

**THE 2003 SUMMER WATER TEMPERATURE
AND FLOW MANAGEMENT PROJECT**

*NECHAKO FISHERIES CONSERVATION PROGRAM
Technical Report No. RM03-1*

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ABSTRACT

The 2003 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) between July 20 and 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 2003, 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 2003 Summer Water Temperature and Flow Management Project (July 10 to August 20), the total volume of water released was 7,570.6 m³/s-d, (267,354 cfs-d), and the average release during the Project was 180.3 m³/s (6,366 cfs).

INTRODUCTION

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. Since 1988, water temperature and flow management projects (Triton 1995a through 1995h, Triton 1996 through 2002) have been carried out under the auspices of the Nechako Fisheries Conservation Program (NFCP).

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). These dates may vary as directed by the NFCP in accordance with the timing of sockeye runs in the system. Flows in the Nechako River at Cheslatta Falls are also to be reduced to fall spawning flows by early September. 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.

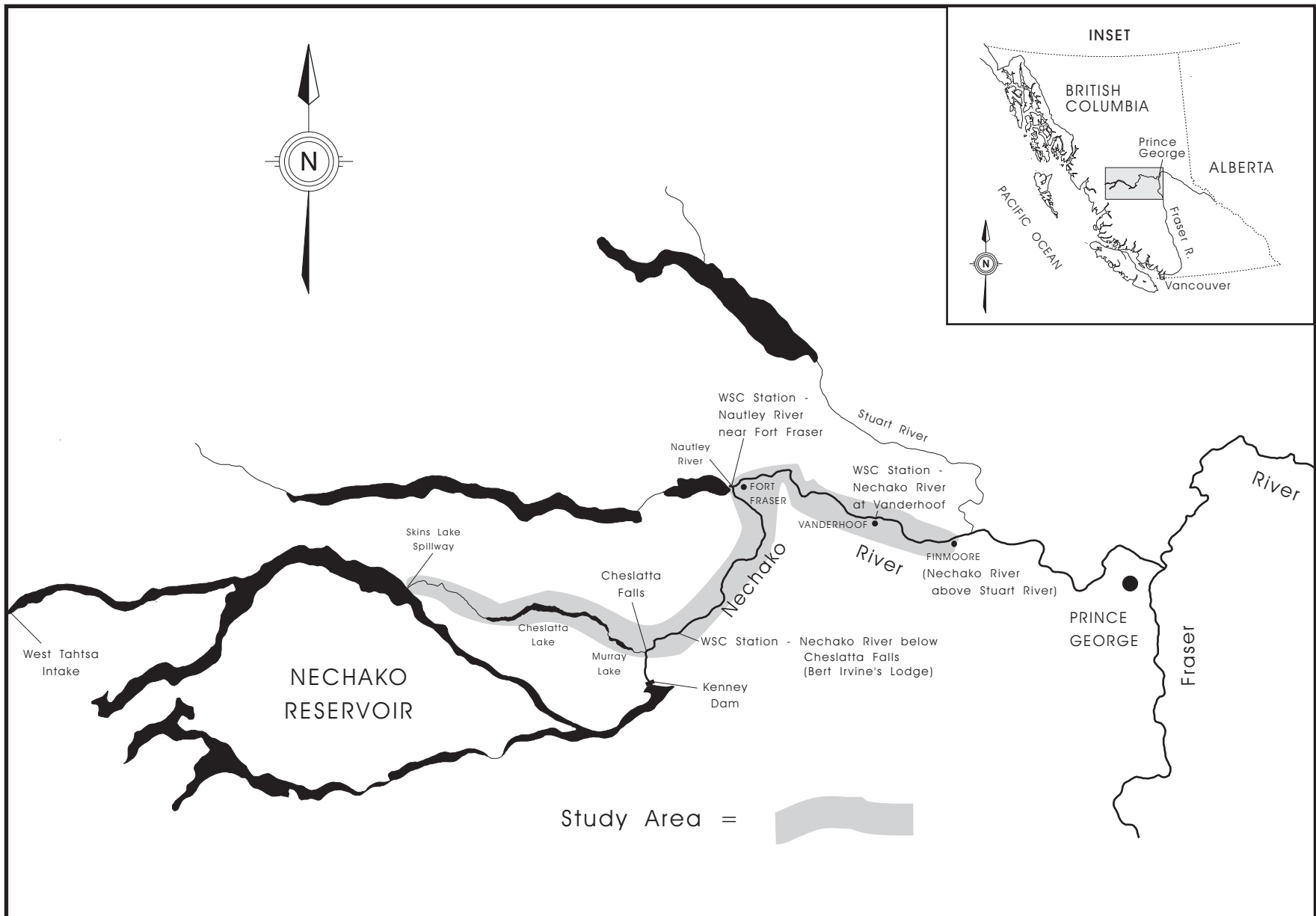
This report reviews the 2003 Summer Water Temperature and Flow Management Project and includes an outline of Triton's method of determining Skins Lake

Spillway releases, a summary of Triton's 2003 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 2003 Summer Water Temperature and Flow Management Project.

METHODS

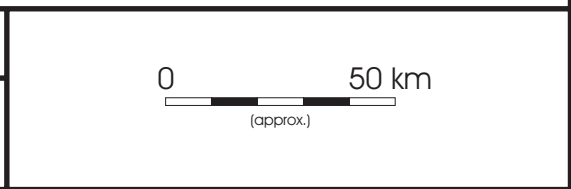
The management of the Nechako River flows and water temperatures was accomplished using water temperature predictions based on five-day meteorological forecasts to determine the schedule of Skins Lake Spillway releases required to meet project objectives. The Summer Water Temperature and Flow Management 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 as set out 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



Nechako Fisheries Conservation Program Map # RM03-1

FIGURE 1. NECHAKO RIVER STUDY AREA



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 10 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 and to increase flows in the Nechako River from spring flows to the minimum cooling flow of 170 m³/s (6,000 cfs) below Cheslatta Falls. The 2003 Skins Lake Spillway spring base release as directed by the NFCP was 49.0 m³/s (1,730 cfs). Upon commencement of the operational period on July 10, the observed flow in the Nechako River below Cheslatta Falls was 50.6 m³/s (1,787 cfs). On July 11, 2003, 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, 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.
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

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

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.

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 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.

