

**Crane Valley Hydroelectric Project, FERC No. 1354**  
**Crane Valley Water Temperature Monitoring Results – 2005**  
**Addressing License Article 405 and U. S. Forest Service Condition No. 5**



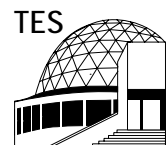
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**1 INTRODUCTION**

**1.1 Objective**

The Crane Valley Water Temperature Monitoring Program was initiated to determine the water temperature conditions in the Crane Valley Project area under licensed operating conditions and ambient hydrological and meteorological conditions.

**1.2 FERC License Article 405 and U. S. Forest Service Condition No. 5**

Pacific Gas and Electric Company (PG&E) filed with the Federal Energy Regulatory Commission (FERC) a water temperature monitoring plan on September 24, 2004 that was prepared in consultation with the California Department of Fish and Game (CDFG), the U.S. Fish and Wildlife Service (USFWS), the U.S. Forest Service (USFS), and the State Water Resources Control Board (SWRCB) (PG&E 2004). The water temperature monitoring plan was verbally approved by the USFS on September 17, 2004 pursuant to USFS Condition No. 5. An Order was issued by FERC on January 18, 2005 approving the water temperature monitoring plan pursuant to Article 405 and subject to the modifications outlined in the Order (FERC 2005).

**1.3 Project Area**

The Crane Valley Hydroelectric Project (Project), FERC No. 1354, includes the North Fork Willow Creek (NFWC), the South Fork Willow Creek (SFWC), mainstem Willow Creek, two major tributaries (Peckinpah Creek and Whiskey Creek), and four lakes (Bass Lake, Manzanita Lake, Chilkoot Lake, and Corrine Lake) in Madera County (Figure 1.1-1). The Project was constructed between 1895 and 1920 by the San Joaquin Electric Company and later the San Joaquin Power and Light Corporation (Studley et al. 1995). FERC issued a new license to PG&E for the continued operation of the Project on September 16, 2003 (FERC 2003). Project elevations range from 966 ft at Wishon Powerhouse on the San Joaquin River to 7,497 ft at Chilkoot Lake.

Bass Lake is the main storage reservoir for the Project and has a drainage area of 50.4 square miles and a maximum water surface elevation of 3,377 ft. Bass Lake is formed by Crane Valley Dam and is approximately 4 miles long. Bass Lake receives inflow from the NFWC, the SFWC (through the 2-mile long Browns Creek conduit), and other smaller streams.

Upstream of Bass Lake, Chilkoot Dam is located on Chilkoot Creek and creates Chilkoot Lake. The Chilkoot Lake Pick-Up Ditch collects water, primarily spring runoff, and delivers it to Chilkoot Lake. When



the water stored in Chilkoot Lake is released, it flows down Chilkoot Creek to the NFWC and then into Bass Lake.

Water from Bass Lake enters a tunnel beneath the lakes' floor and passes through the dam to the Crane Valley Powerhouse. Outflow from the powerhouse travels approximately 3.5 miles through the No. 3 Conduit to a forebay upstream of the San Joaquin No. 3 Powerhouse. Outflow from this powerhouse enters the NFWC at the upper end of Manzanita Lake and is diverted again at Manzanita Lake Dam into the No. 2 Conduit, which carries water approximately 3 miles to the No. 2 Forebay. Water then travels approximately 0.75 miles through a penstock to the San Joaquin No. 2 Powerhouse.

Water from the San Joaquin No. 2 Powerhouse combined with water diverted from NFWC (including water diverted from the SFWC into NFWC) travels to the San Joaquin No. 1A Powerhouse via approximately 5 miles of conduit. Water released from the powerhouse flows into Corrine Lake, which is the forebay for the A. G. Wishon Powerhouse. Water is released from the A. G. Wishon Powerhouse into the San Joaquin River.

## 2 METHODS

### 2.1 Sample Location

Water temperature was measured at twelve (12) historic stream locations from May 1 to November 1, 2005. Waters associated with the Crane Valley Project include the NFWC, SFWC, mainstem Willow Creek, and Bass Lake. The twelve water temperature monitoring stations are listed below.

- NFWC below Bass Lake at the Crane Valley Powerhouse tailrace (T1)
- NFWC below Bass Lake at river mile 7.13 (T2)
- NFWC upstream of Manzanita Lake at river mile 4.39 (T3)
- NFWC at the Manzanita Lake diversion dam (T4)
- NFWC downstream of Manzanita Lake at river mile 3.00 (T5)
- NFWC upstream of the North Fork diversion dam at river mile 0.25 (T6)
- SFWC upstream of the Browns Creek diversion dam at river mile 6.59 (T7)
- SFWC downstream of the Browns Creek diversion dam at river mile 6.5 (T8)
- SFWC above the South Fork diversion dam at river mile 0.1 (T9)
- Willow Creek at Gage W-26, river mile 4.3 (T10)
- Willow Creek at Whiskey Creek, river mile 1.8 (T11)
- Willow Creek at USGS Gage 2465, river mile 0.37 (T12)

Table 2.1-1 presents a list of the sampling locations and the rationale for their selection. The spatial locations of the sampling sites are presented in Figure 2.1-1.

In addition to the twelve stream temperature monitoring stations, water temperature profiles were collected on a monthly basis (May-October 2005) from Bass Lake from one location near the outlet structure.

An additional water temperature monitoring station will be added below the confluence of the NFWC and the SFWC after the Licensee makes the necessary modifications to the current facilities to release water into this area.

### 2.2 Water Temperature

Stream temperatures were automatically measured *in situ* at 20-minute intervals from May 1 through October 31, 2005 using VEMCO MiniLog 12 TR digital thermographs at the 12 water temperature stations to determine daily maximum, minimum, and average water temperatures. Redundant temperature recorders were installed at all stations to reduce the risk of loss of water temperature data due to recorder malfunction or due to periods of low flow which leave the recorders out of water. The MiniLog 12 TR is a miniature microprocessor controlled temperature logger that stores data in non-volatile memory. The



MiniLog 12 TR has an accuracy of  $\pm 0.1^{\circ}\text{C}$  between 5 and  $40^{\circ}\text{C}$ . Data were downloaded to a laboratory computer and stored to disk at bi-weekly intervals.

Redundant temperature recorders were deployed at each station in protective metal housings that were fixed to the stream bank using a metal chain to minimize the potential for theft and vandalism. Each temperature recorder was deployed in an accessible portion of the stream that is thermally homogenous and representative.

In addition to the 12 stream water temperature stations, water temperature profiles were collected on a monthly basis using a TSK MICOM Bathythermograph (BT). The BT is a microprocessor-controlled depth and temperature logger with an accuracy of approximately  $\pm 0.1^{\circ}\text{C}$  between  $-2$  and  $38^{\circ}\text{C}$ . Data were downloaded and stored to disk in the field. The location of the reservoir sampling site was recorded using GPS.

### **2.3 Stream Flow**

In addition to water quality, stream flow was measured continuously at twenty (20) existing PG&E maintained and two U.S. Geological Survey (USGS) maintained locations during the monitoring program. A complete list of the stream flow monitoring stations is listed below. Spatial locations of the stream flow monitoring stations is presented in Figure 2.3-1.

- North Fork Willow Creek near Sugar Pine (W24), USGS maintained location
- Browns Creek Diversion Dam Spill (W22)
- Browns Creek Canal at Bass Lake (W1)
- Bass Lake Storage (W2)
- Crane Valley Powerhouse (W19)
- North Fork Willow Creek near Bass Lake (W3)
- Conduit #3 Near Bass Lake (W4)
- San Joaquin #3 Powerhouse (W6)
- Manzanita Lake Spill (W8)
- #2 Conduit (W9)
- San Joaquin Powerhouse #2 (W11)
- South Fork Willow Creek Canal above North Fork Willow Creek (W12)
- Spill over North Fork Diversion Dam (W15)
- Spill over South Fork Diversion Dam (W13)
- Willow Creek Diversion to #1 Conduit (W14)
- #1 Conduit Spillway at San Joaquin #2 Powerhouse (W27)
- Willow Creek below Confluence of North and South Forks (W26)
- Willow Creek at Mouth (USGS- Southern California Edison (SCE) gage 2465)

- #1 Conduit below Bass Lake (W25)
- San Joaquin #1A Powerhouse (W16)
- Corrine Lake Storage (W17)
- A. G. Wishon Powerhouse (W18)

All stream flow data is presented as daily average flow data in cubic feet per second (cfs) and storage data are presented in thousand acre feet (TAF).

## **2.4 Meteorological Stations**

In order to collect data on ambient weather conditions during the sampling periods, two meteorological stations were monitored within the Project area. The meteorological stations were located near the Crane Valley Powerhouse (at an elevation of 3,400 ft) and at the A. G. Wishon Powerhouse (at an elevation of 990 ft). Date, time, and hourly average air temperatures were recorded at the meteorological stations. Relative humidity and solar radiation were also measured for model calibration. Daily average and daily maximum air temperatures are presented in Appendix C for both meteorological stations during the 2005 monitoring program period (May-October).

### **3 RESULTS**

#### **3.1 Water Temperature**

Water temperature was measured at 20-minute intervals at twelve locations in the NFWC, SFWC, and mainstem Willow Creek from May 1 through October 31, 2005. Water temperature data are reported as daily averages, minimum, and maximum for all stations (Figures 3.2-1 to 3.2-12) and as daily average and daily maximum water temperature compared with daily maximum and average air temperature (Figures 3.2-13—3.2-24). The twenty-minute water temperature data is presented in Appendix A (on CD).

The data from the redundant temperature recorders were compared at each station using a T-test. Small differences were observed in a majority of the duplicate recorders. With the data sets from the redundant temperature recorders at many stations being consistent with each other one complete data set was chosen from each unique station and was used for the data analysis presented in this report. There were a few recorders (one or both redundant recorder(s) from select stations) that either malfunctioned or were out of the water for a period of time rendering the data incomplete and inaccurate at those stations. Water temperature data were discarded if the recorder was out of the water. In most cases, the data from the backup recorder was used to fill any gaps resulting from lost data when only one of the two recorders was out of the water or when a recorder malfunctioned. However, at times, both recorders (for stations T3, T6, T9, T10, T11, and T12) were subject to data loss (out of the water, recorder malfunction, limited site access, and vandalism) during the same period, therefore no water temperature data are available during those periods of time.

The monthly average, minimum and maximum water temperatures measured during the monitoring period are presented in Table 3.2-1. The monthly statistics are based on daily average data, and represent the maximum, minimum, and mean of the daily average water temperatures recorded in each month. The daily average water temperature data are based on hourly average water temperatures recorded during each day.

In general, water temperature increased as the water moved downstream. The highest monthly average water temperatures observed during the monitoring program during the summer were measured at the most downstream station on Willow Creek, at river mile 0.37 at U. S. Geological Survey (USGS) gage 2465 (station T12) (Figure 3.2-13).

Water temperatures observed at stations T7 and T8, on the SFWC upstream and downstream of the Browns Diversion Dam were similar to each other, respectively (Figures 3.2-14 and 3.2-15, respectively).

Water temperatures of water released through Crane Valley Powerhouse (T1) show a distinct decrease in temperatures of approximately 4°C during a scheduled outage for maintenance activities from July 10 to

August 18 (Figure 3.2-4). Conversely, water temperatures in NFWC at stations T2 and T3 below Bass Lake and above Manzanita Lake show an increase in water temperatures during the scheduled outage (Figures 3.2-5 and 3.2-6, respectively). Water temperatures downstream of Manzanita Lake (stations T4, T5, and T6) show increased water temperatures during the scheduled outage (July 10 to August 18). It appears that the water released from Manzanita Lake is warmer during the outage providing an increase in water temperature at stations T4 and T5 on average of 10-11°C (Figures 3.2-7 and 3.2-8, respectively).

Water temperatures measured in the NFWC, river mile 0.25 upstream of the NFWC Diversion Dam (T6), were slightly elevated compared to water temperatures measured at the SFWC, river mile 0.1 upstream of the SFWC Diversion Dam (T9) (Figures 3.2-9 and 3.2-10, respectively). Stations T10 and T11 showed similar trends in water temperature during the monitoring program with the warmest temperatures in July and August (corresponding to the scheduled outage) (Figures 3.2-11 and 3.2-12, respectively). Daily average water temperatures at stations T10 and T11 differed by approximately 1°C or less (Table 3.2-1). The earliest date that water temperature recorders could be installed at station T11 was May 18 due to limited access to private property (permission was not received from the landowner until after May 1).

Mean daily average water temperatures were above 20°C at stations T2 (August), T3 (July and August), T5 (July), T6 (August), T10 (July and August), T11 (July and August), and T12 (July, August, and September) (Table 3.2-1). A scheduled outage for maintenance activities occurred from July 10 through August 18, which corresponds to the period time when temperatures were the highest at the stations listed above.

In addition to the stream water temperature data, water temperature profiles were collected from Bass Lake monthly during the monitoring program. Bass Lake temperature profiles are presented in Figure 3.2-1. Bass Lake was thermally stratified with a distinct thermocline during July, August, September, and October. A weak thermocline was present during May and June. Surface water temperatures were above 20°C in July, August, and September with the highest surface water temperatures recorded in July up to 28°C. Bottom waters (around 12 meters and lower) ranged from less than 10°C (May) to 16°C (October).

Comparison of previous temperature data (1984 and 1986-1992) collected on the SFWC below Browns Diversion, SFWC below the Forest Service Road, and NFWC below Bass Lake (Studley et al 1995) with the 2005 monitoring year data indicates similar trends in water temperatures at these locations from May through October. Water temperatures tend to warm in June and July with maximum water temperatures occurring in late July and early August. Water temperatures begin to decrease from mid-August through October.

### 3.2 Stream Flow

Flow or storage is monitored at twenty-two gage stations in the Project area. Data from all stations are presented as a summary of monthly average flows in Table 3.3-1. Only flow data for the period May 1 through October 31 are discussed in detail as the data pertains to the water temperature monitoring program. A discussion and available data are presented in Appendices B1 and B2. Plots of daily average flows are also presented in Appendix B2.

### 3.3 Discussion of Results

During the 2005 water temperature monitoring program some of the temperature recorders were found in very shallow water (T1, T2, T6, T8, T9, T10, and T11), were subject to vandalism (T3), or had malfunctioned (T7 [lost calibration] and T12 [battery died]) resulting in complete data loss for those time periods between servicing. Redundant recorders often provided sufficient backup for data during such events. However, in select instances (at stations T3, T6, T9, T10, T11, and T12) both recorders were subject to data loss. In future years attention will be paid to placement of the temperature recorders in the thalweg of the stream reach to ensure that data is not lost due to recorders ending up out of the water during changes in stream flow. Often, these recorders were moved to deeper pools upon inspection and servicing in the field. Therefore, it is important to place the recorders in an appropriate location each month they are serviced. Water temperature recorders are initially placed in the stream during high flow conditions (May); placement of the recorders needs to be adjusted as stream flows attenuate through the remainder of the year to ensure that the recorders will be under water.

Additionally, it is recommended that *in situ* water temperature be measured during each field visit using a hand-held electronic temperature instrument. This *in situ* measurement will provide additional information that can be used to determine whether a specific temperature recorder may be malfunctioning and will prevent its use in future monitoring until any problems are resolved.

Currently, the monitoring program provides an indication of the blended temperature at the confluence of Whiskey and Willow creeks. An additional water temperature recorder could be placed in Whiskey Creek so that late summer benefits of that unimpeded stream on the lower section of Willow Creek can be monitored. There also seems to be a thermal influence in mid summer due to the scheduled outage. Manzanita Lake appears to heat up and provide warmer water further down stream during the outage. It may be desirable in the future for any planned outages to occur at a different time or for more water to be routed through the bypass reaches during the outages. A majority of the warmest temperatures recorded during the monitoring program occurred during the scheduled outage. Many stations returned to cooler temperatures upon completion of the outage, and this is most evident at stations T4 and T5 (Figures 3.2-4 and 3.2-5).

#### 4 REFERENCES

Federal Energy Regulatory Commission (FERC) 2002. *Supplemental Environmental Assessment for Hydropower License, Crane Valley Project, FERC No. 1354.*

FERC 2003. *Pacific Gas and Electric Company Project No. 1354-005, Order Issuing New License.*

FERC 2005. *Pacific Gas and Electric Company Project No. 1354-041, Order Approving Water Temperature Monitoring Plan, January 18.*

Pacific Gas and Electric Company (PG&E) 2002. *Crane Valley Hydroelectric Project (FERC No. 1354), Amended Application for New License.* PG&E. San Francisco, California.

PG&E 2004. *Crane Valley Project, FERC No. 1354, Article 405 and Condition No. 5, Water Temperature Monitoring Plan.* PG&E. San Ramon, California.

Studley et al., 1995. *Response of Fish Populations to Altered Flows Project, Volume 1: Predicting Trout Populations from Streamflow and Habitat Variables.* PG&E. San Ramon, California.

**Table 2.1-1 Sample locations and the rationale for selection**

Station ID	Station Location	Monitoring Activity	Rationale
Profiles	Bass Lake	TP	Determine temperature changes in the water column of Bass Lake
Meteorology	Crane Valley Powerhouse	Met	Characterize ambient conditions within the Project near Crane Valley PH
T1	NFWC downstream of Bass Lake at the Crane Valley PH Tailrace	TR	Determine temperature of water released through Crane Valley PH
T2	NFWC River Mile 7.13, below Bass Lake	TR	Determine stream temperature at the start of the stream reach
T3	NFWC River Mile 4.39, upstream of Manzanita Lake	TR	Determine stream temperature entering a Project reservoir
T4	Manzanita Lake at the Project Diversion	TR	Determine the temperature of water in Manzanita Lake
T5	NFWC River Mile 3.00, downstream of Manzanita Lake	TR	Determine temperature of water released from Manzanita Lake
T6	NFWC River Mile 0.25, upstream of the NFWC Diversion Dam	TR	Determine water temperature of stream above Project diversion
T7	SFWC River Mile 6.59, upstream of Browns Creek Diversion Dam	TR	Determine water temperature of stream above Project diversion
T8	SFWC River Mile 6.5, downstream of the Browns Creek Diversion Dam	TR	Determine water temperature of stream below Project diversion at the start of the stream reach
T9	SFWC River Mile 0.1, upstream of the SFWC Diversion Dam	TR	Determine water temperature of stream above Project diversion
T10	Willow Creek River Mile 4.3, at Gage W-26	TR	Determine water temperature below the confluence of NFWC and SFWC
T11	Willow Creek River Mile 1.80, at the mouth of Whiskey Creek	TR	Determine water temperature at the confluence of a major tributary
T12	Willow Creek River Mile 0.37, at USGS Gage 2465	TR	Determine water temperature at the end of the Project Reach
Meteorology	A.G. Whishon Powerhouse	Met	Characterize ambient conditions within the Project near A.G. Wishon PH

NFWC = North Fork Willow Creek      SFWC = South Fork Willow Creek

Activity Key:    TR = temperature recorder; Met = meteorological station; TP = temperature profiles

Table 3.2-1 Monthly average, minimum daily average, and maximum daily average water temperatures observed during the monitoring program (5/1/2005 – 10/31/2005) by station

Station ID	Station Location	Month during 2005	Data Days	Water Temperature (°C)		
				Min	Mean	Max
T1	NFWC d/s of Bass Lake at the Crane Valley PH Tailrace	May	31	8.4	9	9.7
		June	30	9.8	10.5	11.5
		July	31	8	9.1	12
		August	31	8.1	10.3	13.2
		September	30	13.1	14	15.7
		October	31	15.4	16.3	17
T2	NFWC River Mile 7.13, below Bass Lake	May	31	9	13.9	20.2
		June	30	11.7	13.6	15.7
		July	31	12.7	19.9	27.1
		August	31	18.5	21.8	25.2
		September	30	15.4	17	20.3
		October	31	14.2	15.1	15.8
T3	NFWC River Mile 4.39, u/s of Manzanita Lake	May	31	9.6	14.1	20.1
		June	30	12.6	14.1	16.2
		July	31	13.7	20.7	26.8
		August	31	18.9	21.8	24.3
		September	30	14.8	16.2	18.7
		October	31	11.8	13.1	15.7
T4	Manzanita Lake at the Project Diversion	May	31	9.2	12.6	17.6
		June	30	11.8	12.9	13.5
		July	31	12.9	18.8	25.1
		August	31	13.6	18.7	23.5
		September	30	14	14.7	16.2
		October	31	15.3	16.3	17
T5	NFWC River Mile 3.00, d/s of Manzanita Lake	May	31	9.2	12.6	17.6
		June	30	11.9	13	13.7
		July	31	13.8	21.7	27
		August	31	14.1	19.7	25
		September	30	14.3	15	16.3
		October	31	15.3	16.2	16.9
T6	NFWC River Mile 0.25, u/s of the NFWC Diversion Dam	May	31	8	12.6	17.7
		June	29	11.3	13.9	16.2
		July	17	16.2	19.8	24.1
		August	31	18.1	21.5	24.5
		September	30	13.7	15.3	17.9
		October	31	10.9	12.4	15.2



Table 3.2-1 Continued

Station ID	Station Location	Month during 2005	Data Days	Water Temperature (°C)		
				Min	Mean	Max
T7	SFWC River Mile 6.59, u/s of the Browns Creek Diversion Dam	May	31	4.8	7.7	10.1
		June	30	7.7	10.7	13.8
		July	31	14	16.3	18.3
		August	31	14.5	15.8	17.7
		September	30	10.9	12.5	14.7
		October	31	8.8	10.1	12.5
T8	SFWC River Mile 6.5, d/s of the Browns Creek Diversion Dam	May	31	4.8	7.8	10.2
		June	27	7.7	10.4	12.3
		July	28	14.8	16.5	18.3
		August	31	14.7	15.8	17.5
		September	30	10.8	12.5	14.6
		October	31	8.7	10	12.5
T9	SFWC River Mile 0.1, u/s of the SFWC Diversion Dam	May	31	6.2	9.5	12.1
		June	27	10.2	13.2	16.7
		July	17	14.1	18.7	20.6
		August	31	17.8	18.9	20.7
		September	30	13.5	15.1	17.6
		October	31	10.5	12	15
T10	Willow Creek River Mile 4.3, at Gage W-26	May	31	7	10.9	14.7
		June	30	11	14.2	19.5
		July	31	17.9	21.6	25
		August	31	19.5	21.3	23.5
		September	30	15.7	17.6	20.7
		October	31	12.3	13.6	17.6
T11	Willow Creek River Mile 1.80, at the mouth of Whiskey Creek	May	14	10.1	11.7	13.5
		June	30	9.1	14	18.8
		July	31	19.1	22.1	25
		August	31	19.7	21.5	23.8
		September	30	15.2	16.9	19.6
		October	31	11.8	13.8	16.3
T12	Willow Creek River Mile 0.37, at USGS Gage 2465	May	31	8.8	12.1	15.8
		June	30	12	15.5	19.5
		July	31	19.9	22.5	25.2
		August	31	21	22.1	24.1
		September	8	19.2	20.2	21.1
		October	28	12.8	14.5	15.6

Monthly values are based on daily average data, and represent the maximum, minimum, and mean of the daily average water temperatures recorded in each month. The daily average is based on hourly average water temperatures recorded during each day.

**Table 3.3-1 Summary of 2005 stream flow (cfs) monitoring and reservoir storage (TAF) at Pacific Gas and Electric Company (PG&E) and USGS Maintained Stations.**

Station	Month	Data Days	Daily Average Flow (cfs) or Storage (TAF)		
			min	mean	max
<b>USGS Gage W24</b> North Fork Willow Creek near Sugar Pine (data provided by Madera Irrigation District [MID])	May	31	84		390
	June	30	79		214
	July	31	15		77
	August	31	6.7		15
	September	30	4.8		9.6
	October	31	4.2		9.4
<b>W22</b> Browns Creek Diversion Dam Spill	May	31	36	294.8	779
	June	30	0	107.8	254
	July	31	0	0	0
	August	31	0	1	16
	September	30	10	13.6	18
	October	31	0	13.7	20
<b>W1</b> Browns Creek Canal at Bass Lake	May	31	0	31.2	63.3
	June	30	0	28.7	70.6
	July	31	0	16.6	47.1
	August	31	0	0.6	4.9
	September	30	0	0	0
	October	31	0	0	0
<b>W2</b> Bass Lake Storage (TAF)	May	31	36.9	40.8	42.5
	June	30	42.7	44.2	44.9
	July	31	44.5	44.9	45.2
	August	31	41.3	43.8	45.1
	September	30	35.3	38.2	41.2
	October	31	28.2	31.7	35.2
<b>W19</b> Crane Valley Powerhouse	May	31	84.6	140.4	148.5
	June	30	109	143.9	148.7
	July	31	0	30.6	149.0
	August	31	0	54.8	149.2
	September	30	98.8	110.4	117.4
	October	31	105.3	127.2	138.8
<b>W3</b> North Fork Willow Creek near Bass Lake	May	31	20.8	174.2	424.8
	June	30	18.8	77.9	106.2
	July	31	7	28.7	65.3
	August	31	2.3	17.7	43.9
	September	30	2	2.2	2.6
	October	31	2	2	2

Table 3.3-1 Continued

Station	Month	Data Days	Daily Average Flow (cfs) or Storage (TAF)		
			min	mean	max
<b>W4</b> Conduit #3 near Bass Lake	May	31	103.2	133.7	137
	June	30	115.4	121.3	131.5
	July	31	0.1	32.2	127.6
	August	31	0.1	62	144.8
	September	30	116	117.1	119.6
	October	No data available for October			
<b>W6</b> San Joaquin #3 Powerhouse	May	31	60.7	107.3	117.9
	June	30	84.2	94.9	111.6
	July	31	0	25.1	93.7
	August	31	0	43.9	120.1
	September	30	82.3	88.9	95.3
	October	31	84.2	105.2	128.6
<b>W8</b> Manzanita Lake Spill	May	31	0	123.8	388
	June	30	0	0	0
	July	31	0	0.7	8
	August	31	0	1.3	5
	September	30	0	0	0
	October	31	2	3.9	32
<b>W9</b> #2 Conduit	May	31	153	154.5	157
	June	30	101	150.4	155
	July	31	0	35.2	151
	August	31	0	64.5	158
	September	30	107	120.2	123
	October	31	108	141.1	153
<b>W11</b> San Joaquin Powerhouse #2	May	31	72.4	136.5	148.6
	June	30	105.2	134.1	157.5
	July	31	0	31.8	133.7
	August	31	0	53.6	133.7
	September	30	93.7	102.1	108.7
	October	31	90.3	117.9	130.1

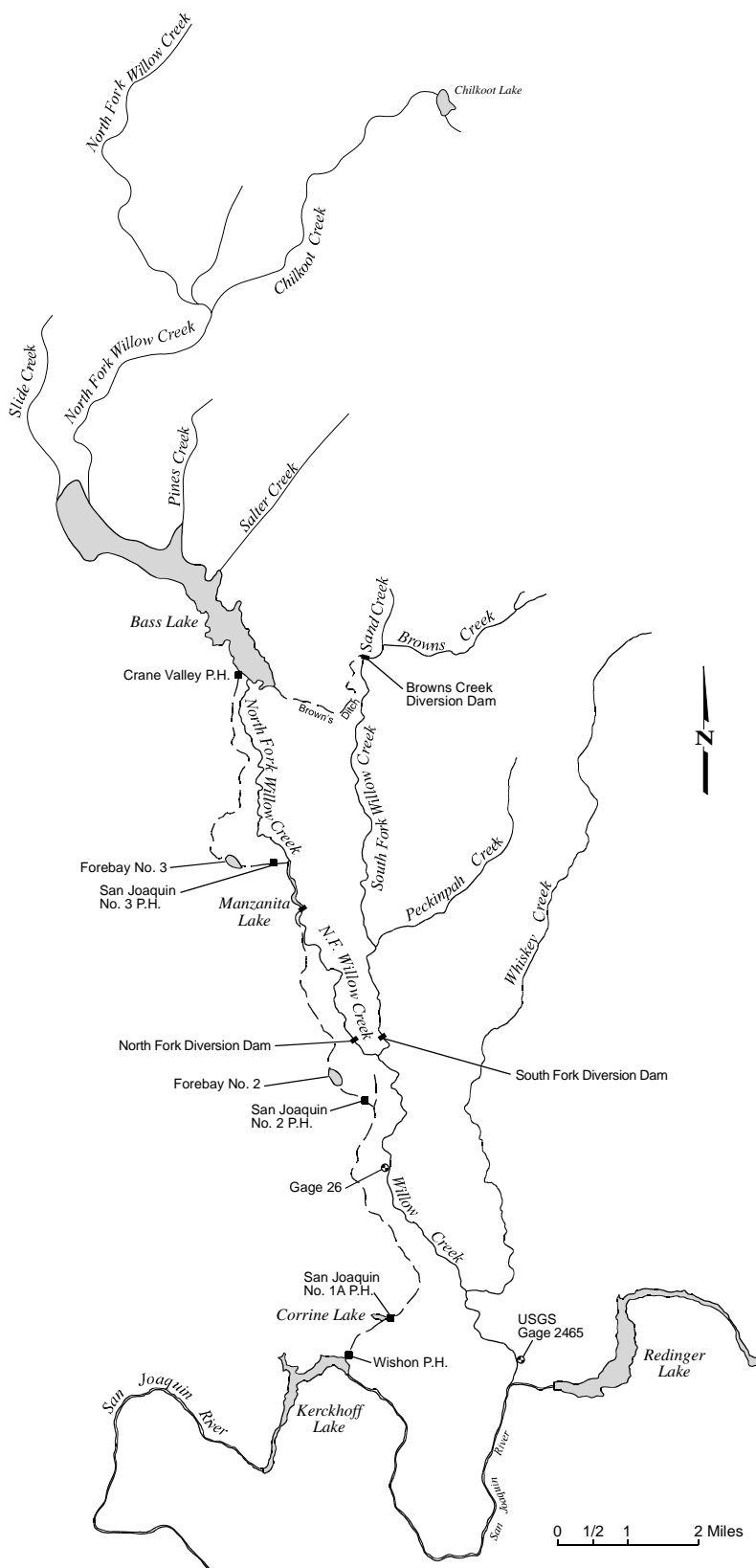
Table 3.3-1 Continued

Station	Month	Data Days	Daily Average Flow (cfs) or Storage (TAF)		
			min	mean	max
<b>W12</b> South Fork Willow Creek Canal above North Fork Willow Creek	May	31	0	41.3	86
	June	30	0	27.2	101
	July	31	0	2.6	12
	August	31	0	1.3	11
	September	30	0	0	0
	October	31	6	8.4	16
<b>W15</b> Spill over North Fork Diversion Dam	May	31	7.7	72.4	127
	June	30	0	7.7	51
	July	31	0	0	0
	August	31	0	0	0
	September	30	0	0	0
	October	31	0	0	0
<b>W13</b> Spill over South Fork Diversion Dam	May	31	33	194.8	865
	June	30	0	22.5	168
	July	31	0	0	0
	August	31	0	0	0
	September	30	0	0	0
	October	31	0	0	0
<b>W14</b> Willow Creek Diversion to #1 Conduit	May	31	40	87.5	95
	June	30	58	85.8	98
	July	31	37	76.5	109
	August	31	0	4.8	40
	September	30	0	2.8	13
	October	31	8	11.6	38
<b>W27</b> #1 Conduit Spillway at San Joaquin #2 Powerhouse	May	31	19	26.4	38
	June	30	0	19.5	52
	July	31	0	0	0
	August	31	0	0	0
	September	30	0	0	0
	October	31	0	0	0
<b>W26</b> Willow Creek below Confluence of North and South Forks	May	31	144.9	445.5	712.5
	June	30	2	129.8	295.7
	July	31	11.1	46.9	133.3
	August	31	0.5	31.8	76.1
	September	30	0.6	0.7	0.9
	October	31	0.5	2.2	26.5

