500.00	0.65	9.00	7.00	93.40	70.00	
17.00	390.00	0.80	11.00	7.00	93.60	80.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 21/01							

16.40	277.60	0.62	12.10	1.80	93.30	79.00	21 07 01
17.50	520.00	0.57	9.50	5.00	93.50	75.00	22 07 01
17.00	500.00	0.60	9.50	5.00	93.10	70.00	
16.80	450.00	0.65	10.00	6.00	93.40	80.00	
16.70	380.00	0.70	11.00	7.00	93.60	80.00	
16.80	400.00	0.65	10.00	6.00	93.40	75.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 22/01							

19.20	516.00	0.29	13.00	4.40	93.40	70.00	22 07 01
18.10	350.00	0.75	12.50	6.00	93.50	78.00	23 07 01
17.60	430.00	0.65	11.50	6.00	93.40	80.00	
17.30	410.00	0.60	11.50	6.00	93.60	75.00	
17.00	400.00	0.70	12.00	7.00	93.50	80.00	
17.10	420.00	0.65	12.50	5.00	93.40	75.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 23/01							

17.20	372.90	0.75	12.10	6.10	93.50	73.00	23 07 01
16.50	440.00	0.65	9.50	6.50	93.60	75.00	24 07 01
17.00	420.00	0.70	10.00	6.00	93.60	80.00	
16.70	420.00	0.70	12.00	6.00	93.60	75.00	
16.90	430.00	0.65	12.50	7.50	93.50	78.00	
17.20	400.00	0.75	12.00	10.00	93.40	85.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 24/01							

Appendix D (continued)
Recorded and Forecast Meteorological Data

14.70	471.90	0.68	10.80	6.30	93.60	67.00	24 07 01
15.50	480.00	0.40	10.00	5.00	93.60	65.00	25 07 01
15.20	450.00	0.60	11.00	6.00	93.60	75.00	
15.50	420.00	0.70	11.50	7.00	93.50	80.00	
16.00	400.00	0.75	11.50	12.00	93.40	80.00	
15.50	400.00	0.80	12.00	10.00	93.40	75.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 25/01							

14.80	682.20	0.27	8.00	3.10	93.80	67.40	25 07 01
14.30	480.00	0.65	9.00	8.00	93.70	70.00	26 07 01
14.00	440.00	0.70	10.00	6.00	93.60	80.00	
14.40	420.00	0.70	11.00	10.00	93.50	75.00	
14.50	460.00	0.60	9.00	8.00	93.50	70.00	
15.00	550.00	0.30	8.00	3.00	93.60	65.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 26/01							

14.20	503.80	0.60	8.80	4.90	93.60	72.70	26 07 01
14.40	430.00	0.75	9.50	7.00	93.40	78.00	27 07 01
14.60	380.00	0.90	11.50	9.00	93.20	85.00	
14.50	440.00	0.70	9.00	10.00	93.40	70.00	
14.80	550.00	0.40	8.00	4.00	93.50	65.00	
15.00	550.00	0.30	8.50	3.00	93.70	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 27/01							

14.60	289.90	0.77	10.30	4.60	93.40	76.50	27 07 01
13.50	210.00	0.90	10.50	10.00	93.10	90.00	28 07 01
14.20	420.00	0.70	9.00	8.00	93.30	75.00	
14.50	530.00	0.40	8.00	5.00	93.40	65.00	
15.00	560.00	0.30	8.00	3.00	93.60	60.00	
16.00	500.00	0.50	9.00	4.00	93.80	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 28/01							

12.30	337.30	0.96	10.50	7.70	93.10	89.20	28 07 01
12.40	330.00	0.90	10.00	10.50	93.30	87.00	29 07 01
13.50	520.00	0.50	8.00	5.00	93.40	70.00	
14.60	550.00	0.40	8.00	3.00	93.60	65.00	
16.00	460.00	0.60	9.00	5.00	93.70	60.00	
15.00	420.00	0.70	10.00	6.00	93.70	75.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 29/01							

Appendix D (continued)
Recorded and Forecast Meteorological Data

12.90	587.60	0.85	10.70	14.20	93.30	87.10	29 07 01
14.00	540.00	0.60	7.50	8.00	93.29	65.00	30 07 01
15.00	560.00	0.55	7.60	4.50	93.32	61.00	
15.40	410.00	0.75	9.50	6.50	93.30	68.00	
14.50	360.00	0.80	8.00	6.00	93.46	65.00	
14.00	410.00	0.65	5.50	6.50	93.47	57.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 30/01							