Mean daily water temperatures recorded during the control period 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 20.0°C (68.0°F) on July 31, and 17.1°C (62.8°F) on August 20. 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 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, flows in the Nechako River below Cheslatta Falls and at Vanderhoof, and Nautley River flows are tabulated in Appendix C. A record of Skins

Table 2
 Predicted and Recorded Mean Daily Water Temperatures in the Nechako River Above the Stuart River Confluence, July 10 to August 20, 2003

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					20.6	19.5	19.0	19.5	19.0	19.4	19.8	19.1	18.3	19.4	18.7	18.8	19.3	19.3	19.5	19.8	19.7	19.6
4th Day's Predicted Water Temperature at Date + 3 Days			21.0	20.2	19.7	19.5	18.6	18.8	19.5	18.8	17.5	19.3	19.0	19.1	19.4	18.8	18.6	19.6	19.9	19.7	19.7	
3rd Day's Predicted Water Temperature at Date + 2 Days			21.0	20.8	20.7	19.8	18.6	18.5	19.2	18.2	16.9	18.7	18.9	19.4	19.9	18.8	17.7	18.8	19.9	19.7	19.9	19.7
2nd Day's Predicted Water Temperature at Date + 1 Day		20.5	20.9	21.5	20.6	19.1	18.9	19.3	18.0	17.2	18.4	18.7	19.6	20.3	19.4	17.8	18.0	19.9	19.8	20.0	19.9	19.9
Current Day's Predicted Water Temperature at Date	20.0	20.7	21.6	21.0	20.0	19.4	19.7	18.2	18.1	18.5	18.4	19.4	20.1	19.8	18.8	17.9	19.4	19.7	20.0	20.0	20.0	20.2
Previous Day's Calculated Water Temperature at Date - 1 Day	20.0	20.9	21.5	20.7	20.0	19.7	19.2	18.4	18.4	18.3	18.7	19.6	19.9	19.5	18.8	18.5	19.3	19.7	20.0	20.0	20.1	20.2
Previous Day's Recorded Water Temperature at Date - 1 Day	19.0	20.6	20.7	20.4	19.6	19.1	18.6	17.9	17.3	17.7	18.4	18.3	19.2	19.1	18.3	18.4	18.6	19.3	19.5	19.5	19.7	20.0
Current Day's Skins Lake Spillway Release at Date (m ³ /s)	49.3	49.299 to 226.53 @ 1600 hrs	226.5	226.5	226.5	226.5	226.53 to 453.07 @ 1600 hrs	453.07 to 14.158 @ 1600 hrs	14.158 to 226.53 @ 1600 hrs	226.53 to 453.07 @ 1600 hrs	453.07 to 169.9 @ 1600 hrs	169.9	169.9	169.9	169.9	169.9 to 453.1 @ 1600 hrs	453.1	453.1 to 283.17 @ 1400 hrs	283.17 to 14.158 @ 1600 hrs	14.16	14.16	

Table 2 (continued)
 Predicted and Recorded Mean Daily Water Temperatures in the Nechako River Above the Stuart River Confluence, July 10 to August 20, 2003

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	19.5	19.0	18.5	18.5	18.5	18.5	18.4	18.5	18.8	18.7	18.6	18.7	18.8	19.0	19.0	18.7	18.9	19.1	18.0	17.8	
4th Day's Predicted Water Temperature at Date + 3 Days	19.4	18.8	18.5	18.4	18.6	18.4	18.3	18.6	18.7	18.8	18.8	18.8	18.6	18.7	18.9	19.0	19.5	18.5	18.1	17.2	
3rd Day's Predicted Water Temperature at Date + 2 Days	19.3	19.0	18.4	18.6	18.5	18.5	18.5	18.7	18.8	19.5	19.3	18.4	18.3	18.9	19.0	19.8	19.5	18.9	17.7	17.4	
2nd Day's Predicted Water Temperature at Date + 1 Day	19.8	19.1	18.6	18.8	18.7	18.9	18.9	18.7	20.6	20.2	19.0	18.5	19.1	19.1	19.7	20.4	19.9	18.6	17.8	18.5	
Current Day's Predicted Water Temperature at Date	20.0	19.3	18.9	18.9	19.0	19.0	18.4	20.4	20.7	19.6	18.8	19.1	19.2	19.4	20.4	20.5	19.6	18.4	18.5	18.1	
Previous Day's Calculated Water Temperature at Date - 1 Day	20.1	19.4	18.9	18.9	19.6	18.8	18.9	20.3	20.3	19.4	19.0	19.1	19.1	19.6	20.3	20.3	19.4	18.6	18.3		
Previous Day's Recorded Water Temperature at Date - 1 Day	19.7	19.1	18.6	18.2	18.2	18.2	19.0	19.3	19.9	19.1	18.5	18.8	18.8	19.1	19.7	19.8	19.1	18.6	17.7	17.1	
Current Day's Skins Lake Spillway Release at Date (m ³ /s)	14.16	169.9	169.9	169.9	169.9	169.9	169.9	169.9	453.07	14.158	169.9	169.9	169.9	169.9	169.9	169.9	14.16	14.16	14.158	14.158	14.16
	to								to	to						to					
	169.9								453.07	14.158	169.9					14.158					
	@								@	@	@					@					
	1600								1600	1600	1600					1600					
	hrs								hrs	hrs	hrs					hrs					

Figure 2
 Recorded Mean Daily Temperatures in the Nechako River Above the
 Stuart River Confluence, July 10 to August 20, 2003

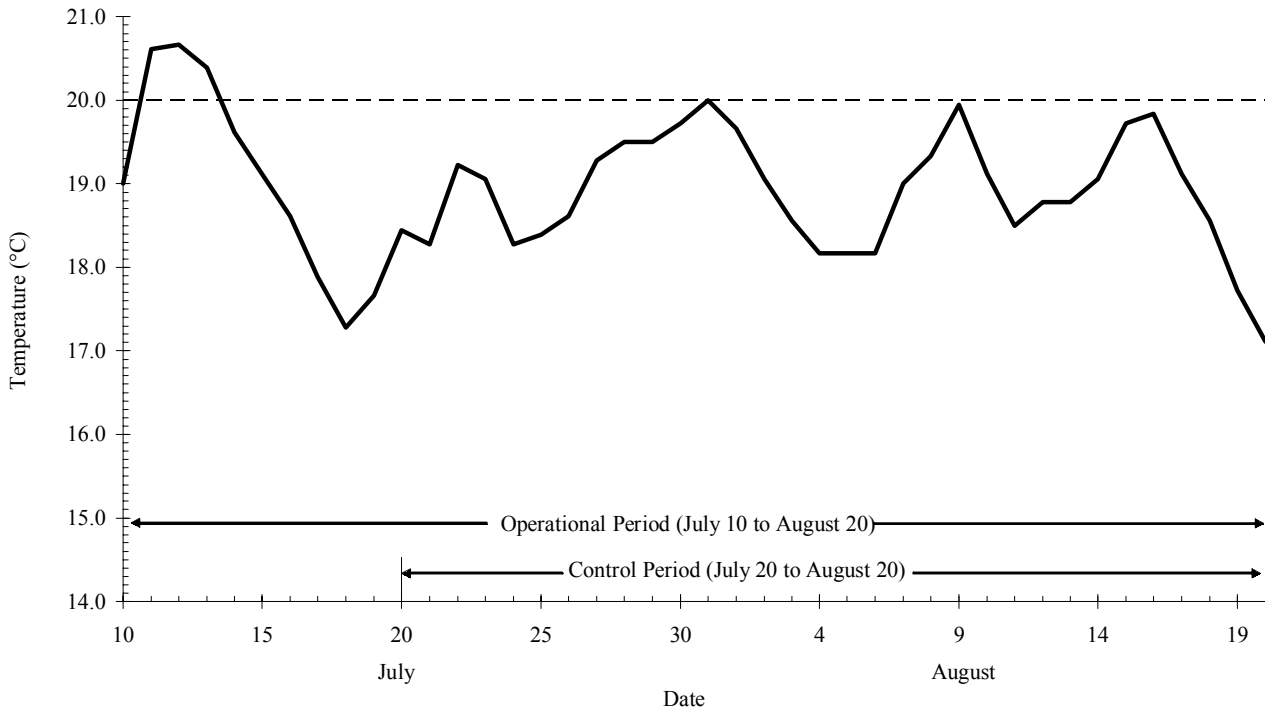


Figure 3
 Skins Lake Spillway Releases and Flows in the Nechako River Below Cheslatta Falls
 and at Vanderhoof, July 10 to September 6, 2003