Table 3.3-1 Continued

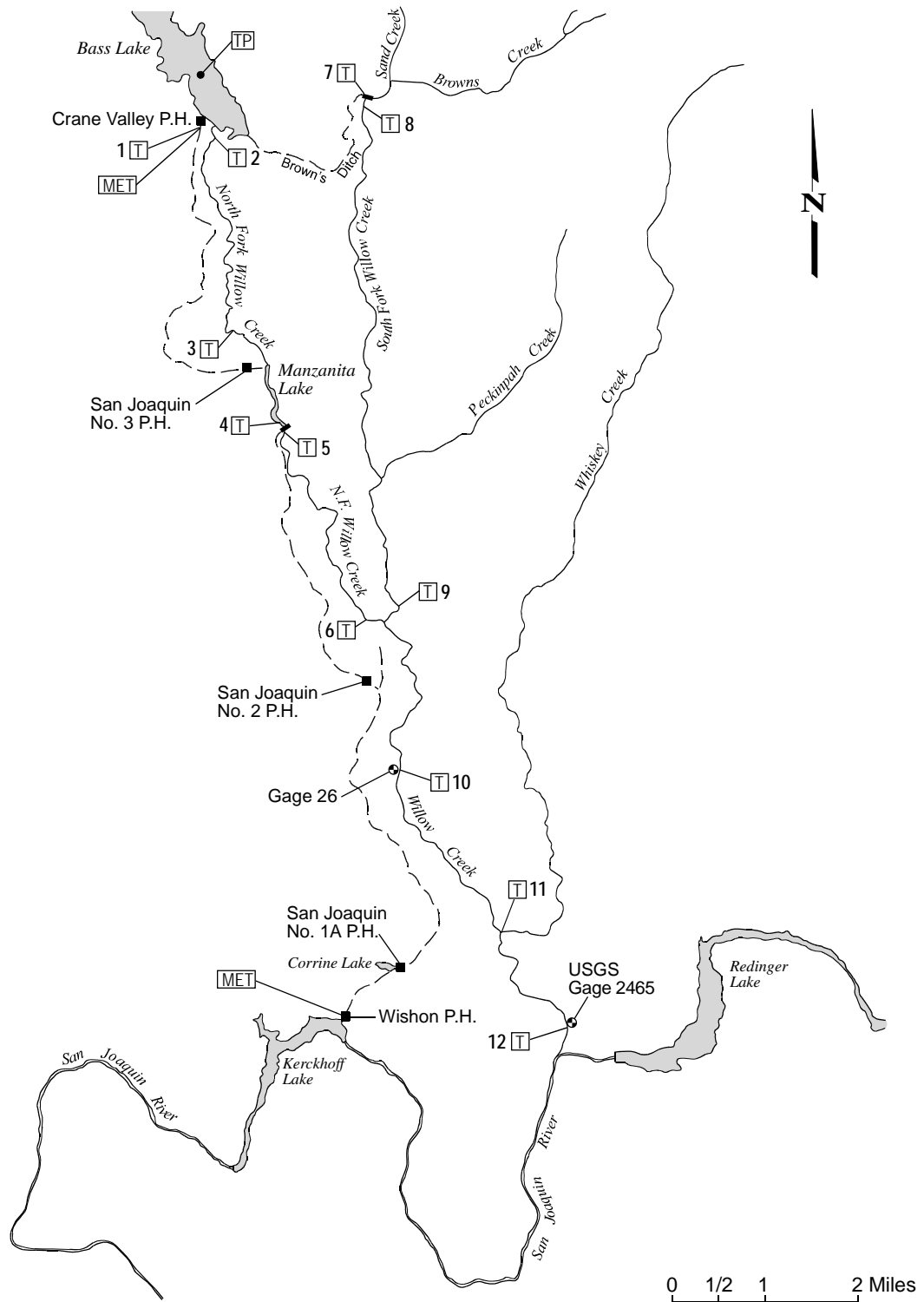
Station	Month	Data Days	Daily Average Flow (cfs) or Storage (TAF)		
			min	mean	max
<b>USGS Gage 2465</b> Willow Creek at Mouth (Southern California Edison [SCE] maintained)	May	31	235	605.4	1080
	June	30	29	135.6	341
	July	31	16	48.6	109
	August	31	3	30.7	68
	September	30	1.9	2.9	3.7
	October	31	1.7	4	23
<b>W25</b> #1 Conduit below Bass Lake	May	31	143.5	195.6	201.7
	June	30	168.1	195.4	203.2
	July	31	0	41.2	176.5
	August	31	0	59.9	148.1
	September	30	116.9	119.6	124.3
	October	31	119	137.6	150
<b>W16</b> San Joaquin #1A Powerhouse	May	31	0	0	0
	June	30	0	0	0
	July	31	0	0	0
	August	31	0	0	0
	September	30	0	0	0
	October	31	0	0	0
<b>W17</b> Corrine Lake Storage (TAF)	May	31	0.034	0.043	0.051
	June	30	0.041	0.042	0.048
	July	31	0.037	0.05	0.063
	August	31	0.027	0.046	0.069
	September	30	0.048	0.051	0.057
	October	31	0.05	0.053	0.064
<b>W18</b> A.G. Wishon Powerhouse	May	31	118.3	188	212.9
	June	30	163.4	194.2	204.5
	July	31	0	40.7	182.5
	August	31	0	59.1	156
	September	30	115	121.1	133.6
	October	31	115	137	155.1

**Figure 1.1-1 Crane Valley Project area map**



031236/crane valley project

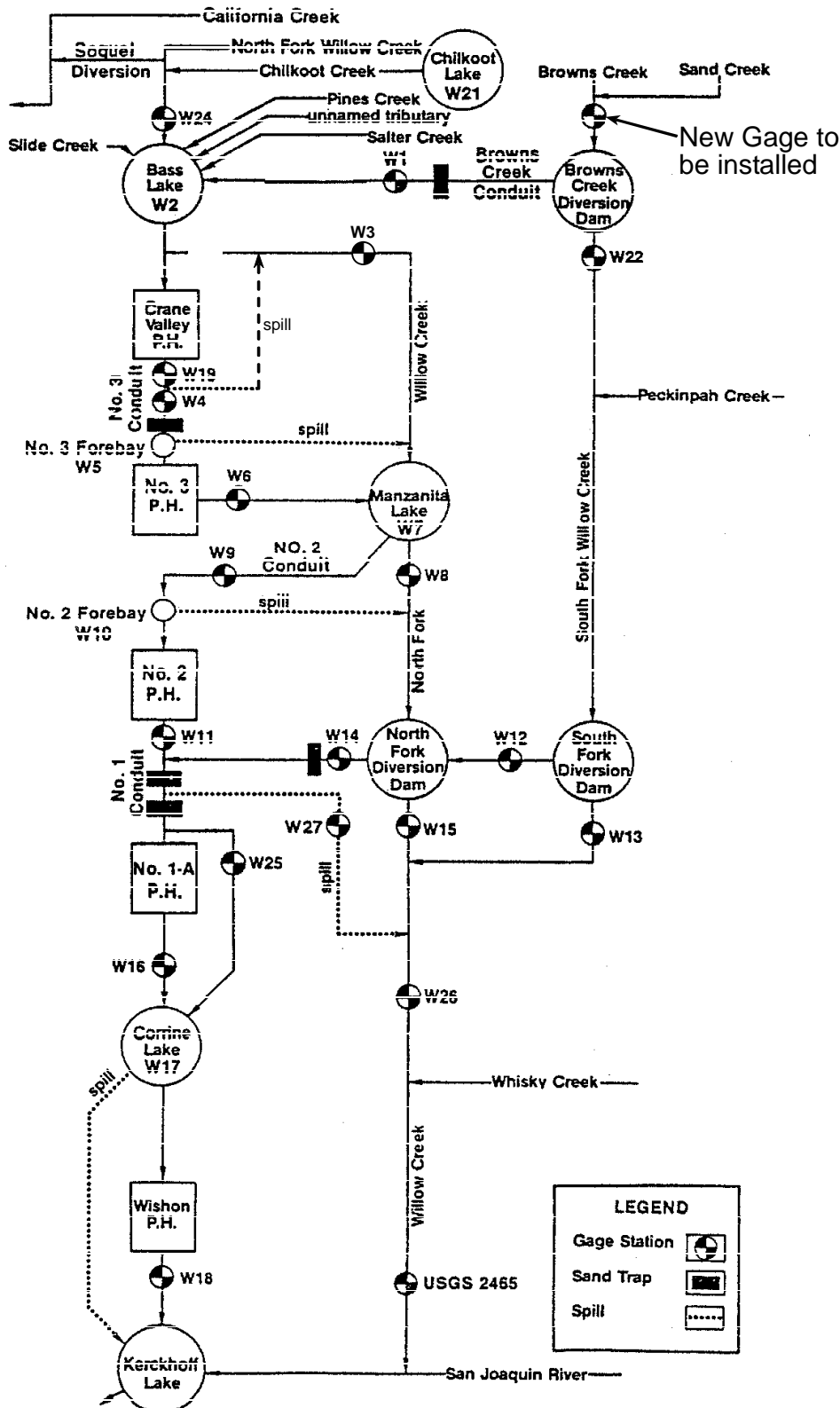
**Figure 2.1-1 Spatial representation of water temperature sampling locations.**



031236/willow creek temp stations

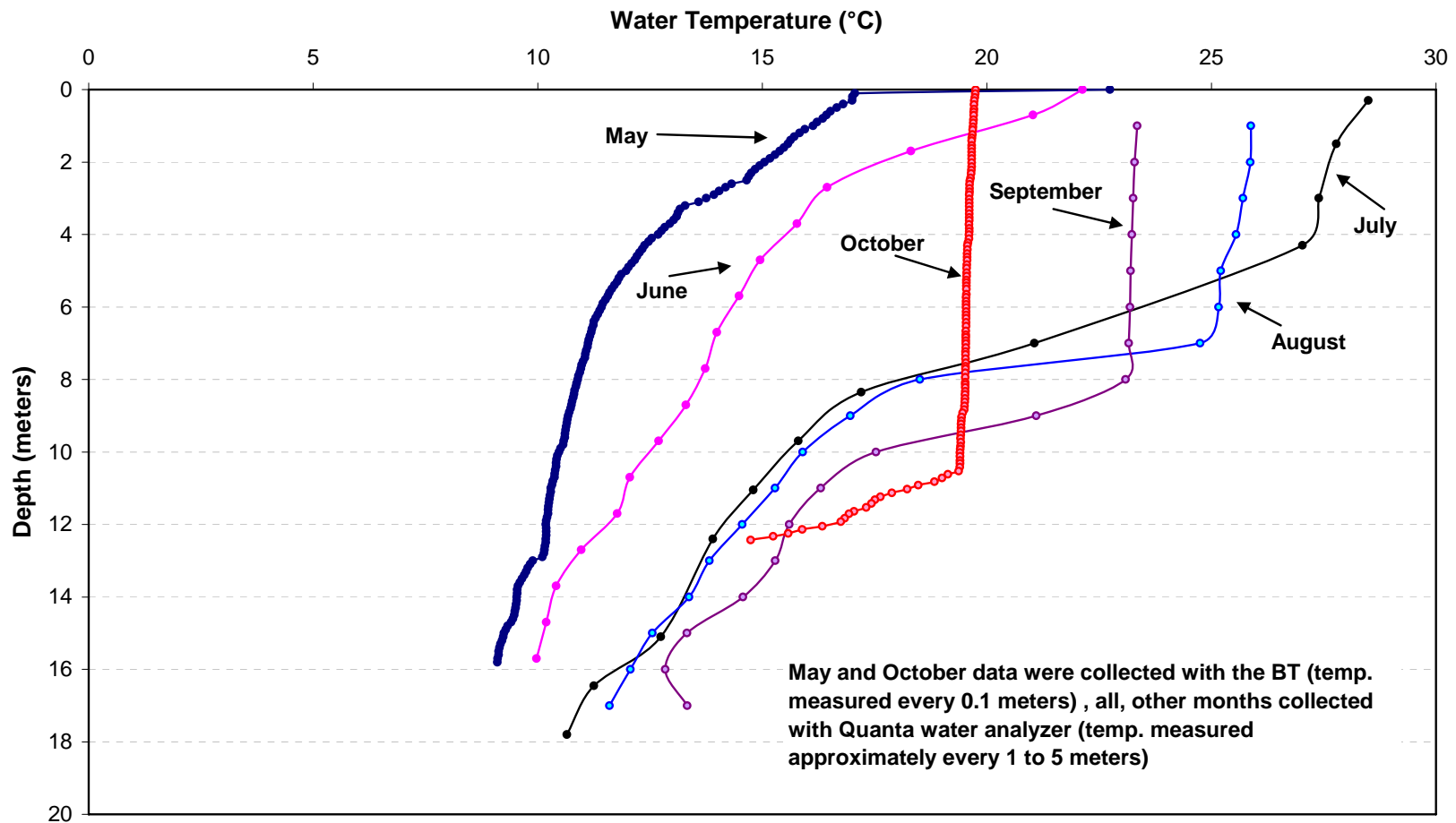
- T Temperature Monitoring Station
- TP Reservoir Temperature Profile
- MET Meteorological Station

Figure 2.3-1 Spatial representation of stream flow monitoring stations.

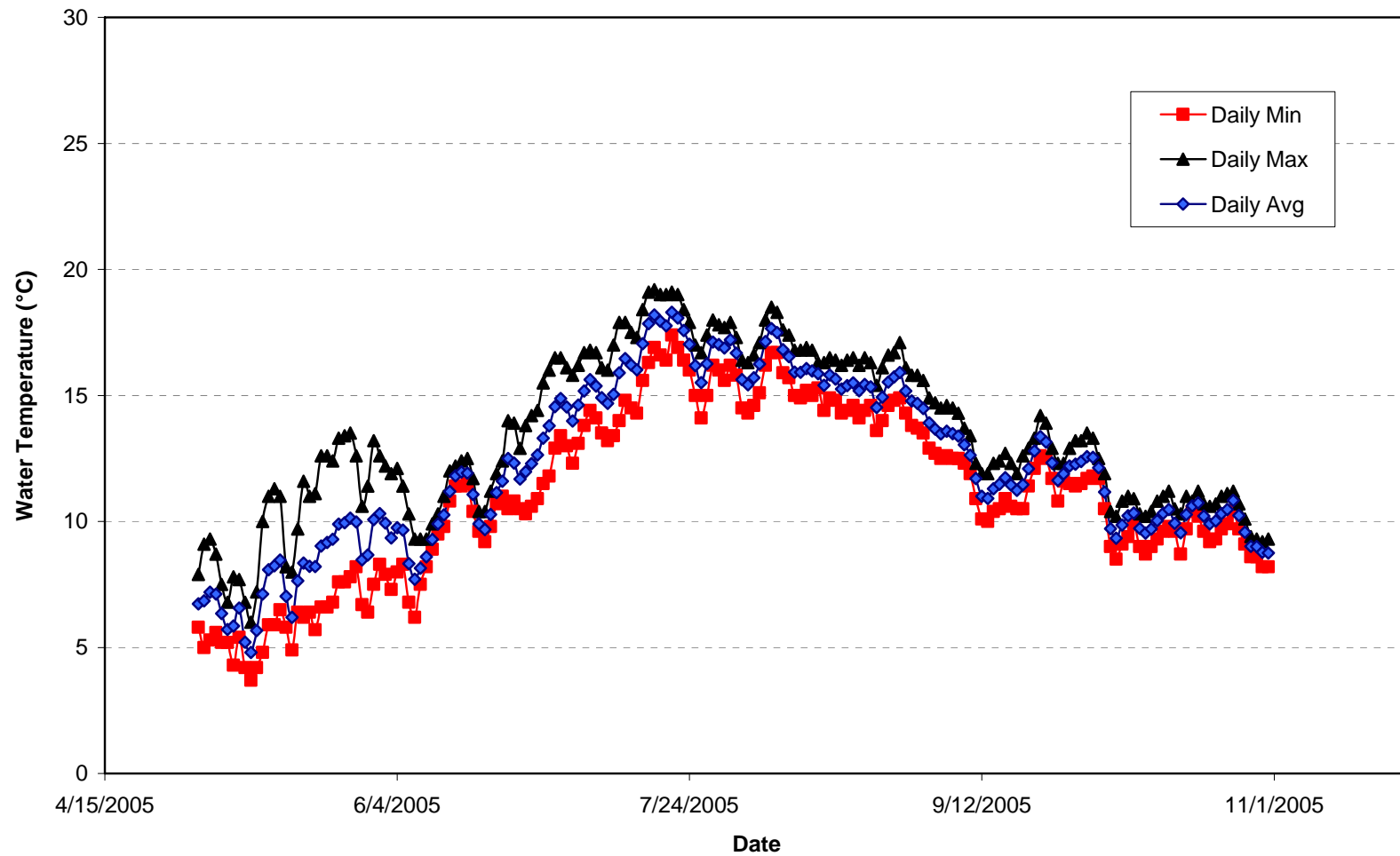




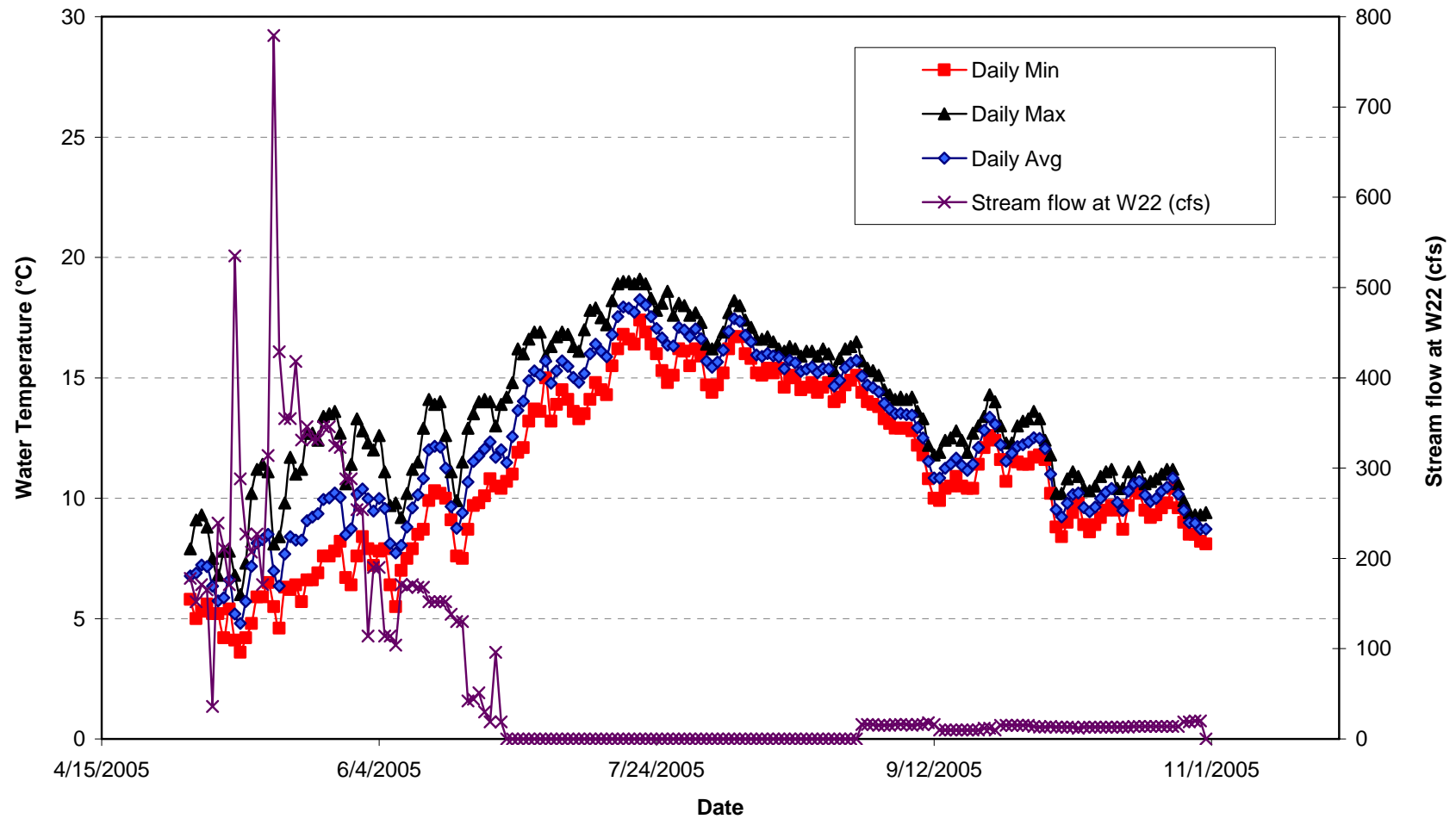
**Figure 3.2-1  
Bass Lake Water Temperature Profiles, May through October 2005**



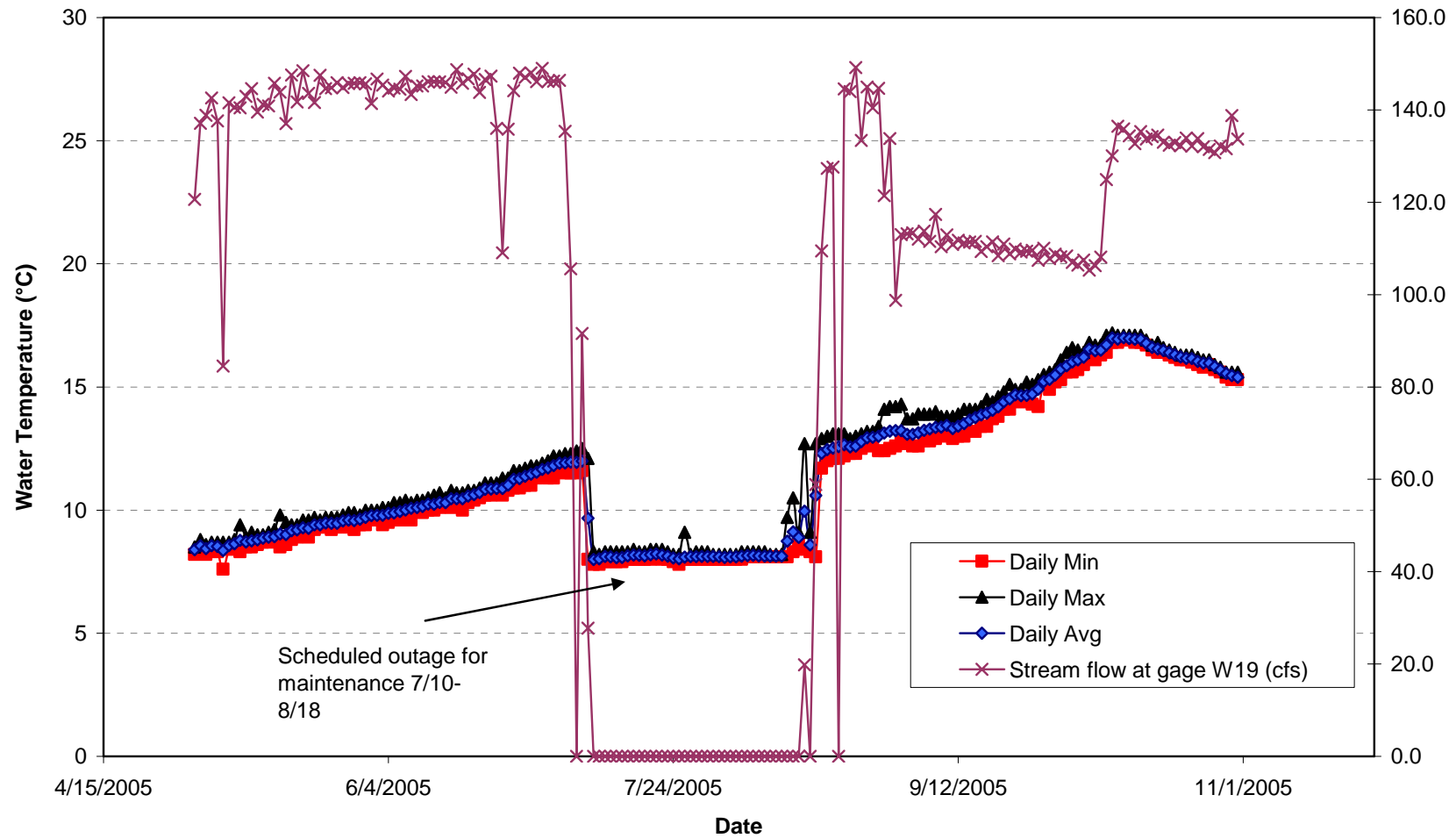
**Figure 3.2-2**  
**Station T7, SFWC River Mile 6.59, upstream of the Browns Creek Diversion Dam**  
**Daily Average, Minimum, and Maximum Water Temperatures (°C)**



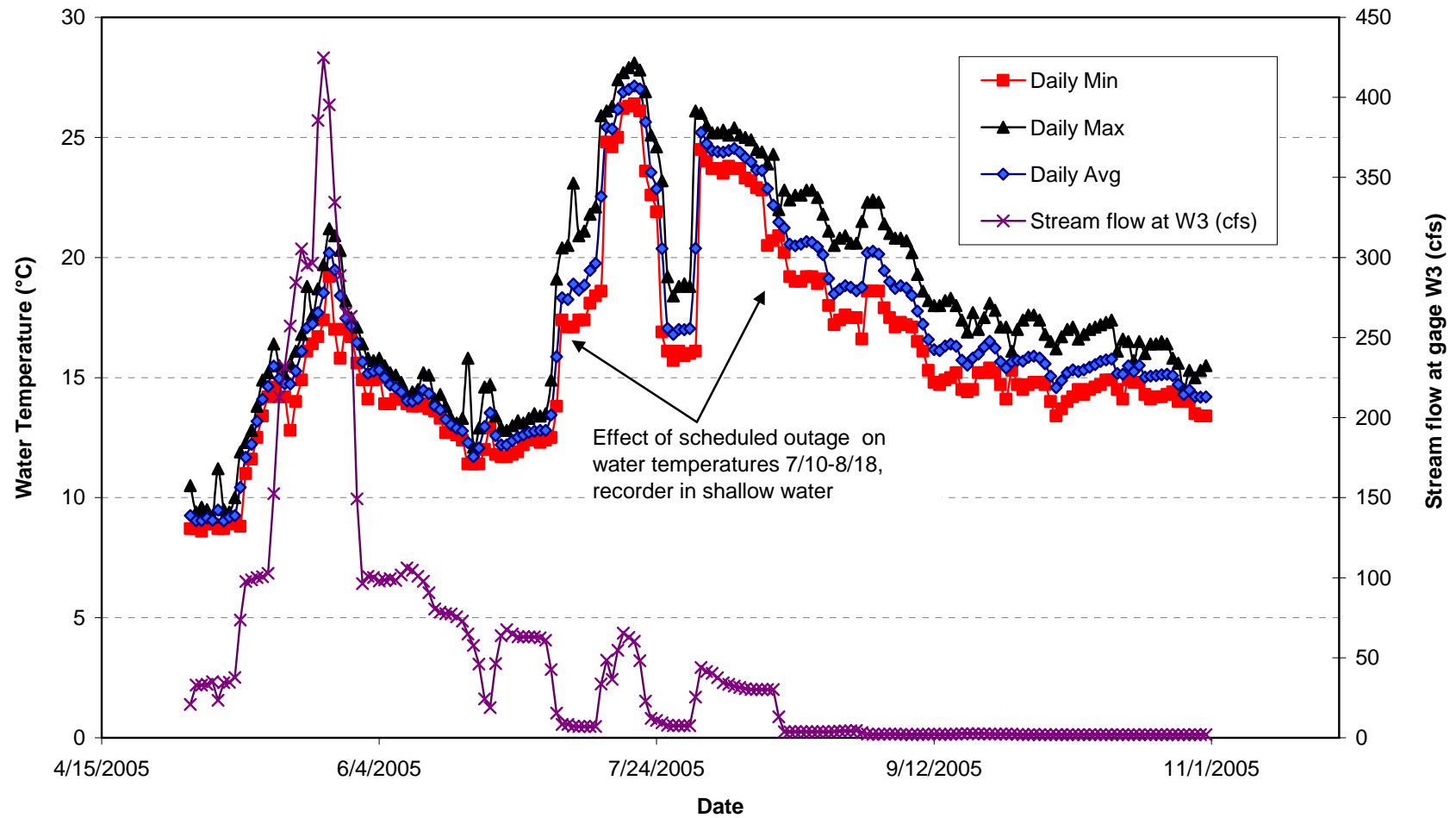
**Figure 3.2-3**  
**Station T8, SFWC River Mile 6.5, downstream of the Browns Creek Diversion Dam**  
**Daily Average, Minimum, and Maximum Water Temperatures (°C)**  
**and streamflow at gage W22 (cfs)**



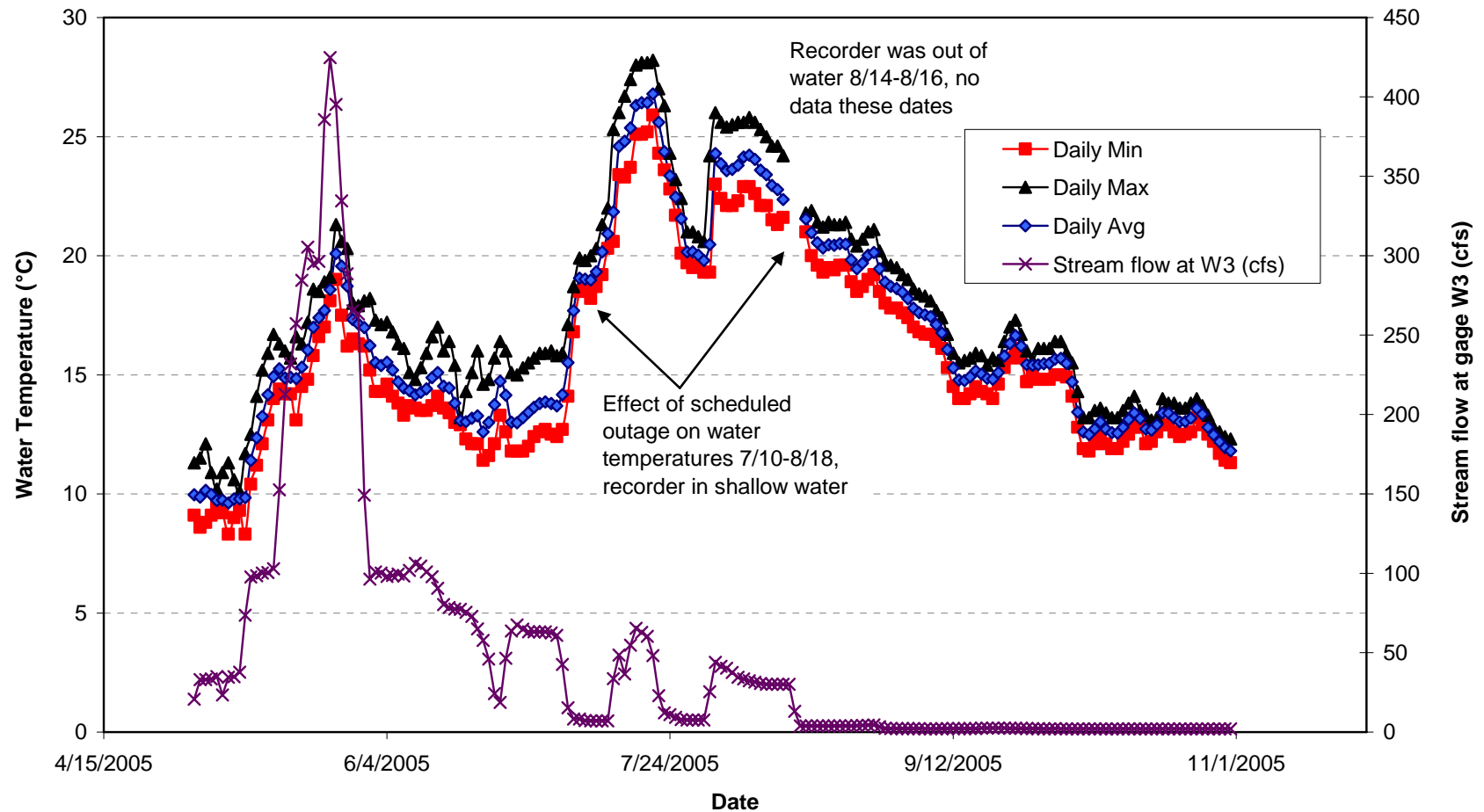
**Figure 3.2-4**  
**Station T1, NFWC downstream of Bass Lake at the Crane Valley PH Tailrace**  
**Daily Average, Minimum, and Maximum Water Temperatures (°C)**



