PPRP-DC-2

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YOUGHIOGHENY RIVER TEMPERATURE ENHANCEMENT PROTOCOL: MODEL DEVELOPMENT AND RESULTS FOR 1995 AND 1996

February 1998

MARYLAND POWER PLANT RESEARCH PROGRAM

STATE OF MARYLAND
DEPARTMENT OF NATURAL RESOURCES

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Maryland Department of Natural Resources

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February 1998

FOREWORD

This final report, "Youghiogheny River Temperature Enhancement Protocol: Model Development and Results for 1995 and 1996" was prepared by Stephen P. Schreiner of Versar, Inc., at the request of Rich McLean of the Power Plant Research Program (PPRP), Maryland Department of Natural Resources (MDNR). This report documents the work done under tasks SSH-1, SSH-4, and DC-2 of PPRP Contract PR96-055-001(97).

ABSTRACT

The Pennsylvania Electric Company (Penelec) generates electricity at the Deep Creek Hydroelectric Station by periodically releasing water impounded at Deep Creek Lake into the Youghiogheny River. Historically, the timing and duration of these releases were primarily driven by the economics of power generation and water availability in Deep Creek Lake. As part of the Federal Energy Regulatory Commission relicensing process, uses of project releases to provide minimum flows for fish habitat, flows scheduled for whitewater boating recreation, and flows to moderate elevated river temperatures to enhance fish habitat were evaluated. Previous studies indicated that appropriately timed power generation releases would be the most cost-effective and balanced use of project releases to lower the river temperature, thereby enhancing fish habitat from the power plant tailrace for a distance of 3.6 miles downstream. This report, which deals with temperature enhancement of fish habitat, consists of two parts; the first describes the development of a protocol to predict river temperature and make temperature enhancement releases, and the second describes the results of the first two years that the protocol was implemented.

A protocol for predicting maximum daily river temperature during summer was developed using daily measurements of river flow and temperature changes and available predictions of maximum daily air temperature and cloud cover in the region of the project. The protocol consists of a series of equations (developed using multiple regression models) to be used by power plant operators during the morning and early afternoon to predict river temperature. The operators use these predictions to determine whether a release is needed to enhance temperature. These releases are then announced for public knowledge via a telephone recording. The target maximum river temperature is 25 °C, a maximum value for brown trout habitat. The protocol equations were based on historical data from 1987 through 1993 for daily average river flow, hourly river temperatures, maximum daily air temperature, and mid-day cloud-cover fraction. Using historical data, the rate of releases unnecessary for temperature was estimated to be about 14%, and the rate of failure to make needed releases for temperature was estimated to be about 4%. In an average year needing 17 releases for temperature, only 2 to 3 unnecessary releases would be made.

The protocol was formally implemented in the summer of 1995. From June 20 through August 31, 1995, releases for all purposes were made on 62 days, or 85% of the time. Twenty-four (33%) of these were releases for temperature enhancement. On 35 days, or 48% of the time, releases were scheduled (either for whitewater recreation or power generation) and announced in advance. Temperatures exceeded the target of 25 °C at Sang Run on 18 days (25% of the time). At the next most upstream station, the temperature exceeded the target level on only 10 of these days. Four of the exceedances at Sang Run were attributable to operator error; 13 of the remaining exceedances were due to uncertainty within the protocol. Although the temperature exceeded 25 °C on 18 days with the protocol in place, the maximum temperature never exceeded 27.5 °C. In spite of the errors and uncertainty in the protocol, river temperature would have exceeded the target value on at least 40 days in 1995 and would have exceeded 27.5 °C on 12 days in 1995 if no releases had been made from the project.

During the period of June 19 through August 31,1996, releases were made on 59 days, or 80% of the time. Of these, releases for temperature enhancement were made on 8 days, or 11% of the time. On 44 days, or 60% of the time, releases were scheduled and announced in advance (either for whitewater recreation or power generation). A total of 3 days (4% of the time period) had temperatures exceeding the target of 25 °C at Sang Run. On only one of these dates did the temperature exceed the target level at the next most upstream station. The three exceedances at Sang Run were attributable to uncertainty within the protocol.

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1.0 INTRODUCTION

The Pennsylvania Electric Company (Penelec) received a Water Appropriations Permit to operate the Deep Creek Hydroelectric Station for power generation from the Maryland Department of Natural Resources (MDNR) Water Resources Administration (WRA).[1] Condition 16 of this permit requires Penelec to submit a plan for operating the project (alone or in combination with minimum flow releases) to maintain temperatures of less than 25 °C in the Youghiogheny River between the Deep Creek tailrace and Sang Run 3.6 miles downstream (Figure 1-1). Condition 16 requires the plan to include a triggering mechanism(s) and real-time monitoring of river temperature and to be implemented within 120 days of approval. Temperature enhancement[2] measures are intended to enhance cool-water habitat for trout in the designated reach of the river.

Penelec outlined a general temperature enhancement protocol (see Section 4.2.2.2 of the Support Document for Permit Application to Appropriate and Use Waters of the State, Revised Section 4.0, June 1994). The goals of the protocol are to (1) operate the Deep Creek Station, as necessary, to prevent water temperatures from exceeding 25 °C in the Youghiogheny River between the tailrace and Sang Run; (2) minimize unnecessary temperature enhancement releases; (3) provide maximum advance notice of releases to those interested in whitewater recreation; and (4) provide simple, automated implementation. Using available historical river temperature and meteorological data, MDNR's Power Plant Research Program (PPRP) worked with Penelec to develop and test a proposed protocol to meet these goals. Penelec submitted a draft temperature enhancement plan presenting a proposed protocol, developed jointly with PPRP, to WRA and other interested parties in June 1994.

This report describes the protocol for predicting maximum daily river temperature during summer using daily measurements of river flow and temperature changes in the river and available predictions of maximum daily air temperature and cloud cover in the region of the project. The protocol consists of a series of equations (developed using multiple regression models) to be used by power plant operators during the morning and early afternoon to predict river temperature. The operators use these predictions to determine whether a release is needed to enhance temperature. These releases are then announced for public knowledge via a telephone recording. This report also presents results of the first two years the protocol was formally implemented in the summers of 1995 and 1996.

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[1]Following reorganization of state government in 1995, this permit is now administered by the Maryland Department of the Environment.

[2]The term "temperature enhancement" as used in this report refers to enhancement of cool-water habitat for trout, not the temperature itself.

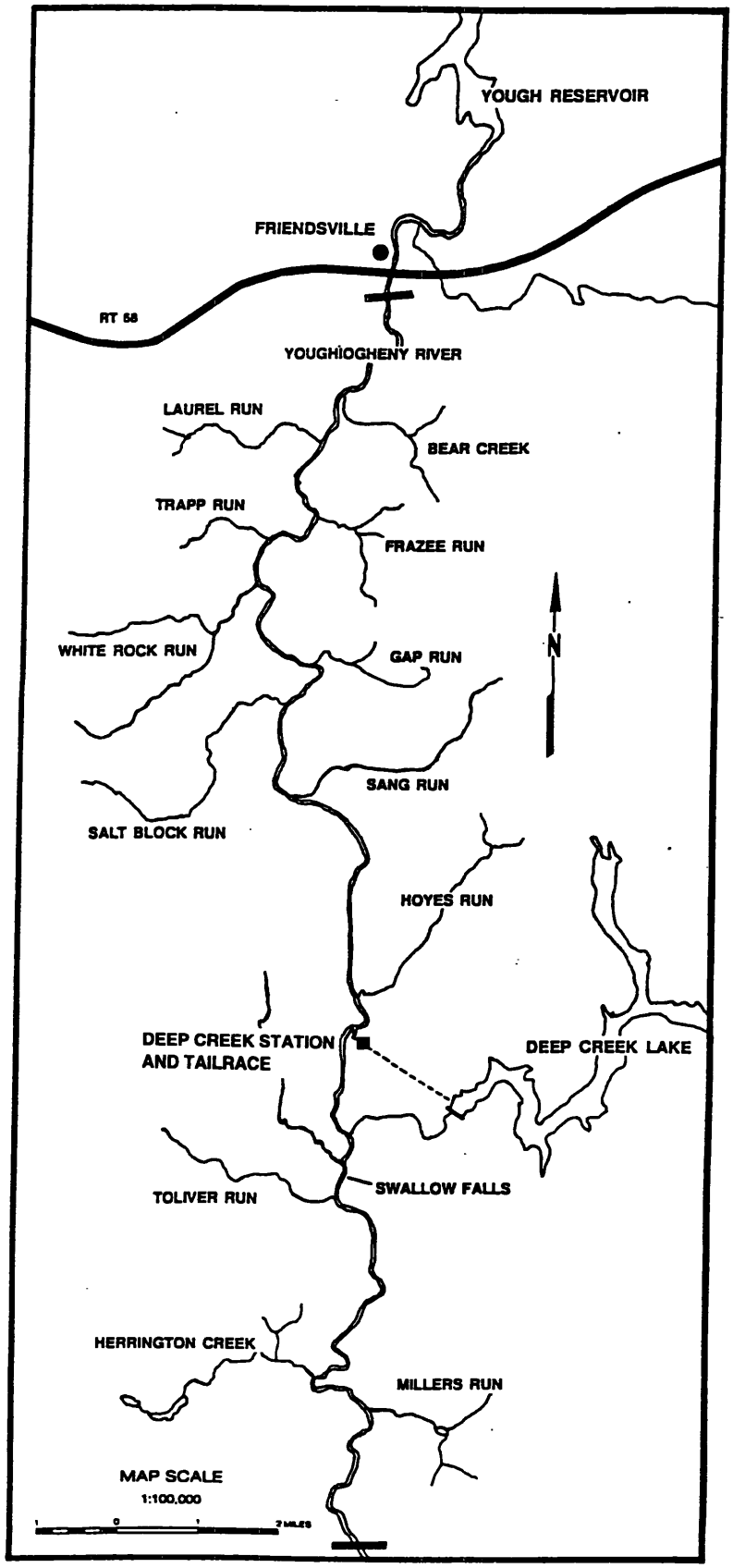

Figure 1-1. Map of the Youghiogheny River between Oakland and Friendsville, MD, showing location of Deep Creek Station tailrace and major tributaries

2.0 TEMPERATURE ENHANCEMENT MODEL

2.1 PROTOCOL DEVELOPMENT

Versar (1992)[3] used a combination of model simulations and test releases from the Deep Creek Hydroelectric Station to show that a 2-hour, 2-unit release beginning at 1100 hours would be sufficient to maintain temperatures less than 25 °C in the river to Sang Run, even under very warm, low flow, conditions. Although other release scenarios are possible [e.g., several hours of a minimum flow of 100 cubic feet per second (cfs) or a series of pulsed operational releases], a 2-hour, 2-unit release would generate power and be usable for whitewater recreation if potential users were notified in advance. The first step in developing a release protocol with advance notification was to identify means for predicting when river temperatures will exceed a certain target. In this case, 25 °C was used to trigger a temperature enhancement release based on the temperature requirements of brown trout (see Appendix A). In developing this protocol, Versar assumed that Penelec would use a 2-hour, 2-unit release to enhance temperature whenever it could provide at least 3 hours advance notice. Under less extreme conditions (maximum river temperatures of less than 26 °C to 27 °C), only a 1-hour, 2-unit release would be required, and would be used whenever less than 3 hours notice would be possible. Penelec could save water by using only a 1-hour release because whitewater boaters and rafters are less likely to use a release with less than 3 hours notice.

2.1.1 Prediction Parameters

River temperature is affected by inflow volume and temperature, air temperature, solar radiation, humidity, wind speed, and other factors. Predicting river temperature requires forecasted meteorological parameters, measured river temperature, and flow measurements. Simple multiple regression models can provide an adequate prediction and are relatively easy to implement. The MDNR's Division of Freshwater Fisheries has monitored summer water temperature in the Youghiogheny River from above the tailrace to Sang Run since 1987. Summertime data for 7 years (1987 to 1993) were available to develop this protocol; during 3 of the years (1989, 1990, and 1992), hydrological and meteorological conditions were naturally wet and cool, and water temperature rarely exceeded 25 °C. The other 4 years (1987, 1988, 1991, and 1993) were relatively dry with several days per month exceeding a water temperature of 25 °C. Data for all 7 years were used to develop models to predict maximum river temperature based on river flow, temperature, and meteorological variables.

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[3]A Temperature Simulation Model of the Youghiogheny River from Deep Creek Station to Sang Run. Draft report prepared for the Power Plant Research Program, Maryland Department of Natural Resources, March 1992.

2.1.1.1 Air Temperature and Cloud Cover

The two most important meteorological factors affecting the diurnal increase in river temperature are air temperature over the river and solar radiation entering the river. These parameters are not measured at this section of the Youghiogheny River, although daily minimum and maximum air temperatures are recorded nearby in McHenry and Oakland, MD. Solar radiation is not measured routinely at any nearby locations; however, cloud cover is used as a surrogate measure. The closest sites with recorded cloud cover are Elkins and Morgantown, WV. Hourly air temperature and cloud cover data for these locations are available from the National Weather Service. Because river temperature will be predicted based on air temperature and cloud cover, a prediction model must be based on forecasts of this information. Data are available for Elkins and Morgantown, WV, but not for Oakland or McHenry, MD.

Choosing which station to use for meteorological data depended on how well each candidate station represented the proposed site. Data are collected hourly on a 24-hour basis at Morgantown, which is about 29 miles west-northwest of the Youghiogheny River site, at elevation 1250 feet above mean sea level (MSL). Historically, data were collected hourly for approximately 18 hours per day at Elkins, which is about 52 miles south-southeast of the Youghiogheny site, at elevation 1990 feet MSL. The Youghiogheny site is at about elevation 2000 feet MSL. To select the most appropriate source of data for predicting the temperature of the Youghiogheny River, available air temperature and cloud cover data from Elkins and Morgantown were compared with each other. Air temperature was also compared with data from Oakland, MD. Tables 2-1 and 2-2 show these comparisons.

Table 2-1. Mean and standard deviation (in brackets) of differences in daily minimum and maximum air temperature at Oakland, MD; Morgantown, WV; and Elkins, WV, during the summer (June through August 1987, 1988, 1991, and 1993).

Location	Daily Minimum	Daily Maximum
Elkins - Oakland	0.6 [2.0]	0.8 [2.0]
Morgantown - Elkins	2.6 [2.2]	1.7 [1.6]
Morgantown - Oakland	3.2 [2.2]	2.5 [2.1]

Table 2-2. Mean and standard deviation (in brackets) of differences in daily average of total opaque cloud cover (between 1000 and 1400 hours) at Morgantown and Elkins, WV, during the summer (June through August, 1987, 1988, 1991, and 1993).

Location	Difference
Morgantown - Elkins	0.1 [1.9]

Differences in maximum and minimum air temperature values between all stations were significant (based on a paired t-test, $p = 0.0001$) for this dataset. Differences in cloud cover between Morgantown and Elkins were not significant (based on a paired t-test, $p = 0.22$). The Elkins station is more similar to Oakland than is the Morgantown station with regard to air temperature, and there is no difference in cloud cover between Elkins and Morgantown. No data on cloud cover in Oakland were available. These results, combined with the fact that elevation at Elkins is similar to the elevation at the Youghiogheny River site, suggested that data from the Elkins station would be the best to use for developing models to predict the temperature of the Youghiogeny River.

2.1.1.2 River Flow and Temperature

Based on available observations of river temperature and flow, monitoring for a temperature release would be needed only when the river flow at Oakland was less than 100 cfs (equivalent to about 146 cfs in the river just above the tailrace). This will allow Penelec to limit monitoring to periods when river temperature is most likely to exceed the desired threshold for an enhancement release and minimize monitoring costs. The tailrace flow value was calculated from the equation $Q_{DC} = 1.68 \times Q_o^{0.97}$, where Q_{DC} is the flow above Deep Creek Station and Q_o is the flow at Oakland. Penelec derived this equation and presented it in the Deep Creek Station Support Document, Revised Section 4.0, June 1994. Figure 2-1 illustrates the relationship between daily average river flow and daily maximum water temperature in the Youghiogheny River near Sang Run during the summer, when the project was not operating. The figure illustrates that river temperature exceeds 25 °C only when flows at Oakland are less than about 100 cfs. There appears to be little relationship between flow and river temperature at low flows (i.e., less than 30 to 40 cfs). Successive regressions between flow and temperature, with the flow range varying from 20 to 40 cfs up to 170 cfs, shows a maximum correlation in the range of 30 to 170 cfs.

2.1.2 Regression Models

Appendix B lists available river flow, water temperature, air temperature, cloud cover data, and project operation information. These data were used to develop a series of regression models to predict maximum river temperature at Sang Run at various times of the morning and early afternoon during summer days, when a temperature release could be required. Only data for days when the river flow at Oakland did not exceed 100 cfs and no generation occurred from Deep Creek Station (or generation occurred only after 1500 hours because generation before then would affect maximum river temperature) were used to develop the models.

Although Penelec could use weather data forecasted the day before a potential release to predict maximum river temperature on the following day, rather than using data forecasted on the day of a release, the greater uncertainty in the information would probably cause more

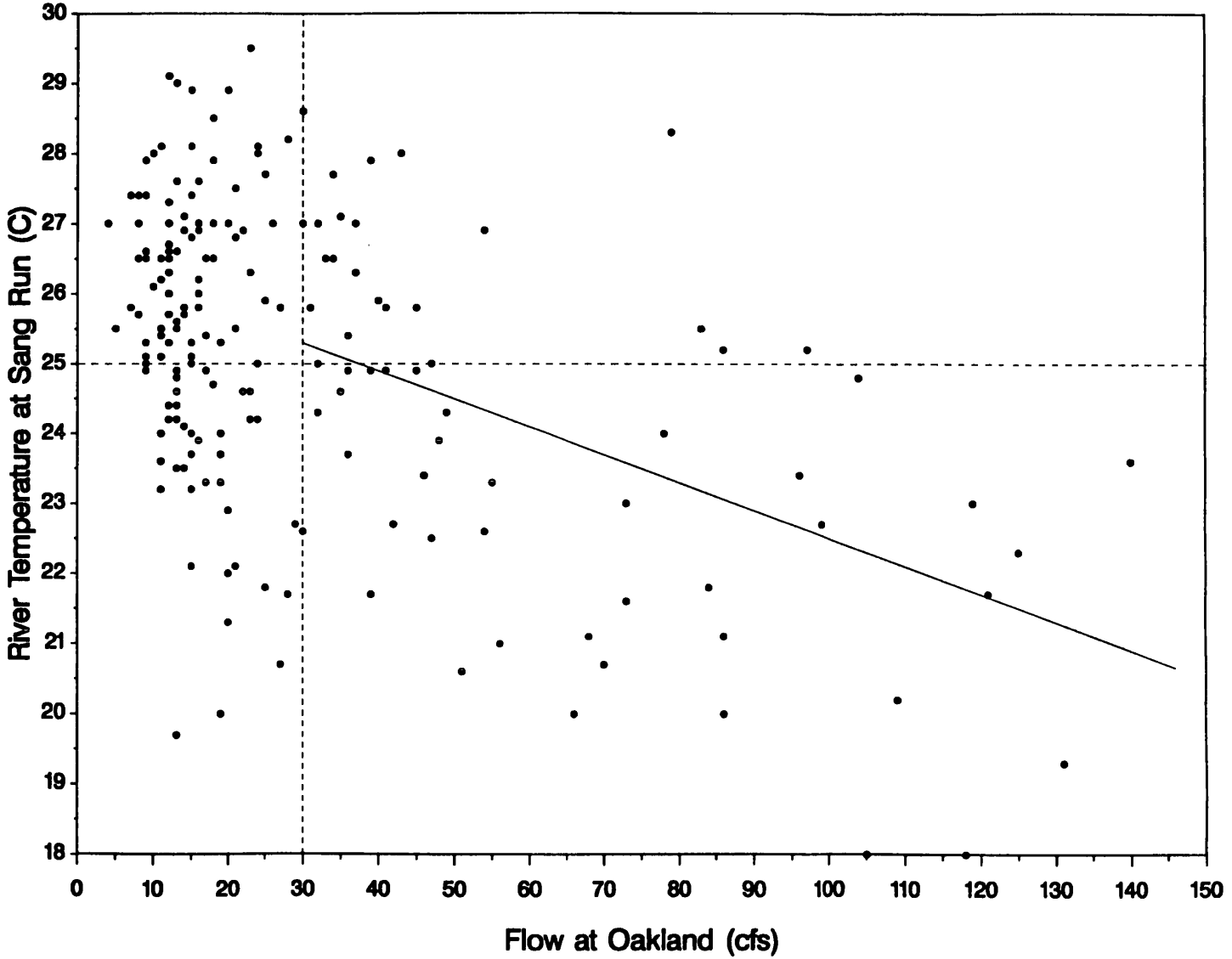


Figure 2-1. Daily average flow in the Youghiogheny River at Oakland, MD, and maximum daily water temperature at Sang Run for June through August 1987 to 1993, on days when the Deep Creek Station was not operated. Vertical line at 30 cfs shows the break-point below which there is little significant relationship between flow and river temperature. The diagonal line shows the relationship between flow and temperature between 30 and 170 cfs at Oakland (river temperature = 26.5 - 0.04 * flow; R^2 = 0.28).

unnecessary releases. The resulting extra use of water could affect scheduled whitewater releases, lake levels, and other generation releases. Using data forecasted before the day of a release, therefore, was not considered a reasonable option for predicting maximum river temperature.

Combinations of variables were tested to obtain the best predictions of maximum daily river temperature for several times during the day. Table 2-3 lists these variables. (These variables also were used to predict the maximum daily change in temperature to determine if a more significant result would be obtained with this equilibrium temperature approach. Results were no better for this approach than for predictions of maximum temperature.)

Table 2-3. Parameters tested for use as regression model predictors of maximum daily river temperature in the Youghiogheny River at Sang Run.

Flow (daily average)	
All flows < 100 cfs at Oakland Flows < 30 cfs Flows > 30 cfs and < 100 cfs	
Air Temperature (daily)	
Maximum at Elkins Minimum at Elkins	
Cloud Cover Fraction at Elkins (average of 1000-1400)	
Square of Cloud Cover Fraction at Elkins	
Cloud cover factor from physical water temperature model (1 - (0.65 * (cloud cover fraction/10)^2)	
Measured River Water Temperatures (at times listed below)	
0700 0700 - 0900 0700 - 1100	0700 - 1200 0700 - 1400 0700 - 1500

2.2 MODEL RESULTS

There are two distinct groups of data with respect to the relationship between flow and river temperature (see Figure 2-1). Because of concern about having split formulas based on river flow, the regressions for models to be used before 1100 were run by adjusting the value of the measured temperature in the Youghiogheny River at Sang Run to account for higher flows. This adjustment was made whenever the daily average flow at Oakland was greater than 30 cfs. The formula used was SMAXADJ = SMAX - 0.04 (OFLOW - 30), where SMAXADJ is Sang Run adjusted temperature, SMAX is Sang Run maximum daily temperature

(°C), and OFLOW is daily average river flow at Oakland (cfs). The value of SMAXADJ was then used as the dependent variable in the regressions for these models (PSANG1 through PSANG3). This adjustment creates one set of parameter estimates for the independent variables (e.g., maximum air temperature, cloud cover, etc.) for the full range of flow being considered while still allowing for the effect of flow on river temperature.

Table 2-4 lists the results of the multiple regression analyses, using the input data discussed above, to predict maximum water temperature in the river at Sang Run. Although many combinations of variables were analyzed, Table 2-4 includes only the model results with the highest R^2 and the variables with a statistically significant influence on maximum river temperature. The first column of Table 2-4 lists the model name, the time of use for the model, and the root mean squared error (RMS) based on the input data used to develop the model. The RMS number represents the mean difference between the actual maximum river temperature and the predicted maximum river temperature based on that model. The second column lists the variables used in the models in order of decreasing importance or correlation with the maximum river temperature. The third column shows the parameter estimates for each variable; these can be used in an equation to compute a predicted temperature. The fourth column of Table 2-4 shows the R^2 for each parameter individually; this number indicates the degree of correlation between that variable and the measured maximum river temperature. (An R^2 of 1.0 indicates a correlation of 100% or exact correspondence between variables, whereas an R^2 of 0.0 indicates no correlation.) The fifth column in Table 2-4 lists the cumulative R^2 value for the predictor variables. The most important variables for all models were maximum daily air temperature at Elkins (TMAXAIR), average total opaque cloud cover at Elkins (CLOUDCOV), and various combinations of river temperature values throughout the day. Table 2-4 shows the diminishing importance of the predicted variables of TMAXAIR and CLOUDCOV as the day progresses as shown in the partial R-square column; the models rely more on measured river temperatures from 1200 through 1500 hours. This series of models will provide advance notice of the most likely releases (those needed for the highest temperatures) and minimize unnecessary releases. Releases needed for less severe temperatures will be made later during the morning or early afternoon.

Predictions must be conservative to minimize unnecessary releases. Since predicted air temperature and cloud cover data instead of measured data are used to implement this protocol, predictions of maximum river temperature are less certain than suggested in Table 2-4, which is based on actual data. The following adjustments were made to account for this uncertainty, at least partially, and to use historical data to estimate the number of releases that would be triggered. Measured maximum air temperature was adjusted downward by 1.5 °C (2.7 °F) because forecasts are often given as a range (e.g., upper 80s could be 87 to 89.9 °F). Cloud cover forecasts usually are provided as descriptions; Table 2-5 lists these descriptions and their quantitative definitions. The measured cloud cover values were adjusted to the upper limit of each of the first 5 categories.

Maximum river temperature was predicted using the equations listed in Table 2-6 with the historical data and adjusting the maximum air temperature and cloud cover values as

Table 2-4. Youghiogheny River temperature enhancement release trigger regression models using 1987 through 1993 river temperatures at Sang Run and meteorological data from Elkins, WV, on days with either no generation or generation after 1500 hours and river flow at Oakland less than 100 cfs.

MODEL NUMBER AND HOUR	Variables	Parameter Estimate	Partial R-Square	Model R-Square
PSANG1	(intercept)	14.430	-	-
(no water temperature available)	TMAXAIR	0.356	0.53	0.53
	CLOUDCOV	-0.017	0.02	0.55
	TMINAIR	0.109	0.03	0.58
RMS = 1.28				
PSANG2	(intercept)	10.920	-	-
(0700)	TMAXAIR	0.322	0.53	0.53
	CLOUDCOV	-0.019	0.06	0.56
	S7	0.338	0.03	0.62
RMS = 1.21				
PSANG3	(intercept)	10.203	-	-
(0900)	TMAXAIR	0.284	0.53	0.53
	CLOUDCOV	-0.021	0.07	0.60
	S9	1.208	0.04	0.64
	S7	-0.779	0.02	0.65
RMS = 1.16				
PSANG4	(intercept)	6.202	-	-
(1100)	TMAXAIR	0.247	0.55	0.58
	S11	1.393	0.09	0.64
	S9	-0.828	0.08	0.72
	CLOUDCOV	-0.010	0.01	0.74
RMS = 1.08				
PSANG5	(intercept)	5.555	-	-
(1200)	TMAXAIR	0.214	0.55	0.55
	S12	1.059	0.13	0.68
	S9	-0.448	0.06	0.74
RMS = 1.06	CLOUDCOV	-0.008	0.01	0.75
PSANG6	(intercept)	3.563	-	-
(1400)	S14	1.356	0.80	0.80
	S12	-0.600	0.05	0.86
RMS = 0.76	TMAXAIR	0.103	0.01	0.87
PSANG7	(intercept)	3.075	-	-
(1500)	S15	1.140	0.89	0.89
	S12	-0.312	0.02	0.91
RMS = 0.61	TMAXAIR	0.049	0.002	0.92

Variables:
TMAXAIR,TMINAIR = Maximum, minimum daily air temperature at Elkins, WV (°C)
CLOUDCOV = Square of total opaque cloud cover, as measured at Elkins, WV, from 1000 to 1400 hours, fraction from 0 (no clouds) to 10 (totally cloud covered)
S7 - S14 = Temperature at Sang Run 0700 to 1400 hours (°C)
OFLOW = Daily average flow at Oakland (cfs)
RMS = Root Mean Squared error

described above for PSANG2 through PSANG5. After 1200 hours (PSANG6 and PSANG7), maximum air temperature and cloud cover are less important predictors of maximum river temperature than measured temperatures; therefore, the uncertainty adjustments are no longer needed. Appendix C shows plots of predicted versus measured maximum river temperature data for the series of models.

Table 2-5. Ranges of fractional cloud cover associated with descriptions of cloudiness. Source: National Weather Service

Description	Lower Limit	Upper Limit	Midpoint
Overcast or Cloudy	9	10	9.5
Mostly Cloudy or Considerable Cloudiness	7	8	7.5
Partly Cloudy or Partly Sunny	3	6	4.5
Mostly Clear or Mostly Sunny	1	3	2.0
Clear or Sunny	0	1	0.5
Fair	0	4	2.0
Variable Cloudiness	0	10	5.0

PSANG1 is intended for use only when measured water temperature data are not available. A conservative estimate cannot be made in this case because only one prediction can be made on a given day. Higher numbers of false positives (unnecessary releases) and false negatives (failures to make needed releases) will occur with PSANG1 than with releases based on water temperature measurements (PSANG2 through PSANG7).

Sensor reading times were chosen to maximize the number of releases for which at least 3 hours of notice can be provided while minimizing the number of unneeded releases and limiting the total number of readings to six. The earliest temperature release would occur at 1100 hours, based on sensor readings at 0700 and 0900 hours, and the released water would reach Sang Run at 1300 hours. Releases based on these readings would provide maximum notice times of 6 and 4 hours, respectively. A sensor reading at 1100 hours originally was planned to trigger a release at 1200 hours, which would reach Sang Run at 1400 hours, for a maximum of 3 hours notice. At the request of American Whitewater Affiliation (AWA), a release time of 1230 (to reach Sang Run at 1430 and provide an additional half-hour of notice) was evaluated. The risk of river temperature exceeding 25 °C increased slightly with the later release time. Four (15%) of the 27 releases predicted from temperature recorded at 1200 hours occurred with temperature exceeding 25 °C by 1430 hours; however, temperatures never exceeded 26.0°C during the 30- to 60-minute period before a release reached Sang Run. The average increase during the extra 30-minute period was 0.6 °C for the 4 occurrences within the historical dataset. Since these temperature exceedances occurred infrequently, and for only a short period of time, it should be acceptable to change the release time to accommodate whitewater recreation interests.

Table 2-6. Youghiogheny River temperature enhancement protocol prediction equations.

Hour	Equation
-	PSANG1a = 14.43 + .356*TMAXAIR - 0.017*CLOUDCOV + .109*TMINAIR (oflow ≤ 30 cfs) PSANG1b = 14.43 + .356*TMAXAIR - 0.017*CLOUDCOV + .109*TMINAIR - 0.04* (OFLOW -30) (oflow > 30 cfs)
0700	PSANG2a = 10.926 + .322*TMAXAIR - .019*CLOUDCOV + .338*S7 (oflow ≤ 30 cfs) PSANG2b = 10.926 + .322*TMAXAIR - .019*CLOUDCOV + .338*S7 - 0.04* (OFLOW -30) (oflow > 30 cfs)
0900	PSANG3a = 10.203 + .284*TMAXAIR - .021*CLOUDCOV + 1.208*S9 - 0.779*S7 (oflow ≤ 30 cfs) PSANG3b = 10.203 + .284*TMAXAIR - .021*CLOUDCOV + 1.208*S9 - 0.779*S7 - 0.04* (OFLOW -30) (oflow > 30 cfs)
1100	PSANG4 = 6.202 + .247*TMAXAIR - .010*CLOUDCOV - .828*S9 + 1.393*S11
1200	PSANG5 = 5.555 + .214*TMAXAIR - .008*CLOUDCOV - .448*S9 + 1.059*S12
1400	PSANG6 = 3.563 + .103*TMAXAIR - .600*S12 + 1.356*S14
1500	PSANG7 = 3.075 + .049*TMAXAIR - .312*S12 + 1.140*S15

Variables:

TMAXAIR = Predicted maximum air temperature for Elkins WV (°C)
CLOUDCOV = Square of predicted local cloud cover fraction (see Table 2-5)
TMINAIR = Measured minimum air temperature for Elkins WV (°C)
S7 - S15 = Measured temperature in the Youghiogheny River at Sang Run at hours indicated (°C)
OFLOW = Flow at Oakland gage (cfs)

Note: To test the models PSANG2 - PSANG5 under forecasting uncertainty using the measured data, TMAXAIR = TMAXAIR - 1.5 (measured maximum air temperature at Elkins, WV - 1.5) and CLOUDCOV = square of upper limit of the category listed in Table 2-5, based on the measured total opaque cloud cover at Elkins, WV between 1000 - 1400.

Table 2-7 summarizes the temperature enhancement protocol and results using historical data. Appendix D lists model results for individual dates. Trigger temperatures were selected so that releases would minimize false positives, particularly for PSANG2 through PSANG4, without severely restricting the number of releases for which notification could be provided. Based on historical data, using this protocol would result in about a 14% rate of unnecessary releases (false positives) and about a 4% rate of failure to make needed releases (false negatives). The actual temperature was 25 °C for 4 of the 16 "unnecessary" releases and 24.9 °C for 3 of those releases. This means that almost half of the unnecessary releases were triggered by temperatures very close to the threshold temperature. Based on total percentage of unnecessary releases estimated from historical data, 2 to 3 additional releases would be made during an average year that required 17 temperature enhancement releases (see next section).

2.3 ESTIMATE OF DAYS AND HOURS OF RELEASE REQUIRED TO ENHANCE TEMPERATURE

The total number of days and hours per month during which a release from the Deep Creek Station would be needed to enhance temperature can be estimated as follows. An upper limit on the number of days during which a release could be needed is based on the information in Figure 2-1, which shows that temperature has never exceeded the threshold value of 25 °C unless the flow in the river at Oakland was less than 100 cfs. A frequency distribution of temperature exceedances for various flow ranges was calculated using available river temperature data from 1987 to 1993 (Table 2-8). These frequencies were used with historical flow data available for 1961 to 1993 to calculate the number of days per year from June through August during which temperature enhancement releases would have been needed (Table 2-9). The number of days in each flow category for each year was multiplied by the frequencies of temperature exceedances for each flow category as listed in Table 2-8. The sum of these values was then adjusted to account for scheduled whitewater releases as described in the following paragraph. The number of hours was calculated by assuming that 66% of the daily releases would be for 2 hours and 34% of the releases would be for 1 hour (based on the results shown in Table 2-7).

During a typical summer (June through August), approximately 29 days of whitewater releases would be scheduled on Fridays, Mondays, and one Saturday per month. These scheduled releases would also enhance temperature if a release would have been required on the same day. A scheduled release would occur 29 of 92 days or 32% of the time; therefore, the number of releases needed only for temperature enhancement would be reduced by this amount, assuming that temperature enhancement releases are randomly distributed. These scheduled releases could be reduced during very dry years (i.e., the Monday and Saturday releases would be eliminated whenever the lake water level is below the lower rule curve, and the Friday release would be eliminated whenever the lake level is 1 foot or more below the lower rule curve). Penelec's project operations model (presented as Appendix D of the June 1994 Support Document for Permit Application to Appropriate and Use Waters of the State,

Table 2-7. Predicted results using Youghiogheny River temperature enhancement release protocol based on 177 days of historical data from 1987 through 1993.

	PSANG 1	PSAN G2	PSAN G3	PSAN G4	PSAN G5	PSAN G6	PSAN G7	TOTAL
READ SENSOR	-	0700	0900	1100	1200	1400	1500	
RELEASE TIME	1100	1100	1100	1230	1200	1400	1500	
TIME AT SANG	1300	1300	1300	1430	1400	1600	1700	
RELEASE DURATION (hr)	2	2	2	2	1	1	1	
MAX. NOTICE (hr)	6	6	4	3.5	2	2	2	
TRIGGER TEMP. °C	25.1	26.4	25.9	25.4	25.3	25.2	25.1	
TOTAL RELEASES	112	25	22	28	11	18	8	112
% TOTAL	-	22	20	25	10	16	7	
CUM. %	-	22	42	67	77	93	100	
FALSE + (unneeded release)	24	0	1	4	3	4	4	16 (14%)
FALSE - (needed release not made)	13						5	5 (4%)

Note: The distribution of actual maximum river temperature on dates with unneeded releases (false positives) is as follows: 4 @ 25.0; 3 @ 24.9; 2 @ 24.6; 1 @ 24.2; 3 @ 24.0, 2 @ 23.9; and 1 @ 23.4. The actual temperatures on dates when a needed release was not made (false negatives) are: 25.8, 25.4, 25.3, and 2 @ 25.2.

Revised Section 4.0) was used to determine how often this would have occurred under historical hydrological conditions. Lake level never dropped more than 1 foot below the lower rule curve during June through August in any of the years simulated. During 4 years, the Friday and Monday releases were eliminated for 1 month during summer (1964, 1976, 1986, 1991). During another 4 years, these releases were eliminated for 2 months during summer (1965, 1966, 1969, and 1988). The number of releases in these years that would have been coincident with scheduled releases, therefore, was reduced by only 24% and 20%, respectively, for the purpose of estimating the number of temperature enhancement releases that would have been needed under historical conditions.

Table 2-8. Frequency distribution of flows less than 100 cfs at Oakland and occurrences of temperature greater than 25 °C at Sang Run for June through August of 1987 to 1993, when the Deep Creek Station was not operating (based on available data as listed in Appendix B).

Flow Range (cfs)	Total Days	Days Temp > 25 °C	% days > 25 °C
0-10	18	15	83
11-20	79	62	78
21-30	29	17	59
31-40	19	11	58
41-50	10	3	30
51-100	20	4	20

Table 2-9 shows that the average number of days with flow in the river less than 100 cfs at Oakland during the summers of 1961 through 1993 was about 54 out of a possible 92 (59%). In an average year, 17 days of temperature enhancement releases would be needed, based on the adjustments described above. This figure is probably an overestimate because it is biased by low-flow periods, when the total of all releases from Deep Creek Station would be less frequent. Note that 13 days were estimated for 1992 based on this method, but none actually were needed during that year. There is additional unquantified uncertainty in the estimate because the predictions are based on forecasted weather information rather than the measured data on which this protocol is based. These compounding factors tend to cancel each other out to some unknown extent. Approximately 42% of the unscheduled releases (7 days on average) would occur with 4 to 6 hours notice on the day of the release. An additional 24% could have a maximum of 3.5 hours notice, and the remaining 34% would have less than 2 hours notice.

Table 2-9. Estimate of days and hours requiring temperature enhancement releases from the Deep Creek Station during the summer, based on river flow frequencies for June through August of each year, temperature exceedance frequencies shown in Table 2-8, and adjusted for scheduled whitewater releases.

	Days at Flow Range (cfs)						Annual Number of Additional Flow Releases for Temperature	
Year	0-10	11-20	21-30	31-40	40-50	51-100	Days	Hours
1961	0	0	0	1	3	31	5	9
1962	3	10	12	11	6	16	20	33
1963	0	0	4	11	5	31	11	19
1964	3	25	14	17	8	19	34	57
1965	22	43	12	9	2	3	50	85
1966	13	33	16	7	10	12	43	73
1967	0	0	2	16	8	29	13	22
1968	0	4	14	13	9	20	17	30
1969	0	8	11	15	3	26	21	36
1970	0	0	0	6	8	29	8	14
1971	0	4	12	18	8	25	19	32
1972	0	0	0	0	0	37	5	9
1973	0	0	4	17	12	22	14	23
1974	0	0	10	18	6	19	15	25
1975	0	0	1	7	10	26	9	15
1976	0	4	10	6	13	31	16	28
1977	0	0	0	3	7	43	8	14
1978	0	0	0	6	2	18	5	9
1979	0	0	0	1	6	46	8	13
1980	0	0	0	0	0	13	2	3
1981	0	0	0	6	3	20	6	10
1982	0	0	0	5	8	30	8	13
1983	0	3	21	14	5	24	20	34
1984	0	0	0	5	4	25	6	11
1985	0	0	0	2	7	24	5	9
1986	0	0	5	17	4	36	15	26
1987	0	14	11	9	6	32	21	36
1988	7	37	14	9	2	14	40	67
1989	0	0	0	0	0	11	1	3
1990	0	0	0	7	2	23	6	11
1991	19	43	14	10	2	4	47	80
1992	0	0	11	8	4	31	13	21
1993	30	19	12	10	4	10	43	73
Average	3	7	6	9	5	24	17	29

2.4 ESTIMATE OF UNNEEDED RELEASES

False negatives (needed releases that are not made) will be detected by the sensor at Sang Run; however, there is no way to measure the number of false positives (unnecessary releases) because the release will keep the temperature at Sang Run below 25 °C most of the time. The best way to estimate what the temperature at Sang Run would have been in the absence of project operation is to use a similar upstream station. The best station to use for this purpose is at Swallow Falls, approximately 2 miles upstream of the project tailrace and just below a similar flat stretch of river. Data for this site are available for only a portion of the summer of 1987 and for most of the summer of 1993 (see Appendix B for raw data). These data (Figure 2-2) show a direct correlation between temperature at Swallow Falls and at Sang Run in the absence of project operation. Temperature at Swallow Falls is 1.4 °C (SD 1.2) higher than at Sang Run, on average. The figure also shows the linear relationship between stations when adjusted for this difference. This relationship will be used to evaluate the results of project operations for temperature enhancement each year.

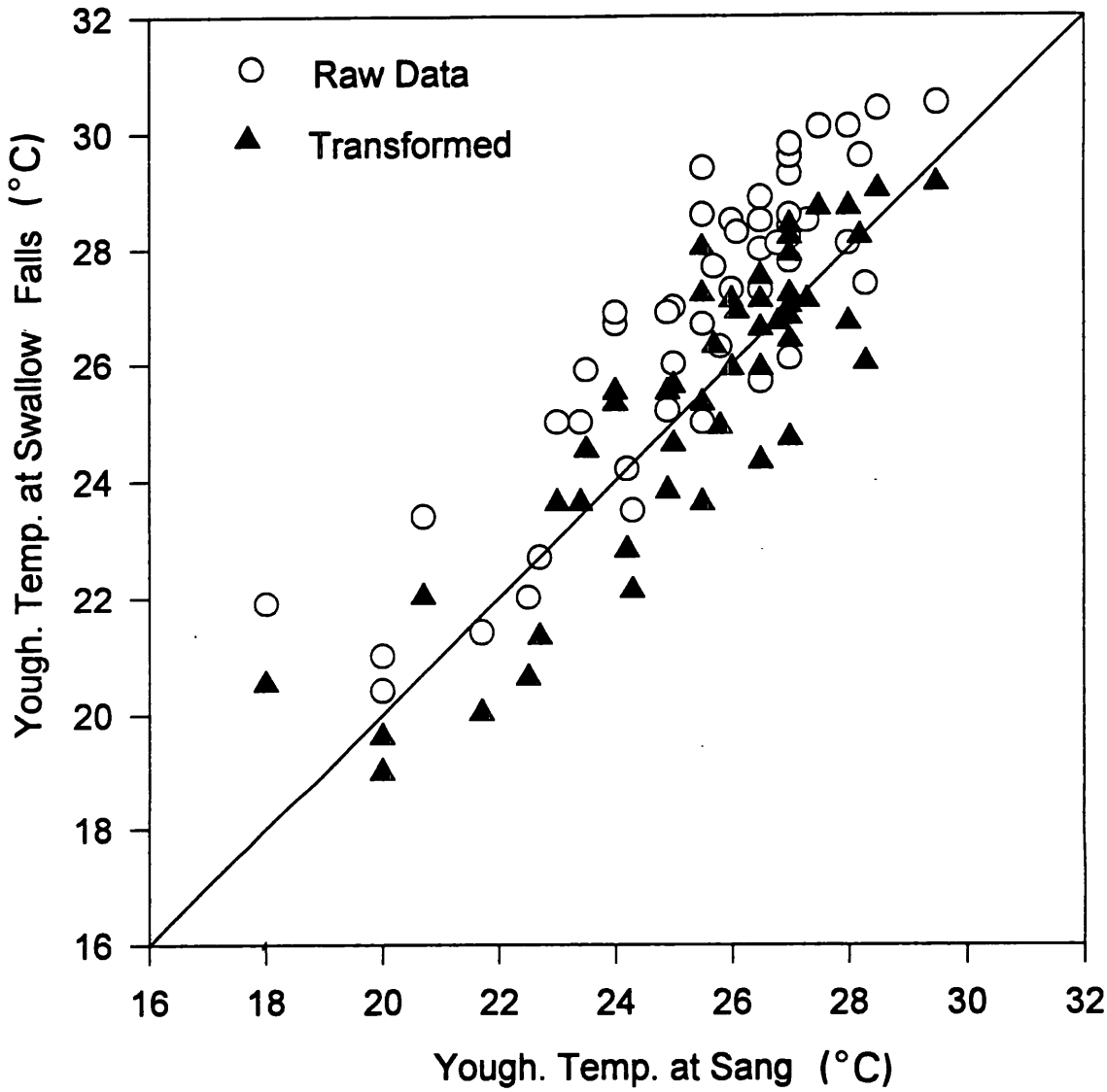


Figure 2-2. Comparison of Youghiogheny River temperature at Swallow Falls and Sang Run in summer 1987 and 1993 when the Deep Creek Station was not operating

3.0 RESULTS FOR 1995 AND 1996

3.1 METHODS

Data were obtained from various sources and summarized for use in evaluating the temperature enhancement protocol for 1995 and 1996. Appendix E presents the summarized data and Appendix F presents graphs for each day that water temperature data were available. The sources of each kind of data are described below.

3.1.1 Water Temperature

Penelec recorded water temperatures at the Sang Run bridge at 2-minute intervals from June through August 1995 and 1996. These data were available to the station operators for real-time decision-making regarding whether to release water for temperature enhancement according to the protocol. The 2-minute data were subsetted at half-hour intervals for comparison with data collected by MDNR using TempMentors placed in the river at the following locations (see Figure 1-1): Swallow Falls, above the tailrace, in the tailrace; Hoyes Run, between Hoyes Run and Steep Run; Steep Run, between Steep Run and Sang Run; and Sang Run (two recorders). The TempMentors recorded temperatures at half-hour intervals from June 20 through September 30, 1995 and from June 19 through September 30, 1996. These data were available after the summer season to evaluate river temperature and its relationship to releases from Deep Creek Station. Data from the two Sang Run stations and the Penelec Station were plotted daily for comparison with operation of the Deep Creek Station and flow and meteorological data (Appendix F).

For 1995, we used the average of MDNR's TempMentor data from the Sang Run station to determine if the target temperature of 25 °C was maintained because Penelec's data were not reliable until after mid-July. For 1996, we also used the average of MDNR's Sang Run data to be consistent with 1995. We used data from the Swallow Falls station to estimate what the river temperature at Sang Run would have been without releases from Deep Creek Station.

3.1.2 Meteorological Data

Penelec used forecasted information from Elkins, WV, as part of the temperature enhancement protocol. Penelec recorded the information for dates during June through August when no releases were scheduled for any purpose other than temperature enhancement. Hourly records of actual meteorological data from the Elkins station were obtained from the National Climatic Data Center in Asheville, NC, after the summer season. These data were used to obtain daily values for actual cloud cover and daily minimum and maximum air

temperatures for comparison with predicted values. Daily minimum and maximum air temperatures for Oakland, MD, also were obtained.

Prior to 1996, cloud cover information was available for the Elkins station as cloud cover fraction in tenths, a number ranging from 0 to 10. As shown in Table 2-5, these numerical values correspond to certain descriptive terms for cloud cover. In 1996, apparently, because the station was automated, cloud cover fraction was no longer reported. Instead, sky cover descriptive terms were used. We converted these descriptive terms to an average numerical value as follows: CLR or FEW = 0.5; SCT = 3; BKN = 7.5; OVC = 9.5. These values applied to analyses using the measured cloud cover fractions; Penelec continued to use descriptions of cloud cover predictions as listed in Table 2-5.

3.1.3 River Flow Data

Penelec obtained instantaneous, early morning flow readings for the Youghiogheny River at Oakland from the U.S. Army Corps of Engineers' river bulletin board (Internet address: http://www.orp-wc.usace.army.mil/current/yc.html). Flow information recorded at 15-minute intervals was obtained from the U.S. Geological Survey (station number 03075500) and summarized to provide daily averages. The 15-minute data were plotted with temperature measurements to indicate changes in flow that may have occurred during the day because of storms. Average flow for June through August 1995 was 88 cfs, as compared with a long-term average flow of 167 cfs for these months. This period ranks as the 16th driest year out of the last 55. Average flow for the June through August 1996 was 417 cfs, the second wettest year on record since 1942 (Table 3-1).

3.2 RESULTS AND DISCUSSION

3.2.1 1995

Table 3-2 summarizes the releases from Deep Creek Station between June 20 and August 31, 1995 (there were no temperature enhancement releases before June 20, and MDNR was not able to deploy temperature sensors at all the stations before then because of high water levels in the river). The table shows that 48% of the days during that period had announced and scheduled releases (at least one day in advance). Announced and scheduled whitewater releases were 37% of the total (Mondays, Fridays, and at least one Saturday per month during the whitewater boating season from April 15 through October 15, water levels permitting), and announced and scheduled releases for power generation were 11% of the total. Unscheduled releases were 37% of the total, consisting of 33% for temperature enhancement and 4% for unscheduled power generation. There were no releases of any kind on 15% of days during this period.

Table 3-1. Hydrologic ranking of summer average flow in cfs at Oakland from 1942 through 1996 (USGS station 03075500).

Year	Rank	June	July	August	Average
1965	1	24	17	13	18
1991	2	25	20	11	19
1966	3	41	18	18	26
1953	4	46	10	23	26
1957	5	42	32	13	29
1988	6	72	20	17	36
1964	7	60	35	20	38
1959	8	60	38	23	40
1952	9	74	21	36	44
1944	10	112	29	11	51
1993	11	94	41	20	52
1983	12	139	73	28	80
1971	13	104	41	99	81
1960	14	94	77	83	85
1987	15	167	50	43	87
1995	16	111	37	116	88
1947	17	129	76	61	89
1976	18	187	76	38	100
1979	19	109	102	102	104
1973	20	202	59	73	111
1967	21	84	181	89	118
1977	22	100	117	139	119
1969	23	30	92	236	119
1968	24	253	33	82	123
1986	25	58	278	45	127
1962	26	264	103	20	129
1942	27	101	45	242	129
1946	28	331	49	19	133
1950	29	252	121	35	136
1943	30	70	147	208	142
1945	31	94	141	211	149
1970	32	198	109	156	154
1994	33	69	109	316	165
1955	34	180	74	246	167
1963	35	331	125	97	184
1949	36	109	387	70	189
1951	37	449	138	27	205
1954	38	261	71	337	223
1982	39	277	329	66	224
1975	40	195	74	405	225
1984	41	84	350	245	226

Table 3-1. Continued

Year	Rank	June	July	August	Average
1974	42	571	84	46	234
1992	43	153	466	97	239
1958	44	75	410	331	272
1990	45	229	579	91	300
1961	46	410	85	411	302
1972	47	593	254	110	319
1978	48	182	629	154	322
1981	49	730	164	88	327
1948	50	345	508	154	336
1989	51	470	392	159	340
1985	52	568	496	85	383
1956	53	345	233	586	388
1996	54	273	567	362	401
1980	55	464	203	585	417
Average		202	164	135	167

Table 3-2. Summary of releases from Deep Creek Station in 1995 during implementation of the temperature enhancement protocol (June 20 through August 31). Note: DNR's temperature sensors were not deployed until June 19.

Release Type	# Days (6/20-8/31)	% of Days (6/20-8/31)
Announced and Scheduled for WW	27	37
Announced and Scheduled for Power	8	11
TOTAL announced and scheduled	**35**	**48**
Not announced or scheduled (for Power)	3	4
Temperature Enhancement	24	33
TOTAL unscheduled	**27**	**37**
Days with no release	11	15
TOTAL DAYS or %	**73**	**100**

Table 3-3 lists the dates on which temperature exceeded 25 °C, the duration of the exceedance, the maximum temperature for the date, and possible reasons for the exceedances. The first part of the table lists 4 dates when temperature exceeded 25 °C, but no release was made (i.e., false negatives). On 2 occasions, the operator failed to make a needed

release for some unknown reason. On 2 other occasions, the protocol was followed correctly but conditions were outside the range for which the protocol was developed. On July 16, the river flow at Oakland was greater than 100 cfs, which means the protocol did not require a release. On July 19, the 0700 temperature prediction was 20.9°C, which according to the protocol was cool enough to suspend further monitoring for the day.

Table 3-3. Summary of temperatures exceeding 25 °C in the Youghiogheny River at Sang Run between June 20 and August 31, 1995.