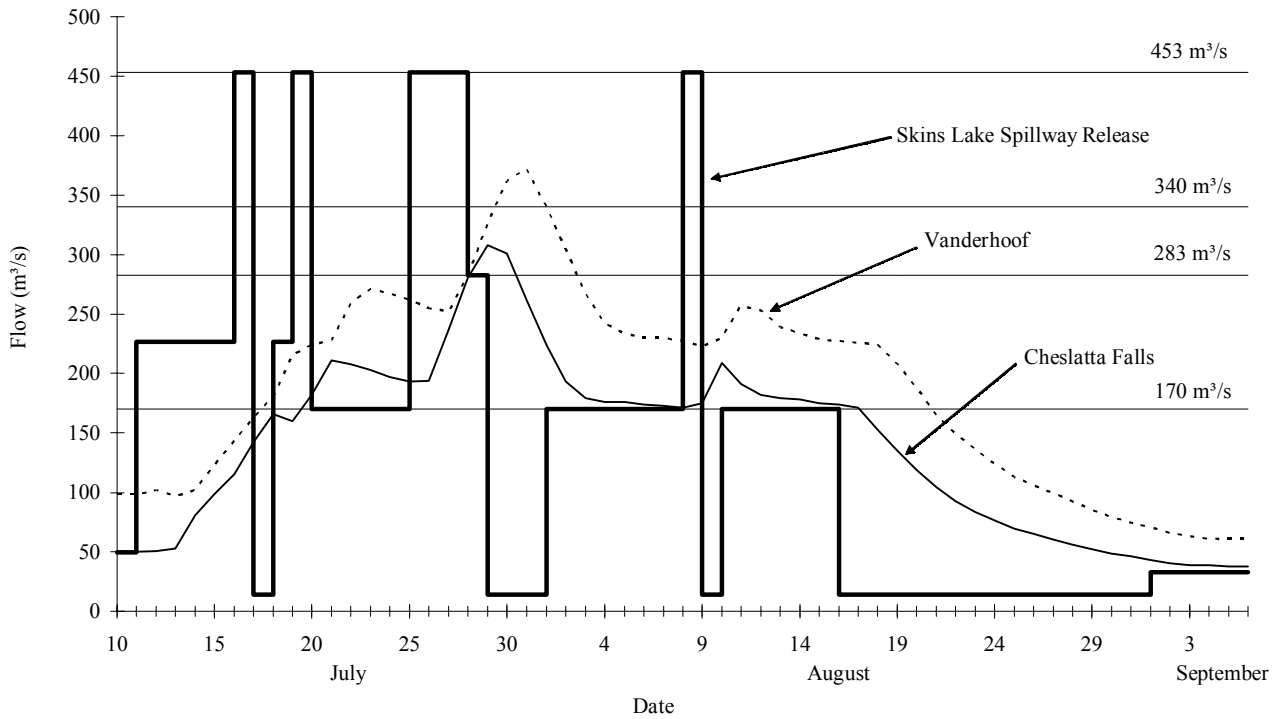


Table 3
Recorded Mean Daily Water Temperatures in the
Nechako River Above the Stuart River Confluence,
July 10 to August 20, 2003

Date	Water Temperature (°C)	Date	Water Temperature (°C)
10-Jul	19.0	01-Aug	19.7
11-Jul	20.6	02-Aug	19.1
12-Jul	20.7	03-Aug	18.6
13-Jul	20.4	04-Aug	18.2
14-Jul	19.6	05-Aug	18.2
15-Jul	19.1	06-Aug	18.2
16-Jul	18.6	07-Aug	19.0
17-Jul	17.9	08-Aug	19.3
18-Jul	17.3	09-Aug	19.9
19-Jul	17.7	10-Aug	19.1
20-Jul	18.4	11-Aug	18.5
21-Jul	18.3	12-Aug	18.8
22-Jul	19.2	13-Aug	18.8
23-Jul	19.1	14-Aug	19.1
24-Jul	18.3	15-Aug	19.7
25-Jul	18.4	16-Aug	19.8
26-Jul	18.6	17-Aug	19.1
27-Jul	19.3	18-Aug	18.6
28-Jul	19.5	19-Aug	17.7
29-Jul	19.5	20-Aug	17.1
30-Jul	19.7		
31-Jul	20.0		

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 308 m³/s (10,880 cfs) on July 29 and a minimum of 119 m³/s (4,200 cfs) on August 20. Flows measured in the Nechako River at Vanderhoof ranged between a maximum of 372 m³/s (13,141 cfs) on July 31 and a minimum of 188 m³/s (6,640 cfs) on August 20. Following the control period, the mean daily flow in the Nechako River below Cheslatta Falls was reduced to 37.6 m³/s (1,328 cfs) by September 6.

DISCUSSION

The discussion of the 2003 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 2003 Summer Water Temperature and Flow Management Project. The third section provides a brief discussion of the application of the Project release criteria.

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 2003, 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 throughout the Project operational period. The ability to obtain hourly stage data from the gauging stations located on the Nechako River below Cheslatta Falls and at the west end of Cheslatta Lake proved very useful in verifying the daily predictions of the flow routing 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 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

Table 4
Rationale for Skins Lake Spillway Release Changes, July 10 to September 6, 2003

Date 2000	Old Setting (m ³ /s)	New Setting (m ³ /s)	Time of Change (hrs)	Reason for Changing SLS Release Setting
11-Jul	49.0	227	1600	To ensure base flow of 170 m ³ /s in the Nechako River below Cheslatta Falls by July 20
16-Jul	227	453	1600	In response to a predicted warming trend
17-Jul	453	14.2	1700	In response to a predicted cooling trend
18-Jul	14.2	227	1600	To ensure base flow of 170 m ³ /s in the Nechako River below Cheslatta Falls by July 20
19-Jul	227	453	1600	In response to a predicted warming trend
20-Jul	453	170	1430	In response to a predicted cooling trend
25-Jul	170	453	1600	In response to a predicted warming trend
28-Jul	453	283	1400	Flow control
29-Jul	283	14.2	1500	In response to a predicted cooling trend
01-Aug	14.2	170	1600	Flow control
08-Aug	170	453	1600	In response to a predicted warming trend
09-Aug	453	14.2	1430	In response to a predicted cooling trend
10-Aug	14.2	170	1600	Flow control
16-Aug	170	14.2	1400	To achieve spawning flow in the Nechako River below Cheslatta Falls by early Sept.

water temperatures following the method outlined in the Methods section of this report.

