Progress Report
Icicle Creek Water Temperatures:
November 1, 2005 – October 31, 2006

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Introduction

Water temperature monitoring in Icicle Creek was initiated in 2005 to evaluate effects of Leavenworth National Fish Hatchery (LNFH) operations on Icicle Creek water temperatures. LNFH water operations include supplementation of Icicle Creek with releases of water stored in the Snow Creek basin, diversion of water for hatchery operations, splitting of flows by a headgate dam into an artificially constructed bypass and an altered original channel, and return to Icicle Creek of used hatchery water which consists of the diverted stream water and well water. Icicle Creek is used by bull trout *Salvelinus confluentus* and steelhead *Oncorhynchus tshawytscha* which are listed as threatened and endangered, respectively, under the Endangered Species Act. Several other fish species also use Icicle Creek. The objectives of the water monitoring were to:

1. Monitor hourly water temperatures at several locations in Icicle Creek.
2. Compare water temperatures at different locations to evaluate how specific hatchery operations affect the water temperature.
3. Calculate water temperature metrics consistent with regional metrics and comparable to water quality standards.
4. Use water temperature metrics to evaluate suitability of water temperature regimes in Icicle Creek for bull trout and salmonids.

This progress report presents data collected from November 1, 2005 to October 31, 2006 and includes data summaries since water temperature monitoring began in July 2005 through October 2006. A previous report includes data from July 16, 2005 – November 9, 2005 (Kelly Ringel 2006). Additional reports will be prepared as more data is collected.

Study Area

The Icicle Creek watershed is on the east side of the Cascade Mountains in North Central Washington and drains 214 square miles. Icicle Creek is a Class I, fifth order tributary to the Wenatchee River providing 20% of the low season flows (WRWSC 1998). Icicle Creek is 31.8 miles long from its headwaters at Lake Josephine, elevation 4,681 ft, near Stevens Pass to its confluence with the Wenatchee River in the town of Leavenworth, elevation 1200 ft. Approximately 87% of the watershed is publicly owned and managed by the U.S. Forest Service with 74% of the watershed in the Alpine Lakes Wilderness area.

The Icicle Creek watershed is characterized by a high basin relief with a change of 6,900 ft over a horizontal distance of less than 3 mi from LNFH. The upper basin has areas that were glaciated, with steep slopes of cirque headwalls and failure escarpments that have very little water storage capacity. In the lower basin Icicle Creek flows out onto a low sloping valley composed of thick deposits of sand and gravel alluvium, and glacial deposits.

Annual mean, minimum, and maximum flows in Icicle Creek at the USGS gauging station at rm 5.8 are 613, 44, and 19,800 cfs, respectively for the period of record from 1937-2005. Precipitation in the watershed ranges from 120 inches at the crest of the Cascades to 20 inches at

the east end of the watershed. Flow is primarily from snowmelt. In a hot dry summer about 21% of the flow is estimated to originate from glacier melt (Mullan et al. 1992). The 14 glaciers in the Stuart Range have the highest mean altitude (8,227 ft) of any glaciers in the North Cascades. The Icicle Creek watershed also has 102 lakes.

There are two main water diversions on Icicle Creek. At the diversion structure at rm 5.7 the Icicle Peshastin Irrigation District diverts from 60 to 103 cfs from April through September, and the City of Leavenworth diverts about 2 cfs year round (Montgomery Water Group, Inc. 2004). At the diversion structure at rm 4.5, LNFH diverts about 20 to 40 cfs year round while Cascade Orchard Irrigation Company diverts about 7 cfs from May through September (Montgomery Water Group, Inc. 2004). The greatest quantity of water is diverted from Icicle Creek in June, July, and August when diversions typically total from 134 to 144 cfs. Water diversions in April, May, and September are close to 120 cfs, and from October through March are about 40 cfs (Montgomery Water Group, Inc. 2004).

LNFH has water rights for 16,000 acre-ft from the Snow Lakes. The lakes drain into Snow Creek which enters Icicle Creek at rm 5.4. A valve below Upper Snow Lakes is opened during the summer and drains water from the bottom of Upper Snow Lake which then flows into Nada Lake. Surface water from Nada Lake flows into Snow Creek. Snow Creek water flows from July through September are typically from 44 to 52 cfs (Montgomery Water Group, Inc. 2004). During times of extremely low flow the amount of water diverted from Icicle Creek can exceed the natural stream flow, and supplementation from Snow Lakes probably keeps the stream from going dry in some reaches. The LNFH uses a mix of well water and Icicle Creek water diverted at the intake at rm 4.5, which is influenced by inflow of Snow Creek water. Monthly water use from several on-site wells has typically been from 1.4 to 10.3 cfs (Montgomery Water Group, Inc. 2004 - data from 1999, 2002, 2003).

Water used at the hatchery is discharged into Icicle Creek at three locations: (1) at the base of the adult salmon return ladder at rm 2.8; (2) through the adult salmon return fish ladder at rm 2.8; or (3) through the pollution abatement pond at rm 2.7. The majority of the river and well water used at the hatchery is returned at the base of the fish ladder except during cleaning of the ponds and raceways when water is routed to the pollution abatement pond where solids are settled to improve the quality of the water returned to the river (USFWS 2006). The abatement pond outflow enters the river downstream of the spillway pool at rm 2.7 and generally has low flows.

Methods

Beginning in July 2005 temperature loggers were deployed in Icicle Creek from downstream of LNFH at rm 2.6 to upstream of Snow Creek and one logger was placed in Snow Creek (Table 1 and Figure A1). Temperatures were recorded hourly using ONSET Optic Stowaway temperature loggers. In July 2006 Hobo Water Temp Pro V2 loggers were placed in the LNFH fish ladder, the outfall to their abatement pond, and used to replace loggers at the Hatchery Intake and at the lower end of the original channel at Dam 5. Prior to deployment loggers were tested at different temperatures to evaluate accuracy and comparability with each other. Loggers were selected that were within 0.2^{o}C of each other. Each temperature logger was placed in a metal tube attached to a metal chain and securely anchored at the site. The temperature loggers were downloaded using

a data shuttle. Air temperatures at the LNFH weather station were measured with a minimum-maximum thermometer and recorded to the nearest degree Fahrenheit.

Data Analysis: Data was imported into the Boxcar Pro 4 or HOBOware Pro V2x programs and these programs were used to calculate daily minimums, maximums, and means. Raw data and the calculated data summaries were exported into Excel spreadsheets for further manipulation and analysis. Outliers in the recorded data that could be associated with having the logger out of the water or other discrepancies were excluded from the data set. To evaluate water temperature differences between sites, daily mean temperatures were compared and summarized by month. Mean daily air temperatures were calculated by averaging the minimum and maximum air temperatures and converting to degrees Celsius. Statistical summaries of temperature data including metrics described by Dunham et al. 2005 were calculated. These metrics primarily focus on daily maximum water temperatures due to their regulatory importance (Dunham et al. 2005).

Results

Temperature differences between sites are summarized in Table 1. Daily mean water temperatures for all sites are shown in Figure A2 and listed in Table A2. Mean, maximum, and minimum daily water temperatures for all sites are displayed in Figures A11, and air temperature data are in Figure A12. Statistical metrics for each site for 2005 and 2006 are in Table A2.

Icicle Creek water temperatures at the nine stations monitored between rm 2.6 and rm 5.5 showed considerable variation from July through September while October to June temperatures were less variable between the sites (Figure A4 and A5). In general the water temperatures in 2006 were cooler than in 2005 (Table 1 and Table A2). Water flows in Icicle Creek in 2006 were near normal whereas 2005 flows were well below normal (Figure A13 and Table A4). However the air temperatures in 2006 tended to be warmer than in 2005 (Table A2).

Comparisons of daily mean water temperatures at some of the sites were made to describe how various hatchery operations might be affecting water temperature. Data summarizing differences between sites are shown in Figure A4 and A5 and listed in Table 1.

1. ***Snow Creek Supplementation***: On July 26, 2006 the valve draining Upper Snow Creek was opened to allow outflow of 25 cfs. On August 16 the valve was adjusted and allowed outflow of 49-56 cfs until the valve was closed on October 5 (Wurster 2007). Mean daily water temperatures in Snow Creek were $\geq$14°C for 23 d before the valve was open and for 11d after the valve was open. After August 8 mean daily water temperatures in Snow Creek rarely exceeded 14°C (Figure A11).

   The effect of inflow from Snow Creek was measured by comparing water temperatures upstream of Snow Creek (rm 5.5) and at the hatchery intake (rm 4.5) in 2006. Typically the site upstream of Snow Creek is compared to the site downstream of Snow Creek (rm 5.4), but it did not log temperature data in summer 2006. In June and July the daily mean water temperature from the site upstream of Snow Creek to upstream of the intake typically increased about 0.3°C (Table 1 and Figure A5 and A6). From when the Snow

Creek valve was first opened on July 26 until August 16, the water temperature difference varied from 0.4°C to -0.3°C (Table 1 and Figure A6). From when the flow was increased on August 16 until the valve was closed on October 5, the mean daily water temperature was decreased an average of -1.2°C (Table 1 and Figure A6).

2. ***Water Diversion***: Icicle Creek water temperatures upstream and downstream of the LNFH water diversion were compared to evaluate any immediate effects of the diversion. In both 2005 and 2006 the mean daily difference between the water temperatures from upstream of the LNFH water diversion to downstream of the diversion was typically 0.1°C or less (Table 1). The difference was less than the level of accuracy of the loggers and was considered to be insignificant.

   Data was not available in 2006 to compare the rate of warming by distance upstream and downstream of the diversion. In summer 2005 the rate of warming downstream of the intake was more than double for the reach upstream. The mean temperature increases from the intake to the original channel were less in 2006 (0.3-0.7°C for June-Oct) than in 2005 (0.6-1.6°C for July-Sep) (Table 1, Figure A4,A5, A7).

3. ***Original Channel***: The mean daily water temperature increases for the almost 1-mile reach from the upper to the lower end of the original channel by month for June to September 2006 were 0.0°C to 0.4°C which was less than in 2005 when increases in August were 1.3°C and September were 1.0°C (Table 1, Figure A4, A5, and A8). The temperature increase rate was greater in the 0.7 mi upstream reach from the intake to the original channel in both years. In 2006 the temperature increase by distance in the original channel was less than half the rate upstream from the intake to the upper end of the original channel.

4. ***Hatchery Return Water***: The LNFH uses a mix of well water and Icicle Creek water diverted at the intake at rm 4.5, which is influenced by inflow of Snow Creek water. The hatchery drain is located in the fish ladder and water returns to the river from the raceways and ponds via this outlet. In 2006 the mean daily temperature difference from the intake to the drain averaged -0.6°C to -0.9°C in July and August (Table 1). The cooler temperatures would be attributed to the addition of well water. In September and October the temperature differences were -0.1°C and 0.2°C (Table 1).

   Where there were daily records for both the spillway pool and the drain, water temperatures were essentially the same (average difference=0.03°C, SD=0.05°C, t-test P=3.5E-19). Also it was noted that flow from the ladder flowed directly to where the spillway logger was located. Therefore water temperatures at the drain and spillway pool were interchanged on dates when records for the pool were missing. The mean daily water temperature in the spillway pool/hatchery drain was cooler than in the lower original channel by -1.6°C in August, -0.9°C in September, and -0.1°C in October. In August 2005 the difference was -3.4°C. From November 2005 to May 2006 the water temperature in the spillway pool was warmer than in the lower original channel, with the daily mean difference averaging from 0.2 (April-May) to 0.7 (Nov-March) (Table 1, Figure A5 and A9).

The temperature of the water coming out of the abatement pond in summer 2006 were typically from 0.5°C to 0.8°C warmer than water at the intake and 1.4°C warmer than water coming out of the hatchery at the drain (Table 1). However, it was still cooler than water at the lower end of the original channel, with daily differences averaging -0.2°C cooler in August and -0.3°C cooler in September (Table 1).

5. ***Cumulative Affect***: Icicle Creek water temperatures from upstream of Snow Creek to downstream of the LNFH were compared to evaluate cumulative effects of the different hatchery actions on water temperature. In 2006 the mean daily water temperature was cooler at the site downstream of LNFH compared to upstream of Snow Creek by -0.3°C average for August and -0.7°C average for September. In 2005 the temperature decrease in August averaged -1.0°C. Through the other seasons, from October through July, the daily mean water temperatures were warmer at the site downstream of LNFH typically by 0.3 °C to 0.4°C (Table 1, Figure A5 and A10.).

Table 1. Summary of mean monthly water temperature differences at Icicle Creek sites affected by LNFH operations, July 2005-October 2006.

LNFH action affecting water temperature	Two sites compared	Site locations in rm	Dates compared	Mean difference ^{o}C	SD of difference ^{o}C
Snow Creek Supplementation	Up Snow Cr and Down Snow Cr	5.5 -5.4	Jul 16-31 2005	-0.2	0.2
			Aug 2005	-2.4	0.7
			Sep 2005	-2.2	0.7
			Oct 2005	-0.2	0.2
			Nov-Mar 2006	-0.1	0.1
			April-May 2006	-0.1	0.1
			June 2006	na	na
			July 2006	na	na
			Aug 2006	na	na
			Sep 2006	na	na
			Oct 2006	na	na
	Up Snow Cr and Up Intake	5.5-4.5	Jul 16-31 2005	0.2	0.2
			Aug 2005	-1.7	0.6
			Sep 2005	-1.7	0.6
			Oct 2005	0.0	0.2
			Nov-Mar 2006	0.0	0.1
			April-May 2006	0.1	0.1
			June 2006	0.2	0.3
			July 2006	0.3	0.1
			Aug 2006	-0.7	0.8
			Sep 2006	-1.2	0.5
			Oct 2006	-0.1	0.2

Water Diversion	Down Snow Cr and Up Intake	5.4 - 4.5	Jul 19-31	0.4	0.1
			Aug 1-31	0.7	0.1
			Sep 1-30	0.5	0.2
			Oct 1-31	0.2	0.1
			Nov-Mar 2006	0.1	0.1
			April-May 2006	0.2	0.0
			June 2006	na	na
			July 2006	na	na
			Aug 2006	na	na
	Up Intake and Down Intake	4.5 – 4.45	Jul 19-31	0.0	0.0
			Aug 1-31	0.1	0.1
			Sep 1-30	0.1	0.0
			Oct 1-31	0.0	0.1
			Nov-Mar 2006	0.0	0.1
			April-May 2006	0.1	0.1
			June 2006	0.1	0.2
			July 2006	0.0	0.1
			Aug 2006	0.0	0.0
	Up Intake and Up Original Channel	4.5-3.8	Jul 19-31	0.6	0.1
			Aug 2005	1.6	0.6
			Sep 2005	1.3	0.5
			Oct 2005	0.1	0.04
			Nov-Mar 2006	na	na
			April-May 2006	0.2	0.1
			June 2006	0.3	0.2
			July 2006	0.3	0.1
			Aug 2006	0.7	0.2
			Sep 2006	0.6	0.3
			Oct 2006	0.3	0.1
Original Channel	Up Original Channel and lower O. Channel	3.8 – 2.85	Jul 19-31	0.6	0.1
			Aug 2005	1.3	0.4
			Sep 2005	1.0	0.3
			Oct 2005	0.6	0.6
			Nov-Mar 2006	Na	Na
			April-May 2006	na	na
			June 2006	0.2	0.1
			July 2006	0.0	0.1
			Aug 2006	0.4	0.2
			Sep 2006	0.2	0.3
			Oct 2006	-0.1	0.1

Hatchery Return Water	Lower O. Channel and Spillway Pool	2.85 – 2.8	July 2005	na	na
			Aug 2005	-3.4	1.1
			Sep 2005	-2.3	0.8
			Oct 2005	-0.5	0.6
			Nov-Mar 2006	0.7	0.9
			April-May 2006	0.2	0.3
			June 2006	na	na
			July 2006	na	na
			Aug 2006	-1.6	0.3
			Sep 2006	-0.9	0.5
			Oct 2006	-0.1	0.2
	Up Intake and fish ladder	4.5-LH2.8	Jul 22-31 2006	-0.9	0.3
			Aug 2006	-0.6	0.2
			Sep 2006	-0.1	0.1
			Oct 2006	0.2	0.2
	Up Intake and Abatement Outflow	4.5-LH2.6	Jul 22-31 2006	0.5	0.4
			Aug 2006	0.8	0.3
			Sep 2006	0.5	0.7
			Oct 2006	0.5	0.2
Cumulative Affect	Up Snow Cr and down LNFH	5.5 – 2.6	Jul 19-31 2005	0.6	0.2
			Aug 2005	-1.0	0.7
			Sep 2005	na	Na
			Oct 2005	0.3	0.2
			Nov-Mar 2006	0.4	0.2
			April-May 2006	0.4	0.1
			June 2006	0.4	0.1
			July 2006	0.6	0.1
			Aug 2006	-0.3	0.7
			Sep 2006	-0.7	0.4
			Oct 2006	0.3	0.2

Discussion

Water temperature comparisons from different sites and over time in Icicle Creek reveal effects from different LNFH operations, including supplementation with water from the Snow Lakes, diversion of water, and return of used hatchery water which is a mix of river and well water. While base flow, amount of flow from Snow Creek, and air temperatures are presented, the overall effects of these on the water temperature have not been analyzed.

The greatest differences in water temperatures in Icicle Creek were in August and September when there was a greater influence from inflow from Snow Creek and solar warming would be greatest. There was little water temperature variability between the sites beginning in October through early July.

Snow Creek Supplementation: Of the LNFH actions evaluated, inflow of water from Snow Creek had one of the greatest effects on water temperature. After increased outflow from the Snow Lakes in mid August 2006 the mean daily water temperature was typically lowered by over -1°C. The magnitude of the difference was not as great as in 2005 when the base flow of Icicle Creek was 25-30% less by average for August and September and the water temperature was typically cooled by more than -2°C. Further analysis could also be conducted to determine the relationship between flow volume in Icicle Creek, inflow from Snow Creek, and changes in water temperature in Icicle Creek.