15.00	579.60	0.57	7.70	6.90	93.30	63.50	30 07 01
15.20	560.00	0.58	7.70	6.00	93.42	61.00	31 07 01
15.00	350.00	0.88	9.50	7.50	93.29	70.00	
14.00	320.00	0.90	9.00	7.00	93.04	72.00	
13.50	370.00	0.75	6.50	7.50	93.00	63.00	
13.50	470.00	0.65	6.20	6.00	92.73	61.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 31/01							

13.70	388.60	0.64	8.50	4.80	93.30	72.70	31 07 01
13.90	350.00	0.90	10.00	6.00	93.20	80.00	01 08 01
14.00	330.00	0.90	9.00	8.00	93.10	75.00	
13.50	400.00	0.70	7.00	7.50	93.00	70.00	
13.80	470.00	0.60	7.00	5.00	92.90	65.00	
14.50	550.00	0.30	8.50	3.00	93.30	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 01/01							

14.10	351.70	0.82	10.30	5.50	93.20	79.30	01 08 01
13.30	330.00	0.90	10.00	3.50	93.10	87.00	02 08 01
13.20	390.00	0.70	9.00	5.00	93.00	80.00	
13.80	470.00	0.60	8.00	5.00	92.90	85.00	
14.20	500.00	0.50	8.50	5.00	93.30	75.00	
14.80	470.00	0.60	9.00	7.00	93.50	65.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 02/01							

13.30	375.70	0.83	10.30	6.70	93.30	83.80	02 08 01
13.50	370.00	0.85	10.50	7.00	93.00	82.00	03 08 01
13.30	400.00	0.75	9.50	11.00	92.80	80.00	
13.60	390.00	0.75	9.00	6.00	93.00	75.00	
14.50	450.00	0.60	9.50	6.00	93.50	70.00	
14.00	470.00	0.50	9.00	3.00	94.10	65.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 03/01							

Appendix D (continued)
Recorded and Forecast Meteorological Data

15.30	376.10	0.83	11.80	7.60	92.90	82.00	03 08 01
14.00	380.00	0.72	10.80	10.00	92.60	88.00	04 08 01
13.60	340.00	0.80	11.00	7.00	92.80	85.00	
14.10	400.00	0.65	10.00	6.00	93.20	80.00	
15.10	460.00	0.55	9.50	5.00	93.40	70.00	
17.20	520.00	0.40	8.50	4.00	93.60	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 04/01

12.50	327.60	0.74	9.50	9.10	92.80	83.00	04 08 01
14.00	450.00	0.63	8.50	10.00	92.90	85.00	05 08 01
14.20	410.00	0.65	10.00	6.00	93.20	75.00	
15.50	480.00	0.50	9.00	5.00	93.40	70.00	
17.40	550.00	0.40	8.00	4.00	93.50	60.00	
17.80	590.00	0.30	7.50	4.00	93.50	55.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 05/01

13.00	405.80	0.70	8.10	11.50	93.30	75.00	05 08 01
13.50	420.00	0.63	9.60	10.00	93.90	78.00	06 08 01
15.00	480.00	0.60	9.30	8.00	94.20	70.00	
17.00	530.00	0.50	8.50	4.00	94.30	65.00	
17.50	580.00	0.40	8.00	5.00	94.00	60.00	
17.90	610.00	0.35	8.00	5.00	93.90	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 06/01

13.80	408.00	0.69	9.30	7.50	93.80	77.00	06 08 01
14.10	480.00	0.40	7.70	7.00	94.30	68.00	07 08 01
17.50	580.00	0.20	7.50	5.00	94.40	60.00	
18.20	600.00	0.20	7.00	4.00	94.50	55.00	
18.50	620.00	0.15	7.00	3.00	94.10	55.00	
18.70	620.00	0.20	7.00	4.00	93.80	53.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 07/01

12.70	358.70	0.59	7.80	6.60	94.30	75.20	07 08 01
16.10	550.00	0.40	9.10	3.40	94.70	65.00	08 08 01
17.00	600.00	0.20	8.50	4.00	94.30	60.00	
17.50	620.00	0.20	8.50	2.00	94.00	59.00	
18.00	620.00	0.20	8.80	2.00	93.80	58.00	
18.00	560.00	0.35	9.20	6.00	93.60	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 08/01