Recorded and forecast meteorological data were obtained daily from World Weatherwatch, a sub-consultant to Triton. The 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 2003 Summer Water Temperature and Flow Management Project. Also indicated is the minimum cooling flow of 170 m³/s

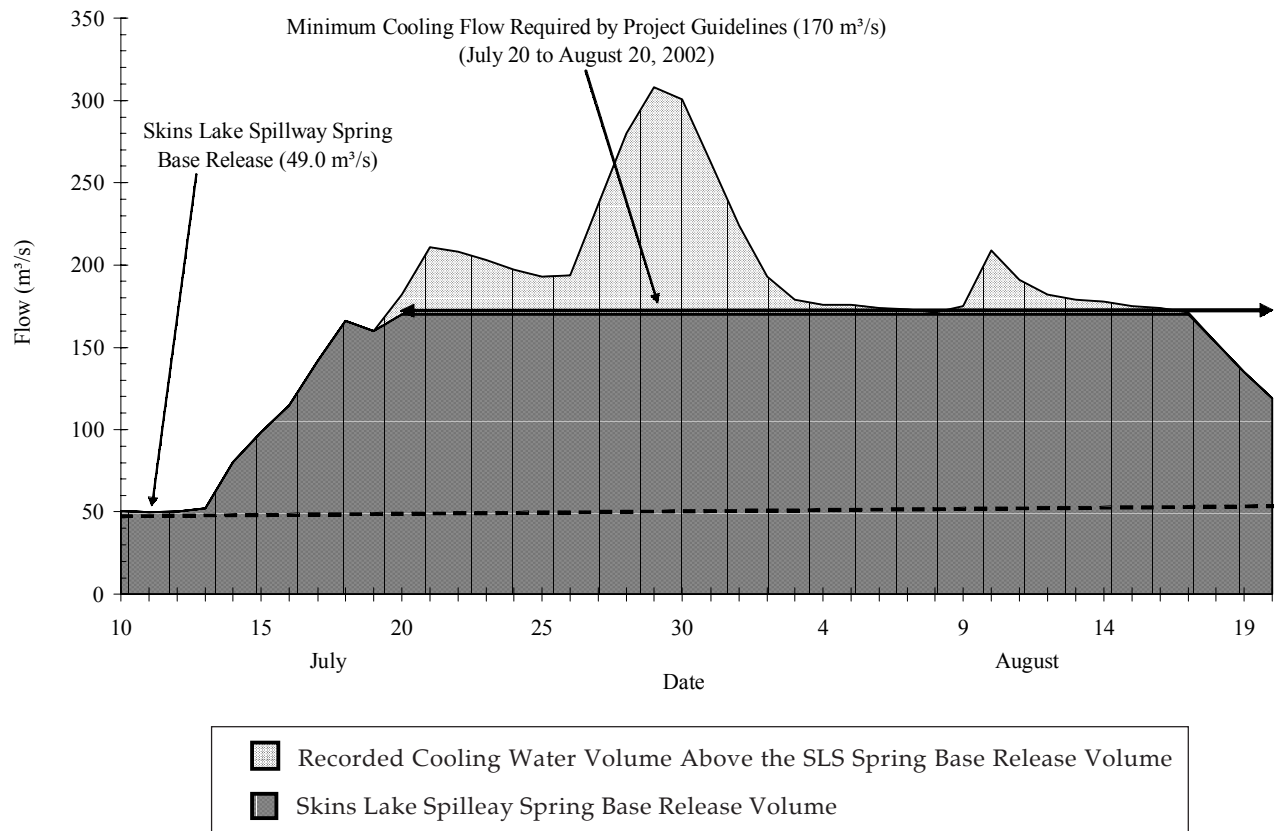
(6,000 cfs) in the Nechako River below Cheslatta Falls, and the Skins Lake Spillway release of 49.0 m³/s (1,730 cfs) as determined by the NFCP Technical Committee as part of the "Annual Water Allocation" defined in the Settlement Agreement.

The total volume of water released during the 2003 Summer Water Temperature and Flow Management Project operational period was 7,570.6 m³/s-d, (267,354 cfs-d). The volume released for cooling purposes was 5,512.6 m³/s-d (194,676 cfs-d), and is based on an assumed Skins Lake Spillway release of 49.0 m³/s (1,730 cfs) for the period July 10 to August 20, inclusive. The average release during the operational period was 180.3 m³/s (6,366 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

Figure 4
Flows in the Nechako River below Cheslatta Falls Resulting from Skins Lake Spillway Releases,
July 10 to August 20, 2003



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. This judgement is based on experience gained in the operation of the Summer Water Temperature and Flow Management Project since 1984 and may result in exceptions to the decision based on strict adherence to the release criteria.

On July 20 an exception was made to the application of the release criteria. The Skins Lake Spillage release was decreased from 453 m³/s (16,000 cfs) to 170 m³/s (6,000 cfs) rather than to 14m³/s (500 cfs) as outlined in the release criteria. The reason for this exception to the release criteria was due to unavailability of flow

data for the Nechako River below Cheslatta Falls (WSC station #08JA017) for a few days at the start of the water temperature control period (July 20). This departure from the release criteria was thus implemented as a conservative measure to ensure that flow in the Nechako River below Cheslatta Falls was at or above 170 m³/s (6,000 cfs) by July 20 as required.

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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 0.4°C from 18.1°C (J14) to 17.7°C (J15). Take the previous day's recorded temperature 17.7°C (J15) and extrapolate the trend for five days at -0.4°C . The observed trend shows that the water temperature could potentially reach $17.7^{\circ}\text{C} + 5(-0.4^{\circ}\text{C}) = 15.7^{\circ}\text{C}$.

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 18.9°C to 18.4°C with the potential to reach 18.4°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	18.8 to 18.4 = down 0.4°C
July 17	18.5 to 18.6 = up 0.1°C
July 18	18.6 to 18.5 = down 0.1°C
Mean of 3 differences	= down 0.1°C

This mean of -0.1°C is added to the fifth day predicted water temperature to give $18.4.3^{\circ}\text{C} + (-0.1^{\circ}\text{C}) = 18.3^{\circ}\text{C}$.

The forecast trend is down 0.1°C with the potential to reach 18.3°C .

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

Date	JULY										
	10	11	12	13	14	15	16	17	18	19	20
5th Day's Predicted Water Temperature at Date + 4 Days					20.6	19.5	19.0	19.5	19.0	19.4	19.8
4th Day's Predicted Water Temperature at Date + 3 Days				21.0	20.2	19.7	19.5	18.6	18.8	19.5	
3rd Day's Predicted Water Temperature at Date + 2 Days			21.0	20.8	20.7	19.8	18.6	18.5	19.2		
2nd Day's Predicted Water Temperature at Date + 1 Day		20.5	20.9	21.5	20.6	19.1	18.9	19.3			
Current Day's Predicted Water Temperature at Date	20.0	20.7	21.6	21.0	20.0	19.4	19.7				
Previous Day's Calculated Water Temperature at Date - 1 Day	20.0	20.9	21.5	20.7	20.0	19.7					
Previous Day's Recorded Water Temperature at Date - 1 Day	19.0	20.6	20.7	20.4	19.6	19.1					
Current Day's Skins Lake Spillway Release at Date (m ³ /s)	49.3	49.3	226.5	226.5	226.5	226.5	226.5				
		to					to				
		226.5					453.1				
		@					@				
		1600					1600				
		hrs					hrs				

APPENDIX B
**Mean Daily Water Temperatures in the Nechako
and Nautley Rivers, 2003**