In 2006 the water temperatures in Snow Creek varied with several days of warmer water both before and after the Snow Creek valve was opened. The warmer water temperatures in Snow Creek may have been due to surface warming of Nada Lake. When the Upper Snow Creek valve is opened, the warmer water from Nada Lake is probably displaced before the Upper Snow Lakes water dominates the flows in Snow Creek. Flow volume in Icicle Creek compared to Snow Creek would affect the magnitude of the temperature decrease in Icicle Creek. Additionally water temperatures at the bottom of Upper Snow Lake and in Nada Lake would influence water temperatures in Snow Creek. Water temperature measurements at the lakes and in the upper end of Snow Creek when the valves are opened could be helpful in evaluating water temperatures in the upper basin on lower Snow Creek.

Water Diversion*:* Diversion of water had no immediate effect on water temperature in Icicle Creek from upstream of the intake to downstream of the intake. However, the rate of warming in the stream is affected by flow volume and flow velocity. In 2005 the rate of warming was greater downstream of the intake, but in 2006 data was not available for this comparison.

Original Channel: The summertime water temperature increased in the mile long original channel typically by 0.4°C or less in 2006 compared to about 1^{o}C in 2005. In both years the rate of temperature warming by distance was less than the reach upstream of it from the water diversion to the upper end of the original channel. Many factors may contribute to this relationship including the rate of flow in these reaches which is influenced by channel roughness and width:depth ratio and shading.

Hatchery Return Water: Water returning to Icicle Creek via the hatchery drain located in the ladder during summer months is cooler than the river water at the hatcheries diversion point. The well water obviously has a cooling effect on the mix of waters in the summer. By contrast during the winter months the well water increases the temperature of the hatchery return water above the temperature of the diverted water. Hatchery water returned via the abatement pond is warmer than other hatchery return water due to its retention in the pond which allows for solar warming.

The spillway pool primarily is fed by hatchery return water entering via the fish ladder. During high flows when the headgate is partly closed water flowing downstream enters via the spillway

at the head of the pool. The original channel enters the spillway pool at its lower end. During a period when the temperature logger located on the ladder side of the spillway pool at the end of a barb was logging as was the logger in the drain, these water temperatures were the same. In 2007 the logger in the spillway pool was relocated to the side opposite of the ladder to determine if there is mixing with other sources of water at this location. The spillway pool is probably over 3 m deep in areas and is used by adult salmon, steelhead, bull trout, and other fish species. The spillway pool provides a deepwater refugia with cooler than downstream and upstream of it.

Cumulative Affect: We compared water temperatures from upstream of Snow Creek to downstream of LNFH to evaluate the cumulative effects of the LNFH actions. Water downstream of the LNFH is a mix of water coming down the original channel, and water returned after use by the LNFH into the spillway pool and abatement pond outfall. The mean summer water temperature for 2006 was -0.3°C cooler at the site downstream of the LNFH than at the site upstream of Snow Creek.

Water naturally warms in the 2.9 miles reach from upstream of Snow Creek to downstream of LNFH due to solar warming. The amount of warming would be increased by the decreases in flow due to the water diversions. Water held in the pollution abatement pond would be warmed more than in the stream channel due to the retention time in the pond and lack of shading. However, the flow from the pond entering the river is typically less than 5% of flow and would have negligible effect on stream temperatures.

Icicle Creek water temperatures are cooled by the inflow of the supplemental water drawn from the bottom of the Snow Lakes which enters via Snow Creek. In the summer well water used by LNFH is also cooler than stream water. Even after use by the hatchery the mix of river and well water returned to Icicle Creek is cooler than the stream water. Reductions in water temperatures due to inflow of Snow Lakes and well water were greatest in August and September.

From October through June there is a slight warming of the water from upstream of Snow Creek to downstream of the hatchery. During this period water is not drawn from the bottom of the Snow Lakes. Stream water could be warmed by solar radiation and well water returned by the hatchery would be warmer than river water during the colder months. Since typically less than 10 cfs of well water is used, the influence on stream water temperatures depends on stream flow.

Char and Salmonid Water Temperature Criteria

Several salmonid species use lower Icicle Creek which is where LNFH operations affect water temperatures. To evaluate influence of water temperature on the various fish species, water temperature metrics were compared to water temperature criteria and thermal tolerance limits. Water temperature is a vital factor influencing the health and survival of native fish. Several salmonid species spawn in lower Icicle Creek including spring Chinook salmon, summer Chinook salmon, steelhead, and coho salmon. Juveniles of all these species have been found rearing in the lower part of Icicle Creek. Adult, subadult, and occasionally juvenile bull trout (bull char) have been observed in lower Icicle Creek.

Bull Trout: Water temperature criteria and requirements are cooler for bull trout than for other salmonid species. Washington State Department of Ecology (WDOE) criteria for the 7-day

average of daily maximums for bull trout rearing is 12°C (WAC 173-201A-602). This was not met at any of the sites for both years. Many studies suggest that juvenile bull trout are uncommon where water temperatures exceed 15°C for extended periods of time (Fraley and Shepard 1989; Rieman and Chandler 1999: Dunham and Chandler 2001), and adult bull trout prefer 9-13°C (Selong et al. 2001). In both 2005 and 2006 water temperatures at all the sites exceeded 14°C from 30 to 74 days. These results indicate that the water temperature regime in lower Icicle Creek is not preferable for bull trout. However, adult bull trout are more tolerant of warmer water though are rare where temperatures are warmer than 19°C (McPhail and Baxter 1996). In 2005 the spillway pool did not exceed 18°C, and in 2006 it only exceeded 18°C on 1d. The warmest site was the lower end of the original channel and temperatures there exceeded 18°C for 51 d in 2005 and 26 d in 2006. At the other sites water temperatures exceeded 18°C for 10-37 days in 2005 and 8-11 days in 2006.

Bull trout adults, subadults, and some juveniles have mostly been observed in the spillway pool and numbers have been highest (up to ~100) in late August through October. While this large deep spillway pool may not always have water temperatures that meet bull trout preferences, temperatures are within the range of tolerance, and the cooler water temperatures appear to provide important refugia for adult and subadult bull char. However, the warmer waters experienced in Icicle Creek and even in the spillway pool could have some adverse affects on the movements, distribution, and health of bull trout.

Salmonids: WDOE criteria for the 7-day average of daily maximums for rearing of salmonid spawning, rearing, and migration is 17.5°C (WAC 173-201A-602). In 2005 and 2006 this criteria was only met in the spillway pool. These results indicate that lower Icicle Creek with the exception of the spillway pool does not meet state maximum temperature criteria and would not provide preferred rearing conditions for salmon, steelhead, and trout.

However, the lower end of Icicle Creek does have a temperature regime that generally would not exclude juvenile salmonid rearing. Juvenile spring Chinook salmon can rear and grow at temperatures up to 19°C and can be found at temperatures up to 22°C (McCullough 1999). The only site to exceed 22°C was the lower end of the original channel in 2005 for 18 d. The addition of cooler water from the Snow Lakes and LNFH wells helps to keep the water temperatures within a range that these fish species can tolerate.

Temperature Barrier: Another influence on movement of any fish species in lower Icicle Creek would be the formation in some years of a temperature barrier at the lower end of the original channel. WDOE assumes that barriers to adult salmonid migration exist any time the 1-D max temperatures is greater than 22°C and the adjacent downstream water temperatures are 3°C or more cooler (WDOE 2006). In 2005 the lower end of the original channel exceeded 22°C on 22 days. Fish might prefer to hold in the cooler waters of the spillway pool, which in 2005 was often 3°C or more cooler, rather than migrate upstream.

Future Monitoring

This report summarizes some of the water temperatures recorded in Icicle Creek beginning mid-July 2005 through October 2006. Monitoring of the sites will continue. There may not be a need

to monitor water temperature at all of the sites year round since the water temperatures during the warmer summer months are of more interest because of limitations to fish and more influences by LNFH operations. The site downstream of the LNFH water intake could be removed since there was no significant difference from the temperatures recorded upstream of the intake. The LNFH has initiated monitoring of water temperature in their return water. Additional monitoring sites in lower Icicle Creek and in the Wenatchee River should be considered.

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Appendix Tables and Figures

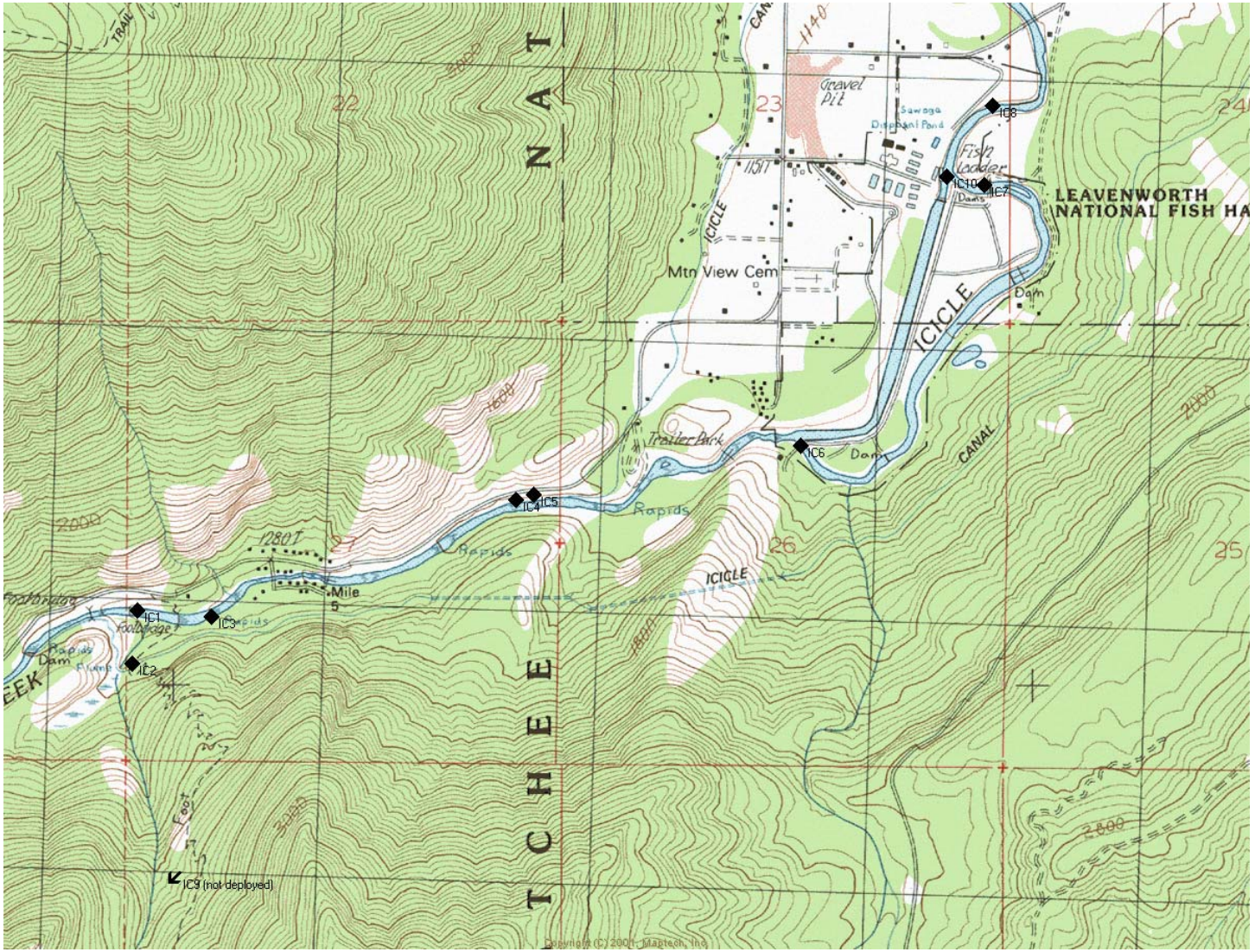


Figure A1. Locations of nine Optic StowAway Temperature Loggers in Icicle and Snow Creeks, 2005.

Table A2. Summary of temperature metrics for Icicle Creek water temperature data, 2005-2006.

Year Date info	River Mile	Location	1d Mean	7d avg Mean	1d Max	7d avg Max	21d avg Max	62d Mean[a]	41d Mean[b]	Week_ d≥14°C	Week_ d≥15°C	Week_ d≥18°C	Week_ d≥22°C	Sum_ d≥14°C	Sum_ d≥15°C	Sum_ d≥18°C	Sum_ d≥22°C	Sum_ d≤15°C
2005	5.5	up Snow Cr	17.3	17.0	19.5	18.9	18.5	15.4	16.1	7	7	6	0	56	51	23	0	15
	0.2	in Snow Cr	16.3	15.2	17.0	16.6	15.9	12.5	13.2	7	7	0	0	30	20	0	0	0
	5.4	dn Snow Cr	16.7	16.3	18.6	18.1	17.5	13.5	14.3	7	7	7	0	40	33	10	0	1
	4.5	up Intake	17.2	16.7	19.2	18.6	18.0	14.0	14.9	7	7	7	0	44	38	11	0	6
	4.4	dn Intake	17.2	16.8	19.4	18.8	18.1	14.1	15.0	7	7	7	0	44	38	13	0	5
	3.8	up O Chan	17.8	17.4	21.3	20.3	19.6	15.4	16.3	7	7	7	0	60	52	37	0	8
	2.7	dn O Chan	19.4	18.5	25.6	24.0	22.9	16.4	17.4	7	7	7	7	66	63	51	18	11
only7/29-9/12	2.8	Spillway Pool	16.1	15.3	17.7	17.0	16.5		14.1	7	7	0	0	*30*[c]	*24*[c]	0	0	0
	2.8	LH drain																
	2.7	LH Ab Outfall																
only7/18-8/31	2.6	dn LH	17.6	17.2	20.0	19.6	19.0		15.6	7	7	7	0	*43*[c]	*42*[c]	24	0	7
	2.8	Air	26.1	24.3	37.8	36.1	34.5	20.6	21.8									
2006	5.5	up Snow Cr	17.1	16.6	19.5	18.6	17.2	14.6	15.0	7	7	6	0	66	55	8	0	2
end 8/31/06	0.2	in Snow Cr	18.8	17.7	20.1	18.8	17.0		14.2	7	7	6	0	*46*[c]	38	9	0	13
	5.4	dn Snow Cr																
	4.5	up Intake	17.6	17.0	19.8	18.8	17.3	13.9	14.6	7	7	6	0	59	46	8	0	7
	4.4	dn Intake	17.6	17.0	19.8	18.8	17.3			7	7	6	0					7
	3.8	up O Chan	17.9	17.3	20.2	19.2	17.8	14.5	15.2	7	7	6	0	67	60	11	0	8
	2.7	dn O Chan	18.0	17.4	20.2	19.4	18.3	14.8	15.5	7	7	6	0	74	65	26	0	8
	2.8	Spillway Pool																
start 7/22/06	2.8	LH drain	16.4	15.9	18.3	17.4	16.1		13.9	7	7	1	0	*40*[c]	*23*[c]	1	0	1
start 7/22/06	2.7	LH Ab Outfall	18.1	17.4	20.4	19.1	17.5		15.3	7	7	6	0	*46*[c]	*41*[c]	8	0	10
	2.6	dn LH	17.8	17.2	19.8	18.9	17.6	14.3	15.0	7	7	6	0	66	56	8	0	8
	2.8	Air	29.2	26.7	41.1	37.9	34.7	21.7	22.1									

[a] The average temperature recorded across all observations from 15 July through 15 September. This is the overall average summer temperature (AWAT).

[b] The average temperature recorded across all observations from 21 July through 31 August. This shorter summer period was selected because missing data for several sites would not allow for calculation of AWAT.

[c] These counts were taken even though not all dates when temperatures could have exceeded these values were in the dataset. See the first column for dates data collected.

LH= Leavenworth National Fish Hatchery,

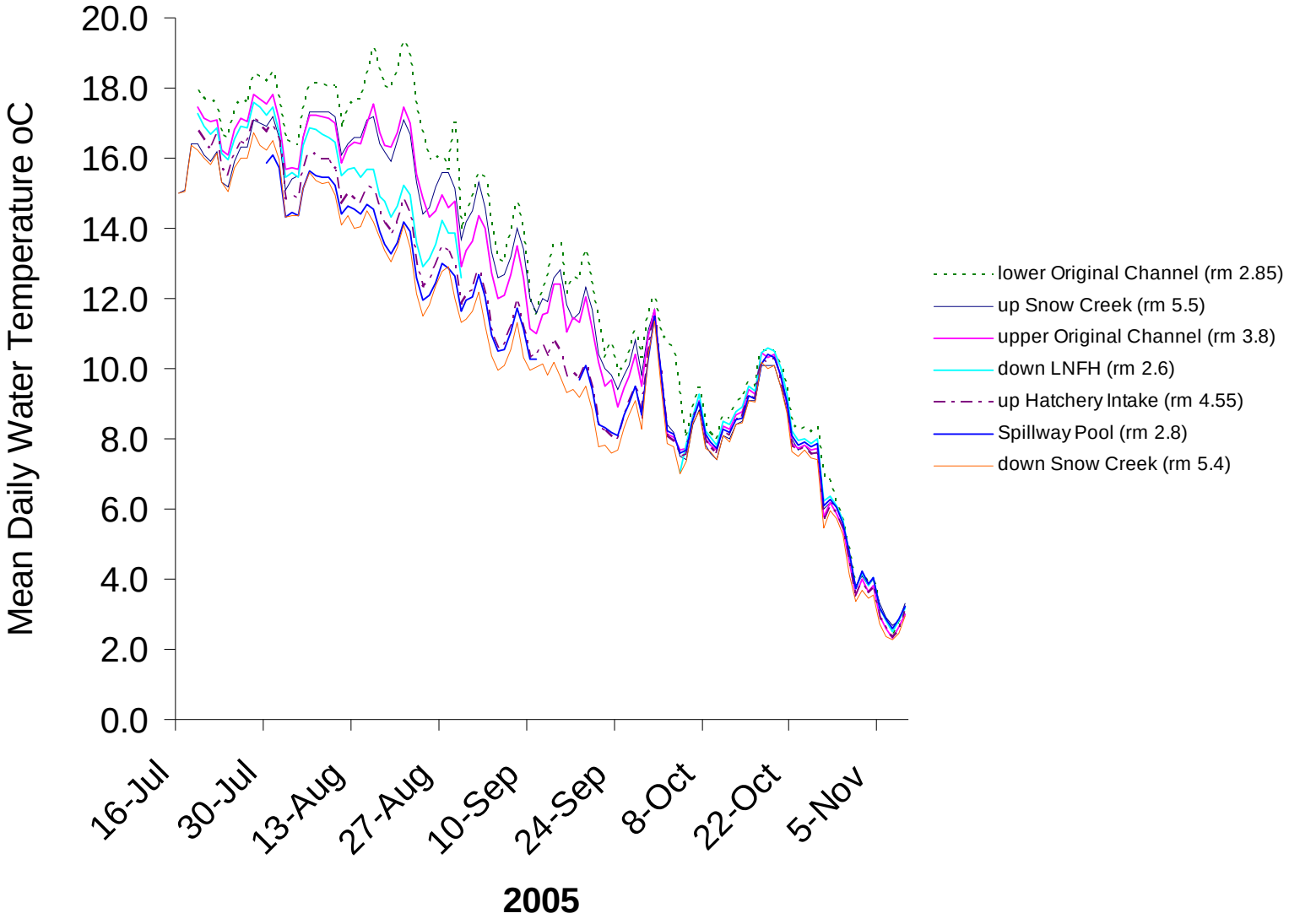


Figure A2. Mean daily water temperatures at seven sites in Icicle Creek between rm 2.6 and rm 5.5, July 16-November 9, 2005.