Date	Duration of exceedance (hours)	Max Temp (°C) Penelec	Max Temp (°C) MDNR	Start time of release	Duration of release	Possible Reason
1. No release made						
7/9	2.8	25.8	25.6			operator error
7/16	6.4	27.6	26.9			flow>100
7/18	6.0	27.1	26.7			operator error
7/19	3.4	25.6	25.3			low 7AM temp
2. Release made but insufficient or not in time						
6/21	0.4	25.9	25.7	1230	2	protocol uncertainty
7/11	0.1	24.9	25.3	1230	2	protocol uncertainty
7/22	3.0	27.1	26.4	1530	1	operator error - delay
7/23	2.9	27.3	27.2	1525	1	operator error - delay
7/25	1.4	26.4	26.0	1400	1	protocol uncertainty
7/27	0.4	25.5	25.8	1200	2	"
8/13	0.1	24.9	25.1	1230	2	"
8/14	3.4	26.2	25.9	1000	3	flow>100
8/15	1.6	25.9	26.4	1230	6	flow>100
8/16	2.0	26.2	26.7	1250	6	flow>100
8/17	1.7	26.1	27.1	1200	4	flow>100
8/20	0.1	24.4	25.1	1230	2	protocol uncertainty
8/23	1.3	26.5	25.4	1515	1	late due to high cloud cover prediction
8/24	0.6	26.1	25.4	1430	1	protocol uncertainty

The second part of Table 3-3 lists dates when water was released, but the volume was insufficient or the release occurred too late to prevent river temperature from exceeding 25 °C at Sang Run. Table 3-4 summarizes the reasons for exceedances and indicates that 4 of 18 exceedances were caused by operator error. Thirteen of the remaining 14 exceedances were the result of the inherent uncertainty in the protocol. On 4 occasions, the exceedance was less than 0.4°C, and on 3 occasions, the exceedance lasted less than 15 minutes. On 5 other occasions, temperature exceeded 25 °C because of poor predictions of cloud cover, predictions of a low temperature in the morning, or unexplained uncertainty.

Table 3-4. Summary of reasons for temperature exceeding 25 °C in the Youghiogheny River at Sang Run between June 20 and August 31, 1995.

Reason	No. of Times
Operator Error	4
Small Exceedance (< = 25.4)	4
Flow > 100 cfs at Oakland	5
Poor cloud cover prediction	1
Other uncertainty	3
Low AM temperature	1
TOTAL	**18**

On 5 occasions, the river flow exceeded 100 cfs at Oakland, but the river temperature exceeded 25 °C. River temperature historically had not exceeded 25 °C when flow was greater than 100 cfs at Oakland, based on data collected since 1987. Four of these exceedances occurred between August 14 and August 17, when water was released for other purposes, yet temperature exceeded 25 °C for 1.7 to 3.4 hours per day. On August 14, water was released between 1000 and 1300 hours, and temperature exceeded 25 °C at about 1630 hours. An additional 4-hour release probably would have been needed to maintain temperature below 25 °C because of the large volume of relatively fast-moving warm water in this river reach on that date. On the subsequent 3 days, water was released after 1200 hours for purposes other than temperature enhancement; consequently, the releases occurred too late to maintain temperature below 25 °C. The only way to correct this situation would have been to monitor river temperature and implement the protocol with instantaneous river flows in the morning as high as 308 cfs at Oakland. Since this situation seems to occur rarely, the cost to correct it does not seem warranted at this time.

Figures 3-1 through 3-5 show the maximum daily temperatures in 1995 at all the stations monitored except for the tailrace. These figures show maximum temperatures at

Swallow Falls and above the tailrace, the two stations unaffected by releases from Deep Creek Station. The figures show temperatures immediately downstream and at several locations between Hoyes Run and Sang Run. The figures illustrate that there were 18 dates with river temperature greater than 25 °C at Sang Run; however, river temperature exceeded 25 °C between Hoyes Run and the station immediately upstream of Sang Run (labelled Steep_Sang) on only 10 of these dates. Six of the 8 days on which the temperature was less than 25 °C at all stations except Sang Run had a release too late to maintain temperature at Sang Run, but the release was sufficient to maintain temperatures at the locations upstream from there (6/21, 7/11, 7/25, 7/27, 8/13, and 8/20).

Table 3-5 illustrates the frequency distribution of river temperatures greater than 25 °C at Sang Run compared with temperatures at Swallow Falls, adjusted to represent temperature at Sang Run without releases from the Deep Creek Station. As described in Section 2.4, the temperature at Swallow Falls was an average of 1.4 °C warmer than at Sang Run (in the absence of project operation), based on data from 1987 and 1993. This table shows 18 days with temperatures greater than 25 °C; the maximum temperature was less than 27.5°C. Without releases from the Deep Creek Station, temperatures would have exceeded 25 °C on an estimated 40 days and 27.5 °C on 12 days.

Table 3-5. Distribution of temperatures greater than 25 °C in the Youghiogheny River at Sang Run and Swallow Falls between June 20 and August 31, 1995 (Swallow Falls data were also adjusted to represent temperatures in Sang Run without releases from Deep Creek Station by subtracting 1.4 °C from the measured temperature at Swallow Falls).

Temperature Range	Sang Run, Days > 25 °C	Swallow Falls, Days > 25 °C	Adjusted Swallow Falls, Days > 25 °C
25.1 - 25.5	6	4	11
25.6 - 26.0	5	6	7
26.1- 26.5	2	4	4
26.6 - 27.0	3	13	6
27.1 - 27.5	2	3	0
27.6 - 28.5	0	10	4
28.6 - 30.0	0	5	6
> 30.0	0	7	2
Total	18	52	40

The data from Swallow Falls also can be used to estimate when releases may have been unnecessary (i.e., false positives). On 5 of 24 days with a temperature enhancement

release, the adjusted maximum daily temperature at Swallow Falls did not exceed 25 °C. The actual temperature at Swallow Falls was less than 25 °C on only 2 of those days. These results suggest that the protocol was successful at maintaining temperatures below 25 °C most of the time, while not releasing water for temperature enhancement unnecessarily.

3.2.2 1996 Results

Table 3-6 summarizes the releases from Deep Creek Station between June 29 and August 31, 1996 (there were no temperature enhancement releases before June 19, and MDNR was not able to deploy temperature sensors at all the stations before then because of high water levels in the river). The table shows that about 60% of the days during that period had announced and scheduled releases (at least one day in advance). Announced and scheduled whitewater releases were 38% of the total (Mondays, Fridays, and at least one Saturday per month during the whitewater boating season from April 15 through October 15, water levels permitting), and announced and scheduled releases for power generation were 22% of the total. Tabulation of scheduled whitewater releases included all Mondays and Fridays plus those Saturdays previously requested by boaters as a scheduled whitewater boating day. Since 1996 was such a wet year, a number of these days had more hours of releases than originally scheduled to keep lake levels down due to excess water and in some cases, these releases may have created water levels too high for some or all boaters. Unscheduled releases were 20% of the total, consisting of 11% for temperature enhancement and 9% for unscheduled power generation. There were no releases of any kind on 20% of days during this period.

Table 3-6. Summary of releases from Deep Creek Station in 1996 during implementation of the temperature enhancement protocol (June 19 through August 31). Note: DNR's temperature sensors were not deployed until June 18.

Release Type	# Days (6/19-8/31)	% of Days (6/19-8/31)
Announced and Scheduled for WW	28	38
Announced and Scheduled for Power	16	22
TOTAL announced and scheduled	**44**	**60**
Not announced or scheduled (for Power)	7	9
Temperature Enhancement	8	11
TOTAL unscheduled	**15**	**20**
Days with no release	15	20
TOTAL DAYS or %	**74**	**100**

Table 3-7 lists the dates on which temperature exceeded 25 °C, the duration of the exceedance, the maximum temperature for the date, and possible reasons for the exceedances. The first part of the table lists 1 date when temperature exceeded 25 °C, but no release was made (i.e., false negatives). On this date, the river flow at Oakland was greater than 100 cfs, which means the protocol did not require a release.

Table 3-7. Summary of temperatures exceeding 25 °C in the Youghiogheny River at Sang Run between June 19 and August 31, 1996.

Date	Duration of exceedance (hours)	Max Temp (°C) Penelec	Max Temp (°C) MDNR	Start time of release	Duration of release	Possible Reason
1. No release made						
6/23	4.1	26.4	26.1			flow >100
2. Release made but insufficient or not in time						
6/29	0.5	25.4	24.1	1230	2	protocol uncertainty
7/2	1.5	25.8	26	1430	1	late due to high cloud cover prediction

Figures 3-6 through 3-10 show the maximum daily temperatures in 1996 at all the stations monitored except for the tailrace. These figures show maximum temperatures at Swallow Falls and above the tailrace, the two stations unaffected by releases from Deep Creek Station. The figures show temperatures immediately downstream and at several locations between Hoyes Run and Sang Run. The figures illustrate that there were 3 dates with river temperature greater than 25 °C at Sang Run; however, river temperature exceeded 25 °C between Hoyes Run and the station immediately upstream of Sang Run (labelled Steep_Sang) on only 1 of these dates. There were 2 days when the temperature was less than 25 °C at all stations except Sang Run. On these days, the release was too late to maintain temperature at Sang Run, but was sufficient to maintain temperatures at the locations upstream from there (6/29 and 7/2).

Table 3-8 illustrates the frequency distribution of river temperatures greater than 25 °C at Sang Run compared with temperatures at Swallow Falls, before and after adjustment to represent temperature at Sang Run without releases from the Deep Creek Station. As described in Section 2.4, the temperature at Swallow Falls was an average of 1.4 °C warmer than at Sang Run (in the absence of project operation), based on data from 1987 and 1993. This table shows 3 days with temperatures greater than 25 °C; the maximum temperature was

less than 26.5°C. Without releases from the Deep Creek Station, temperatures would have exceeded 25 °C between 4 and 10 days.

The data from Swallow Falls also can be used to estimate when releases may have been unnecessary (i.e., false positives). On 5 of 8 days with a temperature enhancement release, the adjusted maximum daily temperature at Swallow Falls did not exceed 25 °C. The actual temperature at Swallow Falls was less than 25 °C on only 1 of those days. These results suggest that the protocol was successful at maintaining temperatures below 25 °C most of the time, while not releasing water for temperature enhancement unnecessarily.

Table 3-8. Distribution of temperatures greater than 25 °C in the Youghiogheny River at Sang Run and Swallow Falls between June 19 and August 31, 1996 (Swallow Falls data were also adjusted to represent temperatures in Sang Run without releases from Deep Creek Station by subtracting 1.4 °C from the measured temperature at Swallow Falls).

Temperature Range	Sang Run, Days > 25 °C	Swallow Falls, Days > 25 °C	Adjusted Swallow Falls, Days > 25 °C
25.1 - 25.5	1	1	1
25.6 - 26.0	1	2	1
26.1- 26.5	1	3	2
26.6 - 27.0	0	1	0
27.1 - 27.5	0	1	0
27.6 - 28.0	0	2	0
> 28.0	0	0	0
Total	3	10	4

3.3 SUMMARY AND CONCLUSIONS

Implementation of the temperature enhancement protocol in 1995 and 1996 was very successful at maintaining lower temperatures than expected in the river without the releases. A small further improvement is possible with greater operator training in implementing the protocol to make sure that water is released when necessary. The only change in the protocol that might improve the temperature enhancement plan would be to reduce the low morning temperature threshold, which would have prevented a temperature exceedance on one date (July 19). It seems unlikely that an adjustment in the protocol at this time to account for higher flows would improve attainment of the temperature enhancement goal. After several more years of monitoring the effectiveness of the temperature enhancement protocol, sufficient data may be available to evaluate the need to adjust the protocol.

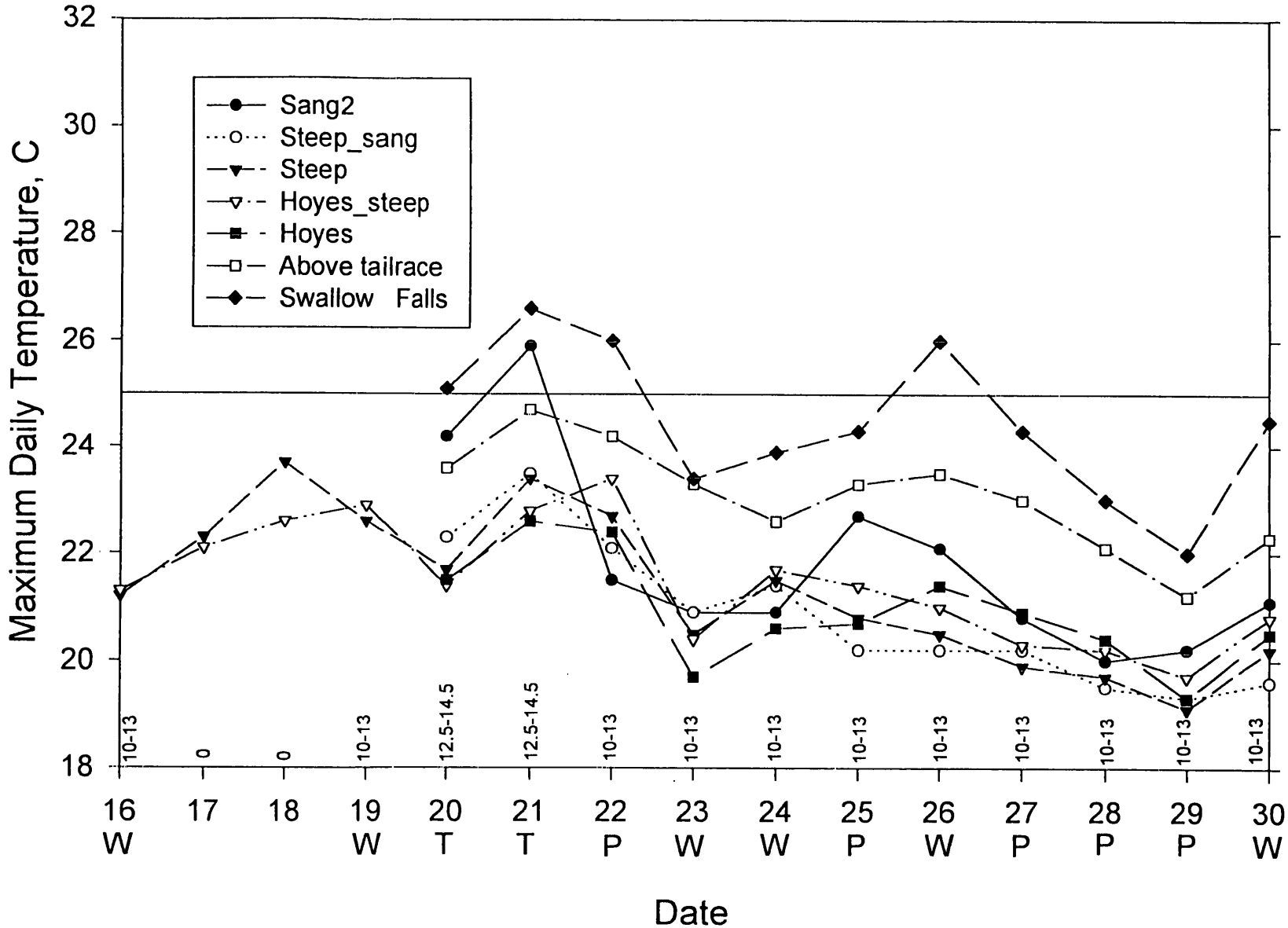


Figure 3-1. Maximum daily water temperature at several locations in the Youghiogheny River, June 1995. Time of releases more than 30 minutes is listed above each date (to the nearest half-hour). Below each date is a code listing the type of release (if any); W = whitewater; T = temperature enhancement; P = power.

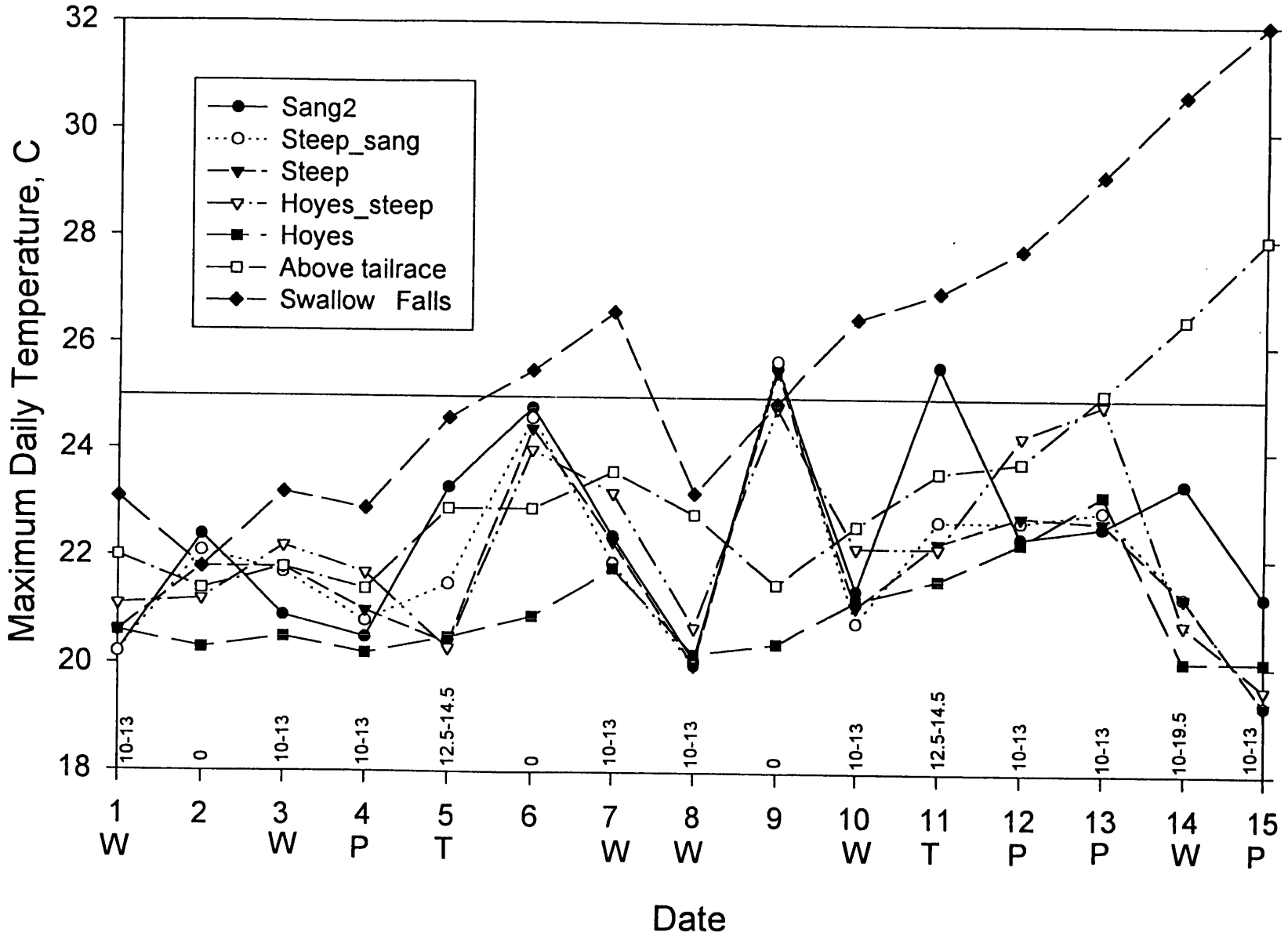


Figure 3-2. Maximum daily water temperature at several locations in the Youghiogheny River, July 1 through 15, 1995. Time of releases more than 30 minutes is listed above each date (to the nearest half-hour). Below each date is a code listing the type of release (if any); W = whitewater; T = temperature enhancement; P = power.

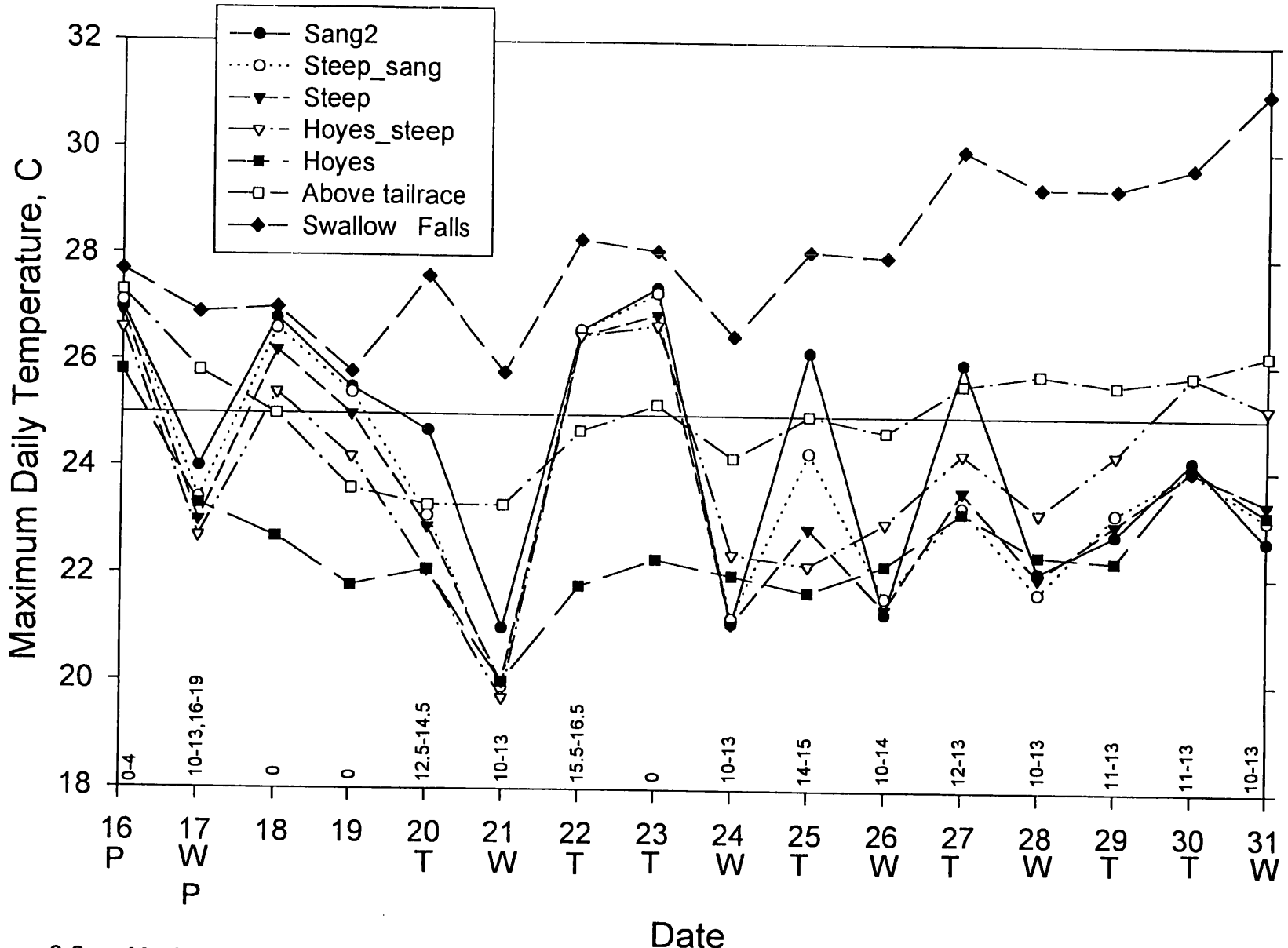


Figure 3-3. Maximum daily water temperature at several locations in the Youghiogheny River, July 16 through 31, 1995. Time of releases more than 30 minutes is listed above each date (to the nearest half-hour). Below each date is a code listing the type of release (if any); W = whitewater; T = temperature enhancement; P = power.

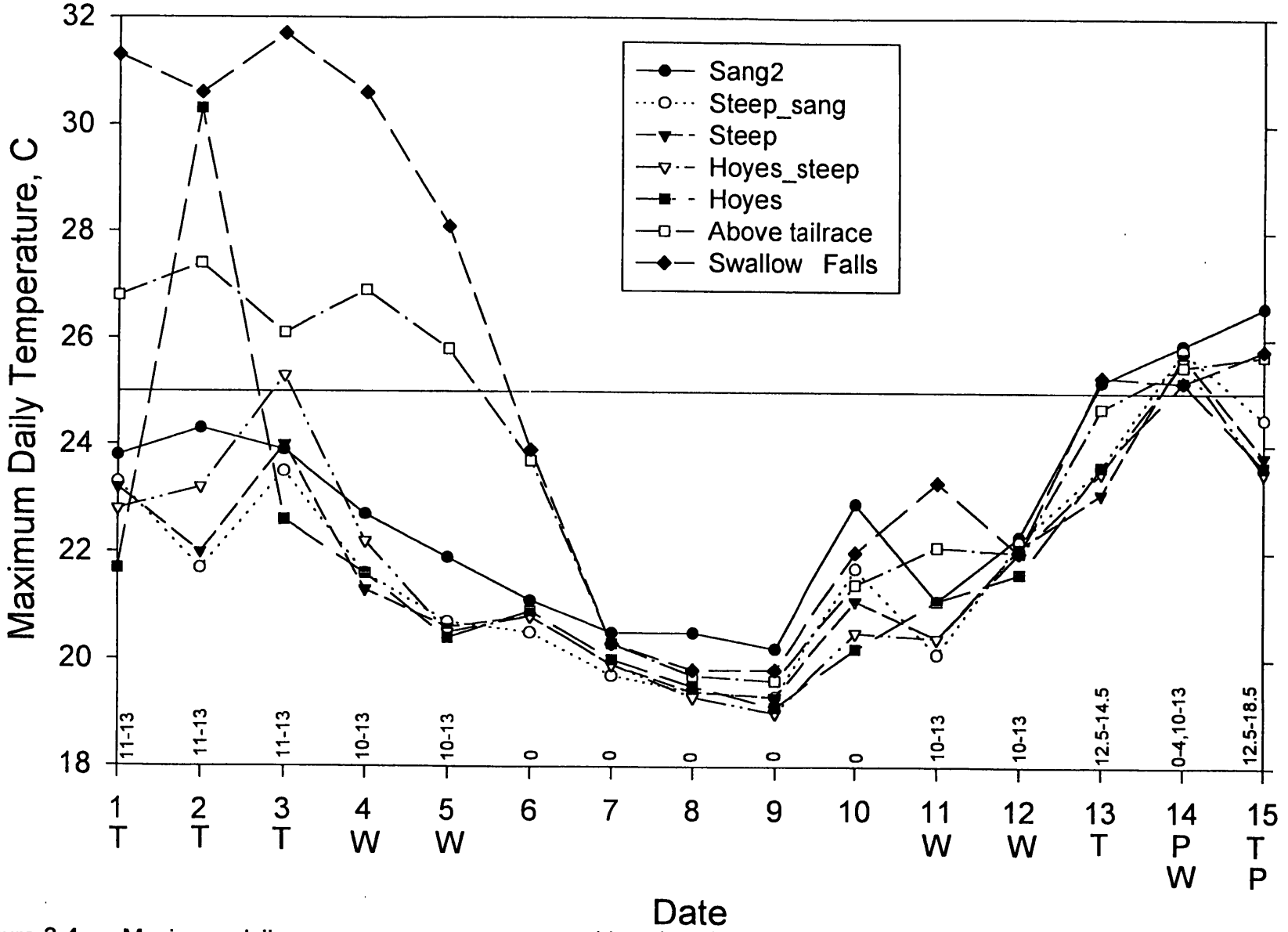


Figure 3-4. Maximum daily water temperature at several locations in the Youghiogheny River, August 1 through 15, 1995. Time of releases more than 30 minutes is listed above each date (to the nearest half-hour). Below each date is a code listing the type of release (if any); W = whitewater; T = temperature enhancement; P = power.

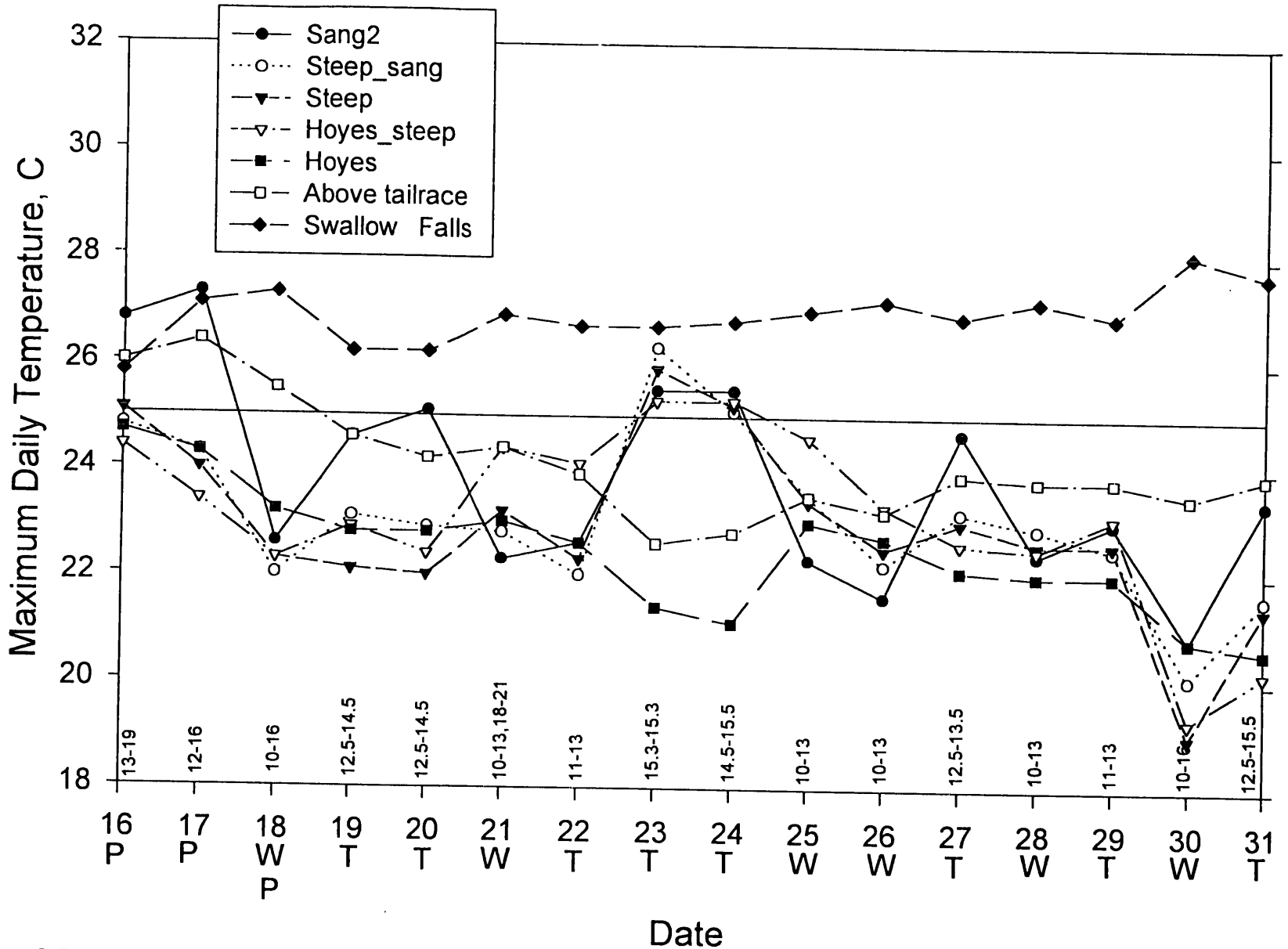


Figure 3-5. Maximum daily water temperature at several locations in the Youghiogheny River, August 16 through 31, 1995. Time of releases more than 30 minutes is listed above each date (to the nearest half-hour). Below each date is a code listing the type of release (if any); W = whitewater; T = temperature enhancement; P = power.

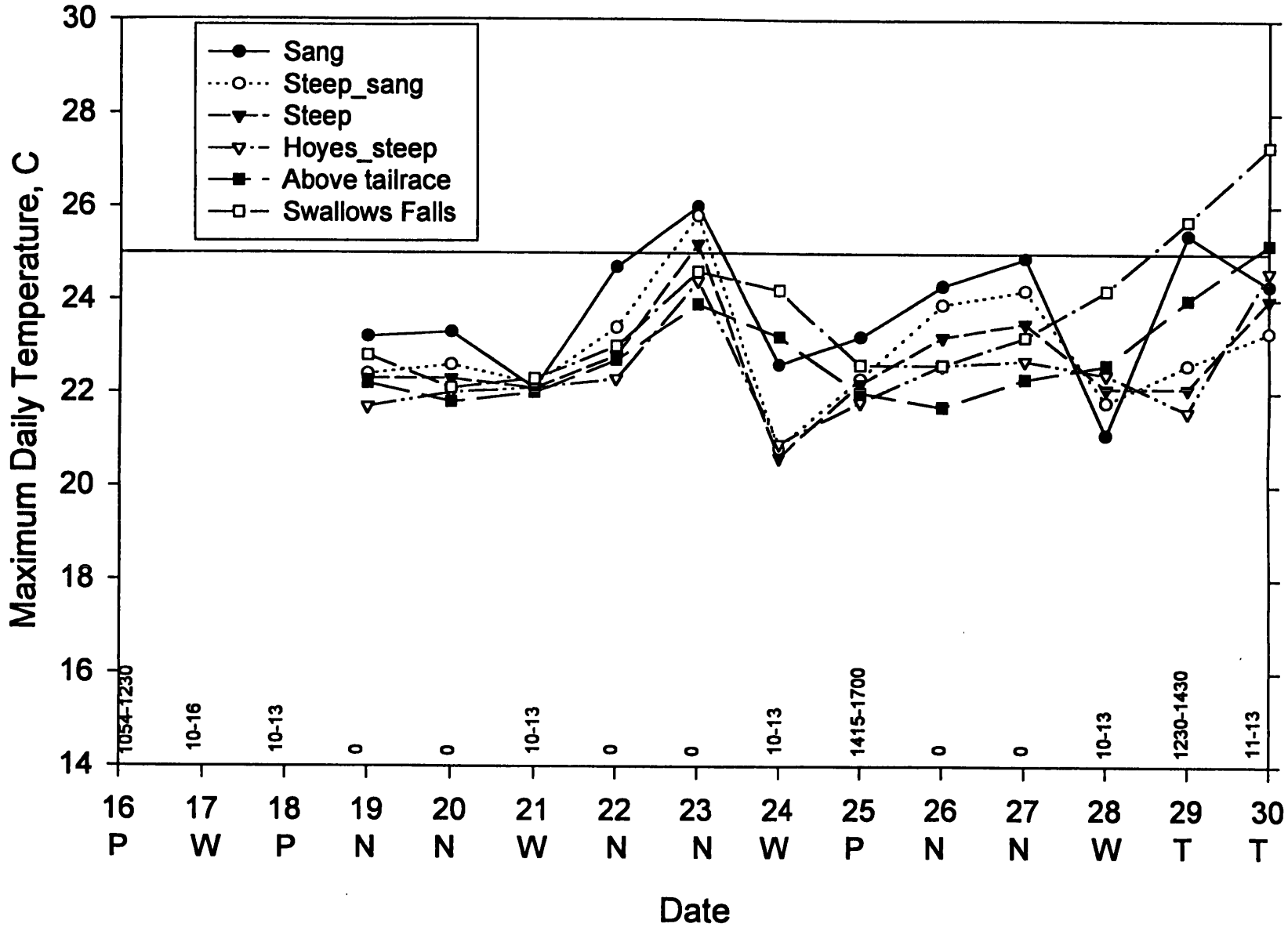


Figure 3-6. Maximum daily water temperature at several locations in the Youghiogheny River, June 1996. Time of releases more than 30 minutes is listed above each date (to the nearest half-hour). Below each date is a code listing the type of release (if any); W = whitewater; T = temperature enhancement; P = power.

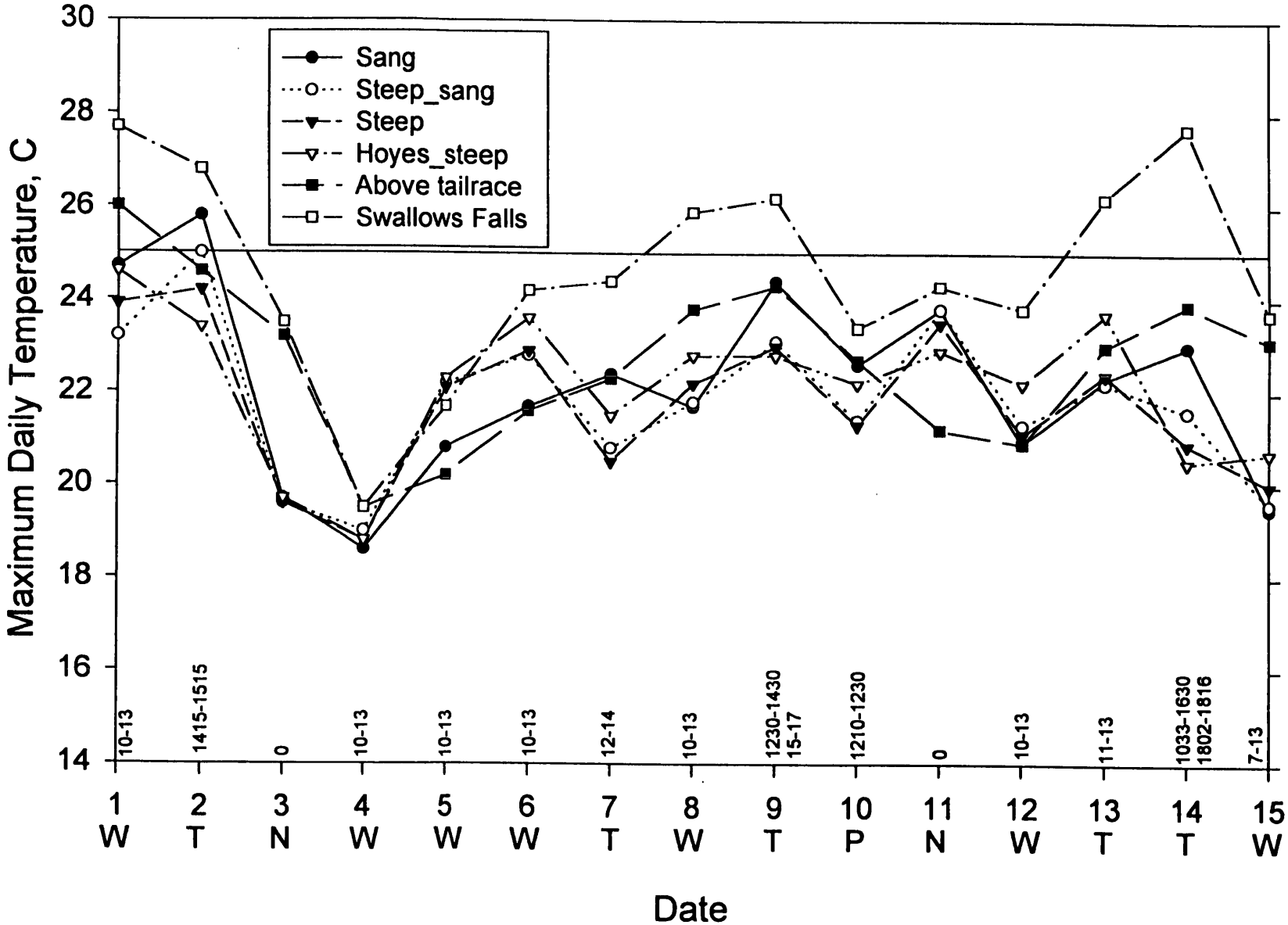


Figure 3-7. Maximum daily water temperature at several locations in the Youghiogheny River, July 1 through 15, 1996. Time of releases more than 30 minutes is listed above each date (to the nearest half-hour). Below each date is a code listing the type of release (if any); W = whitewater; T = temperature enhancement; P = power.

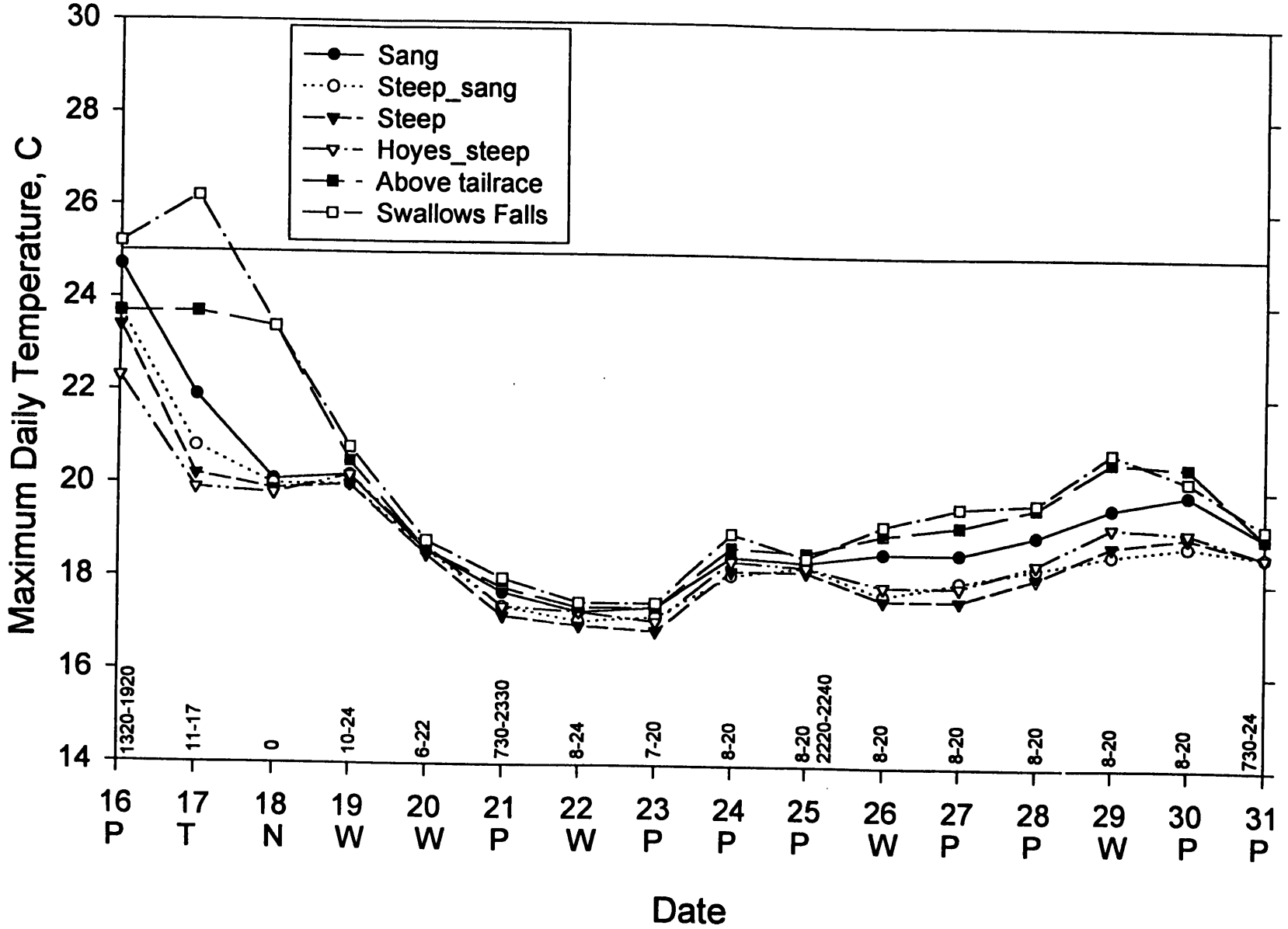


Figure 3-8. Maximum daily water temperature at several locations in the Youghiogheny River, July 16 through 31, 1996. Time of releases more than 30 minutes is listed above each date (to the nearest half-hour). Below each date is a code listing the type of release (if any); W = whitewater; T = temperature enhancement; P = power.

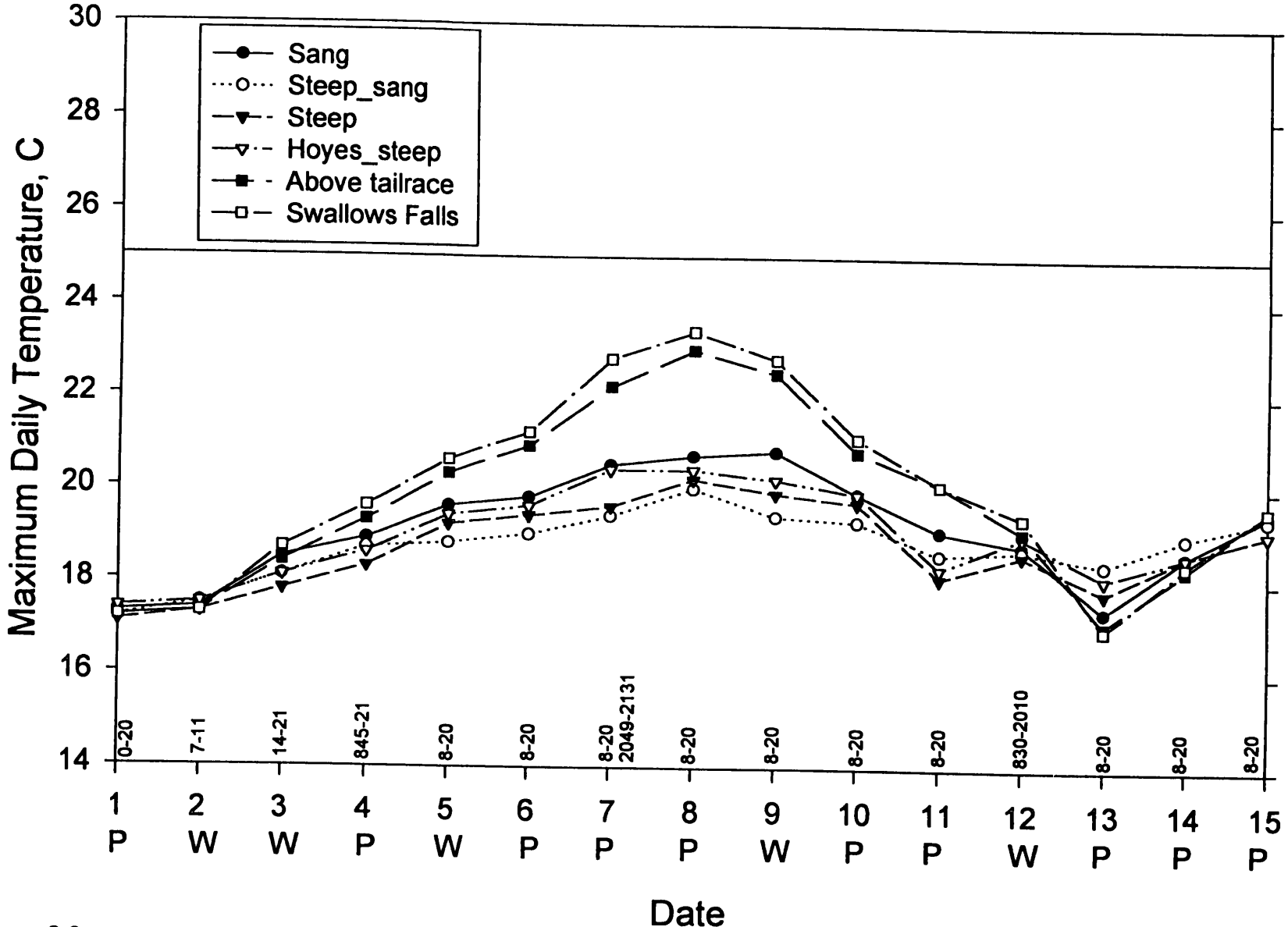


Figure 3-9. Maximum daily water temperature at several locations in the Youghiogheny River, August 1 through 15, 1996. Time of releases more than 30 minutes is listed above each date (to the nearest half-hour). Below each date is a code listing the type of release (if any); W = whitewater; T = temperature enhancement; P = power.

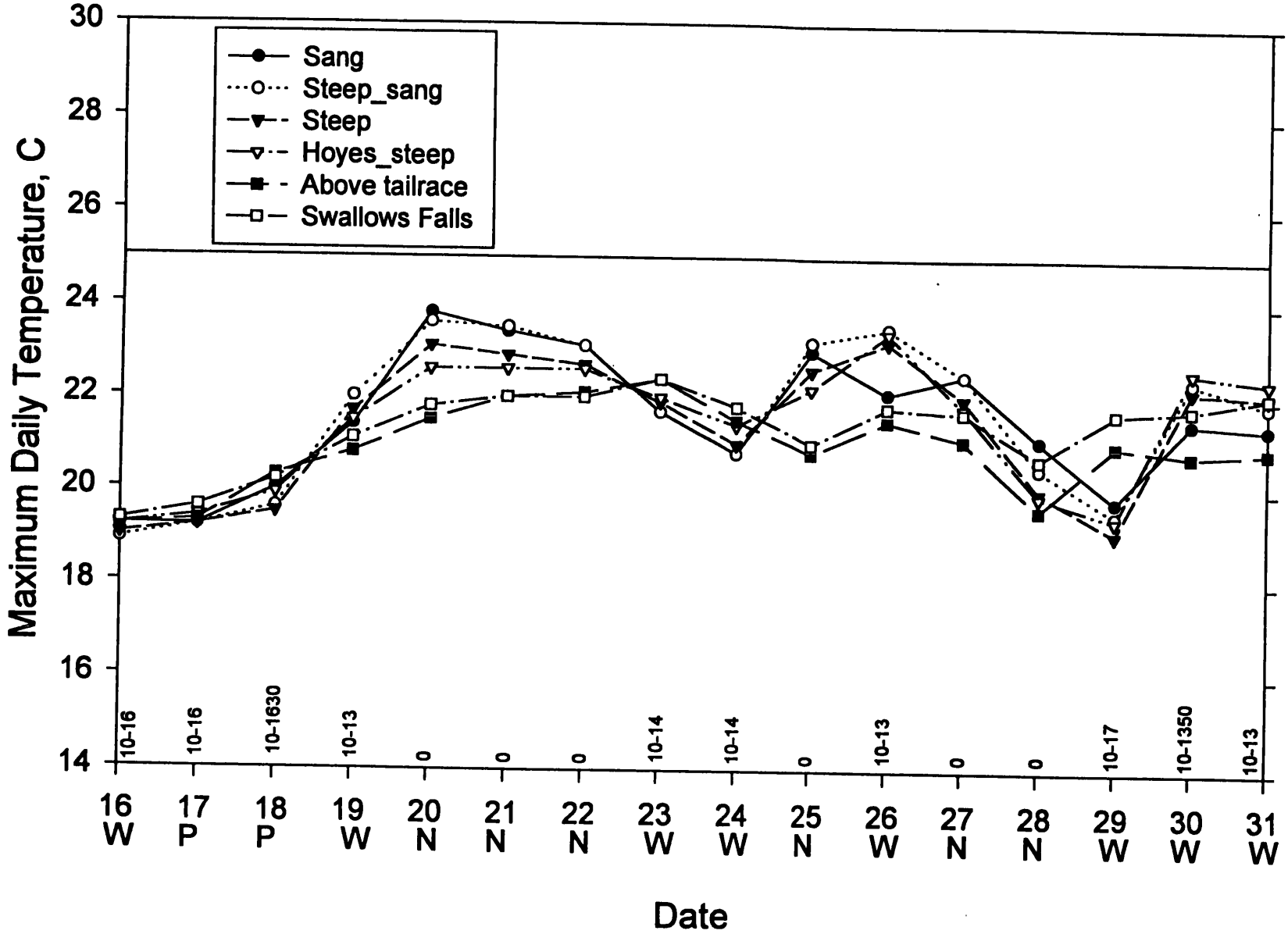


Figure 3-10. Maximum daily water temperature at several locations in the Youghiogheny River, August 16 through 31, 1996. Time of releases more than 30 minutes is listed above each date (to the nearest half-hour). Below each date is a code listing the type of release (if any); W = whitewater; T = temperature enhancement; P = power.

APPENDIX A

TEMPERATURE CRITERIA FOR BROWN TROUT AND MAXIMUM TEMPERATURES IN THE YOUGHIOGHENY RIVER

TEMPERATURE CRITERIA FOR BROWN TROUT AND MAXIMUM TEMPERATURES IN THE YOUGHIOGHENY RIVER

As a means of enhancing brown trout habitat in the Youghiogheny River, Maryland DNR proposed 25 °C as a target for maximum temperature in the five-mile reach of river below the Deep Creek project discharge. Penelec accepted this proposal. Project releases would be used to keep the river temperature below this value. Several sources in the literature indicate that 25 °C is a reasonable value for maximum temperature for this species. Raleigh et al. (1986) presented temperature suitability data for various life stages of brown trout; Table A-1 shows these data.

Table A-1. Brown trout temperature tolerances for various life stages (from Raleigh et al. 1986)

Life Stage	Optimal Range (°F)	Maximum (°F)	Optimal Range (°C)	Maximum (°C)
spawning/eggs	43 - 48	55	6.1 - 8.9	12.8
fry	43 - 59	72	6.1 - 15.0	22.2
juvenile	43 - 75	79	6.1 - 23.9	26.1
adult	54 - 72	75	12.2 - 22.2	23.9

Armour (1991) stated that the maximum weekly average temperature (MWAT) can be calculated based on experimental data and that the value can be interpreted as the upper temperature recommended for a specific life stage. MWAT can be calculated from the equation:

$$MWAT = OT + (UUILT - OT)/3$$

where

OT = reported optimal temperature for the particular life stage or function, and

UUILT = the upper temperature at which tolerance does not increase with increasing acclimation temperature.

For adult brown trout, based on the data of Raleigh et al. (1986), the MWAT is calculated to be 22.8, for OT = 22.2 °C and UUILT = 23.9 °C.

Armour (1991) also discussed the short-term maximum (STM) survival temperature, which is the maximum temperature that 50% of the fish could survive for a short time (i.e., 24 h or less); he also said it is the same as the incipient lethal temperature. For brown trout, based on Raleigh et al. (1986), the value is 26.1 °C for juveniles and 23.9 °C for adults. The mean of these values is 25 °C. Because spawning, egg incubation, and fry are more likely to occur during cooler periods, these life stages were not considered in this evaluation.