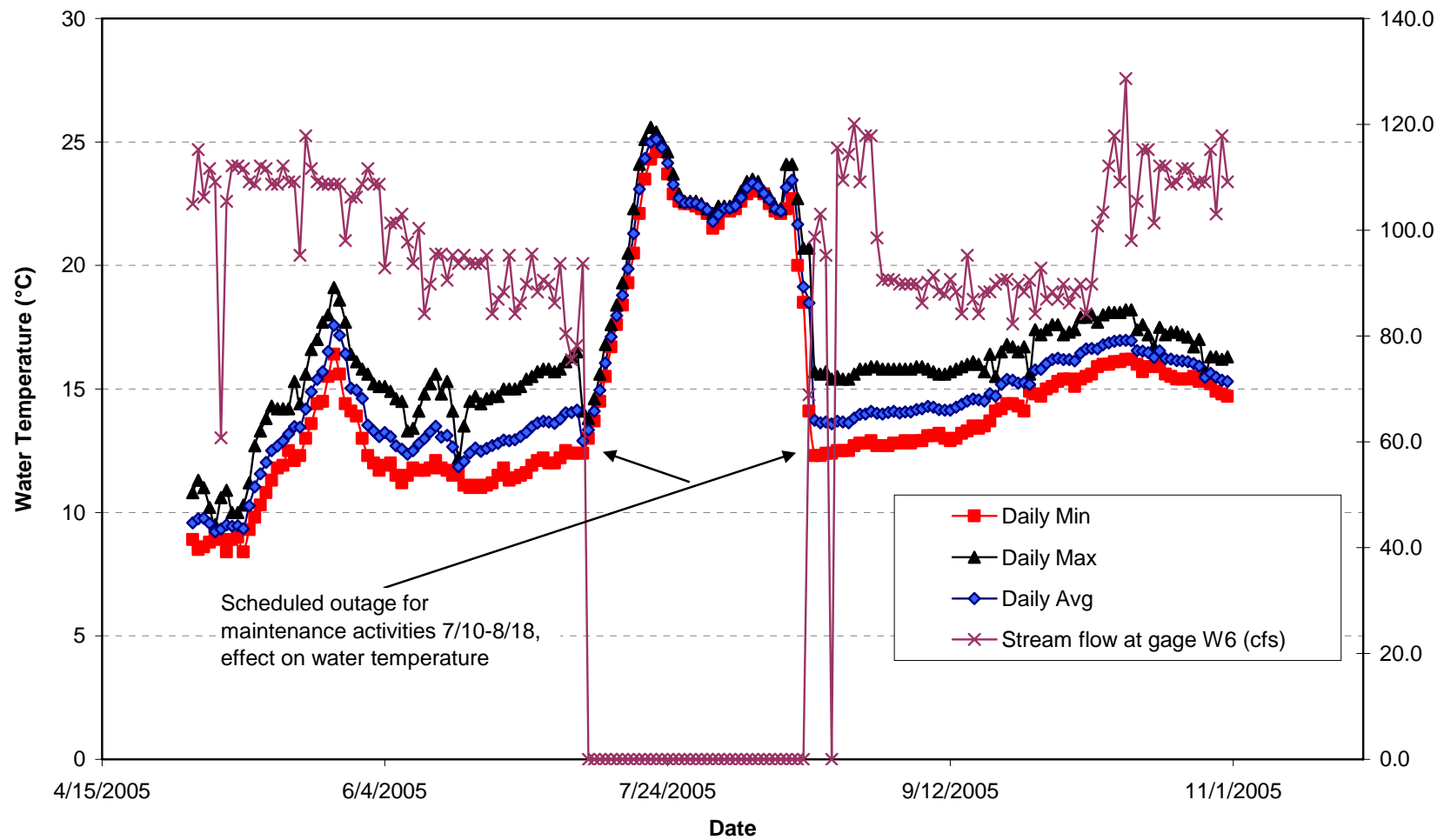
**Figure 3.2-5**  
**Station T2, NFWC River Mile 7.13 below Bass Lake**  
**Daily Average, Minimum, and Maximum Water Temperatures (°C) and stream flow at gage W3**  
**(cfs)**



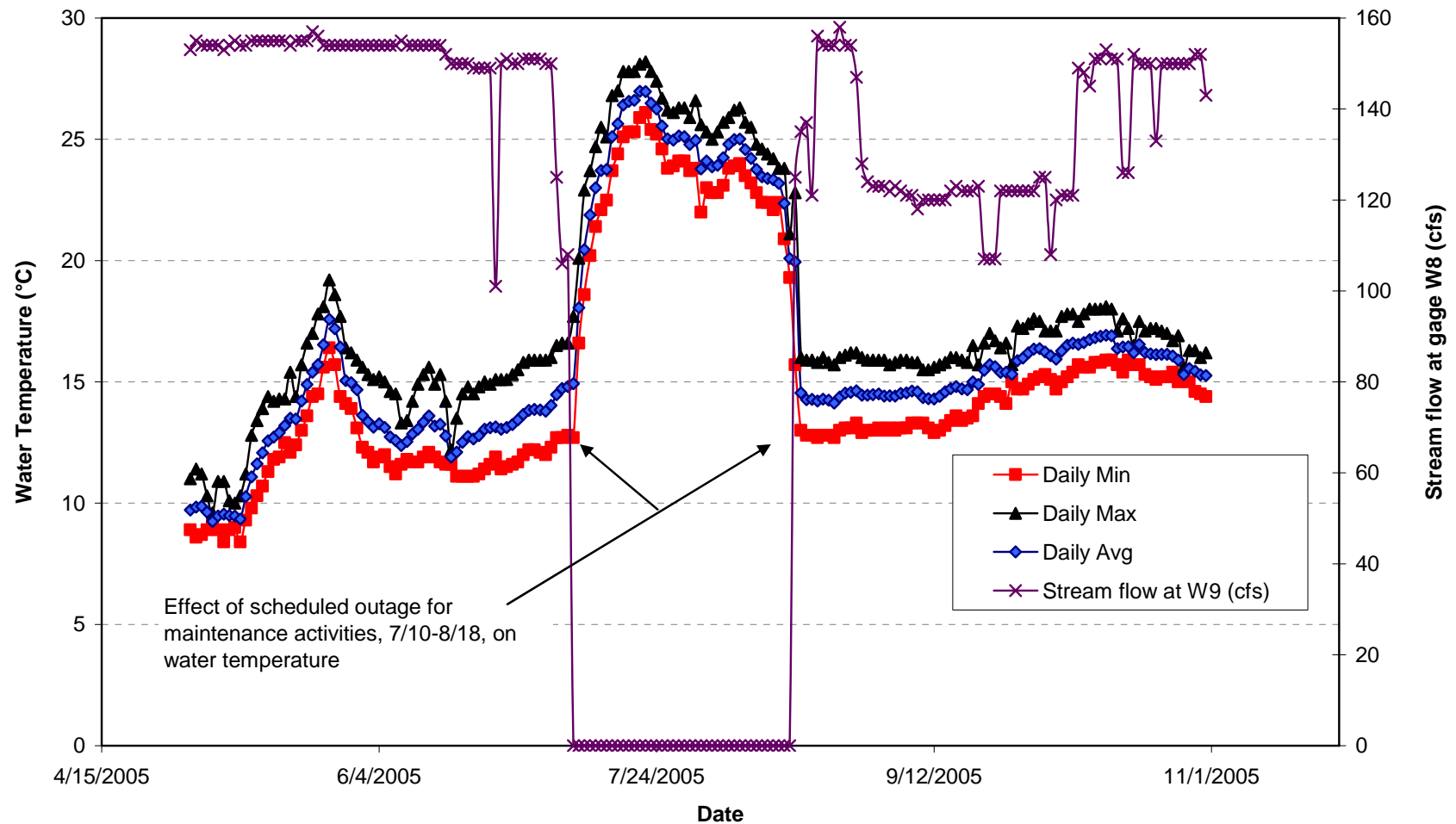
**Figure 3.2-6**  
**Station T3, NFWC River Mile 4.39, upstream of Manzanita Lake**  
**Daily Average, Minimum, and Maximum Water Temperatures (°C) and stream flow at gage W3**  
**(cfs)**



**Figure 3.2-7**  
**Station T4, Manzanita Lake at the Project Diversion**  
**Daily Average, Minimum, and Maximum Water Temperatures (°C)**

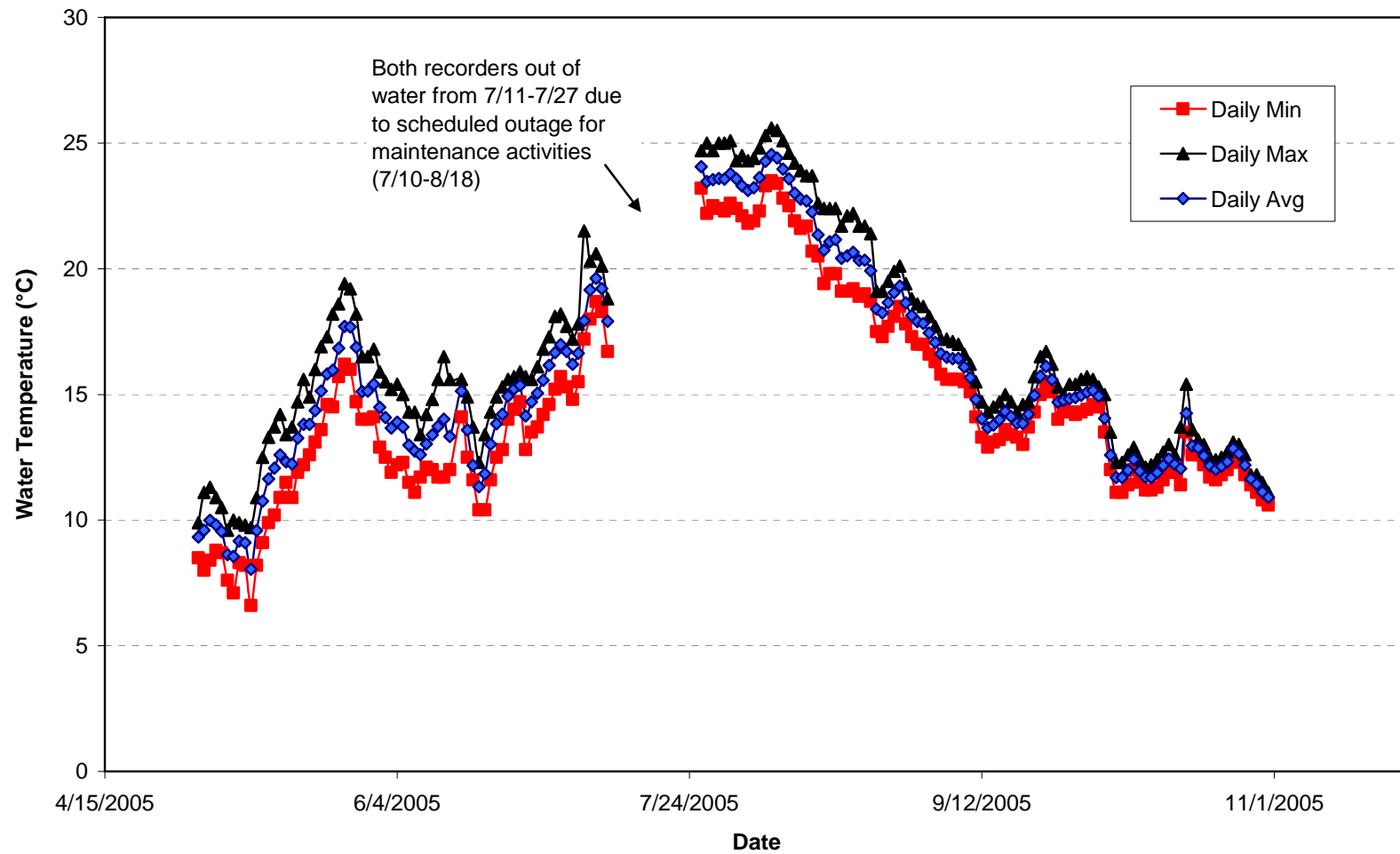


**Figure 3.2-8**  
**Station T5, NFWC River Mile 3.00, downstream of Manzanita Lake**  
**Daily Average, Minimum, and Maximum Water Temperatures (°C)**

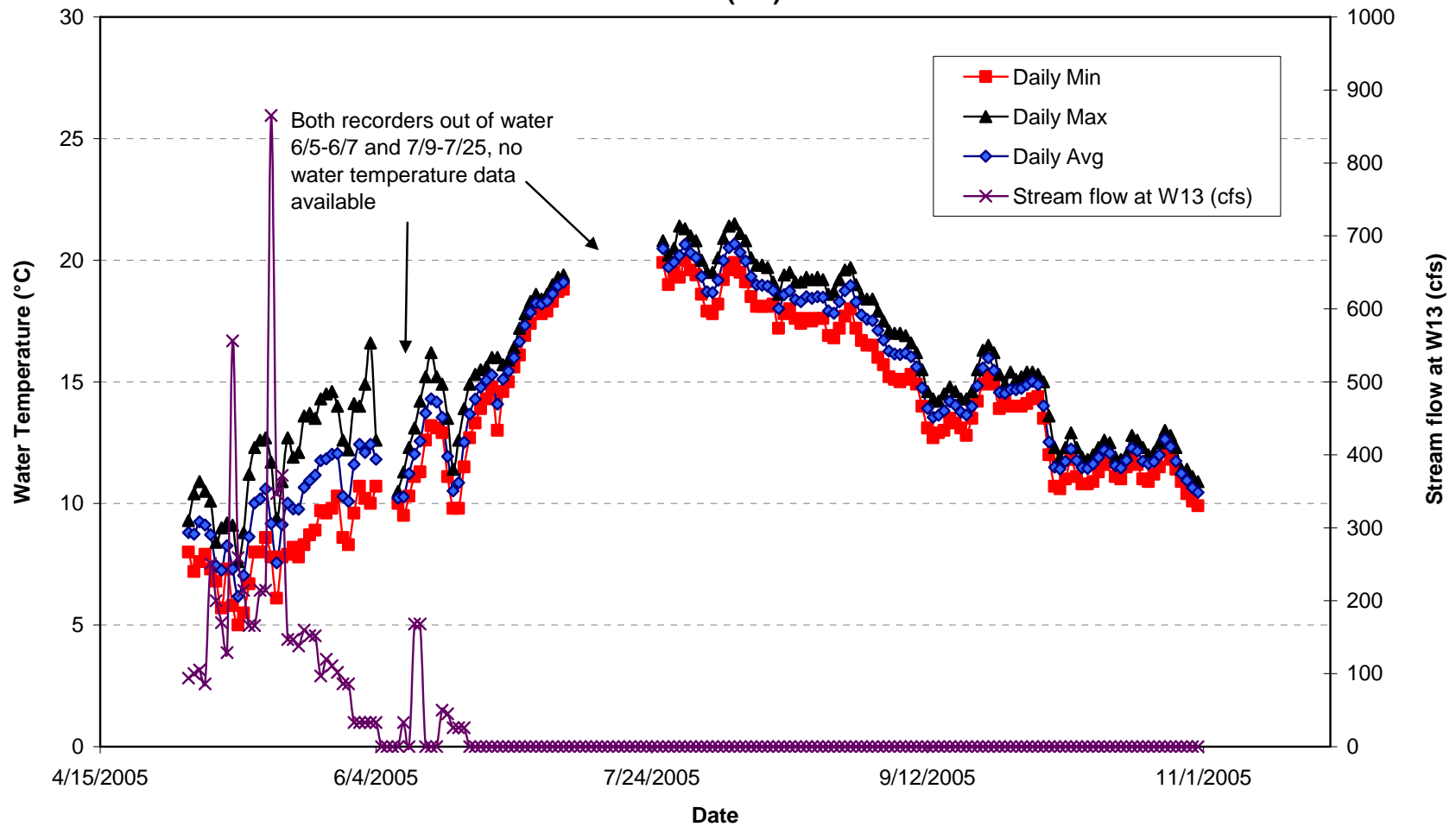




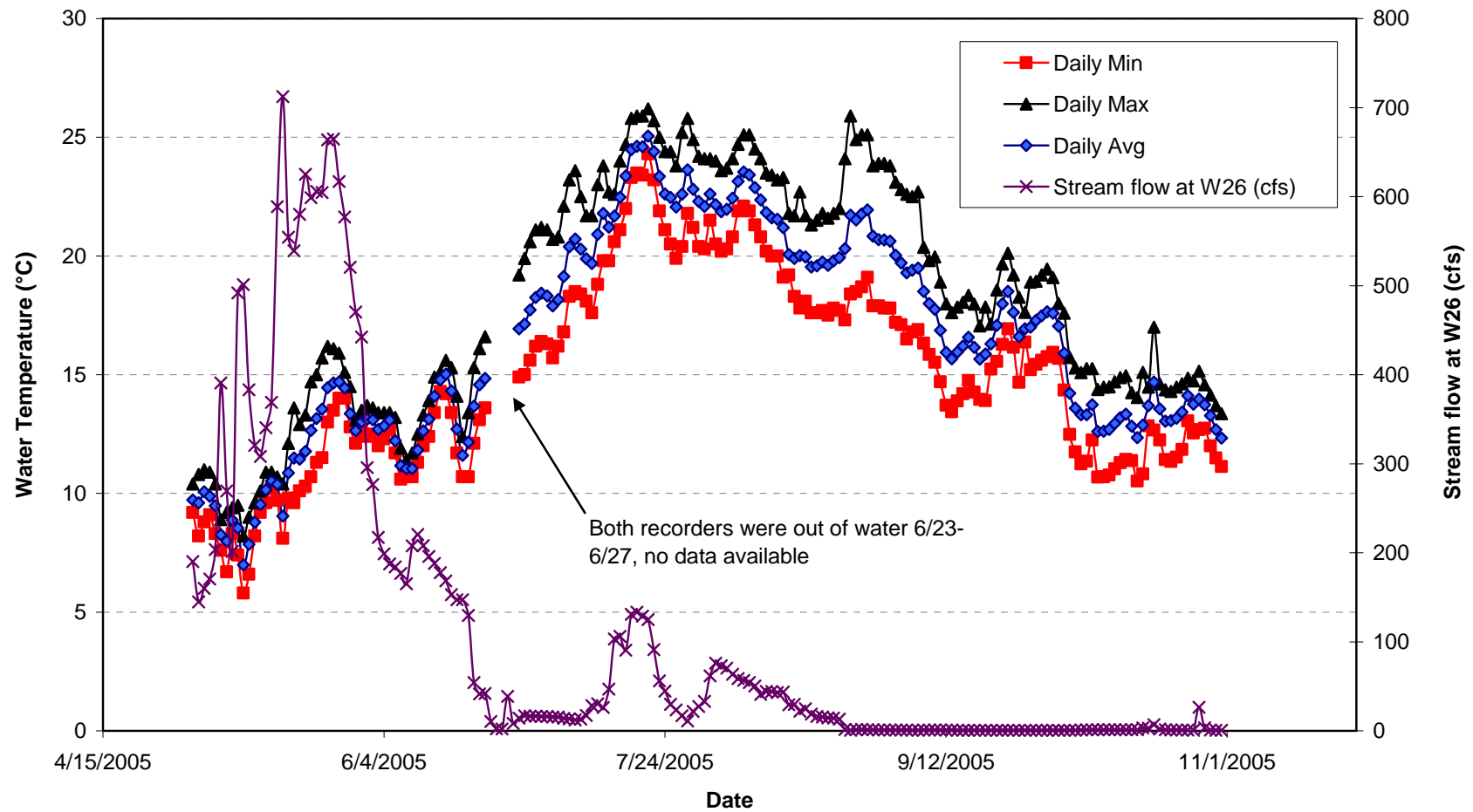
**Figure 3.2-9**  
**Station T6, NFWC River Mile 0.25, upstream of the NFWC Diversion Dam**  
**Daily Average, Minimum, and Maximum Water Temperatures (°C)**



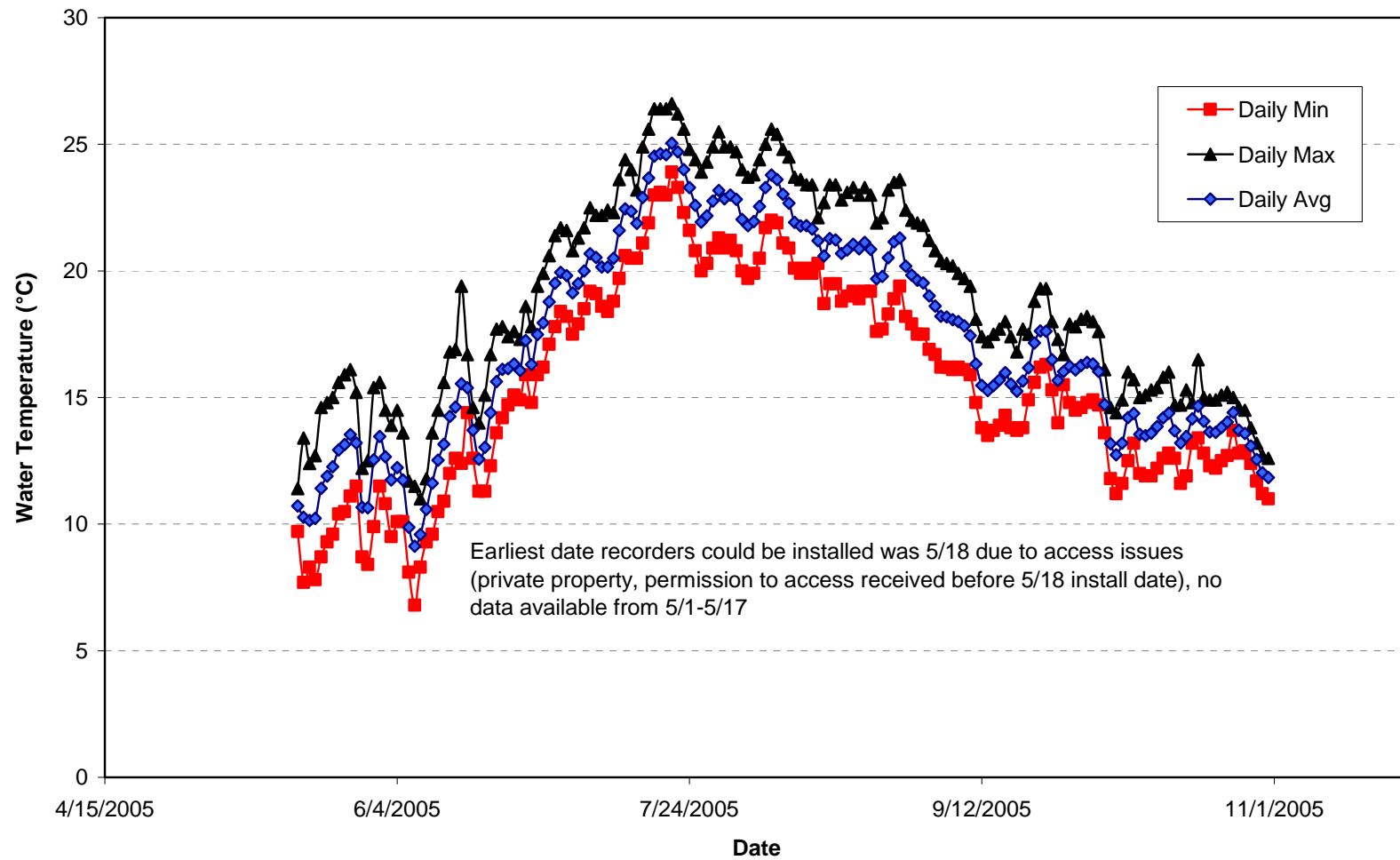
**Figure 3.2-10**  
**Station T9, SFWC River Mile 0.1, upstream of the SFWC Diversion Dam**  
**Daily Average, Minimum, and Maximum Water Temperatures (°C) and stream flow at gage**  
**W13 (cfs)**



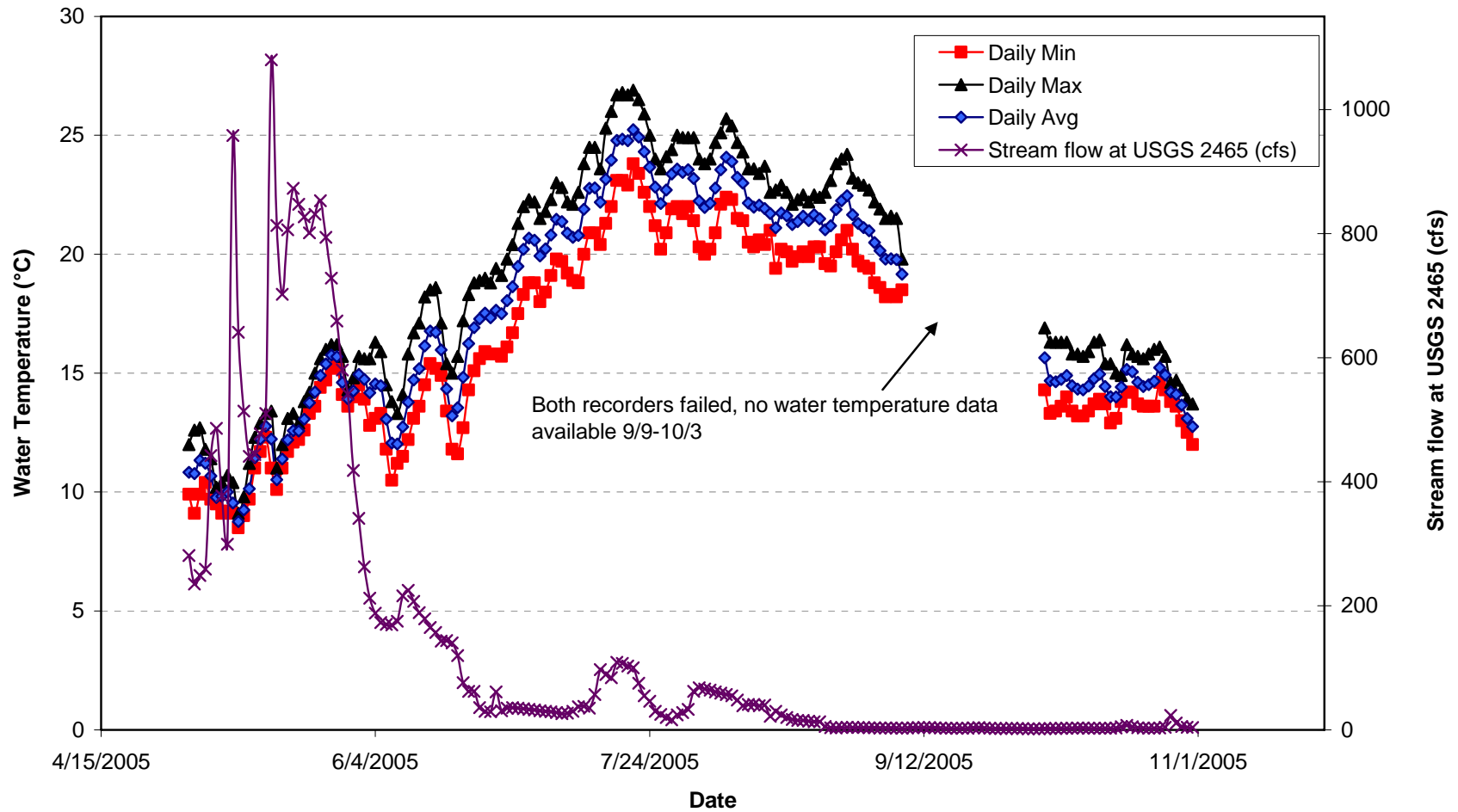
**Figure 3.2-11**  
**Station T10, Willow Creek River Mile 4.3 (at Gage W-26)**  
**Daily Average, Minimum, and Maximum Water Temperatures (°C) and stream flow at gage**  
**W26 (cfs)**



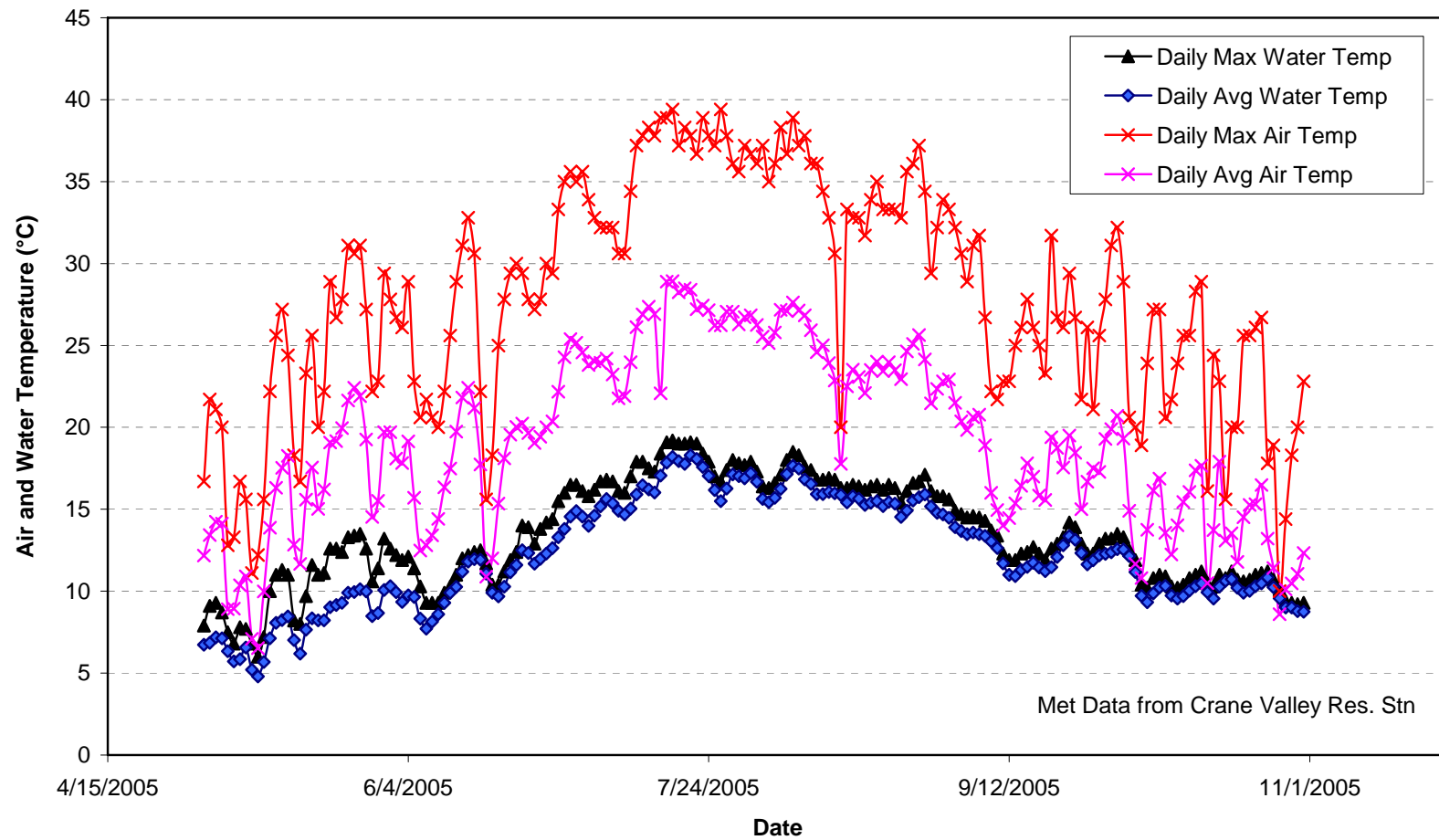
**Figure 3.2-12**  
**Station T11, Willow Creek River Mile 1.8 at the mouth of Whisky Creek**  
**Daily Average, Minimum, and Maximum Water Temperatures (°C)**