APPENDIX B
Mean Daily Water Temperatures in the Nechako and Nautley Rivers, 2003

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	17.0	18.7	19.0	17.6	01-Aug	17.6	18.7	19.7	19.8
11-Jul	16.2	19.6	20.6	17.6	02-Aug	17.4	18.5	19.1	19.2
12-Jul	17.8	19.9	20.7	18.1	03-Aug	17.4	18.5	18.6	19.1
13-Jul	16.7	18.8	20.4	17.4	04-Aug	17.4	18.8	18.2	19.4
14-Jul	16.4	17.9	19.6	17.9	05-Aug	17.3	18.1	18.2	18.2
15-Jul	16.5	17.5	19.1	17.7	06-Aug	17.3	18.9	18.2	19.6
16-Jul	15.9	17.5	18.6	17.1	07-Aug	17.5	20.3	19.0	19.4
17-Jul	15.7	17.1	17.9	16.8	08-Aug	17.5	19.7	19.3	20.8
18-Jul	15.6	17.2	17.3	17.3	09-Aug	17.5	19.8	19.9	20.0
19-Jul	15.6	17.4	17.7	17.2	10-Aug	17.2	18.8	19.1	19.3
20-Jul	15.6	17.8	18.4	17.5	11-Aug	17.4	19.1	18.5	19.7
21-Jul	16.5	17.9	18.3	18.1	12-Aug	17.5	19.3	18.8	18.8
22-Jul	16.4	18.2	19.2	18.7	13-Aug	17.4	19.2	18.8	18.8
23-Jul	16.2	17.8	19.1	18.7	14-Aug	17.5	19.2	19.1	19.4
24-Jul	15.9	17.2	18.3	17.6	15-Aug	17.7	19.6	19.7	20.0
25-Jul	16.2	17.5	18.4	18.7	16-Aug	17.8	19.3	19.8	19.3
26-Jul	16.4	18.3	18.6	19.0	17-Aug	17.4	18.4	19.1	18.3
27-Jul	16.6	18.4	19.3	19.3	18-Aug	17.4	18.8	18.6	18.4
28-Jul	16.6	18.3	19.5	19.3	19-Aug	17.0	18.3	17.7	17.8
29-Jul	16.8	18.2	19.5	19.7	20-Aug	16.6	17.9	17.1	17.8
30-Jul	17.3	18.7	19.7	21.0					
31-Jul	17.5	19.1	20.0	21.3					

APPENDIX C
Mean Daily Skins Lake Spillway Releases and Flows
in the Nechako and Nautley Rivers, 2003

APPENDIX C
Mean Daily Skins Lake Spillway Releases and Flows
in the Nechako and Nautley Rivers, 2003

Date	Skins Lake	Nechako River		Nautley River
	Spillway Release (m ³ /s)	Cheslatta Falls (m ³ /s)	At Vanderhoof (m ³ /s)	Fort Fraser (m ³ /s)
10-Jul	49.3	50.6	98.3	27.5
11-Jul	49.3 to 227 @ 1600 hrs	49.8	98.3	27.5
12-Jul	227	50.4	102.0	29.0
13-Jul	227	52.5	96.8	29.8
14-Jul	227	80.4	102.0	29.0
15-Jul	227	98.6	123.0	29.8
16-Jul	227 to 453 @ 1600 hrs	115.0	143.0	29.0
17-Jul	453 to 14.2 @ 1600 hrs	142.0	163.0	29.0
18-Jul	14.2 to 227 @ 1600 hrs	166.0	181.0	28.2
19-Jul	227 to 453 @ 1600 hrs	160.0	216.0	27.8
20-Jul	453 to 170 @ 1600 hrs	182.0	224.0	28.2
21-Jul	170	211.0	228.0	27.5
22-Jul	170	208.0	259.0	27.5
23-Jul	170	203.0	271.0	27.1
24-Jul	170	197.0	267.0	26.7
25-Jul	170 to 453 @ 1600 hrs	193.0	262.0	25.7
26-Jul	453	194.0	255.0	25.3
27-Jul	453	237.0	252.0	25.3
28-Jul	453 to 283 @ 1600 hrs	280.0	283.0	24.6
29-Jul	283 to 14.2 @ 1600 hrs	308.0	327.0	23.9
30-Jul	14.2	301.0	362.0	23.3
31-Jul	14.2	262.0	372.0	22.6
01-Aug	14.2 to 170 @ 1600 hrs	224.0	340.0	22.6
02-Aug	170	193.0	305.0	22.6
03-Aug	170	179.0	267.0	22.0
04-Aug	170	176.0	242.0	21.3
05-Aug	170	176.0	234.0	20.7
06-Aug	170	174.0	230.0	20.7
07-Aug	170	173.0	230.0	20.0
08-Aug	170 to 453 @ 1600 hrs	171.0	227.0	19.7

APPENDIX C (continued)
Mean Daily Skins Lake Spillway Releases and Flows
in the Nechako and Nautley Rivers, 2003

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)
09-Aug	453 to 14.2 @ 1600 hrs	175.0	223.0	19.4
10-Aug	14.2 to 170 @ 1600 hrs	209.0	230.0	19.4
11-Aug	170	191.0	257.0	19.4
12-Aug	170	182.0	253.0	19.4
13-Aug	170	179.0	239.0	19.0
14-Aug	170	178.0	234.0	18.4
15-Aug	170	175.0	229.0	18.1
16-Aug	170 to 14.2 @ 1600 hrs	174.0	227.0	18.1
17-Aug	14.2	171.0	226.0	17.2
18-Aug	14.2	153.0	224.0	16.9
19-Aug	14.2	135.0	208.0	16.9
20-Aug	14.2	119.0	188.0	16.3
21-Aug	14.2	104.0	165.0	15.8
22-Aug	14.2	92.9	149.0	15.8
23-Aug	14.2	83.7	136.0	15.7
24-Aug	14.2	76.3	124.0	15.7
25-Aug	14.2	69.8	113.0	15.7
26-Aug	14.2	65.2	106.0	15.6
27-Aug	14.2	60.4	99.5	15.6
28-Aug	14.2	56.2	92.3	15.6
29-Aug	14.2	52.2	85.2	15.5
30-Aug	14.2	48.8	79.3	15.5
31-Aug	14.2	46.2	74.5	15.5
01-Sep	14.2 to 32.7 @ 1600 hrs	43.1	70.7	15.4
02-Sep	32.7	40.4	66.3	14.9
03-Sep	32.7	39.1	63.2	14.9
04-Sep	32.7	38.5	61.1	14.5
05-Sep	32.7	37.8	60.7	14.5
06-Sep	32.7	37.6	60.7	14.5

APPENDIX D
Recorded and Forecast Meteorological Data

APPENDIX D
Recorded and Forecast Meteorological Data

15.6	681.3	0.6	7.2	6.9	94	60.6	09 07 03
17.6	600	0.56	9.8	8.2	94.1	60	10 07 03
19.8	500	0.6	11.1	7.6	93.88	57	
19.5	460	0.66	12.3	8	93.54	63	
17.1	400	0.75	11.3	10.1	93.42	69	
16.5	370	0.8	10.4	8.1	93.26	67	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 10/03

17.50	564.60	0.52	9.20	7.30	94.00	62.20	10 07 03
19.50	500.00	0.60	11.00	7.50	93.75	58.00	11 07 03
19.00	450.00	0.68	11.70	8.50	93.43	63.00	
16.80	390.00	0.78	10.70	9.50	93.35	67.00	
15.80	400.00	0.70	9.70	7.50	93.27	67.00	
15.50	420.00	0.70	8.00	7.50	93.31	61.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 11/03