Appendix D (continued)
Recorded and Forecast Meteorological Data

15.50	582.30	0.28	9.30	3.30	94.60	70.30	08 08 01
15.20	600.00	0.18	9.20	2.00	94.30	69.00	09 08 01
16.00	620.00	0.10	8.70	2.00	94.00	65.00	
17.40	620.00	0.15	9.00	2.00	93.80	63.00	
17.40	550.00	0.35	9.20	4.00	93.60	63.00	
16.60	500.00	0.40	9.00	6.00	93.40	65.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 09/01							

15.60	571.10	0.14	9.20	1.30	94.20	70.30	09 08 01
17.40	600.00	0.02	9.50	3.00	94.00	64.00	10 08 01
17.80	600.00	0.05	9.70	6.00	93.70	62.00	
18.00	580.00	0.15	9.70	5.00	93.60	61.00	
17.50	550.00	0.35	9.80	6.00	93.40	64.00	
17.00	570.00	0.25	9.00	6.00	93.50	62.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 10/01							

17.10	551.40	0.13	9.80	1.50	93.80	66.60	10 08 01
18.00	520.00	0.20	10.50	2.00	93.70	65.00	11 08 01
18.50	550.00	0.20	10.30	4.00	93.70	63.00	
18.50	550.00	0.30	10.50	5.00	93.80	64.00	
17.60	520.00	0.30	9.60	4.00	93.90	64.00	
18.00	560.00	0.25	9.80	2.00	93.80	62.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 11/01							

17.50	578.80	0.23	10.20	2.10	93.70	65.90	11 08 01
18.50	580.00	0.20	11.00	4.00	93.63	62.00	12 08 01
18.30	560.00	0.30	11.00	4.50	93.64	62.00	
17.90	520.00	0.35	9.80	5.00	93.97	59.00	
18.00	580.00	0.25	9.80	4.00	93.79	59.00	
18.20	500.00	0.40	10.50	6.00	93.87	61.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 12/01							

18.90	576.20	0.08	11.80	4.20	93.60	68.00	12 08 01
19.30	590.00	0.15	10.50	3.50	93.82	57.00	13 08 01
18.50	550.00	0.30	10.00	4.00	93.95	58.00	
18.50	530.00	0.35	10.10	4.00	93.86	58.00	
18.20	460.00	0.50	11.00	5.50	93.67	63.00	
18.00	440.00	0.50	12.50	5.00	93.62	70.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 13/01							

Appendix D (continued)
Recorded and Forecast Meteorological Data

19.80	601.90	0.04	10.60	1.70	93.80	60.80	13 08 01
19.50	590.00	0.20	10.00	4.00	94.06	54.00	14 08 01
19.00	550.00	0.30	9.80	4.00	93.98	55.00	
18.80	450.00	0.45	10.50	6.00	93.88	59.00	
18.60	400.00	0.60	12.40	7.50	93.59	67.00	
15.30	310.00	0.85	10.70	13.00	93.26	74.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 14/01

18.40	580.40	0.10	9.10	1.10	94.00	60.50	14 08 01
19.00	575.00	0.20	10.00	3.50	93.75	56.00	15 08 01
19.00	480.00	0.40	10.50	5.00	93.68	58.00	
18.20	380.00	0.63	12.00	7.50	93.28	67.00	
15.00	280.00	0.90	10.70	12.00	92.97	75.00	
12.50	210.00	0.90	9.00	10.50	93.17	79.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 15/01

18.80	580.50	0.09	9.40	0.70	93.70	59.90	15 08 01
19.40	540.00	0.30	10.50	4.00	93.66	56.00	16 08 01
18.20	380.00	0.60	11.50	7.00	93.13	65.00	
14.50	230.00	0.90	10.60	12.00	93.28	77.00	
12.50	260.00	0.85	8.50	9.50	93.09	77.00	
13.50	430.00	0.50	7.00	3.00	93.40	65.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 16/01

19.60	470.60	0.27	12.70	1.20	93.50	67.90	16 08 01
19.20	410.00	0.60	11.20	6.00	93.40	65.00	17 08 01
16.20	260.00	0.80	10.50	12.00	93.30	80.00	
13.20	260.00	0.85	8.50	9.00	93.20	80.00	
14.00	450.00	0.50	7.00	3.00	93.40	65.00	
15.20	400.00	0.70	8.00	4.00	93.30	75.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 17/01