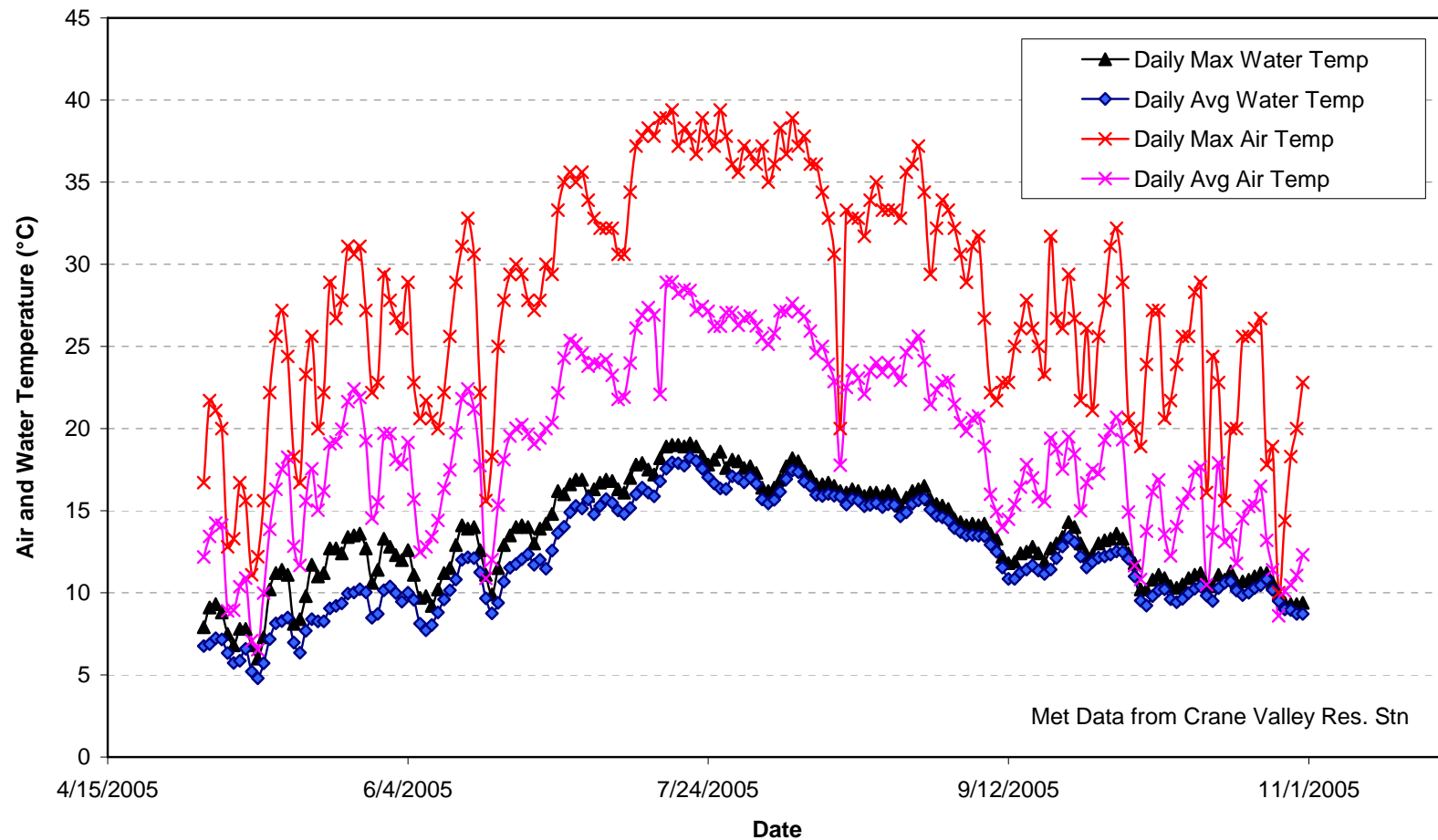
**Figure 3.2-13**  
**Station T12, Willow Creek River Mile 0.37 at USGS Gage 2465**  
**Daily Average, Minimum, and Maximum Water Temperatures (°C) and stream flow at USGS**  
**gage 2465 (cfs)**



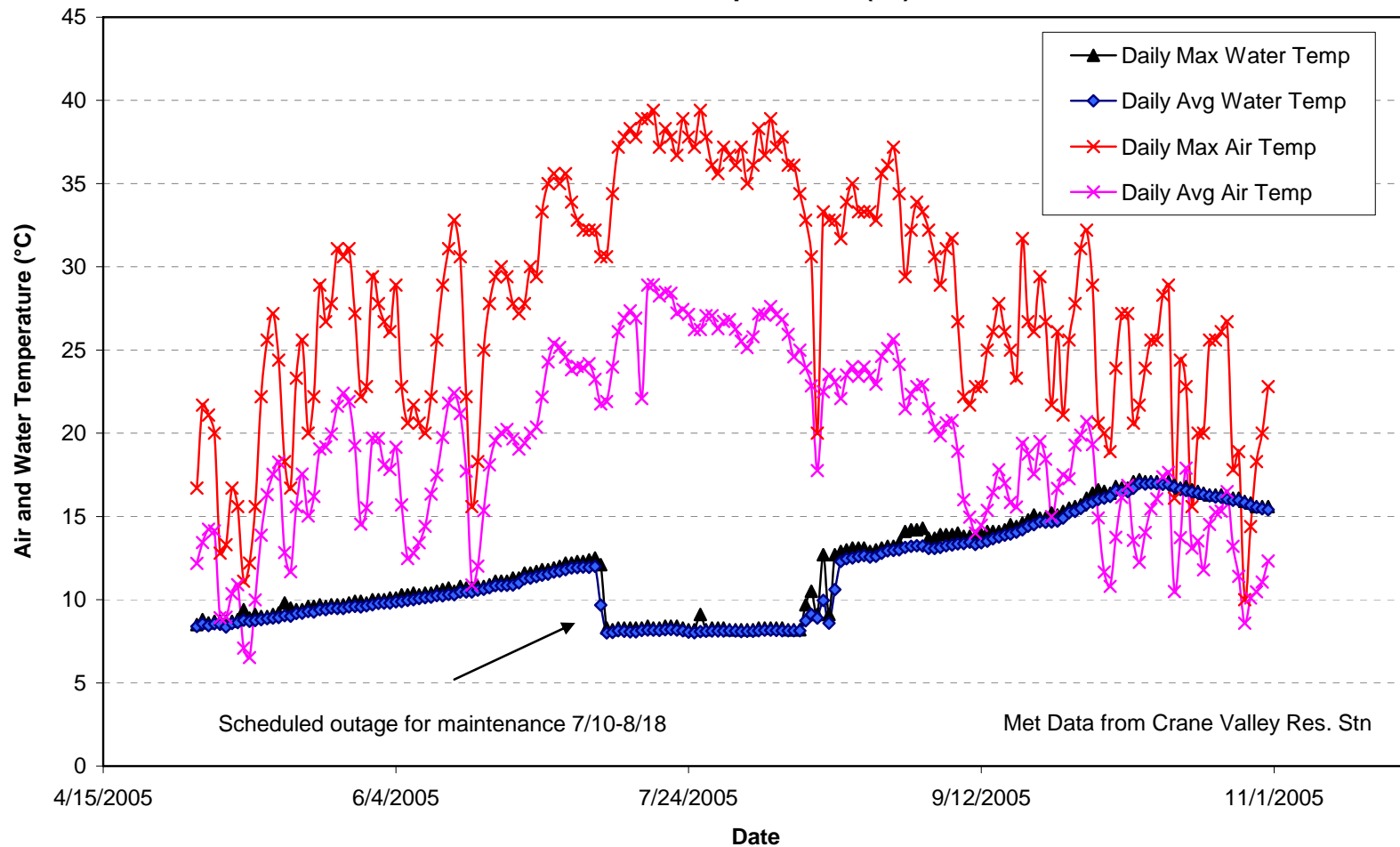
**Figure 3.2-14**  
**Station T7, SFWC River Mile 6.59, upstream of the Browns Creek Diversion Dam**  
**Daily Average and Maximum Water Temperatures (°C)**  
**and Air Temperatures (°C)**



**Figure 3.2-15**  
**Station T8, SFWC River Mile 6.5, downstream of the Browns Creek Diversion Dam**  
**Daily Average and Maximum Water Temperatures (°C)**  
**and Air Temperatures (°C)**

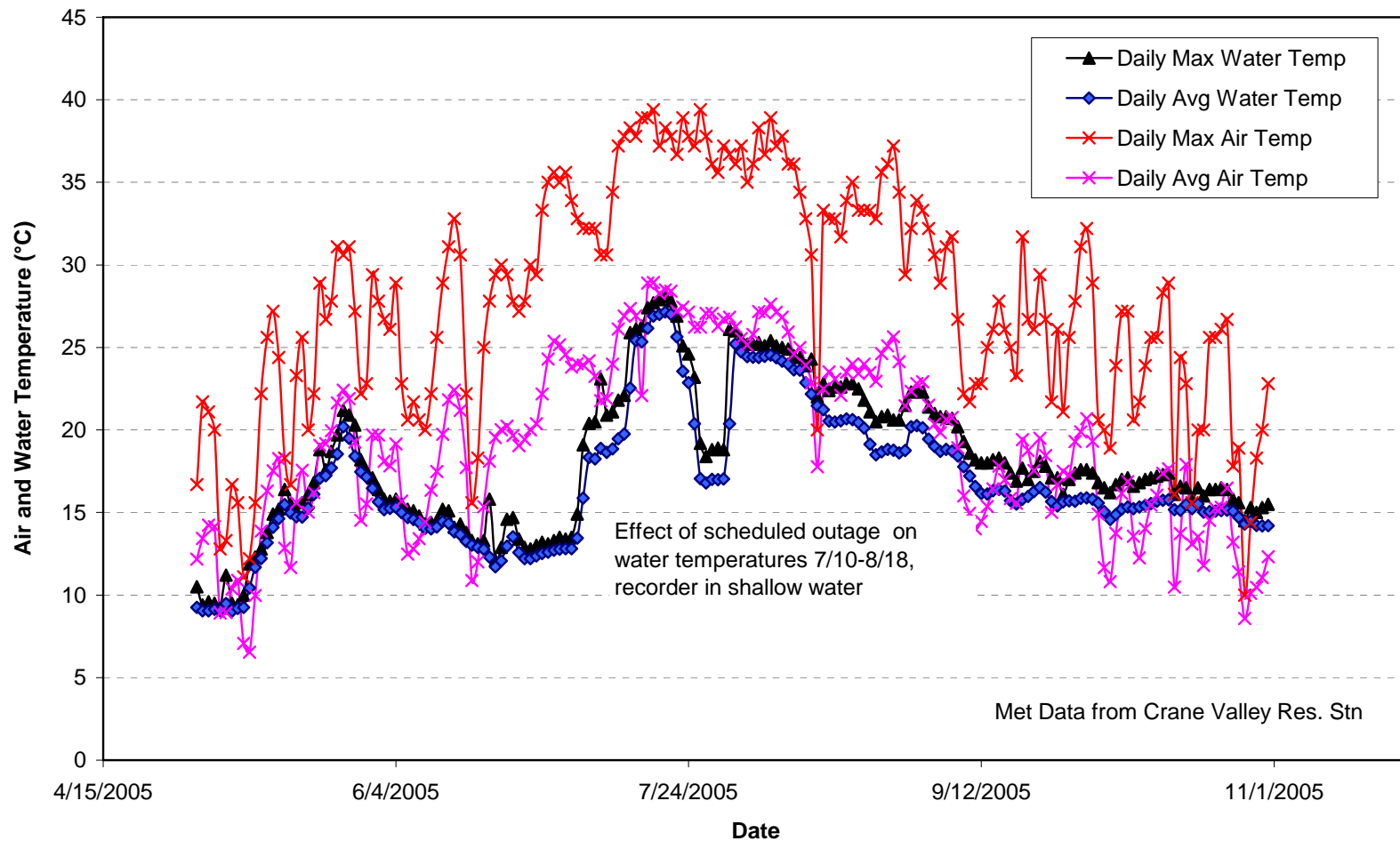


**Figure 3.2-16**  
**Station T1, NFWC downstream of Bass Lake at the Crane Valley PH Tailrace**  
**Daily Average and Maximum Water Temperatures (°C)**  
**and Air Temperatures (°C)**

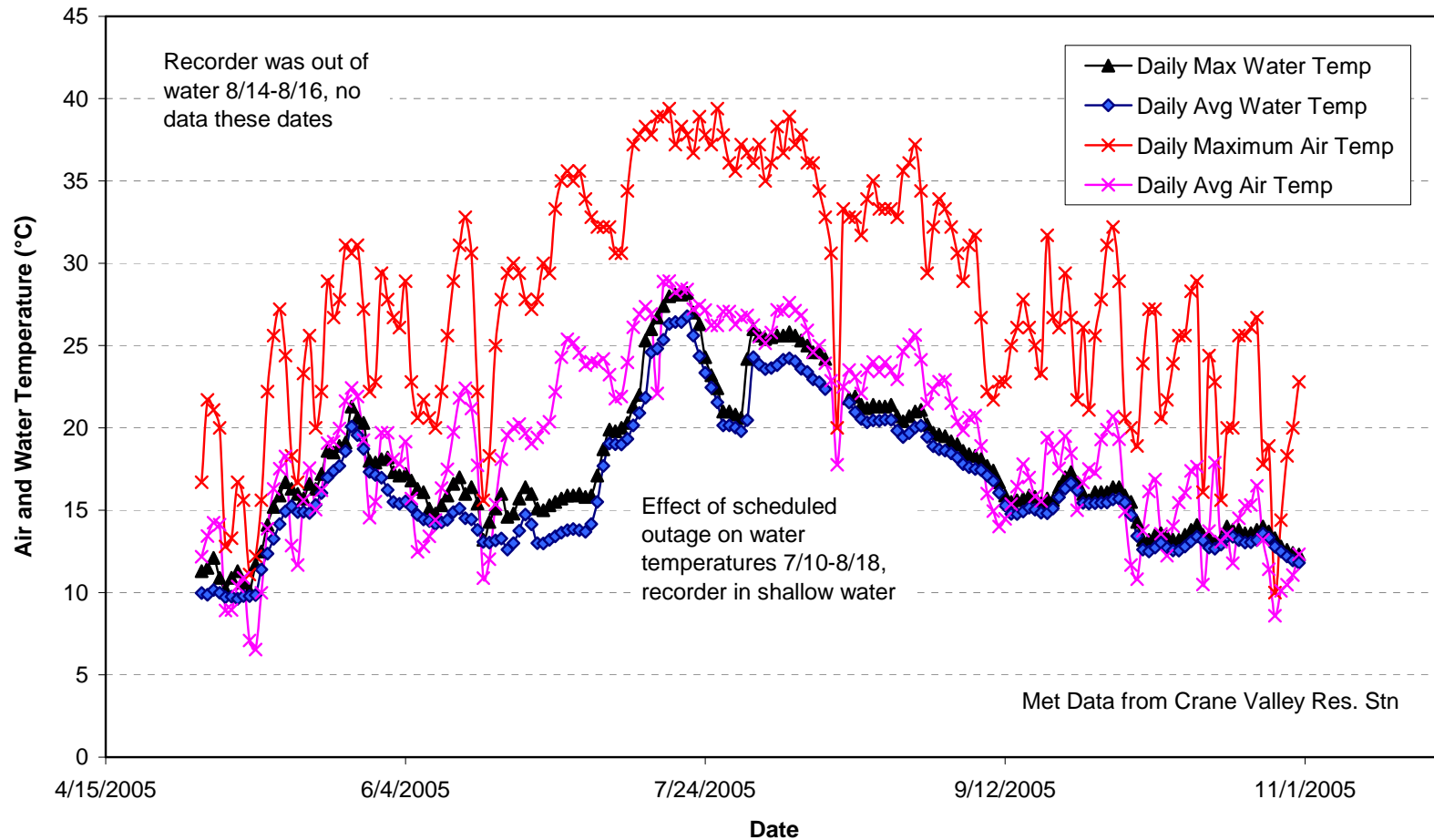




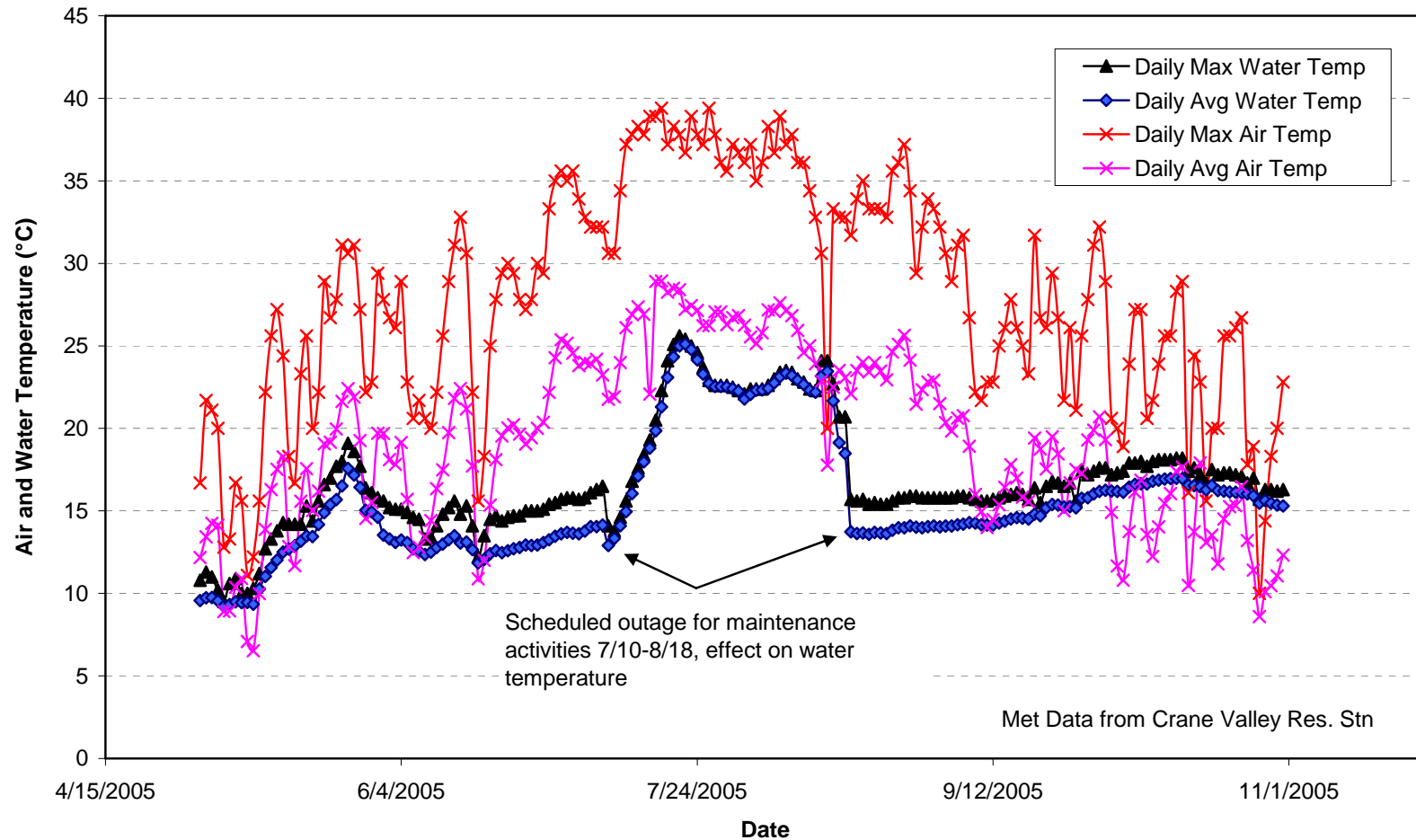
**Figure 3.2-17**  
**Station T2, NFWC River Mile 7.13 below Bass Lake**  
**Daily Average and Maximum Water Temperatures (°C)**  
**and Air Temperatures (°C)**



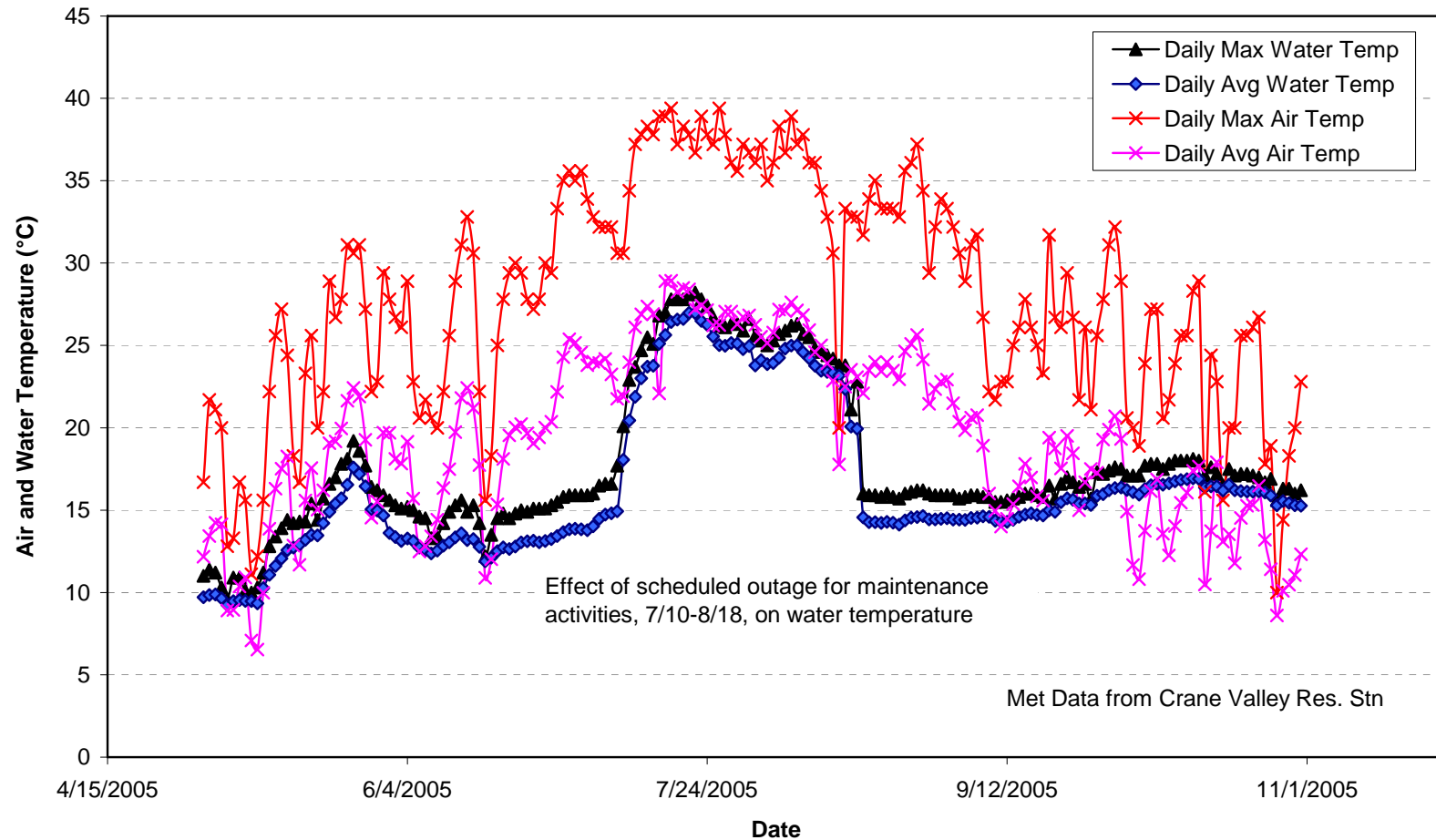
**Figure 3.2-18**  
**Station T3, NFWC River Mile 4.39, upstream of Manzanita Lake**  
**Daily Average and Maximum Water Temperatures (°C)**  
**and Air Temperatures (°C)**



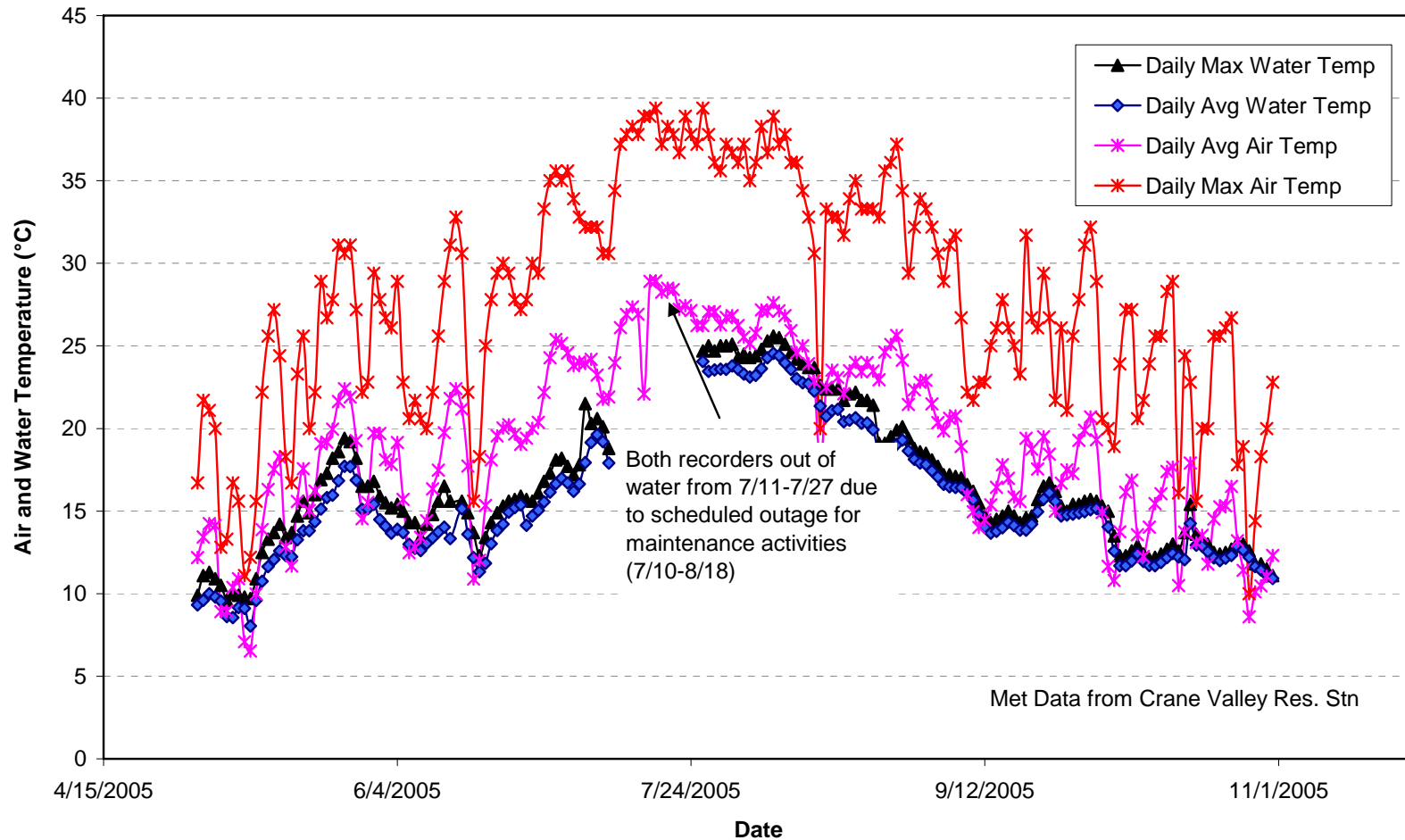
**Figure 3.2-19**  
**Station T4, Manzanita Lake at the Project Diversion**  
**Daily Average and Maximum Water Temperatures (°C)**  
**and Air Temperatures (°C)**



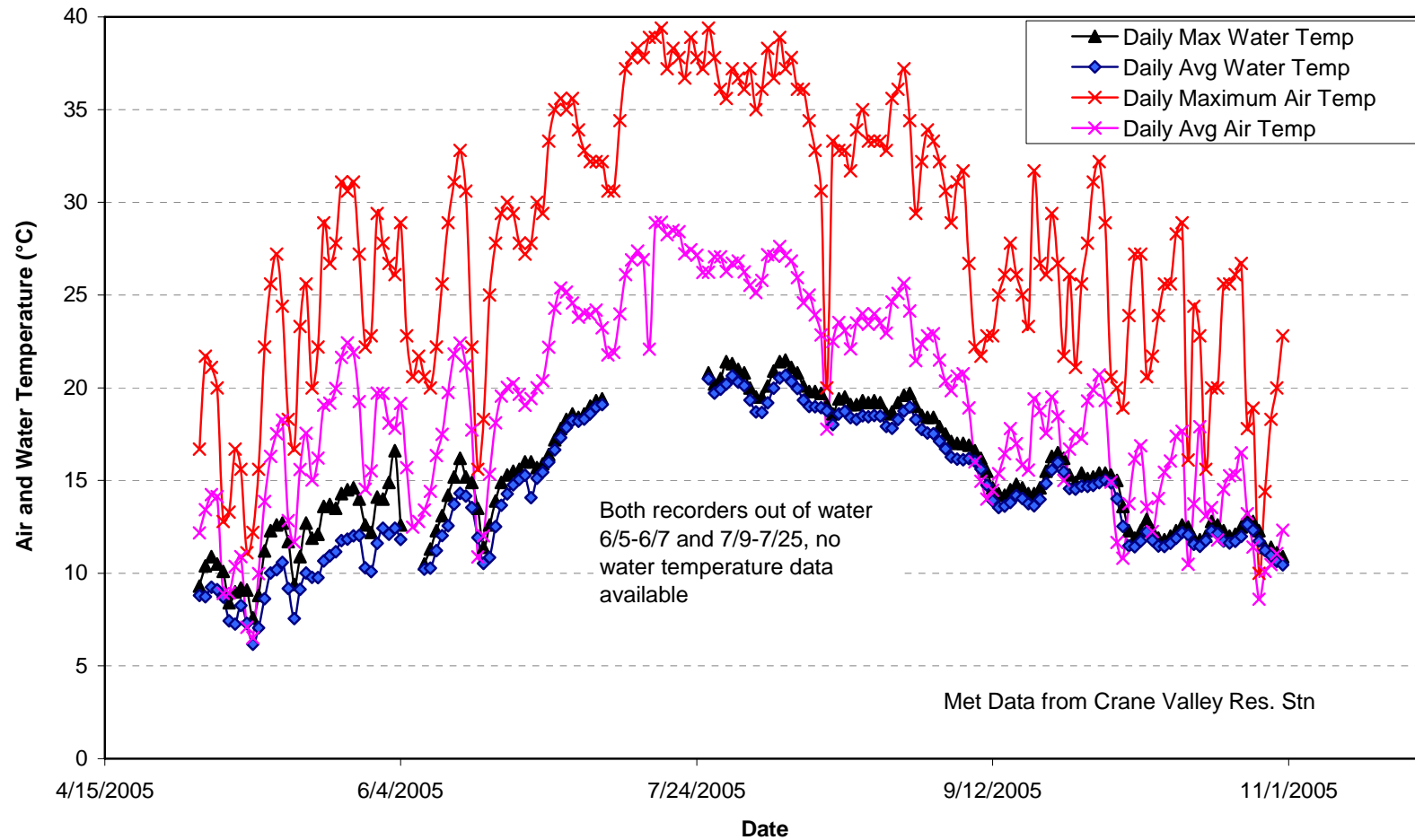
**Figure 3.2-20**  
**Station T5, NFWC River Mile 3.00, downstream of Manzanita Lake**  
**Daily Average and Maximum Water Temperatures (°C)**  
**and Air Temperatures (°C)**



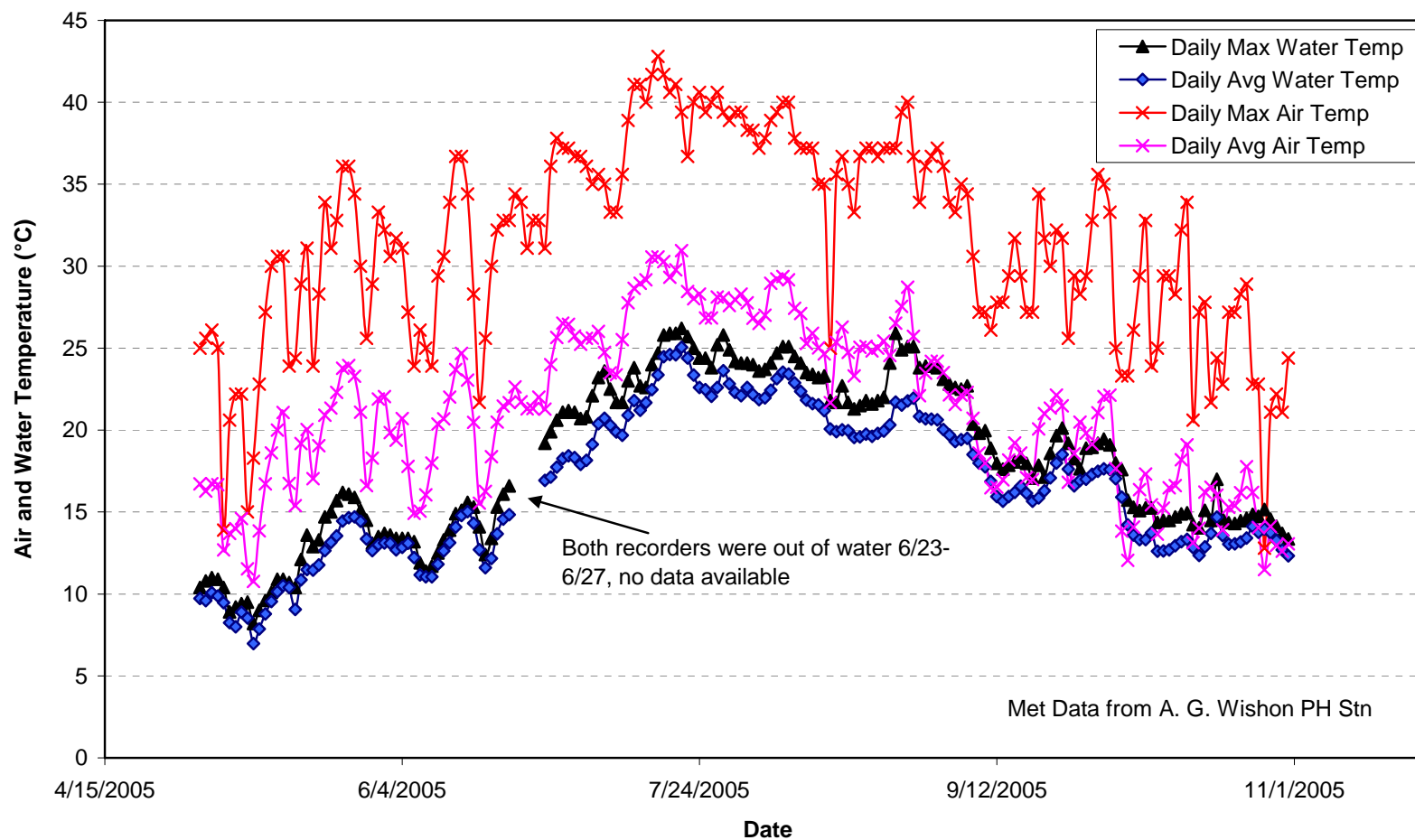
**Figure 3.2-21**  
**Station T6, NFWC River Mile 0.25, upstream of the NFWC Diversion Dam**  
**Daily Average and Maximum Water Temperatures (°C)**  
**and Air Temperatures (°C)**