19.30	586.90	0.36	10.40	7.00	93.60	61.30	11 07 03
19.00	490.00	0.75	11.80	8.50	93.25	62.00	12 07 03
17.00	390.00	0.80	10.70	9.00	93.35	66.00	
16.00	420.00	0.75	9.50	7.00	93.30	65.00	
15.70	410.00	0.75	8.50	8.00	93.15	62.00	
17.00	470.00	0.75	8.00	7.50	93.64	55.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 12/03

18.90	484.50	0.73	11.20	6.30	93.00	62.60	12 07 03
16.80	390.00	0.80	11.00	8.50	93.00	69.00	13 07 03
16.00	420.00	0.75	9.70	7.00	93.45	66.00	
15.70	420.00	0.80	9.00	7.50	93.25	64.00	
17.00	470.00	0.75	8.70	7.50	93.40	58.00	
17.50	500.00	0.60	10.50	9.50	93.48	64.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 13/03

15.20	385.10	0.71	10.50	9.10	93.20	74.30	13 07 03
14.50	450.00	0.55	9.10	10.00	93.50	68.00	14 07 03
15.40	400.00	0.70	9.00	6.00	93.30	65.00	
16.70	450.00	0.65	8.50	6.00	93.50	60.00	
17.20	480.00	0.60	10.20	8.00	93.70	58.00	
17.50	550.00	0.30	9.00	5.50	93.90	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 14/03

APPENDIX D (continued)
Recorded and Forecast Meteorological Data

14.20	473.50	0.47	8.50	10.90	93.50	72.00	14 07 03
14.50	450.00	0.55	9.00	8.00	93.50	70.00	15 07 03
15.50	450.00	0.60	8.50	7.00	93.30	65.00	
16.00	480.00	0.50	9.50	5.00	93.80	60.00	
17.00	590.00	0.30	8.50	4.00	94.10	57.00	
17.30	620.00	0.20	8.00	3.00	93.90	55.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 15/03							

14.60	552.40	0.52	8.50	8.00	93.50	69.90	15 07 03
14.50	560.00	0.40	8.50	7.00	93.20	68.00	16 07 03
15.00	530.00	0.40	8.80	5.00	93.90	63.00	
15.80	600.00	0.20	8.20	4.00	94.20	57.00	
17.50	650.00	0.20	8.00	3.00	93.90	55.00	
16.80	580.00	0.35	8.80	5.00	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 16/03							

12.90	440.40	0.56	9.00	8.50	93.40	78.80	16 07 03
14.00	480.00	0.70	7.80	13.50	94.10	66.00	17 07 03
15.50	550.00	0.45	7.50	7.00	94.20	59.00	
16.50	650.00	0.20	7.30	6.00	93.90	53.00	
17.00	580.00	0.35	7.80	7.00	93.60	55.00	
16.50	530.00	0.45	8.00	10.00	93.40	57.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 17/03							

13.90	396.20	0.95	11.50	5.40	92.90	86.30	17 07 03
13.50	260.00	0.95	10.50	15.00	92.88	82.00	18 07 03
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 18/03							

13.70	483.50	0.35	7.90	10.50	94.10	71.30	18 07 03
14.60	550.00	0.48	8.50	5.00	94.00	75.00	19 07 03
15.50	520.00	0.60	8.70	4.00	93.70	65.00	
16.60	630.00	0.30	8.20	4.00	93.90	55.00	
16.80	600.00	0.40	8.00	6.00	93.50	55.00	
16.00	560.00	0.40	8.50	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 JUL 19/03							

APPENDIX D (continued)
Recorded and Forecast Meteorological Data

15.20	375.00	0.71	10.60	3.70	94.00	76.90	19 07 03
17.80	420.00	0.77	12.30	9.00	93.70	75.00	20 07 03
17.50	580.00	0.40	9.50	4.00	94.00	60.00	
17.20	610.00	0.30	8.50	6.00	93.60	55.00	
16.80	570.00	0.40	8.80	8.00	93.50	60.00	
16.50	530.00	0.50	9.00	10.00	93.30	65.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 20/03							

18.00	468.40	0.77	13.40	7.10	93.70	75.00	20 07 03
18.20	580.00	0.35	9.00	4.00	94.20	60.00	21 07 03
18.00	620.00	0.30	8.50	5.00	93.90	55.00	
17.50	600.00	0.30	8.20	7.00	93.60	60.00	
16.80	510.00	0.55	9.00	11.00	93.40	65.00	
16.10	530.00	0.50	9.50	8.00	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 21/03							

19.00	680.90	0.40	9.00	6.30	94.00	54.00	21 07 03
19.00	710.00	0.20	7.50	7.00	93.90	53.00	22 07 03
18.50	680.00	0.30	7.80	6.00	93.70	55.00	
16.80	490.00	0.60	9.20	10.00	93.30	60.00	
16.20	510.00	0.55	9.50	7.00	93.50	70.00	
16.00	650.00	0.25	8.00	4.00	93.40	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 22/03							

18.00	694.10	0.13	6.80	9.10	93.80	50.10	22 07 03
16.00	700.00	0.05	6.80	8.00	93.70	55.00	23 07 03
16.20	510.00	0.50	8.00	8.00	93.50	60.00	
15.80	490.00	0.60	9.00	6.00	93.50	65.00	
16.30	650.00	0.25	8.00	4.00	93.60	60.00	
16.00	650.00	0.20	7.50	4.00	93.90	50.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 23/03							

15.80	578.00	0.25	5.50	7.40	93.60	55.00	23 07 03
14.20	370.00	0.65	6.90	8.00	93.60	63.00	24 07 03
14.50	450.00	0.60	7.50	6.00	93.40	65.00	
16.50	600.00	0.30	8.00	4.00	93.70	58.00	
17.00	620.00	0.25	7.80	4.00	94.00	50.00	
17.50	650.00	0.20	8.50	3.00	93.80	50.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 24/03							

APPENDIX D (continued)
Recorded and Forecast Meteorological Data

12.90	437.60	0.57	7.40	7.30	93.70	70.00	24 07 03
15.00	520.00	0.45	7.80	6.50	93.70	65.00	25 07 03
16.90	630.00	0.25	8.00	4.00	93.70	52.00	
17.00	640.00	0.20	8.00	4.00	94.10	50.00	
17.20	650.00	0.20	8.50	5.00	94.10	50.00	
17.50	610.00	0.30	9.00	6.00	94.00	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 25/03							

15.90	658.00	0.30	8.60	5.30	93.70	66.30	25 07 03
17.30	650.00	0.28	9.00	5.00	93.73	58.00	26 07 03
17.20	630.00	0.30	8.20	6.00	94.01	55.00	
17.80	650.00	0.30	9.30	3.00	94.20	57.00	
18.20	590.00	0.40	9.50	5.50	94.05	57.00	
18.60	500.00	0.55	11.00	8.50	93.30	61.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 26/03							

18.80	575.60	0.29	8.00	6.50	93.60	56.30	26 07 03
18.80	620.00	0.30	7.40	8.00	94.10	47.00	27 07 03
18.60	650.00	0.28	8.50	3.50	94.39	52.00	
19.00	600.00	0.35	9.00	5.00	94.20	52.00	
19.60	520.00	0.50	10.50	7.50	93.53	56.00	
19.30	500.00	0.55	11.00	6.50	93.07	59.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 27/03							