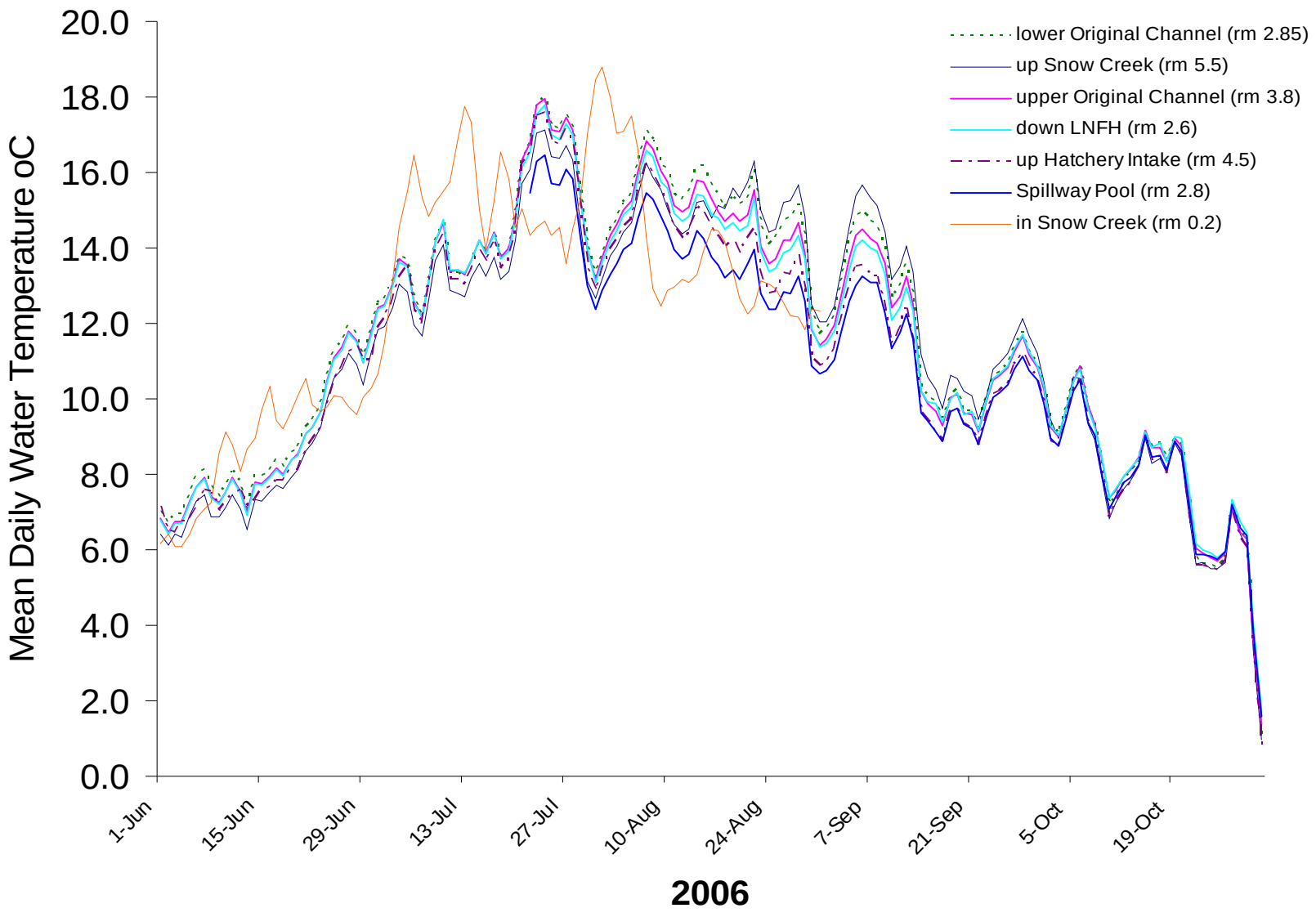


Figure A3. Mean daily water temperatures at seven sites in Icicle Creek between rm 2.6 and rm 5.5, June 1-October 31, 2006.

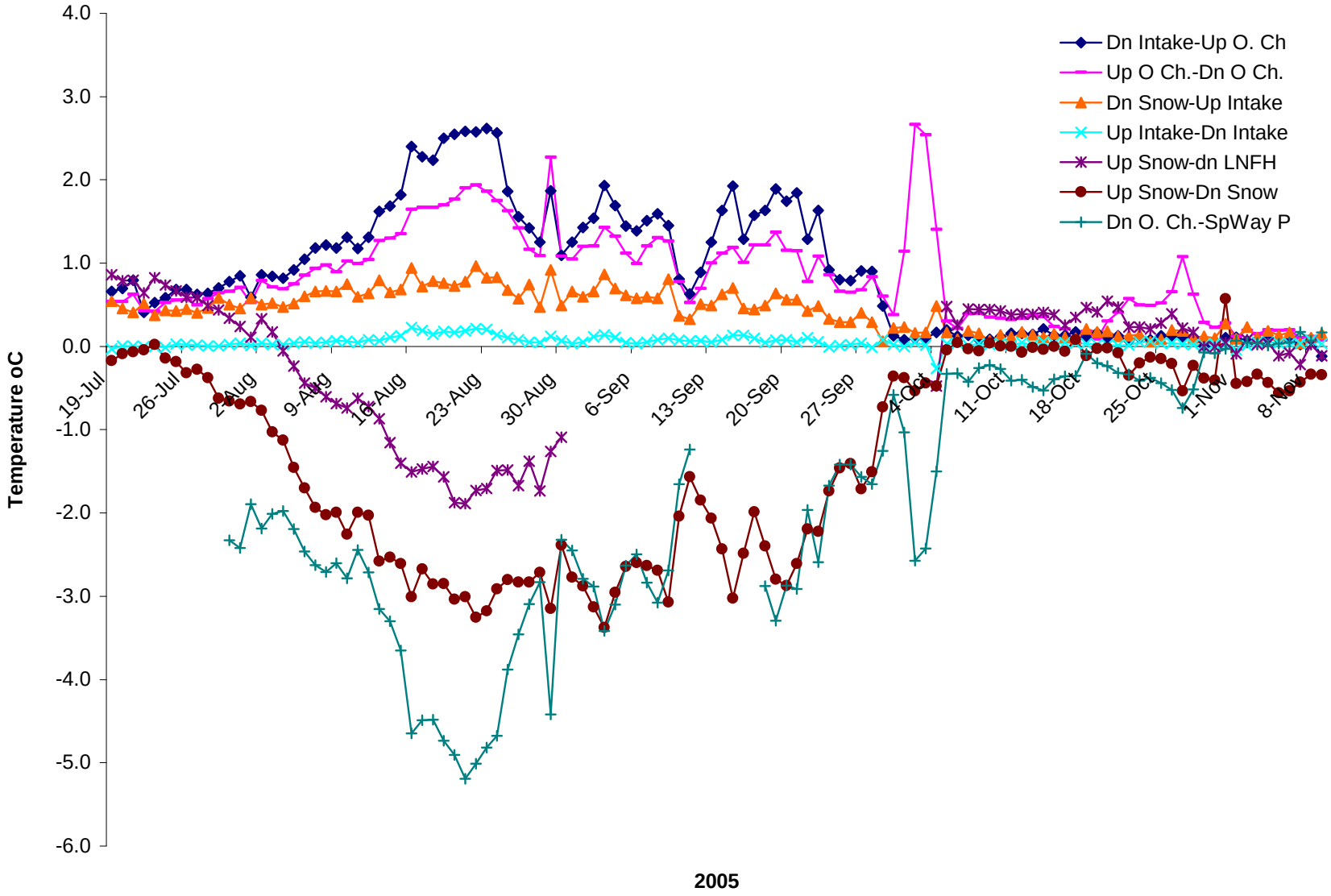


Figure A4. Temperature differences between seven sites in Icicle Creek between rm 2.6 and rm 5.5, July 16-November 9, 2005.

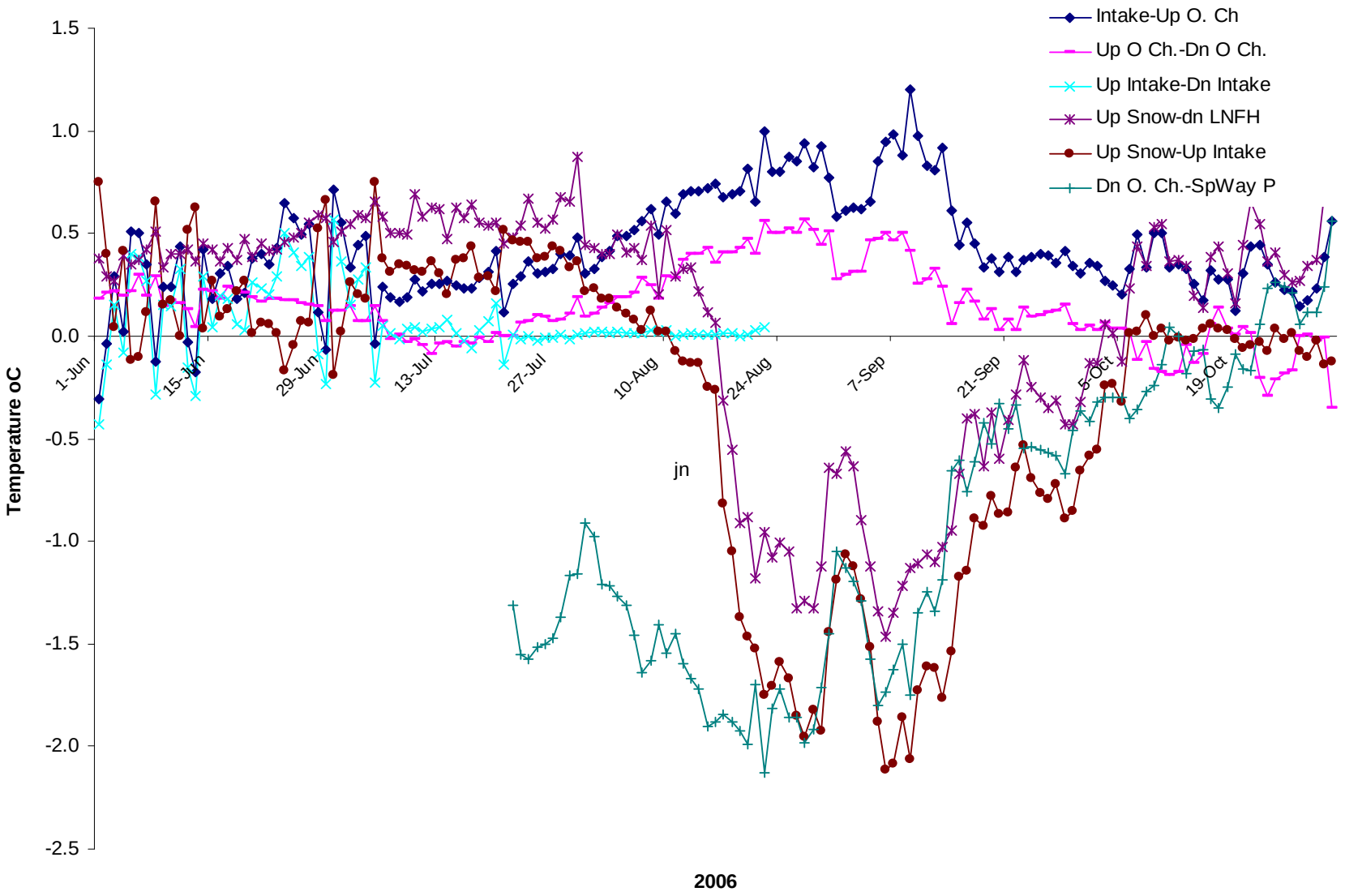


Figure A5. Temperature differences between seven sites in Icicle Creek between rm 2.6 and rm 5.5, June 1-October 31, 2006.

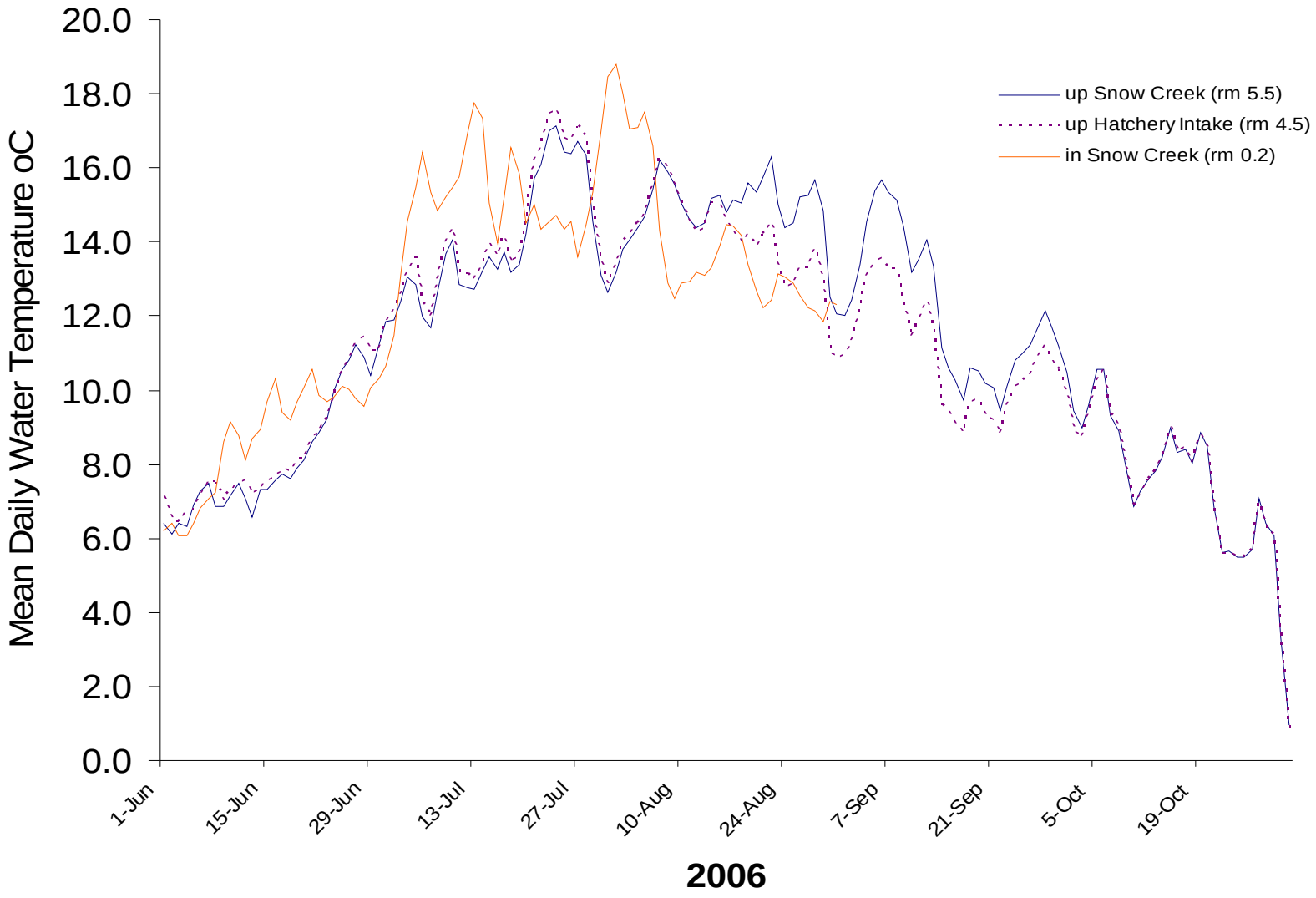


Figure A6. Comparison of mean daily water temperatures in Icicle Creek upstream of Snow Creek, in Snow Creek, and at the LNFH Intake, less than 1-mile down of Snow Creek, June 1-October 31, 2006.

Figure A7. Comparison of mean daily water temperatures in Icicle Creek from upstream of the LNFH water diversion intake to 0.7 mi downstream at the upper end of the original channel, June 1 – October 31, 2006.