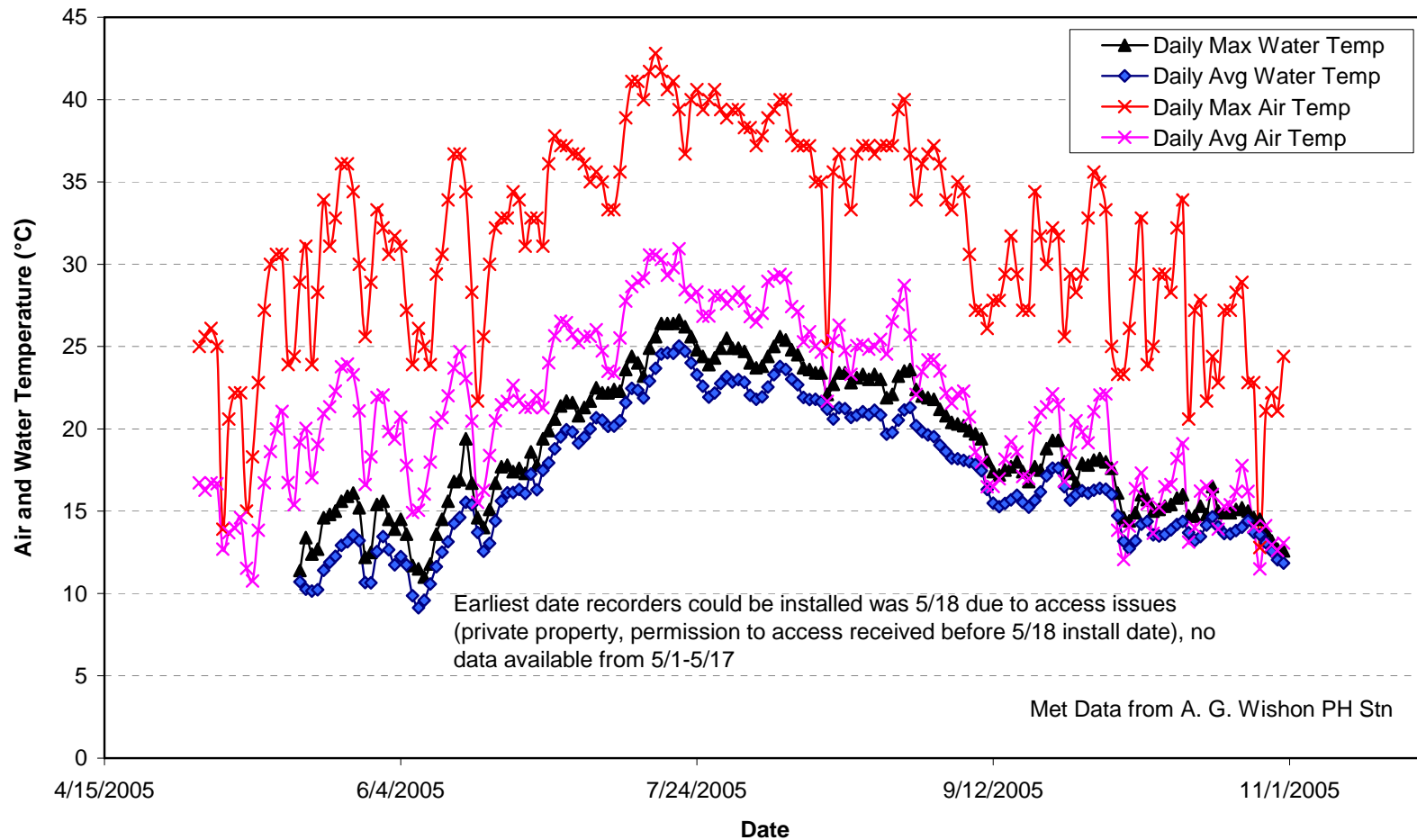
**Figure 3.2-22**  
**Station T9, SFWC River Mile 0.1, upstream of the SFWC Diversion Dam**  
**Daily Average and Maximum Water Temperatures (°C)**  
**and Air Temperatures (°C)**



**Figure 3.2-23**  
**Station T10, Willow Creek River Mile 4.3 (at Gage W-26)**  
**Daily Average and Maximum Water Temperatures (°C)**  
**and Air Temperature (°C)**

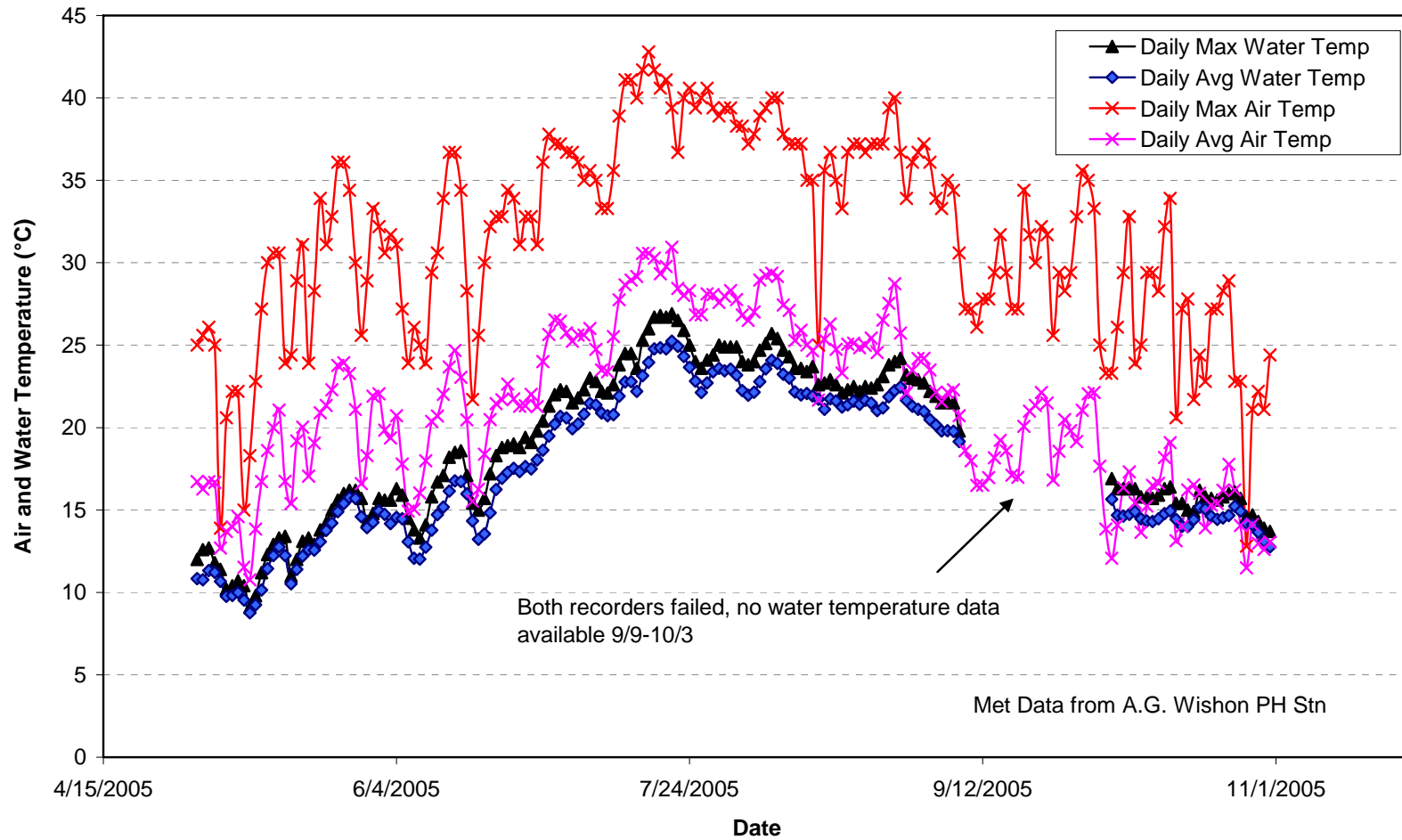


**Figure 3.2-24**  
**Station T11, Willow Creek River Mile 1.8 at the mouth of Whisky Creek**  
**Daily Average, and Maximum Water Temperatures (°C)**  
**and Air Temperatures (°C)**





**Figure 3.2-25**  
**Station T12, Willow Creek River Mile 0.37 at USGS Gage 2465**  
**Daily Average and Maximum Water Temperatures (°C)**  
**and Air Temperatures (°C)**



**Appendix A**  
**Temperature Data (CD)**

**Appendix B**  
**Stream Flow and Storage Data**

## **Appendix B1**

### **Stream Flow Discussion**

Stream flow data are presented here as part of the Crane Valley Federal Energy Regulatory Commission (FERC) Project No. 1354 (Project) Annual Water Temperature Monitoring Program Report for the 2005 water year. Stream flow was measured continuously at twenty-one (21) existing Pacific Gas and Electric Company (PG&E) maintained and two U.S. Geological (USGS) maintained gaging stations. Stream flow and storage data during May through October 2005 are presented in this appendix as supporting documentation for the water temperature monitoring program. All stream flow data are presented as cubic feet per second (cfs) and storage data are presented in units of thousand acre feet (TAF). Stream flow data will help to provide insight to understand affects of flows on stream water temperatures in the Project area.

A complete list of the stream flow monitoring stations is listed below.

- North Fork Willow Creek near Sugar Pine (W24), (USGS maintained gage station)
- Browns Creek Diversion Dam Spill (W22)
- Browns Creek Canal at Bass Lake (W1)
- Bass Lake Storage (W2)
- Crane Valley Powerhouse (W19)
- North Fork Willow Creek near Bass Lake (W3)
- Conduit #3 Near Bass Lake (W4)
- San Joaquin #3 Powerhouse (W6)
- Manzanita Lake Spill (W8)
- #2 Conduit (W9)
- North Fork Willow Creek near Bass Lake – Total Flow (WC3)
- San Joaquin Powerhouse #2 (W11)
- South Fork Willow Creek Canal above North Fork Willow Creek (W12)
- Spill over North Fork Diversion Dam (W15)
- Spill over South Fork Diversion Dam (W13)
- Willow Creek Diversion to #1 Conduit (W14)
- #1 Conduit Spillway at San Joaquin #2 Powerhouse (W27)
- Willow Creek below Confluence of North and South Forks (W26)
- Willow Creek at Mouth (USGS-Southern California Edison maintained gage 2465)
- #1 Conduit below Bass Lake (W25)
- San Joaquin #1A Powerhouse (W16) [flow here was zero cfs during entire monitoring program]
- Corrine Lake Storage (W17)
- A. G. Wishon Powerhouse (W18)

A scheduled outage from July 10 through August 18 affected the stream flows measured at a number of stations during the 2005 water temperature monitoring program. Stream flows were zero cfs during the outage at the powerhouse and conduit stream flow stations (W11, W18, W19, W25, W4, W6, and W9). Figures of daily average stream flow and daily average storage are included in Appendix B2.

Stream flow was zero cfs at times in the Browns Creek Canal at Bass Lake (W1), which is a seasonal ditch that is dependent on natural flows. There typically is not a lot of flow in the canal in September and October (per communication with PG&E employee, Paul Linderman). The South Fork Willow Creek (SFWC) Canal above North Fork Willow Creek (NFWC) (station W12) is partially dependent on flow coming from the Browns Creek Canal (W1).

Spill flows were zero cfs on or around June 20 for spill over the South Fork Diversion Dam (W13), spill over the North Fork Diversion Dam (W15), spill over Browns Creek Diversion Dam (W22), and Manzanita Lake spill (W8). Subsequently measured flows were zero cfs at the Willow Creek Diversion to the #1 Conduit in August and September due to zero spill flow and little flow supplied from Browns Creek Canal.

Measured stream flows coming from the NFWC near Sugar Pine (W24) were highest in the spring (May and early June) and decreased steadily through the summer months. This gage station is a USGS maintained stream flow station and data were provided by the Madera Irrigation District (MID).

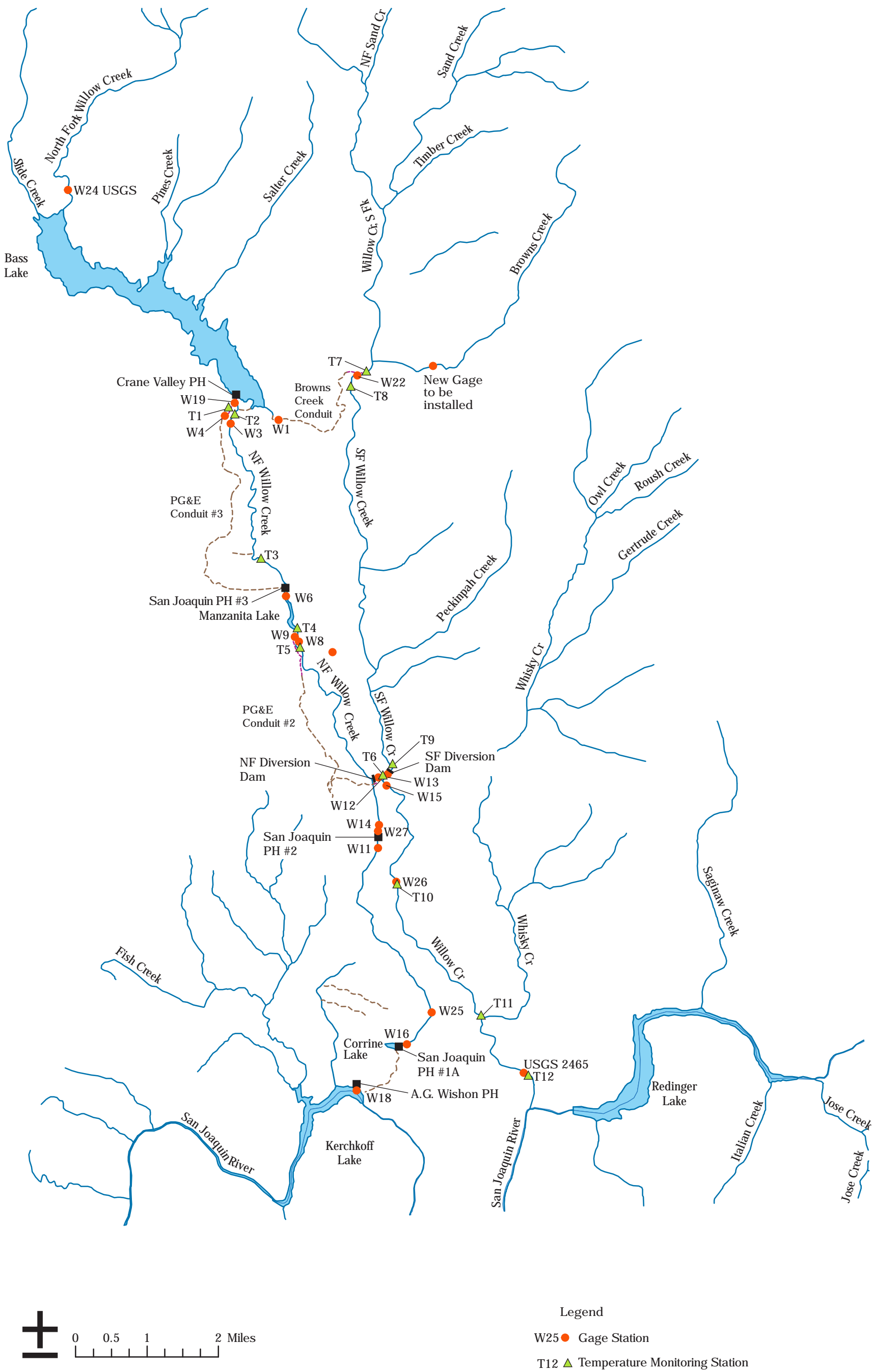
Measured stream flows in Willow Creek below the confluence of the North and South Forks at PG&E gage W26 were highest (between 600 and 700 cfs) in the spring (May) and decreased through June. The minimum stream flow release of 0.5 cfs or greater was achieved in all months of the monitoring program at gage W26. Some maintenance work was conducted during July 11 through July 27, 2005 at this gage site (new gate at ditch 1 sand trap).

Stream flows in the NFWC near Bass Lake at station W3 were highest in the spring (May) with a maximum flow of approximately 425 cfs. Stream flows ranged from approximately 4 cfs on August 16 down to 2 cfs during October.

Storage in Corrine Lake (W17) was around 0.04 TAF during May through June. A drawdown from July 10 to August 9 may be related to the scheduled outage. Storage in Corrine Lake averaged around 0.05 TAF for the remainder of the monitoring program. Storage in Bass Lake (W2) was around 45 TAF in June, July, and early August. Drawdown of the lake started in mid-August and storage levels were around 28 TAF by the end of October.

## **Appendix B2**

### **Crane Valley Project Water Temperature and Stream Flow Gage Station Locations**



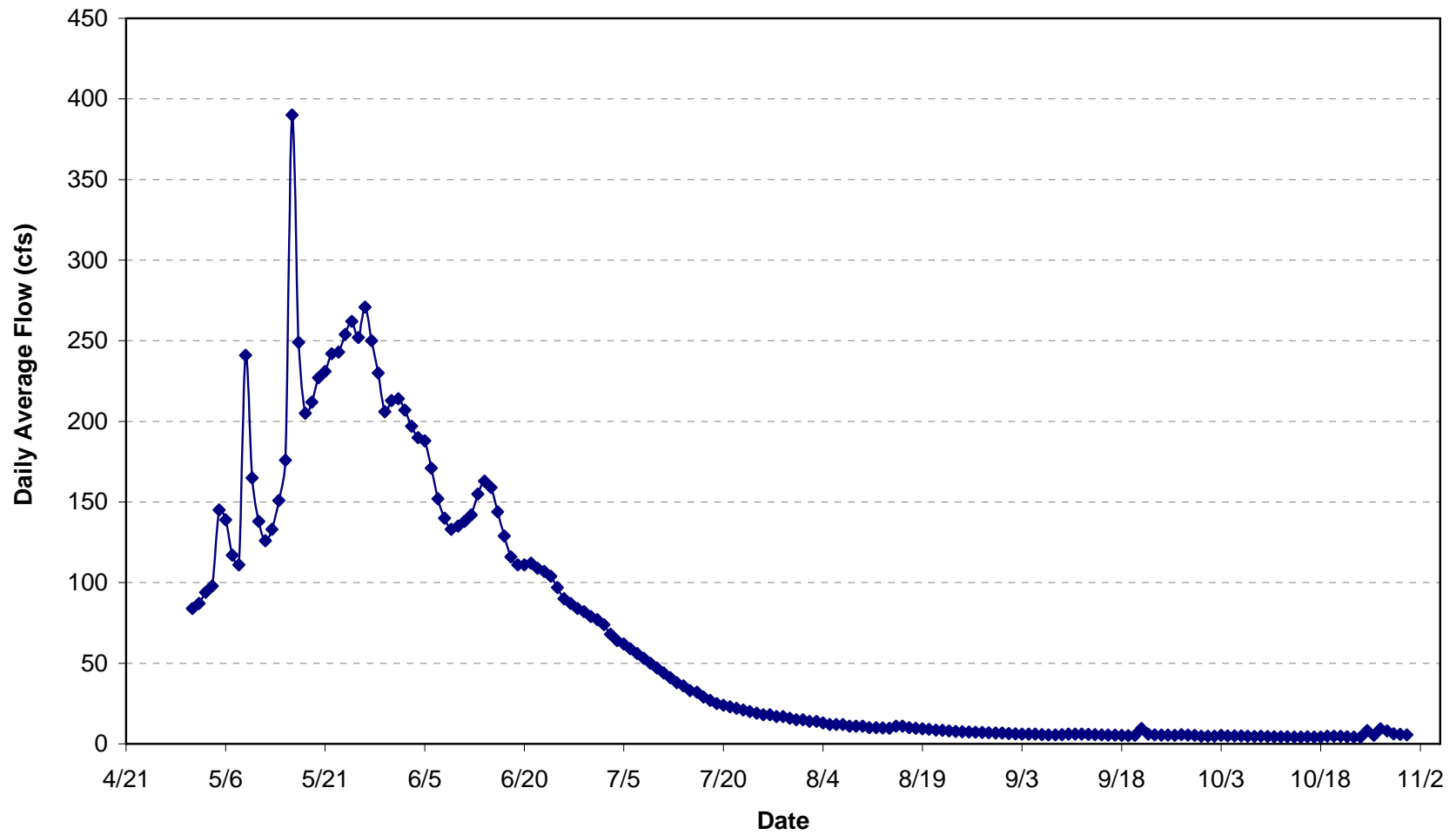
Crane Valley Project Water Temperature and Stream Flow Gage Station Locations



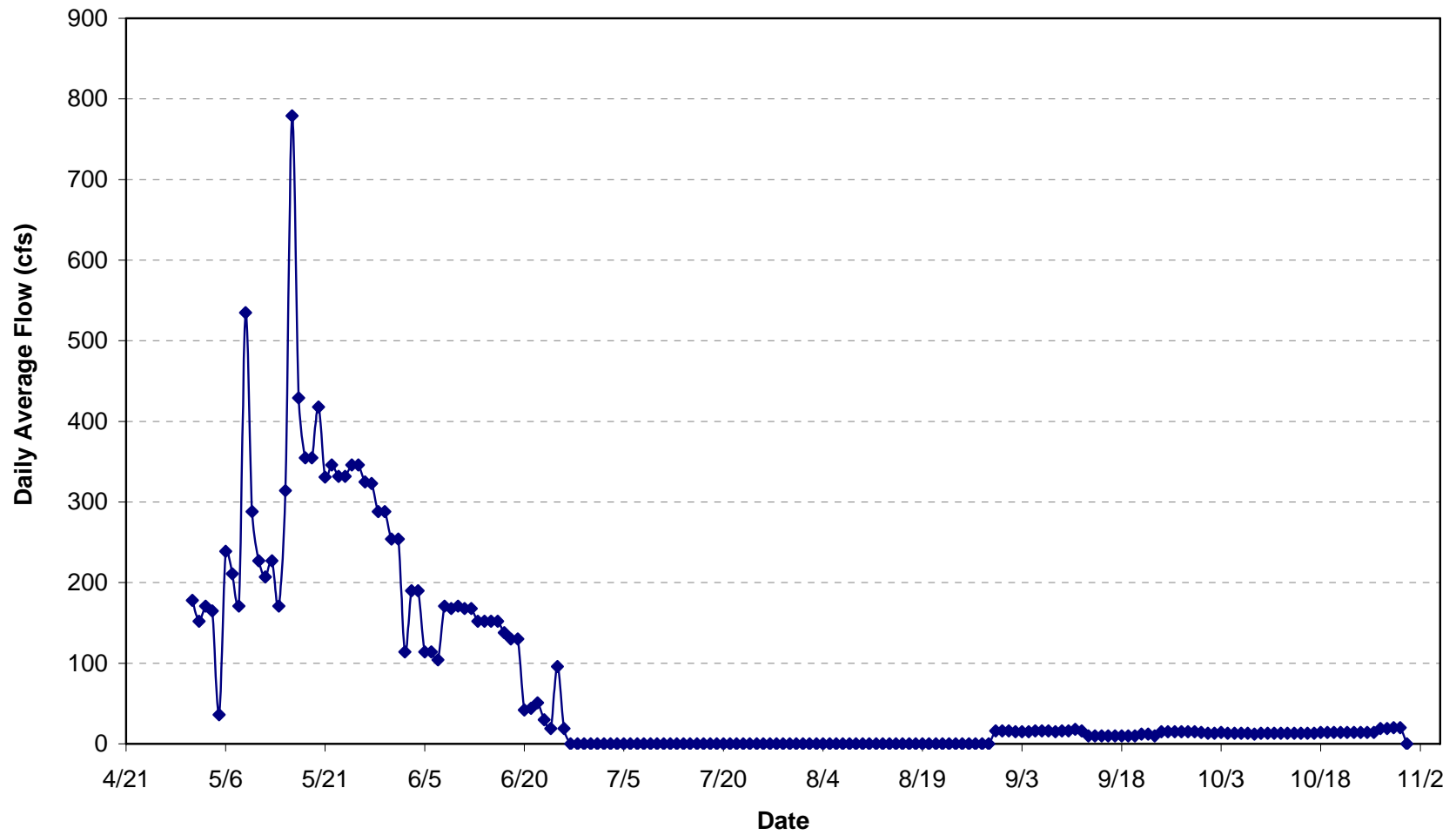
## **Appendix B3**

### **Stream Flow Data Plots**

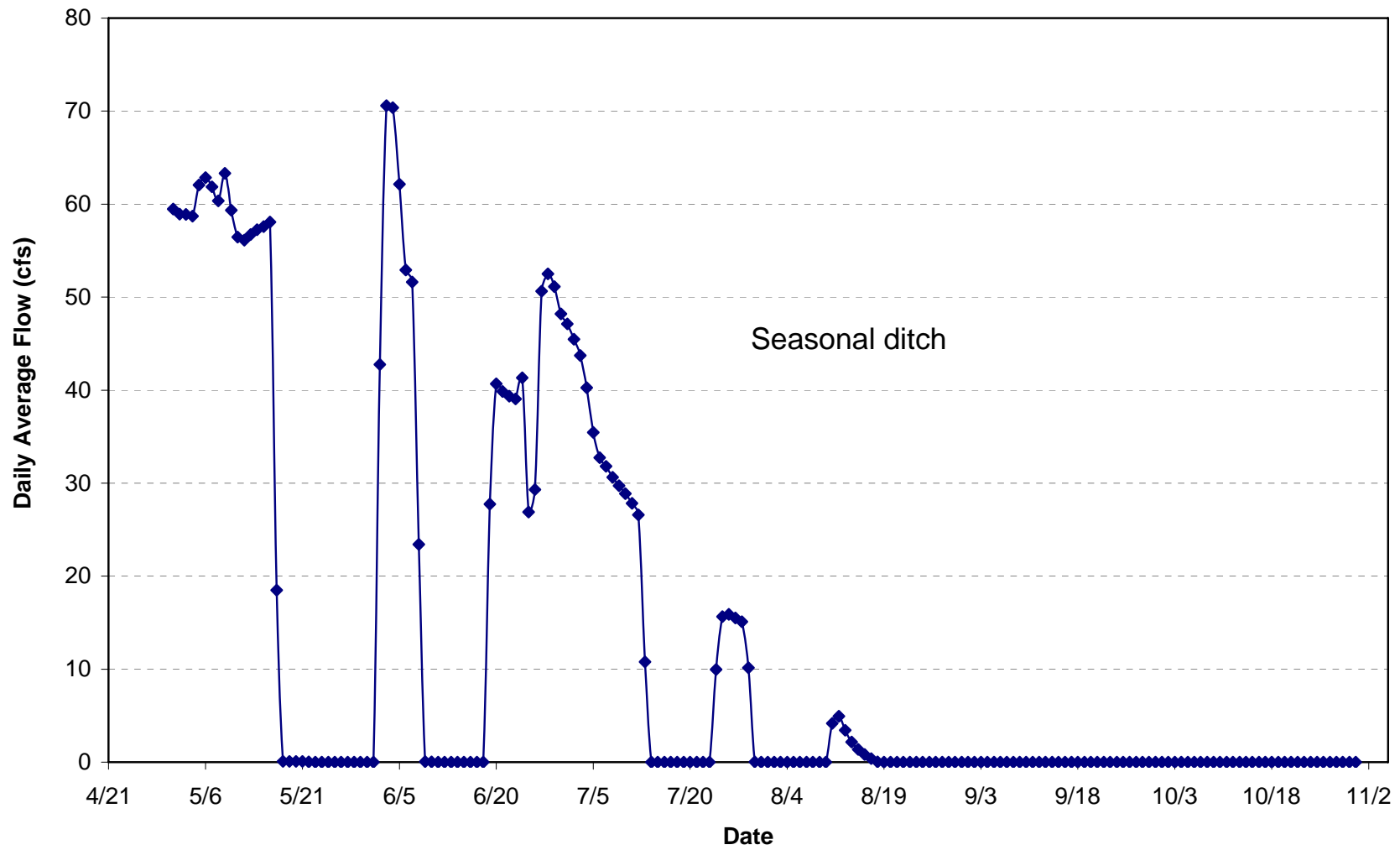
**W24**  
**North Fork Willow Creek near Sugar Pine**