Brungs and Jones (1977) listed upper lethal threshold temperatures for brown trout, depending on life stage and acclimation temperature. One source that they cited listed 26 °C as the ultimate upper incipient lethal temperature for adults acclimated to 20°C; another source listed 25 °C as the upper limit for fish of unknown ages acclimated to temperatures between 15 °C and 23 °C.

Data from the Youghiogheny River collected between 1987 and 1991 during summer months show that during low flow periods, weekly averages of daily maximum temperatures can exceed both the MWAT and the STM (Figure A-1) for several days at a time during low flow, warm periods. A goal of maintaining maximum river temperatures below 25 °C seems reasonable based on data from the Youghiogheny River and literature values cited above. This goal would provide an enhanced habitat for brown trout by keeping the temperature below the STM and the MWAT.

References:

Armour, C.L. 1991. Guidance for evaluating and recommending temperature regimes to protect fish. U.S. Fish Wildl. Serv., Biol. Rep. 90(22). 13pp.

Brungs, W.A. and B.R. Jones. 1977. Temperature criteria for freshwater fish: protocol and procedures. USEPA Environmental Research Laboratory, Duluth, MN. EPA-600/3-77-061.

Raleigh, R.F., L.D. Zuckerman, and P.C. Nelson. 1986. Habitat suitability index models and instream flow suitability curves: brown trout, revised. U.S. Fish Wildl. Serv., Biol. Rep. 82(10.124). 65 pp.

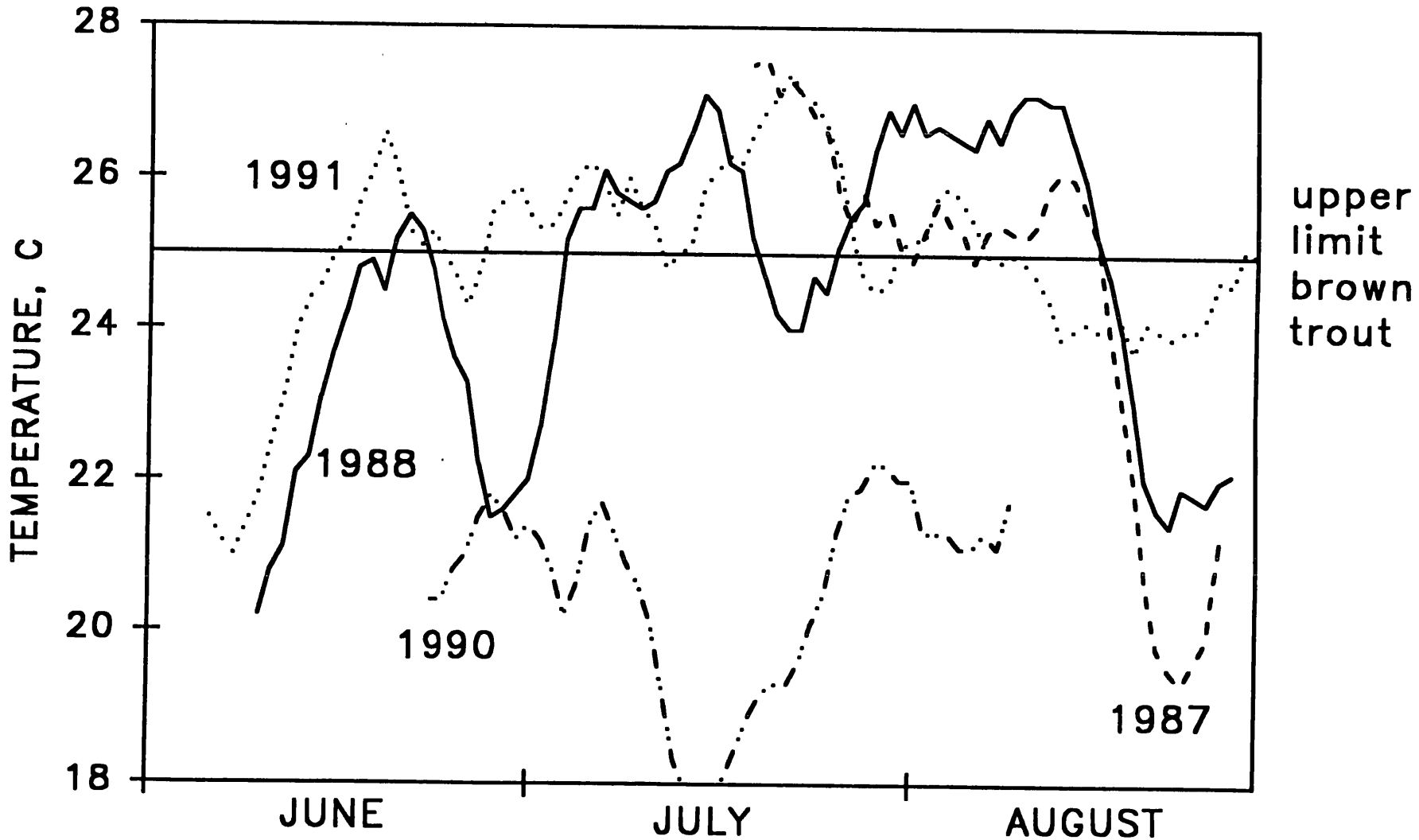


Figure A-1. Weekly moving average of maximum daily water temperature in the Youghiogheny River at Sang Run for 1987, 1988, 1990, and 1991

APPENDIX B

YOUGHIOGHENY RIVER TEMPERATURE ENHANCEMENT PROTOCOL MODEL INPUT DATA

Variable Definitions:

OFLOW	=	Daily average Youghiogheny River flow at Oakland, MD (cfs)
TFLOW	=	Daily average Youghiogheny River flow above the Deep Creek tailrace (cfs); based on equation TFLOW = (1.68 * OFLOW ** 0.97)
SMEAN	=	Daily mean river temperature at Sang Run (°C)
SMIN	=	Daily minimum river temperature at Sang Run (°C)
SMAX	=	Daily maximum river temperature at Sang Run (°C)
SWAMAX	=	Daily maximum river temperature at Swallow Falls (°C)
OMIN	=	Daily minimum air temperature recorded at Oakland, MD (°C)
EMIN	=	Daily minimum air temperature recorded at Elkins, WV (°C)
OMAX	=	Daily maximum air temperature recorded at Oakland, MD (°C)
EMAX	=	Daily maximum air temperature recorded at Elkins, WV (°C) (=TMAXAIR)
ECLD	=	Average total opaque cloud cover fraction recorded at Elkins, WV between 1000 and 1400 (0=no clouds; 10=total cloud cover)
S7-S15	=	Youghiogheny River temperature at 0700 to 1500 (±15 minutes)
GEN	=	Generation code; N=no generation; G=generation occurred
SG1, EG1	=	Starting and ending hours (nearest hour) of first generation of the day
SG2, EG2	=	Starting and ending hours (nearest hour) of second generation of the day

Youghiogeny River Temperature Enhancement Input Data

DATE	OFLOW	TFLOW	SMEAN	SMIN	SMAX	SWAMAX	OMIN	EMIN	OMAX	EMAX	ECLD	S7	S8	S9	S10	S11	S12	S13	S14	S15	GEN	SG1	EG1	SG2	EG2
18JUL87	33	53	21.2	17.0	26.5	25.7	9.4	10.0	27.8	29.4	2.2	17.0	17.0	17.0	18.0	19.0	20.5	22.0	23.5	24.5	N	0	0	.	.
19JUL87	30	47	22.0	17.5	27.0	26.1	10.0	10.0	28.9	30.6	4.2	17.5	17.5	17.5	18.5	19.5	21.0	22.0	24.0	24.5	N	0	0	.	.
21JUL87	24	39	23.5	19.5	28.0	30.1	18.9	16.1	31.1	32.8	5.6	20.0	20.0	20.5	21.0	22.0	23.5	24.5	26.0	27.0	N	0	0	.	.
22JUL87	23	38	24.8	20.5	29.5	30.5	15.6	15.6	30.6	32.2	3.2	21.0	20.5	21.0	21.5	22.5	23.5	25.0	26.5	27.5	N	0	0	.	.
23JUL87	21	34	21.9	18.5	27.5	30.1	15.0	15.6	31.7	33.9	3.4	20.5	20.5	20.5	21.5	22.0	23.0	25.0	26.0	27.0	G	15	17	.	.
24JUL87	18	30	20.5	18.5	28.5	30.4	15.0	16.1	31.1	32.8	2.6	19.0	19.5	20.0	21.0	22.0	23.0	24.5	26.0	27.0	G	15	17	.	.
25JUL87	18	29	22.2	18.5	27.0	29.3	14.4	13.9	31.1	31.7	3.4	18.5	18.5	19.0	19.5	20.5	22.0	23.0	24.0	25.5	N	0	0	.	.
26JUL87	19	30	22.6	20.5	24.0	26.7	17.8	15.6	30.0	28.3	7.8	20.5	20.5	20.5	21.0	21.5	22.5	23.0	23.0	23.5	N	0	0	.	.
27JUL87	34	54	22.7	20.0	26.5	28.0	17.8	16.1	26.7	28.3	5.2	20.0	20.0	20.0	20.5	21.0	22.0	23.0	24.5	25.5	N	0	0	.	.
28JUL87	26	42	22.7	19.5	27.0	28.2	12.8	15.6	26.7	27.2	1.0	19.5	19.5	19.5	20.0	21.0	22.0	23.0	24.5	25.5	N	0	0	.	.
29JUL87	20	32	22.7	19.5	27.0	28.4	11.1	12.8	27.8	30.0	2.2	19.5	19.5	19.5	20.0	21.5	22.0	23.0	24.5	26.0	N	0	0	.	.
30JUL87	16	27	22.0	18.0	26.0	28.5	11.1	10.6	29.4	30.6	4.4	18.5	18.0	18.5	18.5	19.5	21.0	22.0	23.0	24.0	N	10	10	.	.
01AUG87	15	25	20.3	17.5	24.0	26.9	12.2	17.2	28.3	31.1	5.4	17.5	17.5	17.5	18.0	18.5	19.0	20.5	22.0	23.0	N	0	0	.	.
02AUG87	16	26	22.8	19.5	27.0	28.2	16.1	16.7	31.1	31.7	5.6	19.5	19.5	19.5	20.0	21.0	22.0	23.0	24.0	25.0	N	0	0	.	.
04AUG87	43	67	23.0	18.5	28.0	28.1	17.2	16.7	30.6	30.6	5.8	19.5	19.5	20.0	21.0	22.0	23.0	24.0	25.0	26.5	N	0	0	.	.
05AUG87	73	112	21.9	21.0	23.0	25.0	17.8	14.4	30.6	25.0	9.6	21.5	21.5	21.5	21.5	21.5	21.5	21.0	21.0	21.5	N	0	0	.	.
08AUG87	30	48	22.5	19.0	27.0	27.8	15.6	16.1	28.3	31.1	5.4	19.0	19.0	19.0	20.0	21.0	22.0	23.5	25.0	26.0	N	0	0	.	.
09AUG87	24	38	22.6	20.0	25.0	27.0	17.2	16.7	29.4	31.7	6.8	20.0	20.0	20.5	20.5	21.0	22.5	23.5	24.0	24.5	N	0	0	.	.
11AUG87	21	33	20.8	17.5	25.5	26.7	12.8	15.0	24.4	28.9	5.2	17.5	17.5	17.5	18.5	19.0	20.0	21.5	23.0	24.0	N	0	0	.	.
12AUG87	17	28	22.4	19.0	26.5	27.3	16.1	12.8	26.1	29.4	2.2	19.0	19.0	19.5	20.0	20.5	22.0	23.0	24.5	25.5	N	0	0	.	.
15AUG87	12	20	21.2	17.0	26.5	28.5	10.0	9.4	29.4	31.7	4.6	17.0	17.0	17.5	18.0	19.0	21.0	22.0	23.5	24.5	N	0	0	.	.
16AUG87	11	19	22.9	19.5	26.5	28.9	15.0	16.1	29.4	32.2	5.4	19.5	19.5	19.5	19.5	20.5	22.0	23.5	25.0	25.5	N	2	2	.	.
18AUG87	12	20	22.1	18.5	27.0	29.6	17.8	13.3	27.8	28.9	1.4	18.5	18.5	18.5	20.0	21.0	22.5	24.0	25.5	26.5	N	0	0	.	.
19AUG87	13	21	22.1	18.5	25.5	28.6	11.7	12.2	28.9	30.0	0.6	18.5	18.5	18.5	19.0	20.0	21.5	22.5	24.0	25.5	N	0	0	.	.
29AUG87	66	102	18.2	17.5	20.0	21.0	14.4	12.2	22.2	20.6	9.6	17.5	17.5	17.5	17.5	17.5	17.5	18.5	18.5	18.5	N	2	2	.	.
30AUG87	47	73	18.8	15.5	22.5	22.0	7.2	10.0	23.3	25.0	2.4	15.5	16.0	16.5	18.0	18.0	19.0	20.0	21.0	21.5	N	0	0	.	.
11JUN88	109	164	15.4	12.1	20.2	.	0.6	1.7	17.8	20.0	0.0	12.1	12.1	12.2	12.7	13.4	14.5	15.9	17.3	18.5	N	0	0	.	.
12JUN88	84	127	16.6	12.8	21.8	.	5.6	2.8	24.4	25.0	2.0	12.8	12.8	13.1	13.6	14.5	15.6	17.0	18.5	19.9	N	0	0	.	.
16JUN88	47	73	18.7	16.5	25.0	.	11.1	10.6	28.9	29.4	4.0	17.1	17.2	17.4	18.0	18.8	20.0	21.4	22.6	23.9	G	15	17	.	.
18JUN88	45	70	19.2	14.4	25.8	.	8.9	13.3	23.3	26.1	3.0	14.5	14.6	15.0	15.8	17.0	18.2	20.0	21.5	23.1	N	0	0	.	.
19JUN88	40	63	20.3	15.6	25.9	.	11.1	11.1	27.8	29.4	4.4	15.6	15.7	16.1	16.9	18.0	18.8	20.5	22.0	23.2	N	0	0	.	.
21JUN88	34	53	21.9	17.4	27.7	.	18.3	15.0	30.6	31.1	0.8	17.9	18.1	18.3	19.1	20.2	21.4	22.9	24.5	25.8	N	0	0	.	.
25JUN88	25	40	21.0	16.1	27.7	.	11.7	15.0	30.0	32.2	2.6	16.2	16.2	16.5	17.4	18.6	20.1	21.7	23.2	24.6	N	0	0	.	.
26JUN88	23	37	21.8	19.7	24.6	.	18.3	9.4	30.6	26.7	8.6	20.2	20.0	20.0	20.0	20.1	20.6	21.6	23.0	24.1	N	0	0	.	.
28JUN88	20	33	17.7	13.2	22.9	.	3.9	3.9	25.0	25.6	1.2	13.3	13.2	13.4	14.3	15.5	16.8	18.2	20.0	21.5	N	0	0	.	.
29JUN88	20	32	19.2	16.8	22.0	.	13.9	12.2	23.9	22.8	9.8	17.0	16.8	17.1	17.5	18.2	18.8	19.1	19.4	19.8	N	0	0	.	.
30JUN88	19	31	16.7	13.4	20.0	.	2.2	2.8	21.7	20.6	4.4	13.7	13.4	13.6	14.2	15.0	15.9	16.4	17.0	17.5	N	0	0	.	.
02JUL88	17	28	16.9	11.8	23.3	.	2.2	1.7	21.1	23.9	1.8	11.8	11.8	12.2	13.1	14.3	15.6	17.2	18.8	20.3	N	0	0	.	.
03JUL88	17	28	19.3	14.0	25.4	.	6.1	5.0	27.8	28.9	1.0	14.4	14.0	14.1	15.0	16.1	17.5	18.8	20.3	22.1	N	0	0	.	.
06JUL88	15	24	21.1	16.6	26.8	.	10.6	9.4	30.6	31.7	0.2	16.7	16.6	16.8	17.4	18.5	19.7	21.1	22.8	24.2	N	0	0	.	.

DATE	OFLOW	TFLOW	SMEAN	SMIN	SMAX	SWAMAX	OMIN	EMIN	OMAX	EMAX	ECLD	S7	S8	S9	S10	S11	S12	S13	S14	S15	GEN	SG1	EG1	SG2	EG2
07JUL88	13	21	22.9	18.5	27.6	.	13.3	11.7	33.3	33.3	1.80	19.0	18.6	18.5	18.8	19.9	21.2	22.5	24.2	25.8	N	0	0	.	.
09JUL88	12	19	22.0	18.6	26.3	.	16.7	13.3	33.3	33.3	7.80	18.6	18.6	18.9	19.5	20.5	21.8	23.2	24.2	25.4	N	0	0	.	.
10JUL88	11	18	22.0	18.5	25.5	.	12.8	11.7	32.8	33.9	7.60	18.8	18.5	18.6	19.1	19.8	20.8	21.9	22.9	23.9	N	0	0	.	.
11JUL88	11	18	20.9	17.5	26.5	.	16.1	16.1	30.6	30.6	6.20	19.6	19.4	19.5	20.1	21.0	22.2	23.5	24.2	25.1	G	15	17	.	.
12JUL88	25	41	19.8	18.0	21.8	.	18.3	18.3	30.0	27.8	9.60	18.2	18.3	18.6	18.6	19.1	19.7	20.8	21.4	21.6	N	0	0	.	.
13JUL88	37	58	22.0	18.2	26.3	.	14.4	18.3	27.8	27.8	7.60	18.3	18.3	18.5	19.1	20.2	21.4	22.6	23.9	25.0	N	0	0	.	.
14JUL88	22	35	22.0	19.3	26.9	.	17.2	18.3	28.3	30.0	7.80	20.3	20.2	20.3	20.6	21.3	22.1	23.2	23.9	25.0	G	15	15	16	17
16JUL88	15	24	22.8	18.2	28.9	.	14.4	14.4	35.0	36.7	3.20	18.2	18.3	18.5	19.3	20.5	21.8	23.1	24.7	26.0	N	0	0	.	.
17JUL88	13	21	24.4	21.7	26.6	.	20.6	17.2	33.9	33.3	6.60	22.0	21.7	21.7	22.3	23.2	24.4	25.7	26.3	26.2	N	12	12	.	.
18JUL88	12	20	24.1	20.2	29.1	.	15.0	15.0	32.8	31.7	4.80	20.4	20.2	20.4	21.2	22.2	23.5	24.6	25.5	26.9	N	0	0	.	.
19JUL88	13	21	23.2	22.0	24.4	.	18.9	18.3	32.8	26.1	10.00	22.3	22.0	22.1	22.3	22.4	22.6	22.9	22.9	22.9	N	9	9	.	.
20JUL88	22	36	22.0	20.4	24.6	.	19.4	18.3	26.1	30.0	8.80	20.5	20.5	20.4	20.6	20.8	20.9	21.2	22.0	23.0	N	0	0	.	.
21JUL88	54	83	20.7	19.4	22.6	.	17.8	18.3	27.2	22.8	10.00	19.8	19.7	19.7	19.7	19.9	20.3	20.6	20.8	21.4	N	15	15	.	.
23JUL88	30	48	20.7	19.3	22.6	.	17.2	15.0	26.1	22.2	9.80	19.4	19.3	19.4	19.5	19.7	20.1	20.7	21.3	21.5	N	0	0	.	.
24JUL88	46	72	20.8	18.2	23.4	.	14.4	13.3	26.1	26.7	7.60	18.4	18.2	18.3	18.8	19.5	20.0	20.8	21.9	22.6	N	0	0	.	.
25JUL88	27	43	21.5	17.8	25.8	.	11.1	12.8	27.2	27.2	5.20	18.1	17.8	17.9	18.5	19.3	20.4	21.9	22.9	23.3	N	0	0	.	.
26JUL88	19	31	20.8	18.6	23.3	.	14.4	14.4	27.2	24.4	10.00	18.8	18.6	18.6	19.1	19.4	19.8	20.2	20.2	20.4	N	0	0	.	.
27JUL88	17	27	21.3	18.1	24.9	.	13.9	16.1	27.2	27.2	9.00	18.3	18.3	18.1	18.7	19.6	20.5	21.5	22.5	23.4	N	11	11	.	.
28JUL88	14	23	22.7	18.8	27.1	.	13.3	13.9	27.8	28.3	4.20	19.1	18.8	18.8	19.4	20.4	21.7	22.9	24.2	25.1	N	0	0	.	.
30JUL88	12	20	21.8	18.1	26.6	.	13.9	15.0	31.1	31.7	3.60	18.1	18.1	18.3	19.1	20.2	21.8	23.2	24.6	25.8	N	0	0	.	.
31JUL88	11	18	22.3	19.0	26.2	.	20.0	17.2	28.3	28.3	6.80	19.1	19.0	19.2	19.4	20.2	21.2	22.5	24.0	25.1	N	0	0	.	.
02AUG88	10	16	22.3	18.1	28.0	.	15.0	14.4	32.8	32.8	2.80	18.1	18.2	18.5	19.2	20.3	21.7	22.9	24.3	25.8	N	0	0	.	.
04AUG88	9	14	21.5	18.5	25.1	.	17.8	18.9	31.1	30.0	6.80	18.5	18.5	18.8	19.7	21.1	22.5	22.9	23.2	23.9	N	0	0	.	.
06AUG88	15	24	20.9	18.5	23.7	.	16.7	17.8	27.8	26.7	9.40	18.6	18.5	19.0	19.3	20.1	20.8	21.8	22.6	23.5	N	0	0	.	.
07AUG88	14	23	23.2	20.0	26.9	.	15.6	16.7	28.3	28.3	4.60	20.3	20.1	20.1	20.6	21.5	22.8	23.9	24.9	25.7	N	0	0	.	.
09AUG88	9	16	21.6	16.8	27.4	.	11.7	11.7	32.8	32.2	2.60	16.9	16.8	17.1	18.0	19.1	20.7	22.3	23.8	25.4	N	0	0	.	.
10AUG88	8	13	23.7	20.0	27.4	.	13.9	13.9	32.8	32.2	2.80	20.2	20.0	20.0	20.5	21.5	22.5	23.5	24.9	25.6	N	0	0	.	.
13AUG88	9	15	21.8	18.3	26.5	.	16.7	17.2	32.2	32.2	5.20	18.5	18.5	18.6	19.3	20.3	21.5	22.9	24.1	25.0	N	0	0	.	.
14AUG88	9	15	23.8	20.2	27.9	.	16.7	17.8	34.4	33.3	2.00	20.8	20.4	20.2	20.6	21.5	22.4	23.4	24.5	25.6	N	0	0	.	.
16AUG88	8	13	21.3	17.2	26.5	.	13.9	15.6	31.1	30.6	2.20	17.3	17.3	17.5	18.4	19.6	21.0	22.6	24.0	25.2	N	0	0	.	.
17AUG88	7	12	23.5	19.5	27.4	.	15.0	15.0	36.1	33.3	2.20	20.0	19.7	19.6	20.2	21.3	22.6	24.2	25.4	26.4	N	0	0	.	.
20AUG88	68	105	19.7	19.0	21.1	.	17.8	17.2	25.0	22.2	10.00	19.1	19.1	19.2	19.3	19.3	19.1	19.1	19.2	19.7	N	0	0	.	.
27AUG88	15	25	20.1	16.2	25.0	.	12.2	14.4	28.9	30.6	2.20	16.4	16.2	16.4	16.9	17.9	19.0	20.5	22.0	23.1	N	0	0	.	.
28AUG88	13	21	20.6	17.5	23.5	.	18.3	17.2	30.6	28.9	4.80	18.0	17.6	17.5	17.6	18.2	18.9	20.3	21.5	22.3	N	0	0	.	.
03JUN89	128	191	.	.	.	.	11.1	13.9	26.1	28.3	6.75	.	.	.	.	.	.	.	.	.	N	0	.	.	.
04JUN89	146	217	.	.	.	.	16.1	14.4	25.0	23.3	0.90	.	.	.	.	.	.	.	.	.	N	0	.	.	.
02JUL89	162	239	20.0	17.8	22.9	.	12.2	12.8	27.2	28.3	7.25	17.8	17.8	18.0	18.5	19.1	20.0	20.6	21.4	22.0	N	0	.	.	.
30JUL89	131	195	18.5	17.4	19.3	.	12.8	12.2	22.8	26.7	9.75	17.4	17.4	17.5	18.0	18.4	18.7	19.2	19.3	19.2	N	0	.	.	.
06AUG89	97	147	22.0	19.7	25.2	.	15.6	16.7	27.8	28.9	7.25	19.9	19.8	19.9	20.1	20.3	21.1	21.8	22.5	23.5	N	0	.	.	.
13AUG89	55	85	19.3	16.4	23.3	.	12.2	12.2	25.0	26.7	6.25	16.5	16.5	16.5	17.1	17.7	18.5	19.7	21.3	22.1	N	0	.	.	.

DATE	OFLOW	TFLOW	SMEAN	SMIN	SMAX	SWAMAX	OMIN	EMIN	OMAX	EMAX	ECLD	S7	S8	S9	S10	S11	S12	S13	S14	S15	GEN	SG1	EG1	SG2	EG2
19AUG89	121	181	18.5	17.1	21.7	.	13.9	13.9	21.7	26.7	4.75	17.1	17.1	17.1	17.1	17.3	17.7	18.6	19.4	20.0	N	0	.	.	.
20AUG89	125	187	19.0	16.5	22.3	.	12.8	13.3	25.0	27.2	6.25	16.6	16.5	16.7	17.1	17.7	18.5	19.6	20.4	21.2	N	0	.	.	.
27AUG89	162	240	19.5	17.7	22.3	.	12.2	15.0	26.7	27.8	0.50	17.8	17.8	17.8	18.1	18.6	19.0	19.9	20.7	21.5	N	0	.	.	.
17JUN90	127	190	.	.	.	.	12.8	13.3	29.4	30.0	0.20	.	.	.	.	.	.	.	.	.	N	0	.	.	.
22JUN90	86	131	17.8	16.2	21.1	.	8.9	11.1	25.0	27.8	1.00	16.4	16.2	16.3	16.8	17.5	18.5	19.7	20.2	20.4	G	15	18	.	.
24JUN90	118	177	17.0	15.9	18.0	.	12.2	9.4	21.1	20.6	9.75	16.8	16.7	16.7	16.6	16.5	16.6	16.6	16.5	16.9	N	0	.	.	.
29JUL90	86	131	20.7	17.6	25.2	.	11.1	11.1	25.6	30.0	0.20	17.7	17.6	17.7	18.1	18.5	19.6	21.0	22.3	23.1	N	0	.	.	.
05AUG90	51	79	19.8	19.3	20.6	.	19.4	19.4	25.6	25.6	1.00	19.3	19.3	19.3	19.3	19.7	19.8	19.9	20.2	20.3	N	0	.	.	.
12AUG90	35	55	20.2	17.1	24.6	.	12.8	13.3	26.7	28.3	0.20	17.2	17.1	17.1	17.4	18.2	19.1	20.3	21.7	22.3	N	0	.	.	.
16AUG90	35	55	20.0	16.8	24.6	.	12.2	13.3	26.1	29.4	1.50	16.8	16.8	16.9	17.6	18.6	19.6	21.1	22.0	23.0	N	0	.	.	.
19AUG90	36	57	21.8	19.0	25.4	.	18.3	19.4	27.8	29.4	7.50	19.1	19.1	19.2	19.7	20.2	21.1	22.9	24.0	24.4	N	0	.	.	.
26AUG90	140	208	19.8	18.3	23.6	.	14.4	16.7	27.2	29.4	0.50	18.3	18.3	18.3	18.7	19.3	20.2	21.1	22.3	23.2	G	16	18	.	.
11JUN91	19	30	18.8	14.6	23.7	.	12.2	10.6	26.1	26.7	7.80	14.7	15.1	15.6	16.6	17.9	19.4	20.8	21.8	22.4	N	0	0	.	.
12JUN91	18	30	20.8	17.7	24.7	.	16.1	17.2	25.0	24.4	9.20	18.1	18.0	17.9	17.8	18.0	18.9	20.6	22.0	23.2	N	0	0	.	.
13JUN91	19	30	20.6	16.2	25.3	.	8.3	12.2	25.0	25.6	1.00	16.4	16.3	16.7	17.5	18.7	20.0	21.5	22.8	23.8	N	0	0	.	.
15JUN91	15	24	19.5	14.2	25.3	.	7.2	7.8	28.9	30.0	6.20	14.2	14.3	14.9	15.9	17.4	19.2	21.3	22.9	23.8	N	9	9	.	.
16JUN91	17	27	22.5	19.3	26.5	.	18.3	18.3	29.4	30.0	7.40	19.5	19.4	19.6	20.4	21.5	22.8	23.6	25.0	25.8	N	20	20	.	.
18JUN91	32	50	20.9	18.6	24.3	.	16.7	17.8	27.2	25.0	9.20	18.7	18.9	19.2	19.7	20.2	20.7	21.2	22.3	23.3	N	12	12	.	.
19JUN91	20	33	23.2	19.3	28.9	.	15.6	15.0	26.7	29.4	8.00	19.3	19.3	19.5	20.0	21.2	22.6	24.0	25.5	26.9	N	0	0	.	.
20JUN91	18	29	23.2	19.0	27.9	.	12.2	16.7	27.8	30.0	5.60	19.2	19.0	19.5	20.3	21.4	22.3	24.2	25.0	26.2	N	18	18	.	.
22JUN91	15	25	19.2	17.4	22.1	.	17.8	18.9	28.9	21.7	10.00	17.4	17.4	17.4	17.5	17.8	18.3	18.9	19.6	20.2	N	0	0	.	.
23JUN91	56	87	19.4	18.1	21.0	.	15.6	16.1	21.1	22.8	9.60	18.6	18.3	18.3	18.2	18.1	18.2	18.4	19.1	19.6	N	0	0	.	.
25JUN91	25	40	20.6	16.5	25.9	.	8.9	10.0	23.9	25.0	6.20	16.5	16.6	17.1	17.9	18.9	20.2	21.9	23.2	24.2	N	0	0	.	.
26JUN91	18	30	21.1	16.5	26.5	.	10.0	11.1	25.0	27.2	3.80	16.8	16.5	16.8	17.2	18.5	19.7	21.4	23.2	24.3	N	0	0	.	.
29JUN91	13	21	21.6	18.2	25.6	.	16.7	17.8	28.9	28.9	9.00	18.2	18.3	18.8	19.6	20.6	21.5	22.4	23.4	24.5	N	0	0	.	.
30JUN91	12	20	23.5	20.1	26.7	.	20.0	18.3	30.0	30.0	5.40	20.2	20.2	20.6	21.4	22.1	23.2	24.6	25.8	26.4	N	0	0	.	.
02JUL91	15	25	23.5	20.5	27.4	.	18.9	19.4	28.9	27.2	9.60	20.5	20.6	20.9	21.3	22.2	23.1	24.3	25.4	26.5	N	0	0	.	.
03JUL91	15	25	21.9	20.1	23.2	.	16.7	18.3	26.7	26.1	9.80	20.6	20.4	20.1	20.2	20.4	20.6	21.5	22.0	22.1	N	0	0	.	.
04JUL91	16	27	21.4	19.4	23.9	.	17.8	16.7	26.7	28.3	7.40	19.5	19.5	19.7	19.7	19.8	20.7	22.1	23.0	23.5	N	0	0	.	.
06JUL91	15	24	22.5	17.8	28.1	.	13.3	14.4	28.9	30.0	2.40	17.8	17.9	18.4	19.6	20.9	22.3	23.6	25.0	25.8	N	0	0	.	.
07JUL91	13	21	24.4	20.4	29.0	.	17.8	17.8	31.7	31.1	0.60	20.5	20.4	20.6	21.6	22.9	24.2	25.9	27.3	28.2	N	23	23	.	.
09JUL91	32	50	21.9	17.8	25.0	.	16.1	18.3	23.9	26.7	4.20	19.9	20.0	20.2	20.7	21.7	22.8	24.1	24.6	24.9	N	0	0	.	.
10JUL91	20	32	20.4	19.0	21.3	.	16.1	17.2	23.3	23.9	9.60	19.3	19.1	19.2	19.4	19.9	20.5	20.8	21.1	21.1	N	0	0	.	.
11JUL91	16	26	22.3	18.5	26.9	.	15.6	16.1	26.7	27.8	3.20	18.5	18.6	18.9	19.6	20.8	22.1	23.7	24.7	25.6	N	0	0	.	.
13JUL91	35	56	22.2	18.1	27.1	.	19.4	17.2	26.1	27.2	6.60	18.8	19.0	19.4	20.0	21.0	22.2	23.5	24.4	25.2	N	0	0	.	.
14JUL91	36	56	22.0	19.4	24.9	.	16.7	14.4	26.7	23.3	10.00	20.1	19.8	19.4	19.6	20.0	20.4	21.9	22.9	23.7	N	0	0	.	.
16JUL91	16	26	20.6	15.8	26.2	.	7.8	10.0	28.3	30.0	3.00	15.9	15.8	16.3	17.3	18.8	19.9	21.2	22.3	23.5	N	0	0	.	.
18JUL91	11	18	21.9	16.4	28.1	.	11.7	13.3	31.1	30.6	4.40	16.5	16.5	17.1	18.1	19.6	21.1	22.9	24.6	25.9	N	19	19	.	.
20JUL91	9	15	22.1	19.1	26.6	.	16.7	18.9	28.3	30.0	8.00	19.1	19.3	19.7	20.5	21.4	22.1	23.6	24.5	25.4	N	16	17	.	.
21JUL91	39	62	23.3	19.1	27.9	.	17.8	18.3	31.1	29.4	8.20	19.2	19.3	19.6	20.6	21.6	23.0	24.7	25.3	26.5	N	0	0	.	.

DATE	OFLOW	TFLOW	SMEAN	SMIN	SMAX	SWAMAX	OMIN	EMIN	OMAX	EMAX	ECLD	S7	S8	S9	S10	S11	S12	S13	S14	S15	GEN	SG1	EG1	SG2	EG2
23JUL91	24	38	22.8	18.9	28.1	.	18.9	20.0	30.6	31.7	3.00	19.3	19.6	20.3	21.4	22.8	24.2	25.9	26.9	27.7	N	0	0	.	.
24JUL91	30	47	24.1	21.0	28.6	.	18.9	18.9	27.8	27.8	5.60	21.1	21.0	21.2	22.0	23.0	23.8	25.0	25.8	26.8	N	5	5	21	21
25JUL91	23	37	22.6	18.9	26.3	.	16.7	18.3	27.2	27.8	8.00	19.0	19.0	19.3	20.2	20.9	22.3	24.2	25.0	25.8	N	0	0	.	.
27JUL91	13	22	21.3	18.9	24.9	.	17.2	15.0	22.8	25.6	9.20	19.0	19.0	19.1	19.7	20.5	21.2	22.4	23.2	24.0	N	0	0	.	.
28JUL91	12	20	20.8	17.1	24.2	.	10.6	13.3	25.0	26.1	9.00	17.3	17.1	17.3	18.0	19.3	20.6	22.0	22.8	23.5	N	0	0	.	.
30JUL91	23	38	20.2	16.5	24.2	.	12.2	13.3	26.1	28.3	3.60	16.5	16.6	17.1	17.8	19.0	20.2	22.0	22.9	23.7	N	0	0	.	.
31JUL91	21	34	22.4	18.6	26.8	.	12.8	14.4	26.1	26.7	2.40	18.9	18.8	18.6	19.6	20.5	22.0	24.0	24.7	25.4	N	11	11	.	.
01AUG91	16	25	22.4	17.4	27.6	.	9.4	12.2	28.9	28.9	0.00	17.7	17.5	17.8	18.7	20.0	21.4	23.1	24.4	25.9	N	0	0	.	.
03AUG91	11	18	21.8	18.1	25.4	.	13.3	13.3	32.2	30.6	4.20	18.2	18.1	18.7	19.3	20.5	22.0	23.3	24.1	25.0	N	0	0	.	.
04AUG91	12	19	22.1	20.3	24.4	.	17.8	17.8	28.9	26.1	9.00	20.7	20.5	20.5	20.3	20.5	20.5	21.4	22.4	23.5	N	0	0	.	.
05AUG91	12	19	21.4	18.1	25.7	.	10.6	11.7	24.4	24.4	4.40	18.3	18.2	18.1	18.3	19.2	20.5	22.0	23.2	24.5	N	15	15	.	.
06AUG91	11	18	20.8	16.4	25.1	.	8.9	11.7	26.7	25.0	8.20	16.5	16.4	17.0	17.9	18.9	20.1	21.7	22.8	24.0	N	8	8	.	.
07AUG91	9	15	22.5	19.5	25.3	.	14.4	15.6	28.9	28.3	4.00	19.6	19.6	19.9	20.8	21.9	23.2	24.7	24.9	24.6	N	10	11	.	.
08AUG91	7	12	22.3	18.7	25.8	.	12.8	14.4	28.3	30.0	1.00	18.9	18.8	19.1	19.9	21.1	22.6	24.0	24.8	25.2	N	0	0	.	.
10AUG91	45	70	21.0	18.0	24.9	.	13.9	13.3	22.8	25.0	7.00	18.0	18.1	18.5	19.2	20.1	21.1	22.3	23.1	23.6	N	0	0	.	.
11AUG91	24	38	20.9	17.1	25.0	.	9.4	10.0	25.0	25.0	2.20	17.2	17.1	17.4	18.3	19.4	20.8	22.3	23.2	23.8	N	0	0	.	.
12AUG91	15	25	21.0	16.8	25.1	.	8.9	11.1	26.7	27.2	4.60	16.9	16.8	17.1	18.0	19.3	20.5	22.0	23.0	24.2	N	0	0	.	.
13AUG91	11	19	20.5	16.8	23.6	.	8.3	11.1	26.7	27.8	4.60	17.2	16.9	17.1	18.0	19.2	20.1	21.4	21.7	23.0	N	0	0	.	.
14AUG91	11	18	20.8	18.7	23.2	.	15.0	16.7	23.9	23.9	9.40	19.0	18.7	18.8	19.1	19.6	20.5	21.3	21.8	22.6	N	13	13	.	.
15AUG91	21	33	20.2	18.5	22.1	.	16.1	15.0	22.8	23.9	9.40	18.6	18.6	18.6	19.2	20.2	21.0	21.7	22.1	21.7	N	0	0	.	.
17AUG91	21	33	20.9	16.8	25.5	.	11.1	13.3	27.2	28.3	1.80	17.0	16.9	17.2	18.0	19.2	21.4	22.1	23.1	24.2	N	0	0	.	.
18AUG91	14	22	21.3	18.8	24.1	.	17.2	17.2	27.2	26.7	9.00	18.9	19.0	19.0	19.3	19.8	20.3	20.9	21.6	22.6	N	0	0	.	.
19AUG91	12	20	21.7	19.0	25.3	.	15.0	16.1	27.2	27.2	6.60	19.0	19.0	19.2	19.6	20.4	21.2	22.3	22.9	23.9	N	10	10	16	16
20AUG91	13	22	21.0	18.3	24.2	.	14.4	12.8	26.1	22.8	8.80	18.5	18.4	18.4	19.0	19.7	20.2	21.2	22.2	23.1	N	0	0	.	.
21AUG91	13	21	18.7	17.7	19.7	.	12.8	11.7	21.7	21.1	10.00	18.1	17.8	18.0	17.8	17.9	18.0	18.1	18.2	18.6	N	0	0	.	.
22AUG91	13	21	19.3	14.7	24.4	.	7.8	9.4	25.6	26.1	0.60	14.7	14.7	15.0	15.9	17.2	18.6	20.0	21.3	22.5	N	3	3	.	.
24AUG91	13	21	20.9	17.2	24.6	.	12.8	15.0	27.8	29.4	3.40	17.4	17.2	17.4	18.2	19.4	20.6	22.0	23.0	24.0	N	0	0	.	.
25AUG91	13	21	21.5	18.5	24.8	.	13.9	13.9	27.2	26.7	3.00	18.8	18.5	18.7	19.0	19.7	20.8	21.6	23.0	23.8	N	0	0	.	.
26AUG91	14	23	21.8	18.7	25.8	.	16.1	12.2	26.1	28.3	2.00	19.0	18.8	18.8	18.9	19.4	20.6	22.0	23.5	24.6	N	0	0	.	.
27AUG91	14	23	22.1	18.2	25.7	.	11.1	12.2	28.9	29.4	4.80	18.4	18.2	18.3	19.2	20.0	21.3	22.4	23.5	24.6	N	0	0	.	.
31AUG91	11	18	21.7	19.6	24.0	.	17.2	17.8	30.0	28.9	6.80	19.6	19.6	20.0	20.5	21.2	22.2	22.9	23.8	23.5	N	0	0	.	.
02JUN92	109	164	.	.	.	.	.	7.8	.	21.7	9.50	.	.	.	.	.	.	.	.	.	N	0	.	.	.
03JUN92	84	128	.	.	.	.	.	7.8	.	26.1	0.60	.	.	.	.	.	.	.	.	.	N	0	.	.	.
04JUN92	75	115	.	.	.	.	.	12.2	.	20.6	1.00	.	.	.	.	.	.	.	.	.	N	0	.	.	.
13JUN92	158	234	.	.	.	.	.	7.8	.	26.7	2.50	.	.	.	.	.	.	.	.	.	N	0	.	.	.
14JUN92	130	194	.	.	.	.	.	12.8	.	25.6	9.75	.	.	.	.	.	.	.	.	.	N	0	.	.	.
16JUN92	138	205	.	.	.	.	.	14.4	.	26.7	5.25	.	.	.	.	.	.	.	.	.	N	0	.	.	.
17JUN92	96	145	.	.	.	.	.	13.9	.	26.7	5.25	.	.	.	.	.	.	.	.	.	N	0	.	.	.
18JUN92	80	122	.	.	.	.	.	17.2	.	25.0	1.00	.	.	.	.	.	.	.	.	.	N	0	.	.	.
20JUN92	85	129	.	.	.	.	.	12.2	.	20.6	9.25	.	.	.	.	.	.	.	.	.	N	0	.	.	.

DATE	OFLOW	TFLOW	SMEAN	SMIN	SMAX	SWAMAX	OMIN	EMIN	OMAX	EMAX	ECLD	S7	S8	S9	S10	S11	S12	S13	S14	S15	GEN	SG1	EG1	SG2	EG2
21JUN92	70	107	.	.	.	.	.	5.6	.	13.3	1.00	.	.	.	.	.	.	.	.	.	N	0	.	.	.
23JUN92	51	79	.	.	.	.	.	3.3	.	23.3	5.25	.	.	.	.	.	.	.	.	.	N	0	.	.	.
24JUN92	53	82	.	.	.	.	.	15.0	.	24.4	9.50	.	.	.	.	.	.	.	.	.	N	0	.	.	.
25JUN92	82	125	.	.	.	.	.	12.8	.	25.0	7.50	.	.	.	.	.	.	.	.	.	N	0	.	.	.
28JUN92	39	61	.	.	.	.	.	6.7	.	26.1	0.75	.	.	.	.	.	.	.	.	.	N	0	.	.	.
30JUN92	31	49	20.8	17.1	25.8	.	.	16.1	.	28.9	0.80	17.2	17.2	17.6	18.3	19.2	20.6	21.7	22.4	23.5	N	0	.	.	.
01JUL92	29	46	20.9	18.6	22.7	.	.	16.7	.	25.0	9.75	18.7	18.6	18.8	19.5	20.0	20.9	21.2	21.3	21.7	N	0	.	.	.
02JUL92	41	64	21.3	18.6	24.9	.	.	17.2	.	28.9	0.40	18.6	18.6	18.6	18.8	19.2	20.3	21.1	21.8	22.6	N	0	.	.	.
05JUL92	41	64	20.8	16.8	25.8	.	.	10.0	.	26.1	6.75	16.8	16.8	17.3	18.2	19.3	21.2	22.6	23.2	24.1	N	0	.	.	.
07JUL92	78	119	20.3	17.6	24.0	.	.	8.3	.	23.9	3.25	17.6	17.6	17.7	18.2	19.0	20.9	22.1	22.9	23.6	N	0	.	.	.
08JUL92	48	75	20.4	17.3	23.9	.	.	12.8	.	30.6	6.75	17.3	17.3	17.5	18.2	19.3	21.0	22.0	22.3	23.0	N	0	.	.	.
21JUL92	119	178	20.3	18.0	23.0	.	.	13.9	.	27.2	0.80	19.0	18.9	19.4	19.8	20.1	21.0	22.2	22.6	22.9	G	15	16	.	.
23JUL92	99	149	20.4	18.5	22.7	.	.	18.9	.	26.7	0.90	18.6	18.6	18.6	18.7	19.2	20.4	21.8	22.0	22.4	N	0	.	.	.
08AUG92	73	112	19.6	17.7	21.6	.	.	16.7	.	26.1	9.75	17.8	17.8	17.8	18.1	18.5	19.7	20.2	20.3	20.8	N	0	.	.	.
09AUG92	104	157	21.1	19.0	24.8	.	.	17.2	.	26.7	6.25	19.0	19.0	19.1	19.3	20.0	21.3	22.3	22.9	23.9	N	0	.	.	.
15AUG92	105	158	17.4	16.6	18.0	.	.	15.6	.	21.1	1.00	17.3	17.2	17.2	17.2	17.3	17.5	17.4	17.4	17.5	N	0	.	.	.
16AUG92	86	131	17.6	16.1	20.0	.	.	12.8	.	24.4	9.25	16.1	16.1	16.1	16.2	16.5	17.5	18.2	18.5	19.0	N	0	.	.	.
22AUG92	39	61	18.6	16.2	21.7	.	.	13.9	.	25.0	9.50	16.3	16.2	16.3	16.7	17.3	18.5	19.4	19.9	20.8	N	0	.	.	.
23AUG92	36	57	20.0	17.5	23.7	.	.	14.4	.	28.9	3.75	17.5	17.5	17.6	17.8	18.3	19.6	20.5	21.0	22.1	N	0	.	.	.
30AUG92	70	107	16.8	13.7	20.7	.	.	5.6	.	27.2	0.20	13.9	13.9	13.7	14.3	15.2	16.8	18.0	18.7	19.8	N	0	.	.	.
23JUN93	54	83	21.5	17.8	26.9	.	10.00	13.9	25.6	29.4	0.00	17.8	17.9	18.6	19.4	20.7	22.1	23.5	24.9	26.0	N	0	0	.	.
24JUN93	37	58	20.9	16.0	27.0	.	9.44	7.8	27.2	30.6	0.20	16.0	16.2	16.8	17.9	19.3	21.1	22.9	24.4	25.8	N	0	0	.	.
27JUN93	32	51	20.7	16.0	27.0	.	11.60	10.0	26.7	28.3	2.20	16.0	16.2	17.0	18.2	19.6	21.3	22.9	24.5	25.8	N	0	0	.	.
30JUN93	49	76	20.2	17.5	24.3	23.5	14.40	15.6	24.4	27.2	8.40	17.5	17.6	18.1	18.8	19.6	20.5	21.2	21.7	22.4	N	0	0	.	.
04JUL93	83	126	21.6	19.1	25.5	25.0	18.30	18.3	29.4	31.1	5.00	19.1	19.3	19.6	20.0	20.8	21.7	22.6	23.5	24.3	N	0	0	.	.
06JUL93	79	121	21.6	18.2	28.3	27.4	15.50	17.8	30.0	32.2	4.60	19.9	20.0	20.6	21.5	22.9	24.0	25.4	26.3	27.3	G	16	17	.	.
11JUL93	28	44	22.8	18.6	28.2	29.6	16.10	17.8	29.4	32.2	5.00	18.7	18.9	19.6	20.2	21.0	22.7	24.4	25.8	26.8	G	21	21	.	.
17JUL93	15	24	20.8	15.6	26.8	28.1	7.22	8.3	25.0	30.6	0.40	15.6	15.8	16.5	17.7	19.0	20.5	22.0	23.7	25.1	N	0	0	.	.
18JUL93	12	19	21.8	16.8	27.3	28.5	10.50	12.8	29.4	31.7	3.60	16.8	16.8	17.1	18.2	19.8	21.3	22.6	24.0	25.4	N	0	0	.	.
21JUL93	14	22	19.8	16.9	23.5	25.9	12.70	15.6	27.2	28.3	8.20	16.9	17.0	17.4	17.8	18.7	19.6	20.5	21.4	22.3	N	0	0	.	.
24JUL93	8	14	19.8	15.1	25.7	27.7	7.78	11.7	28.3	31.7	3.40	15.2	15.2	15.4	16.2	16.9	18.5	20.3	21.8	22.9	N	0	0	.	.
25JUL93	8	13	22.5	18.4	27.0	28.6	13.30	15.0	31.1	32.8	3.20	18.6	18.5	18.4	19.1	20.1	21.6	23.3	25.0	26.0	N	0	0	.	.
29JUL93	96	145	19.9	17.7	23.4	25.0	18.30	20.6	31.1	27.8	6.20	18.5	18.6	19.7	20.9	21.6	22.1	22.3	23.3	23.4	G	15	17	.	.
31JUL93	28	44	19.0	16.8	21.7	21.4	14.40	15.0	25.0	23.9	9.60	17.1	17.3	17.7	18.0	18.3	19.1	20.3	21.1	21.4	N	0	0	.	.
01AUG93	24	38	20.0	16.5	24.2	24.2	11.60	11.1	25.6	28.9	4.20	16.5	16.5	17.1	17.8	18.8	19.6	20.7	22.1	23.2	N	0	0	.	.
03AUG93	39	61	20.4	17.1	24.9	25.2	14.40	16.1	26.1	28.3	3.80	17.1	17.1	17.4	18.4	19.8	21.1	22.0	23.1	24.0	N	0	0	.	.
04AUG93	27	44	19.4	17.4	20.7	23.4	12.20	12.2	25.0	25.6	7.80	17.4	17.4	18.0	18.9	19.9	20.5	20.5	20.5	20.2	N	0	0	.	.
08AUG93	42	66	19.2	16.0	22.7	22.7	9.44	11.7	23.3	26.1	4.40	16.2	16.0	16.4	17.5	18.6	20.1	21.4	22.0	22.5	N	0	0	.	.
11AUG93	16	27	21.3	17.7	25.8	26.3	16.10	16.7	26.1	27.8	5.20	17.8	17.8	18.0	18.7	20.0	20.9	22.2	23.5	24.4	G	20	21	.	.
14AUG93	12	20	21.1	16.9	26.0	27.3	12.70	15.0	27.2	30.6	6.40	17.1	16.9	17.4	18.1	19.4	21.0	22.1	23.8	24.6	N	0	0	.	.

DATE	OFLOW	TFLOW	SMEAN	SMIN	SMAX	SWAMAX	OMIN	EMIN	OMAX	EMAX	ECLD	S7	S8	S9	S10	S11	S12	S13	S14	S15	GEN	SG1	EG1	SG2	EG2
15AUG93	10	17	21.2	17.1	26.1	28.3	11.60	12.8	27.8	32.2	2.0	17.1	17.1	17.4	18.2	19.3	20.6	22.3	23.8	24.9	N	0	0	.	.
21AUG93	9	15	21.0	18.0	25.0	26.0	13.80	15.0	24.4	26.7	4.2	18.1	18.1	18.4	19.1	19.9	21.1	22.1	23.1	24.0	N	0	0	.	.
22AUG93	9	15	20.4	16.0	24.9	26.9	7.22	12.8	26.7	28.9	3.0	16.2	16.0	16.2	17.1	18.3	19.8	21.0	22.3	23.5	N	0	0	.	.
28AUG93	5	8	20.6	16.8	25.5	29.4	16.60	18.3	31.1	32.8	7.8	16.8	16.8	17.2	18.0	19.3	20.8	22.3	23.7	25.0	N	0	0	.	.
29AUG93	4	7	22.9	19.0	27.0	29.8	15.50	16.7	32.2	33.9	1.8	19.2	19.0	19.3	20.0	21.2	22.6	24.1	25.5	26.6	N	0	0	.	.