20.50	659.00	0.31	6.20	13.10	94.10	40.80	27 07 03
17.60	675.00	0.20	7.20	4.50	94.40	52.00	28 07 03
19.20	630.00	0.30	9.30	4.00	94.30	55.00	
19.30	550.00	0.35	10.00	6.50	93.80	55.00	
18.50	510.00	0.50	10.60	7.00	93.70	60.00	
18.00	520.00	0.50	9.50	8.00	93.50	65.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 28/03							

17.50	669.50	0.08	6.00	5.30	94.30	51.90	28 07 03
18.50	680.00	0.05	8.50	2.50	94.10	55.00	29 07 03
19.20	590.00	0.20	9.50	4.00	93.80	58.00	
18.80	530.00	0.35	10.00	7.00	93.10	60.00	
17.00	510.00	0.50	9.50	8.00	93.20	65.00	
15.20	460.00	0.60	8.00	12.00	93.30	65.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 29/03							

APPENDIX D (continued)
Recorded and Forecast Meteorological Data

18.60	650.90	0.03	6.50	3.10	94.10	51.40	29 07 03
19.80	650.00	0.08	7.90	3.90	93.70	48.00	30 07 03
19.50	570.00	0.30	8.50	7.00	93.10	50.00	
17.00	480.00	0.55	8.00	10.00	93.20	55.00	
15.80	520.00	0.50	7.50	10.00	93.30	58.00	
15.40	480.00	0.55	7.00	10.00	93.40	57.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 30/03

20.20	627.40	0.09	8.80	4.10	93.70	51.80	30 07 03
19.70	550.00	0.24	9.20	3.00	93.40	53.00	31 07 03
17.00	450.00	0.58	8.00	10.00	93.30	57.00	
15.50	480.00	0.55	7.30	12.00	93.40	60.00	
15.00	520.00	0.45	6.80	10.00	93.30	58.00	
15.50	500.00	0.50	6.50	6.00	93.10	55.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED JUL 31/03

20.80	516.60	0.29	8.90	8.00	93.30	52.20	31 07 03
19.20	350.00	0.75	7.50	11.00	93.10	47.00	01 08 03
15.00	450.00	0.60	7.00	12.00	93.40	55.00	
14.50	510.00	0.45	6.50	9.00	93.40	60.00	
15.20	500.00	0.50	6.20	6.00	93.20	50.00	
16.00	400.00	0.70	8.00	8.00	93.00	45.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 01/03

18.50	457.60	0.64	7.80	11.70	93.20	50.20	01 08 03
16.00	450.00	0.60	7.00	12.00	93.50	55.00	02 08 03
15.10	520.00	0.45	6.50	8.00	93.40	60.00	
14.80	540.00	0.40	6.00	6.00	93.30	50.00	
15.50	430.00	0.60	7.80	7.00	93.10	48.00	
15.80	400.00	0.70	8.00	8.50	92.90	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 02/03

16.60	521.80	0.58	5.60	12.30	93.60	50.20	02 08 03
14.80	530.00	0.40	5.50	6.50	93.40	50.00	03 08 03
13.90	520.00	0.45	5.00	5.50	93.40	55.00	
15.00	450.00	0.50	7.50	7.00	93.20	50.00	
16.00	410.00	0.65	8.00	9.00	93.00	55.00	
15.80	390.00	0.75	9.00	7.00	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 03/03

Appendix D (continued)
Recorded and Forecast Meteorological Data

13.90	579.60	0.31	4.40	5.30	93.40	56.50	03 08 03
13.60	560.00	0.30	4.20	5.50	93.60	53.00	04 08 03
15.20	520.00	0.45	6.50	6.00	93.30	50.00	
16.00	420.00	0.60	7.50	8.50	93.10	53.00	
15.50	400.00	0.75	9.00	7.00	93.40	65.00	
16.50	540.00	0.40	8.50	6.00	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 04/03							

14.30	626.30	0.26	3.60	6.00	93.70	51.80	04 08 03
14.80	430.00	0.65	6.50	5.00	93.30	55.00	05 08 03
16.00	460.00	0.55	7.50	7.50	93.20	50.00	
15.50	400.00	0.75	9.00	7.00	93.40	65.00	
16.20	520.00	0.50	8.50	6.50	93.50	55.00	
16.00	450.00	0.65	8.80	6.00	93.50	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 05/03							

15.00	999.00	0.76	7.60	9.30	93.30	63.00	05 08 03
15.60	510.00	0.63	8.50	7.00	93.20	63.00	06 08 03
14.90	400.00	0.78	9.00	6.00	93.50	62.00	
15.60	480.00	0.60	8.70	6.50	93.40	63.00	
15.70	450.00	0.68	9.00	6.50	93.40	64.00	
15.00	440.00	0.70	9.10	8.00	93.20	68.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 06/03							

16.40	589.00	0.59	8.20	7.50	93.20	62.00	06 08 03
15.10	340.00	0.88	12.00	6.80	93.60	82.00	07 08 03
16.10	500.00	0.60	9.10	6.50	93.40	65.00	
15.40	430.00	0.75	9.60	8.00	93.30	68.00	
15.20	440.00	0.70	9.10	7.50	93.40	67.00	
15.20	390.00	0.90	10.00	9.50	93.60	71.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 07/03							

16.70	569.00	0.72	11.80	6.40	93.70	74.00	07 08 03
15.60	560.00	0.45	9.10	6.30	93.80	65.00	08 08 03
15.80	460.00	0.65	9.60	8.00	93.50	67.00	
15.40	430.00	0.70	9.20	7.50	93.30	68.00	
15.40	420.00	0.80	10.00	9.00	93.50	70.00	
15.70	440.00	0.80	9.50	8.00	93.80	67.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 08/03							

APPENDIX D (continued)
Recorded and Forecast Meteorological Data

16.40	576.00	0.35	8.20	5.50	93.70	65.00	08 08 03
16.30	510.00	0.65	10.00	7.00	93.50	66.00	09 08 03
15.30	460.00	0.60	9.50	7.50	93.30	68.00	
15.20	420.00	0.80	10.00	9.00	93.50	71.00	
15.40	440.00	0.75	9.00	8.00	93.80	66.00	
15.70	510.00	0.60	8.00	7.00	93.20	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 09/03

16.30	273.00	0.81	11.90	8.10	93.60	76.00	09 08 03
14.70	350.00	0.85	9.50	7.50	93.80	73.00	10 08 03
15.10	400.00	0.80	9.00	9.00	93.70	67.00	
15.40	460.00	0.70	8.50	8.00	93.60	63.00	
15.40	500.00	0.60	8.00	7.00	93.60	61.00	
16.00	560.00	0.40	8.00	6.00	93.50	59.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 10/03

11.60	394.10	0.80	8.50	5.90	93.90	82.60	10 08 03
12.20	400.00	0.75	8.50	5.00	93.80	75.00	11 08 03
14.70	470.00	0.60	8.50	6.00	93.60	65.00	
15.20	520.00	0.50	8.00	6.00	93.70	60.00	
15.50	560.00	0.40	7.50	7.00	93.60	60.00	
15.00	520.00	0.50	7.00	5.00	93.90	55.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 11/03