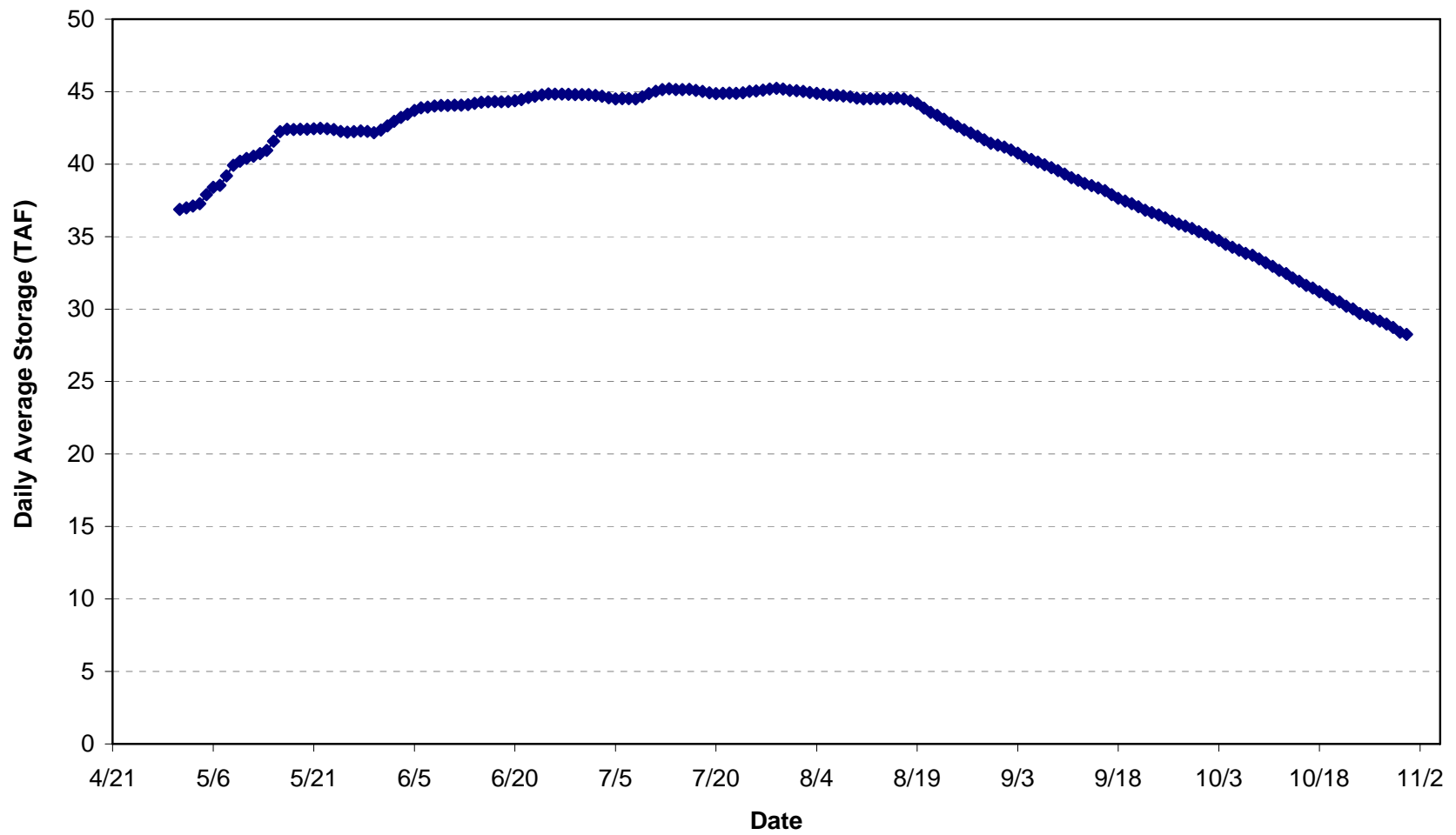
# W22 Browns Creek Diversion Dam Spill



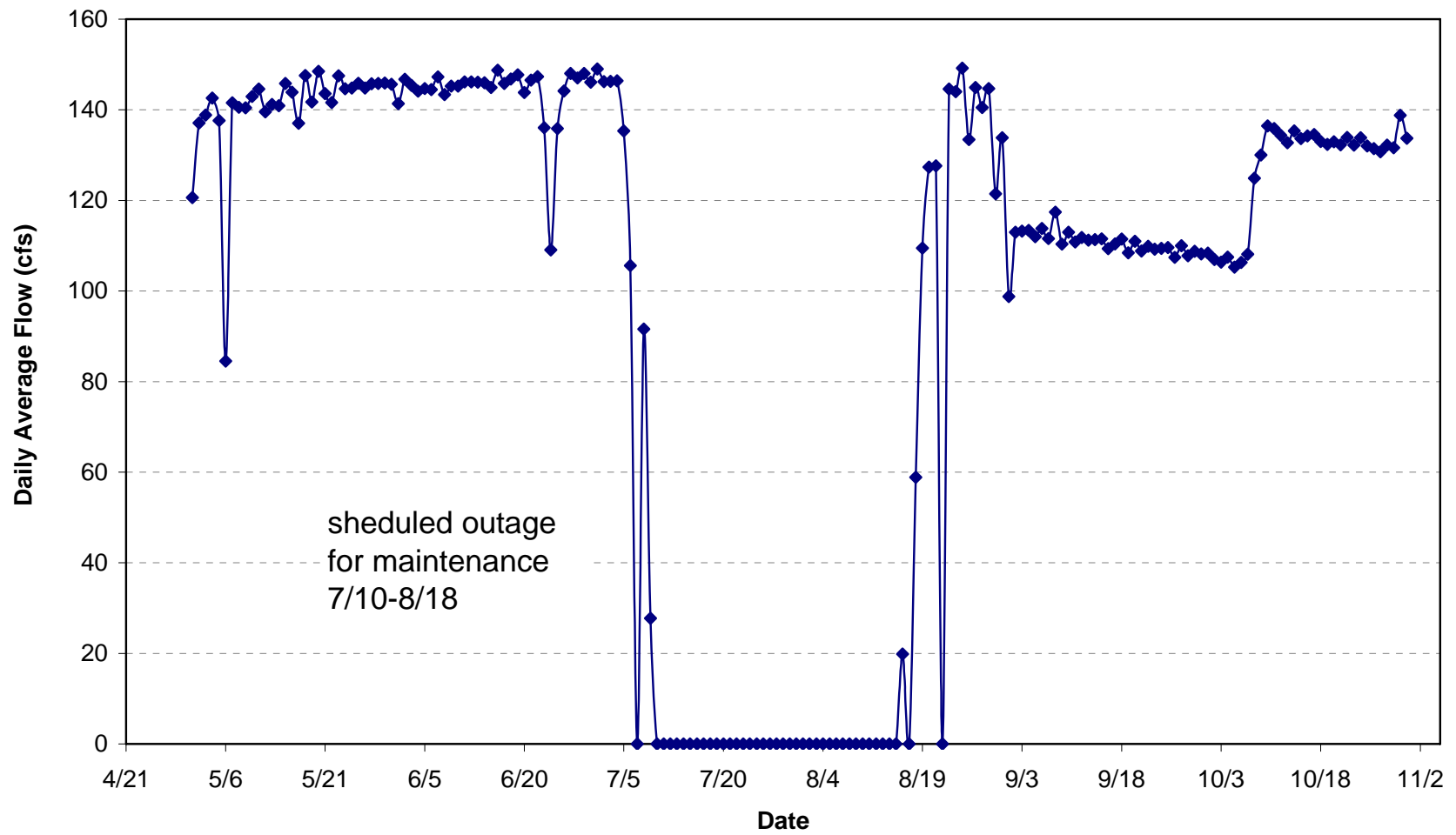
W1  
Browns Creek Canal at Bass Lake



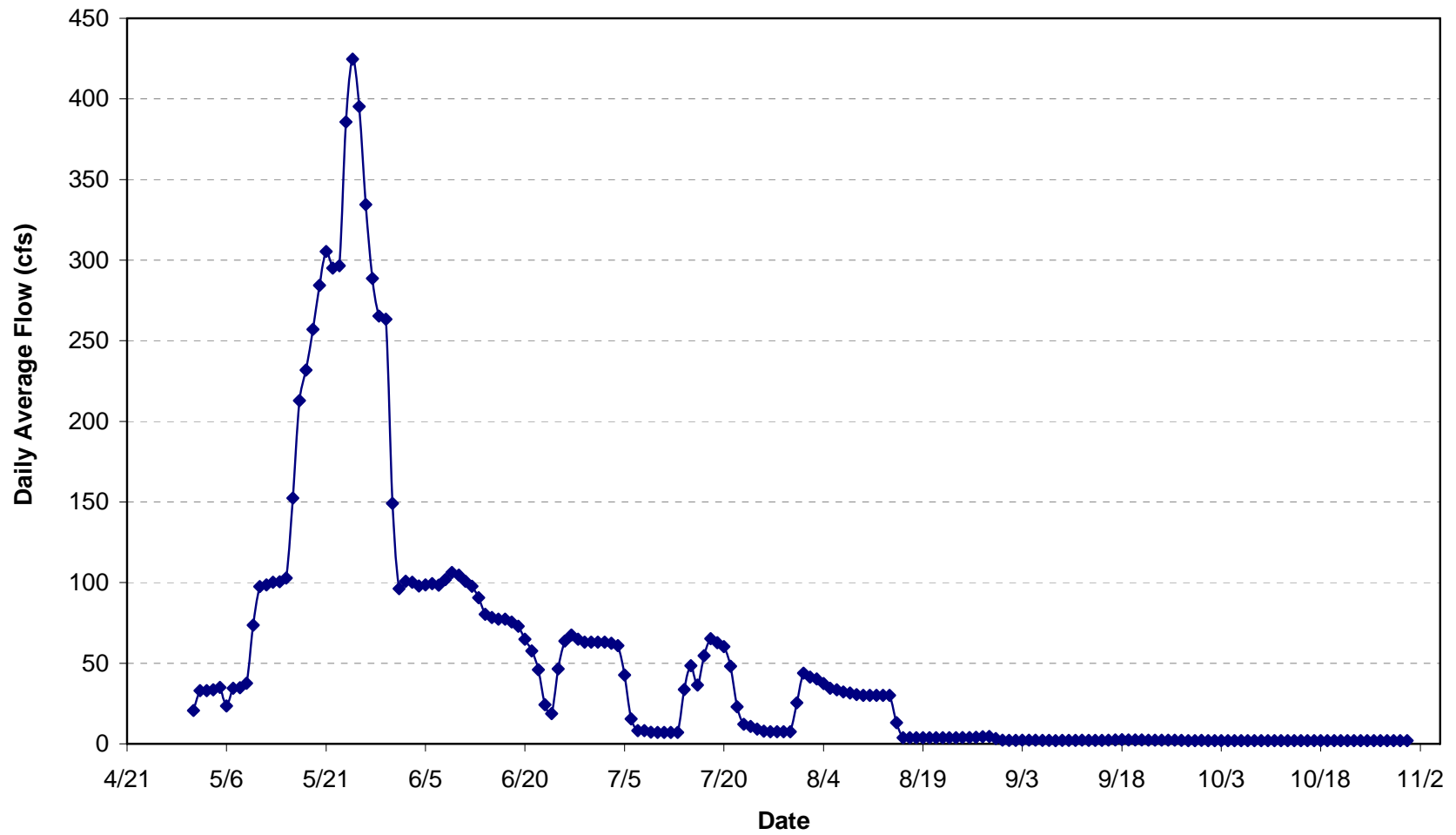
## W2 Bass Lake Storage



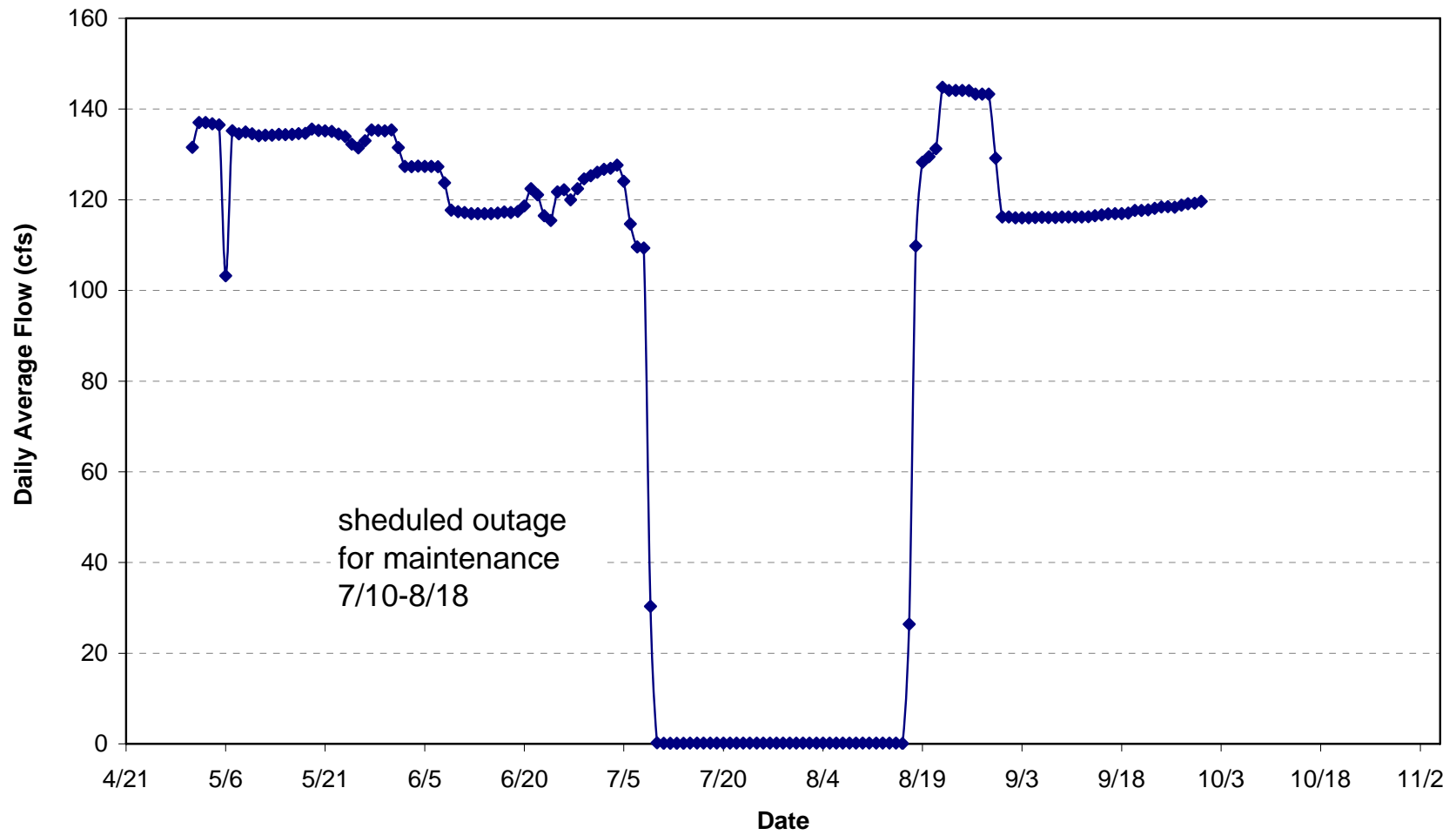
# W19 Crane Valley Powerhouse



**W3**  
**North Fork of Willow Creek near Bass Lake**

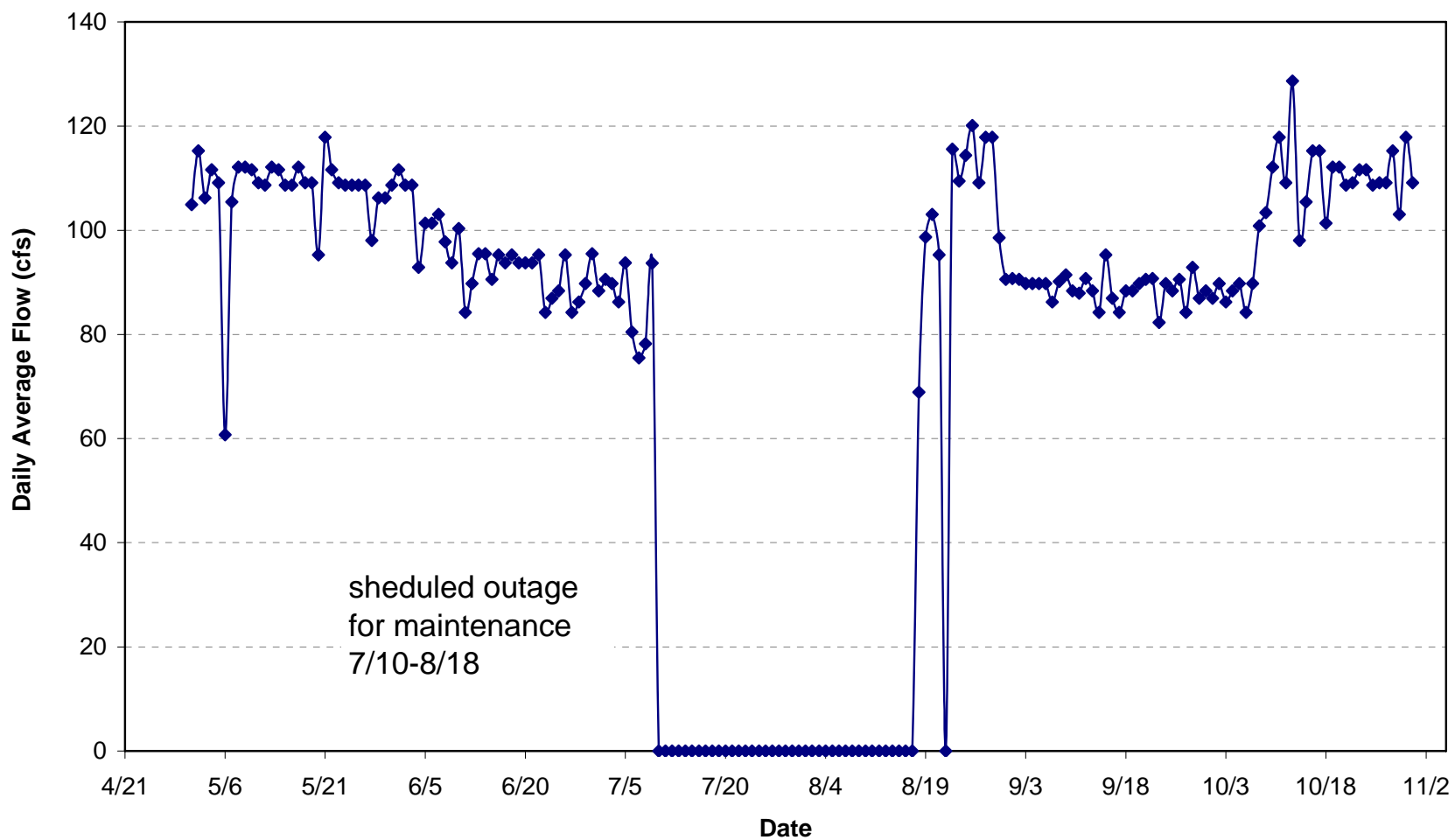


# W4 Conduit #3 Near Bass Lake

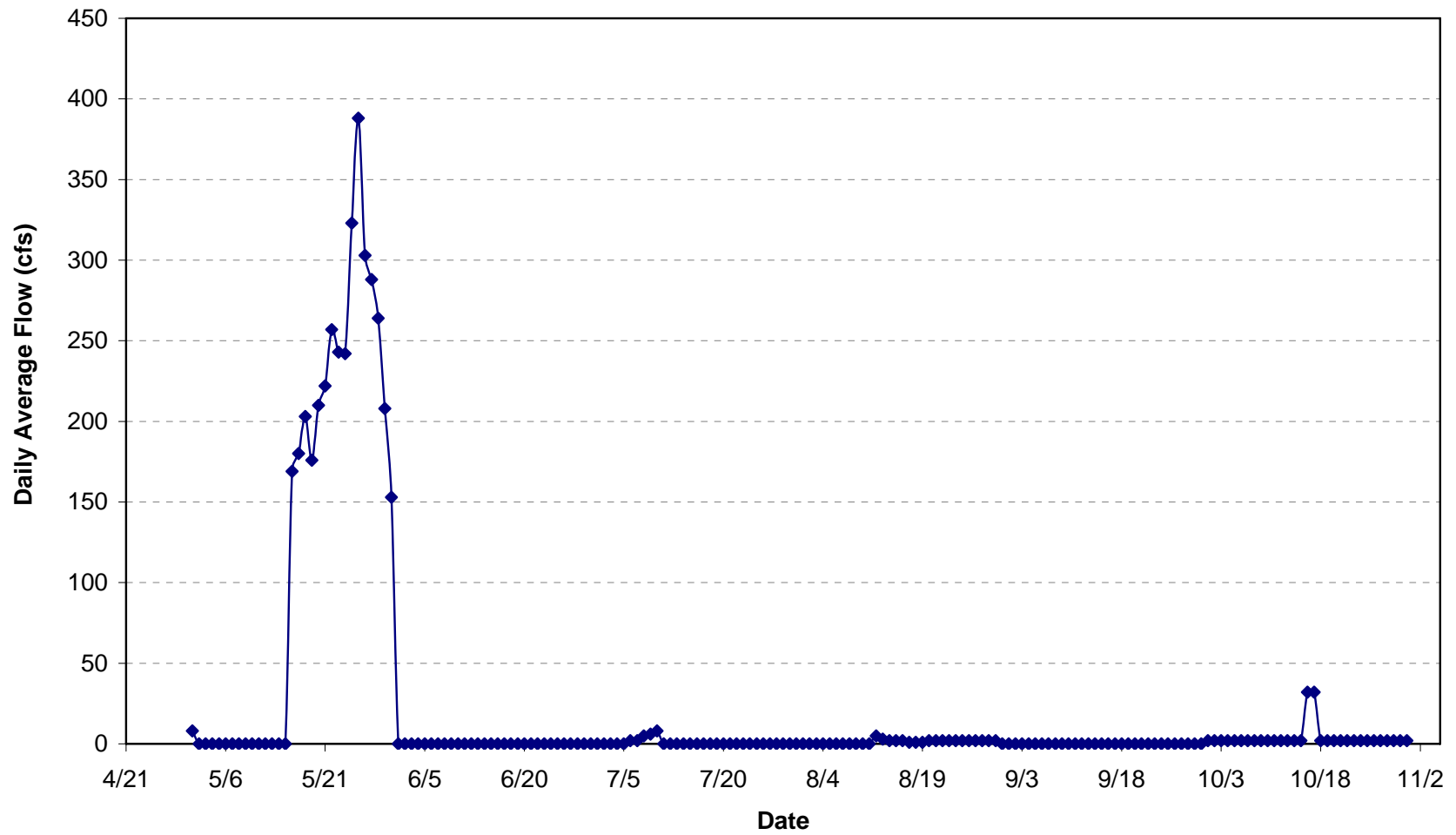




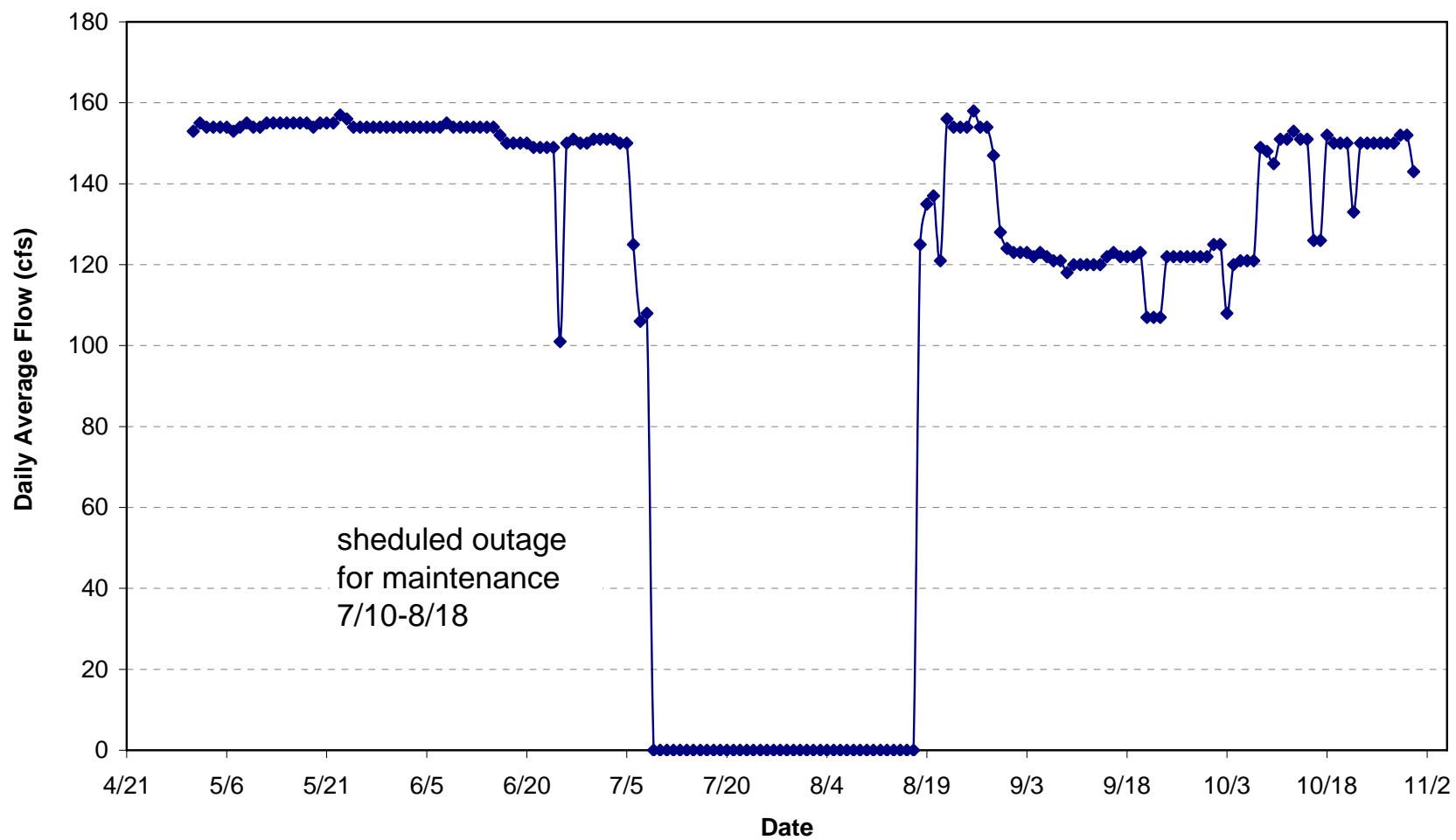
# W6 San Joaquin #3 Powerhouse



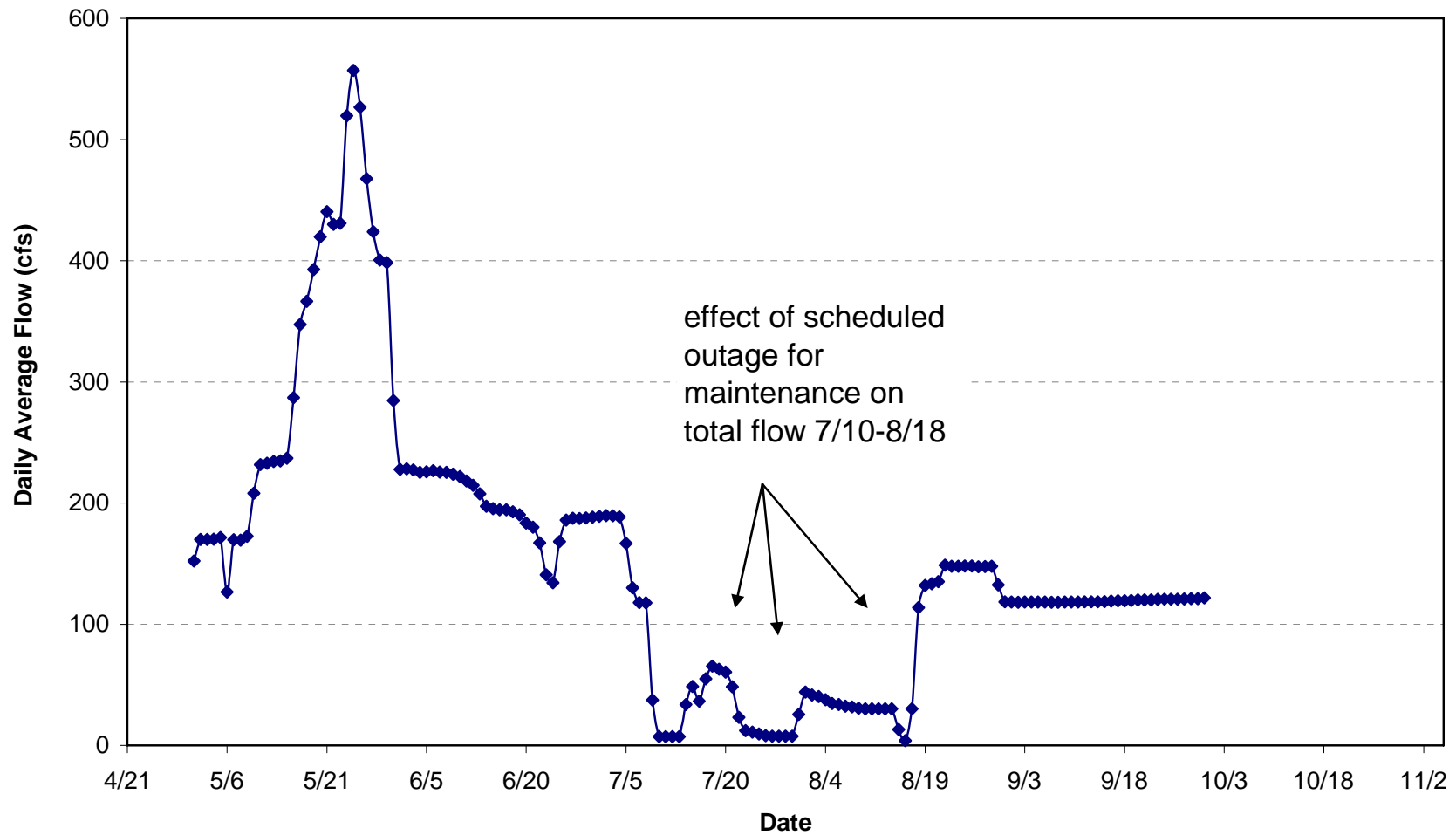
# W8 Manzanita Lake Spill



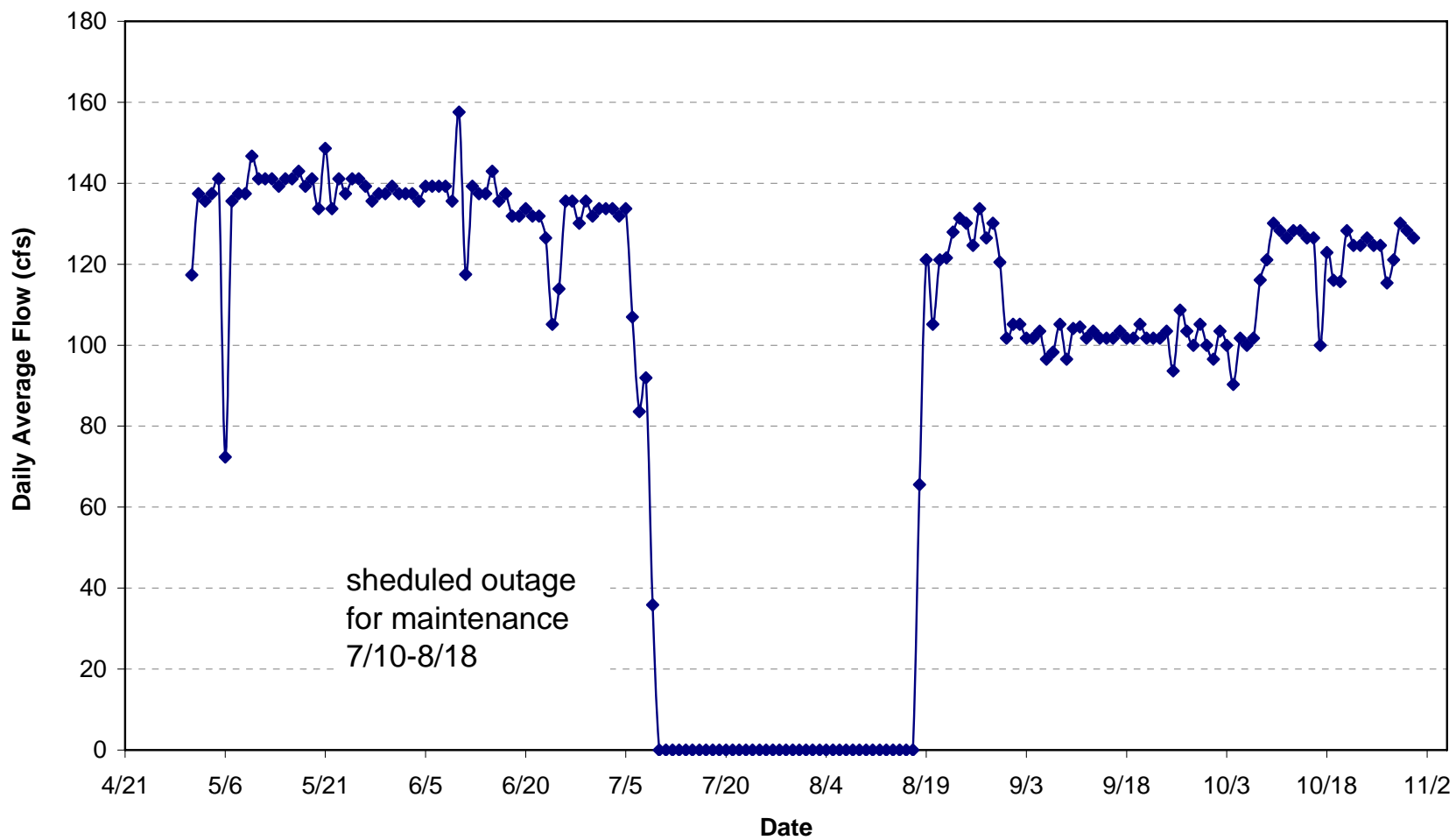
# W9 #2 Conduit



**WC3**  
**North Fork Willow Creek near Bass Lake (Total Flow)**

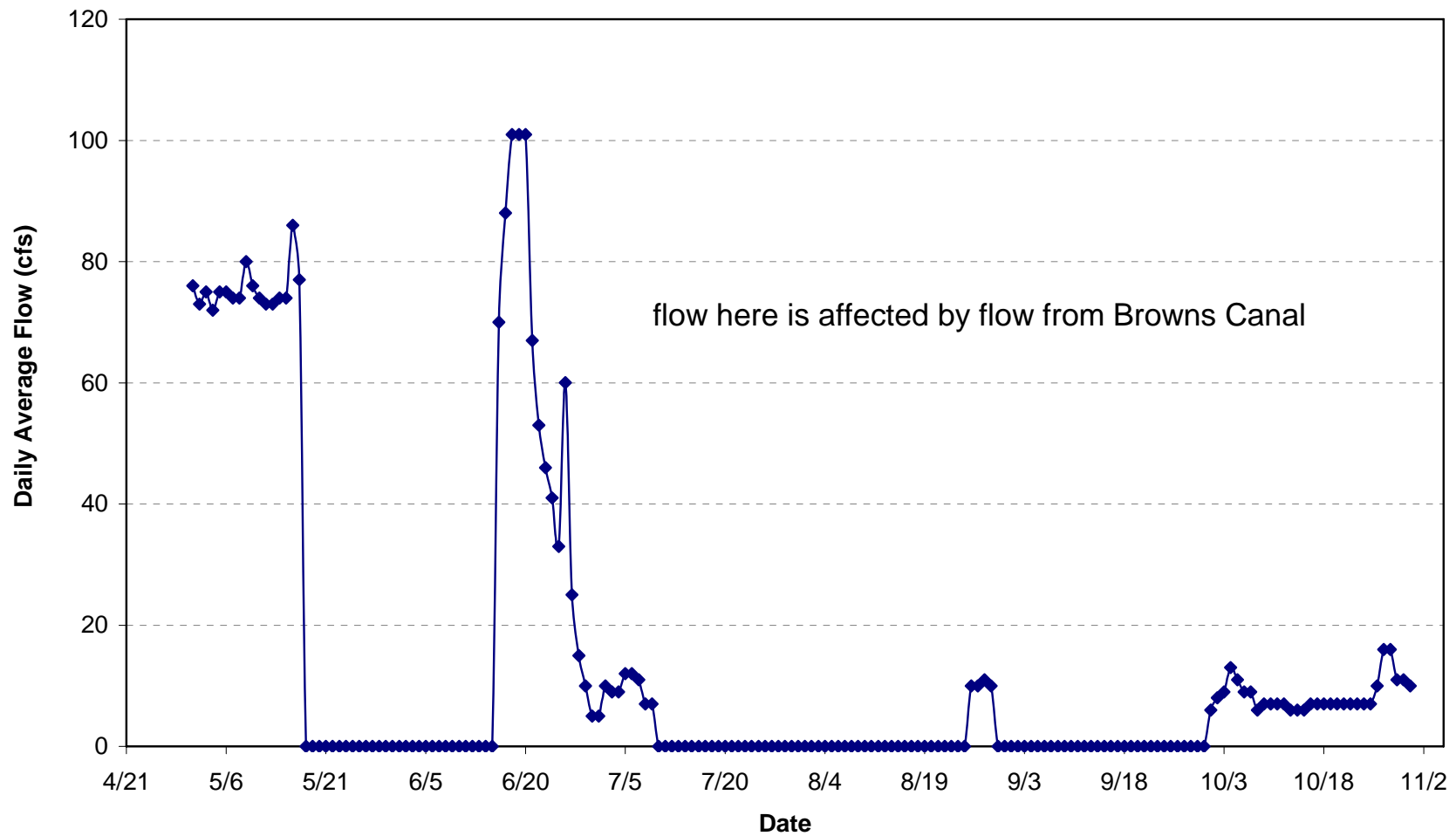