APPENDIX C

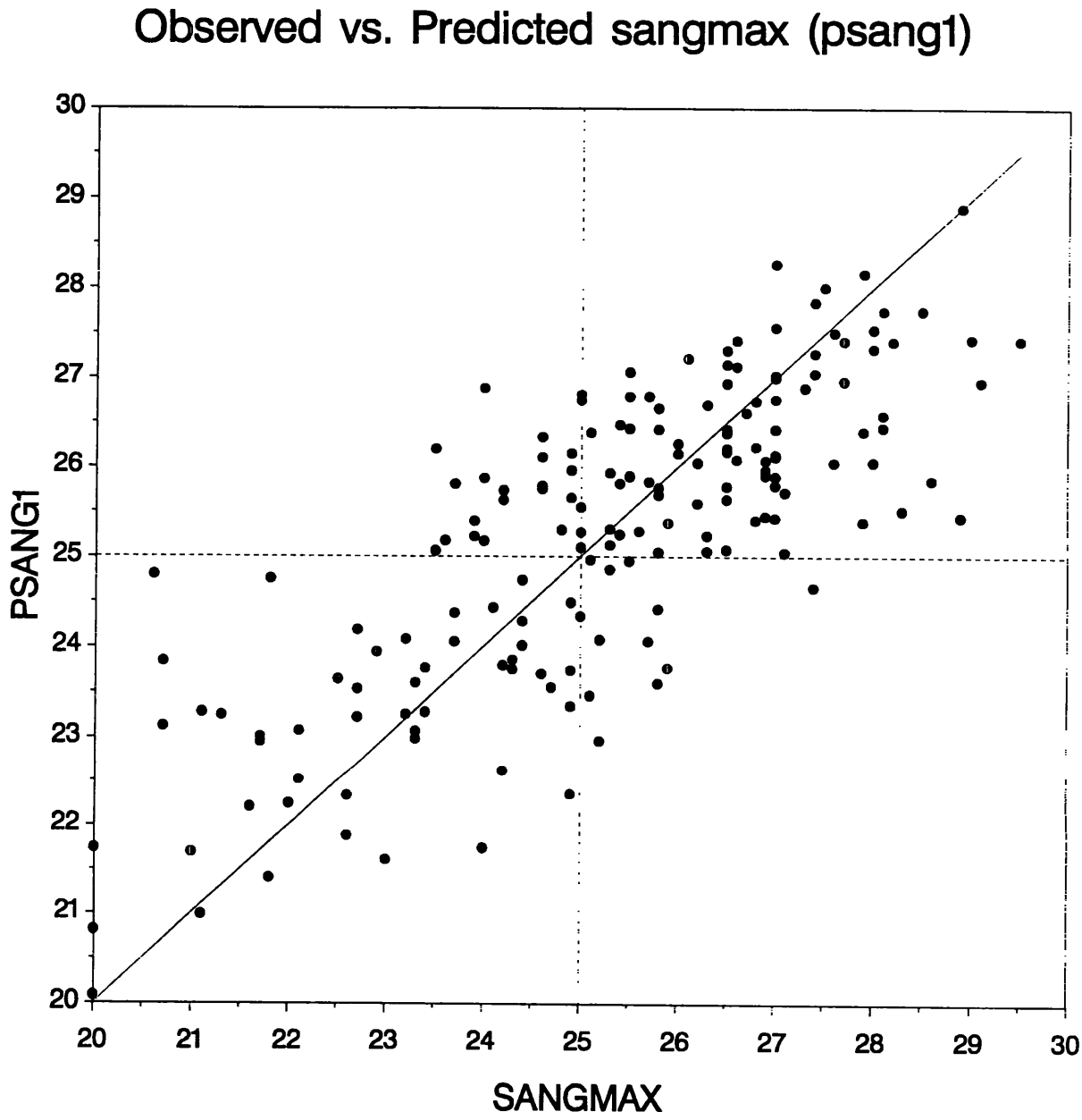
YOUGHIOGHENY RIVER TEMPERATURE ENHANCEMENT PROTOCOL PLOTS OF OBSERVED (SANGMAX) VS. PREDICTED (PSANG*) AND RESIDUAL PLOTS OF MAXIMUM DAILY RIVER TEMPERATURE AT SANG RUN FOR A SERIES OF REGRESSION MODELS

Notes for the observed vs. predicted plots:

the diagonal line represents the ideal or perfect prediction model

The lower right quarter shows needed releases that are not predicted (false negatives)

The upper left quarter shows releases that were predicted but not necessary (false positives)


Observed vs. Predicted sangmax (psang1)
PSANG1
SANGMAX
30
29
28
27
26
25
24
23
22
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20
20
21
22
23
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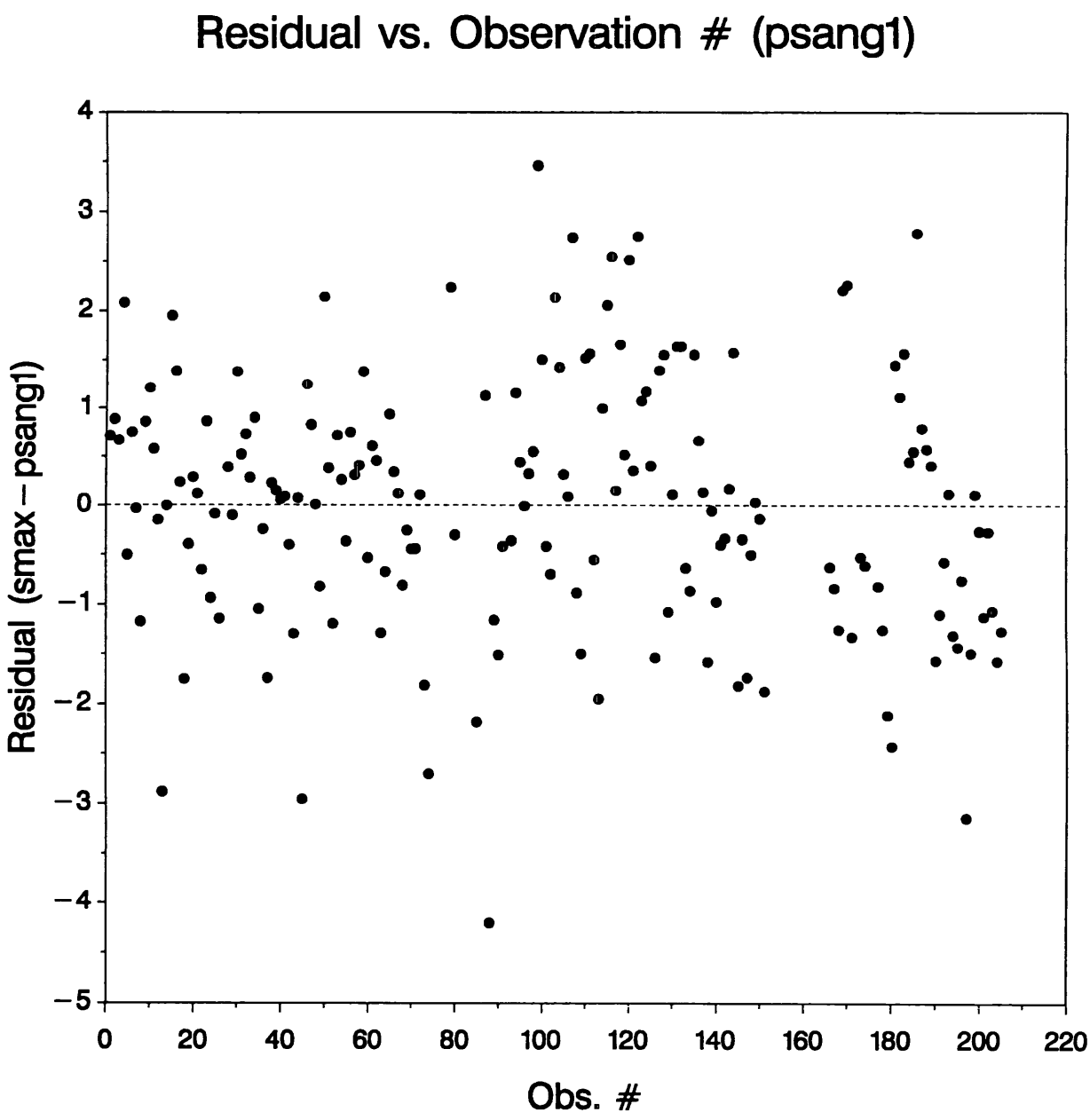
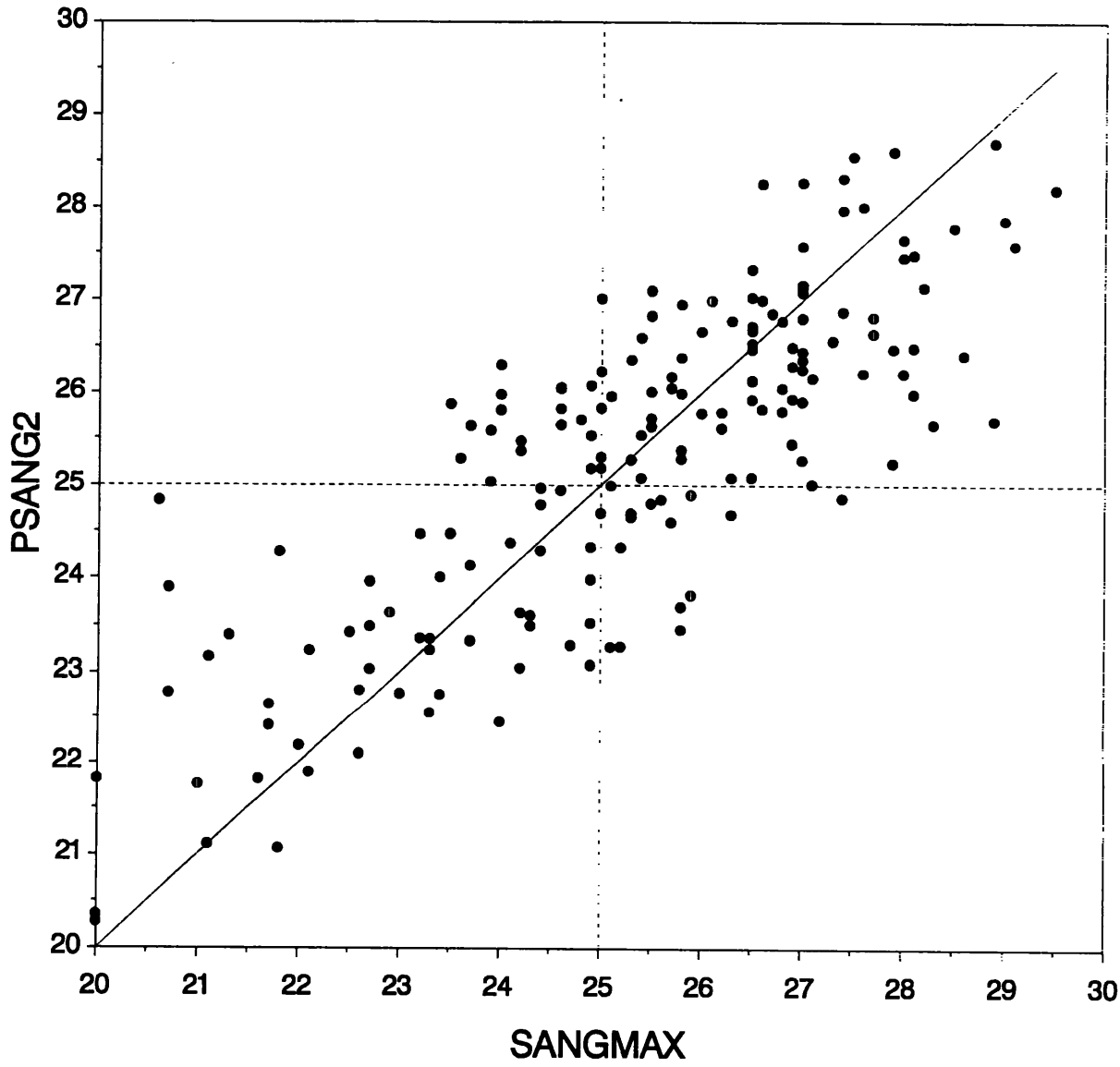
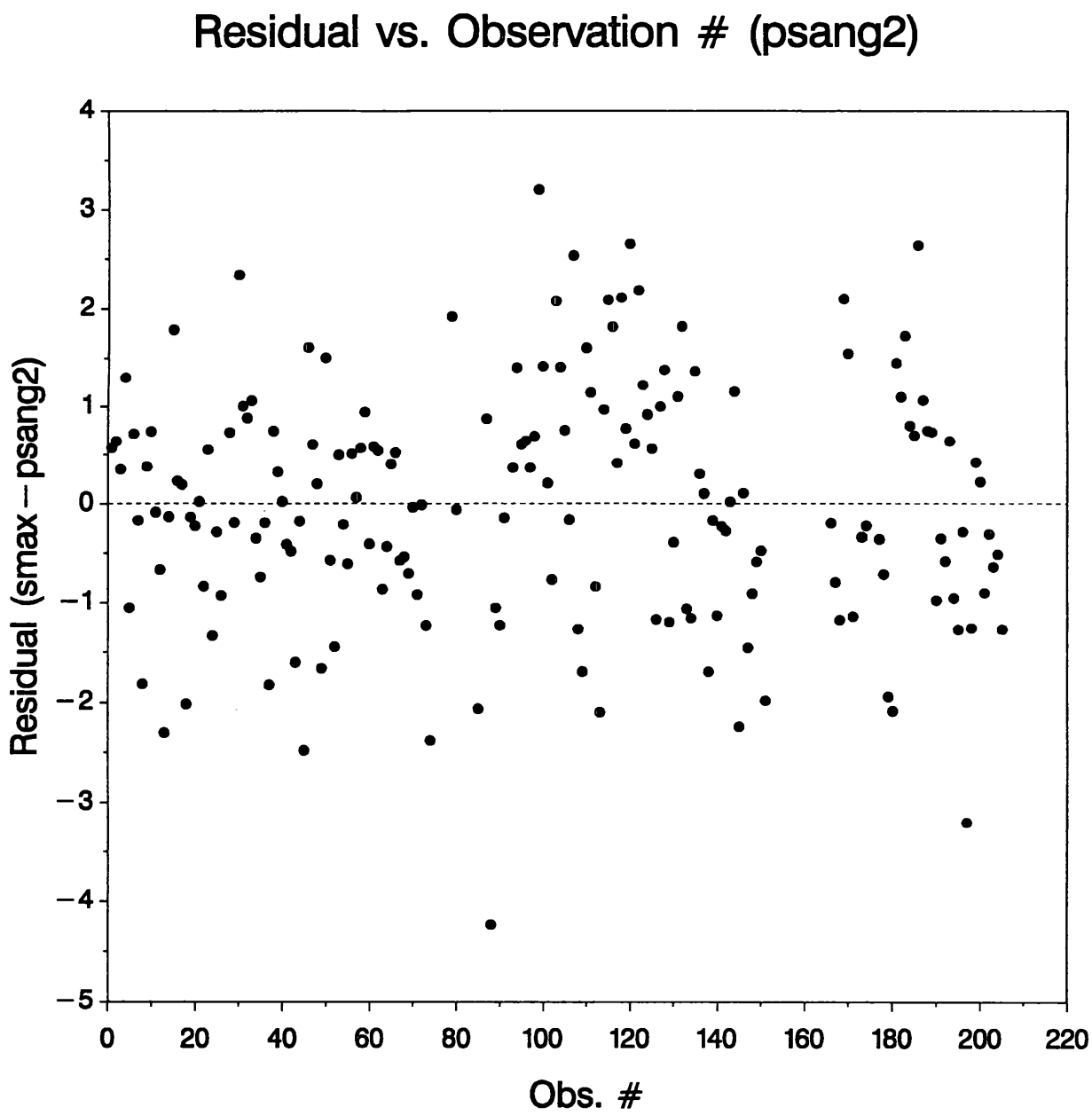
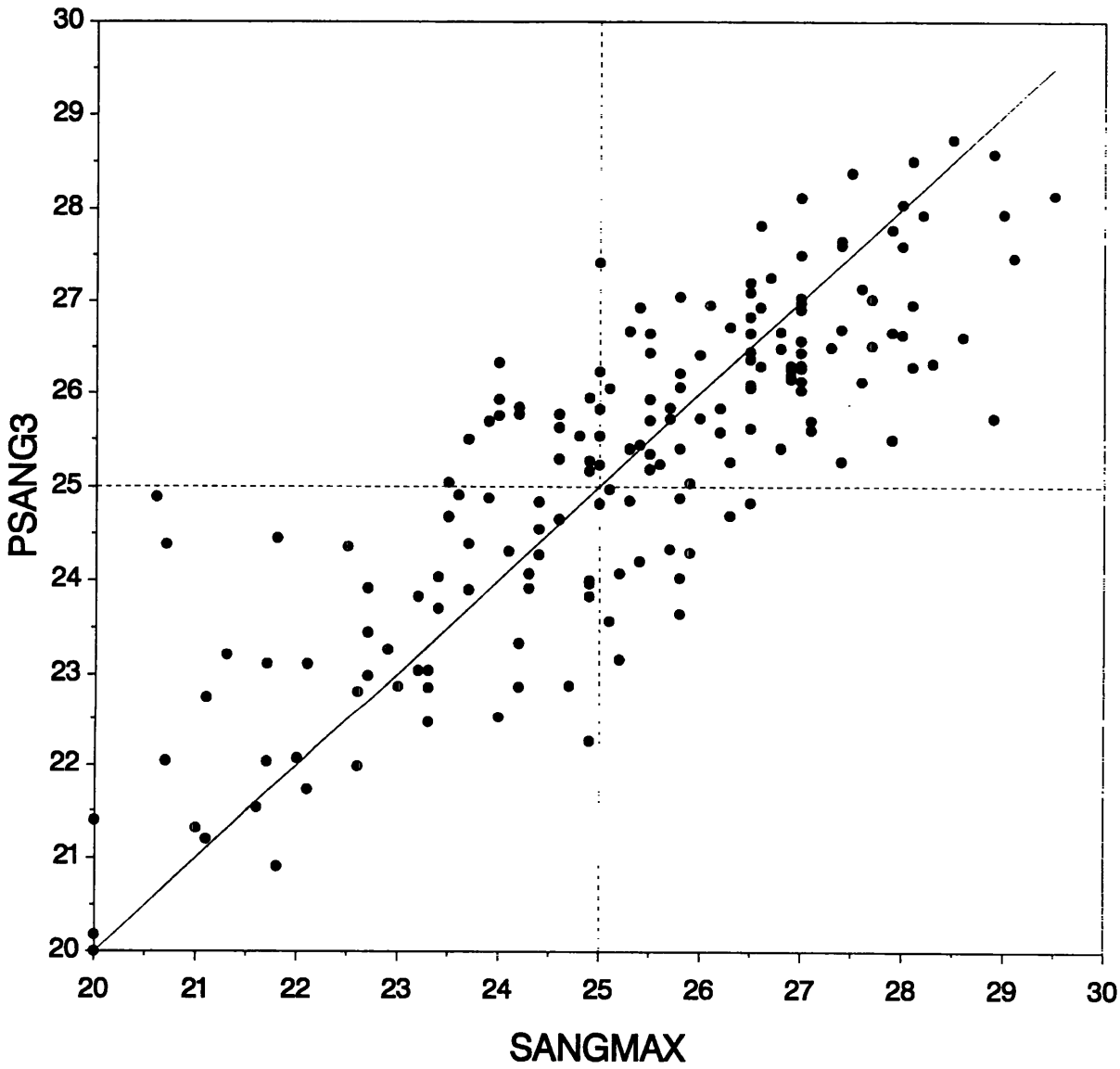
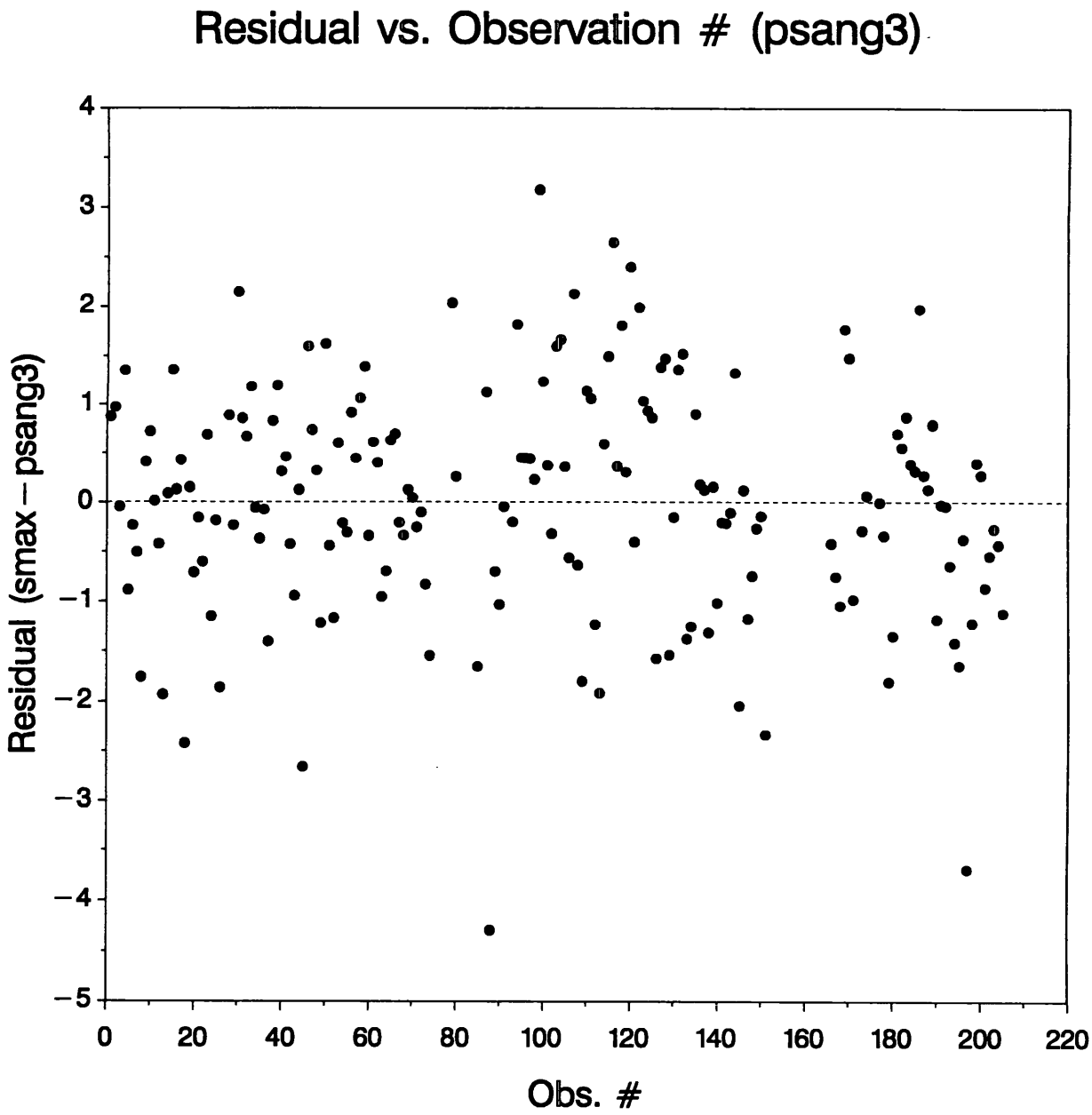
26
27
28
29
30

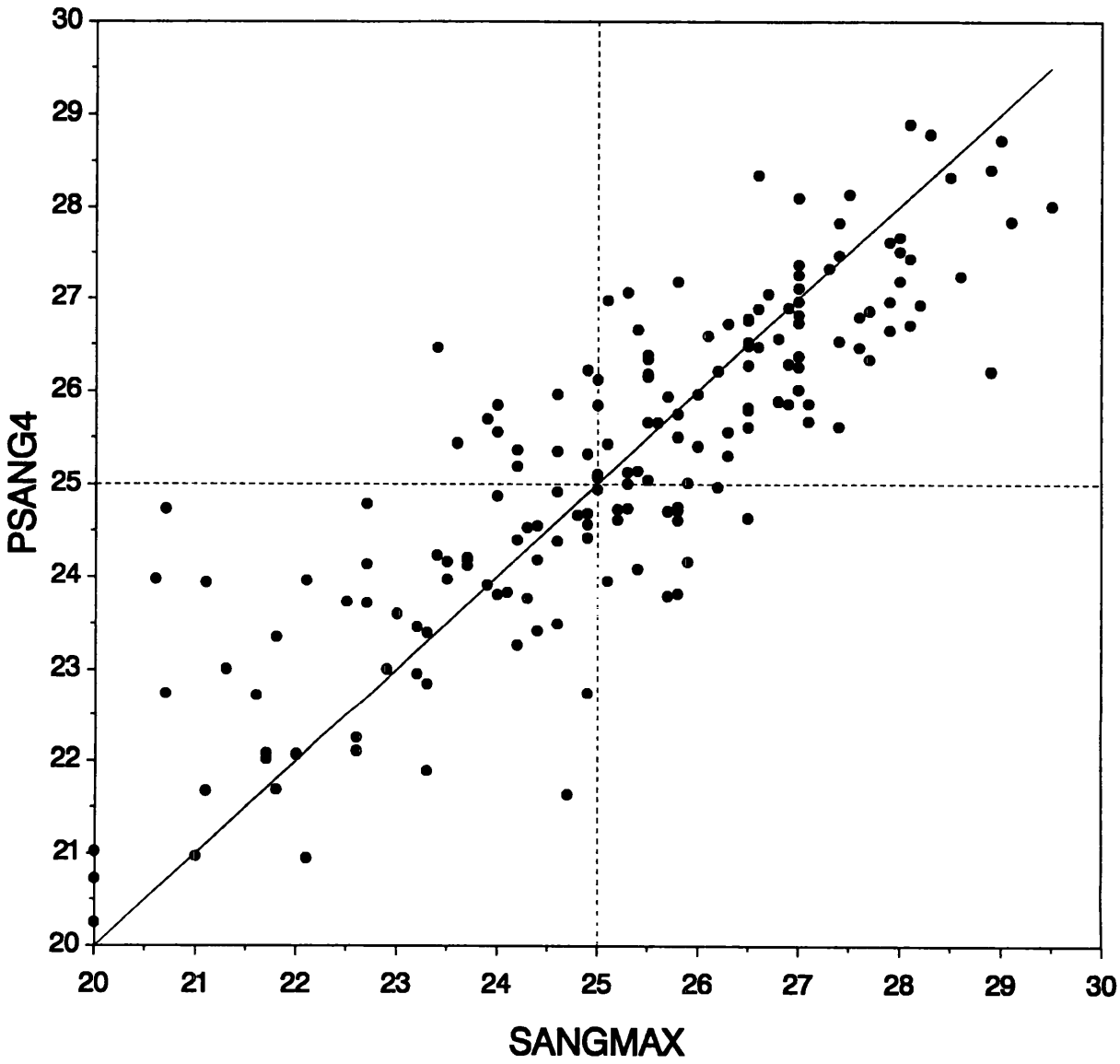

Residual vs. Observation # (psang1)
Residual (smax – psang1)
4
3
2
1
0
−1
−2
−3
−4
−5
0
20
40
60
80
100
120
140
160
180
200
220
Obs. #

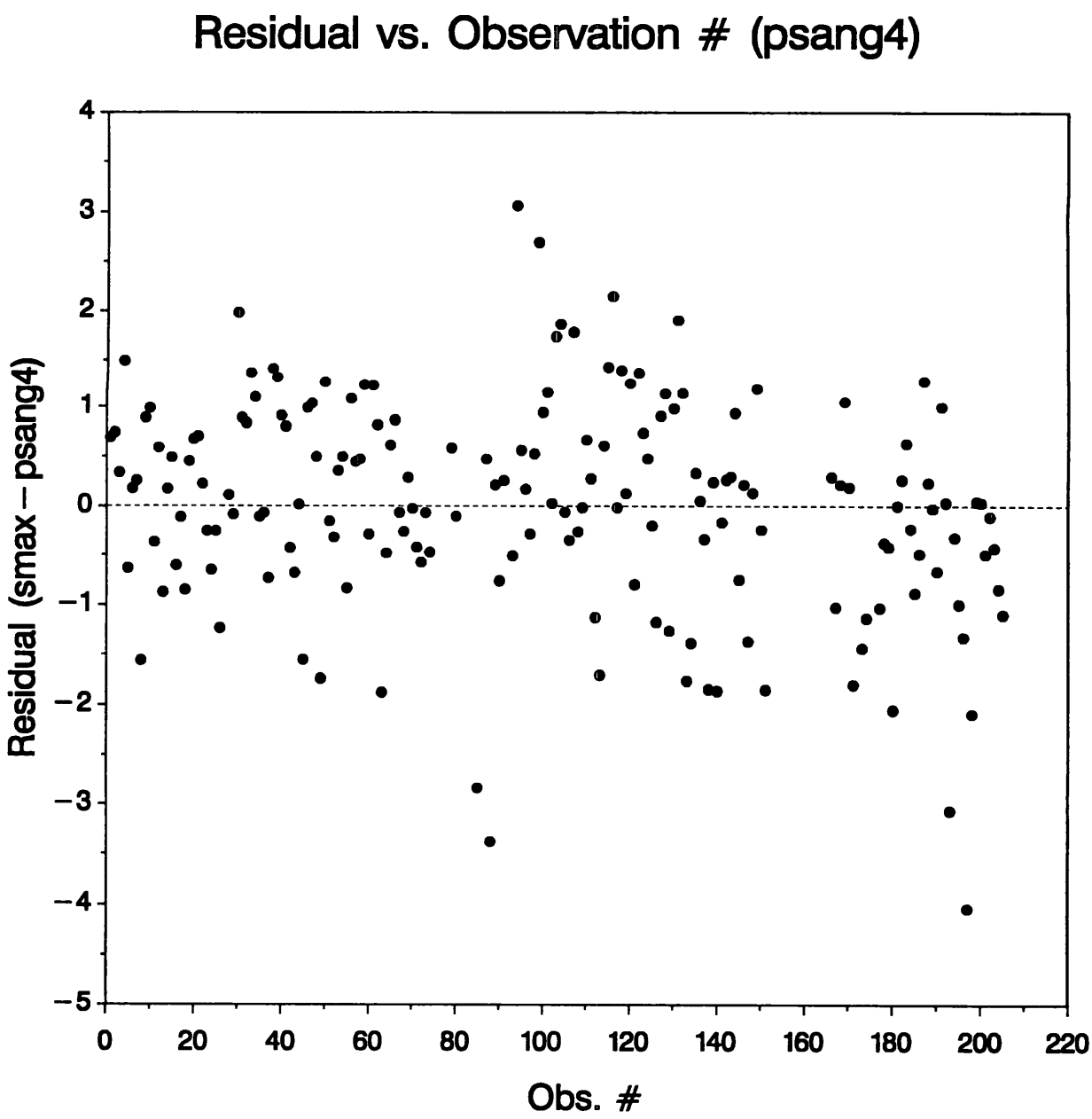

Observed vs. Predicted sangmax (psang2)
PSANG2
SANGMAX
30
29
28
27
26
25
24
23
22
21
20
20
21
22
23
24
25
26
27
28
29
30

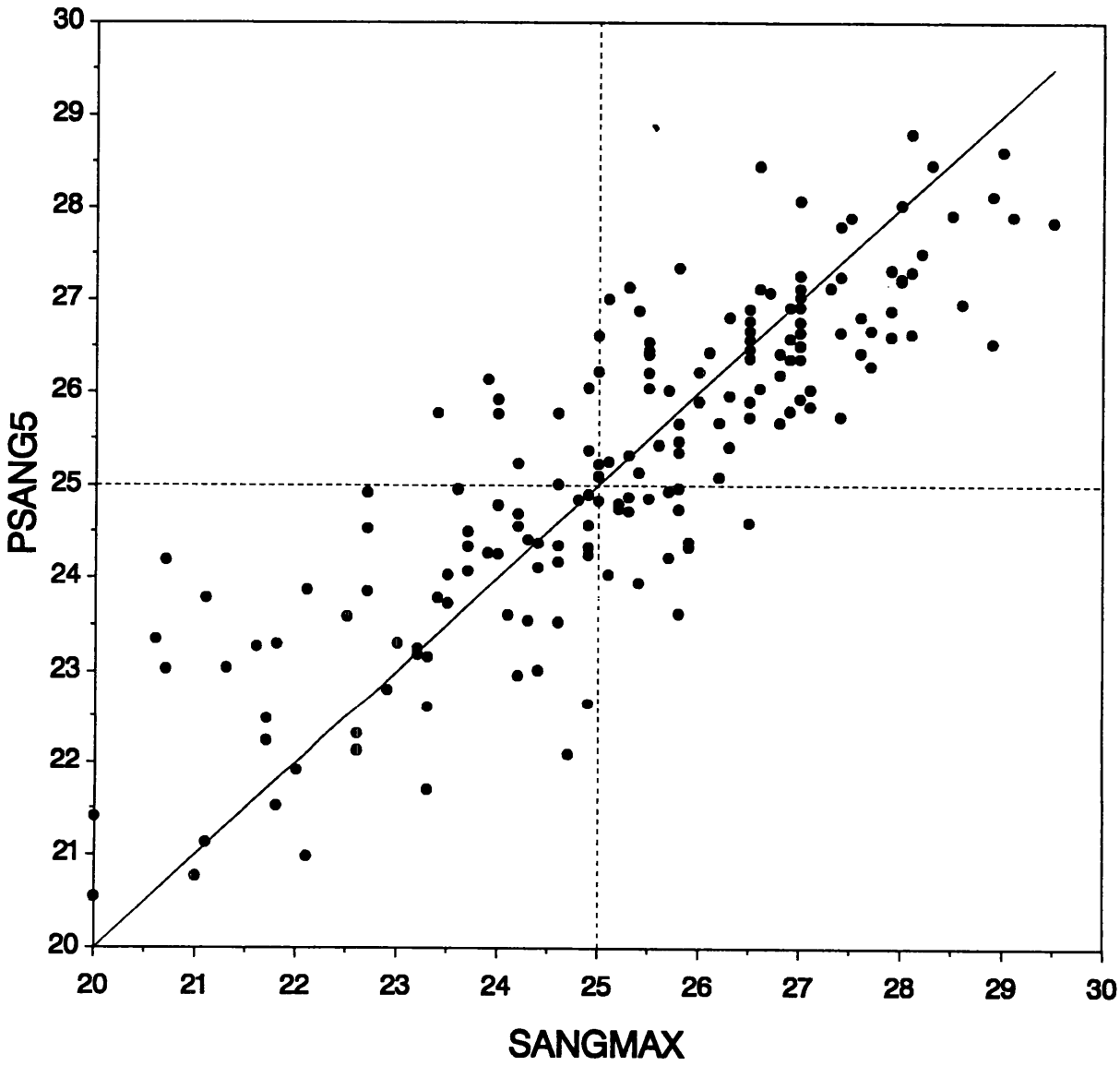

Residual vs. Observation # (psang2)
Residual (smax – psang2)
4
3
2
1
0
−1
−2
−3
−4
−5
0
20
40
60
80
100
120
140
160
180
200
220
Obs. #

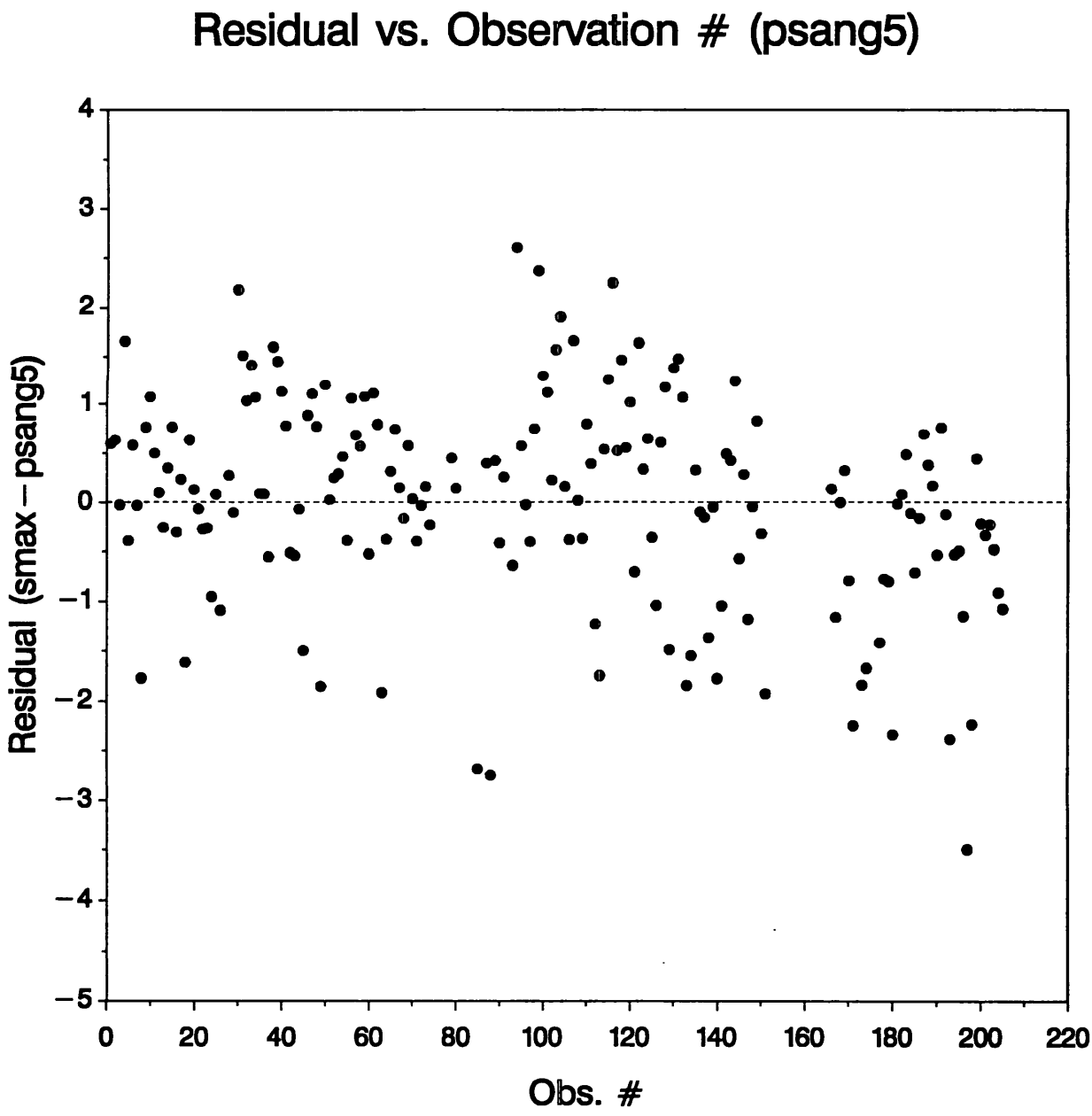

Observed vs. Predicted sangmax (psang3)
PSANG3
SANGMAX
30
29
28
27
26
25
24
23
22
21
20
20
21
22
23
24
25
26
27
28
29
30

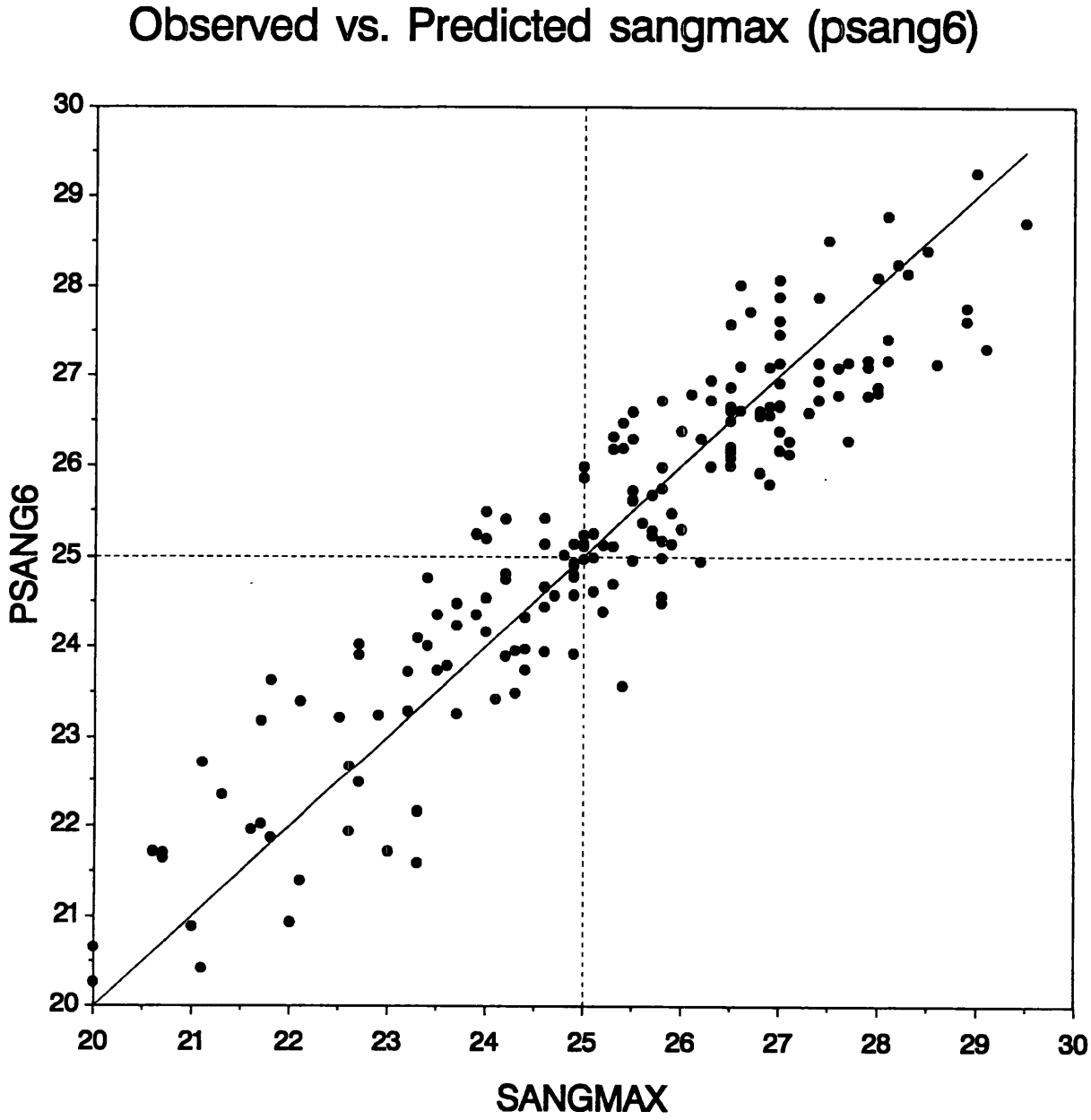

Residual vs. Observation # (psang3)
Residual (smax – psang3)
4
3
2
1
0
−1
−2
−3
−4
−5
0
20
40
60
80
100
120
140
160
180
200
220
Obs. #

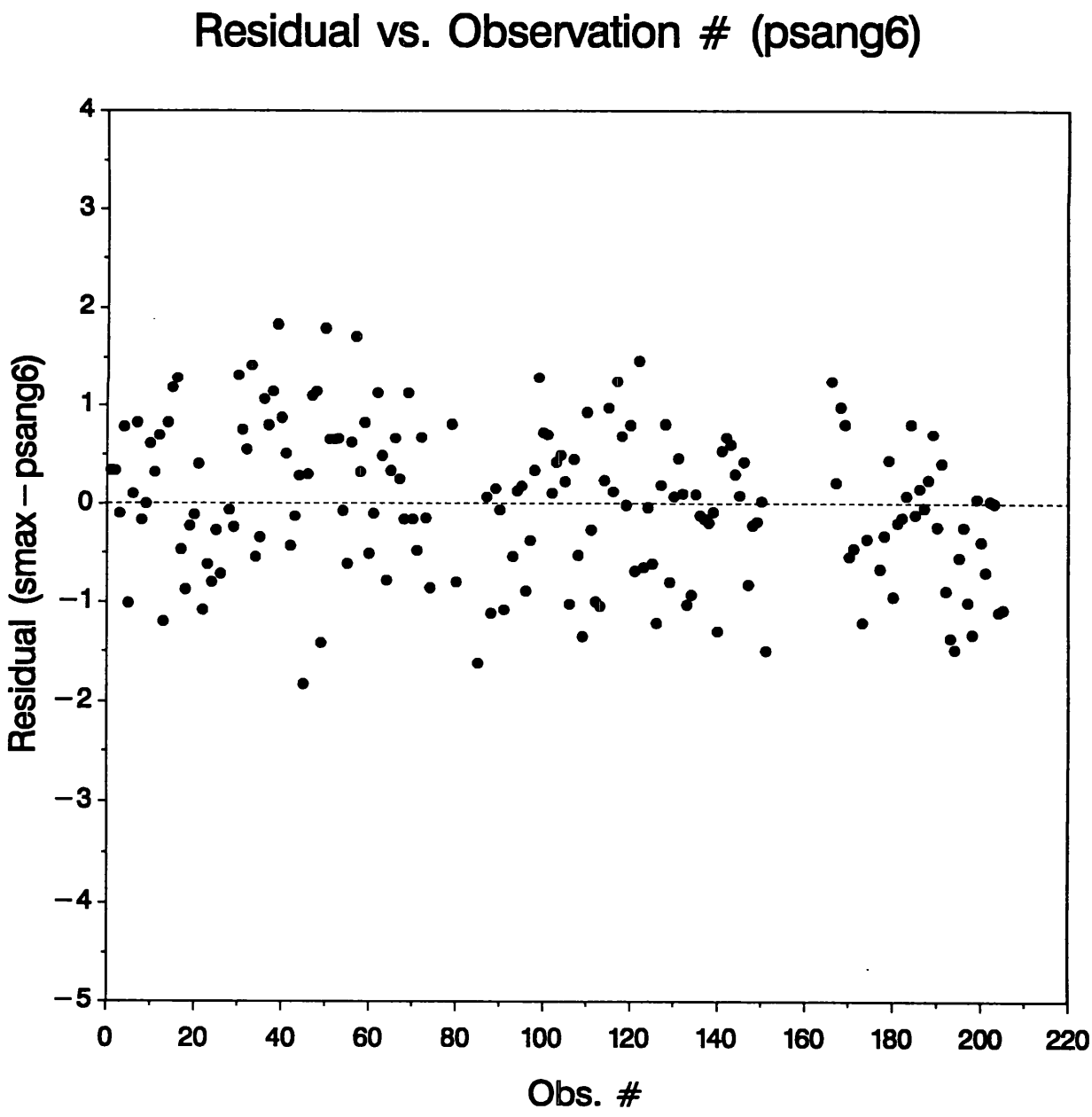

Observed vs. Predicted sangmax (psang4)
PSANG4
SANGMAX
30
29
28
27
26
25
24
23
22
21
20
20
21
22
23
24
25
26
27
28
29
30

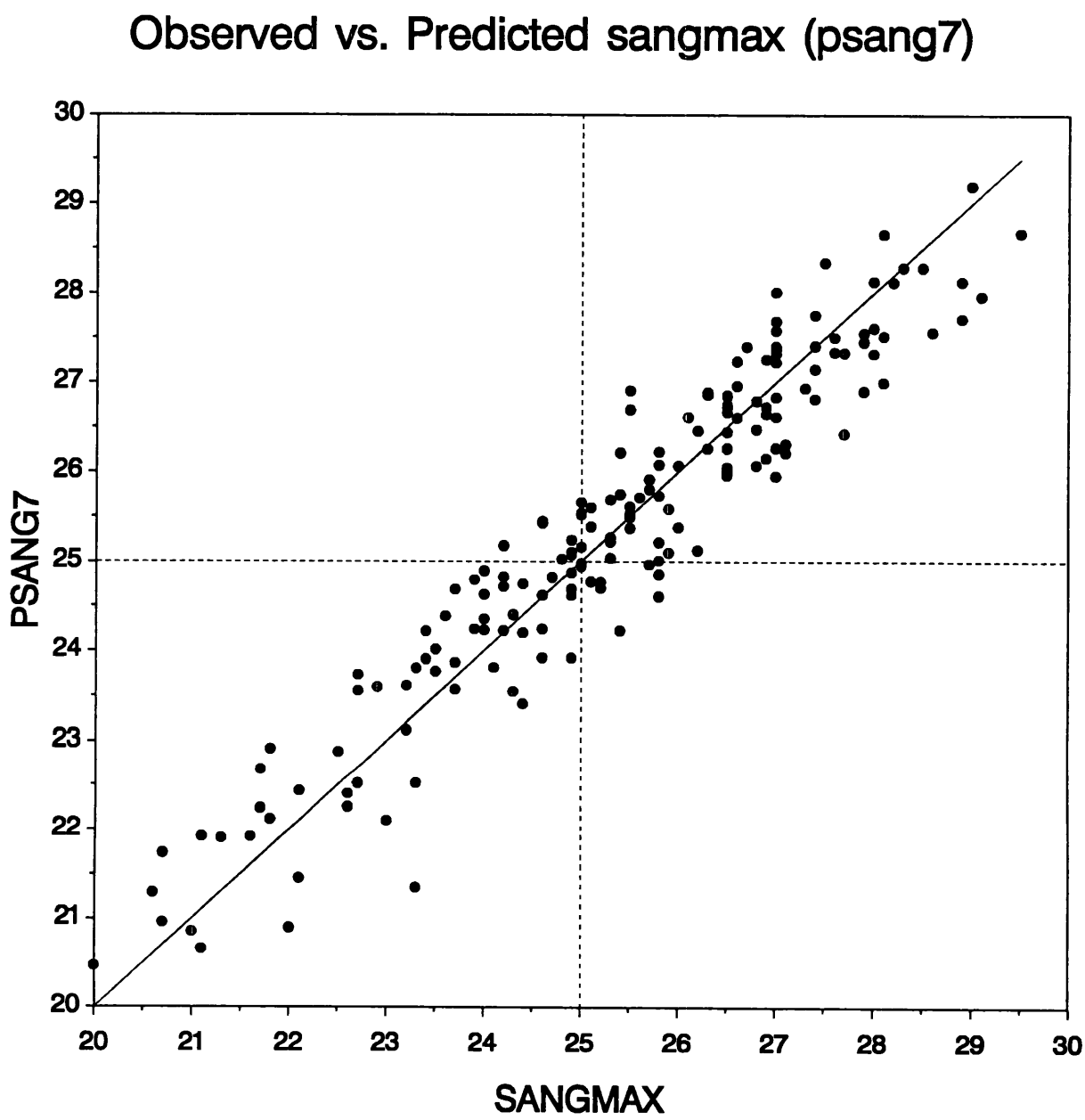

Residual vs. Observation # (psang4)
Residual (smax – psang4)
4
3
2
1
0
−1
−2
−3
−4
−5
0
20
40
60
80
100
120
140
160
180
200
220
Obs. #

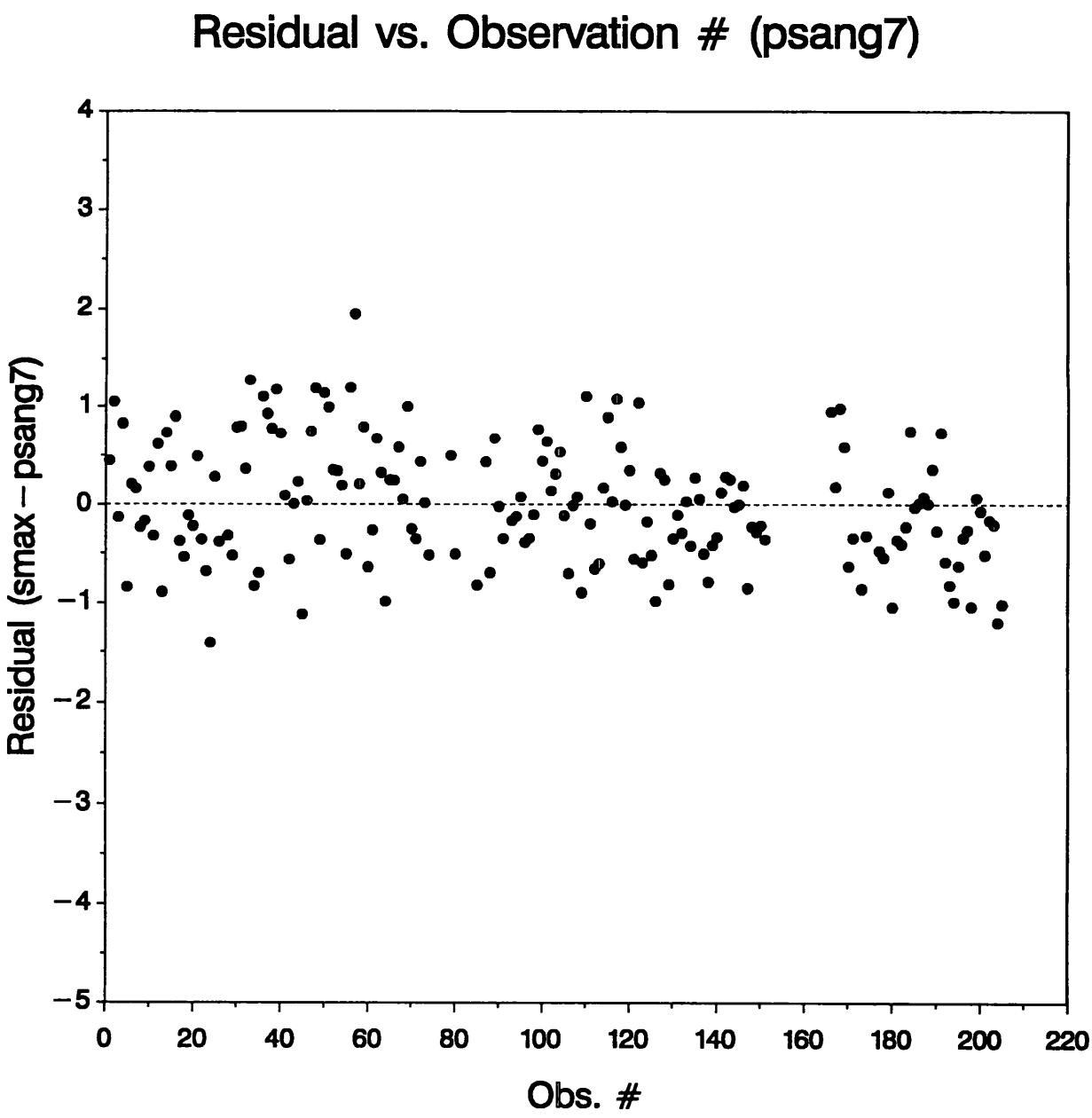

Observed vs. Predicted sangmax (psang5)
PSANG5
SANGMAX
30
29
28
27
26
25
24
23
22
21
20
20
21
22
23
24
25
26
27
28
29
30


Residual vs. Observation # (psang5)
Residual (smax – psang5)
4
3
2
1
0
−1
−2
−3
−4
−5
0
20
40
60
80
100
120
140
160
180
200
220
Obs. #


Observed vs. Predicted sangmax (psang6)
PSANG6
SANGMAX
30
29
28
27
26
25
24
23
22
21
20
20
21
22
23
24
25
26
27
28
29
30