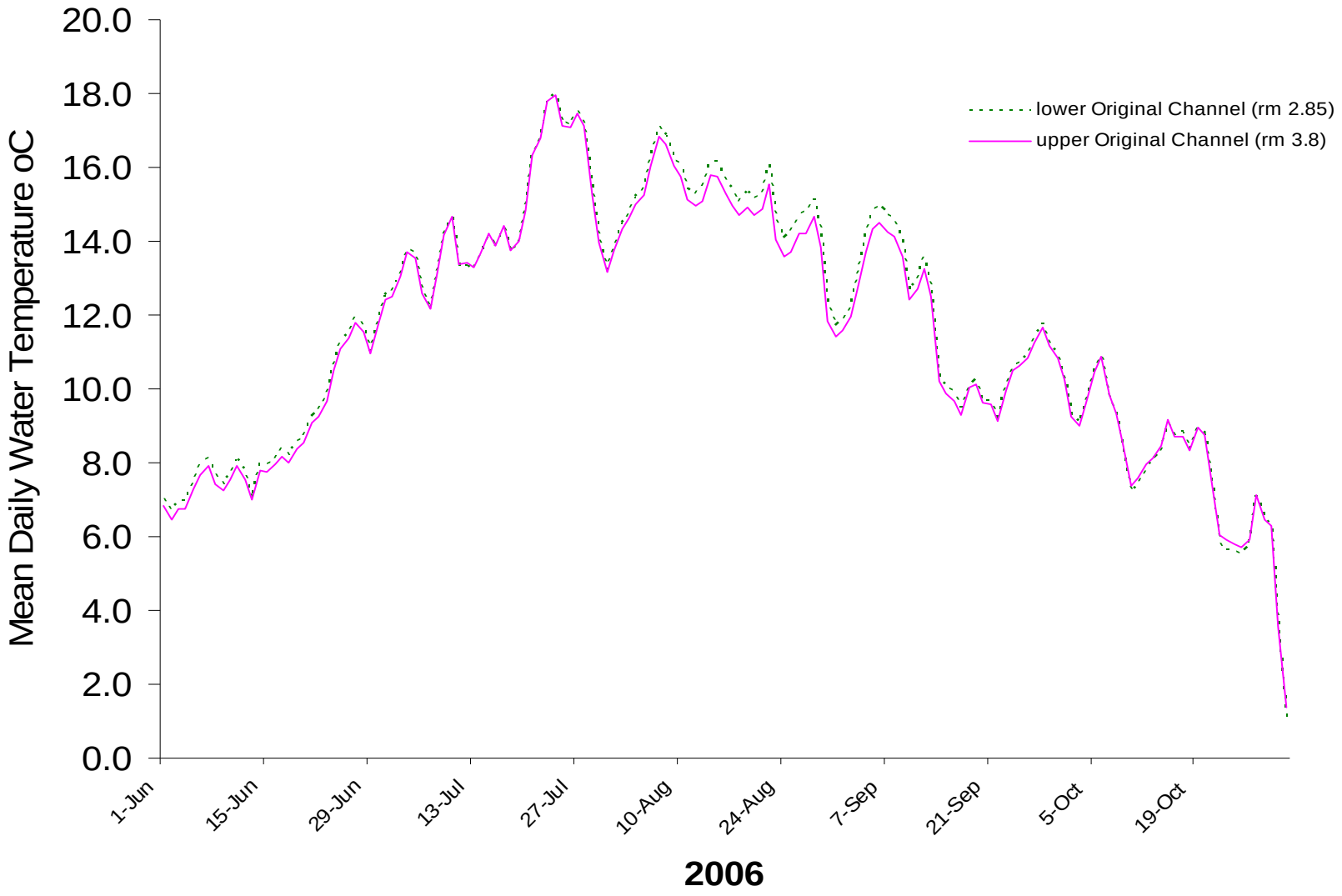


Figure A8. Comparison of mean daily water temperatures in Icicle Creek at the upper and lower end of the original channel, June 1-October 31, 2006.

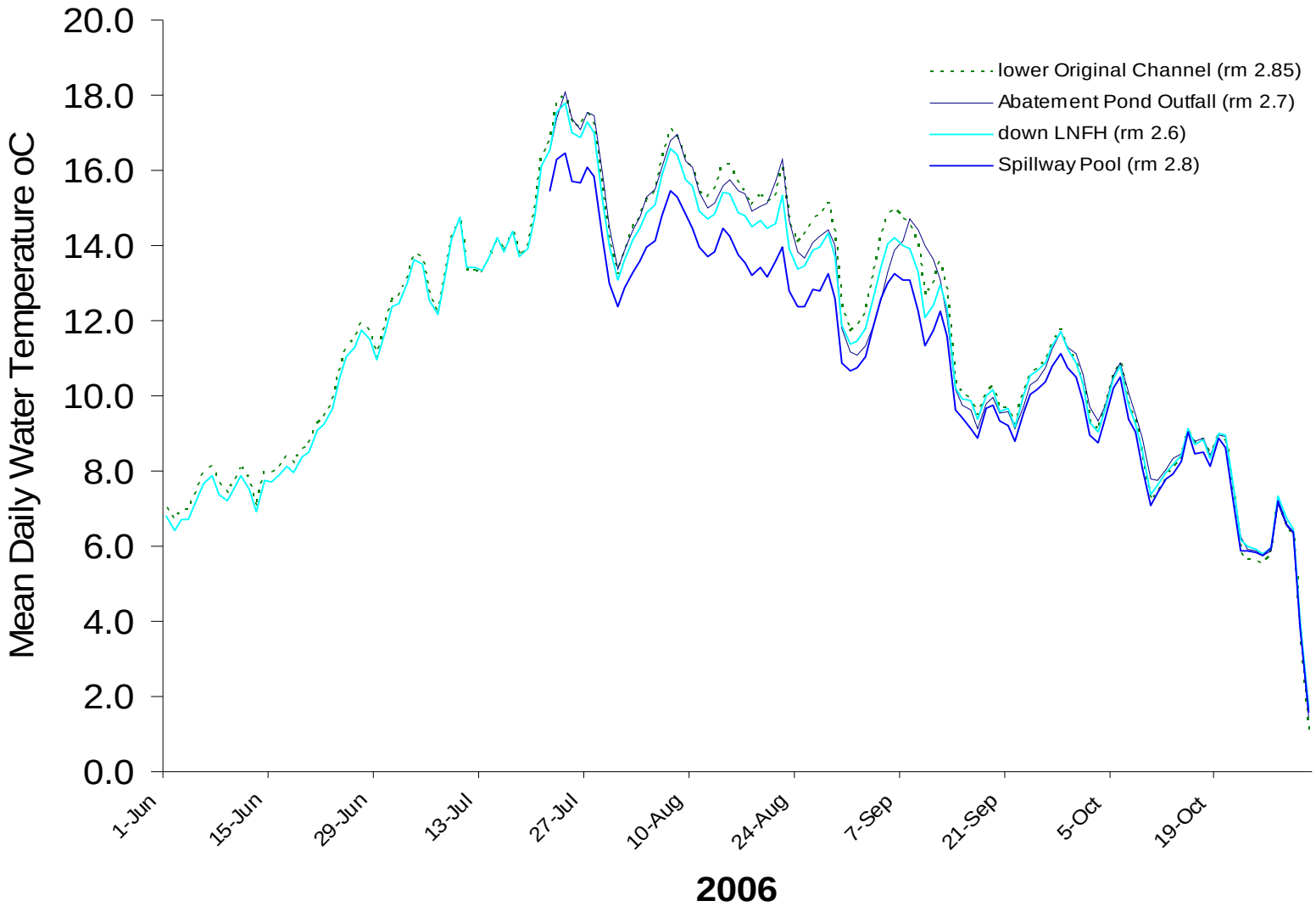


Figure A9. Comparison of mean daily water temperatures in Icicle Creek at the lower end of the original channel, in the spillway pool, abatement pond outfall, and downstream of LNFH, June 1-October 31, 2006.

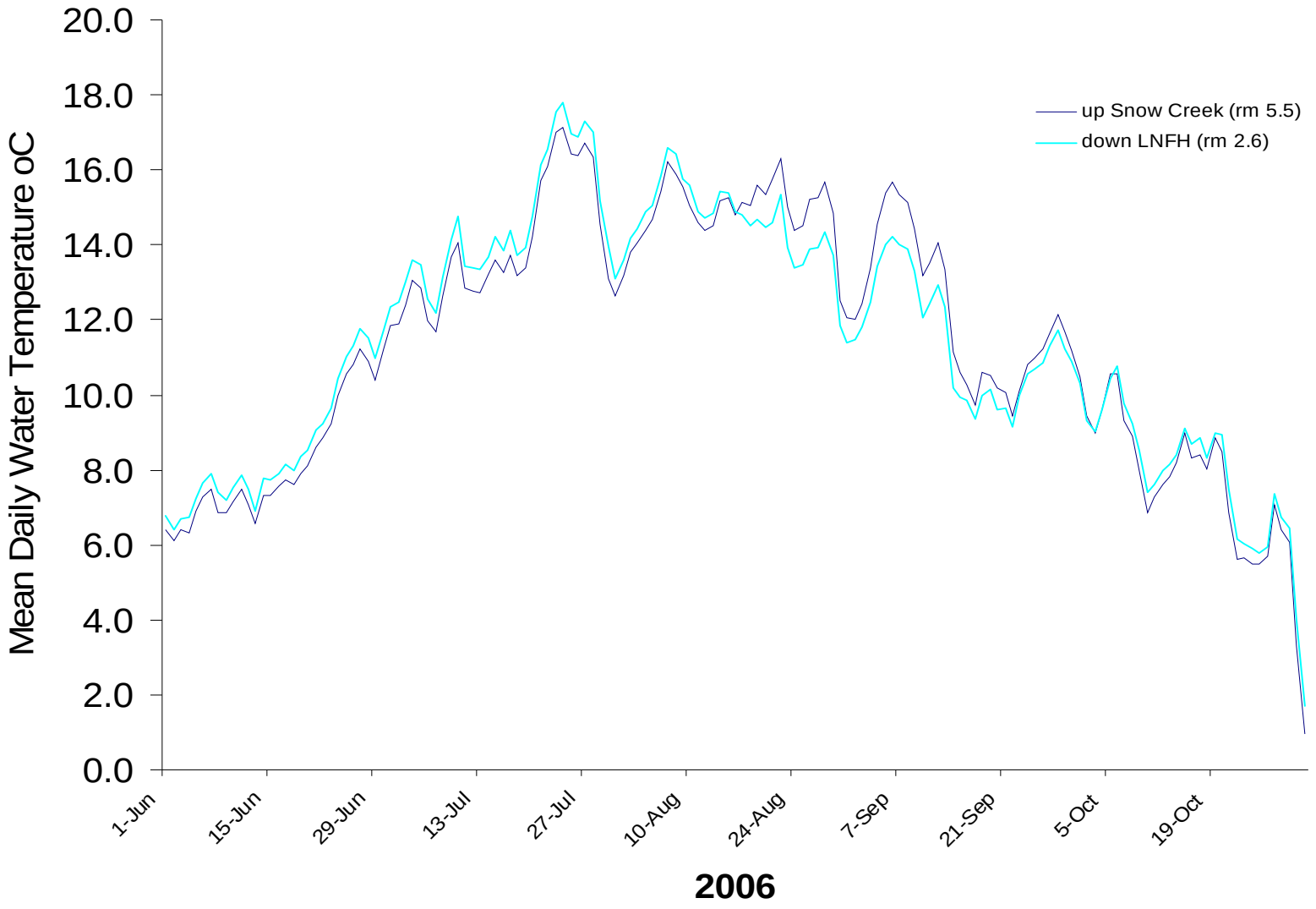
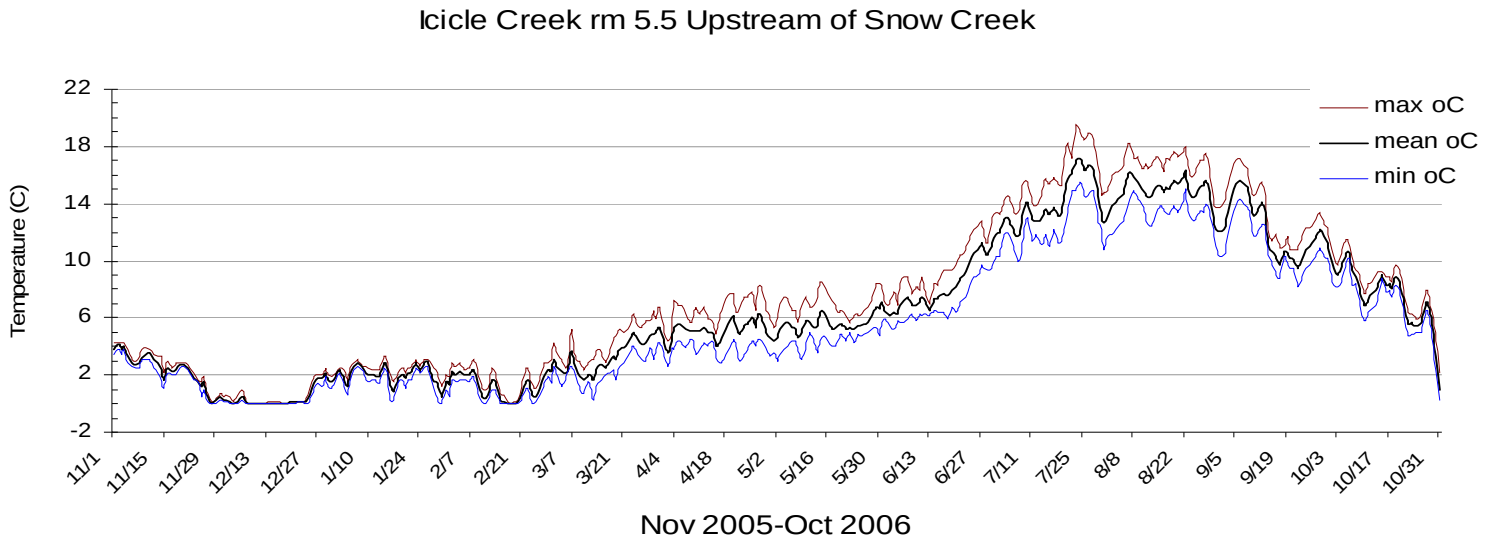
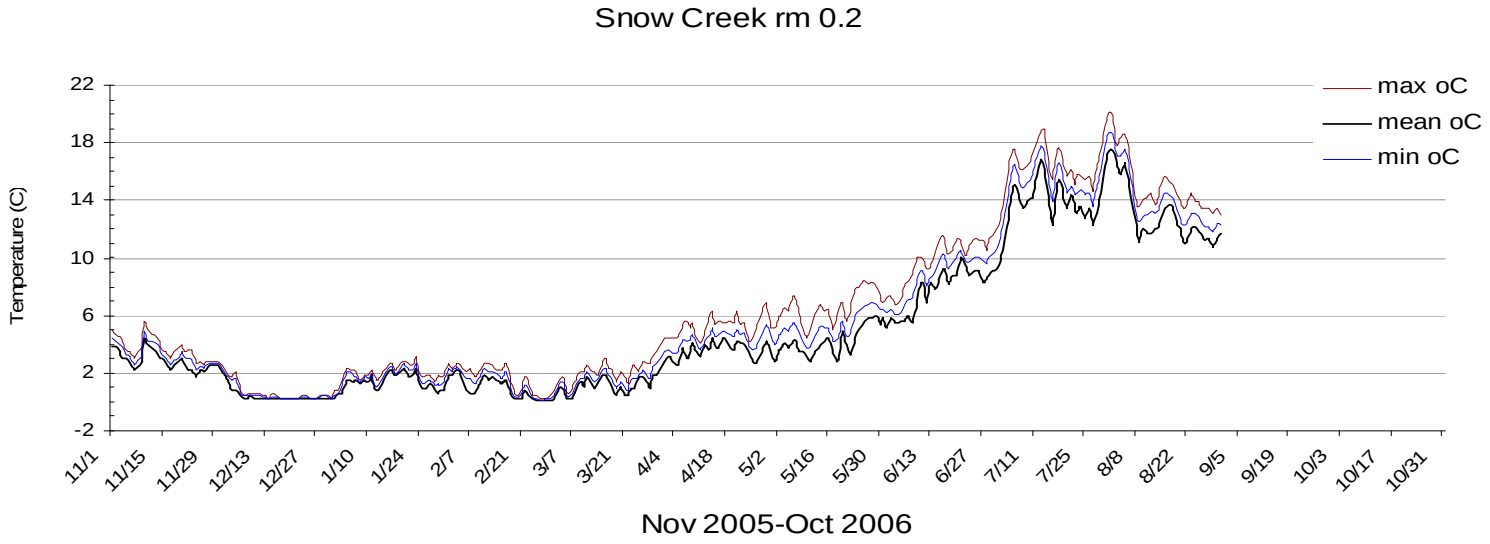
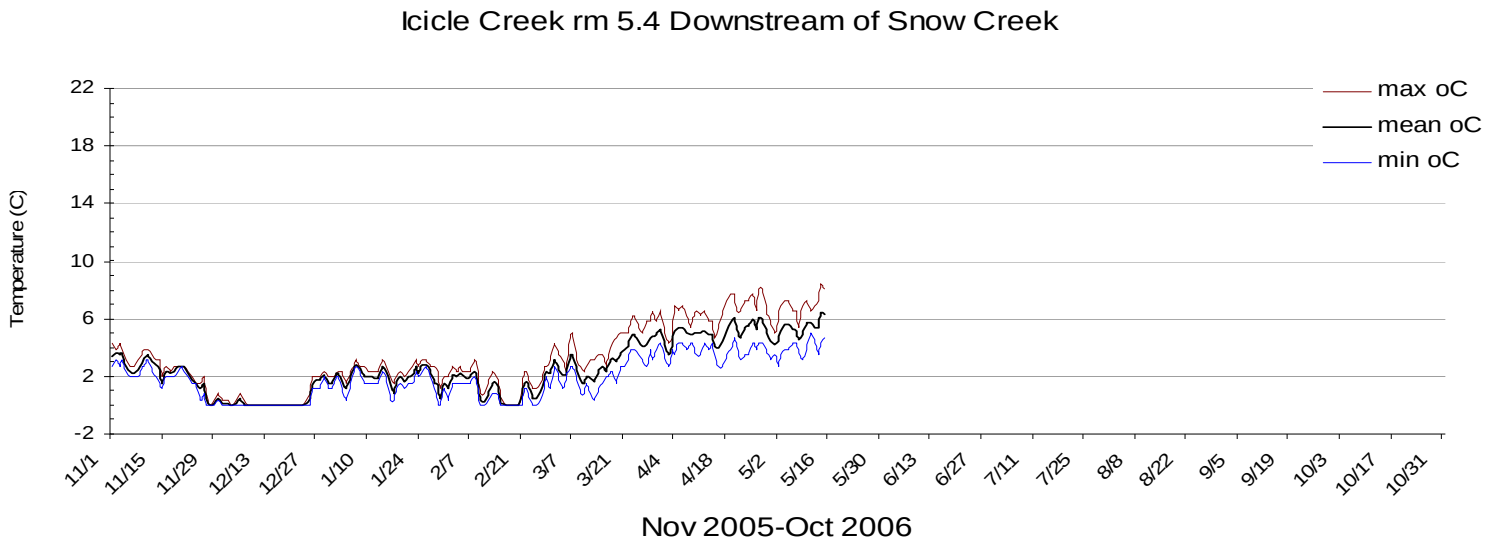