13.00	532.20	0.59	8.10	6.80	93.80	75.30	11 08 03
15.60	470.00	0.60	8.50	15.50	93.50	65.00	12 08 03
16.20	540.00	0.45	8.00	7.00	93.60	55.00	
15.50	540.00	0.50	7.50	7.00	93.80	60.00	
15.00	500.00	0.60	8.00	8.00	93.70	55.00	
14.80	380.00	0.80	9.00	10.00	93.50	70.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 12/03

16.30	476.70	0.72	9.50	19.80	93.40	66.00	12 08 03
17.30	480.00	0.70	8.50	18.00	93.50	55.00	13 08 03
16.50	520.00	0.60	8.00	10.00	93.90	60.00	
15.80	550.00	0.40	8.50	8.00	93.70	52.00	
15.20	400.00	0.75	9.00	10.00	93.60	65.00	
14.80	540.00	0.50	8.00	8.00	93.70	50.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY

WORLD WEATHERWATCH FORECAST ISSUED AUG 13/03

APPENDIX D (continued)
Recorded and Forecast Meteorological Data

17.00	410.30	0.81	8.80	19.30	93.50	58.80	13 08 03
17.80	550.00	0.28	9.20	8.00	93.90	57.00	14 08 03
18.00	600.00	0.25	9.40	10.00	93.70	57.00	
16.50	500.00	0.60	9.00	10.00	93.50	63.00	
15.00	460.00	0.70	8.00	8.00	93.30	65.00	
14.80	480.00	0.60	7.80	10.00	93.10	62.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 14/03							

18.60	581.00	0.10	9.90	4.30	93.90	53.30	14 08 03
19.00	630.00	0.20	9.40	10.00	93.70	54.00	15 08 03
16.50	500.00	0.55	9.00	10.00	93.50	63.00	
15.00	450.00	0.70	8.40	14.00	93.30	67.00	
14.80	450.00	0.65	7.80	14.00	93.10	62.00	
14.00	400.00	0.70	7.20	8.00	93.30	65.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 15/03							

20.30	539.20	0.30	10.20	6.00	93.60	50.00	15 08 03
18.50	400.00	0.55	8.60	7.00	93.30	53.00	16 08 03
16.50	480.00	0.55	8.00	10.00	93.50	57.00	
14.80	380.00	0.70	7.80	14.00	93.50	63.00	
14.20	430.00	0.50	6.80	10.00	93.40	60.00	
14.00	400.00	0.60	7.00	6.00	93.20	63.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 16/03							

19.40	326.90	0.61	8.10	9.00	93.50	49.80	16 08 03
17.50	400.00	0.50	6.90	10.00	93.70	50.00	17 08 03
15.50	300.00	0.70	7.40	10.00	93.40	58.00	
14.50	400.00	0.50	6.80	12.00	93.20	60.00	
13.80	380.00	0.60	6.50	14.00	93.00	60.00	
13.60	380.00	0.60	6.20	14.00	92.80	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 17/03							

17.30	276.30	0.60	8.00	9.90	93.60	57.40	17 08 03
16.50	330.00	0.70	9.80	12.00	93.45	65.00	18 08 03
14.20	400.00	0.50	7.80	10.00	93.45	65.00	
14.20	390.00	0.60	7.30	10.00	93.40	63.00	
13.90	340.00	0.70	7.40	10.00	93.00	65.00	
15.00	370.00	0.75	9.00	7.00	92.95	67.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 18/03							

APPENDIX D (continued)
Recorded and Forecast Meteorological Data

17.00	386.30	0.66	8.70	11.00	93.30	64.30	18 08 03
13.60	450.00	0.50	6.80	8.00	93.60	63.00	19 08 03
14.40	420.00	0.55	6.80	7.50	93.70	60.00	
14.50	340.00	0.70	7.80	7.00	93.30	64.00	
15.80	330.00	0.70	9.00	6.00	92.75	64.00	
15.00	290.00	0.85	10.00	10.00	92.60	72.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 19/03							

13.20	475.00	0.38	4.40	6.70	93.80	58.10	19 08 03
13.40	390.00	0.65	6.00	7.00	93.90	61.00	20 08 03
14.50	340.00	0.75	7.40	8.00	93.40	62.00	
15.40	360.00	0.75	8.50	6.00	92.85	63.00	
14.50	270.00	0.85	9.50	10.00	92.70	72.00	
13.30	390.00	0.65	5.50	8.00	93.60	59.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 20/03							

APPENDIX E
Summer Water Temperature and Flow Management
Project Reservoir Release Volume Calculations for
July 10 to August 20, 2003

APPENDIX E
 Summer Water Temperature and Flow Management Project Reservoir Release
 Volume Calculations for July 10 to August 20, 2003

Skins Lake Spillway base release for the period July 10 (191) to August 20 (232) = 49.0 m³/s (1,730 cfs)

Summer Water Temperature and Flow Management Project Base Release Volume = (232 - 190) * 49.0 = 2,058.0 m³/s*days

Time period (Julian Day)	Time (hrs)	Flow Rate (m ³ /s)	Volume (m ³ /s*hrs)
July 10 (191) @ 2400 hrs to July 11 (192) @ 1600 hrs	40.0	49.5	1,980
July 11 (192) @ 1600 hrs to July 16 (192) @ 1600 hrs	120.0	227	27,184
July 16 (197) @ 1600 hrs to July 17 (198) @ 1600 hrs	25.0	453	11,327
July 17 (198) @ 1600 hrs to July 18 (199) @ 1600 hrs	23.0	14.2	326
July 18 (199) @ 1600 hrs to July 19 (200) @ 1600 hrs	24.0	227	5,437
July 19 (200) @ 1600 hrs to July 20 (201) @ 1600 hrs	22.5	453	10,194
July 20 (201) @ 1600 hrs to July 25 (206) @ 1600 hrs	121.5	170	20,643
July 25 (206) @ 1600 hrs to July 28 (209) @ 1600 hrs	70.0	453	31,715
July 28 (209) @ 1600 hrs to July 29 (210) @ 1600 hrs	25.0	283	7,079
July 29 (210) @ 1600 hrs to August 1 (213) @ 1600 hrs	73.0	14.5	1,061
August 1 (213) @ 1600 hrs to August 8 (220) @ 1600 hrs	168.0	170	28,543
August 8 (220) @ 1600 hrs to August 9 (221) @ 1600 hrs	22.5	453	10,194
August 9 (221) @ 1600 hrs to August 10 (222) @ 1600 hrs	25.5	14.4	367
August 10 (222) @ 1600 hrs to August 16 (228) @ 1600 hrs	142.0	170	24,126
August 16 (228) @ 1600 hrs to August 20 (232) @ 2400 hrs	106.0	14.3	1,519
Total	1,008 (42 days)		181,694
Total Release Volume		= 181,694 m ³ /s*hrs = 7,570.6 m ³ /s*days = 267,354 cfs*days	
Volume Released for Cooling Purposes		= Total Volume - Base Volume = 7,570.6 - 2,255.4 = 5,512.6 m ³ /s*days = 194,676 cfs*days	
Average Release over Summer Management Period (July 10 to August 20, 2003)		= 7,570.6 m ³ /s*days / 42 days = 180.3 m ³ /s = 6,365.6 cfs	