Residual vs. Observation # (psang6)
Residual (smax – psang6)
4
3
2
1
0
−1
−2
−3
−4
−5
0
20
40
60
80
100
120
140
160
180
200
220
Obs. #


Observed vs. Predicted sangmax (psang7)
PSANG7
SANGMAX
30
29
28
27
26
25
24
23
22
21
20
20
21
22
23
24
25
26
27
28
29
30


Residual vs. Observation # (psang7)
Residual (smax – psang7)
4
3
2
1
0
−1
−2
−3
−4
−5
0
20
40
60
80
100
120
140
160
180
200
220
Obs. #

APPENDIX D

YOUGHIOGHENY RIVER TEMPERATURE ENHANCEMENT PROTOCOL MODEL INPUT DATA AND PREDICTED TEMPERATURES FOR A SERIES OF REGRESSION MODELS

Variable Definitions:

SMAX	=	Daily maximum river temperature at Sang Run (°C)
EMAX	=	Daily maximum air temperature recorded at Elkins, WV (°C) (= TMAXAIR)
ECLD	=	Average total opaque cloud cover fraction recorded at Elkins, WV between 1000 and (= CLOUDCOV) 1400 (0 = no clouds; 10 = total cloud cover)

Model Results: (see Table 5 for regression equations)

PSANG1L	=	Lower range for the PSANG1 model (uses TMAXAIR-1.5 and upper limit of cloud cover fraction range
PSANG1	=	Unadjusted PSANG1 model
PSANG1U	=	Upper range for the PSANG1 model (uses TMAXAIR + 1.5 and lower limit of cloud cover fraction range
PSANG2L	=	Lower range for the PSANG2 model (uses TMAXAIR-1.5 and upper limit of cloud cover fraction range
PSANG3L	=	Lower range for the PSANG3 model (uses TMAXAIR-1.5 and upper limit of cloud cover fraction range
PSANG4L	=	Lower range for the PSANG4 model (uses TMAXAIR-1.5 and upper limit of cloud cover fraction range
PSANG5L	=	Lower range for the PSANG5 model (uses TMAXAIR-1.5 and upper limit of cloud cover fraction range
PSANG6	=	Unadjusted PSANG6 model
PSANG7	=	Unadjusted PSANG7 model

DATE	SMAX	EMAX	ECLD	PSANG1L	PSANG1	PSANG1U	PSANG2L	PSANG3L	PSANG4L	PSANG5L	PSANG6	PSANG7
18JUL87	26.5	29.4	2.2	25.2	25.8	26.4	25.4	25.1	25.4	25.5	26.2	26.0
19JUL87	27.0	30.6	4.2	25.3	26.1	26.8	25.5	25.2	25.7	25.9	26.7	26.0
21JUL87	28.0	32.8	5.6	26.7	27.3	28.2	27.1	27.5	27.2	27.7	28.1	28.1
22JUL87	29.5	32.2	3.2	26.4	27.4	28.0	27.2	27.2	27.4	27.3	28.7	28.7
23JUL87	27.5	33.9	3.4	27.1	28.0	28.6	27.6	27.4	27.5	27.4	28.5	28.3
24JUL87	28.5	32.8	2.6	27.2	27.7	28.4	27.3	28.3	27.9	27.6	28.4	28.3
25JUL87	27.0	31.7	3.4	26.1	27.0	27.6	26.2	26.6	26.1	26.5	26.2	26.8
26JUL87	24.0	28.3	7.8	24.6	25.2	25.9	25.3	25.3	25.2	25.4	24.2	24.2
27JUL87	26.5	28.3	5.2	25.0	25.6	26.5	25.5	25.5	25.2	25.3	26.5	26.7
28JUL87	27.0	27.2	1.0	25.3	25.8	26.3	25.8	25.8	25.6	25.6	26.4	26.6
29JUL87	27.0	30.0	2.2	25.8	26.4	27.0	26.5	26.5	27.0	26.1	26.7	27.3
30JUL87	26.0	30.6	4.4	25.3	26.1	26.9	25.9	25.6	24.9	25.4	25.3	25.4
01AUG87	24.0	31.1	5.4	26.2	26.9	27.8	25.7	25.4	24.4	23.9	25.2	24.9
02AUG87	27.0	31.7	5.6	26.4	27.0	27.9	26.6	26.4	26.4	26.3	26.2	26.3
04AUG87	28.0	30.6	5.8	25.5	26.1	27.0	25.7	26.2	27.1	26.9	26.8	27.6
05AUG87	23.0	25.0	9.6	20.9	21.6	22.3	22.1	22.3	23.2	22.9	21.7	22.1
08AUG87	27.0	31.1	5.4	26.1	26.8	27.6	26.2	26.0	26.7	26.4	27.5	27.4
09AUG87	25.0	31.7	6.8	25.9	26.7	27.2	26.2	26.6	25.3	26.1	25.9	25.5
11AUG87	25.5	28.9	5.2	25.2	25.9	26.7	25.0	24.7	24.6	24.5	25.7	25.6
12AUG87	26.5	29.4	2.2	25.6	26.2	26.8	26.2	26.7	25.4	26.0	26.6	26.7
15AUG87	26.5	31.7	4.6	25.6	26.4	27.1	25.7	25.9	25.3	26.1	26.1	26.0
16AUG87	26.5	32.2	5.4	26.5	27.2	28.0	26.7	26.5	25.8	26.4	27.6	26.9
18AUG87	27.0	28.9	1.4	25.5	26.1	26.7	25.8	25.7	26.8	26.9	27.6	27.7
19AUG87	25.5	30.0	0.6	25.9	26.4	27.0	26.3	26.2	25.8	26.1	26.3	26.9
29AUG87	20.0	20.6	9.6	19.4	20.1	20.8	19.7	19.6	19.8	19.5	20.3	19.7
30AUG87	22.5	25.0	2.4	23.1	23.6	24.3	22.9	23.9	23.3	23.2	23.2	22.9
12JUN88	21.8	25.0	2.0	20.8	21.4	22.0	20.5	20.4	21.3	21.2	21.9	22.1
16JUN88	25.0	29.4	4.0	24.2	25.1	25.8	24.3	24.4	24.5	24.6	25.2	25.5
18JUN88	25.8	26.1	3.0	23.9	24.4	25.1	23.0	23.2	23.4	23.3	24.5	25.0
19JUN88	25.9	29.4	4.4	24.6	25.4	26.1	24.1	24.3	24.5	23.9	25.1	25.1
21JUN88	27.7	31.1	0.8	26.4	27.0	27.5	26.3	26.6	26.5	26.3	27.1	27.3
25JUN88	27.7	32.2	2.6	26.8	27.4	28.0	26.1	26.0	25.9	25.9	26.3	26.4
26JUN88	24.6	26.7	8.6	22.7	23.7	24.1	24.0	23.7	22.9	23.0	25.1	25.4
28JUN88	22.9	25.6	1.2	23.3	23.9	24.5	23.0	22.7	22.6	22.4	23.2	23.6
29JUN88	22.0	22.8	9.8	21.6	22.2	23.0	21.6	21.6	21.7	21.6	20.9	20.9
30JUN88	20.0	20.6	4.4	20.9	21.7	22.4	21.0	20.6	20.2	20.1	19.2	19.1
02JUL88	23.3	23.9	1.8	22.4	23.1	23.6	22.0	21.9	21.5	21.3	22.2	22.5
03JUL88	25.4	28.9	1.0	24.7	25.2	25.8	24.6	23.8	23.7	23.6	23.6	24.2
06JUL88	26.8	31.7	0.2	26.2	26.7	27.3	26.3	26.0	25.5	25.3	25.9	26.1
07JUL88	27.6	33.3	1.8	26.9	27.5	28.1	27.4	26.6	26.4	26.5	27.1	27.5

DATE	SMAX	EMAX	ECLD	PSANG1L	PSANG1	PSANG1U	PSANG2L	PSANG3L	PSANG4L	PSANG5L	PSANG6	PSANG7
09JUL88	26.3	33.3	7.80	26.1	26.7	27.4	26.2	26.2	26.3	26.5	26.7	26.9
10JUL88	25.5	33.9	7.60	26.2	26.8	27.5	26.5	25.9	25.7	25.7	25.6	25.5
11JUL88	26.5	30.6	6.20	25.9	26.4	27.5	26.2	26.0	26.1	26.3	26.2	26.3
12JUL88	21.8	27.8	9.60	24.1	24.8	25.5	23.6	23.9	22.9	22.9	23.6	22.9
13JUL88	26.3	27.8	7.60	24.4	25.1	25.7	24.1	24.1	24.9	25.0	26.0	26.3
14JUL88	26.9	30.0	7.80	25.5	26.1	26.8	25.7	25.7	25.5	25.5	25.8	26.1
16JUL88	28.9	36.7	3.20	27.9	28.9	29.4	27.7	27.6	27.8	27.6	27.8	27.7
17JUL88	26.6	33.3	6.60	26.5	27.4	27.9	27.4	27.0	27.8	28.0	28.0	27.0
18JUL88	29.1	31.7	4.80	26.2	27.0	27.7	26.9	26.8	27.3	27.5	27.3	28.0
19JUL88	24.4	26.1	10.00	23.5	24.0	24.9	24.5	24.4	24.2	24.1	23.7	23.4
20JUL88	24.6	30.0	8.80	24.9	25.8	26.3	25.1	24.9	24.3	23.8	23.9	24.2
21JUL88	22.6	22.8	10.00	21.3	21.9	22.7	21.6	21.6	21.9	22.0	21.9	22.3
23JUL88	22.6	22.2	9.80	21.7	22.3	23.1	22.2	22.3	21.7	21.8	22.7	22.4
24JUL88	23.4	26.7	7.60	23.1	23.8	24.4	23.4	23.1	23.8	23.4	24.0	23.9
25JUL88	25.8	27.2	5.20	24.4	25.0	25.9	24.6	24.3	24.3	24.4	25.2	24.6
26JUL88	23.3	24.4	10.00	22.5	23.0	23.8	22.8	22.4	22.5	22.3	21.6	21.3
27JUL88	24.9	27.2	9.00	23.6	24.5	25.0	23.5	23.0	23.9	23.9	24.6	24.7
28JUL88	27.1	28.3	4.20	24.9	25.7	26.4	25.3	24.9	25.3	25.6	26.3	26.3
30JUL88	26.6	31.7	3.60	26.2	27.1	27.7	26.1	26.0	26.3	26.6	27.1	27.2
31JUL88	26.2	28.3	6.80	24.8	25.6	26.1	24.8	24.8	24.4	24.6	26.3	26.5
02AUG88	28.0	32.8	2.80	27.0	27.5	28.2	27.0	27.2	26.8	26.9	26.9	27.3
04AUG88	25.1	30.0	6.80	25.5	26.4	26.9	25.1	25.3	26.4	26.5	24.6	24.8
06AUG88	23.7	26.7	9.40	23.6	24.4	25.0	23.4	23.7	23.7	23.7	24.5	24.7
07AUG88	26.9	28.3	4.60	25.2	26.0	26.7	25.7	25.5	25.8	26.1	26.6	26.6
09AUG88	27.4	32.2	2.60	26.5	27.1	27.7	26.4	26.2	26.1	26.3	26.7	27.2
10AUG88	27.4	32.2	2.80	26.7	27.3	27.9	27.5	27.2	27.1	26.9	27.1	26.8
13AUG88	26.5	32.2	5.20	26.6	27.3	28.1	26.4	26.2	26.3	26.3	26.7	26.4
14AUG88	27.9	33.3	2.00	27.5	28.2	28.7	28.0	27.2	27.2	27.0	26.8	26.9
16AUG88	26.5	30.6	2.20	26.3	26.9	27.5	26.0	25.9	26.1	26.1	26.7	26.8
17AUG88	27.4	33.3	2.20	27.2	27.8	28.4	27.8	27.1	27.4	27.4	27.9	27.8
20AUG88	21.1	22.2	10.00	20.5	21.0	21.8	20.6	20.8	21.3	20.8	20.4	20.7
27AUG88	25.0	30.6	2.20	26.2	26.8	27.4	25.7	25.3	24.7	24.5	25.1	25.0
28AUG88	23.5	28.9	4.80	25.4	26.2	27.0	25.1	24.3	23.5	23.3	24.4	24.0
06AUG89	25.2	28.9	7.25	22.2	23.0	23.6	22.6	22.5	24.1	24.3	24.4	24.7
13AUG89	23.3	26.7	6.25	23.1	23.6	24.6	22.9	22.7	23.1	22.9	24.1	23.8
22JUN90	21.1	27.8	1.00	22.7	23.3	23.8	22.7	22.3	23.6	23.5	22.7	21.9
29JUL90	25.2	30.0	0.20	23.5	24.1	24.6	23.8	23.6	24.3	24.5	25.1	24.8
05AUG90	20.6	25.6	1.00	24.3	24.8	25.4	24.4	24.5	23.6	23.0	21.7	21.3
12AUG90	24.6	28.3	0.20	25.2	25.8	26.3	25.2	24.9	24.0	23.8	24.4	23.9
16AUG90	24.6	29.4	1.50	25.5	26.1	26.7	25.2	25.1	24.9	24.6	24.7	24.6

DATE	SMAX	EMAX	ECLD	PSANG1L	PSANG1	PSANG1U	PSANG2L	PSANG3L	PSANG4L	PSANG5L	PSANG6	PSANG7
19AUG90	25.4	29.4	7.5	25.1	25.8	26.5	24.9	24.9	24.7	24.8	26.5	25.7
11JUN91	23.7	26.7	7.8	23.5	24.1	24.8	22.8	23.4	23.8	24.0	24.2	23.9
12JUN91	24.7	24.4	9.2	22.8	23.6	24.1	22.5	22.1	21.1	21.7	24.6	24.8
13JUN91	25.3	25.6	1.0	24.3	24.9	25.4	24.2	24.4	24.4	24.4	25.1	25.2
15JUN91	25.3	30.0	6.2	24.8	25.3	26.3	24.2	24.5	24.8	25.0	26.2	25.7
16JUN91	26.5	30.0	7.4	25.5	26.2	26.8	25.5	25.4	26.3	26.5	26.9	26.8
18JUN91	24.3	25.0	9.2	23.0	23.8	24.3	22.8	23.3	23.2	23.1	24.0	24.4
19JUN91	28.9	29.4	8.0	24.9	25.4	26.2	25.2	25.3	25.8	26.2	27.6	28.1
20JUN91	27.9	30.0	5.6	25.8	26.4	27.3	25.9	26.1	26.5	26.2	27.2	27.5
22JUN91	22.1	21.7	10.0	22.0	22.5	23.4	21.4	21.3	20.6	20.7	21.4	21.5
23JUN91	21.0	22.8	9.6	21.0	21.7	22.4	21.1	20.7	20.5	20.4	20.9	20.9
25JUN91	25.9	25.0	6.2	23.3	23.8	24.8	23.4	23.9	23.8	24.0	25.5	25.6
26JUN91	26.5	27.2	3.8	24.2	25.1	25.7	24.2	24.0	24.1	24.1	26.0	26.0
29JUN91	25.6	28.9	9.0	24.4	25.3	25.8	24.0	24.4	25.1	25.0	25.4	25.7
30JUN91	26.7	30.0	5.4	26.0	26.6	27.5	26.2	26.7	26.6	26.7	27.7	27.4
02JUL91	27.4	27.2	9.6	24.0	24.7	25.4	24.2	24.7	25.2	25.4	26.9	27.4
03JUL91	23.2	26.1	9.8	23.5	24.1	24.9	23.9	23.3	23.1	22.8	23.7	23.1
04JUL91	23.9	28.3	7.4	24.7	25.4	26.0	24.9	25.1	23.5	23.9	25.2	24.8
06JUL91	28.1	30.0	2.4	26.0	26.6	27.2	25.9	26.5	27.0	27.0	27.2	27.0
07JUL91	29.0	31.1	0.6	26.9	27.4	28.0	27.4	27.5	28.3	28.3	29.3	29.2
09JUL91	25.0	26.7	4.2	24.7	25.6	26.2	25.0	25.4	25.6	25.8	26.0	25.7
10JUL91	21.3	23.9	9.6	22.6	23.2	24.0	22.8	22.6	22.6	22.7	22.3	21.9
11JUL91	26.9	27.8	3.2	24.9	25.9	26.5	25.0	25.3	25.7	25.8	26.7	26.7
13JUL91	27.1	27.2	6.6	24.2	25.0	25.5	24.1	24.7	25.1	25.4	26.1	26.2
14JUL91	24.9	23.3	10.0	21.8	22.4	23.2	22.6	21.8	22.4	22.3	24.8	24.9
16JUL91	26.2	30.0	3.0	25.5	26.0	26.7	25.3	25.4	25.8	25.4	25.0	25.1
18JUL91	28.1	30.6	4.4	25.6	26.4	27.2	25.2	25.5	26.2	26.2	27.4	27.5
20JUL91	26.6	30.0	8.0	25.5	26.1	26.9	25.3	25.9	26.1	25.7	26.6	26.6
21JUL91	27.9	29.4	8.2	24.9	25.4	26.2	24.8	25.1	26.3	26.6	27.1	27.5
23JUL91	28.1	31.7	3.0	27.2	27.7	28.4	27.0	28.1	28.5	28.5	28.8	28.7
24JUL91	28.6	27.8	5.6	25.2	25.9	26.8	25.8	26.1	26.8	26.6	27.1	27.6
25JUL91	26.3	27.8	8.0	24.7	25.2	26.0	24.6	24.8	25.2	25.6	26.9	26.9
27JUL91	24.9	25.6	9.2	22.9	23.7	24.3	23.2	23.2	23.9	23.8	24.9	25.1
28JUL91	24.2	26.1	9.0	22.9	23.8	24.3	22.8	22.5	23.8	24.1	24.8	24.7
30JUL91	24.2	28.3	3.6	24.8	25.7	26.3	24.4	24.9	24.8	24.7	25.4	25.2
31JUL91	26.8	26.7	2.4	24.8	25.4	26.0	25.3	24.9	25.5	25.8	26.6	26.5
01AUG91	27.6	28.9	0.0	25.5	26.0	26.6	25.7	25.7	26.1	26.1	26.8	27.3
03AUG91	25.4	30.6	4.2	25.6	26.5	27.2	25.8	26.1	26.1	26.4	26.2	26.2
04AUG91	24.4	26.1	9.0	23.4	24.3	24.8	23.9	23.7	22.9	22.5	24.3	24.7
05AUG91	25.7	24.4	4.4	23.2	24.1	24.8	23.8	23.6	23.3	23.8	25.2	25.8

DATE	SMAX	EMAX	ECLD	PSANG1L	PSANG1	PSANG1U	PSANG2L	PSANG3L	PSANG4L	PSANG5L	PSANG6	PSANG7
06AUG91	25.1	25.0	8.20	23.0	23.5	24.3	22.9	23.2	23.6	23.7	25.0	25.4
07AUG91	25.3	28.3	4.00	25.1	25.9	26.6	25.5	25.8	26.5	26.7	26.3	25.3
08AUG91	25.8	30.0	1.00	26.1	26.7	27.2	26.5	26.6	26.8	27.0	26.7	26.2
10AUG91	24.9	25.0	7.00	22.6	23.3	23.9	22.8	23.3	24.0	24.1	24.8	24.6
11AUG91	25.0	25.0	2.20	23.7	24.3	24.9	24.1	24.3	24.5	24.7	25.1	24.9
12AUG91	25.1	27.2	4.60	24.2	25.0	25.7	24.2	24.2	24.9	24.8	25.3	25.6
13AUG91	23.6	27.8	4.60	24.4	25.2	25.9	24.5	24.2	24.9	24.5	23.8	24.4
14AUG91	23.2	23.9	9.40	22.5	23.3	23.9	22.7	22.4	22.5	22.8	23.3	23.6
15AUG91	22.1	23.9	9.40	22.3	23.1	23.7	22.5	22.4	23.5	23.5	23.4	22.4
17AUG91	25.5	28.3	1.80	25.3	25.9	26.5	25.1	25.2	25.2	26.2	25.0	25.4
18AUG91	24.1	26.7	9.00	23.6	24.4	25.0	23.5	23.5	23.3	23.1	23.4	23.8
19AUG91	25.3	27.2	6.60	24.2	25.1	25.6	24.4	24.6	24.4	24.4	24.7	25.0
20AUG91	24.2	22.8	8.80	21.7	22.6	23.1	22.1	22.0	22.7	22.5	23.9	24.2
21AUG91	19.7	21.1	10.00	21.0	21.5	22.4	21.5	21.3	20.1	19.9	19.6	19.7
22AUG91	24.4	26.1	0.60	24.2	24.7	25.3	23.8	23.8	23.8	23.8	24.0	24.2
24AUG91	24.6	29.4	3.40	25.4	26.3	26.9	25.1	24.8	25.4	25.3	25.4	25.4
25AUG91	24.8	26.7	3.00	24.8	25.3	26.0	25.2	25.1	24.3	24.5	25.0	25.0
26AUG91	25.8	28.3	2.00	25.1	25.8	26.4	25.8	25.5	24.2	24.6	26.0	26.1
27AUG91	25.7	29.4	4.80	25.1	25.8	26.6	25.4	25.1	25.4	25.6	25.7	25.9
31AUG91	24.0	28.9	6.80	25.0	25.9	26.4	25.2	25.5	25.3	25.5	25.5	24.4
30JUN92	25.8	28.9	0.80	25.9	26.4	27.0	25.5	25.8	25.1	25.3	24.6	24.9
01JUL92	22.7	25.0	9.75	22.9	23.5	24.3	22.9	22.9	23.3	23.5	22.5	22.5
02JUL92	24.9	28.9	0.40	25.6	26.2	26.7	25.6	25.5	24.3	24.6	23.9	23.9
05JUL92	25.8	26.1	6.75	22.7	23.6	24.1	22.9	23.2	24.2	25.0	25.0	25.2
07JUL92	24.0	23.9	3.25	20.8	21.7	22.3	21.5	21.6	23.2	24.3	24.5	24.6
08JUL92	23.9	30.6	6.75	24.4	25.2	25.7	24.2	24.1	25.1	25.7	24.4	24.2
23JUL92	22.7	26.7	0.90	22.7	23.2	23.8	22.5	22.6	23.8	24.2	23.9	23.6
08AUG92	21.6	26.1	9.75	21.6	22.2	23.0	21.2	21.0	22.3	22.9	22.0	21.9
16AUG92	20.0	24.4	9.25	20.0	20.8	21.4	19.6	19.3	20.5	21.0	20.7	20.5
22AUG92	21.7	25.0	9.50	22.3	23.0	23.6	21.7	21.4	21.6	22.1	22.0	22.2
23AUG92	23.7	28.9	3.75	24.9	25.8	26.4	24.7	24.6	23.5	24.0	23.3	23.6
30AUG92	20.7	27.2	0.20	22.6	23.1	23.7	22.3	21.6	22.4	22.7	21.6	21.7
23JUN93	26.9	29.4	0.00	24.9	25.5	26.0	24.9	25.7	26.5	26.6	27.1	27.3
24JUN93	27.0	30.6	0.20	25.3	25.9	26.4	25.4	26.0	26.4	26.6	27.1	27.4
27JUN93	27.0	28.3	2.20	24.8	25.4	26.0	24.7	25.6	26.0	26.2	26.9	27.2
30JUN93	24.3	27.2	8.40	23.4	23.9	24.8	23.1	23.6	24.2	24.1	23.5	23.5
04JUL93	25.5	31.1	5.00	24.2	25.0	25.8	24.1	24.5	25.9	25.8	25.6	25.5
06JUL93	28.3	32.2	4.60	24.7	25.5	26.3	24.9	25.6	28.3	28.0	28.1	28.3
11JUL93	28.2	32.2	5.00	26.7	27.4	28.2	26.4	27.3	26.4	27.1	28.2	28.1
17JUL93	26.8	30.6	0.40	25.7	26.2	26.8	25.6	26.2	26.2	26.1	26.6	26.8

DATE	SMAX	EMAX	ECLD	PSANG1L	PSANG1	PSANG1U	PSANG2L	PSANG3L	PSANG4L	PSANG5L	PSANG6	PSANG7
18JUL93	27.3	31.7	3.6	26.0	26.9	27.5	25.6	25.6	26.7	26.6	26.6	26.9
21JUL93	23.5	28.3	8.2	24.6	25.1	25.9	24.1	24.3	23.8	23.7	23.7	23.8
24JUL93	25.7	31.7	3.4	25.8	26.8	27.4	25.1	24.8	24.1	24.4	25.3	25.0
25JUL93	27.0	32.8	3.2	26.6	27.6	28.1	26.6	26.1	26.3	26.6	27.9	27.6
29JUL93	23.4	27.8	6.2	22.8	23.3	24.3	22.3	23.7	26.1	25.5	24.8	24.2
31JUL93	21.7	23.9	9.6	22.3	23.0	23.7	22.0	22.5	21.6	21.8	23.2	22.7
01AUG93	24.2	28.9	4.2	24.8	25.6	26.3	24.6	25.0	24.6	24.2	24.7	24.8
03AUG93	24.9	28.3	3.8	24.8	25.7	26.3	24.3	24.4	25.6	25.6	25.1	25.2
04AUG93	20.7	25.6	7.8	23.3	23.8	24.6	23.4	23.9	24.3	23.8	21.7	21.0
08AUG93	22.7	26.1	4.4	23.4	24.2	24.9	23.2	23.1	24.2	24.5	24.0	23.7
11AUG93	25.8	27.8	5.2	25.0	25.7	26.5	24.7	24.8	25.3	25.0	25.8	25.7
14AUG93	26.0	30.6	6.4	25.8	26.3	27.3	25.4	25.4	25.6	25.9	26.4	26.1
15AUG93	26.1	32.2	2.0	26.6	27.2	27.8	26.4	26.4	26.2	26.1	26.8	26.6
21AUG93	25.0	26.7	4.2	24.4	25.3	26.0	24.5	24.7	24.6	24.8	25.0	25.2
22AUG93	24.9	28.9	3.0	25.4	26.0	26.6	25.1	24.7	25.0	25.1	24.9	25.1
28AUG93	25.5	32.8	7.8	26.5	27.1	27.8	25.5	25.4	25.9	26.1	26.6	26.7
29AUG93	27.0	33.9	1.8	27.6	28.3	28.8	27.7	27.6	27.7	27.7	28.1	28.0

APPENDIX E

TABULAR SUMMARY OF DATA FOR EVALUATING THE TEMPERATURE ENHANCEMENT PROTOCOL AT THE DEEP CREEK STATION IN 1995 AND 1996

Tabular summary of data for evaluating the temperature enhancement protocol at the Deep Creek Project in 1995 and 1996

Variables:

OFLOW -	Oakland daily average flow (cfs)
TFLOW -	Tailrace flow, based on conversion formula (see Versar 1995)
SMEAN -	Sang Run daily mean water temperature (DNR sensors)
SMIN -	Sang Run daily minimum temperature (DNR sensors)
SMAX -	Sang Run daily maximum temperature (DNR sensors)
PenSMAX -	Sang Run daily maximum temperature (Penelec sensor)
STIMEMAX -	Time of maximum temperature (if >25°C)
STIME25 -	Time of temperature exceeding 25°C
SWAMAX -	Swallow Falls daily maximum temperature
SWAMAX-1	Swallow Falls daily maximum temperature minus 1.4 °C
OMIN -	Oakland minimum air temperature
EMIN -	Elkins minimum air temperature
OMAX -	Oakland maximum air temperature
EMAX -	Elkins maximum air temperature
ECLD -	Elkins average mid-day cloud cover (1000-1400)
S7-S15 -	Sang Run river temperatures 0700-1500 (average of DNR sensors)
GEN -	Generation (Y or N)
SG1, EG1, etc.	Start and end times of generation
Tair -	Predicted maximum air temperature (Elkins)
PCLD -	Predicted daily cloud cover factor (Elkins)
T7-T15 -	San Run river temperatures 0700-1500 (Penelec Sensor; only on days without scheduled releases and flow < 100 cfs at Oakland). Also shown on plots in Appendix B
P7-P15 -	Predicted daily maximum river temperature calculated by Penelec to determine need for temperature enhancement release
P7a-P15a -	Predicted daily maximum river temperature, based on actual values of cloud cover, maximum air temp, and DNR's river temperature sensor readings (see Appendix B)
P7b-P15b -	Predicted daily maximum river temperature, based on predicted values of cloud cover, maximum air temperature and Penelec's temperature sensor readings (see Appendix B)

1995 Youghiogeny River Temperature Enhancement Data — **Deepcreek/Yough295.wk**

DATE	OFLOW	TFLOW	SMEAN	SMIN	SMAX	PenSMAX	STIMEMAX	STIME25	SWAMAX	swamax-1	OMIN	EMIN	OMAX	EMAX	ECLD	S7	S8	S9	S10	S11	S12	S13	S14	S15	GEN	SG1	EG1	SG2	EG2
01-Jun-95	110	158.0									6.1	7.8	22.2	21.7											Y	1000	1300		
02-Jun-95	117	167.8									13.9	15.6	26.1	27.2											Y	1000	1300		
03-Jun-95	285	397.9									14.4	14.4	22.2	24.4											Y	1000	1300		
04-Jun-95	319	443.8									11.1	12.2	22.2	23.9											N				
05-Jun-95	199	280.8									10.0	12.2	23.3	26.7											Y	1000	1300		
06-Jun-95	158	224.5									11.7	10.6	22.8	26.7											N				
07-Jun-95	138	196.9									12.2	12.8	26.1	26.7											N				
08-Jun-95	138	196.9									18.3	18.3	26.1	28.9											Y	1000	1315	1545	1635
09-Jun-95	111	159.4									15.0	16.1	27.2	28.9											Y	1000	1300		
10-Jun-95	100	144.1				22.4					15.6	16.1	26.1	28.3											N				
11-Jun-95	107	153.8				21.4					16.7	13.9	26.1	28.9											N				
12-Jun-95	254	355.8				23.4					11.7	11.1	25.6	16.7											Y	?	1300		
13-Jun-95	211	297.2				24.7					5.0	10.0	17.2	20.0											Y	730	?		
14-Jun-95	148	210.7				25.3					7.2	6.7	22.2	23.9											Y	1315	1615		
15-Jun-95	118	169.2				19.0					6.7	6.7	22.8	25.0											Y	1300	1600		
16-Jun-95	97	139.9				18.8					7.8	7.8	23.9	26.7											Y	1000	1300	1920	1935
17-Jun-95	83	120.2				20.1					7.2	8.9	25.6	27.8											N				
18-Jun-95	72	104.8				21.1					9.4	8.9	26.1	27.8											Y	2133	2157		
19-Jun-95	65	94.9				21.1					8.9	9.4	27.2	30.6	3.4										Y	1000	1300		
20-Jun-95	59	86.4	19.0	16.5	24.1	24.2			25.1	23.7	12.8	13.9	28.9	31.7	7.6	18.0	18.0	18.5	19.1	20.0	20.9	22.2	23.3	20.2	Y	1230	1430	1719	1824
21-Jun-95	53	77.8	19.5	16.4	25.7	25.9	1424	1424	26.6	25.2	15.6	12.8	27.8	31.7	2.4	18.3	18.5	18.8	19.5	20.8	21.6	22.8	24.4	23.1	Y	1230	1430		
22-Jun-95	48	70.7	19.8	17.8	21.4	20.0			26.0	24.6	16.1	15.6	26.7	26.7	9.4	18.8	18.8	19.0	19.4	19.9	21.2	17.9	17.7	18.2	Y	1000	1300		
23-Jun-95	50	73.5	18.6	16.0	20.8	20.0			23.4	22.0	16.7	16.1	22.2	25.6	10.0	19.3	19.3	19.3	19.3	19.6	19.6	16.0	15.9	16.2	Y	1000	1300	1420	1430
24-Jun-95	60	87.8	19.0	17.0	20.8	20.6			23.9	22.5	16.1	14.4	23.3	27.2	8.8	18.0	18.1	18.6	19.3	19.6	20.3	16.9	17.2	17.9	Y	1000	1300		
25-Jun-95	49	72.1	19.3	17.1	22.7	20.1			24.3	22.9	16.1	16.1	25.6	29.4	5.0	18.8	18.8	19.0	19.9	21.1	22.6	17.7	17.2	17.0	Y	1000	1300		
26-Jun-95	46	67.8	18.9	17.4	22.1	22.6			26.0	24.6	14.4	16.1	23.9	28.3	9.8	18.1	18.2	18.4	19.0	20.1	22.0	17.8	17.5	17.7	Y	1000	1300		
27-Jun-95	57	83.5	19.0	16.6	20.7	21.4			24.3	22.9	18.3	15.6	22.8	30.0	6.6	19.0	19.0	19.3	19.6	20.1	20.5	16.7	16.8	17.4	Y	1000	1300		
28-Jun-95	48	70.7	19.0	17.8	20.0	20.7			23.0	21.6	15.6	18.3	21.7	27.8	8.6	18.7	18.6	18.6	18.8	19.0	19.9	17.7	18.1	18.4	Y	1000	1300		
29-Jun-95	43	63.5	18.2	16.2	20.1	22.8			22.0	20.6	16.7	17.2	20.6	27.2	9.4	18.1	18.2	18.4	18.8	19.1	19.9	16.5	16.2	16.3	Y	1000	1300		
30-Jun-95	39	57.8	18.5	17.2	21.0				24.5	23.1	16.1	16.1	26.1	27.8	6.4	17.7	17.7	18.0	18.7	19.3	20.8	17.4	17.1	17.7	Y	1000	1300		
01-Jul-95	84	121.6	18.5	15.6	20.1				23.1	21.7	17.2	16.7	21.1	23.9	10.0	18.5	18.5	18.8	19.0	19.6	19.9	16.8	15.6	15.6	Y	1015	1315		
02-Jul-95	116	166.4	19.8	17.8	22.3				21.8	20.4	10.0	11.7	22.8	23.9	5.8	17.7	17.7	18.0	18.7	19.2	19.7	20.7	21.4	22.0	N				
03-Jul-95	61	89.2	18.6	17.0	20.8				23.2	21.8	8.3	10.0	23.9	27.2	6.8	17.0	16.9	17.2	18.0	18.8	20.1	17.0	16.9	17.5	Y	1000	1300		
04-Jul-95	45	66.4	18.5	16.5	20.5				22.9	21.5	12.8	14.4	26.1	28.3	9.2	17.5	17.5	17.7	17.8	18.2	18.8	16.4	16.6	17.0	Y	1000	1300		
05-Jul-95	39	57.8	19.2	17.8	23.2				24.6	23.2	14.4	15.0	27.2	29.4	9.4	18.0	18.0	18.3	19.0	19.9	20.8	22.2	22.8	19.3	Y	1230	1430		
06-Jul-95	35	52.0	20.7	18.1	24.7				25.5	24.1	14.4	16.1	27.2	28.9	9.6	18.2	18.2	18.3	18.6	19.0	19.5	20.1	20.9	22.1	N				
07-Jul-95	58	84.9	19.9	17.8	22.2				26.6	25.2	16.1	16.1	26.1	27.2	5.6	18.7	18.8	19.0	19.6	20.7	22.0	18.4	17.7	18.3	Y	1000	1300		
08-Jul-95	48	70.7	18.6	17.0	20.0	20.6			23.2	21.8	12.8	12.2	25.6	22.8	7.8	18.1	18.1	18.1	18.0	18.4	19.4	16.9	17.2	17.7	Y	1000	1300		
09-Jul-95	34	50.6	19.9	15.6	25.6	25.8	1766	1668	24.9	23.5	7.8	8.3	23.3	26.1	4.2	15.6	15.5	15.7	16.4	17.5	18.8	20.4	21.9	23.3	N				
10-Jul-95	33	49.1	19.3	17.7	21.3	21.4			26.5	25.1	13.9	13.9	26.1	27.8	3.4	17.7	17.7	17.8	18.6	19.5	21.1	17.9	17.7	18.4	Y	1000	1300		
11-Jul-95	29	43.4	19.5	17.7	25.3	24.9	1424	712	27.0	25.6	14.4	15.0	26.1	28.3	2.4	17.7	17.7	17.9	18.8	19.9	21.0	22.6	23.8	21.8	Y	1230	1430		
12-Jul-95	23	34.6	19.2	17.2	22.3	22.6			27.8	26.4	12.2	14.4	28.3	30.6	6.4	17.1	17.2	17.5	18.2	19.1	20.7	17.7	17.7	18.2	Y	1000	1300		
13-Jul-95	20	30.2	19.9	18.0	22.5	22.8			29.2	27.8	13.3	13.9	31.1	32.8	0.4	18.0	18.0	18.3	19.0	20.2	21.9	18.6	18.2	18.4	Y	1000	1300		
14-Jul-95	20	30.2	19.0	16.1	23.3	23.4			30.7	29.3	17.2	17.8	30.6	32.8	1.0	19.0	19.0	19.6	20.4	21.6	23.1	18.9	18.8	18.9	Y	1000	1930		
15-Jul-95	22	33.2	17.4	16.1	21.2	21.3			32.0	30.6	19.4	17.2	34.4	35.6	0.8	16.6	17.0	17.7	18.5	19.8	21.0	18.8	18.6	18.8	Y	918	2400		
16-Jul 95	110	158.0	20.5	15.4	26.9	27.6	1717	1535	27.7	26.3	15.0	16.7	28.9	31.1	7.4	15.3	15.6	16.2	17.1	18.1	18.9	20.4	22.5	24.4	Y	0	423		
17-Jul-95	64	93.4	20.6	17.0	23.9	24.4			26.9	25.5	17.2	18.3	28.3	30.0	7.8	21.3	21.0	21.1	21.1	21.7	22.9	18.9	18.9	19.4	Y	1000	1300	1610	1930
18-Jul-95	47	69.3	22.4	17.1	26.7	27.1	1668	1355	27.0	25.6	17.2	15.0	26.1	27.8	5.6	20.2	20.3	20.5	21.1	21.8	22.8	23.9	25.1	25.4	N				
19-Jul-95	32	47.7	21.7	18.4	25.3	25.6	1731	1668	25.8	24.4	12.2	11.7	25.0	27.2	3.8	18.4	18.4	18.8	19.3	20.1	21.1	22.3	23.4	24.2	N				
20-Jul-95	23	34.6	19.6	16.8	24.7	24.7			27.6	26.2	8.9	9.4	27.8	30.0	2.2	17.0	16.8	17.1	17.9	19.0	20.4	21.8	23.4	24.7	Y	1230	1430		
21-Jul-95	20	30.2	18.5	17.4	20.9	21.0			25.8	24.4	16.1	15.0	27.8	29.4	8.6	18.5	18.5	18.6	18.8	19.5	20.7	17.6	17.3	17.4	Y	1000	1300	1330	1350
22-Jul-95	21	31.7	20.4	17.6	26.4	27.1	1731	1570	28.3	26.9	19.4	17.2	26.7	28.3	6.8	18.3	18.5	18.8	19.6	20.7	21.5	22.3	23.5	24.4	Y	1530	1630		
23-Jul-95	23	34.6	20.2	17.9	27.2	27.3	1731	1535	28.1	26.7	15.6	17.2	27.2	28.9	8.6	17.9	17.9	18.2	18.8	19.8	21.3	22.6	23.5	24.6	Y	1525	1625		
24-Jul-95	20	30.2	19.1	17.2	21.0	21.4			26.5	25.1	16.7	17.2	26.7	27.8	10.0	18.3	18.5	18.6	19.0	19.6	20.1	17.3	17.2	17.8	Y	1000	1300		
25-Jul-95	18	27.3	20.7	18.6	26.0	26.4	1604	1535	28.1	26.7	16.7	15.6	28.9	31.7	8.2	18.6	18.6	18.8	19.4	20.2	21.1	22.6	23.5	24.7	Y	952	1004	1400	1500
26-Jul-95	19	28.8	19.5	17.1	21.2	21.7			28.0	26.6	18.3	17.8	28.9	28.9	6.8	19.2	19.2	19.3	19.6	19.8	20.2	17.1	17.2	17.7	Y	1000	1400		
27-Jul-95	19	28.8	21.0	18.6	25.8	25.5	1355	1355	30.0	28.6	15.6	15.6	30.0	30.0	6.8	18.6	18.5	18.8	19.5	20.7	22.0	23.5	25.6	21.1	Y	1200	1300		
28-Jul-95	17	25.8	20.2	18.3	22.0	22.3			29.3	27.9	16.1	16.7	29.4	30.6	8.4	19.2	19.1	19.2	20.0	20.6	21.9	18.3	18.2	18.9	Y	1000	1300		

1995 Youghiogeny River Temperature Enhancement Data — **Deepcreek/Yough295.wk**

DATE	OFLOW	TFLOW	SMEAN	SMIN	SMAX	PenSMAX	STIMEMAX	STIME25	SWAMAX	swamax-1	OMIN	EMIN	OMAX	EMAX	ECLD	S7	S8	S9	S10	S11	S12	S13	S14	S15	GEN	SG1	EG1	SG2	EG2
29-Jul-95	19	28.8	20.5	18.7	22.7	23.1			29.3	27.9	18.3	18.9	28.3	28.9	9.6	19.2	19.1	19.2	19.3	19.7	20.8	22.3	18.8	19.0	Y	1100	1300		
30-Jul-95	20	30.2	20.7	18.5	23.9	23.6			29.7	28.3	15.0	16.7	30.0	31.1	3.2	18.6	18.5	18.8	19.2	19.9	21.4	23.6	19.3	19.5	Y	645	650	1100	1300
31-Jul-95	18	27.3	20.6	18.8	22.6	22.9			31.1	29.7	13.9	15.6	30.6	32.2	1.8	19.0	18.8	19.1	19.9	21.1	22.2	19.3	18.7	18.8	Y	1000	1300		
01-Aug-95	16	24.4	20.8	18.8	23.8	24.1			31.3	29.9	15.0	15.6	31.1	32.2	3.2	19.1	19.0	19.2	19.8	21.0	22.2	23.7	18.8	18.8	Y	1100	1300	1450	1503
02-Aug-95	12	18.4	20.3	18.9	24.1	24.5			30.6	29.2	16.7	17.2	31.1	34.4	4.6	18.8	18.8	19.1	19.9	20.9	22.3	23.9	19.3	19.0	Y	1100	1300		
03-Aug-95	13	19.9	20.1	17.4	23.8	23.8			31.7	30.3	14.4	14.4	31.7	33.9	3.2	17.4	17.4	17.8	18.7	19.9	21.4	23.1	20.0	19.6	Y	1100	1300		
04-Aug-95	14	21.4	20.3	18.8	22.5	22.7			30.6	29.2	16.7	17.2	30.6	32.2	5.6	19.2	19.0	19.1	19.8	20.8	22.3	18.9	18.7	19.3	Y	1000	1300		
05-Aug-95	11	16.9	19.5	17.7	21.7	21.8			28.1	26.7	17.8	18.3	28.3	31.7	8.6	19.4	19.3	19.4	19.8	20.4	21.5	17.7	17.7	18.3	Y	1000	1300		
06-Aug-95	1015	1364.0	19.4	17.6	21.0	21.2			23.9	22.5	17.8	19.4	26.7	23.9	10.0	18.0	17.7	17.5	18.9	18.8	18.8	18.8	19.6	20.2	N				
07-Aug-95	676	919.6	19.8	19.2	20.4	20.3			20.3	18.9	16.7	17.8	23.9	28.3	6.4	19.4	19.3	19.3	19.6	19.8	20.2	20.1	20.0	20.0	N				
08-Aug-95	210	295.9	19.0	18.3	20.4	20.2			19.8	18.4	15.0	16.7	19.4	23.3	9.8	18.3	18.2	18.3	18.3	18.6	18.8	19.3	19.8	20.1	N				
09-Aug-95	128	183.0	18.8	17.7	20.1	20.0			19.8	18.4	15.0	16.7	21.1	24.4	10.0	17.7	17.7	17.9	18.1	18.6	19.2	19.9	19.9	20.0	N				
10-Aug-95	97	139.9	19.8	17.7	22.8	22.6			22.0	20.6	14.4	16.1	25.0	28.9	5.2	17.7	17.7	17.9	18.5	19.2	20.3	21.5	22.4	22.0	N				
11-Aug-95	103	148.3	19.3	18.3	21.0	20.5			23.3	21.9	14.4	16.7	27.2	29.4	4.2	18.5	18.3	18.6	19.2	20.1	20.8	18.7	18.9	18.8	Y	1000	1300		
12-Aug-95	155	220.4	19.9	18.3	22.2	22.6			22.0	20.6	16.7	14.4	27.8	30.0	8.4	18.3	18.6	18.8	19.4	20.1	20.5	18.6	18.8	18.9	Y	1000	1300		
13-Aug-95	90	130.1	21.3	20.1	25.1	24.9	1424	712	25.3	23.9	22.8	22.2	30.0	32.2	7.4	20.2	20.2	20.5	20.9	21.4	21.9	23.1	24.5	20.9	Y	1230	1430		
14-Aug-95	229	321.8	21.7	18.0	25.9	26.2	1731	1668	25.2	23.8	18.3	20.6	30.6	32.2	4.4	18.0	18.0	18.3	19.4	20.9	22.9	20.5	21.4	22.3	Y	10	345	1000	1300
15-Aug-95	126	180.3	22.0	19.4	26.4	25.9	1355	1243	25.8	24.4	19.4	20.0	30.6	32.2	3.6	22.0	22.0	22.0	22.4	23.2	24.2	25.1	26.2	21.3	Y	1230	1830		
16-Aug-95	202	284.9	22.2	19.8	26.7	26.2	1390	1243	25.8	24.4	19.4	20.0	30.0	32.2	4.8	21.9	21.8	21.9	22.4	23.3	24.2	25.4	26.3	23.6	Y	1250	1850		
17-Aug-95	99	142.7	22.1	19.6	27.1	26.1	1355	1228	27.1	25.7	18.3	20.0	30.0	32.2	4.4	22.2	22.0	22.0	22.6	23.5	24.5	25.7	26.9	21.1	Y	1200	1600		
18-Aug-95	69	100.5	20.7	19.2	22.5	22.5			27.3	25.9	17.8	16.7	28.3	31.1	9.8	21.1	21.1	21.4	21.4	21.7	22.4	19.1	19.7	20.2	Y	1000	1600		
19-Aug-95	56	82.1	20.4	19.2	24.5	24.2			26.2	24.8	12.8	14.4	27.8	31.1	3.2	19.2	19.1	19.3	19.8	20.3	20.9	21.7	22.7	21.7	Y	1230	1430		
20-Aug-95	46	67.8	20.2	18.6	25.1	24.4	1424	1424	26.2	24.8	14.4	15.6	27.2	30.0	4.4	18.7	18.6	18.8	19.2	20.2	21.4	22.6	23.6	21.6	Y	1230	1430		
21-Aug-95	41	60.7	19.7	17.5	22.2	23.3			26.9	25.5	13.3	15.0	28.3	29.4	4.2	18.7	18.6	18.6	19.1	19.9	21.7	19.0	19.1	19.5	Y	1000	1300	1750	2050
22-Aug-95	37	54.9	19.0	16.8	22.5	22.1			26.7	25.3	11.7	12.8	27.8	26.7	2.2	16.8	16.9	17.4	18.3	19.2	20.3	22.3	19.6	19.5	Y	1100	1300		
23-Aug-95	31	46.3	19.2	16.2	25.4	26.5	1717	1668	26.7	25.3	7.2	10.0	26.7	29.4	0.6	16.3	16.2	16.2	16.9	18.0	19.1	20.5	22.0	23.2	Y	1515	1615		
24-Aug-95	28	41.9	18.9	15.7	25.4	26.1	1633	1633	26.8	25.4	9.4	11.1	27.8	31.1	0.2	15.8	15.6	15.9	16.8	18.0	19.1	20.5	22.0	23.4	Y	1430	1530		
25-Aug-95	25	37.5	19.5	17.5	22.2	22.8			27.0	25.6	12.8	13.9	27.2	31.1	2.0	17.7	17.5	17.5	18.0	18.8	20.5	19.0	19.6	20.0	Y	1000	1300		
26-Aug-95	22	33.2	19.2	16.8	21.5	21.8			27.2	25.8	12.8	15.0	26.7	30.0	6.4	16.8	16.7	16.8	17.4	18.6	20.1	19.1	19.6	19.9	Y	1000	1300		
27-Aug-95	20	30.2	20.5	18.4	24.6	24.4			26.9	25.5	14.4	15.0	28.3	27.8	8.6	18.5	18.4	18.6	19.0	19.9	20.8	22.0	23.1	24.5	Y	1230	1330		
28-Aug-95	20	30.2	20.0	18.3	22.2	22.6			27.2	25.8	14.4	14.4	26.7	31.1	1.0	18.4	18.3	18.4	18.8	19.1	20.2	18.7	19.4	20.1	Y	1000	1300		
29-Aug-95	19	28.8	20.3	19.0	22.8	23.2			26.9	25.5	16.1	13.9	26.7	28.9	6.6	19.0	19.0	19.0	19.3	20.1	21.1	22.6	19.3	19.4	Y	1100	1300	2021	2037
30-Aug-95	18	27.3	18.8	17.3	20.7	21.2			28.1	26.7	13.3	15.6	27.8	31.1	1.4	17.7	17.3	17.4	18.0	19.0	20.6	19.0	19.5	19.3	Y	1000	1600		
31-Aug-95	17	25.8	18.3	16.1	23.2	23.4			27.7	26.3	10.6	12.2	29.4	31.7	1.2	16.2	16.0	16.2	16.9	18.0	19.1	20.5	22.0	22.1	Y	1230	1535		

1995 Youghiogeny River Temperature Enhancement Data — Deepcreek/Yough295.wk4- YOUGH2

DATE	OFLOW	TFLOW	SMEAN	SMIN	SMAX	PenSMAX	Tair	OMAX	EMAX	CCF	PCLD	ECLD	T7	T9	T11	T12	T14	T15	Q	P7	P9	P11	P12	P14	P15
19-Jun-95	65	94.9				21.1		27.2	30.6			3.4													
20-Jun-95	59	86.4	19.0	16.5	24.1	24.2	30.0	28.9	31.7	36	6	7.6	18.3	18.7	20.0				67	24.6	24.8	25.7			
21-Jun-95	53	77.8	19.5	16.4	25.7	25.9	30.0	27.8	31.7	36	6	2.4	18.6	19.2	21.0				64	24.8	25.3	26.7			
22-Jun-95	48	70.7	19.8	17.8	21.4	20.0		26.7	26.7			9.4													
23-Jun-95	50	73.5	18.6	16.0	20.8	20.0		22.2	25.6			10.0													
24-Jun-95	60	87.8	19.0	17.0	20.8	20.6		23.3	27.2			8.8													
25-Jun-95	49	72.1	19.3	17.1	22.7	20.1		25.6	29.4			5.0													
26-Jun-95	46	67.8	18.9	17.4	22.1	22.6		23.9	28.3			9.8													
27-Jun-95	57	83.5	19.0	16.6	20.7	21.4		22.8	30.0			6.6													
28-Jun-95	48	70.7	19.0	17.8	20.0	20.7		21.7	27.8			8.6													
29-Jun-95	43	63.5	18.2	16.2	20.1	22.8		20.6	27.2			9.4													
30-Jun-95	39	57.8	18.5	17.2	21.0			26.1	27.8			6.4													
01-Jul-95	84	121.6	18.5	15.6	20.1			21.1	23.9			10.0													
02-Jul-95	116	166.4	19.8	17.8	22.3			22.8	23.9			5.8													
03-Jul-95	61	89.2	18.6	17.0	20.8			23.9	27.2			6.8													
04-Jul-95	45	66.4	18.5	16.5	20.5			26.1	28.3			9.2													
05-Jul-95	39	57.8	19.2	17.8	23.2		30.6	27.2	29.4	36	6	9.4	18.3	18.5	20.2				47	25.6	25.6	26.2			
06-Jul-95	35	52.0	20.7	18.1	24.7			27.2	28.9			9.6													
07-Jul-95	58	84.9	19.9	17.8	22.2			26.1	27.2			5.6													
08-Jul-95	48	70.7	18.6	17.0	20.0	20.6		25.6	22.8			7.8													
09-Jul-95	34	50.6	19.9	15.6	25.6	25.8		23.3	26.1			4.2													
10-Jul-95	33	49.1	19.3	17.7	21.3	21.4		26.1	27.8			3.4													
11-Jul-95	29	43.4	19.5	17.7	25.3	24.9	28.3	26.1	28.3	16	4	2.4	18.0	18.1	20.0				47	25.2	25.1	25.9			
12-Jul-95	23	34.6	19.2	17.2	22.3	22.6		28.3	30.6			6.4													
13-Jul-95	20	30.2	19.9	18.0	22.5	22.8		31.1	32.8			0.4													
14-Jul-95	20	30.2	19.0	16.1	23.3	23.4		30.6	32.8			1.0													
15-Jul-95	22	33.2	17.4	16.1	21.2	21.3		34.4	35.6			0.8													
16-Jul-95	110	158.0	20.5	15.4	26.9	27.6		28.9	31.1			7.4													
17-Jul-95	64	93.4	20.6	17.0	23.9	24.4		28.3	30.0			7.8													
18-Jul-95	47	69.3	22.4	17.1	26.7	27.1		26.1	27.8			5.6													
19-Jul-95	32	47.7	21.7	18.4	25.3	25.6		25.0	27.2			3.8													
20-Jul-95	23	34.6	19.6	16.8	24.7	24.7	29.4	27.8	30.0	36	6	2.2	17.4	17.4	19.1				25	25.6	25.2	25.4			
21-Jul-95	20	30.2	18.5	17.4	20.9	21.0		27.8	29.4			8.6													
22-Jul-95	21	31.7	20.4	17.6	26.4	27.1	27.8	26.7	28.3	36	6	6.8	20.3	19.1	21.1	21.8	23.7	24.8	19	26.0	24.6	26.3	25.7	25.5	26.0
23-Jul-95	23	34.6	20.2	17.9	27.2	27.3	27.8	27.2	28.9	36	6	8.6	18.4	18.6	20.0	21.6	24.0	24.9	24	25.4	25.5	25.2	25.7	26.0	26.1
24-Jul-95	20	30.2	19.1	17.2	21.0	21.4		26.7	27.8			10.0													
25-Jul-95	18	27.3	20.7	18.6	26.0	26.4	28.3	28.9	31.7	100	10	8.2	19.0	19.3	20.6	21.5	23.4		18	24.6	24.6	25.0	25.0	25.3	
26-Jul-95	19	28.8	19.5	17.1	21.2	21.7		28.9	28.9			6.8													
27-Jul-95	19	28.8	21.0	18.6	25.8	25.5	27.8	30.0	30.0	100	10	6.8	19.0	19.2	20.9	22.1			19	24.4	24.4	25.3	25.6		
28-Jul-95	17	25.8	20.2	18.3	22.0	22.3		29.4	30.6			8.4													
29-Jul-95	19	28.8	20.5	18.7	22.7	23.1		28.3	28.9			9.6													
30-Jul-95	20	30.2	20.7	18.5	23.9	23.6	29.4	30.0	31.1	36	6	3.2	19.8						16	26.4					
31-Jul-95	18	27.3	20.6	18.8	22.6	22.9	29.4	30.6	32.2	36	6	1.8	19.1	19.5					22	26.2	26.6				
01-Aug-95	16	24.4	20.8	18.8	23.8	24.1	31.7	31.1	32.2	1	1	3.2	19.7						19	27.8					
02-Aug-95	12	18.4	20.3	18.9	24.1	24.5	31.1	31.1	34.4	36	6	4.6	19.4						13	26.8	3.2				
03-Aug-95	13	19.9	20.1	17.4	23.8	23.8	31.1	31.7	33.9	36	6	3.2	17.7	18.1					14	26.3	26.4				
04-Aug-95	14	21.4	20.3	18.8	22.5	22.7		30.6	32.2			5.6													