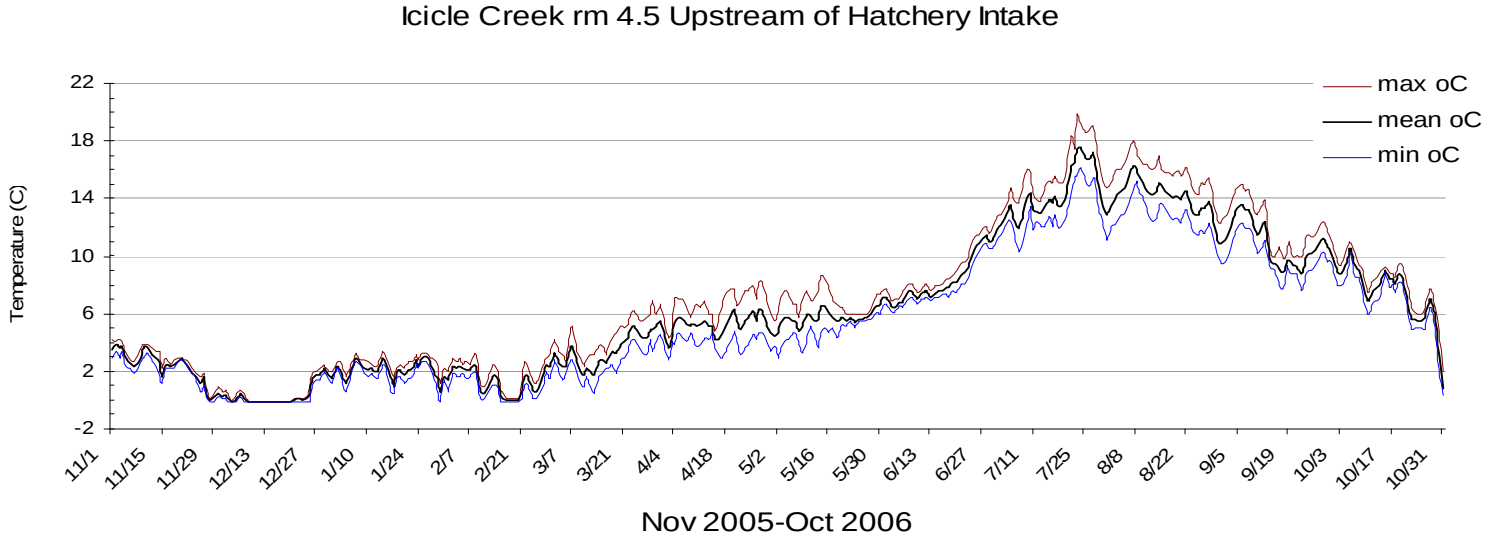
Figure A10. Comparison of mean daily water temperatures in Icicle Creek upstream of Snow Creek and downstream of the LNFH, June 1-October 31, 2006.

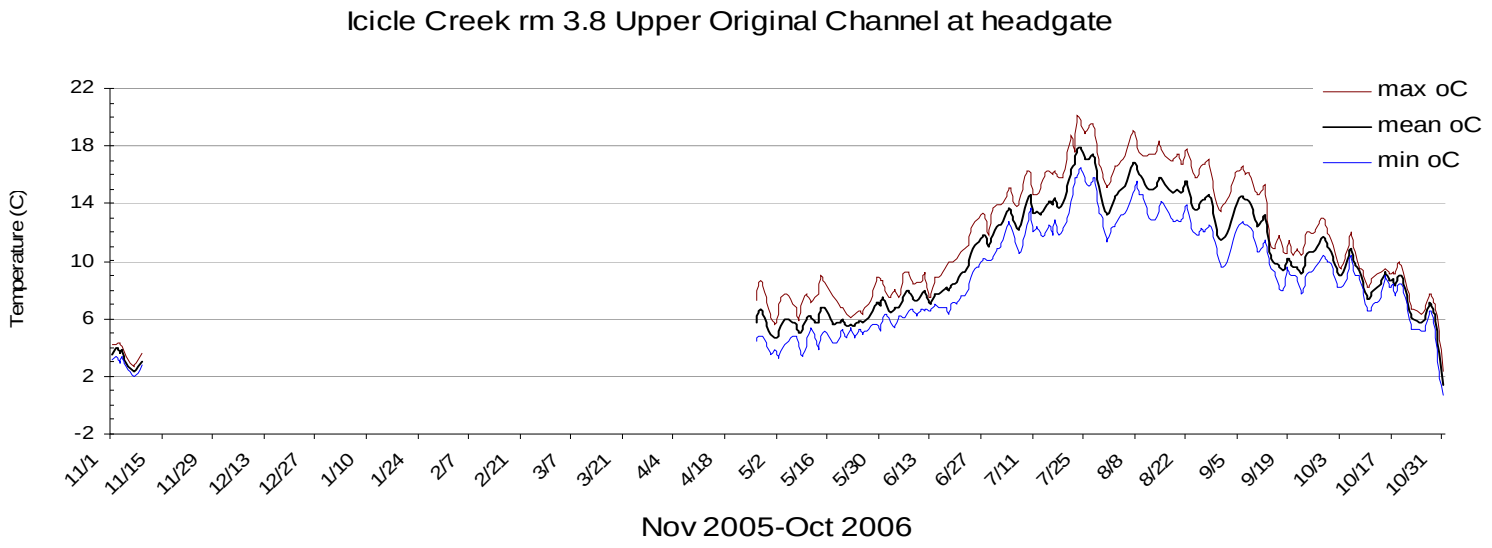
Figures A11. Maximum mean and minimum daily water temperatures at nine Icicle Creek sites and Snow Creek, Nov 2005-Oct 2006.

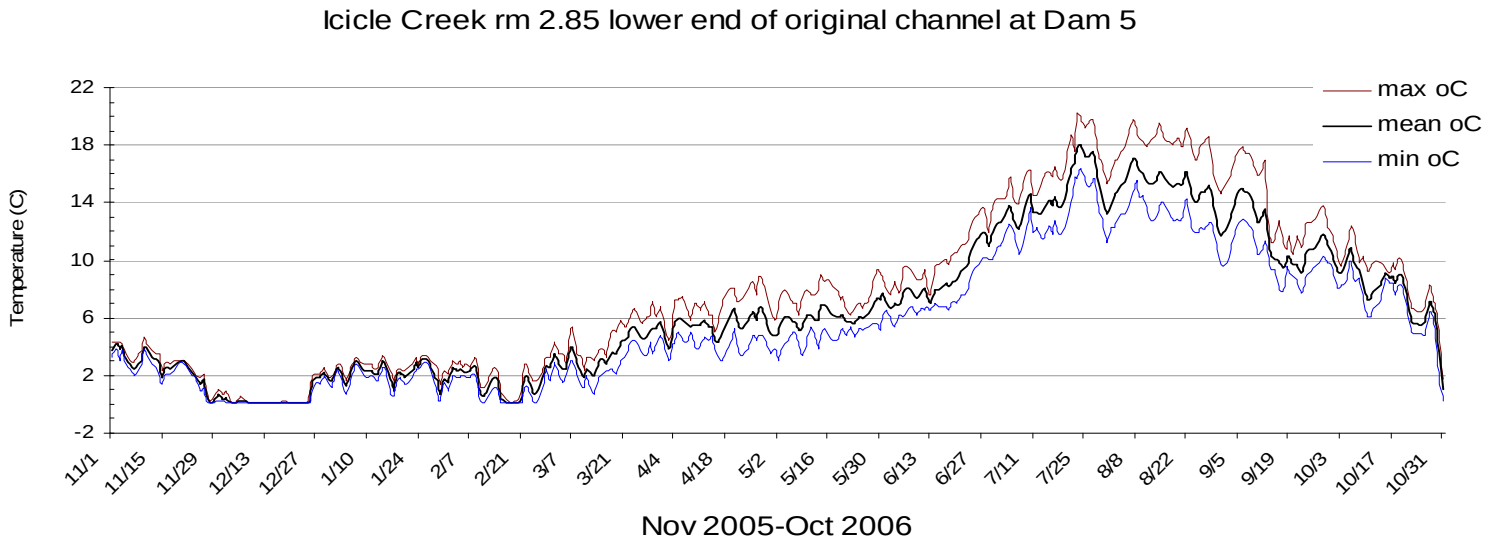


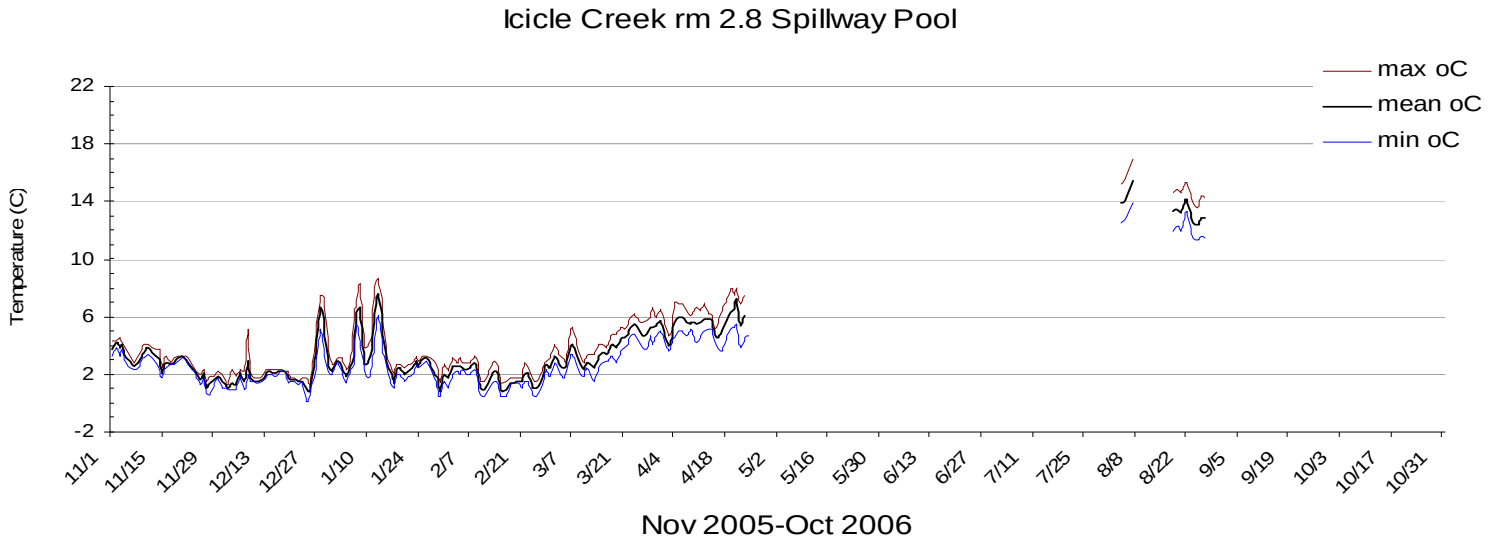


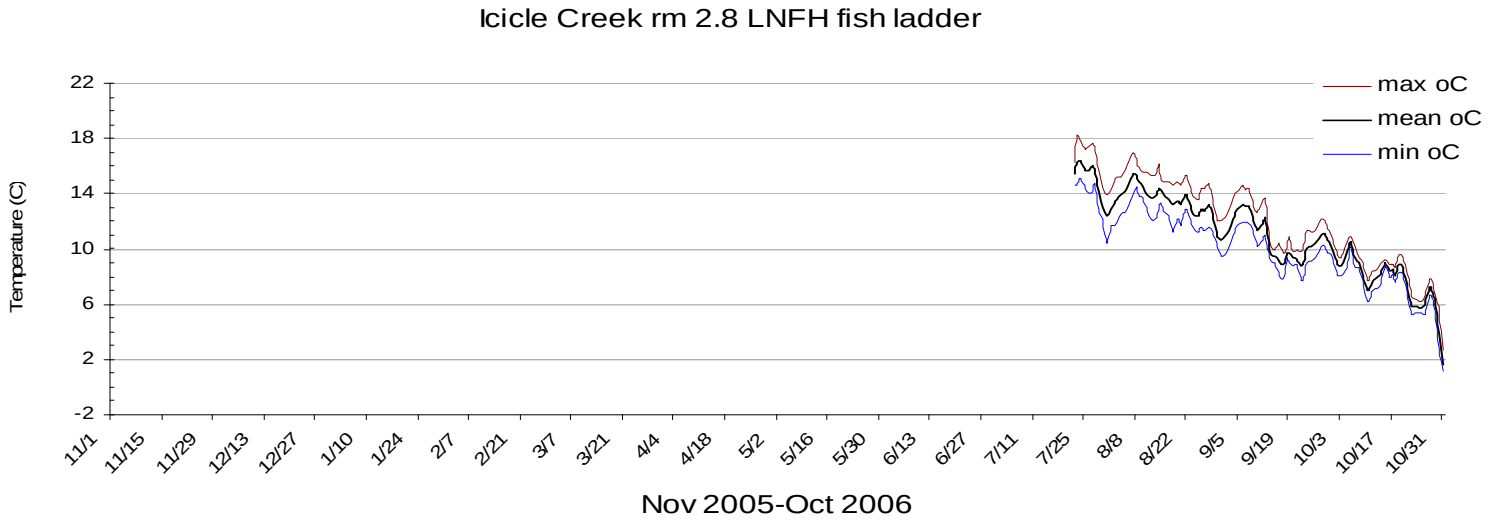

Icicle Creek rm 5.4 Downstream of Snow Creek
Temperature (C)
22
18
14
10
6
2
-2
11/1
11/15
11/29
12/13
12/27
1/10
1/24
2/7
2/21
3/7
3/21
4/4
4/18
5/2
5/16
5/30
6/13
6/27
7/11
7/25
8/8
8/22
9/5
9/19
10/3
10/17
10/31
max oC
mean oC
min oC
Nov 2005-Oct 2006

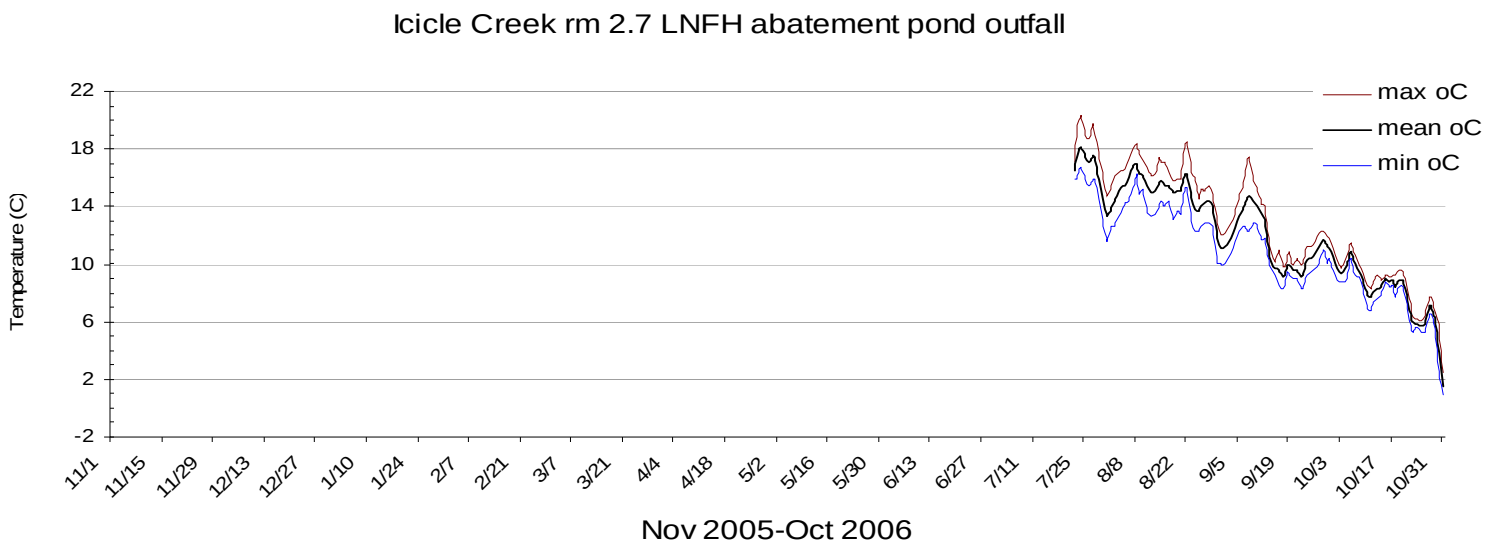

Icicle Creek rm 4.5 Upstream of Hatchery Intake
Temperature (C)
22
18
14
10
6
2
-2
11/1
11/15
11/29
12/13
12/27
1/10
1/24
2/7
2/21
3/7
3/21
4/4
4/18
5/2
5/16
5/30
6/13
6/27
7/11
7/25
8/8
8/22
9/5
9/19
10/3
10/17
10/31
max oC
mean oC
min oC
Nov 2005-Oct 2006