# W11 San Joaquin Powerhouse #2

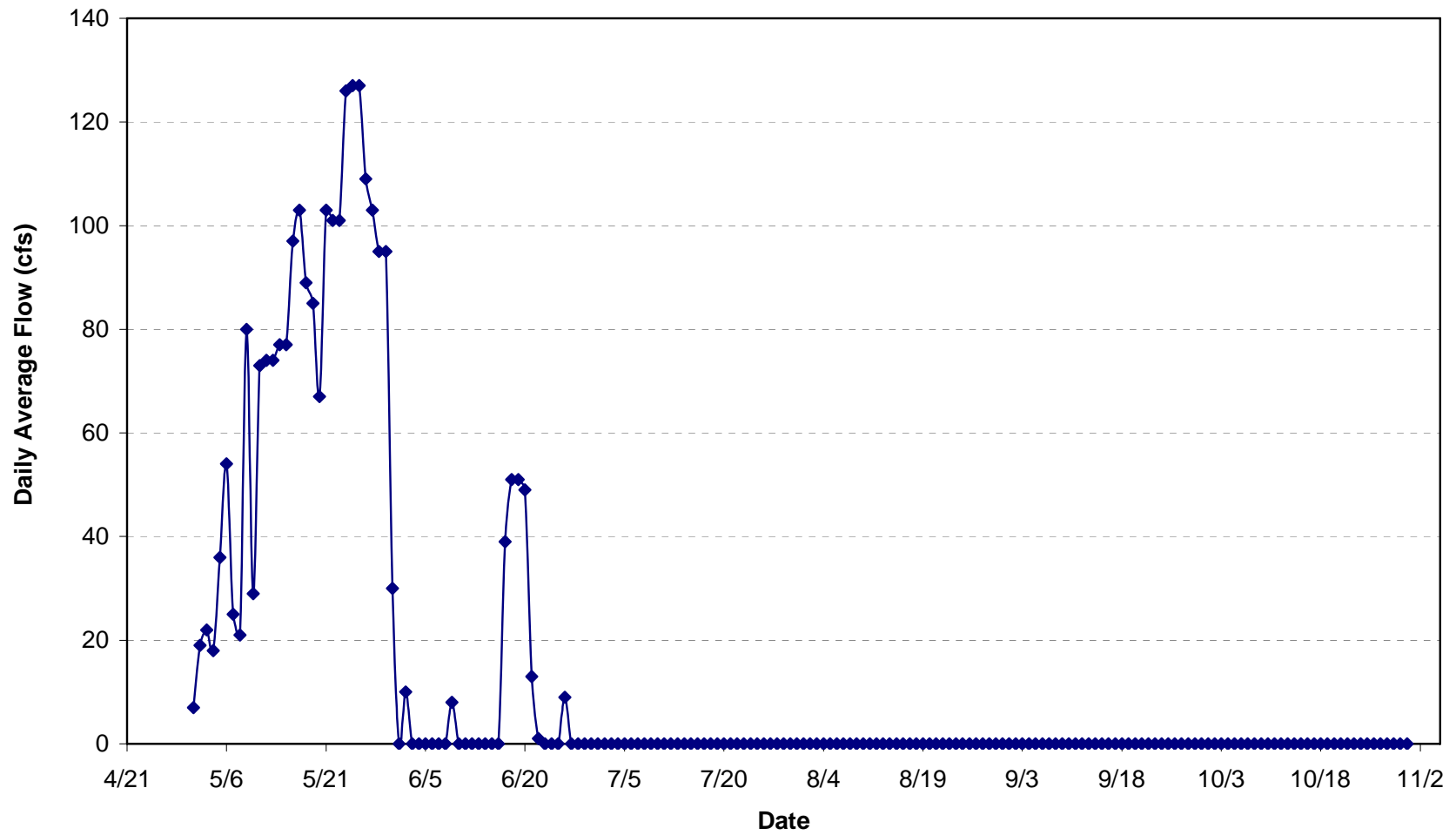


# W12

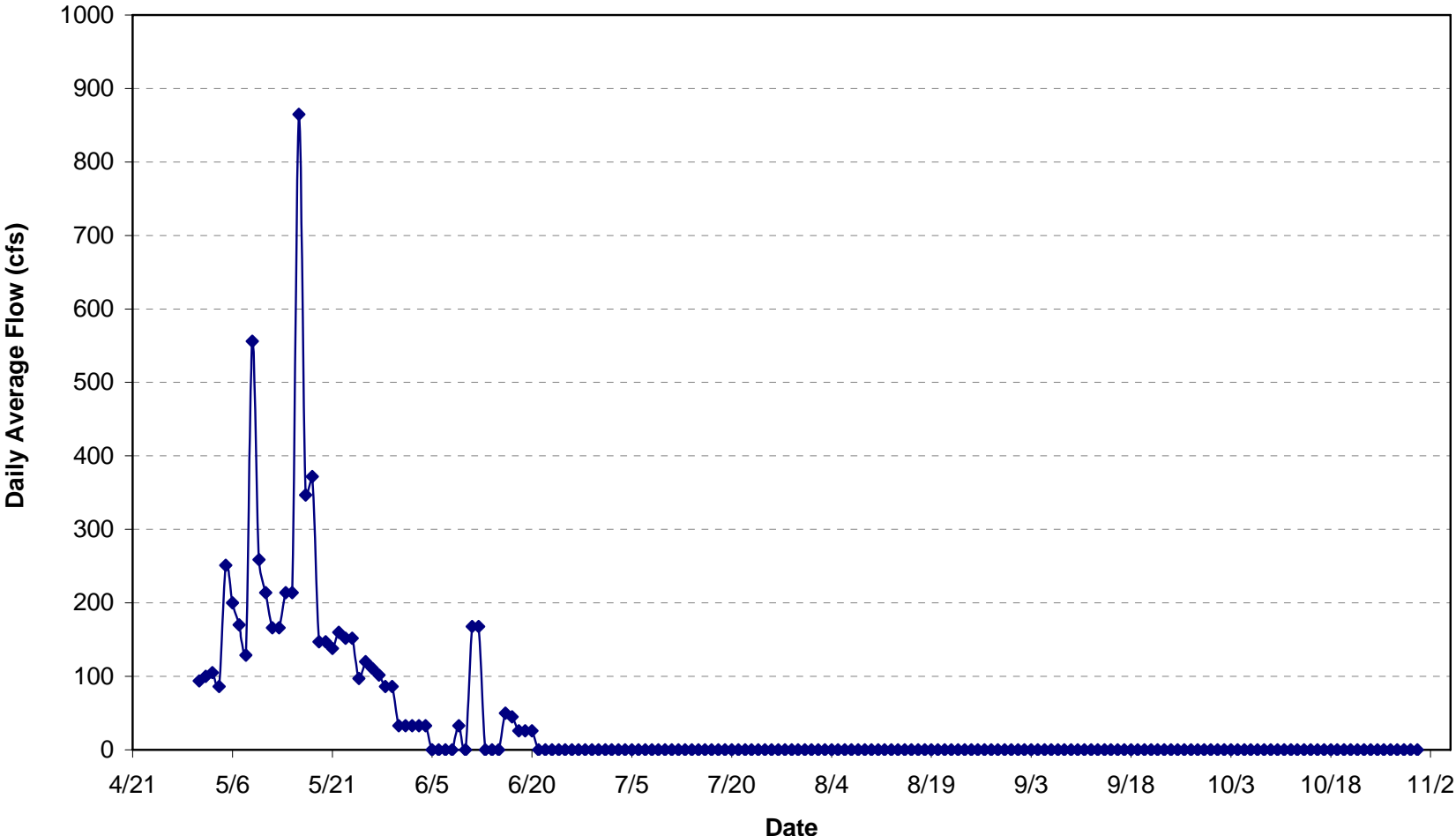
## South Fork Willow Creek Canal above North Fork Willow Creek



# W15 Spill over North Fork Diversion Dam

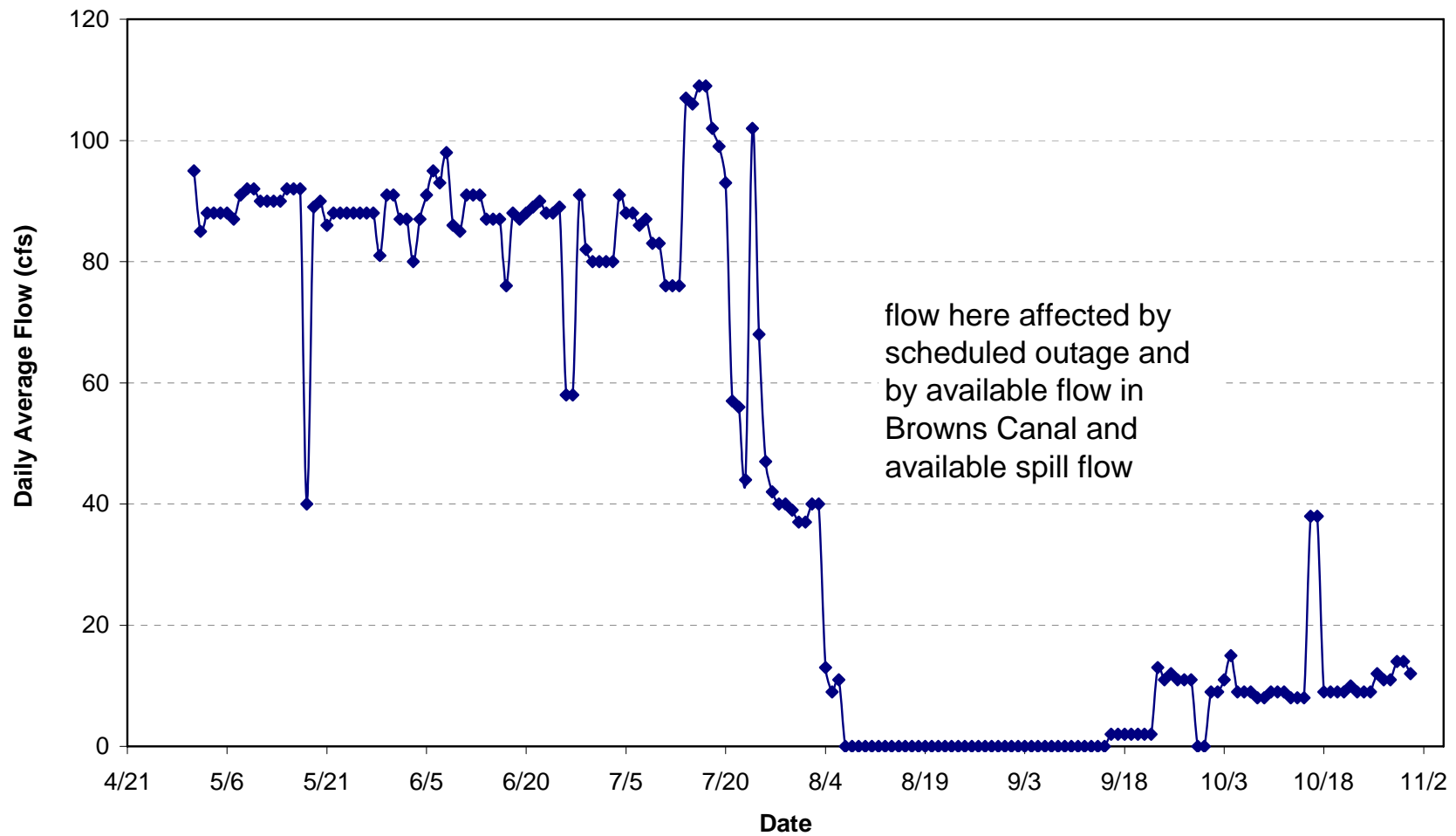


W13  
Spill over South Fork Diversion Dam

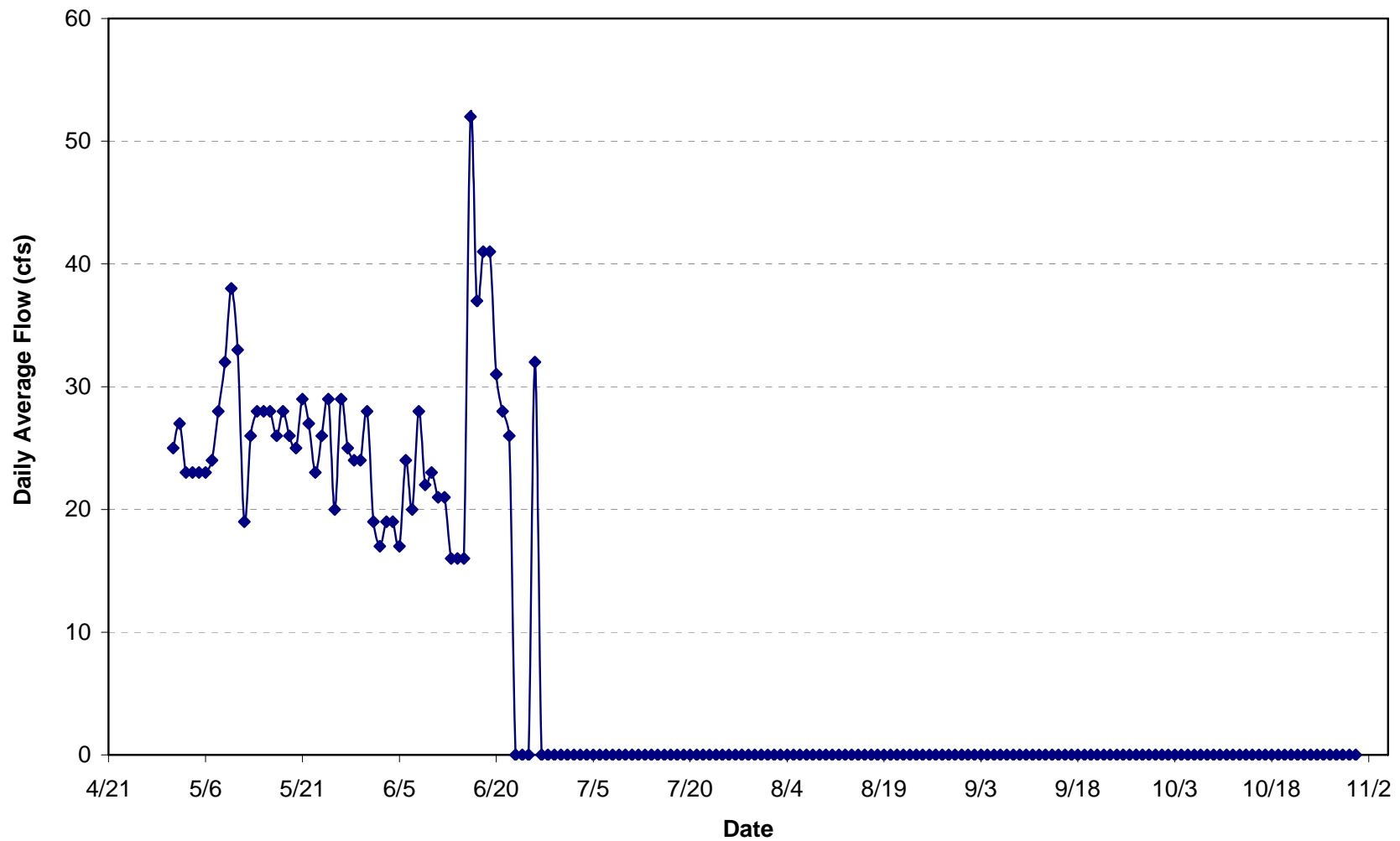




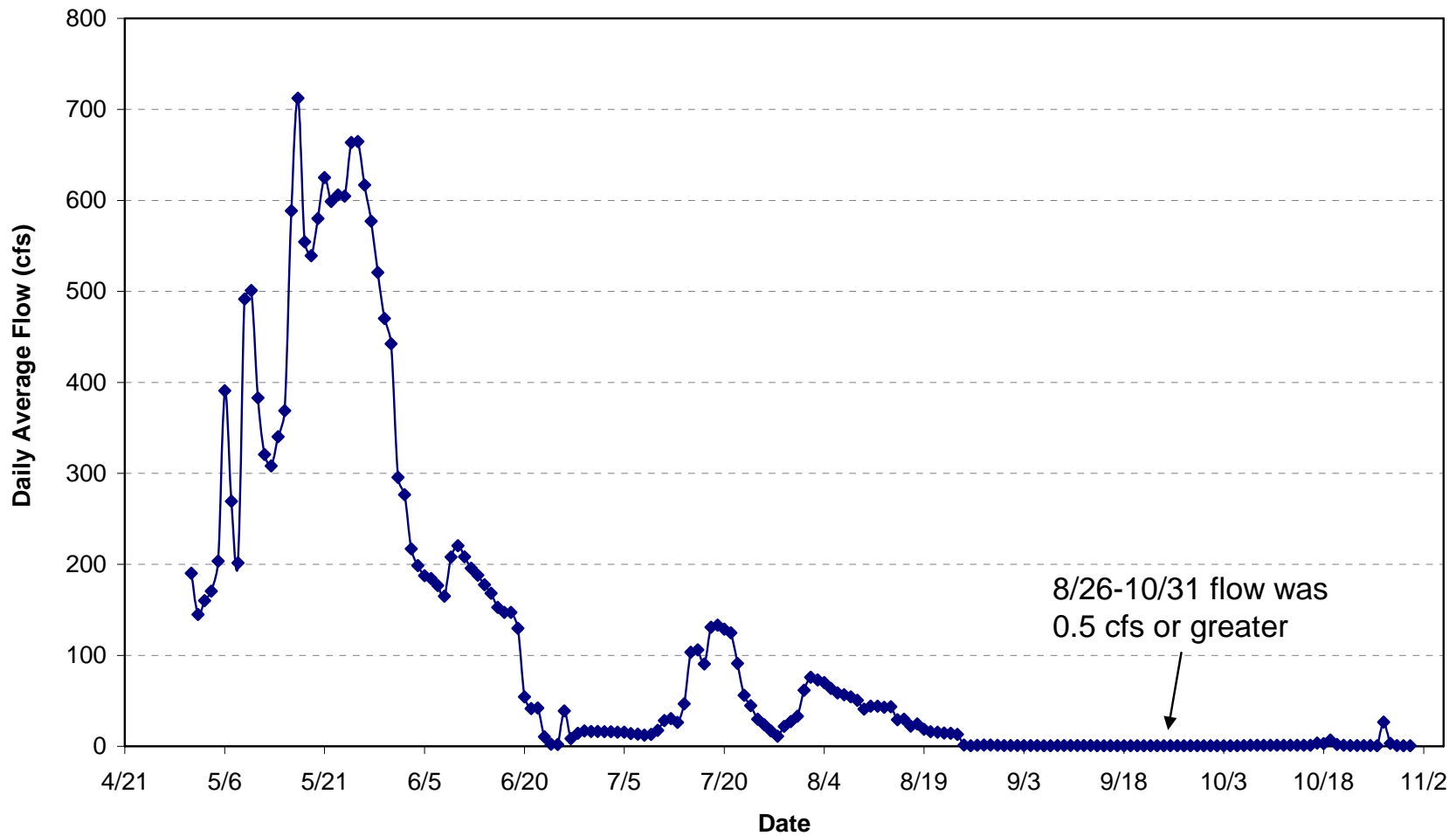
# W14 Willow Creek Diversion to #1 Conduit



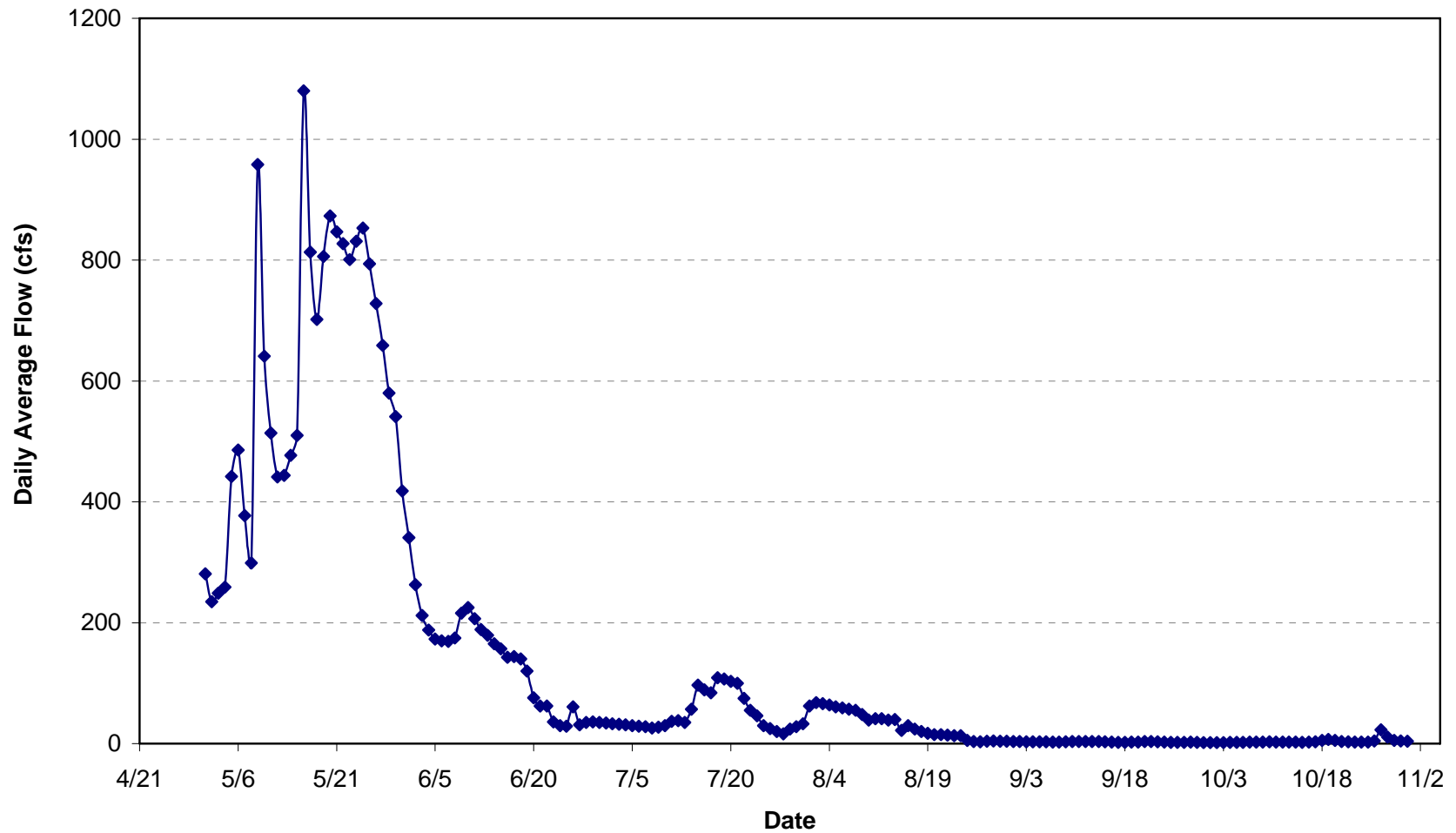
**W27**  
**#1 Conduit Spillway at San Joaquin #2 Powerhouse**



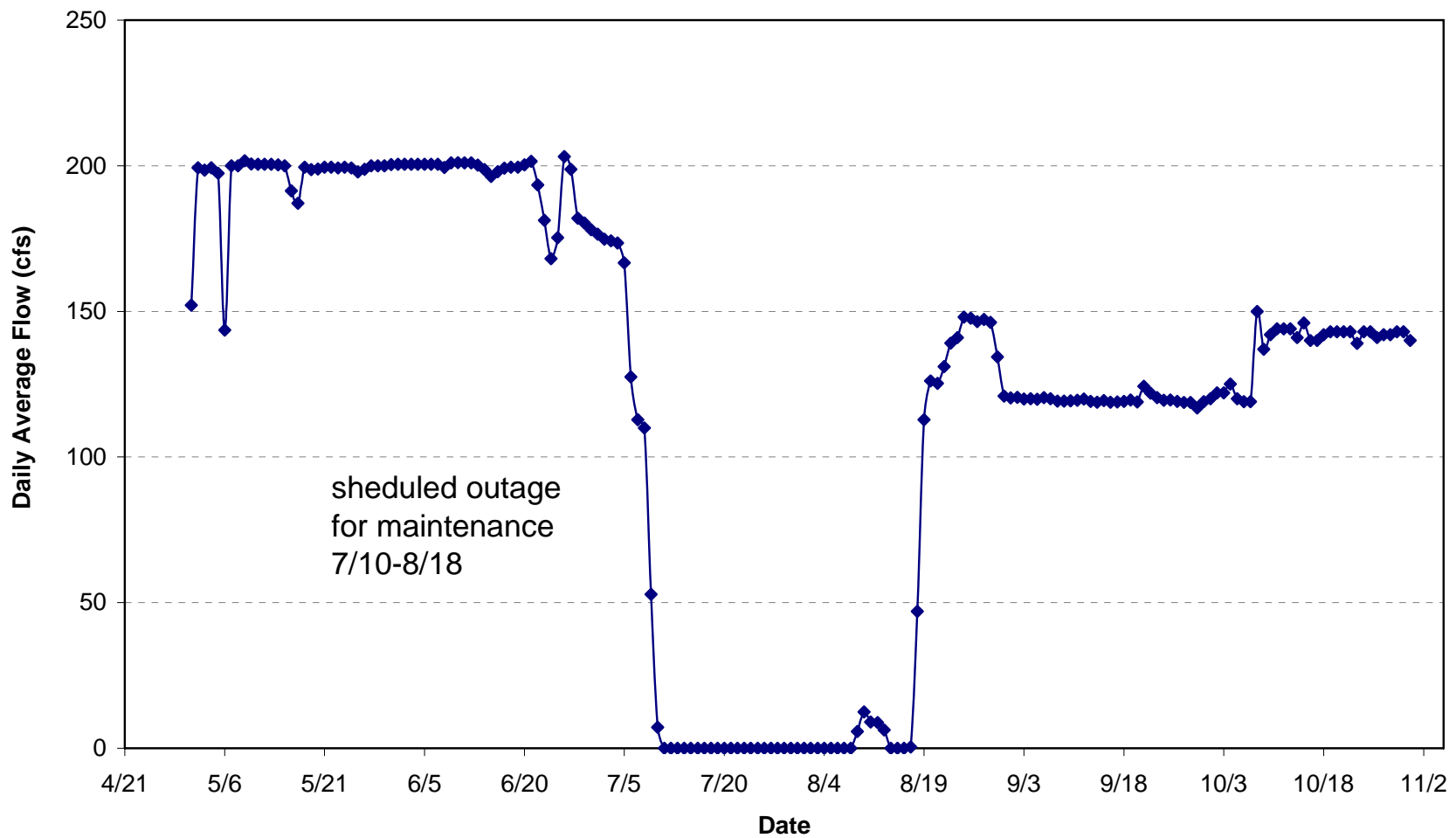
**W26**  
**Willow Creek below Confluence of North and South Forks**