1995 Youghiogeny River Temperature Enhancement Data — **Deepcreek/Yough295.wk4- YOUGH2**

DATE	OFLOW	TFLOW	SMEAN	SMIN	SMAX	PenSMAX	Tair	OMAX	EMAX	CCF	PCLD	ECLD	T7	T9	T11	T12	T14	T15	Q	P7	P9	P11	P12	P14	P15
05-Aug-95	11	16.9	19.5	17.7	21.7	21.8		28.3	31.7			8.6													
06-Aug-95	1015	1364.0	19.4	17.6	21.0	21.2		26.7	23.9			10.0													
07-Aug-95	676	919.6	19.8	19.2	20.4	20.3		23.9	28.3			6.4													
08-Aug-95	210	295.9	19.0	18.3	20.4	20.2		19.4	23.3			9.8													
09-Aug-95	128	183.0	18.8	17.7	20.1	20.0		21.1	24.4			10.0													
10-Aug-95	97	139.9	19.8	17.7	22.8	22.6		25.0	28.9			5.2													
11-Aug-95	103	148.3	19.3	18.3	21.0	20.5		27.2	29.4			4.2													
12-Aug-95	155	220.4	19.9	18.3	22.2	22.6		27.8	30.0			8.4													
13-Aug-95	90	130.1	21.3	20.1	25.1	24.9	32.2	30.0	32.2	36	6	7.4	20.4	20.9	21.4				101	24.7	25.0	26.3			
14-Aug-95	229	321.8	21.7	18.0	25.9	26.2		30.6	32.2			4.4													
15-Aug-95	126	180.3	22.0	19.4	26.4	25.9	32.8	30.6	32.2	36	6	3.6	22.3	22.5	23.3				147	23.6	24.0	27.8			
16-Aug-95	202	284.9	22.2	19.8	26.7	26.2		30.0	32.2			4.8													
17-Aug-95	99	142.7	22.1	19.6	27.1	26.1		30.0	32.2			4.4													
18-Aug-95	69	100.5	20.7	19.2	22.5	22.5		28.3	31.1			9.8													
19-Aug-95	56	82.1	20.4	19.2	24.5	24.2	30.6	27.8	31.1	16	4	3.2	19.9	19.9	20.8				69	25.6	25.5	26.0			
20-Aug-95	46	67.8	20.2	18.6	25.1	24.4	30.6	27.2	30.0	16	4	4.4	19.6	19.2	20.7				58	26.0	25.4	26.5			
21-Aug-95	41	60.7	19.7	17.5	22.2	23.3		28.3	29.4			4.2													
22-Aug-95	37	54.9	19.0	16.8	22.5	22.1	26.7	27.8	26.7	1	1	2.2	17.1	18.7					42	24.8	26.5				
23-Aug-95	31	46.3	19.2	16.2	25.4	26.5	28.3	26.7	29.4	36	6	0.6	16.9	16.8	18.5	19.7	22.3	23.9	36	24.8	24.4	24.7	24.7	25.0	25.6
24-Aug-95	28	41.9	18.9	15.7	25.4	26.1	29.4	27.8	31.1	16	4	0.2	16.1	16.6	18.3	19.5	22.5		29	25.6	25.7	25.1	25.0	25.3	
25-Aug-95	25	37.5	19.5	17.5	22.2	22.8		27.2	31.1			2.0													
26-Aug-95	22	33.2	19.2	16.8	21.5	21.8		26.7	30.0			6.4													
27-Aug-95	20	30.2	20.5	18.4	24.6	24.4		28.3	27.8			8.6													
28-Aug-95	20	30.2	20.0	18.3	22.2	22.6		26.7	31.1			1.0													
29-Aug-95	19	28.8	20.3	19.0	22.8	23.2	29.4	26.7	28.9	16	4	6.6	19.5						20	26.7					
30-Aug-95	18	27.3	18.8	17.3	20.7	21.2		27.8	31.1			1.4													
31-Aug-95	17	25.8	18.3	16.1	23.2	23.4	30.6	29.4	31.7	36	6	1.2	16.5	16.8	18.7				17	25.7	25.5	25.6			

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DATE	OFLOW	TFLOW	SMEAN	SMIN	SMAX	PenSMAX	Tair	OMAX	EMAX	CCF	PCLD	ECLD	T7	T9	T11	T12	T14	T15	Q	P7	P9	P11	P12	P14	P15
01-Jun-96	625	866				15.1		23.3	26.7			1													
02-Jun-96	451	631				15.7		23.9	25.6			1													
03-Jun-96	350	493				15.2		22.2	19.4			9													
04-Jun-96	307	434				15.2		21.1	22.2			6													
05-Jun-96	271	385				17.3		20.0	21.7			3													
06-Jun-96	207	296				17.6		25.6	27.2			2													
07-Jun-96	164	236				19.2		27.2	27.8			4													
08-Jun-96	404	567				19.0		26.7	29.4			4													
09-Jun-96	1099	1497				18.3		20.0	22.2			8													
10-Jun-96	559	777				16.9		25.0	27.2			5													
11-Jun-96	357	503				16.7		25.6	27.8			2													
12-Jun-96	346	488				15.9		22.2	22.8			6													
13-Jun-96	286	405				16.3		23.9	25.0			6													
14-Jun-96	250	356				19.1		26.1	27.2			5													
15-Jun-96	349	492				20.5		26.1	27.8			5													
16-Jun-96	215	307				21.6		27.8	28.9			2													
17-Jun-96	168	242				20.5		28.3	29.4			3													
18-Jun-96	147	213				22.4		27.2	28.9			3													
19-Jun-96	224	320	21.4	20.2	23.3	23.0		26.7	25.6			4													
20-Jun-96	258	367	21.5	20.5	23.4	23.2		27.2	26.1			6													
21-Jun-96	186	267	20.5	18.7	22.1	22.5		25.0	26.1			6													
22-Jun-96	138	200	21.6	19.2	24.7	24.4		26.7	28.9			3													
23-Jun-96	115	168	22.4	20.0	26.1	26.4		27.2	27.2			3													
24-Jun-96	121	176	20.0	17.8	22.7	21.7		26.7	29.4			4													
25-Jun-96	188	270	20.3	18.2	23.2	23.2		22.8	25.6			5													
26-Jun-96	123	179	20.3	17.6	24.3	24.6		22.8	24.4			1													
27-Jun-96	93	136	20.2	16.9	25.0	24.8		24.4	25.6			2													
28-Jun-96	76	112	19.1	17.1	21.2	21.6		25.6	27.8			1													
29-Jun-96	66	98	20.3	18.7	25.4	24.1	31.7	27.8	29.4	36	6	2	19.1	19.4	20.7				77	25.0	25.1	26.3			
30-Jun-96	59	88	21.4	19.0	24.3	23.5	32.2	28.9	29.4	16	4	4	20.7	20.7					71	26.4	26.2				
01-Jul-96	55	82	21.5	18.8	24.6	23.7			29			2													
02-Jul-96	48	72	20.7	18.5	25.8	26.0	28.3		27	100	10	4	19.7	20.0	21.4	21.9	23.8		58	23.7	23.8	25.4	25.1	25.6	
03-Jul-96	127	185	19.1	18.5	19.7	19.9			19			10													
04-Jul-96	106	155	17.2	15.9	18.6	19.1			20			9													
05-Jul-96	67	99	17.4	14.4	20.9	21.7			25			1													
06-Jul-96	50	75	18.3	15.2	21.8	22.4			28			1													
07-Jul-96	42	63	18.5	16.2	22.5	22.0	29.4		29	16	4	6	16.5	17.4					51	24.9	25.5				
08-Jul-96	65	96	19.9	18.5	21.8	21.6			27			7													
09-Jul-96	66	98	19.8	16.9	24.4	24.2	26.7		26	36	6	6	19.8	20.4	21.5				92	23.0	23.8	25.5			
10-Jul-96	44	66	19.4	17.3	22.6	22.6			22			2													
11-Jul-96	35	53	19.5	15.3	23.8	23.9			24			4													
12-Jul-96	30	46	18.6	16.2	21.0	21.3			27			6													
13-Jul-96	28	43	20.1	18.3	22.4	22.2	26.7		27	36	6	3	18.7	18.8	20.4	22.3			29	25.2	25.1	25.3	26.2		
14-Jul-96	28	43	19.1	17.2	23.1	23.2	29.4		28	36	6	6	19.5	19.7	21.4				29	26.3	26.4	26.6			
15-Jul-96	39	59	18.0	16.7	19.5	19.6			23			9													
16-Jul-96	53	79	18.9	16.5	24.7	24.2			27			4													
17-Jul-96	38	57	18.1	16.3	22.0	21.8	30.0		28	1	1	5	17.8	18.7					49	25.8	26.7				

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DATE	OFLOW	TFLOW	SMEAN	SMIN	SMAX	PenSMAX	Tair	OMAX	EMAX	CCF	PCLD	ECLD	T7	T9	T11	T12	T14	T15	Q	P7	P9	P11	P12	P14	P15
18-Jul-96	229	327	19.0	17.5	20.2	20.2			25			10													
19-Jul-96	3668	4817	19.0	18.1	20.3	20.4			26			10													
20-Jul-96	4317	5642	17.9	17.4	18.6	18.8			23			1													
21-Jul-96	1103	1502	17.1	16.0	17.7	17.7			26			1													
22-Jul-96	1095	1491	16.9	16.4	17.3	17.5			24			10													
23-Jul-96	989	1351	16.7	16.1	17.4	17.6			23			9													
24-Jul-96	561	779	17.5	16.2	18.4	18.3			27			1													
25-Jul-96	376	529	17.9	17.3	18.4	18.5			23			4													
26-Jul-96	288	408	17.8	17.0	18.6	18.3			24			6													
27-Jul-96	216	309	17.7	17.0	18.6	18.6			25			2													
28-Jul-96	172	248	17.8	16.8	19.0	18.6			24			5													
29-Jul-96	157	227	18.7	17.9	19.6	19.4			26			3													
30-Jul-96	427	598	19.1	18.2	19.9	19.4			28			6													
31-Jul-96	3111	4106	17.9	17.3	19.1	18.9			21			9													
01-Aug-96	2174	2900	16.9	16.4	17.3	17.5		22.8	24			3													
02-Aug-96	932	1275	16.9	16.0	17.4	17.8		22.8	23			7													
03-Aug-96	574	797	17.4	16.4	18.4	18.7		25.0	26			2													
04-Aug-96	387	544	18.0	16.9	19.0	19.3		25.0	28			3													
05-Aug-96	277	393	18.8	17.7	19.7	19.7		26.1	29			3													
06-Aug-96	213	305	19.2	18.2	19.8	19.5		27.8	30			1													
07-Aug-96	171	246	19.8	19.0	20.5	20.0		27.2	30			2													
08-Aug-96	143	207	19.9	18.9	20.7	20.3		30.6	30			3													
09-Aug-96	235	335	20.0	19.0	20.8	19.8		26.7	26			5													
10-Aug-96	165	238	18.9	17.7	19.9	19.6		23.9	23			3													
11-Aug-96	124	180	18.1	16.8	19.2	19.2		21.7	24			2													
12-Aug-96	446	624	18.2	17.4	18.7	19.3		20.6	19			10													
13-Aug-96	1853	2484	16.7	16.1	17.4	18.4		23.3	23			10													
14-Aug-96	677	935	17.2	15.8	18.5	19.3		25.0	26			3													
15-Aug-96	355	500	18.3	16.9	19.5	19.9		26.1	27			2													
16-Aug-96	307	434	18.7	18.2	19.3	19.3		25.0	26			6													
17-Aug-96	350	493	18.5	17.6	19.2	19.5		22.2	24			5													
18-Aug-96	211	302	18.8	17.8	20.0	20.2		25.0	26			1													
19-Aug-96	166	239	19.3	17.4	21.4	22.2		24.4	28			1													
20-Aug-96	136	197	20.5	18.0	23.9	24.2		27.2	28			2													
21-Aug-96	121	176	20.7	18.9	23.4	24.0		26.7	28			3													
22-Aug-96	204	292	20.9	19.3	23.1	23.6		27.2	28			3													
23-Aug-96	127	185	20.6	19.7	21.7	22.1		27.8	28			5													
24-Aug-96	163	235	20.0	19.0	20.8	21.4		27.2	22			9													
25-Aug-96	167	241	19.9	17.9	23.0	23.6		23.9	26			1													
26-Aug-96	116	169	19.4	17.1	22.2	23.4		26.7	27			2													
27-Aug-96	98	143	20.0	18.2	22.5	22.6		26.1	27			3													
28-Aug-96	91	134	18.7	16.7	21.2	21.4		24.4	27			1													
29-Aug-96	89	131	18.8	17.6	19.8	19.9		24.4	26			1													
30-Aug-96	74	109	19.3	17.4	21.6	22.4		24.4	25			1													
31-Aug-96	63	93	19.1	16.8	21.4	21.8		24.4	26			2													

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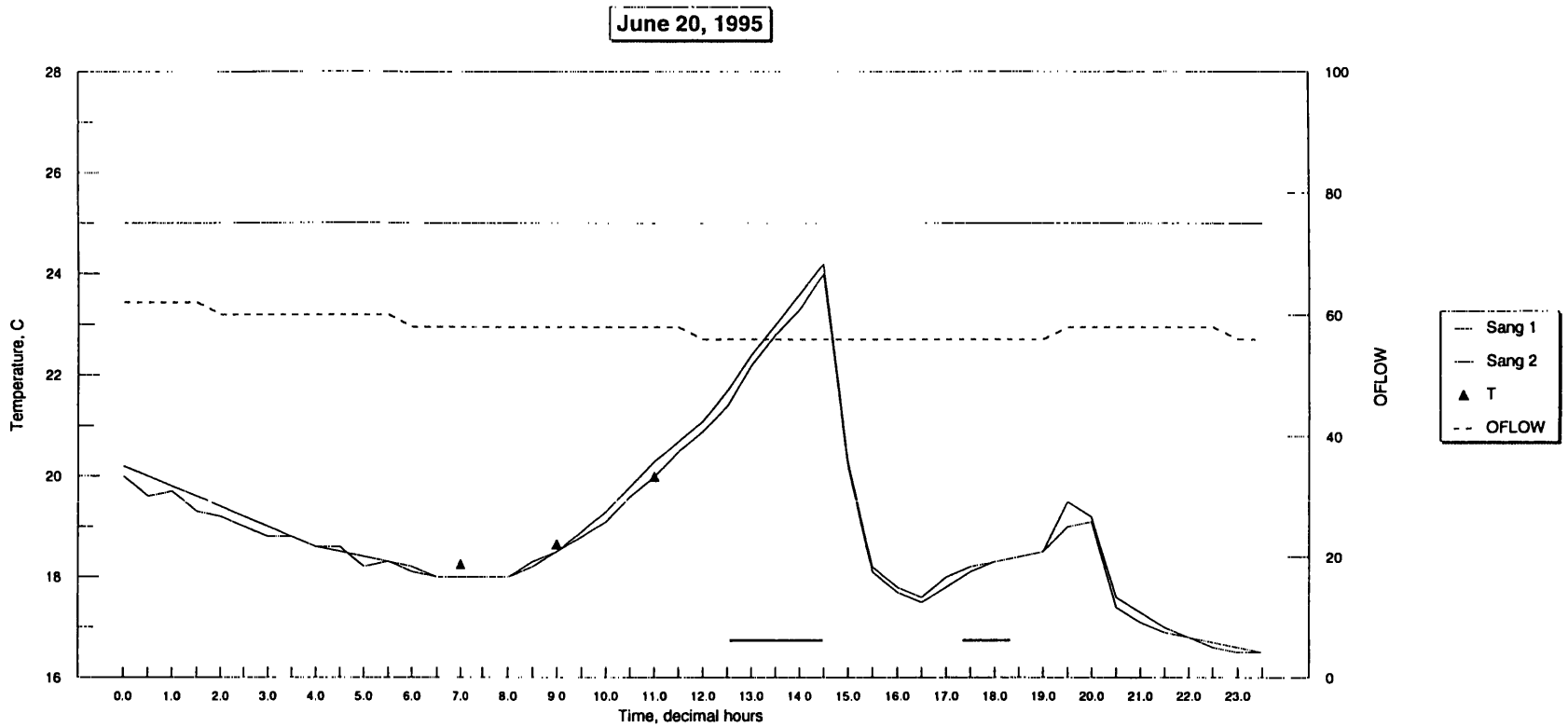
DATE	OFLOW	TFLOW	SMEAN	SMIN	SMAX	PenSMAX	STIMEMAX	STIME25	SWAMAX	swamax-1.	OMIN	EMIN	OMAX	EMAX	ECLD	S7	S8	S9	S10	S11	S12	S13	S14	S15	GEN	SG1	EG1	SG2	EG2
01-Jun-96	625	866				15.1					3.9	4.4	23.3	26.7	1										Y	900	2400		
02-Jun-96	451	631				15.7					6.1	7.2	23.9	25.6	1										Y	800	2400		
03-Jun-96	350	493				15.2					8.3	10.0	22.2	19.4	9										Y	800	2400		
04-Jun-96	307	434				15.2					11.1	10.6	21.1	22.2	6										Y	0	300	800	2400
05-Jun-96	271	385				17.3					6.1	6.7	20.0	21.7	3										Y	1000	1300		
06-Jun-96	207	296				17.6					3.3	5.6	25.6	27.2	2										Y	100	1300	1420	1730
07-Jun-96	164	236				19.2					13.3	15.0	27.2	27.8	4										Y	1000	1300		
08-Jun-96	404	567				19.0					14.4	13.9	26.7	29.4	4										Y	1440	1745		
09-Jun-96	1099	1497				18.3					15.6	16.7	20.0	22.2	8										Y	835	851		
10-Jun-96	559	777				16.9					16.1	13.9	25.0	27.2	5										Y	800	2400		
11-Jun-96	357	503				16.7					12.2	12.8	25.6	27.8	2										Y	600	2200		
12-Jun-96	346	488				15.9					12.8	13.3	22.2	22.8	6										Y	1	2400		
13-Jun-96	286	405				16.3					12.2	13.3	23.9	25.0	6										Y	1	2400		
14-Jun-96	250	356				19.1					12.2	12.8	26.1	27.2	5										Y	1000	1300		
15-Jun-96	349	492				20.5					13.3	12.8	26.1	27.8	5										Y	1230	1850		
16-Jun-96	215	307				21.6					11.7	13.9	27.8	28.9	2										Y	1054	1230		
17-Jun-96	168	242				20.5					13.3	13.9	28.3	29.4	3										Y	1000	1600		
18-Jun-96	147	213				22.4					15.0	13.9	27.2	28.9	3										Y	1000	1300		
19-Jun-96	224	320	21.4	20.2	23.3	23.0	15.4	0	22.8	21.4	17.8	18.9	26.7	25.6	4	20.2	20.2	20.2	20.2	20.6	21.7	22.2	22.7	23.2	N				
20-Jun-96	258	367	21.5	20.5	23.4	23.2	14.9	0	22.1	20.7	18.9	17.8	27.2	26.1	6	20.5	20.5	20.8	21	21.5	21.9	22.3	22.7	23.4	N				
21-Jun-96	186	267	20.5	18.7	22.1	22.5	17.3	0	22.3	20.9	16.1	15.6	25.0	26.1	6	20.05	20.2	20.2	20.4	20.6	19.7	18.9	19	19.5	Y	1000	1300		
22-Jun-96	138	200	21.6	19.2	24.7	24.4	15.8	0	23.0	21.6	16.1	15.0	26.7	28.9	3	19.2	19.4	19.9	20.5	21.7	22.8	23.5	24	24.2	N				
23-Jun-96	115	168	22.4	20.0	26.1	26.4	15.8	14.4	24.6	23.2	16.1	16.7	27.2	27.2	3	19.95	20	20.3	21.1	22.1	23.2	23.8	25	25.8	N				
24-Jun-96	121	176	20.0	17.8	22.7	21.7	11.3	0	24.2	22.8	13.9	15.6	26.7	29.4	4	19.35	19.6	20.1	20.9	22	20.3	18	17.9	18.7	Y	1000	1300		
25-Jun-96	188	270	20.3	18.2	23.2	23.2	15.1	0	22.6	21.2	18.3	12.2	22.8	25.6	5	19.95	20.1	20.2	20.7	20.9	21.8	22.3	22.9	23.2	Y	1415	1700		
26-Jun-96	123	179	20.3	17.6	24.3	24.6	15.8	0	22.6	21.2	8.3	11.1	22.8	24.4	1	17.8	17.7	18.2	18.9	19.9	21.3	22.2	23.3	24	Y	2115	2130		
27-Jun-96	93	136	20.2	16.9	25.0	24.8	15.8	0	23.2	21.8	8.3	9.4	24.4	25.6	2	16.85	17	17.6	18.5	19.7	21.4	22.5	23.7	24.6	N				
28-Jun-96	76	112	19.1	17.1	21.2	21.6	20.4	0	24.2	22.8	9.4	10.6	25.6	27.8	1	17.1	17.1	17.6	18.5	19.7	19.5	18.1	18.1	18.7	Y	1000	1300		
29-Jun-96	66	98	20.3	18.7	25.4	24.1	13.9	13.92	25.7	24.3	15.0	13.9	27.8	29.4	2	18.85	19	19.4	20.2	21.2	22.8	23.8	25.4	19.5	Y	1230	1430		
30-Jun-96	59	88	21.4	19.0	24.3	23.5	12.4	0	27.3	25.9	20.6	19.4	28.9	29.4	4	20.4	20.5	20.8	21.5	22.4	23.9	24	19	19.6	Y	1100	1300		
01-Jul-96	55	82	21.5	18.8	24.6	23.7	11.3	0	27.7	26.3		16.1		29.4	2	21	21.1	21.7	22.6	23.6	22.2	19.1	18.8	19.5	Y	1000	1300		
02-Jul-96	48	72	20.7	18.5	25.8	26.0	15.6	14.87	26.8	25.4		16.1		26.7	4	19.55	19.6	19.9	20.7	21.4	22.4	23.1	24.2	25.2	Y	1415	1515		
03-Jul-96	127	185	19.1	18.5	19.7	19.9	15.8	0	23.5	22.1		8.3		18.9	10	18.55	18.6	19	19	19.1	19.3	19.3	19.4	19.6	N				
04-Jul-96	106	155	17.2	15.9	18.6	19.1	9.1	0	19.5	18.1		5.0		20.0	9	16.55	16.4	16.3	16.3	16.3	16.4	16	16.8	16.9	Y	1000	1300		
05-Jul-96	67	99	17.4	14.4	20.9	21.7	17.9	0	21.7	20.3		6.7		25.0	1	14.4	14.4	15	16	17.3	17.6	17.2	17.5	18.3	Y	1000	1300		
06-Jul-96	50	75	18.3	15.2	21.8	22.4	17.9	0	24.2	22.8		8.9		27.8	1	15.2	15.3	15.9	16.9	18.2	18.9	18.1	18.3	19	Y	1000	1300		
07-Jul-96	42	63	18.5	16.2	22.5	22.0	13.9	0	24.4	23.0		11.1		28.9	6	16.2	16.3	16.9	17.9	19	20.7	21.5	22.5	18.1	Y	1200	1400		
08-Jul-96	65	96	19.9	18.5	21.8	21.6	11.6	0	25.9	24.5		18.9		27.2	7	18.65	18.8	19.2	20	20.9	20.4	18.7	18.7	19.4	Y	1000	1300		
09-Jul-96	66	98	19.8	16.9	24.4	24.2	13.9	0	26.2	24.8		15.6		25.6	6	19.7	19.9	20.4	21.1	21.8	22.6	23.2	24.4	19.6	Y	1230	1430	1500	1700
10-Jul-96	44	66	19.4	17.3	22.6	22.6	13.9	0	23.4	22.0		9.4		22.2	2	17.35	17.5	17.9	18.6	19.3	20.7	21.5	22.6	22.4	Y	1210	1230		
11-Jul-96	35	53	19.5	15.3	23.8	23.9	16.8	0	24.3	22.9		8.3		23.9	4	15.3	15.3	15.8	16.9	18.1	19.8	20.8	22.2	23	N				
12-Jul-96	30	46	18.6	16.2	21.0	21.3	18.4	0	23.8	22.4		11.7		27.2	6	16.2	16.3	16.8	17.4	18.3	18.8	17.9	18.1	18.5	Y	1000	1300		
13-Jul-96	28	43	20.1	18.3	22.4	22.2	12.8	0	26.2	24.8		13.3		27.2	3	18.35	18.3	18.6	19.4	20.5	21.8	22.4	19.4	19.6	Y	1100	1300		
14-Jul-96	28	43	19.1	17.2	23.1	23.2	12.4	0	27.7	26.3		15.6		28.3	6	19.15	19.3	19.7	20.4	21.7	22.9	19.6	18.1	18.3	Y	1033	1630	1802	1816
15-Jul-96	39	59	18.0	16.7	19.5	19.6	19.4	0	23.7	22.3		17.8		23.3	9	17.6	17.7	18.7	16.7	16.8	16.9	17	17.2	17.4	Y	700	1300		
16-Jul-96	53	79	18.9	16.5	24.7	24.2	14.9	0	25.2	23.8		15.0		27.2	4	18.05	18.1	18.5	19.1	20	21.4	22.5	23.4	24.7	Y	1320	1920		
17-Jul-96	38	57	18.1	16.3	22.0	21.8	12.6	0	26.2	24.8		13.3		28.3	5	17.85	18.2	18.6	19.1	19.9	21.4	22	18.9	18.9	Y	1100	1700		
18-Jul-96	229	327	19.0	17.5	20.2	20.2	14.4	0	23.4	22.0		15.6		25.0	10	18.25	18.3	18.3	18.4	18.8	19.4	19.8	20	20.2	N				
19-Jul-96	3668	4817	19.0	18.1	20.3	20.4	2.9	0	20.8	19.4		18.9		25.6	10	19.65	19.5	19.3	18.9	18.1	18.2	18.2	18.3	18.4	Y	1000	2400		
20-Jul-96	4317	5642	17.9	17.4	18.6	18.8	0.5	0	18.8	17.4		10.0		22.8	1	17.85	17.7	17.6	17.6	17.6	17.7	17.7	17.8	17.8	Y	600	2200		
21-Jul-96	1103	1502	17.1	16.0	17.7	17.7	14.9	0	18.0	16.6		8.3		26.1	1	16.3	16.2	16	16.3	16.5	17	17.2	17.5	17.6	Y	730	2330		
22-Jul-96	1095	1491	16.9	16.4	17.3	17.5	1.0	0	17.5	16.1		15.6		23.9	10	17	17	16.9	16.9	17	17	17	17	16.9	Y	800	2400		
23-Jul-96	989	1351	16.7	16.1	17.4	17.6	15.8	0	17.5	16.1		13.9		23.3	9	16.1	16.2	16.3	16.4	16.5	16.8	16.8	16.9	17.2	Y	700	2000		
24-Jul-96	561	779	17.5	16.2	18.4	18.3	22.8	0	19.0	17.6		12.2		26.7	1	16.5	16.6	16.6	16.6	17.2	17.6	17.9	18.1	18.3	Y	800	2000		
25-Jul-96	376	529	17.9	17.3	18.4	18.5	0.0	0	18.5	17.1		12.2		23.3	4	17.45	17.5	17.6	17.3	17.7	17.8	18	18.1	18	Y	800	2000	2220	2240
26-Jul-96	288	408	17.8	17.0	18.6	18.3	13.6	0	19.2	17.8		12.8		23.9	6	17.4	17.4	17.5	17	17.7	18.2	18.5	18.5	18.4	Y	800	2000		
27-Jul-96	216	309	17.7	17.0	18.6	18.6	14.9	0	19.6	18.2		10.6		25.0	2	16.95	17.1	17.2	17.4	17.5	18	18	18.4	18.6	Y	800	2000		
28-Jul-96	172	248	17.8	16.8	19.0	18.6	14.6	0	19.7	18.3		11.1		24.4	5	16.75	16.8	17.2	17.6	17.7	18.4	18.3	18.7	19	Y	800	2000		

1996 Youghiogeny River Temperature Enhancement Data — **Deepcreek/Yough96.wk4- YOUGH96**

DATE	OFLOW	TFLOW	SMEAN	SMIN	SMAX	PenSMAX	STIMEMAX	STIME25	SWAMAX	swamax-1.	OMIN	EMIN	OMAX	EMAX	ECLD	S7	S8	S9	S10	S11	S12	S13	S14	S15	GEN	SG1	EG1	SG2	EG2
29-Jul-96	157	227	18.7	17.9	19.6	19.4	13.7	0	20.8	19.4		16.1		25.6	3	18	18	18.4	18	18.7	19.3	19.4	19.6	19.6	Y	800	2000		
30-Jul-96	427	598	19.1	18.2	19.9	19.4	13.9	0	20.2	18.8		17.2		27.8	6	18.95	19	19.1	18.2	19.1	19.4	19.7	19.9	19.8	Y	800	2000		
31-Jul-96	3111	4106	17.9	17.3	19.1	18.9	0.0	0	19.2	17.8		15.0		20.6	9	18.35	18.2	17.8	17.6	17.5	17.5	17.5	17.5	17.5	Y	730	2400		
01-Aug-96	2174	2900	16.9	16.4	17.3	17.5	0.0	0	17.2	15.8	12.2	14.4	22.8	24.4	3	16.55	16.5	16.4	16.5	16.6	16.8	16.9	16.9	17.1	Y	1	2000		
02-Aug-96	932	1275	16.9	16.0	17.4	17.8	15.6	0	17.3	15.9	12.2	12.8	22.8	23.3	7	16.2	16.2	16.4	16.5	16.6	16.7	16.9	17.3	17.4	Y	700	1100		
03-Aug-96	574	797	17.4	16.4	18.4	18.7	15.6	0	18.7	17.3	13.3	13.9	25.0	26.1	2	16.45	16.4	16.5	16.7	17.2	17.6	17.8	18.1	18.2	Y	1400	2100		
04-Aug-96	387	544	18.0	16.9	19.0	19.3	15.4	0	19.6	18.2	12.8	13.3	25.0	28.3	3	17.05	17	17.1	17.3	17.4	18	18.3	18.7	18.9	Y	845	2100		
05-Aug-96	277	393	18.8	17.7	19.7	19.7	14.9	0	20.6	19.2	12.8	13.9	26.1	28.9	3	17.85	17.9	18.2	17.7	18.8	19.1	19.1	19.3	19.6	Y	800	2000		
06-Aug-96	213	305	19.2	18.2	19.8	19.5	14.9	0	21.2	19.8	15.0	16.1	27.8	30.0	1	18.85	18.9	19.1	18.2	19	19.5	19.7	19.7	19.7	Y	800	2000		
07-Aug-96	171	246	19.8	19.0	20.5	20.0	13.9	0	22.8	21.4	16.7	16.7	27.2	30.0	2	19.6	19.7	20	19.1	19.5	20	20	20.5	20.4	Y	800	2000	2049	2131
08-Aug-96	143	207	19.9	18.9	20.7	20.3	15.4	0	23.4	22.0	16.1	16.7	30.6	30.0	3	19.85	19.8	20.1	19.6	19.8	20.4	20.4	20.3	20.5	Y	800	2000		
09-Aug-96	235	335	20.0	19.0	20.8	19.8	14.4	0	22.8	21.4	17.2	13.9	26.7	26.1	5	19.75	19.8	19.7	19.8	19.4	20.2	20.3	20.5	20.8	Y	800	2000		
10-Aug-96	165	238	18.9	17.7	19.9	19.6	0.0	0	21.1	19.7	8.3	11.1	23.9	23.3	3	18.55	18.3	18.5	17.7	18.6	19.3	19.5	19.6	19.3	Y	800	2000		
11-Aug-96	124	180	18.1	16.8	19.2	19.2	13.1	0	20.1	18.7	8.3	9.4	21.7	23.9	2	16.8	16.8	17.1	17.5	18.3	19	19.1	19.2	19.1	Y	800	2000		
12-Aug-96	446	624	18.2	17.4	18.7	19.3	15.6	0	19.4	18.0	14.4	14.4	20.6	18.9	10	17.9	17.9	17.9	18	17.7	18.5	18.5	18.6	18.7	Y	830	2010		
13-Aug-96	1853	2484	16.7	16.1	17.4	18.4	0.0	0	17.0	15.6	12.8	13.3	23.3	22.8	10	16.15	16.1	16.1	16.3	16.5	16.5	16.6	16.8	17	Y	800	2000		
14-Aug-96	677	935	17.2	15.8	18.5	19.3	15.8	0	18.4	17.0	11.7	13.3	25.0	26.1	3	15.9	15.8	16	16.5	17	17.4	17.7	17.9	18.2	Y	800	2000		
15-Aug-96	355	500	18.3	16.9	19.5	19.9	15.4	0	19.6	18.2	13.3	14.4	26.1	27.2	2	16.9	16.9	17.1	17	18.1	18.7	19	19.3	19.4	Y	800	2000		
16-Aug-96	307	434	18.7	18.2	19.3	19.3	13.9	0	19.3	17.9	14.4	15.0	25.0	25.6	6	18.15	18.2	18.4	18.7	18.9	18.6	19.1	19.2	19.2	Y	1000	1600		
17-Aug-96	350	493	18.5	17.6	19.2	19.5	14.4	0	19.6	18.2	13.3	14.4	22.2	24.4	5	17.6	17.6	17.7	18	18.5	18.5	18.8	19	19.1	Y	1000	1600		
18-Aug-96	211	302	18.8	17.8	20.0	20.2	14.6	0	20.2	18.8	12.8	13.3	25.0	26.1	1	17.75	17.8	17.9	18.5	19	19.1	19.6	19.9	20	Y	1000	1630		
19-Aug-96	166	239	19.3	17.4	21.4	22.2	17.3	0	21.1	19.7	10.6	12.8	24.4	28.3	1	17.4	17.4	17.6	18.2	19.1	19.6	19.7	19.7	20.4	Y	1000	1300		
20-Aug-96	136	197	20.5	18.0	23.9	24.2	15.8	0	21.8	20.4	12.2	13.3	27.2	27.8	2	18	18	18.2	18.9	19.7	20.8	21.8	22.7	23.6	N				
21-Aug-96	121	176	20.7	18.9	23.4	24.0	17.0	0	22.0	20.6	14.4	15.0	26.7	27.8	3	18.85	18.9	19	19.2	19.3	20.5	21.2	22.1	22.9	N				
22-Aug-96	204	292	20.9	19.3	23.1	23.6	15.8	0	22.0	20.6	16.1	16.7	27.2	28.3	3	19.3	19.3	19.6	20	20.5	21.5	22	22.6	22.9	N				
23-Aug-96	127	185	20.6	19.7	21.7	22.1	19.9	0	22.4	21.0	16.1	16.1	27.8	28.3	5	19.65	19.7	19.9	20.4	21	21.3	20.2	20.3	20.3	Y	1000	1400		
24-Aug-96	163	235	20.0	19.0	20.8	21.4	0.0	0	21.8	20.4	16.1	12.8	27.2	22.2	9	19.95	19.9	19.9	19.9	19.9	20.2	19	19.4	19.6	Y	1000	1400		
25-Aug-96	167	241	19.9	17.9	23.0	23.6	15.4	0	21.0	19.6	9.4	12.8	23.9	26.1	1	18.05	17.9	18.1	18.6	19.3	20.7	21.6	22.5	22.9	N				
26-Aug-96	116	169	19.4	17.1	22.2	23.4	17.3	0	21.8	20.4	9.4	12.2	26.7	27.2	2	17.1	17.1	17.4	18.1	19.1	19.4	20.2	20.4	21	Y	1000	1300		
27-Aug-96	98	143	20.0	18.2	22.5	22.6	16.3	0	21.7	20.3	12.8	14.4	26.1	26.7	3	18.25	18.2	18.4	18.7	19.2	20.5	21.4	21.9	22	N				
28-Aug-96	91	134	18.7	16.7	21.2	21.4	15.6	0	20.7	19.3	14.4	13.9	24.4	26.7	1	17.35	17.4	17.5	17.8	18.5	19.3	19.9	20.2	20.8	N				
29-Aug-96	89	131	18.8	17.6	19.8	19.9	13.4	0	21.7	20.3	12.8	13.3	24.4	25.6	1	17.65	17.6	17.7	18.3	19.2	19.1	19.6	19.7	19.7	Y	1000	1700		
30-Aug-96	74	109	19.3	17.4	21.6	22.4	17.3	0	21.8	20.4	11.1	12.8	24.4	25.0	1	17.4	17.4	17.5	18.1	19	19.3	19.6	20.2	20.5	Y	1000	1350		
31-Aug-96	63	93	19.1	16.8	21.4	21.8	16.8	0	22.1	20.7	8.9	12.2	24.4	26.1	2	16.85	16.8	17.1	17.7	18.7	19.4	19.8	20.2	20.4	Y	1000	1300		

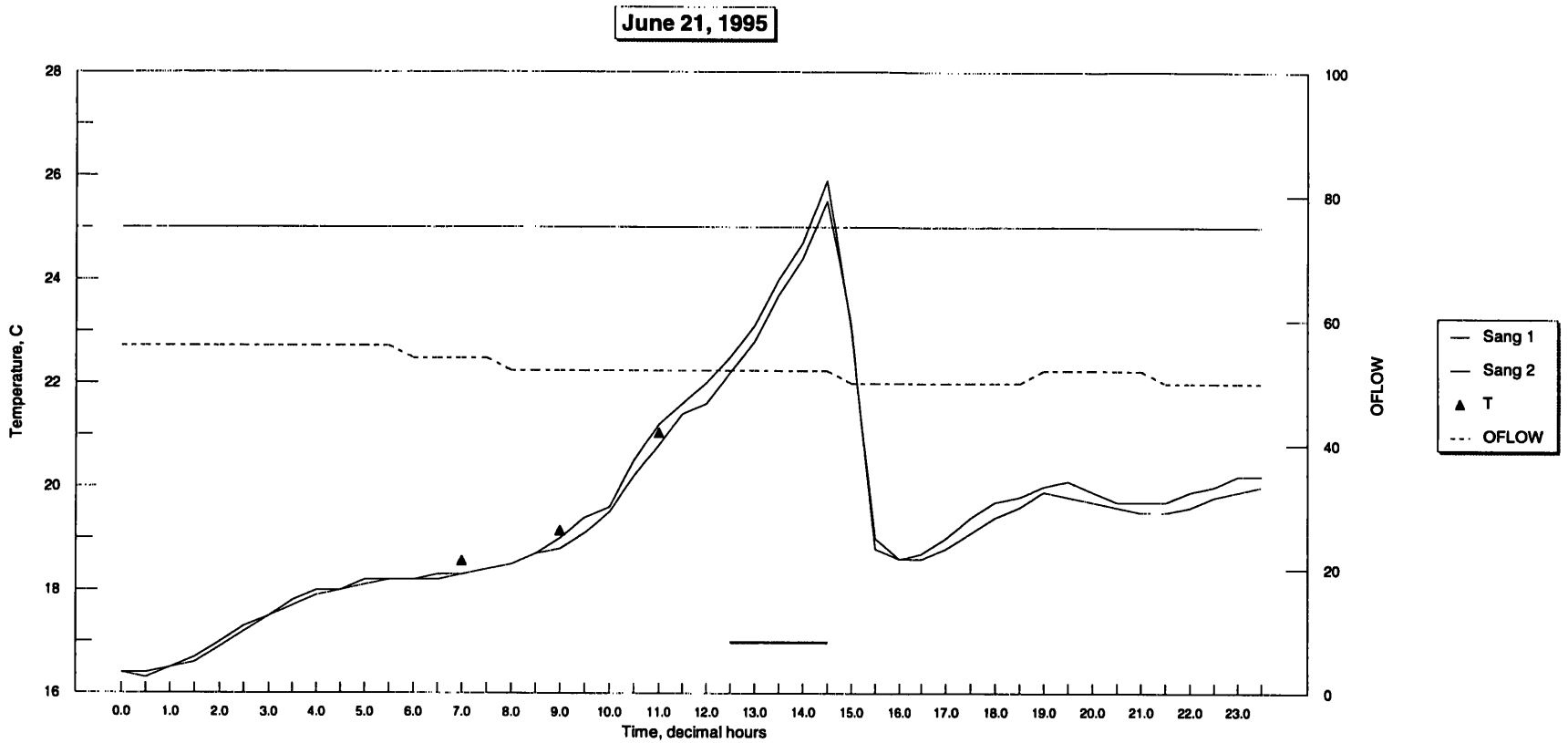
APPENDIX F

DAILY PLOTS OF RIVER FLOW AT OAKLAND AND WATER TEMPERATURE IN THE YOUGHIOGHENY RIVER AT SANG RUN FOR 1995 AND 1996 (VARIABLE NAMES EXPLAINED IN APPENDIX E)



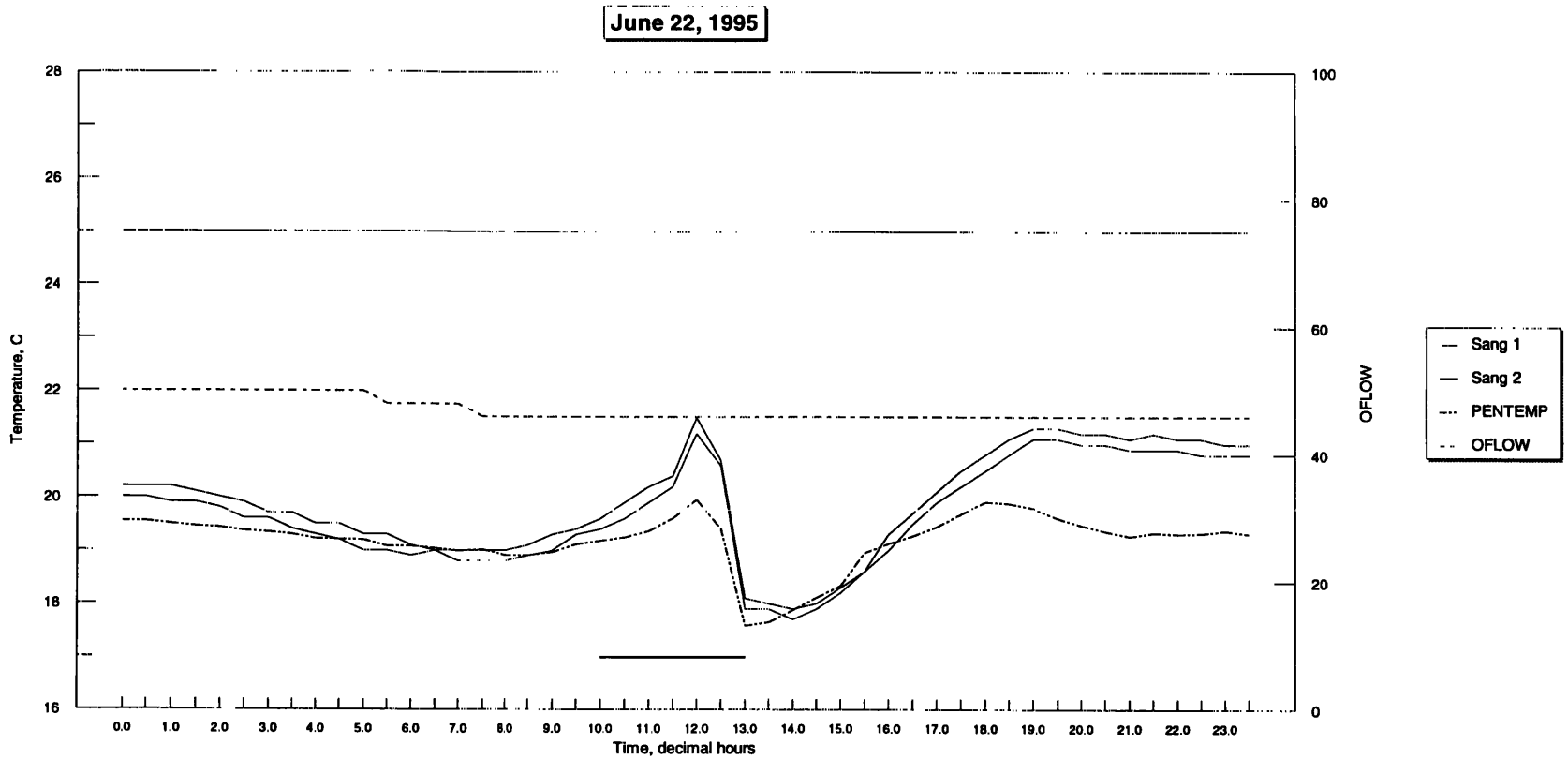
P7	P9	P11	P12	P14	P15
24.6	24.8	25.7			
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
23.5	23.9	24.9			
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
24.6	24.8	25.7			

6/20 Release for: Temperature Enhancement then Penelec			
Oflow	59	**Tair**	30
Omin	12.8	**PCLD**	6
Omax	28.9	**Q**	67
ECLD	7.6	**Swamax**	25.1
Smax	24.1	**EMAX**	31.7
St_max		**St_25**	



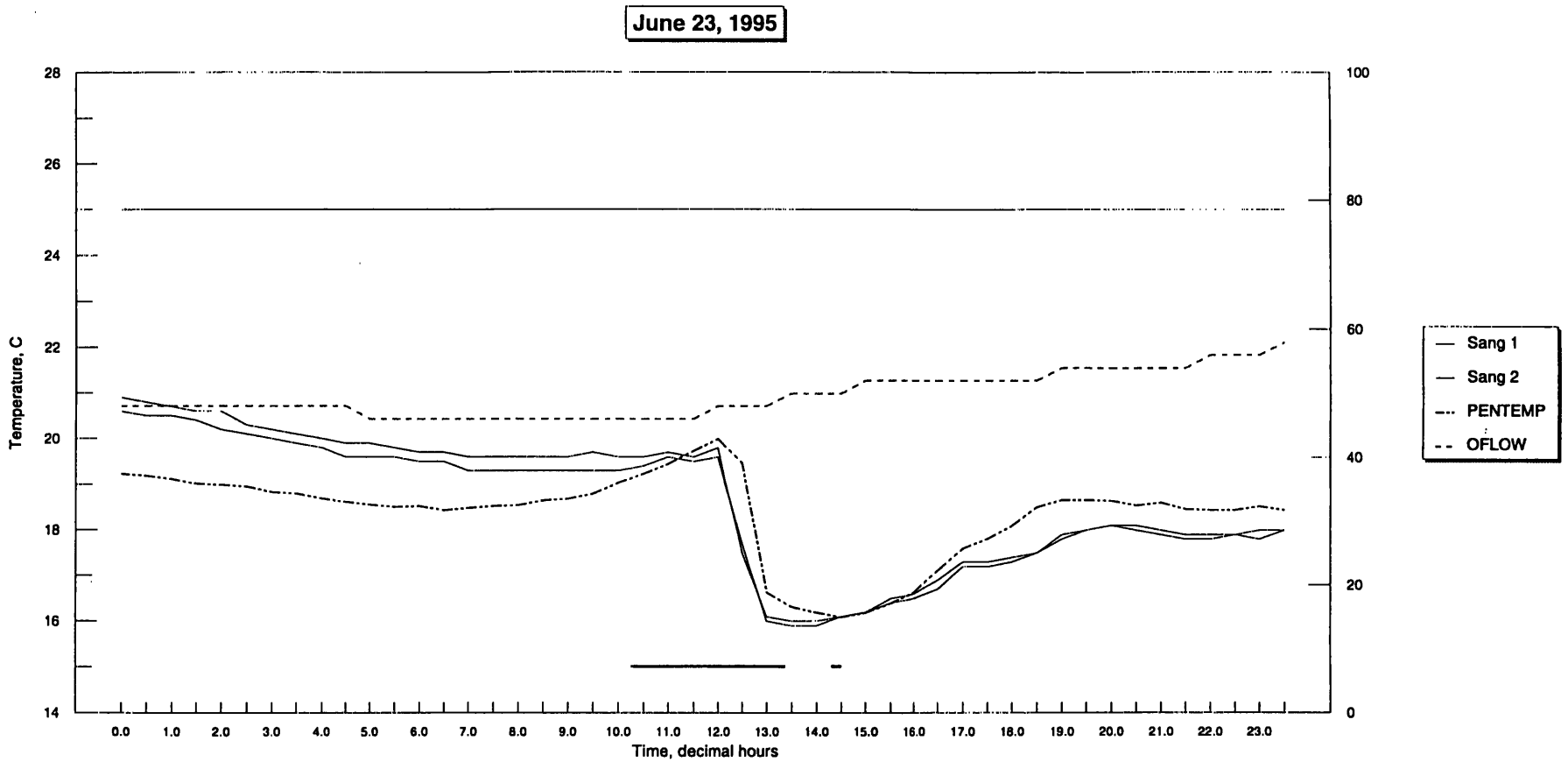
P7	P9	P11	P12	P14	P15
24.8	25.3	26.7			
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
24.0	24.6	25.6			
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
24.8	25.3	26.7			

6/21 Release for: Temperature Enhancement			
Oflow	53	**Tair**	30
Omin	15.6	**PCLD**	6
Omax	27.8	**Q**	64
ECLD	2.4	**Swamax**	26.6
Smax	25.7	**EMAX**	31.7
St_max	14.4	**St_25**	14.4



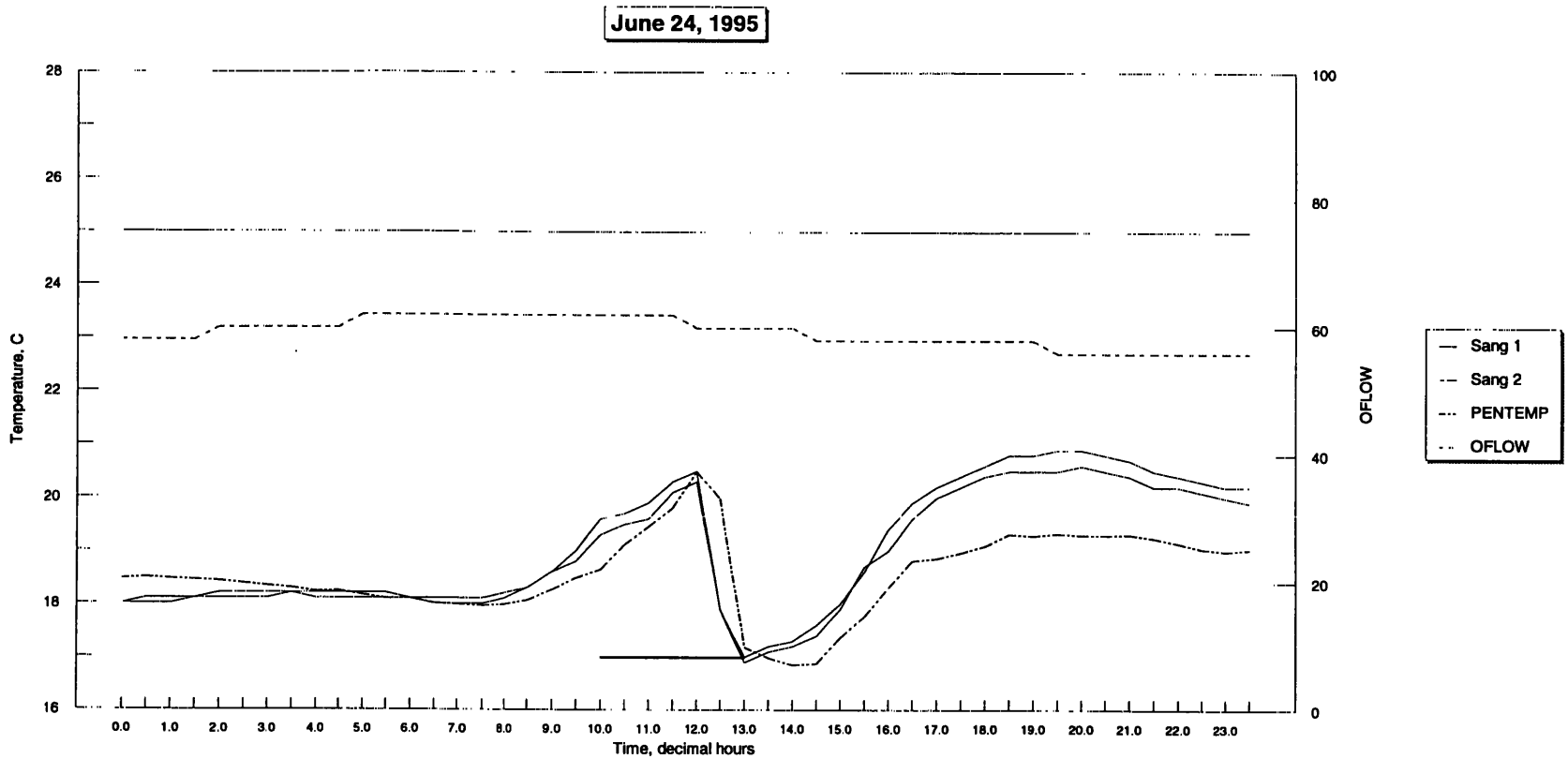
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