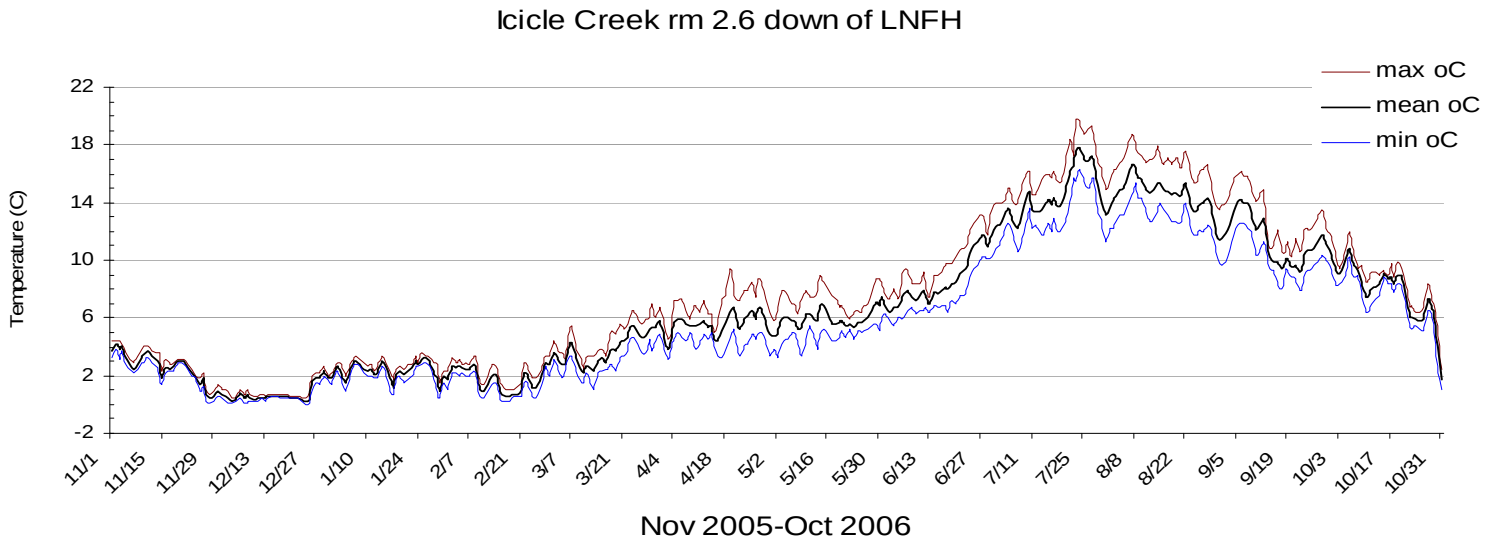

Icicle Creek rm 3.8 Upper Original Channel at headgate
Temperature (C)
22
18
14
10
6
2
-2
11/1
11/15
11/29
12/13
12/27
1/10
1/24
2/7
2/21
3/7
3/21
4/4
4/18
5/2
5/16
5/30
6/13
6/27
7/11
7/25
8/8
8/22
9/5
9/19
10/3
10/17
10/31
max oC
mean oC
min oC
Nov 2005-Oct 2006


Icicle Creek rm 2.85 lower end of original channel at Dam 5
Temperature (C)
22
18
14
10
6
2
-2
11/1
11/15
11/29
12/13
12/27
1/10
1/24
2/7
2/21
3/7
3/21
4/4
4/18
5/2
5/16
5/30
6/13
6/27
7/11
7/25
8/8
8/22
9/5
9/19
10/3
10/17
10/31
max oC
mean oC
min oC
Nov 2005-Oct 2006


Icicle Creek rm 2.8 Spillway Pool
max oC
mean oC
min oC
Temperature (C)
22
18
14
10
6
2
-2
11/1
11/15
11/29
12/13
12/27
1/10
1/24
2/7
2/21
3/7
3/21
4/4
4/18
5/2
5/16
5/30
6/13
6/27
7/11
7/25
8/8
8/22
9/5
9/19
10/3
10/17
10/31
Nov 2005-Oct 2006


Icicle Creek rm 2.8 LNFH fish ladder
max oC
mean oC
min oC
Temperature (C)
22
18
14
10
6
2
-2
11/1
11/15
11/29
12/13
12/27
1/10
1/24
2/7
2/21
3/7
3/21
4/4
4/18
5/2
5/16
5/30
6/13
6/27
7/11
7/25
8/8
8/22
9/5
9/19
10/3
10/17
10/31
Nov 2005-Oct 2006


Icicle Creek rm 2.7 LNFH abatement pond outfall
Temperature (C)
22
18
14
10
6
2
-2
11/1
11/15
11/29
12/13
12/27
1/10
1/24
2/7
2/21
3/7
3/21
4/4
4/18
5/2
5/16
5/30
6/13
6/27
7/11
7/25
8/8
8/22
9/5
9/19
10/3
10/17
10/31
max oC
mean oC
min oC
Nov 2005-Oct 2006


Icicle Creek rm 2.6 down of LNFH
Temperature (C)
22
18
14
10
6
2
-2
11/1
11/15
11/29
12/13
12/27
1/10
1/24
2/7
2/21
3/7
3/21
4/4
4/18
5/2
5/16
5/30
6/13
6/27
7/11
7/25
8/8
8/22
9/5
9/19
10/3
10/17
10/31
max oC
mean oC
min oC
Nov 2005-Oct 2006

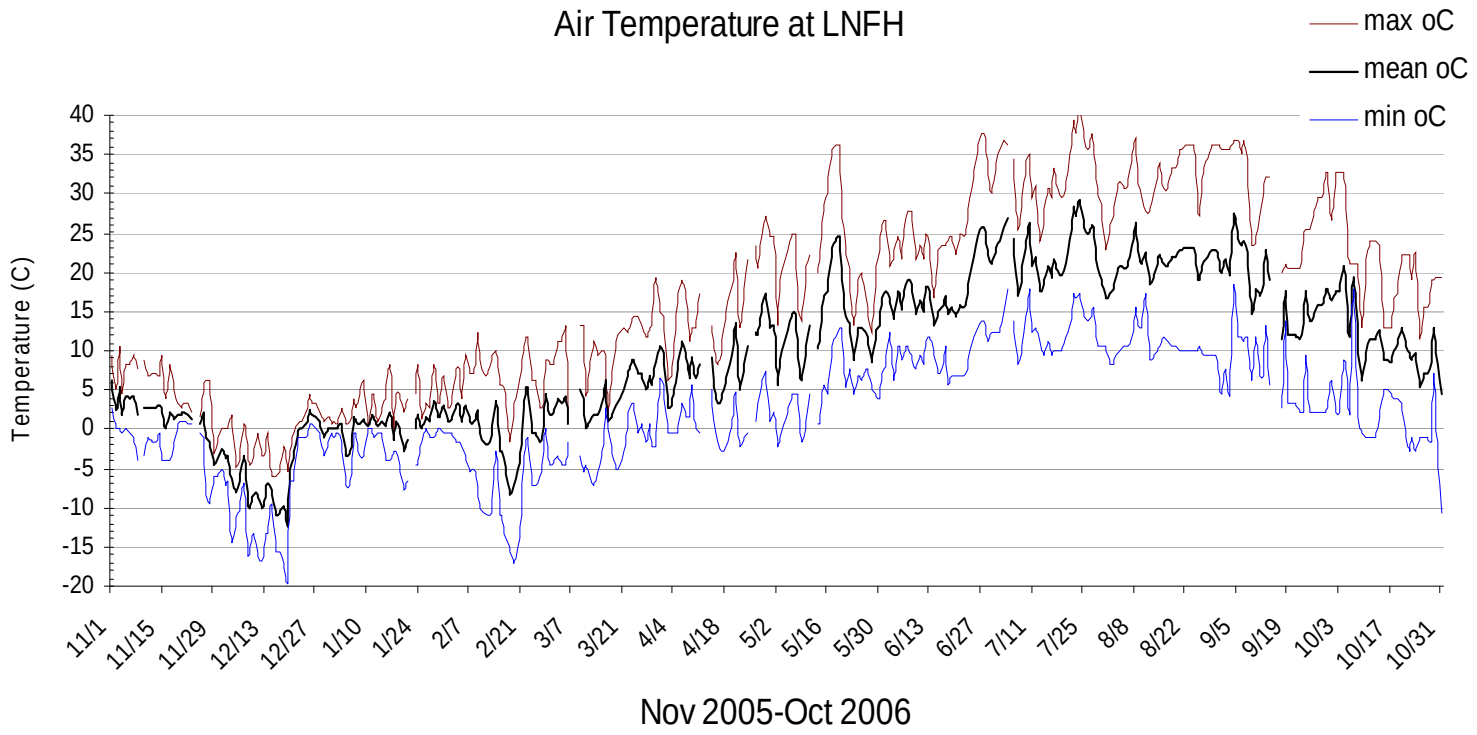


Figure A12. Maximum, mean, and minimum daily air temperatures at LNFH, Nov 2005-Oct 2006.

Table A3. Daily mean water and air temperatures in Icicle Creek at sites from rm 2.6-8.2, November 1, 2005-October 31, 2006.

Date	rm 5.5 mean °C up Snow Cr	rm 0.2 mean °C in Snow Cr	rm 5.4 mean °C down Snow Cr	rm 4.5 mean °C up Intake	rm 4.4 mean °C down Intake	rm 3.8 mean °C up O. Ch HG	rm 2.85 mean °C low O.Ch Dam5	rm 2.8 mean °C Spillway Pool	rm 2.8 mean °C LHDrain	rm 2.7 mean °C LHAbatement Outfall	rm 2.6 mean °C down LNFH	AIR Temp mean °C LNFH
11/1/05	3.8	4.4	3.4	3.4	3.5	3.6	3.7	3.7			3.7	6.1
11/2/05	4.1	4.2	3.7	3.9	3.9	4.0	4.2	4.2			4.2	2.5
11/3/05	3.8	4.0	3.5	3.6	3.6	3.7	3.8	3.8			3.8	5.3
11/4/05	4.0	3.8	3.6	3.8	3.8	3.8	4.0	4.1			4.0	1.9
11/5/05	3.3	3.3	2.7	2.9	2.9	3.0	3.2	3.2			3.2	4.2
11/6/05	2.9	3.1	2.4	2.5	2.6	2.6	2.8	2.9			2.8	3.9
11/7/05	2.7	2.6	2.3	2.3	2.3	2.3	2.4	2.6			2.5	4.2
11/8/05	2.8	2.9	2.5	2.6	2.6	2.7	2.8	2.8			2.8	1.9
11/9/05	3.3	3.1	3.0	3.1	3.1	3.0	3.1	3.2			3.2	
11/10/05	3.5	4.9	3.3	3.7	3.1		4.0	3.5			3.5	2.8
11/11/05	3.5	4.3	3.5	3.6	3.6		3.7	3.8			3.7	2.8
11/12/05	3.1	4.2	3.0	3.1	3.2		3.3	3.5			3.3	2.8
11/13/05	2.9	4.0	2.8	3.0	3.0		3.1	3.3			3.2	2.8
11/14/05	2.4	3.8	2.5	2.6	2.6		2.8	3.0			2.8	3.1
11/15/05	1.6	3.3	1.5	1.7	1.7		1.8	2.0			1.8	2.8
11/16/05	2.5	3.1	2.3	2.4	2.5		2.5	2.8			2.6	0.0
11/17/05	2.2	2.6	2.2	2.3	2.4		2.4	2.7			2.5	2.2
11/18/05	2.4	2.9	2.4	2.4	2.5		2.6	2.8			2.6	1.4
11/19/05	2.7	3.1	2.6	2.7	2.8		3.0	3.1			3.0	1.9
11/20/05	2.8	3.5	2.7	2.9	2.9		3.1	3.2			3.1	1.9
11/21/05	2.7	3.1	2.7	2.7	2.8		3.0	3.1			3.0	2.2
11/22/05	2.3	3.1	2.2	2.4	2.4		2.6	2.8			2.6	1.9
11/23/05	1.8	2.9	1.8	1.9	2.0		2.2	2.4			2.2	1.4
11/24/05	1.6	2.2	1.6	1.7	1.7		1.9	2.1			1.9	
11/25/05	1.1	2.5	1.1	1.2	1.2		1.4	1.6			1.4	0.6
11/26/05	1.5	2.3	1.5	1.6	1.7		1.8	2.1			1.8	2.2
11/27/05	0.5	2.5	0.4	0.5	0.5		0.6	1.0			0.7	-1.1
11/28/05	0.0	2.7	0.0	0.0	0.1		0.2	1.4			0.5	-1.7
11/29/05	0.2	2.7	0.1	0.2	0.2		0.2	1.6			0.6	-4.4
11/30/05	0.5	2.6	0.4	0.5	0.5		0.6	1.9			1.0	-3.6

mean °C Date	rm 5.5 up Snow Cr	rm 0.2 in Snow Cr	rm 5.4 down Snow Cr	rm 4.5 up Intake	rm 4.4 down Intake	rm 3.8 up O. Ch HG	rm 2.85 low O.Ch Dam5	rm 2.8 Spillway Pool	rm 2.8 LHDrain	rm 2.7 LHAbOutfall	rm 2.6 down LNFH	AIR Temp LNFH
12/1/05	0.2	2.3	0.1	0.2	0.3		0.4	1.5			0.6	-2.5
12/2/05	0.3	1.9	0.1	0.3	0.3		0.4	1.2			0.6	-3.6
12/3/05	0.2	1.7	0.1	0.2	0.2		0.3	1.1			0.4	-3.3
12/4/05	0.0	1.5	0.0	-0.1	0.1		0.1	1.3			0.2	-6.4
12/5/05	0.1	1.7	0.1	0.0	0.1		0.1	1.2			0.3	-8.1
12/6/05	0.5	0.6	0.4	0.5	0.5		0.2	2.1			0.7	-6.7
12/7/05	0.1	0.4	0.0	0.1	0.2		0.2	1.5			0.5	-3.3
12/8/05	0.0	0.4	0.0	-0.1	0.1		0.1	2.9			0.6	-9.4
12/9/05	0.0	0.5	0.0	-0.1	0.1		0.1	1.8			0.5	-10.0
12/10/05	0.0	0.4	0.0	-0.1	0.1		0.1	1.5			0.3	-8.3
12/11/05	0.0	0.5	0.0	-0.1	0.1		0.1	1.5			0.4	-8.3
12/12/05	0.0	0.4	0.0	-0.1	0.1		0.1	1.6			0.5	-10.0
12/13/05	0.0	0.3	0.0	-0.1	0.1		0.1	2.0			0.4	-8.1
12/14/05	0.0	0.3	0.0	-0.1	0.1		0.1	2.3			0.5	-6.9
12/15/05	0.0	0.4	0.0	-0.1	0.1		0.1	2.1			0.6	-7.8
12/16/05	0.0	0.4	0.0	-0.1	0.1		0.1	2.1			0.6	-10.8
12/17/05	0.0	0.3	0.0	-0.1	0.1		0.1	2.2			0.6	-10.6
12/18/05	0.0	0.3	0.0	-0.1	0.1		0.1	2.2			0.6	-9.7
12/19/05	0.0	0.3	0.0	-0.1	0.1		0.1	1.8			0.5	-12.5
12/20/05	0.1	0.3	0.0	-0.1	0.1		0.1	1.7			0.5	-5.0
12/21/05	0.1	0.3	0.0	-0.1	0.1		0.1	1.6			0.5	-3.6
12/22/05	0.1	0.3	0.0	0.1	0.1		0.1	1.5			0.5	-0.3
12/23/05	0.1	0.3	0.0	0.0	0.1		0.1	1.5			0.4	0.0
12/24/05	0.1	0.3	0.1	0.1	0.2		0.1	1.1			0.2	0.6
12/25/05	0.6	0.3	0.4	0.5	0.6		0.3	0.8			0.4	2.5
12/26/05	1.5	0.3	1.4	1.5	1.6		1.6	1.9			1.6	1.9
12/27/05	1.7	0.3	1.7	1.8	1.8		1.9	3.4			1.9	1.7
12/28/05	1.7	0.3	1.7	1.8	1.8		1.8	6.7			1.8	0.8
12/29/05	2.2	0.4	2.1	2.2	2.2		2.2	5.4			2.3	-1.1
12/30/05	1.6	0.3	1.5	1.7	1.7		1.7	2.5			1.8	0.0
12/31/05	1.5	0.3	1.5	1.6	1.6		1.7	2.2			1.8	0.0

mean °C Date	rm 5.5 up Snow Cr	rm 0.2 in Snow Cr	rm 5.4 down Snow Cr	rm 4.5 up Intake	rm 4.4 down Intake	rm 3.8 up O. Ch HG	rm 2.85 low O.Ch Dam5	rm 2.8 Spillway Pool	rm 2.8 LHDrain	rm 2.7 LHAbOutfall	rm 2.6 down LNFH	AIR Temp LNFH
1/1/06	1.9	0.5	1.8	1.9	1.9		2.0	2.5			2.1	0.0
1/2/06	2.3	0.6	2.2	2.4	2.4		2.5	3.0			2.7	0.0
1/3/06	1.6	1.1	1.6	1.7	1.8		1.9	2.5			2.1	0.6
1/4/06	1.2	2.1	1.1	1.2	1.2		1.3	1.9			1.5	-3.3
1/5/06	2.0	2.1	1.9	2.0	2.1		2.2	2.6			2.4	-3.1
1/6/06	2.6	1.7	2.5	2.6	2.6		2.8	3.2			2.9	1.7
1/7/06	2.9	1.8	2.9	2.9	2.9		3.0	6.1			3.0	1.1
1/8/06	2.6	1.4	2.6	2.6	2.6		2.7	6.5			2.8	0.6
1/9/06	2.1	1.7	2.0	2.2	2.2		2.4	2.7			2.5	1.4
1/10/06	2.1	1.7	2.0	2.1	2.2		2.3	2.9			2.3	0.3
1/11/06	2.0	2.0	2.0	2.2	2.2		2.4	3.7			2.4	1.9
1/12/06	1.9	1.2	1.9	1.9	1.9		2.0	5.6			2.0	1.7
1/13/06	1.9	1.1	1.9	2.0	2.0		2.1	7.6			2.2	0.3
1/14/06	2.8	1.7	2.7	2.9	2.9		3.0	5.5			3.0	1.1
1/15/06	2.4	2.1	2.3	2.5	2.5		2.6	3.0			2.6	0.3
1/16/06	1.5	2.4	1.5	1.6	1.6		1.7	2.3			1.8	2.2
1/17/06	0.8	2.1	0.8	0.9	0.9		1.0	1.4			1.1	-1.4
1/18/06	1.8	2.0	1.7	1.8	1.9		2.0	2.3			2.1	0.8
1/19/06	2.0	2.4	2.0	2.1	2.1		2.2	2.4			2.3	0.0
1/20/06	1.8	2.6	1.7	1.8	1.8		1.9	2.0			2.1	-2.8
1/21/06	2.1	2.2	2.0	2.1	2.1		2.1	2.2			2.3	-1.4
1/22/06	2.2	2.2	2.1	2.2	2.2		2.3	2.4			2.5	
1/23/06	2.8	2.7	2.7	2.8	2.8		2.9	2.9			3.0	0.0
1/24/06	2.3	1.9	2.2	2.4	2.4		2.6	2.6			2.7	1.9
1/25/06	2.9	1.3	2.9	2.9	3.0		3.1	3.1			3.2	0.0
1/26/06	2.9	1.4	2.9	3.0	3.0		3.2	3.1			3.2	1.7
1/27/06	2.6	1.5	2.5	2.6	2.7		2.8	2.8			3.0	0.8
1/28/06	1.5	1.1	1.5	1.7	1.7		1.9	2.0			2.1	3.6
1/29/06	1.4	1.2	1.4	1.5	1.5		1.6	1.8			1.8	1.7
1/30/06	0.5	1.2	0.4	0.5	0.6		0.7	0.8			0.9	1.7
1/31/06	1.5	1.3	1.5	1.6	1.7		1.8	2.0			1.9	3.1