**USGS Gage 11246500**  
**Willow Creek at Mouth**  
**(preliminary flow data from Southern California Edison)**

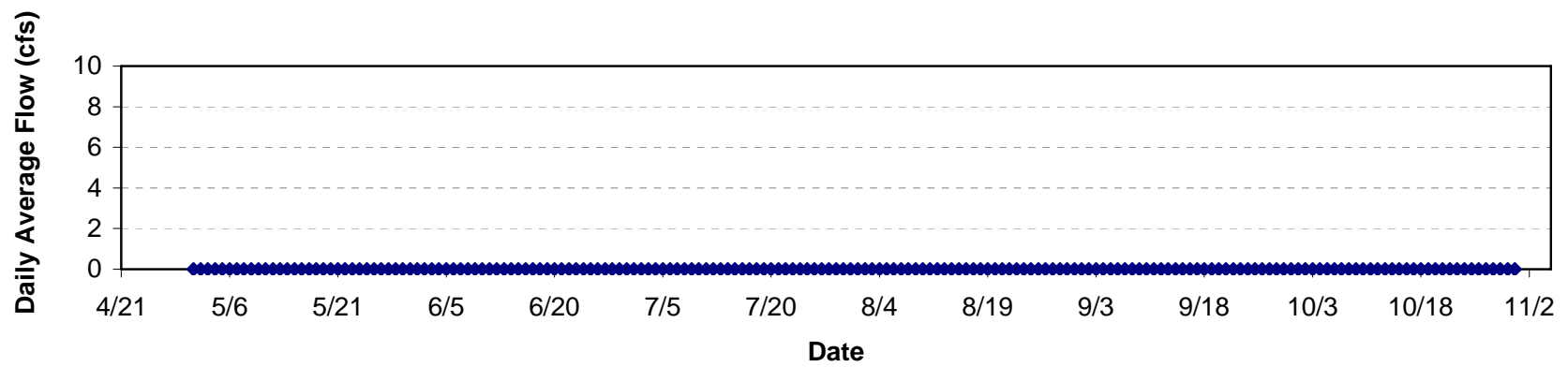


**W25**  
**#1 Conduit below Bass Lake**

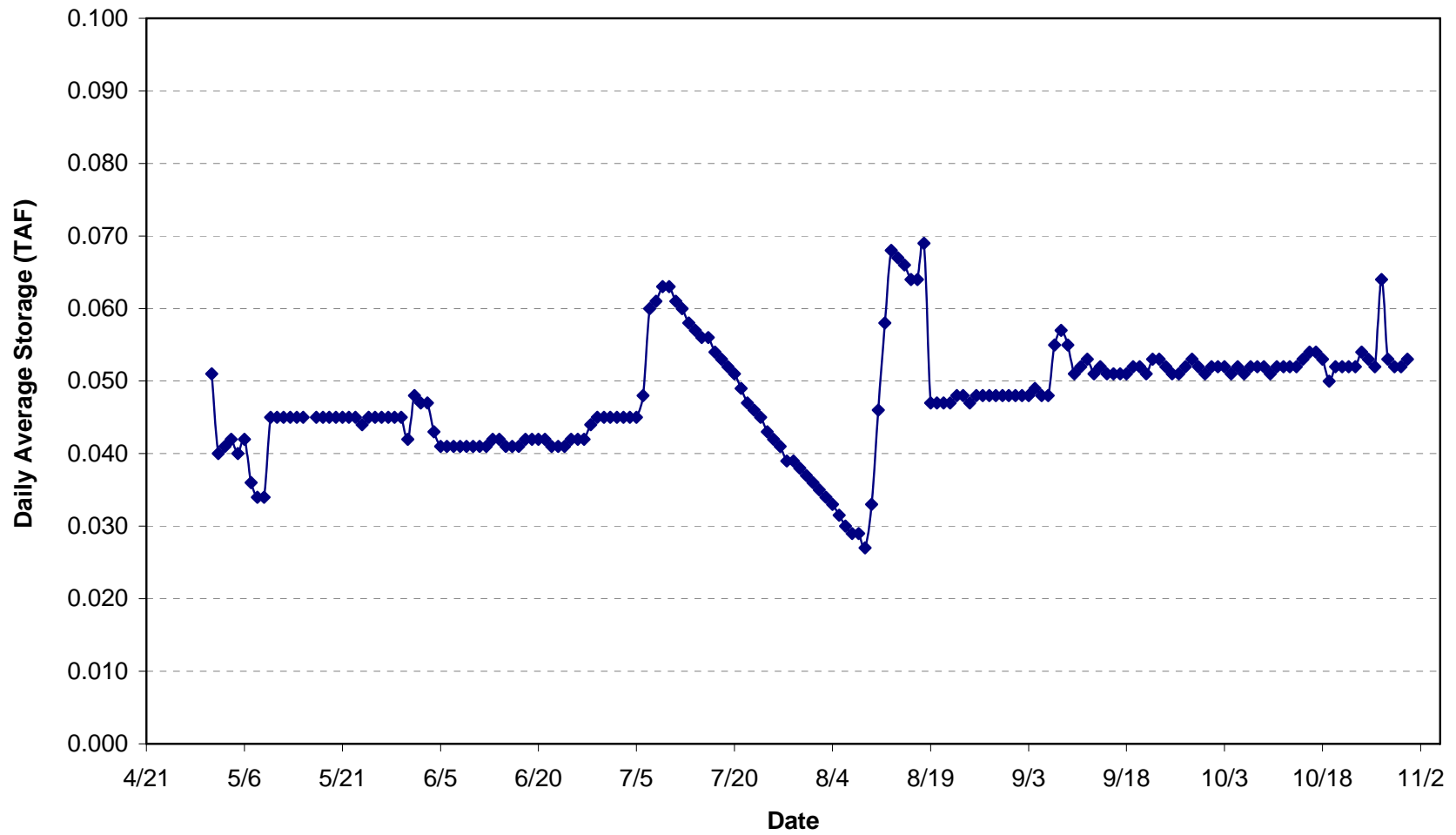


# W16 San Joaquin #1A Powerhouse

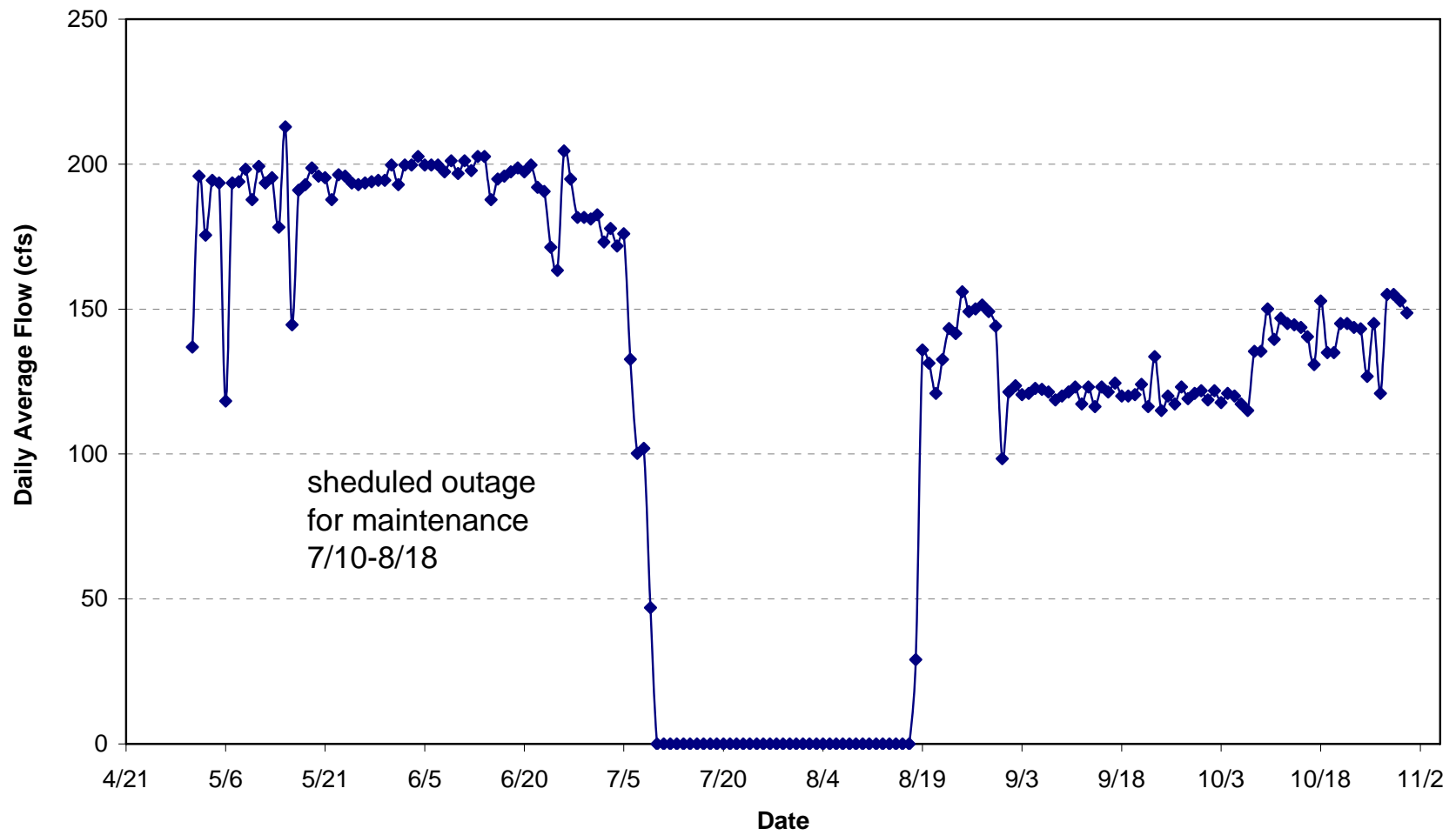
Flow was zero cfs during entire monitoring program



# W17 Corrine Lake Storage



**W18**  
**A. G. Wishon Powerhouse**





## **Appendix C**

### **Meteorological Data**

Daily average and daily maximum air temperatures from A.G. Wishon and Crane Valley powerhouses					
AG Wishon PH Daily Air Tempertaures (°C)			Crane Valley Daily Air Temperatures (°C)		
Date	Daily Average	Daily Maximum	Date	Daily Average	Daily Maximum
5/1/2005	16.7	25.0	5/1/2005	12.2	16.7
5/2/2005	16.3	25.6	5/2/2005	13.4	21.7
5/3/2005	16.7	26.1	5/3/2005	14.2	21.1
5/4/2005	16.7	25.0	5/4/2005	14.1	20.0
5/5/2005	12.7	13.9	5/5/2005	8.9	12.8
5/6/2005	13.7	20.6	5/6/2005	8.9	13.3
5/7/2005	14.0	22.2	5/7/2005	10.4	16.7
5/8/2005	14.6	22.2	5/8/2005	10.9	15.6
5/9/2005	11.5	15.0	5/9/2005	7.1	11.1
5/10/2005	10.8	18.3	5/10/2005	6.5	12.2
5/11/2005	13.8	22.8	5/11/2005	10.0	15.6
5/12/2005	16.7	27.2	5/12/2005	13.9	22.2
5/13/2005	18.6	30.0	5/13/2005	16.3	25.6
5/14/2005	20.0	30.6	5/14/2005	17.5	27.2
5/15/2005	21.1	30.6	5/15/2005	18.3	24.4
5/16/2005	16.7	23.9	5/16/2005	12.8	18.3
5/17/2005	15.4	24.4	5/17/2005	11.7	16.7
5/18/2005	19.2	28.9	5/18/2005	15.6	23.3
5/19/2005	20.0	31.1	5/19/2005	17.6	25.6
5/20/2005	17.0	23.9	5/20/2005	15.0	20.0
5/21/2005	19.1	28.3	5/21/2005	16.2	22.2
5/22/2005	20.9	33.9	5/22/2005	19.1	28.9
5/23/2005	21.3	31.1	5/23/2005	19.2	26.7
5/24/2005	22.3	32.8	5/24/2005	20.0	27.8
5/25/2005	23.8	36.1	5/25/2005	21.6	31.1
5/26/2005	23.9	36.1	5/26/2005	22.4	30.6
5/27/2005	23.3	34.4	5/27/2005	21.9	31.1
5/28/2005	21.1	30.0	5/28/2005	19.3	27.2
5/29/2005	16.6	25.6	5/29/2005	14.5	22.2
5/30/2005	18.3	28.9	5/30/2005	15.5	22.8
5/31/2005	21.9	33.3	5/31/2005	19.7	29.4
6/1/2005	22.1	32.2	6/1/2005	19.7	27.8
6/2/2005	19.9	30.6	6/2/2005	18.1	26.7
6/3/2005	19.4	31.7	6/3/2005	17.8	26.1
6/4/2005	20.7	31.1	6/4/2005	19.2	28.9
6/5/2005	17.8	27.2	6/5/2005	15.7	22.8
6/6/2005	14.9	23.9	6/6/2005	12.5	20.6
6/7/2005	15.1	26.1	6/7/2005	12.8	21.7
6/8/2005	16.0	25.0	6/8/2005	13.4	20.6
6/9/2005	18.0	23.9	6/9/2005	14.4	20.0
6/10/2005	20.4	29.4	6/10/2005	16.3	22.2
6/11/2005	20.7	30.6	6/11/2005	17.5	25.6
6/12/2005	22.0	33.9	6/12/2005	19.7	28.9
6/13/2005	23.7	36.7	6/13/2005	21.8	31.1
6/14/2005	24.7	36.7	6/14/2005	22.4	32.8
6/15/2005	23.1	34.4	6/15/2005	21.2	30.6

Daily average and daily maximum air temperatures from A.G. Wishon and Crane Valley powerhouses					
AG Wishon PH Daily Air Tempertaures (°C)			Crane Valley Daily Air Temperatures (°C)		
Date	Daily Average	Daily Maximum	Date	Daily Average	Daily Maximum
6/16/2005	20.5	28.3	6/16/2005	17.7	22.2
6/17/2005	15.5	21.7	6/17/2005	10.9	15.6
6/18/2005	16.3	25.6	6/18/2005	12.0	18.3
6/19/2005	18.4	30.0	6/19/2005	15.3	25.0
6/20/2005	20.5	32.2	6/20/2005	18.1	27.8
6/21/2005	21.5	32.8	6/21/2005	19.5	29.4
6/22/2005	21.7	32.8	6/22/2005	20.0	30.0
6/23/2005	22.6	34.4	6/23/2005	20.2	29.4
6/24/2005	21.7	33.9	6/24/2005	19.7	27.8
6/25/2005	21.3	31.1	6/25/2005	19.0	27.2
6/26/2005	21.3	32.8	6/26/2005	19.4	27.8
6/27/2005	22.0	32.8	6/27/2005	20.0	30.0
6/28/2005	21.3	31.1	6/28/2005	20.4	29.4
6/29/2005	24.0	36.1	6/29/2005	22.2	33.3
6/30/2005	25.7	37.8	6/30/2005	24.3	35.0
7/1/2005	26.5	37.2	7/1/2005	25.4	35.6
7/2/2005	26.5	37.2	7/2/2005	25.2	35.0
7/3/2005	25.7	36.7	7/3/2005	24.6	35.6
7/4/2005	25.2	36.7	7/4/2005	23.8	33.9
7/5/2005	25.6	36.1	7/5/2005	24.0	32.8
7/6/2005	25.6	35.0	7/6/2005	23.9	32.2
7/7/2005	26.0	35.6	7/7/2005	24.2	32.2
7/8/2005	24.7	35.0	7/8/2005	23.2	32.2
7/9/2005	23.5	33.3	7/9/2005	21.8	30.6
7/10/2005	23.4	33.3	7/10/2005	21.9	30.6
7/11/2005	25.5	35.6	7/11/2005	24.0	34.4
7/12/2005	27.8	38.9	7/12/2005	26.1	37.2
7/13/2005	28.7	41.1	7/13/2005	26.9	37.8
7/14/2005	29.0	41.1	7/14/2005	27.4	38.3
7/15/2005	29.2	40.0	7/15/2005	26.9	37.8
7/16/2005	30.6	41.7	7/16/2005	22.1	38.9
7/17/2005	30.6	42.8	7/17/2005	28.9	38.9
7/18/2005	30.3	41.7	7/18/2005	28.9	39.4
7/19/2005	29.3	40.6	7/19/2005	28.3	37.2
7/20/2005	29.8	41.1	7/20/2005	28.5	38.3
7/21/2005	31.0	39.4	7/21/2005	28.4	37.8
7/22/2005	28.5	36.7	7/22/2005	27.2	36.7
7/23/2005	28.0	40.0	7/23/2005	27.4	38.9
7/24/2005	28.3	40.6	7/24/2005	27.2	37.8
7/25/2005	26.8	39.4	7/25/2005	26.2	37.2
7/26/2005	26.9	40.0	7/26/2005	26.2	39.4
7/27/2005	28.1	40.6	7/27/2005	27.1	37.8
7/28/2005	28.1	39.4	7/28/2005	27.1	36.1
7/29/2005	27.6	38.9	7/29/2005	26.3	35.6
7/30/2005	28.0	39.4	7/30/2005	26.7	37.2
7/31/2005	28.3	39.4	7/31/2005	26.8	36.7

Daily average and daily maximum air temperatures from A.G. Wishon and Crane Valley powerhouses					
AG Wishon PH Daily Air Tempertaures (°C)			Crane Valley Daily Air Temperatures (°C)		
Date	Daily Average	Daily Maximum	Date	Daily Average	Daily Maximum
8/1/2005	27.8	38.3	8/1/2005	26.2	36.1
8/2/2005	26.8	38.3	8/2/2005	25.5	37.2
8/3/2005	26.5	37.2	8/3/2005	25.1	35.0
8/4/2005	27.0	37.8	8/4/2005	25.8	36.1
8/5/2005	29.0	38.9	8/5/2005	27.2	38.3
8/6/2005	29.2	39.4	8/6/2005	27.1	36.7
8/7/2005	29.4	40.0	8/7/2005	27.6	38.9
8/8/2005	29.2	40.0	8/8/2005	27.1	37.2
8/9/2005	27.4	37.8	8/9/2005	26.8	37.8
8/10/2005	27.1	37.2	8/10/2005	25.9	36.1
8/11/2005	25.3	37.2	8/11/2005	24.6	36.1
8/12/2005	25.9	37.2	8/12/2005	25.0	34.4
8/13/2005	25.0	35.0	8/13/2005	23.9	32.8
8/14/2005	24.7	35.0	8/14/2005	22.9	30.6
8/15/2005	21.7	25.0	8/15/2005	17.8	20.0
8/16/2005	25.4	35.6	8/16/2005	22.5	33.3
8/17/2005	26.3	36.7	8/17/2005	23.5	32.8
8/18/2005	24.8	35.0	8/18/2005	23.1	32.8
8/19/2005	23.3	33.3	8/19/2005	22.1	31.7
8/20/2005	25.1	36.7	8/20/2005	23.5	33.9
8/21/2005	25.1	37.2	8/21/2005	24.0	35.0
8/22/2005	24.8	37.2	8/22/2005	23.4	33.3
8/23/2005	25.0	36.7	8/23/2005	24.0	33.3
8/24/2005	25.4	37.2	8/24/2005	23.5	33.3
8/25/2005	24.5	37.2	8/25/2005	22.9	32.8
8/26/2005	26.5	37.2	8/26/2005	24.6	35.6
8/27/2005	27.5	39.4	8/27/2005	25.1	36.1
8/28/2005	28.7	40.0	8/28/2005	25.6	37.2
8/29/2005	25.7	36.7	8/29/2005	24.1	34.4
8/30/2005	22.1	33.9	8/30/2005	21.5	29.4
8/31/2005	23.5	36.1	8/31/2005	22.3	32.2
9/1/2005	24.2	36.7	9/1/2005	22.8	33.9
9/2/2005	24.2	37.2	9/2/2005	22.9	33.3
9/3/2005	23.5	36.1	9/3/2005	21.5	32.2
9/4/2005	22.2	33.9	9/4/2005	20.4	30.6
9/5/2005	21.6	33.3	9/5/2005	19.8	28.9
9/6/2005	22.1	35.0	9/6/2005	20.6	31.1
9/7/2005	22.3	34.4	9/7/2005	20.8	31.7
9/8/2005	20.7	30.6	9/8/2005	18.9	26.7
9/9/2005	18.6	27.2	9/9/2005	16.0	22.2
9/10/2005	18.0	27.2	9/10/2005	15.0	21.7
9/11/2005	16.5	26.1	9/11/2005	14.0	22.8
9/12/2005	16.5	27.8	9/12/2005	14.5	22.8
9/13/2005	17.0	27.8	9/13/2005	15.4	25.0
9/14/2005	18.2	29.4	9/14/2005	16.4	26.1
9/15/2005	19.2	31.7	9/15/2005	17.8	27.8

Daily average and daily maximum air temperatures from A.G. Wishon and Crane Valley powerhouses					
AG Wishon PH Daily Air Tempertaures (°C)			Crane Valley Daily Air Temperatures (°C)		
Date	Daily Average	Daily Maximum	Date	Daily Average	Daily Maximum
9/16/2005	18.6	29.4	9/16/2005	17.0	26.1
9/17/2005	17.1	27.2	9/17/2005	15.8	25.0
9/18/2005	17.0	27.2	9/18/2005	15.6	23.3
9/19/2005	20.1	34.4	9/19/2005	19.4	31.7
9/20/2005	21.0	31.7	9/20/2005	18.8	26.7
9/21/2005	21.3	30.0	9/21/2005	17.5	26.1
9/22/2005	22.1	32.2	9/22/2005	19.5	29.4
9/23/2005	21.5	31.7	9/23/2005	18.5	26.7
9/24/2005	16.8	25.6	9/24/2005	15.0	21.7
9/25/2005	18.6	29.4	9/25/2005	16.7	26.1
9/26/2005	20.5	28.3	9/26/2005	17.5	21.1
9/27/2005	19.8	29.4	9/27/2005	17.3	25.6
9/28/2005	19.2	32.8	9/28/2005	19.3	27.8
9/29/2005	21.1	35.6	9/29/2005	19.9	31.1
9/30/2005	22.1	35.0	9/30/2005	20.7	32.2
10/1/2005	22.1	33.3	10/1/2005	19.3	28.9
10/2/2005	17.7	25.0	10/2/2005	14.9	20.6
10/3/2005	13.8	23.3	10/3/2005	11.7	20.0
10/4/2005	12.1	23.3	10/4/2005	10.8	18.9
10/5/2005	14.1	26.1	10/5/2005	13.7	23.9
10/6/2005	16.4	29.4	10/6/2005	16.2	27.2
10/7/2005	17.3	32.8	10/7/2005	16.9	27.2
10/8/2005	15.4	23.9	10/8/2005	13.6	20.6
10/9/2005	13.7	25.0	10/9/2005	12.2	21.7
10/10/2005	15.2	29.4	10/10/2005	14.0	23.9
10/11/2005	16.5	29.4	10/11/2005	15.5	25.6
10/12/2005	16.6	28.3	10/12/2005	16.1	25.6
10/13/2005	18.2	32.2	10/13/2005	17.4	28.3
10/14/2005	19.1	33.9	10/14/2005	17.7	28.9
10/15/2005	13.1	20.6	10/15/2005	10.5	16.1
10/16/2005	14.0	27.2	10/16/2005	13.7	24.4
10/17/2005	16.2	27.8	10/17/2005	17.9	22.8
10/18/2005	16.5	21.7	10/18/2005	13.1	15.6
10/19/2005	16.0	24.4	10/19/2005	13.5	20.0
10/20/2005	13.9	22.8	10/20/2005	11.8	20.0
10/21/2005	15.3	27.2	10/21/2005	14.5	25.6
10/22/2005	15.4	27.2	10/22/2005	15.3	25.6
10/23/2005	16.2	28.3	10/23/2005	15.3	26.1
10/24/2005	17.8	28.9	10/24/2005	16.5	26.7
10/25/2005	16.2	22.8	10/25/2005	13.2	17.8
10/26/2005	14.1	22.8	10/26/2005	11.4	18.9
10/27/2005	11.5	12.8	10/27/2005	8.6	10.0
10/28/2005	14.1	21.1	10/28/2005	10.1	14.4
10/29/2005	13.0	22.2	10/29/2005	10.5	18.3
10/30/2005	12.6	21.1	10/30/2005	11.1	20.0
10/31/2005	13.1	24.4	10/31/2005	12.3	22.8

**Appendix D**

**Water Quality and Temperature Equipment  
QA/QC Documentation**



# IDRONAUT Srl

Via Monte Amiata, 10  
Tel. +39 039879656 / 039883832  
E-mail: [idronaut@idronaut.it](mailto:idronaut@idronaut.it)

I-20047 BRUGHERIO (MI) ITALY  
Fax. +39 039883382  
Web: [www.idronaut.it](http://www.idronaut.it)

## CERTIFICATE OF CALIBRATION

Model:	Probe 304	Serial No.	0505065
Calibration date	7 June 2005	Client :	Pacific Gas & Electric USA
Next Calibration date		End User:	

This is to certify that the equipment has been calibrated and is within the manufacturers specified accuracy.


Calibration results where appropriate are shown on the attached sheets

The equipment used for calibration was as follows:

Item	Model n°	Serial n°
Automatic thermometer bridge plus conductivity/ salinity adaptor	ATB1250 CSA1250	10072 10072
Pt 25 Hart Scientific	5680	5680
Dead weight tester Budenberg	580DX	26947

All the above equipment is within the manufacturers recommended calibration period and is traceable to the national standards except where no such standards exists.

Calibration Engineer signature

  
Lorenzini Davide

Date: 07-06-05

Quality control Engineer signature

Confalonieri Fabio

Date: 07-06-05



Calibration date : 7 June 2005				
Model : IDRONAUT Pt 100			Measurement range	-5 +35 °C
Data point	Temp.Observed ( deg °C )	Temp.Observed ( counts )	Temp.Calculated ( deg °C )	Temp. Error ( deg °C )
1	-0.1582	6539	-0.1606	-0.0024
2	4.1716	12142	4.1743	+0.0027
3	8.2999	17455	8.3007	+0.0008
4	12.3087	22601	12.3074	-0.0013
5	16.2616	27663	16.2609	-0.0007
6	20.1871	32672	20.1852	-0.0019
7	24.1058	37666	24.1076	+0.0018
<b>Maximum permitted Temp. Error = 0.005 deg°C</b>			a = -5.20352397	
<b>Calibration coefficients</b> →			b = 0.000769711666	
			c = 2.25132264e-10	

Calibration date : 7 June 2005					
Model : KELLER PA-10 serial number : TS 506			Measurement range	10 bar	
Data point	Pressure Applied ( bar )	Press.Observed ( counts )	Press.Calculated ( bar )	Press.error ( bar )	Press.error ( % FSR )
1	2.0000	12023	1.9966	-0.0034	-0.034
2	4.0000	23015	4.0010	+0.001	+0.01
3	6.0000	33969	6.0007	+0.0007	+0.007
4	8.0000	44914	8.0009	+0.0009	+0.009
5	10.0003	55837	9.9994	-0.0009	-0.009
6					
7					
<b>Maximum permitted Depth. Error = 0.05 % FSR</b>			a = -1.93263584		
<b>Calibration coefficients</b> →			b = 0.00182025946		
			c = 9.27170749e-11		





# IDRONAUT Srl

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I-20047 BRUGHERIO (MI) ITALY  
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Web: [www.idronaut.it](http://www.idronaut.it)

## CERTIFICATE OF CALIBRATION

Model : Probe 304  
Serial number : 1205072  
Calibration date : 14 December 2005  
Customer : Pacific & Gas Electric - USA

This is to certify that the equipment has been calibrated and is within the manufacturers specified accuracy.

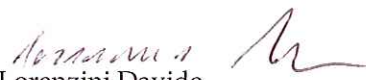
Calibration results where appropriate are shown on the attached sheets

The equipment used for calibration was as follows:

Item	Model n°	Serial n°
Automatic thermometer bridge plus conductivity/ salinity adaptor	ATB1250 CSA1250	10072 10072
Pt 25 Hart Scientific	5680	5680
Dead weight tester Budenberg	580DX	26947
Triple point of water maintenance bath	7312	A54108
Water triple point cell	5901	1459
Gallium cell maintenance system	9230	A54032
Fixed point cell – Melting point of Gallium	5943	GA-43043

All the above equipment is within the manufacturers recommended calibration period and is traceable to the national standards except where no such standards exists.

Calibration engineer signature

  
Lorenzini Davide

14-12-2005

Quality control engineer signature

Confalonieri Fabio

14-12-2005



Calibration date : 14 December 2005				
Model : IDRONAUT Pt 100			Measurement range -5 +35 °C	
Data point	Temp.Observed ( deg °C )	Temp.Observed ( counts )	Temp.Calculated ( deg °C )	Temp. Error ( deg °C )
1	-0.2688	6555	-0.2687	+0.0001
2	4.0527	12137	4.0530	+0.0003
3	8.1830	17455	8.1830	-
4	12.1912	22600	12.1899	-0.0013
5	16.1282	27642	16.1283	+0.0001
6	20.0391	32639	20.0413	+0.0022
7	23.9520	37617	23.9507	-0.0013
<b>Maximum permitted Temp. Error = 0.005 deg°C</b>			a = -5.327016	
<b>Calibration coefficients</b> →			b = 0.00077025338	
			c = 2.1411721e-10	

Calibration date : 14 December 2005					
Model : KELLER PA-10 serial number : TS 568			Measurement range 10 bar		
Data point	Pressure Applied ( bar )	Press.Observed ( counts )	Press.Calculated ( bar )	Press.error ( bar )	Press.error ( % FSR )
1	2.0000	12786	1.9951	-0.0049	-0.049
2	4.0000	24981	4.0020	+0.002	+0.02
3	6.0000	37092	6.0035	+0.0035	+0.035
4	8.0000	49175	8.0027	+0.0027	+0.027
5	10.0003	61216	9.9974	-0.0026	-0.026
<b>Maximum permitted Depth. Error = 0.05% FSR</b>			a = -1.191772		
<b>Calibration coefficients</b> →			b = 0.0016477358		
			c = 7.9427197e-11		

## Memorandum

Date: January 3, 2006

#

File #: 026.11.06.2

To: ENVIRONMENTAL ENGINEERING GROUP

From: ERIC KENZLER

Subject: Hydrolab Instrument 2005 Calibration Report



**Pacific Gas and  
Electric Company**

#

CHARLES WHITE  
ELIZABETH FRANTZ

I certify that between March and December, 2005 the Hydrolab® multiparameter water quality analyzers listed below were calibrated at PG&E's Technical and Ecological Services Department (TES) or at the Hach/Hydrolab Loveland, Colorado repair department using manufacturer's calibration procedures and certified in tolerance. The water quality parameters pH, Conductivity, DO, and Turbidity adjusted and verified prior to field deployment.

These are field instruments for in-situ readings and although a log documenting monthly calibrations are kept in Room 151 at TES, most of the instruments were calibrated by qualified PG&E personnel in the field more often than that depending on deployment schedules.

### Instrument Identification:

Hydrolab Quanta®. #1	S/N 01310/01277
Hydrolab Quanta® #2	S/N 01943/02100
Hydrolab Quanta® #3	S/N 01602/02089
Hydrolab Data Sonde 4a®	S/N 37743
Hydrolab Data Sonde 5®	S/N 42706

A handwritten signature in black ink that reads "Eric Kenzler".

ERIC KENZLER  
Technologist, TES

EMKenzler(251-5806):emk

pc: Ed Cheslak  
Scott Tu

# Memorandum

Date: January 3, 2006

#

File #: 026.11.06.1

To: ENVIRONMENTAL ENGINEERING GROUP

From: ERIC KENZLER

Subject: Temperature Data Logger 2005 Calibration Report



**Pacific Gas and  
Electric Company**

#

CHARLES WHITE  
ELIZABETH FRANTZ

On December 3, 2004 through December 13, 2004 the VEMCO TR-12 temperature recorders on the attached list were calibrated at TES using manufacturer's calibration procedures and certified in tolerance against National Institute of Standards and Technology traceable instrumentation.

Traceable Instrument Identification:

Model No. 15-077-8      S/N 221336702      Fisher Scientific Digital Thermometer  
Probe: 15-077-7      S/N 221336677

Precision Water Bath:

Thermo Neslab RTC 17 S/N 103198062

Certificate information is located in the MS Word document S:\Vemco\2004 Calibration\Cal data sheet 2004-05.doc. Printed graphs of original calibration data are located in my files.

A handwritten signature in black ink, reading 'Eric Kenzler', is positioned above the printed name.

ERIC KENZLER  
Technologist, TES

EMKenzler(251-5806):emk

pc: Ed Cheslak  
Scott Tu

Attachment

Pacific Gas & Electric Company - Technical and Ecological Services  
VEMCO TR-12 Temperature recorders calibrated in December 2004

	SN:	SN:	SN:	SN:
1	2190	2910	7003	935
2	2192	2911	7004	936
3	2193	2912	7005	937
4	2197	2913	7006	939
5	2198	2914	7007	940
6	2199	2915	7008	941
7	2200	2917	9346	942
8	2201	2918	9348	944
9	2202	2919	9349	945
10	2203	2920	9350	946
11	2204	2921	9351	947
12	2205	2922	9352	948
13	2207	3040	9353	949
14	2208	3041	943	950
15	2209	3043		951
16	2554	3044		952
17	2555	3045		953
18	2556	3048		954
19	2557	3049		955
20	2558	3050		956
21	2559	3051		9324
22	2560	3052		9325
23	2561	3053		9326
24	2562	3054		9327
25	2563	3055		9328
26	2564	3056		9329
27	2565	3057		9330
28	2566	3058		9331
29	2568	3060		9332
30	2569	3061		9333
31	2570	3062		9334
32	2571	3063		9335
33	2572	3064		9336
34	2573	3065		9337
35	2903	3066		9338
36	2904	6998		9340
37	2906	6999		9341
38	2907	7000		9342
39	2908	7001		9344
40	2909	7002		9345

## **Appendix E**

### **Photo Documentation of Water Temperature Stations during 2005 (CD)**

## **Appendix F**

### **Agency Consultation**

MEMO 2/28/06

**Re: 2005 Annual Water Temperature Monitoring Report for Crane Valley, contacted agency representatives (Russ Kanz, Julie Means, and Bill Foster) on status of report review**

Russ Kanz (SWRCB)

Spoke w/ Russ on 2/28 at 3:45 via phone call. Russ stated that he has not had time to review the report in detail, but that based on the amount of time he looked at it, it looked fine. He didn't think he would have any comments, but asked when the final report was going to be issued. I told him by the end of March. He stated that if he did have comments, he would get them in before that. He asked about Gage W26, he mentioned that it had been buried in the sand and must have been dug out (I didn't have specifics on this but told him that the flow record has been updated and that flow was never below 0.5 cfs based on the Hydrographer's recent review of the data). I gave my contact information to Russ in case he had questions or comments at a later date.

Julie Means (CDFG)

Left a voicemail message with Julie on 2/28 at 3:40 asking if she had received the report and if so, if she had any comments or questions. I left my contact information for her.

Bill Foster (FWS)

Spoke with Bill on 2/28 at 3:35 via phone call. He stated that he has not had a chance to look at the report in detail and has not conferred with others regarding the report. However, he appreciated the phone call.

Elizabeth Frantz (2/28/06)



MEMO 3/9/06

**Re: 2005 Annual Water Temperature Monitoring Report for Crane Valley, contacted agency representatives (Russ Kanz, Julie Means, and Bill Foster) on status of report review**

Russ Kanz (SWRCB)

A voice message was left with Russ on 3/9/06 at 2:20 to confirm that he does not have any comments with regard to the water temperature report.

Julie Means (CDFG)

A voice message was received from Julie in response to first contact phone call that was made on 2/28/05. Her reply was on 3/3/06. She stated that she had not had time to review the report, but would try to get to it the following weekend and would submit any comments via email by 3/6/06 if she had any comments. A second voice message was left with Julie on 3/9/06 at 1:45 to see if she had any comments since no email had been received by 3/6/06. Specific items that Julie mentioned in her reply voicemail on 3/3/06 included a comment that data loss due to planned outages should be minimized (route water during outage if possible to prevent warming of stream, do not schedule outages in middle of summer when temperatures are warmest, and plan to have data recorders in a location that will not be out of water during the planned outage when the water level is expected to decrease), and avoid data loss from other effects if possible by better placement of recorders in the field.

Bill Foster (FWS)

A voice message was left with Bill on 3/9/06 at 2:15 to confirm that he does not have any comments with regard to the water temperature report.

Elizabeth Frantz (3/9/06)