6/22 Release for: Scheduled Penelec			
Oflow	48	Tair	
Omin	16.1	PCLD	
Omax	26.7	Q	
ECLD	9.4	Swamax	26.0
Smax	21.4	EMAX	26.7
St_max		St_25	



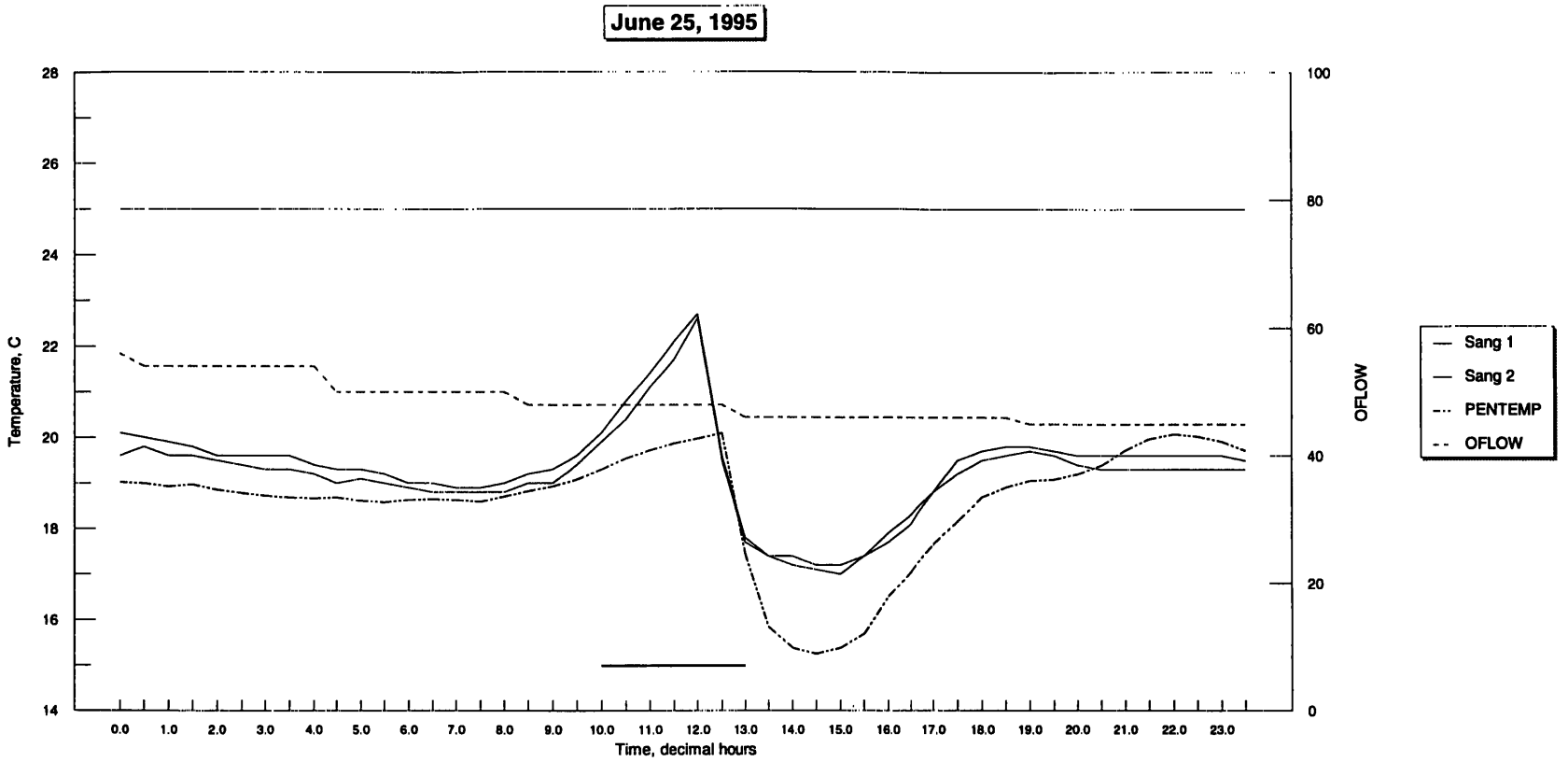
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

6/23 Release for: Scheduled Friday WW			
Oflow	50	Tair	
Omin	16.7	PCLD	
Omax	22.2	Q	
ECLD	10.0	Swamax	23.4
Smax	20.8	EMAX	25.6
St_max		St_25	



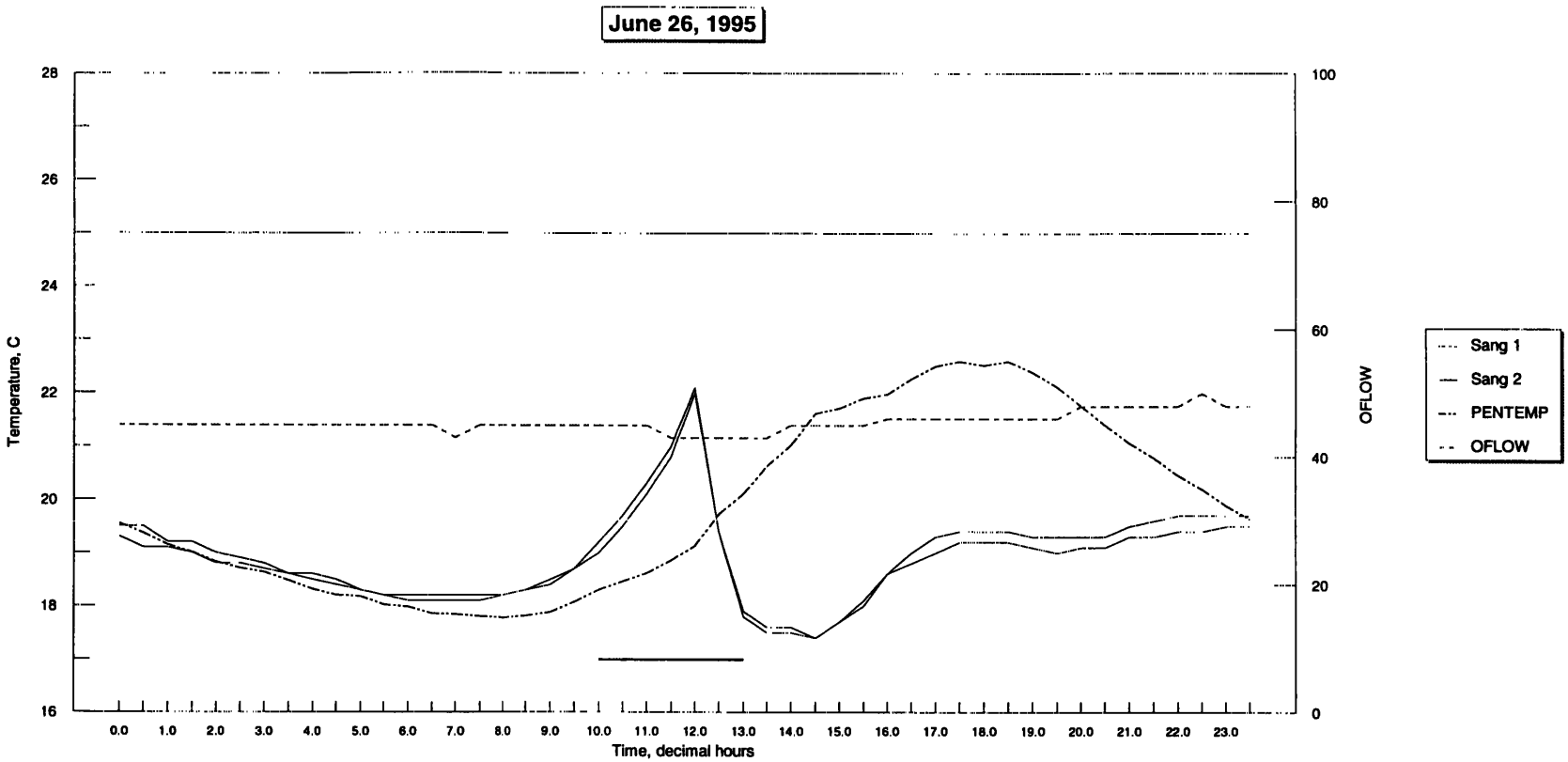
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

6/24 Release for: Scheduled Saturday WW			
Oflow	60	Tair	
Omin	16.1	PCLD	
Omax	23.3	Q	
ECLD	8.8	Swamax	23.9
Smax	20.8	EMAX	27.2
St_max		St_25	



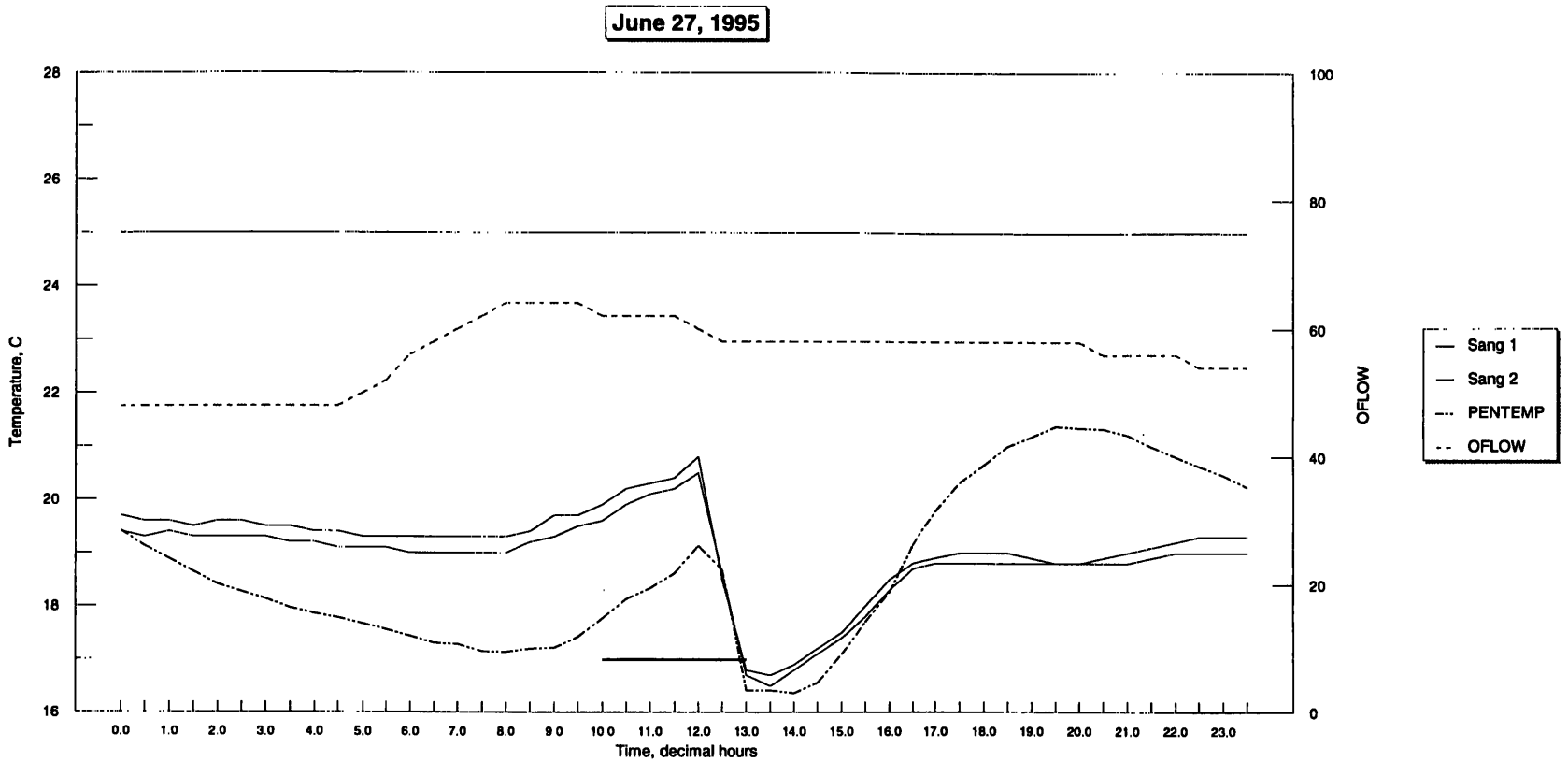
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

6/25 Release for: Scheduled Penelec			
Oflow	49	Tair	
Omin	16.1	PCLD	
Omax	25.6	Q	
ECLD	5	Swamax	24.3
Smax	22.7	EMAX	29.4
St_max		St_25	



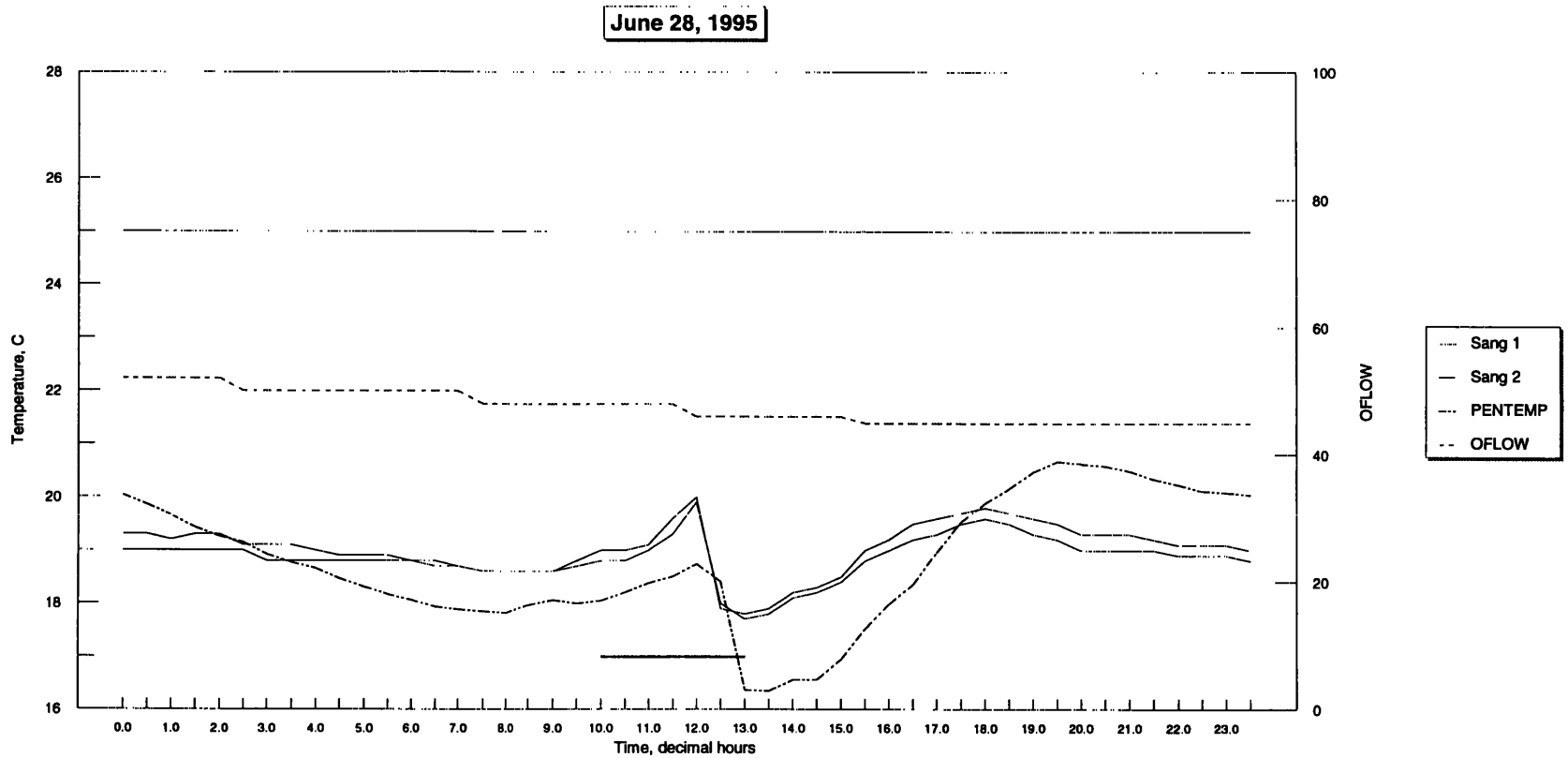
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

6/26 Release for: Scheduled Monday WW			
Oflow	46	Tair	
Omin	14.4	PCLD	
Omax	23.9	Q	
ECLD	9.8	Swamax	26
Smax	22.1	EMAX	28.3
St_max		St_25	



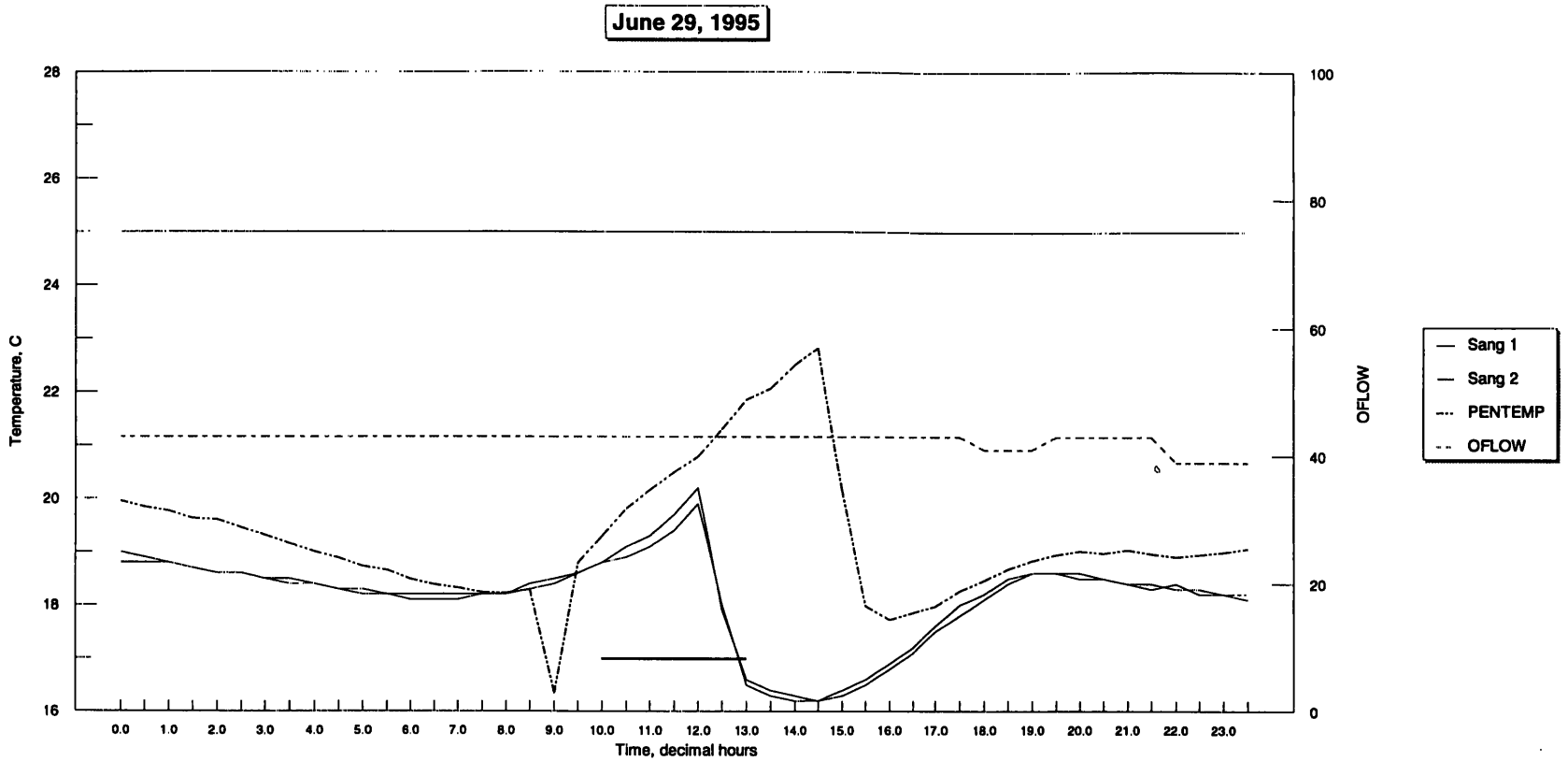
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

6/27 Release for: Scheduled Penelec			
Oflow	57	Tair	
Omin	18.3	PCLD	
Omax	22.8	Q	
ECLD	6.6	Swamax	24.3
Smax	20.7	EMAX	30.0
St_max		St_25	



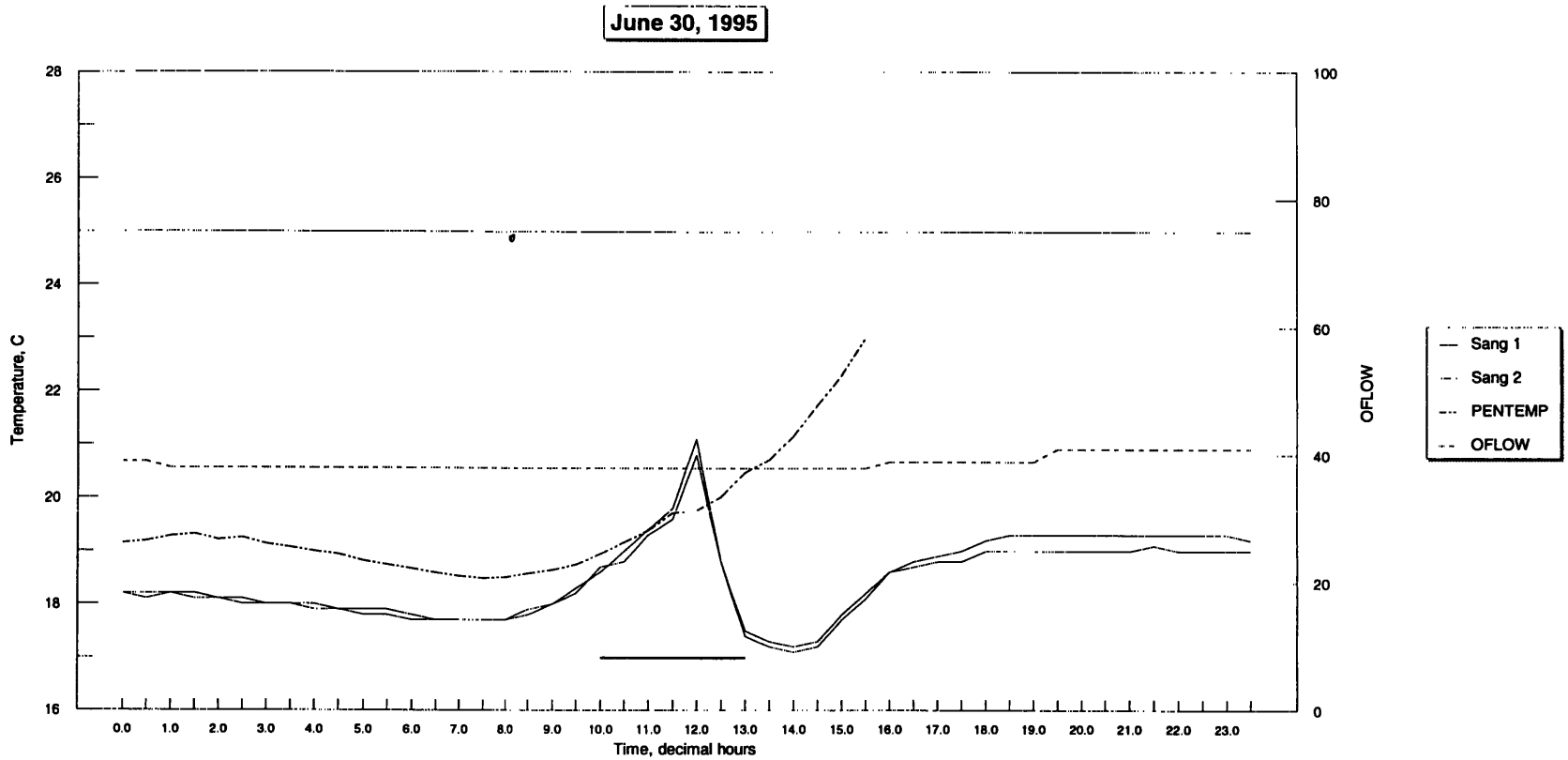
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

6/28 Release for: Scheduled Penelec			
Oflow	48	Tair	
Omin	15.6	PCLD	
Omax	21.7	Q	
ECLD	8.6	Swamax	23.0
Smax	20.0	EMAX	27.8
St_max		St_25	



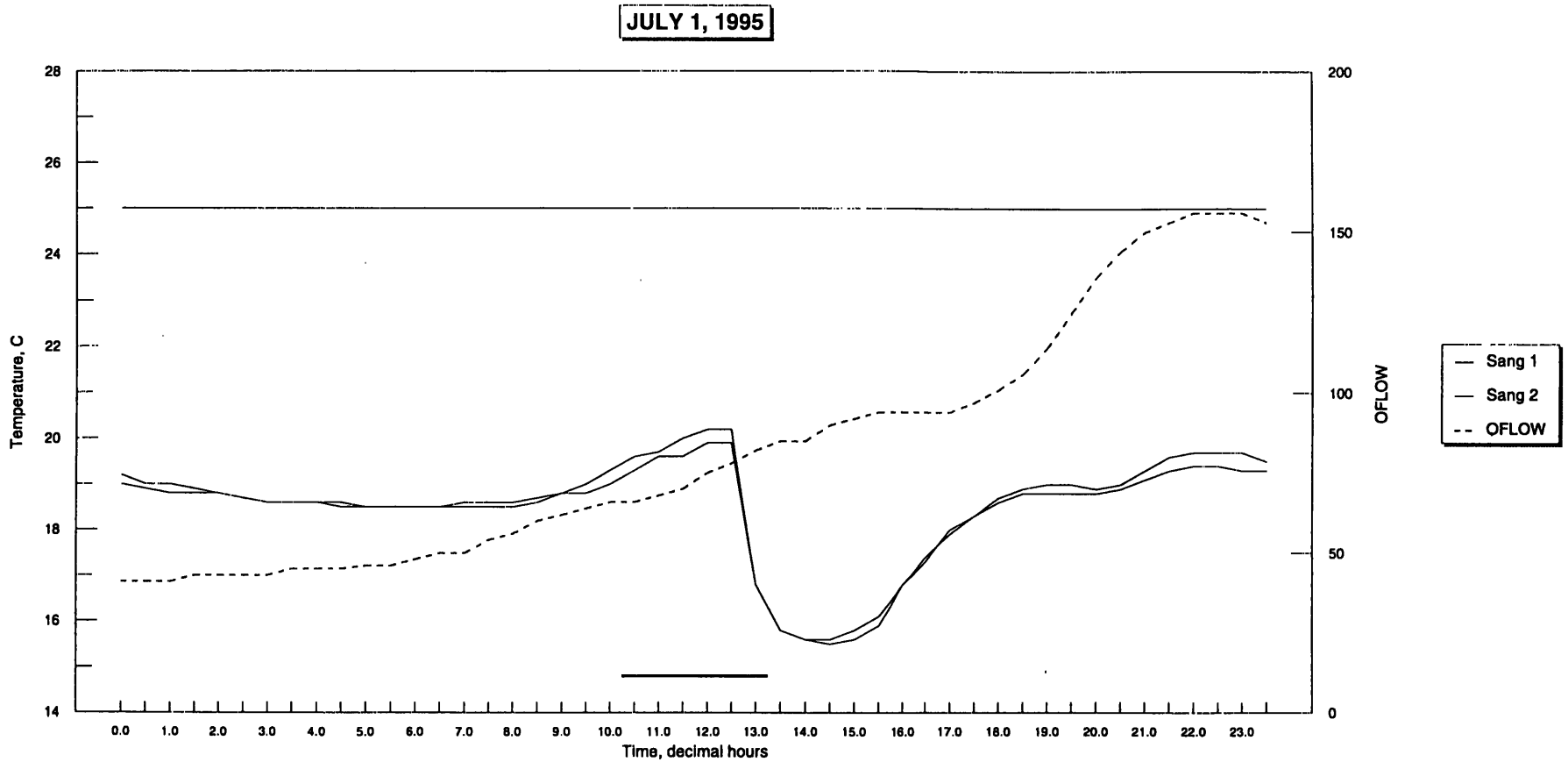
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

6/29 Release for: Scheduled Penelec			
Oflow	43	Tair	
Omin	16.7	PCLD	
Omax	20.6	Q	
ECLD	9.4	Swamax	22.0
Smax	20.1	EMAX	27.2
St_max		St_25	



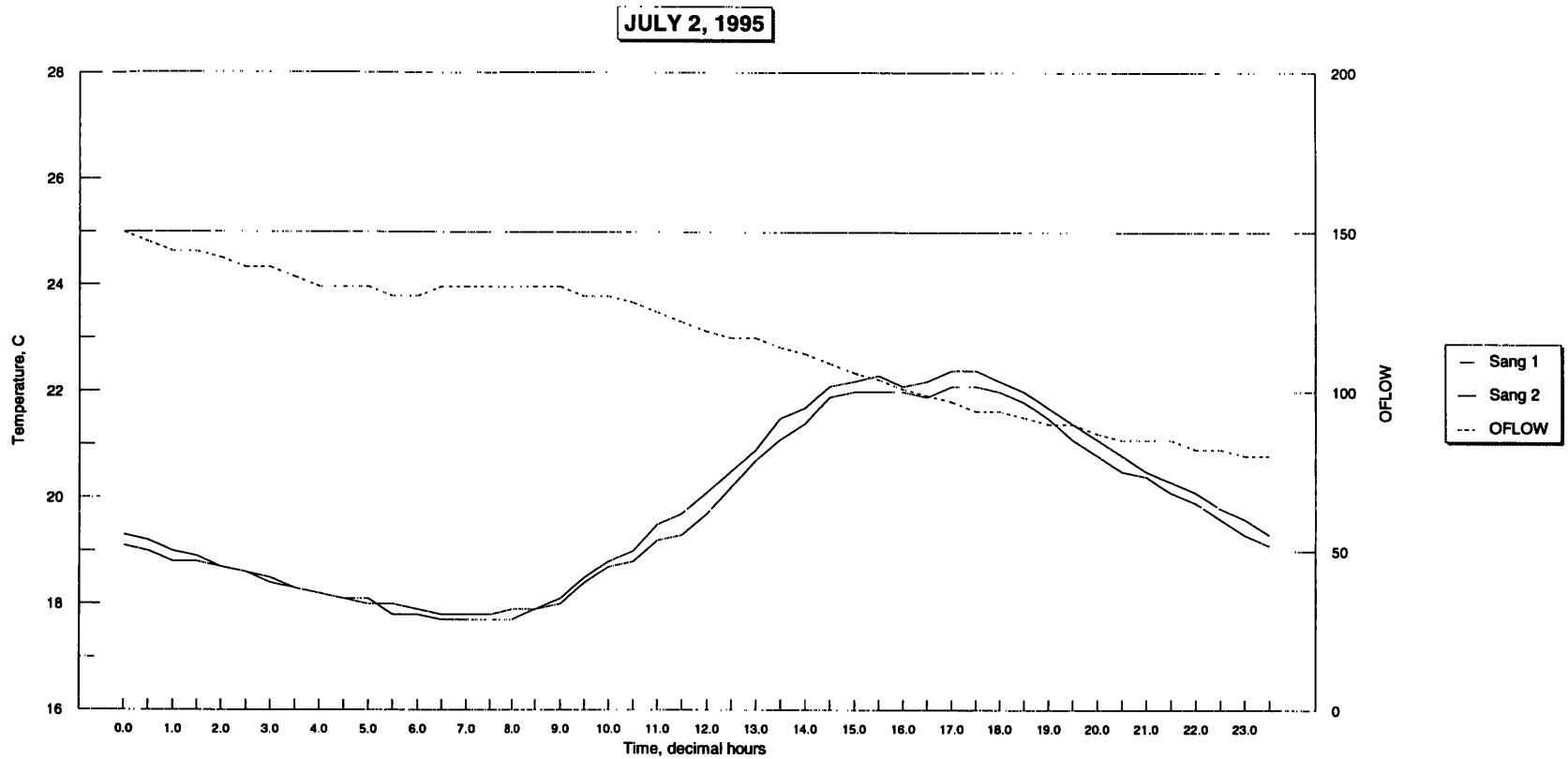
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

6/30 Release for: Scheduled Friday WW			
Oflow	39	Tair	
Omin	16.1	PCLD	
Omax	26.1	Q	
ECLD	6.4	Swamax	24.5
Smax	21.0	EMAX	27.8
St_max		St_25	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

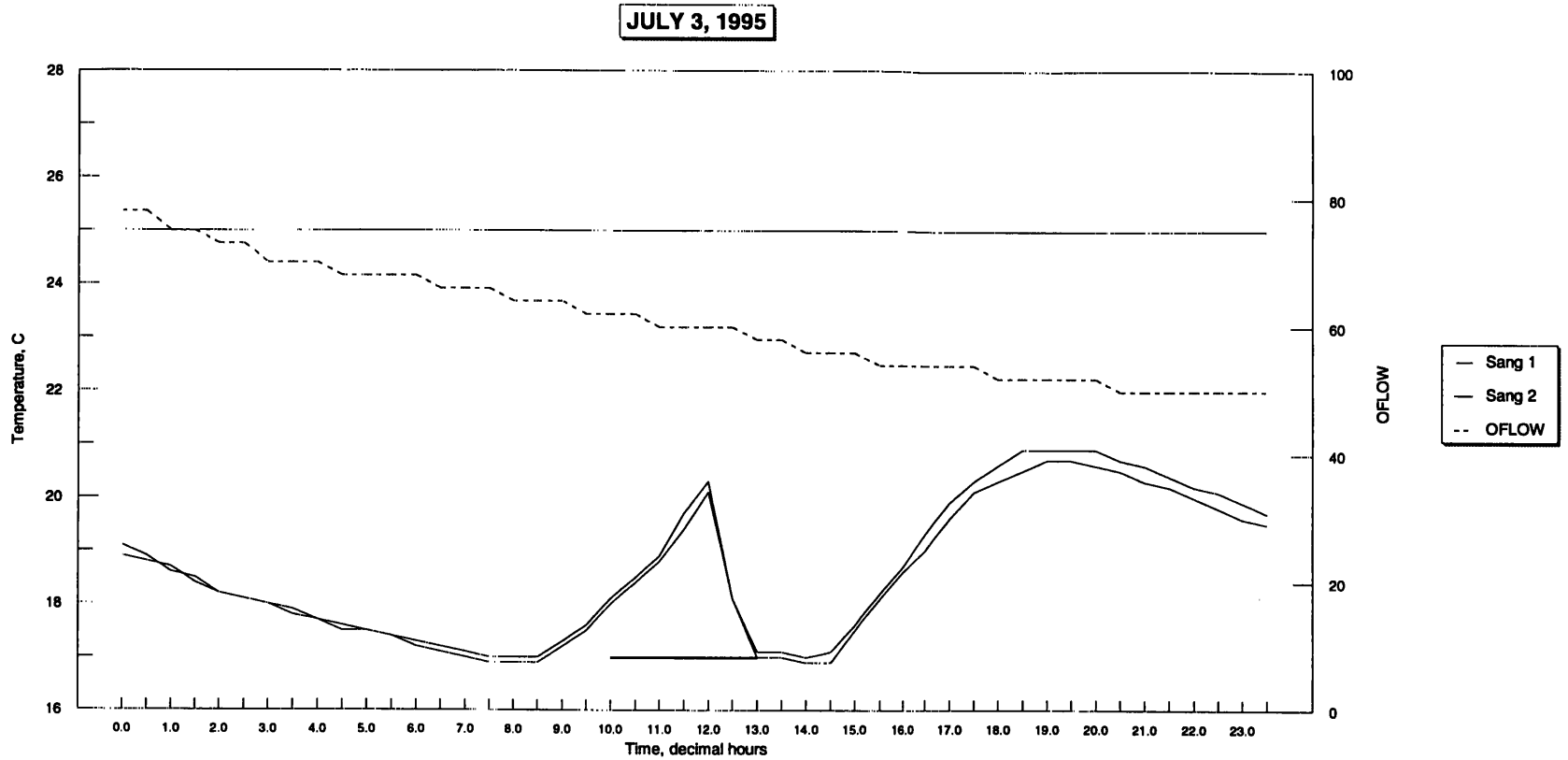
7/1 Release for: Scheduled Saturday WW			
Oflow	84	Tair	
Omin	17.2	PCLD	
Omax	21.1	Q	
ECLD	10	Swamax	23.1
Smax	20.1	EMAX	23.9
St_max		St_25	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

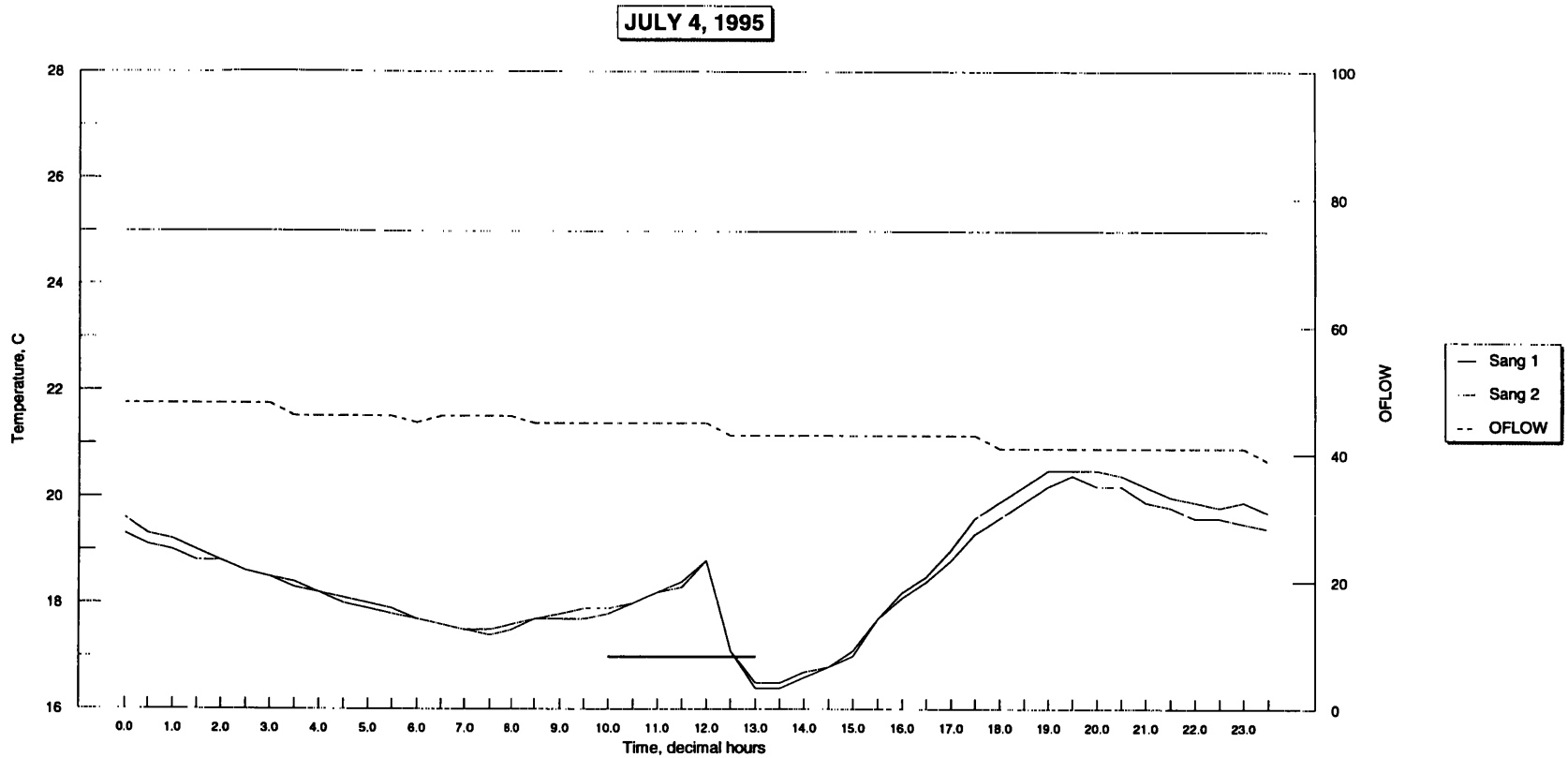
7/2 Release for: None

Oflow	116	Tair	
Omin	10	PCLD	
Omax	22.8	Q	
ECLD	5.8	Swamax	21.8
Smax	22.3	EMAX	23.9
St_max		St-25	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

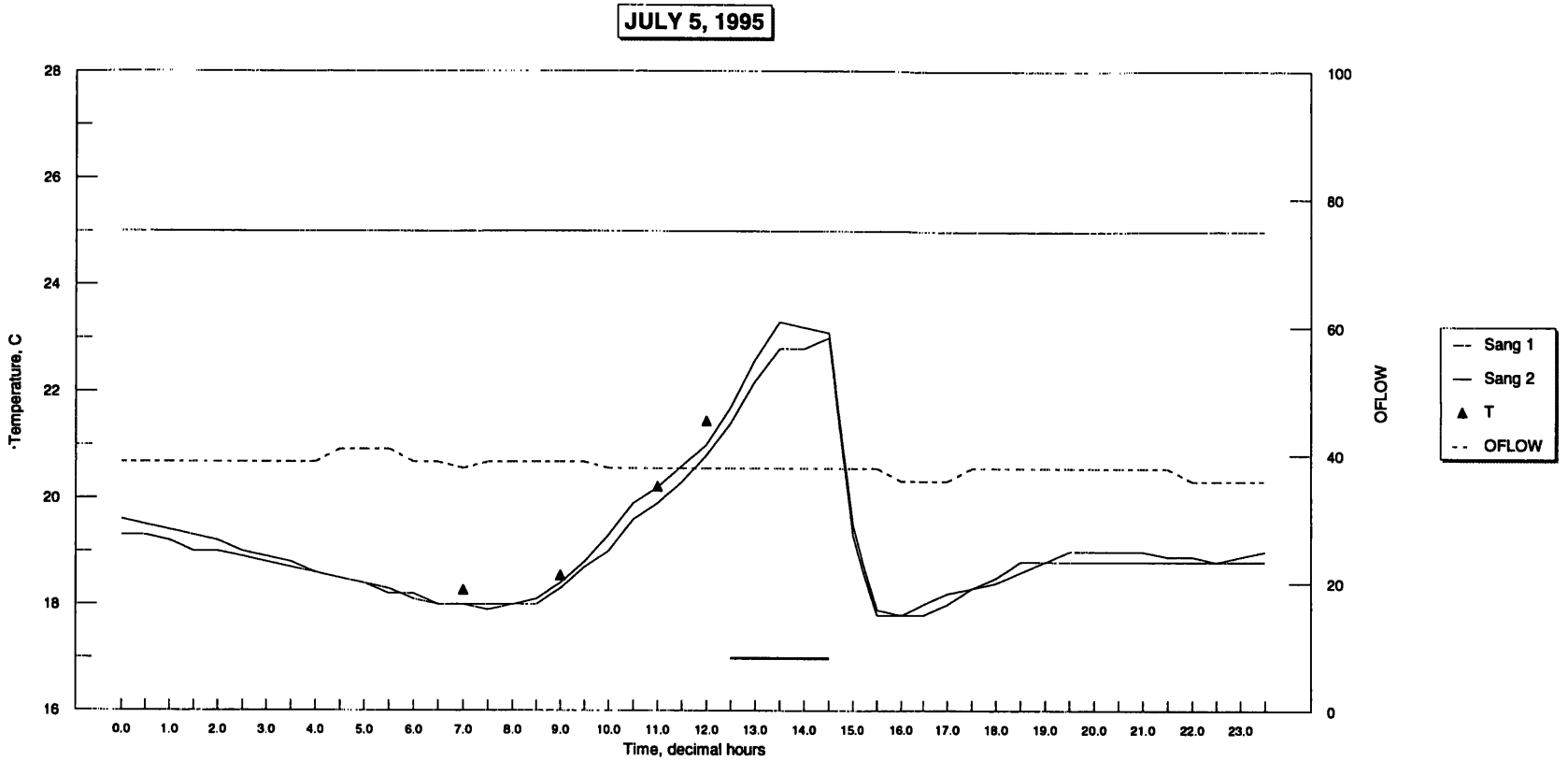
7/3 Release for: Scheduled Monday WW			
Oflow	61	Tair	
Omin	8.3	PCLD	
Omax	23.9	Q	
ECLD	6.8	Swamax	23.2
Smax	20.8	EMAX	27.2
St_max		St_25	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

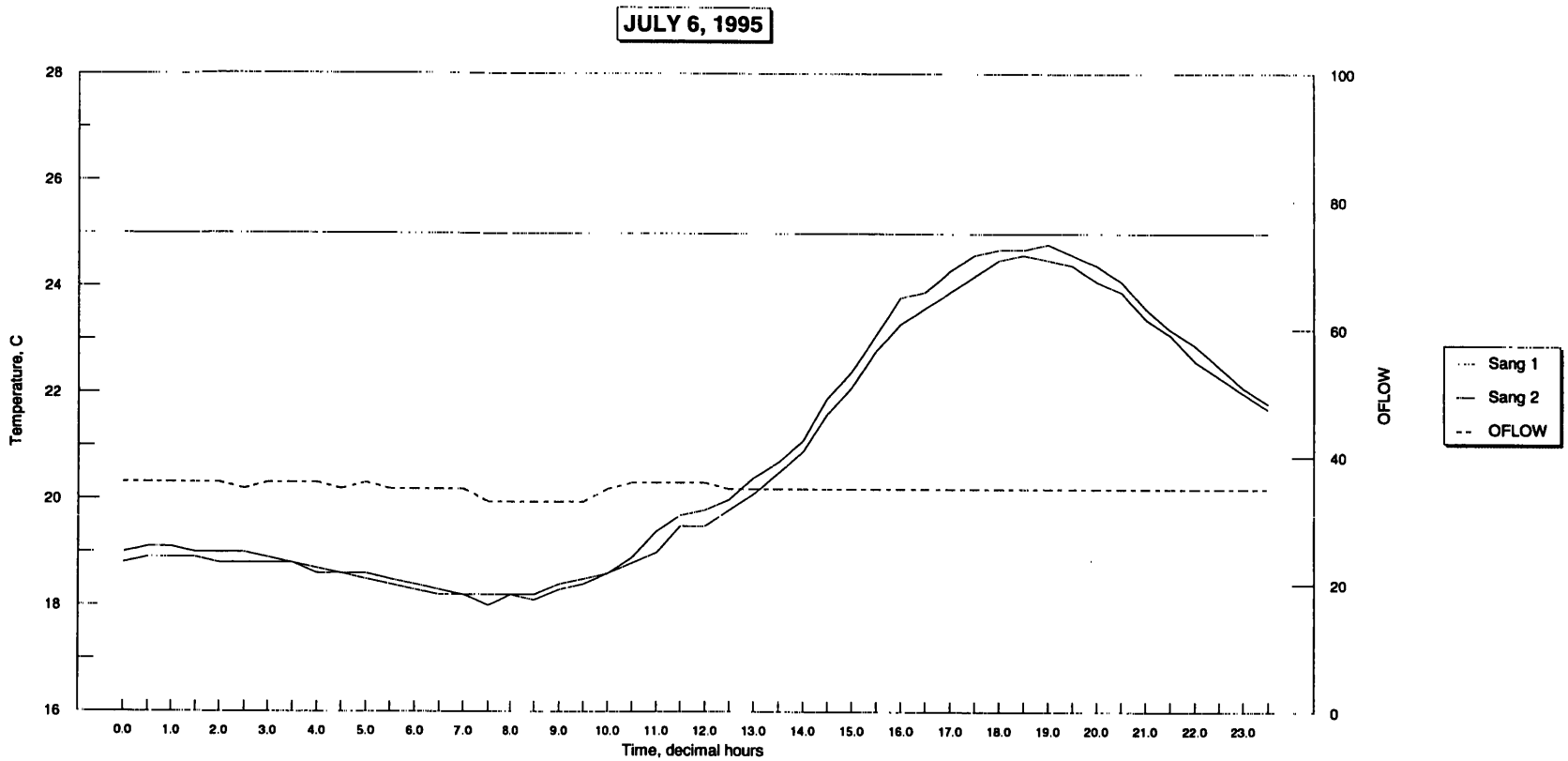
7/4 Release for: Scheduled Penelec

Oflow	45	Tair	
Omin	12.8	PCLD	
Omax	26.1	Q	
ECLD	9.2	Swamax	22.9
Smax	20.5	EMAX	28.3
St_max		St_25	



P7	P9	P11	P12	P14	P15
25.6	25.6	26.2			
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
23.9	24.0	24.7			
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
25.6	25.6	26.2			

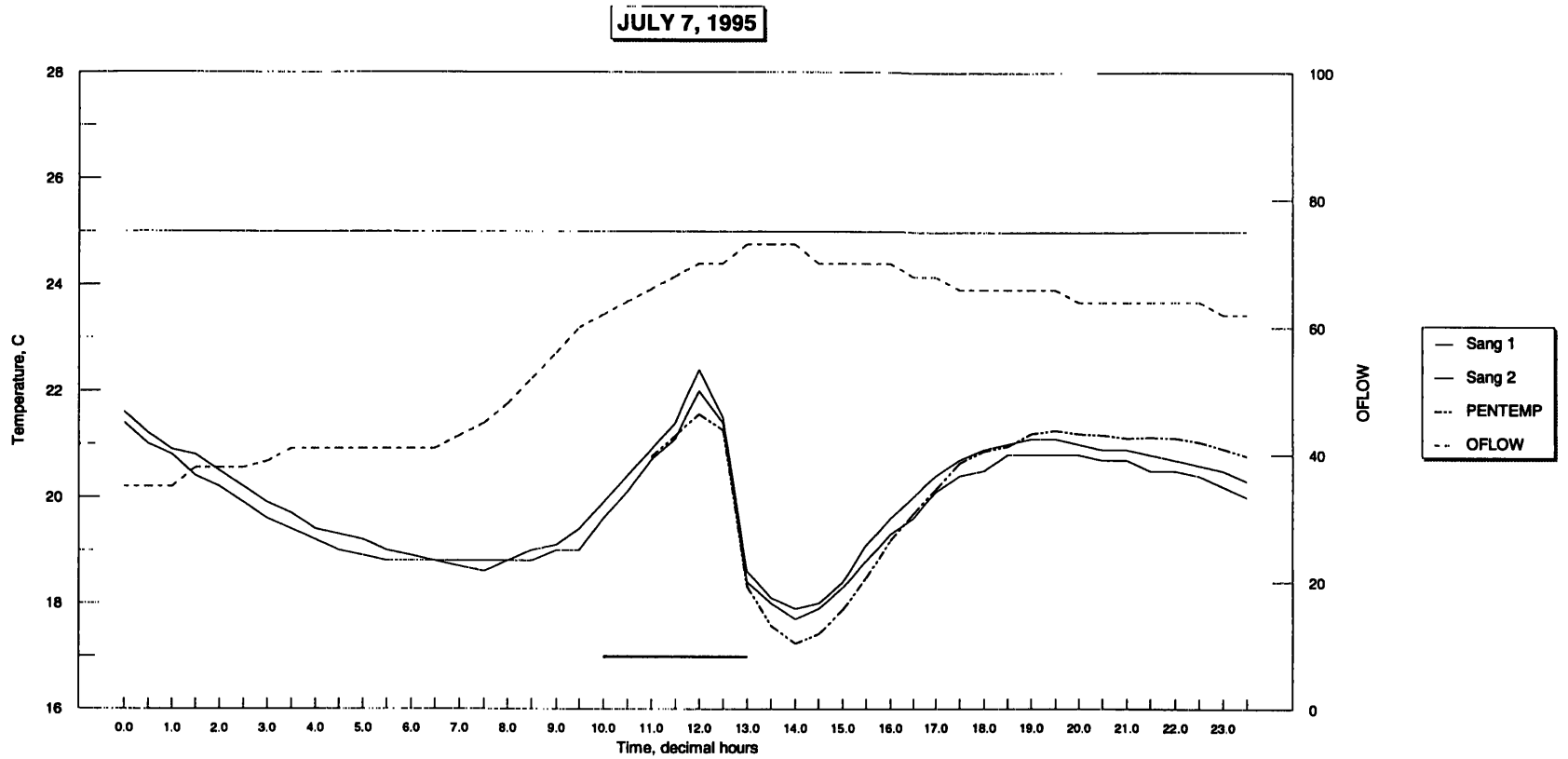
7/5 Release for: Temperature Enhancement			
Oflow	39	**Tair**	30.6
Omin	14.4	**PCLD**	6
Omax	27.2	**Q**	47
ECLD	9.4	**Swamax**	24.6
Smax	23.2	**EMAX**	29.4
St_max		**St_25**	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