mean °C Date	rm 5.5 up Snow Cr	rm 0.2 in Snow Cr	rm 5.4 down Snow Cr	rm 4.5 up Intake	rm 4.4 down Intake	rm 3.8 up O. Ch HG	rm 2.85 low O.Ch Dam5	rm 2.8 Spillway Pool	rm 2.8 LHDrain	rm 2.7 LHAbOutfall	rm 2.6 down LNFH	AIR Temp LNFH
2/1/06	1.3	2.4	1.2	1.3	1.4		1.6	1.7			1.7	1.1
2/2/06	2.2	2.1	2.1	2.3	2.3		2.5	2.6			2.7	1.4
2/3/06	2.1	2.5	2.0	2.2	2.2		2.4	2.5			2.5	3.1
2/4/06	2.2	2.3	2.2	2.3	2.3		2.5	2.6			2.6	3.1
2/5/06	2.0	1.9	2.0	2.2	2.2		2.4	2.5			2.5	0.8
2/6/06	2.0	1.6	1.9	2.1	2.1		2.2	2.3			2.4	3.1
2/7/06	2.0	1.6	1.9	2.1	2.1		2.3	2.4			2.5	0.8
2/8/06	2.4	1.2	2.4	2.5	2.5		2.6	2.8			2.8	1.1
2/9/06	1.4	1.6	1.4	1.6	1.5		1.7	2.0			2.0	2.5
2/10/06	0.5	1.8	0.4	0.6	0.6		0.7	1.1			1.0	-0.6
2/11/06	0.4	2.3	0.3	0.4	0.4		0.5	0.9			0.9	-1.7
2/12/06	0.9	2.1	0.7	0.9	1.0		1.1	1.4			1.4	-1.9
2/13/06	1.6	2.1	1.5	1.7	1.6		1.8	2.1			2.0	-0.8
2/14/06	1.6	1.9	1.5	1.7	1.7		1.9	2.2			2.1	3.6
2/15/06	0.2	1.7	0.2	0.3	0.3		0.5	1.0			0.9	-2.5
2/16/06	0.2	1.7	0.1	0.2	0.2		0.3	0.8			0.7	-2.8
2/17/06	0.0	2.1	0.0	0.0	0.1		0.1	1.0			0.5	-4.7
2/18/06	0.0	1.1	0.0	0.0	0.1		0.1	1.4			0.5	-8.3
2/19/06	0.0	0.4	0.0	0.0	0.1		0.1	1.4			0.7	-7.2
2/20/06	0.1	0.3	0.0	0.0	0.1		0.2	1.5			0.7	-5.0
2/21/06	0.8	0.6	0.7	0.7	0.8		0.6	1.5			1.1	-0.8
2/22/06	1.5	1.1	1.5	1.6	1.6		1.9	2.0			2.1	2.8
2/23/06	1.5	1.0	1.5	1.7	1.7		1.9	2.1			2.1	5.3
2/24/06	0.6	0.3	0.5	0.7	0.7		0.9	1.1			1.2	-0.6
2/25/06	0.5	0.3	0.4	0.6	0.6		0.8	1.0			1.1	-0.6
2/26/06	1.1	0.2	1.0	1.1	1.2		1.4	1.4			1.6	-1.7
2/27/06	1.9	0.1	1.8	2.0	2.0		2.2	2.2			2.5	0.3
2/28/06	2.4	0.2	2.3	2.5	2.5		2.7	2.7			2.9	4.4

mean °C Date	rm 5.5 up Snow Cr	rm 0.2 in Snow Cr	rm 5.4 down Snow Cr	rm 4.5 up Intake	rm 4.4 down Intake	rm 3.8 up O. Ch HG	rm 2.85 low O.Ch Dam5	rm 2.8 Spillway Pool	rm 2.8 LHDrain	rm 2.7 LHAbOutfall	rm 2.6 down LNFH	AIR Temp LNFH
3/1/06	2.3	0.3	2.2	2.3	2.4		2.5	2.4			2.8	1.9
3/2/06	3.1	0.5	3.1	3.2	3.2		3.5	3.3			3.6	2.2
3/3/06	2.5	1.2	2.5	2.6	2.6		2.8	2.8			3.1	3.9
3/4/06	2.2	1.4	2.1	2.3	2.3		2.5	2.5			2.8	3.3
3/5/06	2.2	0.4	2.2	2.3	2.3		2.4	2.5			2.8	4.2
3/6/06	3.0	0.4	2.9	3.1	3.1		3.3	3.4			3.6	0.6
3/7/06	3.6	0.6	3.5	3.7	3.7		4.0	4.1			4.3	
3/8/06	2.5	1.3	2.5	2.7	2.7		2.9	3.3			3.2	
3/9/06	1.9	1.7	1.8	2.0	2.0		2.3	2.7			2.5	5.0
3/10/06	1.6	1.6	1.5	1.7	1.7		1.9	2.4			2.2	3.9
3/11/06	2.1	2.1	2.0	2.2	2.2		2.4	2.8			2.7	0.0
3/12/06	1.9	1.7	1.8	2.0	2.0		2.2	2.7			2.5	0.8
3/13/06	1.7	1.5	1.6	1.8	1.8		2.0	2.4			2.3	1.9
3/14/06	2.6	1.7	2.5	2.6	2.7		2.9	3.3			3.1	1.9
3/15/06	2.7	2.2	2.6	2.8	2.9		3.1	3.5			3.2	3.3
3/16/06	2.4	2.3	2.4	2.6	2.6		2.8	3.3			2.9	6.1
3/17/06	2.9	1.8	2.8	3.0	3.0		3.1	3.5			3.2	1.1
3/18/06	3.3	1.5	3.2	3.4	3.5		3.7	4.0			3.8	1.9
3/19/06	3.1	1.0	3.0	3.2	3.2		3.5	3.9			3.7	3.1
3/20/06	3.8	1.4	3.7	3.9	3.9		4.3	4.4			4.3	3.9
3/21/06	3.9	1.0	3.8	4.1	4.1		4.4	4.6			4.5	5.0
3/22/06	4.2	0.8	4.1	4.3	4.4		4.7	4.7			4.7	6.7
3/23/06	4.8	1.5	4.7	4.9	4.9		5.2	5.3			5.3	7.8
3/24/06	5.0	1.6	4.9	5.2	5.2		5.4	5.5			5.5	8.9
3/25/06	4.5	1.8	4.4	4.6	4.7		4.9	5.1			5.0	6.9
3/26/06	4.2	2.2	4.1	4.3	4.4		4.6	4.7			4.6	6.9
3/27/06	4.2	1.9	4.2	4.4	4.4		4.7	4.8			4.7	5.0
3/28/06	4.7	1.7	4.6	4.9	5.0		5.2	5.3			5.2	6.7
3/29/06	4.8	2.5	4.7	5.0	5.0		5.3	5.3			5.3	5.6
3/30/06	4.9	2.6	4.9	5.1	5.2		5.3	5.4			5.4	8.6
3/31/06	5.3	3.1	5.2	5.5	5.6		5.7	5.8			5.8	10.6

mean °C Date	rm 5.5 up Snow Cr	rm 0.2 in Snow Cr	rm 5.4 down Snow Cr	rm 4.5 up Intake	rm 4.4 down Intake	rm 3.8 up O. Ch HG	rm 2.85 low O.Ch Dam5	rm 2.8 Spillway Pool	rm 2.8 LHDrain	rm 2.7 LHAbOutfall	rm 2.6 down LNFH	AIR Temp LNFH
4/1/06	4.2	3.5	4.2	4.5	4.5		4.6	4.9			4.7	9.7
4/2/06	3.5	3.6	3.5	3.6	3.7		3.8	4.0			3.8	2.8
4/3/06	4.4	3.4	4.3	4.5	4.6		4.7	4.8			4.6	3.3
4/4/06	5.3	3.4	5.2	5.4	5.4		5.7	5.6			5.7	4.4
4/5/06	5.5	3.5	5.4	5.7	5.8		6.0	5.9			6.0	7.8
4/6/06	5.4	4.3	5.4	5.6	5.7		5.9	5.9			5.9	11.1
4/7/06	5.2	4.2	5.1	5.3	5.4		5.6	5.6			5.5	9.2
4/8/06	5.0	4.4	4.9	5.2	5.3		5.4	5.5			5.4	6.4
4/9/06	5.1	4.6	5.0	5.2	5.3		5.5	5.6			5.5	9.2
4/10/06	5.1	4.1	5.0	5.2	5.2		5.5	5.5			5.4	6.4
4/11/06	5.1	3.7	5.0	5.2	5.3		5.5	5.6			5.5	8.3
4/12/06	5.3	4.3	5.2	5.4	5.5		5.8	5.9			5.8	
4/13/06	5.0	4.6	4.9	5.1	5.1		5.3	5.8			5.4	
4/14/06	5.0	5.1	4.9	5.1	5.2		5.4	5.7			5.4	9.2
4/15/06	4.1	4.6	4.0	4.2	4.3		4.4	4.8			4.5	6.1
4/16/06	4.1	4.7	4.0	4.2	4.3		4.4	4.6			4.4	3.3
4/17/06	4.6	4.9	4.5	4.7	4.8		5.0	5.1			5.0	3.9
4/18/06	5.2	4.8	5.1	5.3	5.4		5.6	5.8			5.6	6.4
4/19/06	5.8	4.6	5.7	5.9	6.0		6.2	6.4			6.3	8.3
4/20/06	6.1	4.6	6.1	6.3	6.4		6.7	6.5			6.8	10.8
4/21/06	5.5	5.0	5.5	5.7	5.8		6.1	7.2			6.3	13.3
4/22/06	4.8	4.7	4.7	4.9	5.0		5.2	5.4			5.2	5.3
4/23/06	5.4	4.8	5.3	5.5	5.6		5.5	6.0			5.9	8.3
4/24/06	5.8	3.8	5.4	5.7	5.8		5.9				6.1	10.6
4/25/06	6.0	3.6	5.9	6.1	6.2		6.5				6.5	
4/26/06	5.3	3.8	5.2	5.5	5.6	5.7	5.8				5.9	12.2
4/27/06	6.2	4.2	6.1	6.3	6.4	6.6	6.7				6.7	11.9
4/28/06	6.1	4.8	6.0	6.2	6.3	6.5	6.6				6.6	15.0
4/29/06	5.0	5.4	5.0	5.2	5.3	5.5	5.6				5.6	17.2
4/30/06	4.6	4.6	4.5	4.7	4.7	4.9	4.9				4.9	12.8

mean °C Date	rm 5.5 up Snow Cr	rm 0.2 in Snow Cr	rm 5.4 down Snow Cr	rm 4.5 up Intake	rm 4.4 down Intake	rm 3.8 up O. Ch HG	rm 2.85 low O.Ch Dam5	rm 2.8 Spillway Pool	rm 2.8 LHDrain	rm 2.7 LHAbOutfall	rm 2.6 down LNFH	AIR Temp LNFH
5/1/06	4.4	3.9	4.2	4.5	4.6	4.7	4.8				4.8	13.3
5/2/06	4.6	4.5	4.5	4.7	4.7	4.8	4.9				4.9	5.6
5/3/06	5.2	4.7	5.2	5.3	5.4	5.5	5.6				5.6	8.9
5/4/06	5.6	5.1	5.6	5.8	5.8	6.0	6.1				6.1	10.8
5/5/06	5.7	4.9	5.6	5.8	5.9	6.0	6.1				6.1	12.5
5/6/06	5.3	5.5	5.3	5.5	5.6	5.7	5.8				5.8	14.7
5/7/06	5.3	5.2	5.2	5.4	5.5	5.6	5.7				5.7	14.7
5/8/06	4.6	4.9	4.6	4.8	4.9	5.0	5.1				5.2	10.3
5/9/06	5.0	4.2	4.9	5.1	5.2	5.3	5.4				5.3	6.1
5/10/06	5.8	3.8	5.7	5.9	6.0	6.1	6.2				6.2	10.6
5/11/06	5.7	3.9	5.7	5.9	6.0	6.1	6.2				6.2	13.3
5/12/06	5.4	4.6	5.3	5.5	5.6	5.8	5.9				5.9	
5/13/06	5.5	5.0	5.4	5.6	5.7	5.8	5.9				5.8	10.3
5/14/06	6.4	5.2	6.4	6.6	6.7	6.8	6.9				6.9	11.1
5/15/06	6.4	5.1	6.3	6.5	6.6	6.8	6.9				6.8	16.7
5/16/06	5.8	5.2		6.0	6.1	6.3	6.6				6.3	17.8
5/17/06	5.2	4.2		5.7	5.5	5.6	6.1				5.6	23.1
5/18/06	5.3	4.3		5.4	5.5	5.7	6.1				5.6	23.9
5/19/06	5.5	5.2		5.6	5.7	5.8	6.1				5.7	24.4
5/20/06	5.5	5.6		5.7	5.8	5.9	6.2				5.8	20.6
5/21/06	5.2	4.6		5.5	5.4	5.5	5.7				5.5	14.4
5/22/06	5.3	4.8		5.7	5.5	5.7	5.8				5.5	13.6
5/23/06	5.2	5.9		5.4	5.4	5.5	5.6				5.4	8.9
5/24/06	5.5	6.3		5.7	5.7	5.8	6.0				5.7	12.8
5/25/06	5.5	6.5		5.7	5.7	5.8	6.0				5.7	13.1
5/26/06	5.6	6.6		5.7	5.7	5.8	6.0				5.8	12.5
5/27/06	5.7	6.7		5.8	6.0	6.1	6.3				6.0	11.7
5/28/06	6.2	6.9		6.1	6.4	6.5	6.8				6.5	8.6
5/29/06	6.7	6.8		6.5	7.0	7.1	7.3				7.0	12.2
5/30/06	6.6	6.4		6.7	6.8	6.9	7.2				6.9	13.3
5/31/06	7.1	6.5		7.1	7.3	7.4	7.7				7.4	16.7

mean °C Date	rm 5.5 up Snow Cr	rm 0.2 in Snow Cr	rm 5.4 down Snow Cr	rm 4.5 up Intake	rm 4.4 down Intake	rm 3.8 up O. Ch HG	rm 2.85 low O.Ch Dam5	rm 2.8 Spillway Pool	rm 2.8 LHDrain	rm 2.7 LHAbOutfall	rm 2.6 down LNFH	AIR Temp LNFH
6/1/06	6.4	6.2		7.1	6.7	6.8	7.0				6.8	17.5
6/2/06	6.1	6.4		6.5	6.4	6.5	6.7				6.4	16.7
6/3/06	6.4	6.1		6.5	6.6	6.8	7.0				6.7	14.2
6/4/06	6.3	6.1		6.7	6.7	6.8	6.9				6.7	17.5
6/5/06	6.9	6.4		6.8	7.2	7.3	7.5				7.2	15.3
6/6/06	7.3	6.8		7.2	7.6	7.7	8.0				7.6	17.5
6/7/06	7.5	7.1		7.6	7.8	7.9	8.1				7.9	19.2
6/8/06	6.9	7.2		7.5	7.3	7.4	7.7				7.4	18.3
6/9/06	6.9	8.6		7.0	7.2	7.3	7.4				7.2	14.7
6/10/06	7.1	9.1		7.3	7.5	7.5	7.7				7.5	16.4
6/11/06	7.5	8.8		7.5	7.8	7.9	8.1				7.9	15.0
6/12/06	7.1	8.1		7.6	7.4	7.6	7.7				7.5	18.1
6/13/06	6.6	8.7		7.2	6.9	7.0	7.0				6.9	17.5
6/14/06	7.3	9.0		7.4	7.6	7.8	8.0				7.8	13.3
6/15/06	7.3	9.7		7.6	7.6	7.8	8.0				7.7	15.0
6/16/06	7.6	10.3		7.7	7.8	8.0	8.1				7.9	15.6
6/17/06	7.7	9.4		7.8	8.0	8.2	8.4				8.1	16.9
6/18/06	7.6	9.2		7.8	7.9	8.0	8.2				8.0	14.7
6/19/06	7.9	9.7		8.2	8.2	8.4	8.6				8.4	15.6
6/20/06	8.1	10.1		8.1	8.4	8.5	8.7				8.5	14.4
6/21/06	8.6	10.5		8.7	8.9	9.1	9.2				9.1	15.8
6/22/06	8.8	9.8		8.9	9.1	9.2	9.4				9.3	15.6
6/23/06	9.2	9.7		9.2	9.5	9.7	9.9				9.7	17.2
6/24/06	10.0	9.8		9.8	10.3	10.5	10.6				10.5	19.7
6/25/06	10.6	10.1		10.5	10.9	11.1	11.3				11.0	21.9
6/26/06	10.8	10.0		10.9	11.2	11.4	11.5				11.3	24.4
6/27/06	11.2	9.8		11.3	11.7	11.8	12.0				11.8	25.8
6/28/06	10.9	9.6		11.4	11.3	11.6	11.7				11.5	25.3
6/29/06	10.4	10.1		11.0	10.8	11.0	11.1				11.0	22.2
6/30/06	11.2	10.3		11.1	11.6	11.8	11.9				11.7	21.1