19.30	408.10	0.56	11.00	8.50	93.40	61.50	17 08 01
15.20	260.00	0.85	10.50	10.00	93.50	80.00	18 08 01
13.30	260.00	0.85	9.50	9.00	93.40	85.00	
13.50	430.00	0.60	7.00	3.00	93.20	65.00	
14.50	380.00	0.75	8.50	4.00	93.00	75.00	
14.80	380.00	0.75	9.50	6.00	92.80	75.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 18/01

Appendix D (continued)
Recorded and Forecast Meteorological Data

12.50	237.40	0.86	10.00	7.60	93.60	85.20	18 08 01
11.80	260.00	0.80	8.50	12.00	93.60	85.00	19 08 01
12.50	400.00	0.70	7.00	4.00	93.20	70.00	
13.80	350.00	0.80	8.00	4.00	93.00	80.00	
14.80	380.00	0.75	9.50	8.00	92.80	80.00	
14.50	390.00	0.70	9.00	6.00	92.90	80.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 19/01							

12.70	387.90	0.83	7.90	13.70	93.60	74.00	19 08 01
12.50	390.00	0.70	7.00	9.00	93.00	75.00	20 08 01
13.20	280.00	0.90	9.00	15.00	92.60	88.00	
13.50	330.00	0.80	9.50	10.00	92.00	85.00	
13.70	390.00	0.70	8.50	9.00	92.40	80.00	
14.20	400.00	0.60	8.00	5.00	93.00	75.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 20/01							

Appendix E
Summer Water Temperature and Flow Management
Project Reservoir Release Volume
Calculations for July 10 to August 20, 2001

Appendix E
Summer Water Temperature and Flow Management Project Reservoir Release Volume
Calculations for July 10 to August 20, 2001

Skins Lake Spillway base release for the period July 10 (191) to August 20 (232) = 52.6 m³/s (1,858 cfs)

Summer Water Temperature and Flow Management Project Base Release Volume = (232 - 190) * 52.6 = 2,209.2 m³/s*days

Time period (Julian Day)	Time (hrs)	Flow Rate (m ³ /s)	Volume (m ³ /s*hrs)
July 10 (191) @ 0000 hrs to July 10 (191) @ 1700 hrs	17.0	100.0	1,700
July 10 (191) @ 1700 hrs to July 12 (193) @ 1700 hrs	48.0	110	5,280
July 12 (193) @ 1700 hrs to July 14 (195) @ 1700 hrs	48.0	120	5,760
July 14 (195) @ 1700 hrs to July 18 (199) @ 1600 hrs	95.0	255	24,225
July 18 (199) @ 1600 hrs to July 19 (200) @ 1600 hrs	24.0	198.0	4,752
July 19 (200) @ 1600 hrs to July 20 (201) @ 1600 hrs	24.0	170	4,080
July 20 (201) @ 1600 hrs to July 21 (202) @ 1500 hrs	23.0	453	10,419
July 21 (202) @ 1500 hrs to July 22 (203) @ 2000 hrs	29.0	14.2	412
July 22 (203) @ 2000 hrs to August 7 (219) @ 1700 hrs	381.0	170.0	64,770
August 7 (219) @ 1700 hrs to August 8 (220) @ 1700 hrs	24.0	453.0	10,872
August 8 (220) @ 1700 hrs to August 9 (221) @ 2000 hrs	27.0	14.2	383
August 9 (221) @ 2000 hrs to August 12 (224) @ 1700 hrs	69.0	170.0	11,730
August 12 (224) @ 1700 hrs to August 14 (226) @ 1700 hrs	48.0	453.0	21,744
August 14 (226) @ 1700 hrs to August 16 (228) @ 1700 hrs	48.0	283.0	13,584
August 16 (228) @ 1700 hrs to August 20 (232) @ 2400 hrs	103.0	14.2	1,463
Total	1,008 (42 days)		181,174
Total Release Volume		= 181,174 m ³ /s*hrs = 7,548.9 m ³ /s*days	
Therefore, Volume Released for Cooling Purposes		= Total Volume - Base Volume = 7,548.9 - 2,209.2 = 5,339.7 m ³ /s*days	
Average Release over Summer Management Period (July 10 to August 20, 2000)		= 7,548.9 m ³ /s*days / 42 days = 179.7 m ³ /s = 6,347.4 cfs	