mean °C Date	rm 5.5 up Snow Cr	rm 0.2 in Snow Cr	rm 5.4 down Snow Cr	rm 4.5 up Intake	rm 4.4 down Intake	rm 3.8 up O. Ch HG	rm 2.85 low O.Ch Dam5	rm 2.8 Spillway Pool	rm 2.8 LHDrain	rm 2.7 LHAbOutfall	rm 2.6 down LNFH	AIR Temp LNFH
7/1/06	11.8	10.7		11.9	12.2	12.4	12.5				12.4	23.1
7/2/06	11.9	11.5		12.2	12.3	12.5	12.6				12.5	23.9
7/3/06	12.4	13.1		12.6	12.9	13.1	13.1				13.0	25.8
7/4/06	13.0	14.6		13.2	13.5	13.7	13.8				13.6	26.9
7/5/06	12.8	15.5		13.6	13.4	13.5	13.7				13.5	
7/6/06	12.0	16.4		12.4	12.4	12.6	12.7				12.6	24.2
7/7/06	11.7	15.3		12.0	12.0	12.2	12.1				12.2	16.9
7/8/06	12.6	14.8		13.0	13.0	13.1	13.1				13.1	20.0
7/9/06	13.7	15.2		14.0	14.0	14.2	14.2				14.2	23.9
7/10/06	14.1	15.5		14.4	14.4	14.7	14.6				14.8	26.4
7/11/06	12.9	15.8		13.2	13.2	13.4	13.3				13.4	20.8
7/12/06	12.8	16.9		13.1	13.2	13.4	13.3				13.4	21.9
7/13/06	12.7	17.8		13.0	13.1	13.3	13.2				13.3	17.5
7/14/06	13.2	17.3		13.4	13.5	13.7	13.6				13.7	18.3
7/15/06	13.6	15.0		14.0	14.0	14.2	14.2				14.2	20.8
7/16/06	13.3	14.0		13.6	13.6	13.9	13.8				13.8	19.4
7/17/06	13.7	15.2		14.2	14.1	14.4	14.4				14.4	21.7
7/18/06	13.2	16.6		13.4	13.5	13.7	13.7				13.7	20.3
7/19/06	13.4	15.8		13.7	13.8	14.0	14.0				13.9	19.7
7/20/06	14.2	14.5		14.4	14.6	14.8	14.9				14.8	21.1
7/21/06	15.7	15.0		16.2	16.1	16.3	16.3				16.1	24.2
7/22/06	16.1	14.3		16.5	16.5	16.8	16.8		15.5	16.5	16.5	28.3
7/23/06	17.0	14.5		17.5	17.5	17.8	17.8		16.3	17.4	17.6	27.2
7/24/06	17.1	14.7		17.6	17.6	17.9	18.0		16.4	18.1	17.8	29.2
7/25/06	16.4	14.3		16.8	16.8	17.1	17.2		15.7	17.4	17.0	25.8
7/26/06	16.4	14.5		16.8	16.7	17.1	17.2		15.7	17.1	16.9	24.7
7/27/06	16.7	13.6		17.1	17.1	17.5	17.5		16.1	17.5	17.3	26.1
7/28/06	16.3	14.5		16.7	16.7	17.1	17.2		15.9	17.5	17.0	25.8
7/29/06	14.5	15.3		14.9	14.9	15.3	15.4		14.2	15.9	15.2	20.6
7/30/06	13.1	17.0		13.5	13.5	14.0	14.1		13.0	14.5	14.0	19.2
7/31/06	12.7	18.5		12.9	12.9	13.2	13.3		12.4	13.4	13.1	16.7

mean °C Date	rm 5.5 up Snow Cr	rm 0.2 in Snow Cr	rm 5.4 down Snow Cr	rm 4.5 up Intake	rm 4.4 down Intake	rm 3.8 up O. Ch HG	rm 2.85 low O.Ch Dam5	rm 2.8 Spillway Pool	rm 2.8 LHDrain	rm 2.7 LHAbOutfall	rm 2.6 down LNFH	AIR Temp LNFH
8/1/06	13.2	18.8		13.4	13.4	13.7	13.9		12.9	13.9	13.6	17.2
8/2/06	13.8	18.0		14.0	14.0	14.4	14.5		13.3	14.4	14.2	17.8
8/3/06	14.0	17.0		14.2	14.2	14.6	14.8		13.6	14.8	14.4	19.4
8/4/06	14.4	17.1		14.5	14.6	15.0	15.2		13.9	15.3	14.9	20.8
8/5/06	14.7	17.5		14.8	14.8	15.3	15.4		14.1	15.5	15.1	20.6
8/6/06	15.4	16.6		15.5	15.5	16.0	16.2		14.8	16.1	15.9	20.8
8/7/06	16.2	14.3		16.3	16.3	16.8	17.1		15.5	16.8	16.6	23.3
8/8/06	15.9	12.9		16.0	16.0	16.6	16.9		15.3	17.0	16.4	26.4
8/9/06	15.5	12.5		15.6	15.6	16.1	16.2		14.8	16.2	15.7	22.8
8/10/06	15.1	12.9		15.1	15.1	15.7	16.0		14.5	16.1	15.6	21.1
8/11/06	14.6	12.9		14.5	14.5	15.1	15.4		14.0	15.4	14.9	22.5
8/12/06	14.4	13.2		14.3	14.3	14.9	15.3		13.7	15.0	14.7	18.3
8/13/06	14.5	13.1		14.4	14.4	15.1	15.5		13.8	15.1	14.8	19.7
8/14/06	15.2	13.3		15.1	15.1	15.8	16.2		14.4	15.6	15.4	21.1
8/15/06	15.3	13.9		15.0	15.0	15.7	16.2		14.3	15.8	15.4	22.2
8/16/06	14.8	14.5		14.5	14.6	15.3	15.6		13.8	15.5	14.9	21.1
8/17/06	15.1	14.4		14.3	14.3	15.0	15.4		13.5	15.4	14.8	20.8
8/18/06	15.1	14.2		14.0	14.0	14.7	15.1		13.2	14.9	14.5	21.9
8/19/06	15.6	13.4		14.2	14.2	14.9	15.4		13.4	15.0	14.7	21.9
8/20/06	15.4	12.7		13.9	13.9	14.7	15.2		13.2	15.1	14.5	22.8
8/21/06	15.8	12.2		14.2	14.3	14.9	15.3		13.6	15.7	14.6	22.8
8/22/06	16.3	12.5		14.5	14.6	15.5	16.1		14.0	16.3	15.3	23.1
8/23/06	15.0	13.1		13.3		14.1	14.6		12.8	14.7	13.9	23.1
8/24/06	14.4	13.1		12.8		13.6	14.1		12.4	13.8	13.4	23.1
8/25/06	14.5	12.9		12.8		13.7	14.2		12.4	13.7	13.5	19.2
8/26/06	15.2	12.5		13.4		14.2	14.7		12.8	14.1	13.9	18.9
8/27/06	15.2	12.2		13.3		14.2	14.8		12.8	14.2	13.9	21.4
8/28/06	15.7	12.2		13.8		14.7	15.2		13.3	14.4	14.3	21.9
8/29/06	14.8	11.8		12.9		13.8	14.3		12.6	14.0	13.7	22.8
8/30/06	12.5	12.4		11.1		11.8	12.3		10.9	11.8	11.9	22.8
8/31/06	12.0	12.3		10.9		11.4	11.7		10.7	11.1	11.4	20.8

mean °C Date	rm 5.5 up Snow Cr	rm 0.2 in Snow Cr	rm 5.4 down Snow Cr	rm 4.5 up Intake	rm 4.4 down Intake	rm 3.8 up O. Ch HG	rm 2.85 low O.Ch Dam5	rm 2.8 Spillway Pool	rm 2.8 LHDrain	rm 2.7 LHAbOutfall	rm 2.6 down LNFH	AIR Temp LNFH
9/1/06	12.0			11.0		11.6	11.9		10.7	11.1	11.5	20.0
9/2/06	12.4			11.3		11.9	12.3		11.1	11.4	11.8	21.7
9/3/06	13.4			12.1		12.7	13.0		11.7	11.8	12.5	20.0
9/4/06	14.6			13.0		13.7	14.2		12.6	12.6	13.4	27.5
9/5/06	15.4			13.5		14.3	14.8		13.0	13.3	14.0	24.2
9/6/06	15.7			13.6		14.5	15.0		13.3	13.9	14.2	23.3
9/7/06	15.3			13.3		14.2	14.7		13.1	14.1	14.0	23.9
9/8/06	15.1			13.3		14.1	14.6		13.1	14.7	13.9	22.5
9/9/06	14.4			12.4		13.6	14.0		12.2	14.4	13.3	14.7
9/10/06	13.2			11.5		12.4	12.7		11.3	14.0	12.1	17.8
9/11/06	13.5			11.9		12.7	13.0		11.7	13.6	12.4	16.9
9/12/06	14.0			12.4		13.2	13.6		12.2	13.1	12.9	18.3
9/13/06	13.4			11.6		12.5	12.8		11.6	12.1	12.3	22.8
9/14/06	11.2			9.6		10.2	10.3		9.6	10.2	10.2	18.9
9/15/06	10.6			9.4		9.9	10.0		9.4	9.7	9.9	
9/16/06	10.3			9.1		9.7	9.9		9.1	9.6	9.9	
9/17/06	9.7			8.9		9.3	9.5		8.9	9.1	9.4	11.4
9/18/06	10.6			9.7		10.0	10.1		9.7	9.8	10.0	17.5
9/19/06	10.5			9.8		10.1	10.3		9.7	10.0	10.2	11.9
9/20/06	10.2			9.3		9.6	9.7		9.3	9.5	9.6	11.9
9/21/06	10.1			9.2		9.6	9.7		9.2	9.6	9.7	11.9
9/22/06	9.4			8.8		9.1	9.1		8.8	9.1	9.2	11.4
9/23/06	10.1			9.6		9.9	10.1		9.5	9.7	10.0	13.6
9/24/06	10.8			10.1		10.5	10.6		10.1	10.3	10.6	17.5
9/25/06	11.0			10.2		10.6	10.7		10.2	10.4	10.7	13.9
9/26/06	11.2			10.4		10.8	10.9		10.4	10.8	10.9	14.7
9/27/06	11.6			10.9		11.3	11.4		10.8	11.3	11.3	15.8
9/28/06	12.1			11.2		11.7	11.8		11.1	11.7	11.7	15.8
9/29/06	11.7			10.8		11.2	11.2		10.8	11.3	11.2	17.5
9/30/06	11.2			10.5		10.8	10.9		10.5	11.1	10.9	17.8

mean °C Date	rm 5.5 up Snow Cr	rm 0.2 in Snow Cr	rm 5.4 down Snow Cr	rm 4.5 up Intake	rm 4.4 down Intake	rm 3.8	rm 2.85 low O.Ch Dam5	rm 2.8 Spillway Pool	rm 2.8 LHDrain	rm 2.7 LHAbOutfall	rm 2.6 down LNFH	AIR Temp LNFH
10/1/06	10.5			9.9		10.2	10.3		9.9	10.6	10.3	16.4
10/2/06	9.4			8.9		9.2	9.3		8.9	9.7	9.3	17.5
10/3/06	9.0			8.7		9.0	9.1		8.8	9.3	9.0	17.5
10/4/06	9.6			9.4		9.6	9.7		9.4	9.7	9.6	20.8
10/5/06	10.6			10.3		10.5	10.5		10.2	10.6	10.5	14.2
10/6/06	10.5			10.6		10.9	10.9		10.5	10.9	10.8	11.7
10/7/06	9.3			9.3		9.8	9.7		9.4	10.1	9.8	19.4
10/8/06	8.9			9.0		9.3	9.3		9.0	9.5	9.2	11.4
10/9/06	8.0			8.0		8.5	8.3		8.1	8.9	8.5	6.1
10/10/06	6.8			6.9		7.4	7.2		7.1	7.8	7.4	9.7
10/11/06	7.3			7.2		7.6	7.4		7.4	7.8	7.6	11.4
10/12/06	7.6			7.6		7.9	7.8		7.8	8.1	8.0	11.4
10/13/06	7.8			7.8		8.1	8.1		7.9	8.3	8.2	11.4
10/14/06	8.2			8.2		8.4	8.3		8.2	8.5	8.4	12.5
10/15/06	9.0			9.0		9.2	9.1		9.0	9.0	9.1	8.9
10/16/06	8.3			8.4		8.7	8.7		8.4	8.8	8.7	8.9
10/17/06	8.4			8.4		8.7	8.9		8.5	8.9	8.8	8.6
10/18/06	8.0			8.1		8.3	8.4		8.1	8.4	8.3	10.0
10/19/06	8.8			8.8		8.9	9.0		8.9	8.9	9.0	10.8
10/20/06	8.5			8.4		8.7	8.8		8.6	8.9	8.9	12.8
10/21/06	6.9			6.8		7.2	7.2		7.1	7.5	7.5	10.6
10/22/06	5.6			5.6		6.0	5.8		5.9	6.3	6.2	9.7
10/23/06	5.7			5.6		5.9	5.6		5.9	5.9	6.0	8.9
10/24/06	5.5			5.5		5.8	5.6		5.8	5.9	5.9	9.7
10/25/06	5.5			5.5		5.7	5.5		5.8	5.8	5.8	5.3
10/26/06	5.7			5.7		5.9	5.7		5.9	5.9	5.9	7.2
10/27/06	7.1			7.0		7.1	7.1		7.2	7.1	7.3	7.2
10/28/06	6.4			6.3		6.5	6.5		6.6	6.6	6.7	8.6
10/29/06	6.1			6.1		6.3	6.3		6.4	6.3	6.4	13.1
10/30/06	3.3			3.2		3.6	3.6		3.8	3.8	4.0	8.3
10/31/06	0.9			0.8		1.4	1.0		1.6	1.5	1.7	4.4

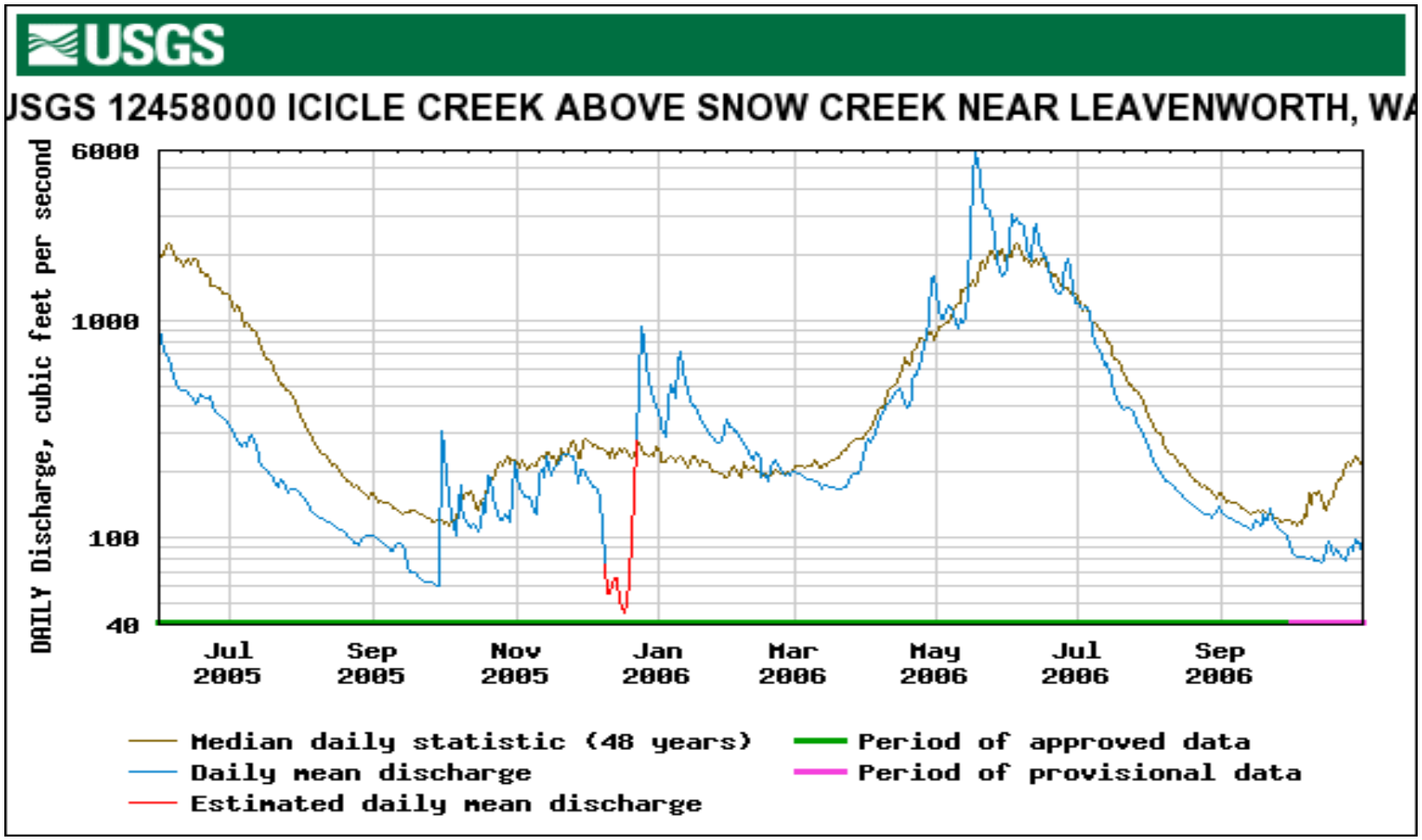


Figure 13. Icicle Creek flows from June 1, 2005 – October 31, 2006 (http://waterdata.usgs.gov/wa/nwis/dv/?site_no=12458000).

Table A4. Mean monthly flows in Icicle Creek above Snow Creek (#12458000) for 2005-2006 and historical monthly means (http://waterdata.usgs.gov/nwis/monthly?referred_module=sw&site_no=12458000&por_12458000_1=1180492,00060,1,1936-10,2006-09&format=html_table&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list).

YEAR	Monthly mean in cfs											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005	881	466	362	550	1,055	494	224	114	87	138	198	234
2006	386	236	185	545	2,117	2,057	611	161	117			
Historical mean of monthly discharge	291	296	288	664	1,690	1,880	862	262	160	238	375	342