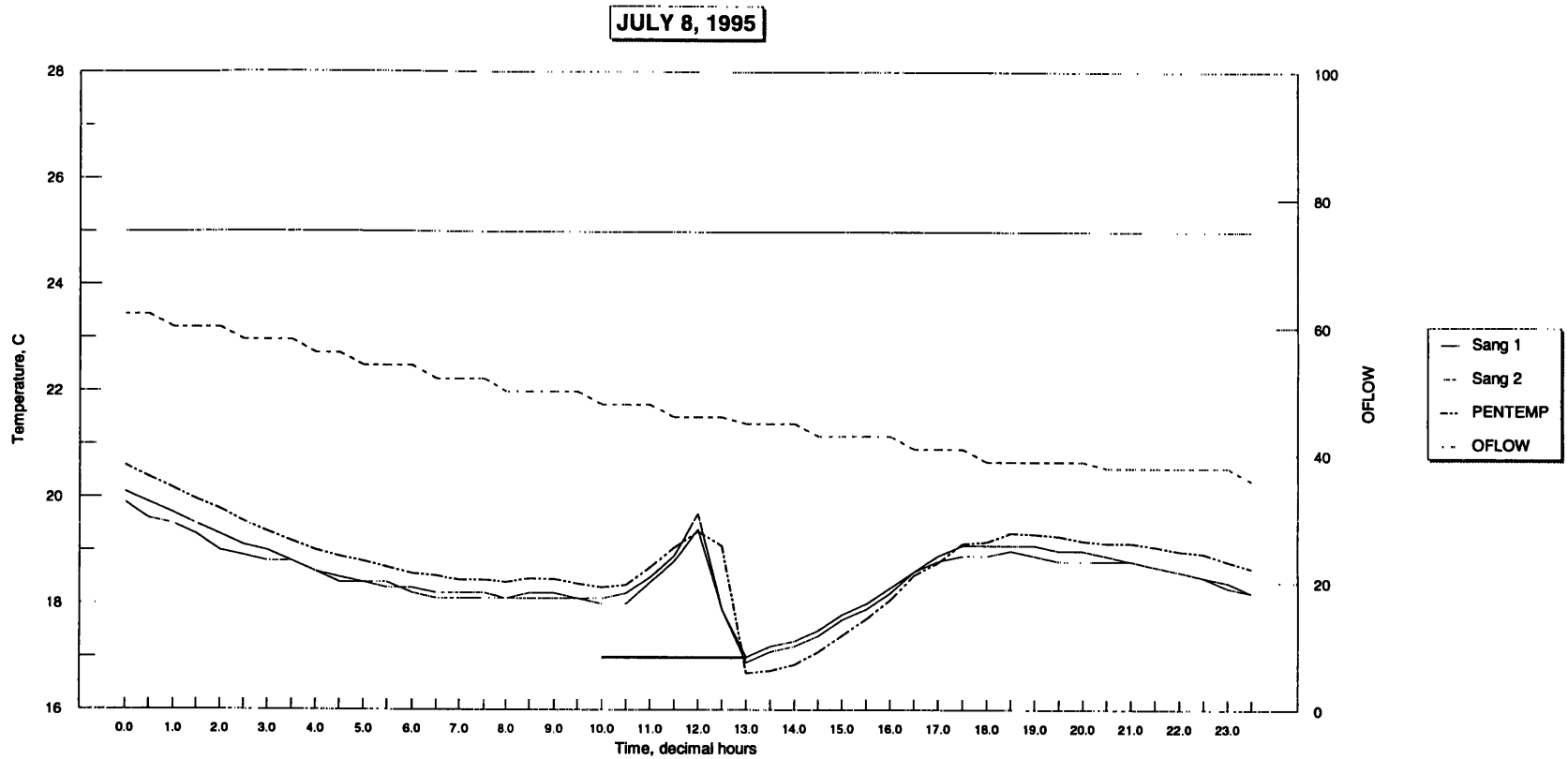
7/6 Release for: None

Oflow	35	Tair	
Omin	14.4	PCLD	
Omax	27.2	Q	
ECLD	9.6	Swamax	25.5
Smax	24.7	EMAX	28.9
St_max		St_25	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

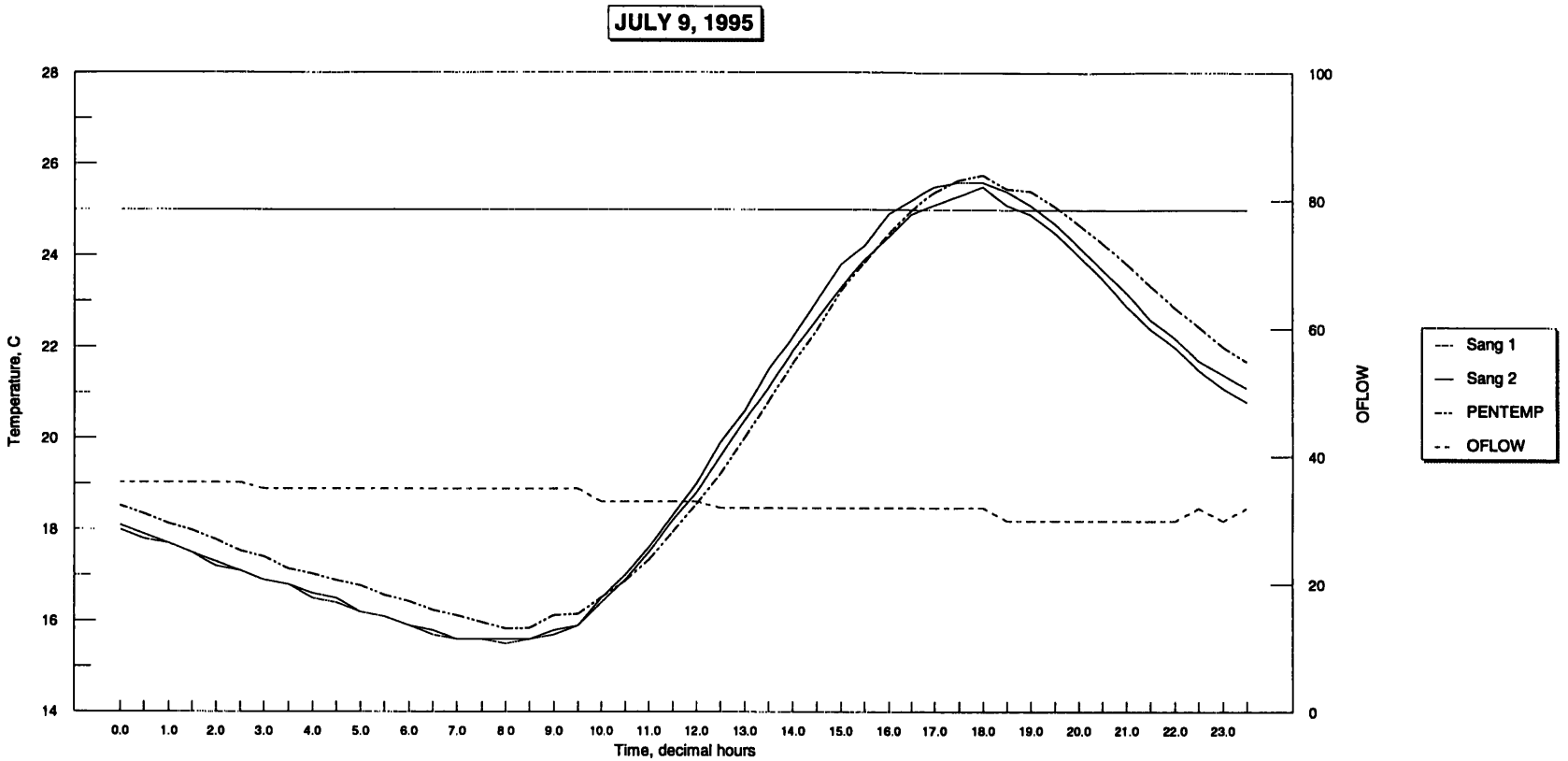
7/7 Release for: Scheduled Friday WW			
Oflow	58	Tair	
Omin	16.1	PCLD	
Omax	26.1	Q	
ECLD	5.6	Swamax	26.6
Smax	22.2	EMAX	27.2
St_max		St_25	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

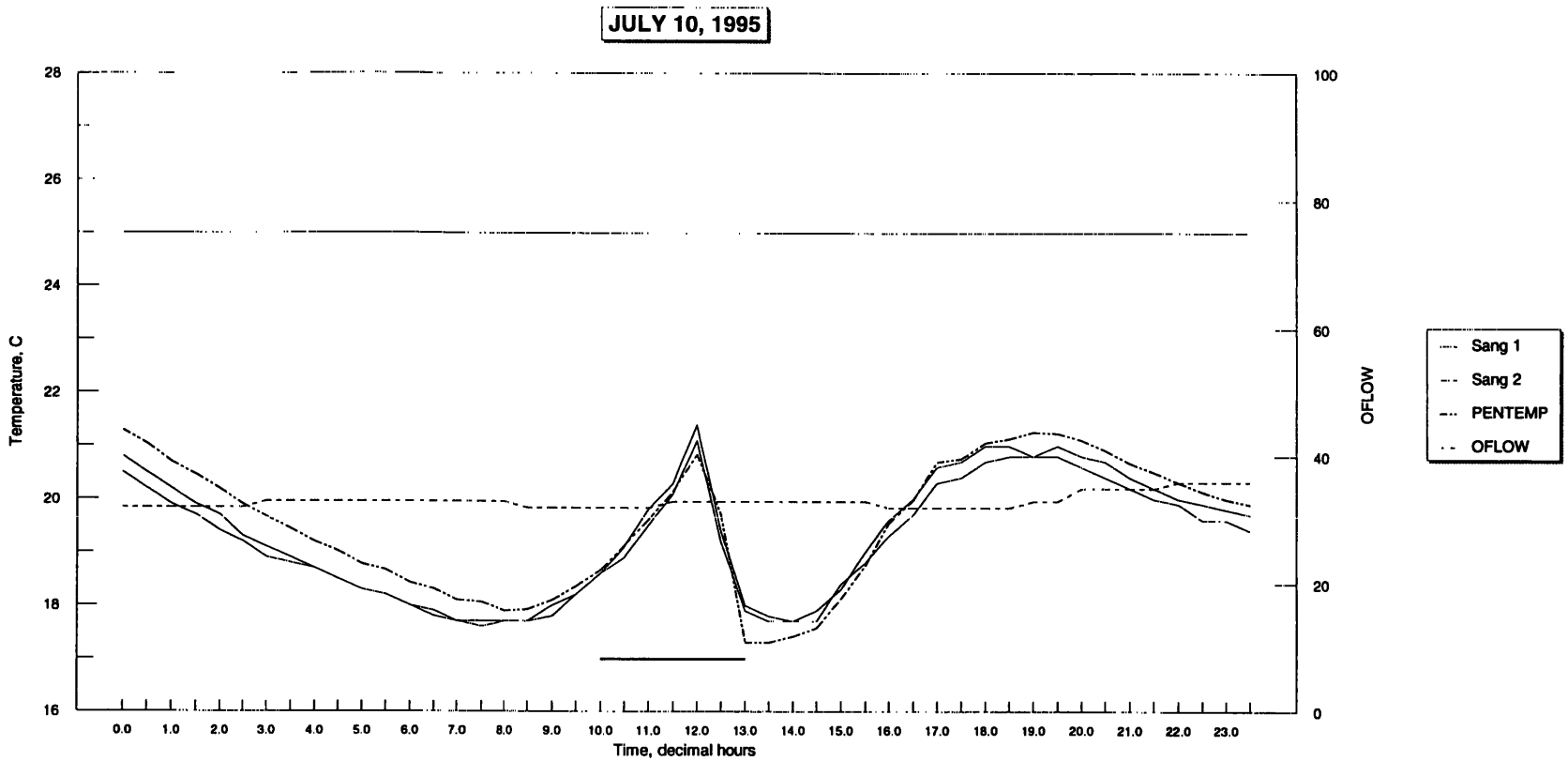
7/8 Release for: Scheduled Saturday WW

Oflow	48	Tair	
Omin	12.8	PCLD	
Omax	25.6	Q	
ECLD	7.8	Swamax	23.2
Smax	20.0	EMAX	22.8
St_max		St_25	



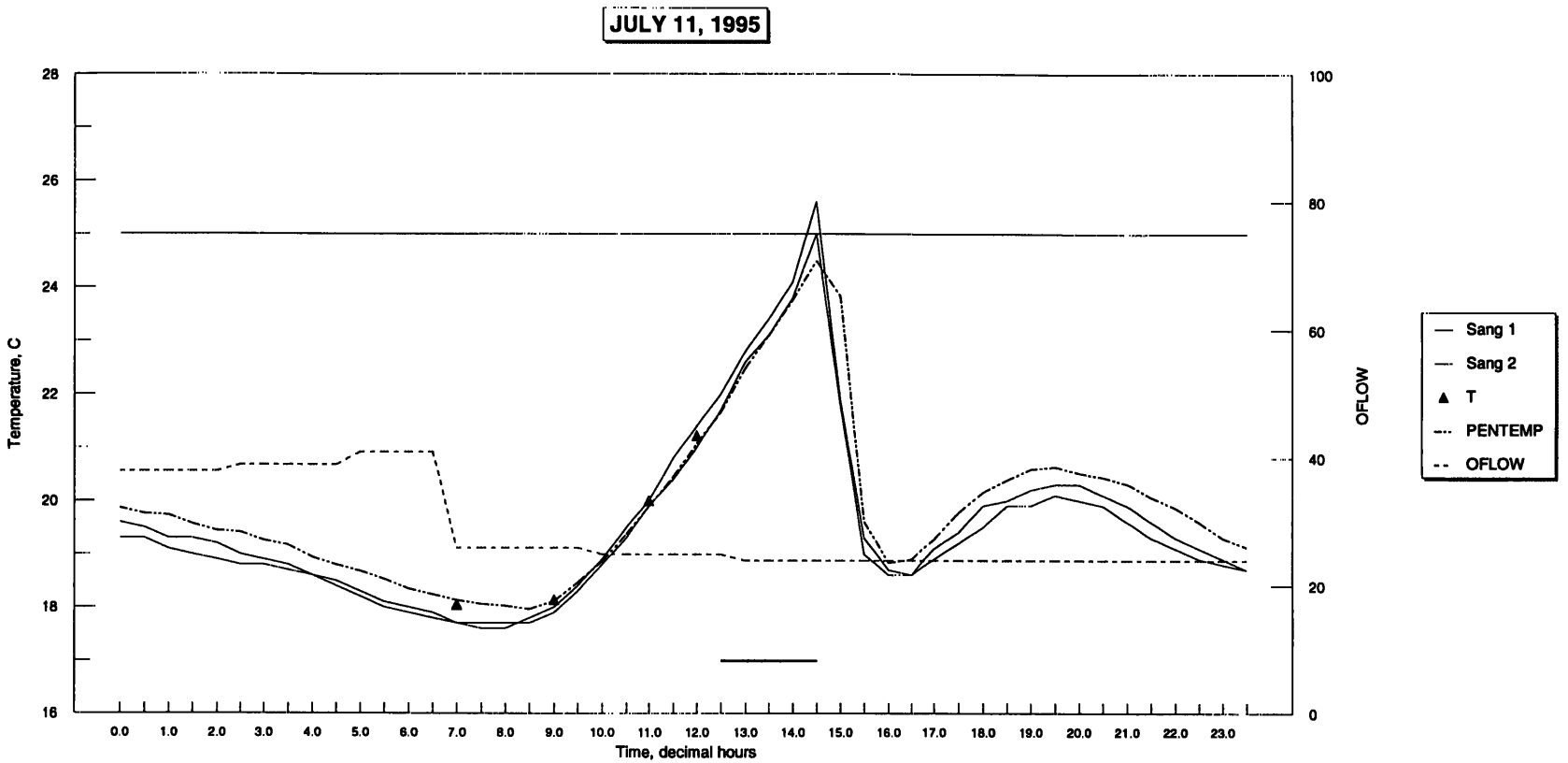
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

7/9 Release for: None			
Oflow	34	Tair	
Omin	7.8	PCLD	
Omax	23.3	Q	
ECLD	4.2	Swamax	24.9
Smax	25.6	EMAX	26.1
St-max	16.8	St_25	17.8



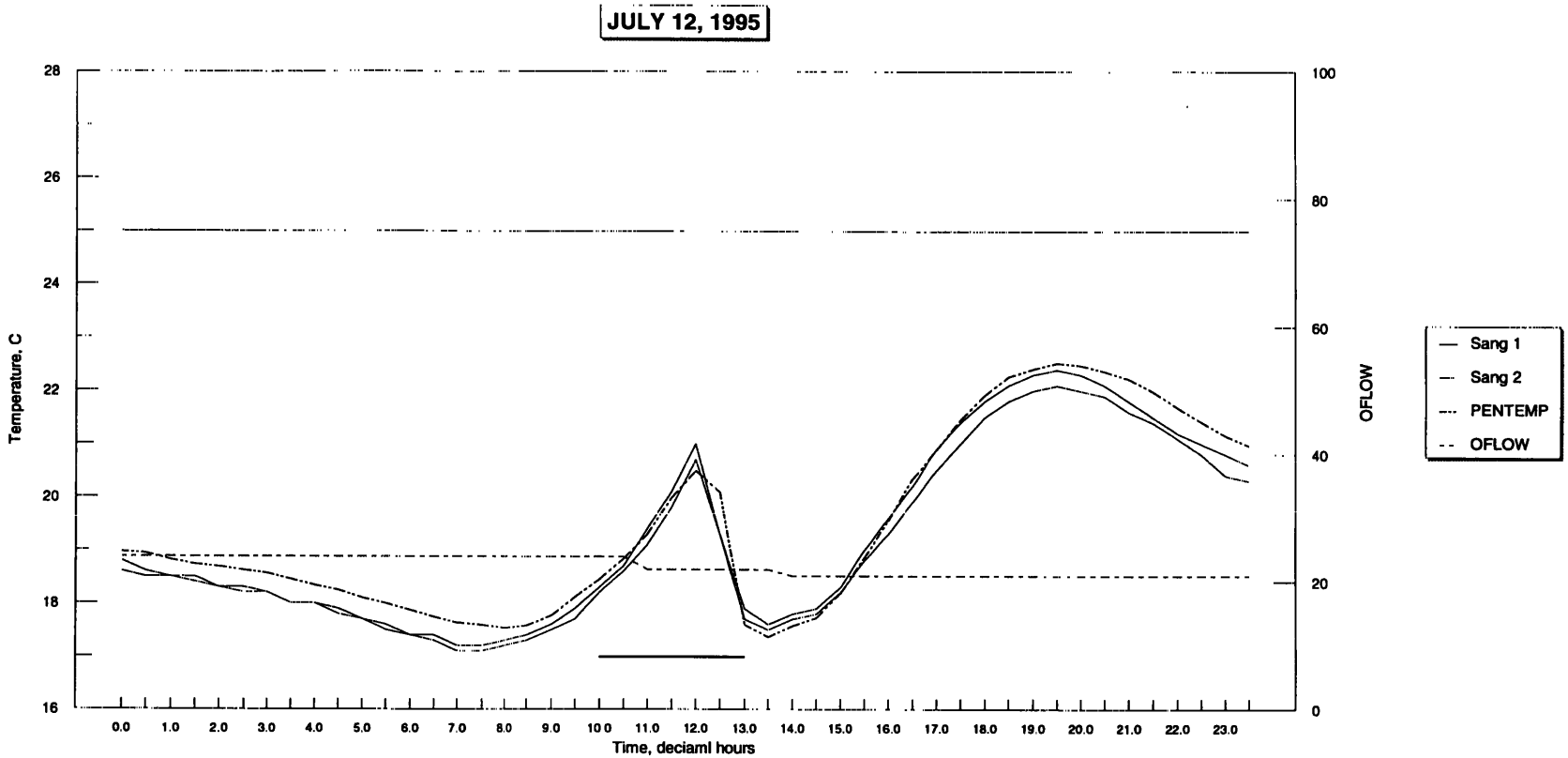
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

7/10 Release for: Scheduled Monday WW			
Oflow	33	Tair	
Omin	13.9	PCLD	
Omax	26.1	Q	
ECLD	3.4	Swamax	26.5
Smax	21.3	EMAX	27.8
St_max		St_25	



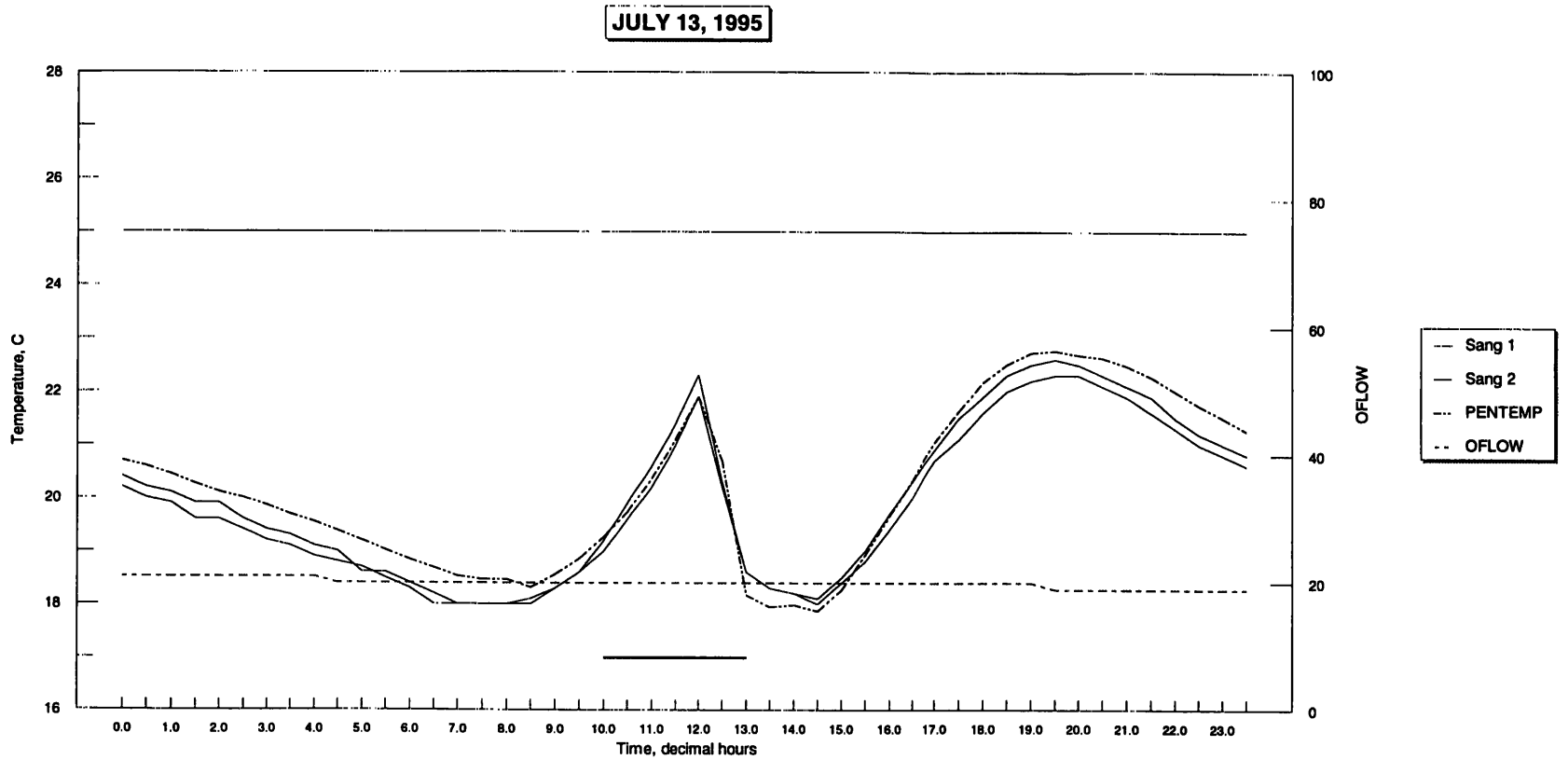
P7	P9	P11	P12	P14	P15
25.2	25.1	25.9			
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
25.0	25.2	25.4			
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
25.2	25.1	25.9			

7/11 Release for: Temperature Enhancement			
Oflow	29	**Tair**	28.3
Omin	14.4	**PCLD**	4
Omax	26.1	**Q**	47
ECLD	2.4	**Swamax**	27.0
Smax	25.3	**EMAX**	28.3
St_max	14.4	**St_25**	14.4



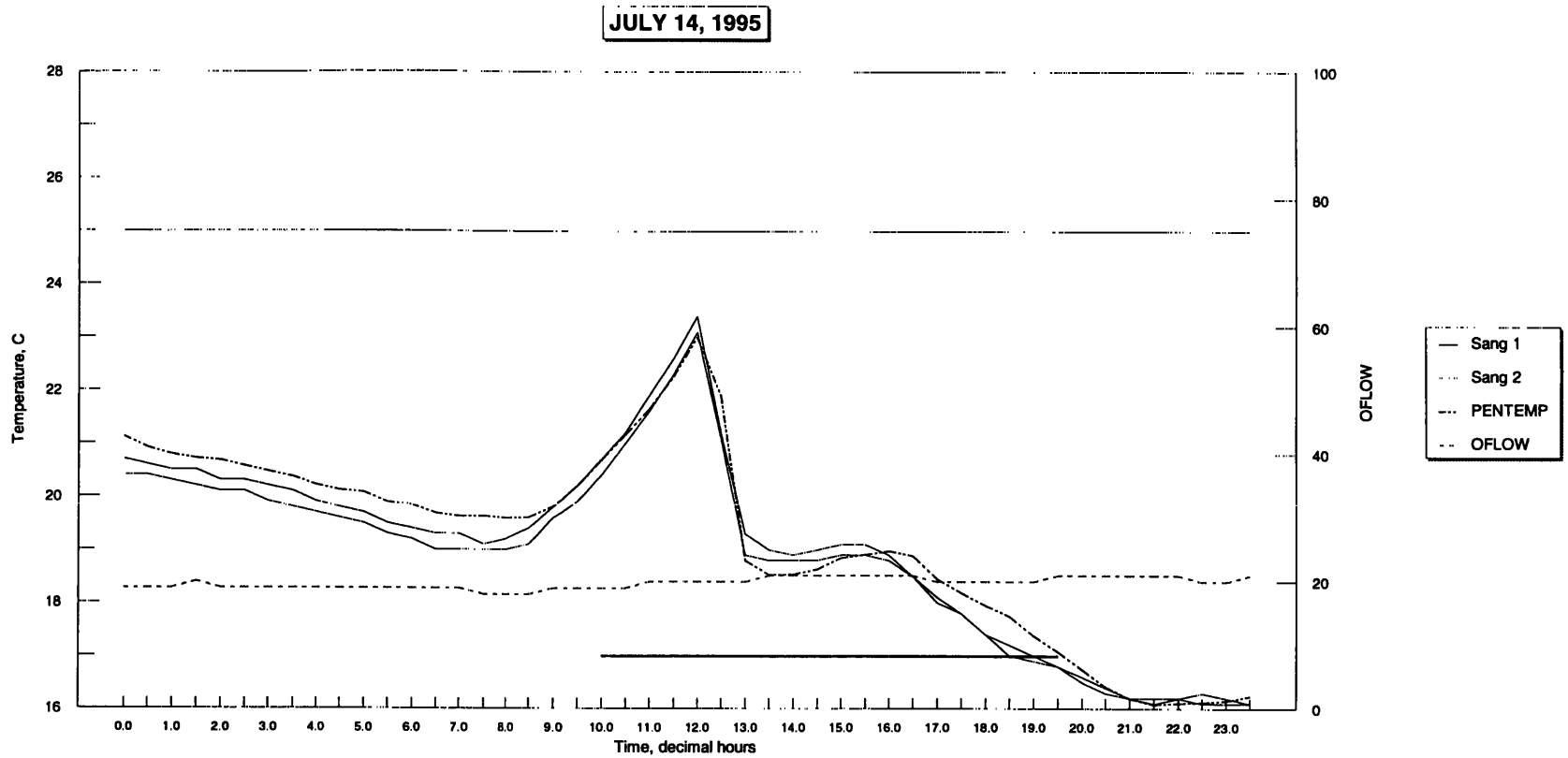
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

7/12 Release for: Scheduled Penelec			
Oflow	23	Tair	
Omin	12.2	PCLD	
Omax	28.3	Q	
ECLD	6.4	Swamax	27.8
Smax	22.3	EMAX	30.6
St_max		St_25	



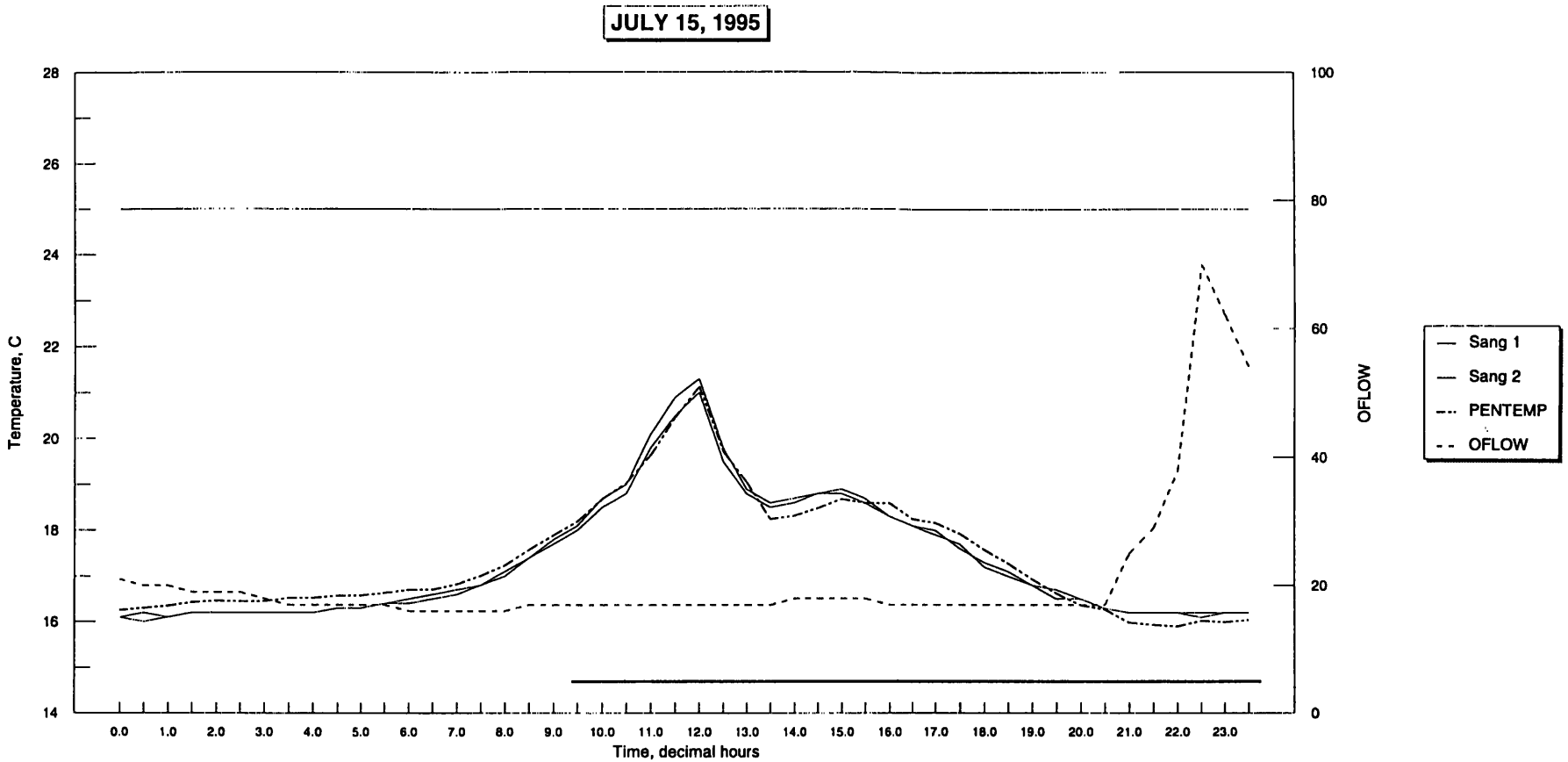
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

7/13 Release for: Scheduled Penelec			
Oflow	20	Tair	
Omin	13.3	PCLD	
Omax	31.1	Q	
ECLD	0.4	Swamax	29.2
Smax	22.5	EMAX	32.8
St_max		St_25	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

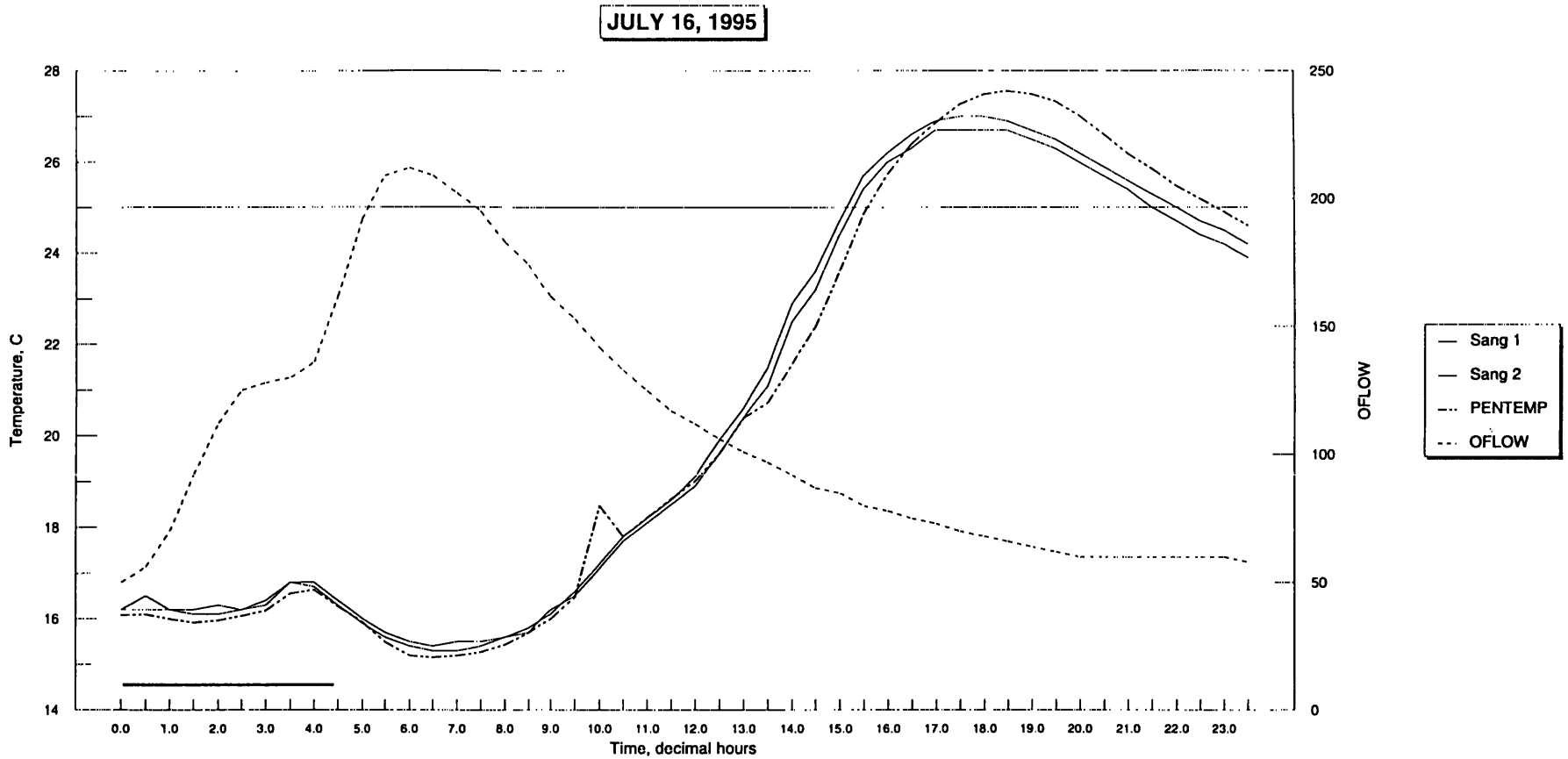
7/14 Release for: Scheduled Friday WW then Penelec			
Oflow	20	Tair	
Omin	17.2	PCLD	
Omax	30.6	Q	
ECLD	1.0	Swamax	30.7
Smax	23.3	EMAX	32.8
St_max		St_25	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

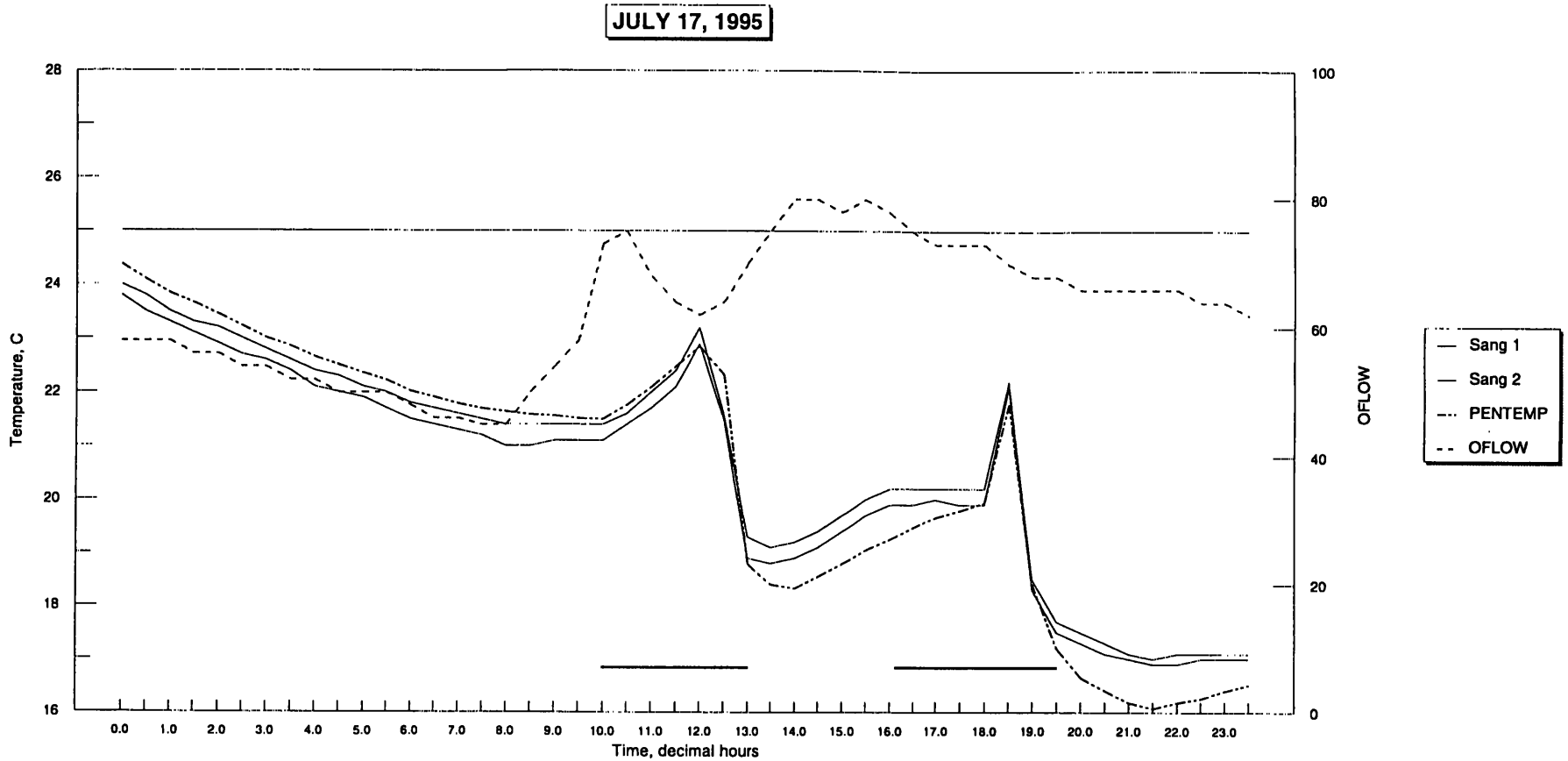
7/15 Release for: Unscheduled Penelec

Oflow	22	Tair	
Omin	19.4	PCLD	
Omax	34.4	Q	
ECLD	0.8	Swamax	32.0
Smax	21.2	EMAX	35.6
St_max		St_25	



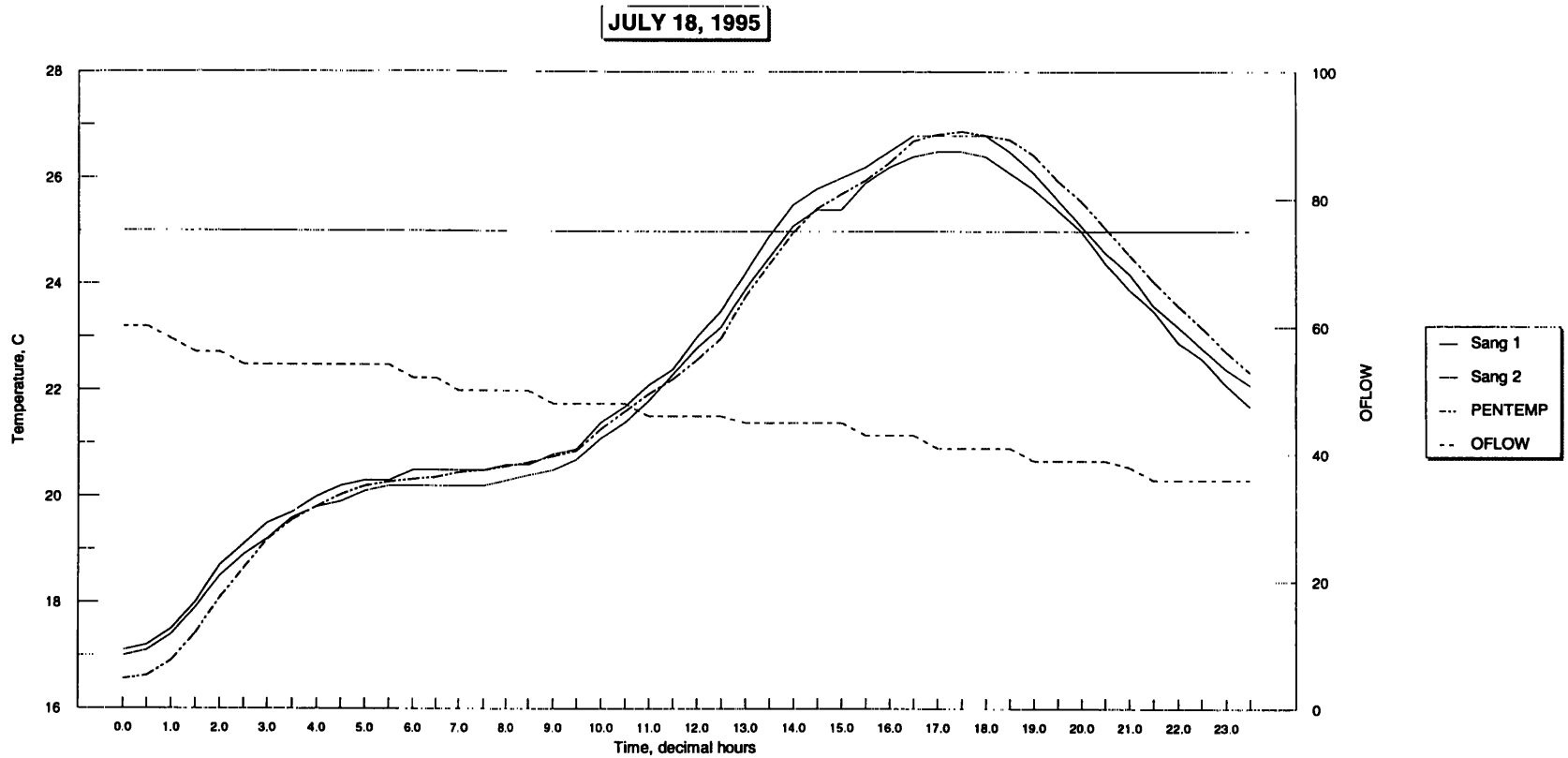
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

7/16 Release for: Unscheduled Penelec			
Oflow	110	Tair	
Omin	15	PCLD	
Omax	28.9	Q	
ECLD	7.4	Swamax	27.7
Smax	26.9	EMAX	31.1
St_max	17.3	St_25	15.6



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

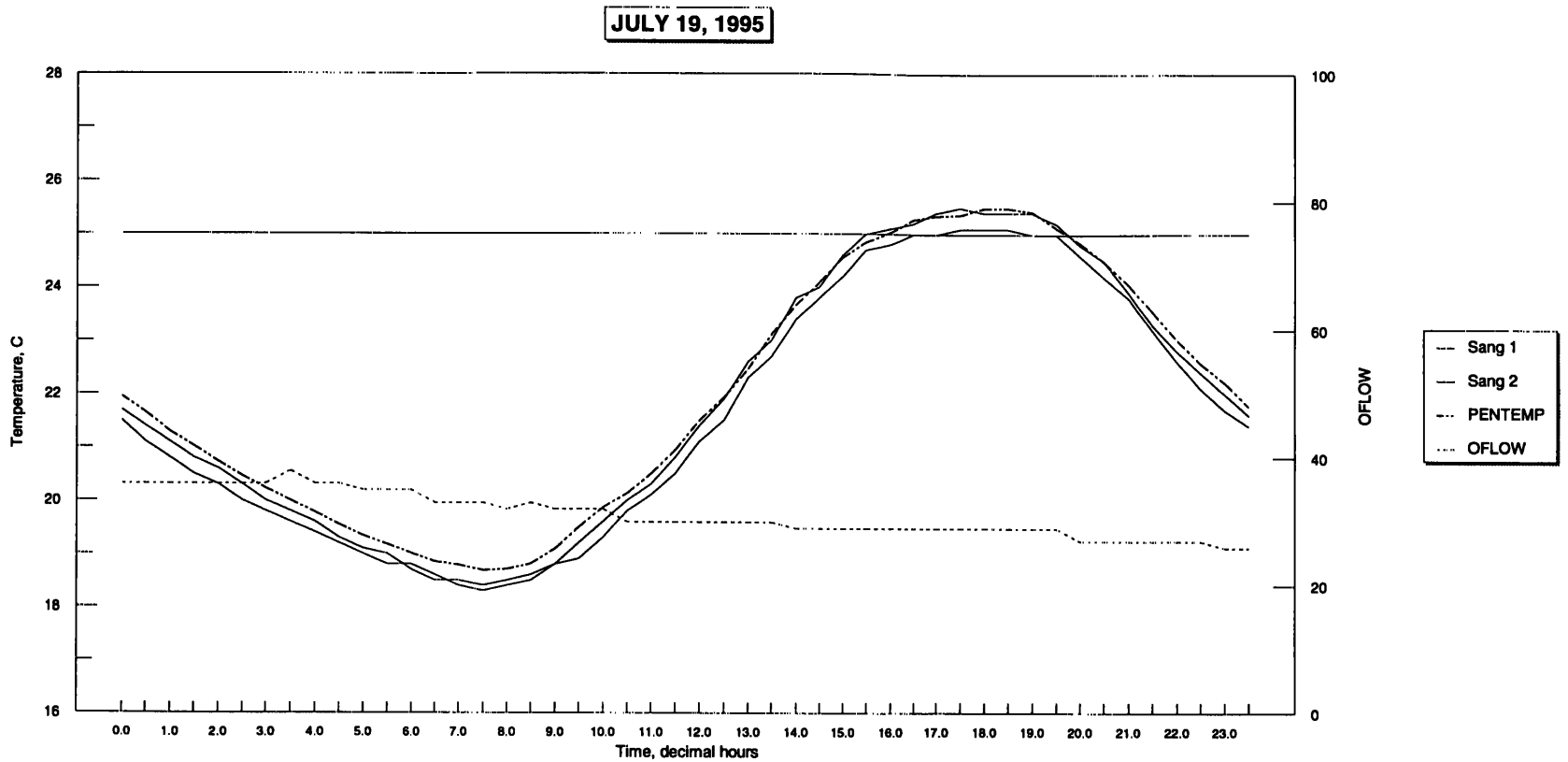
7/17 Release for: Scheduled Monday WW then Penelec			
Oflow	64	Tair	
Omin	17.2	PCLD	
Omax	28.3	Q	
ECLD	7.8	Swamax	26.9
Smax	23.9	EMAX	30.0
St_max		St_25	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

7/18 Release for: None

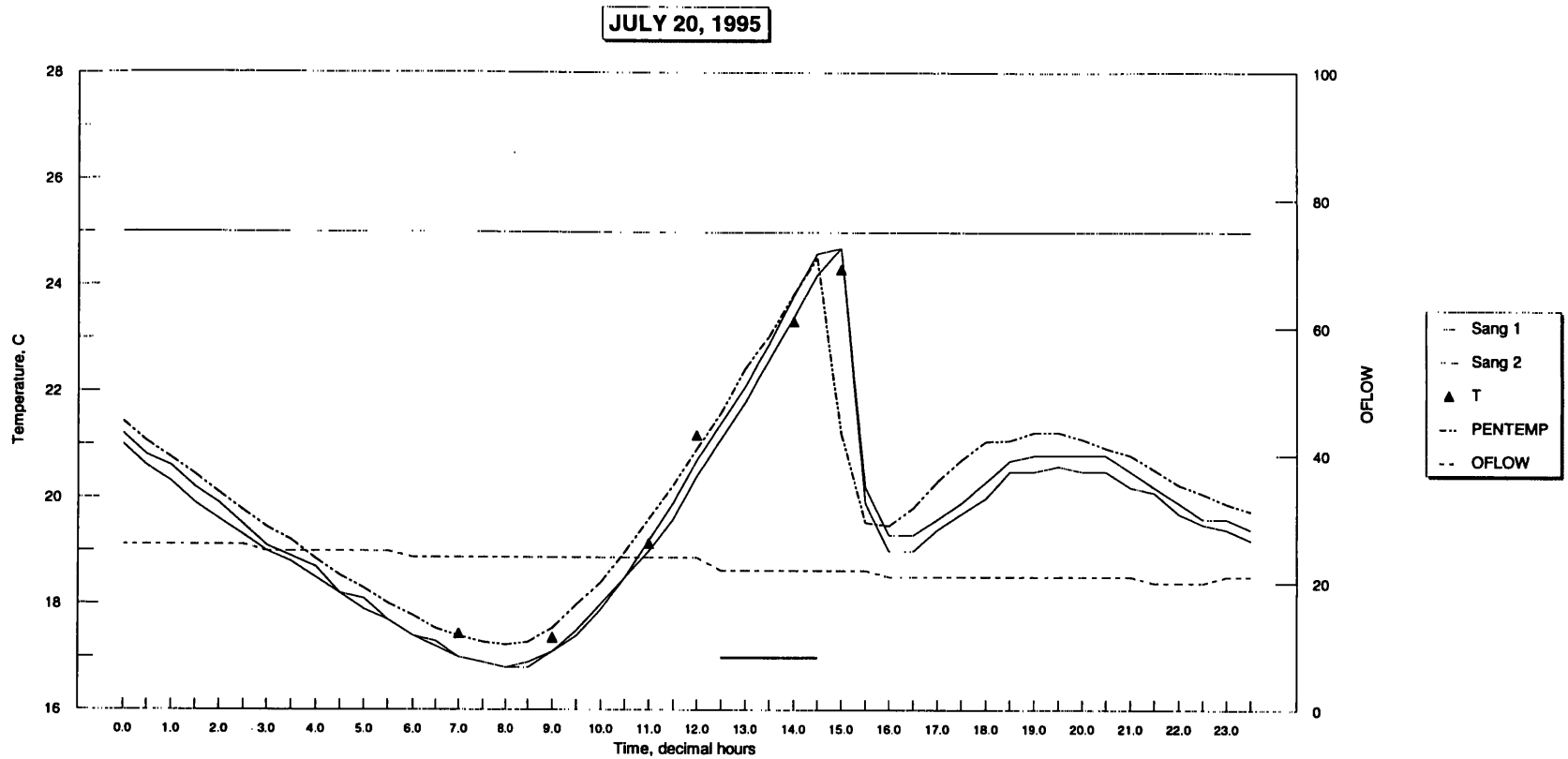
Oflow	47	Tair	
Omin	17.2	PCLD	
Omax	26.1	Q	
ECLD	5.6	Swamax	27.0
Smax	26.7	EMAX	27.8
St_max	16.8	St_25	13.9



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

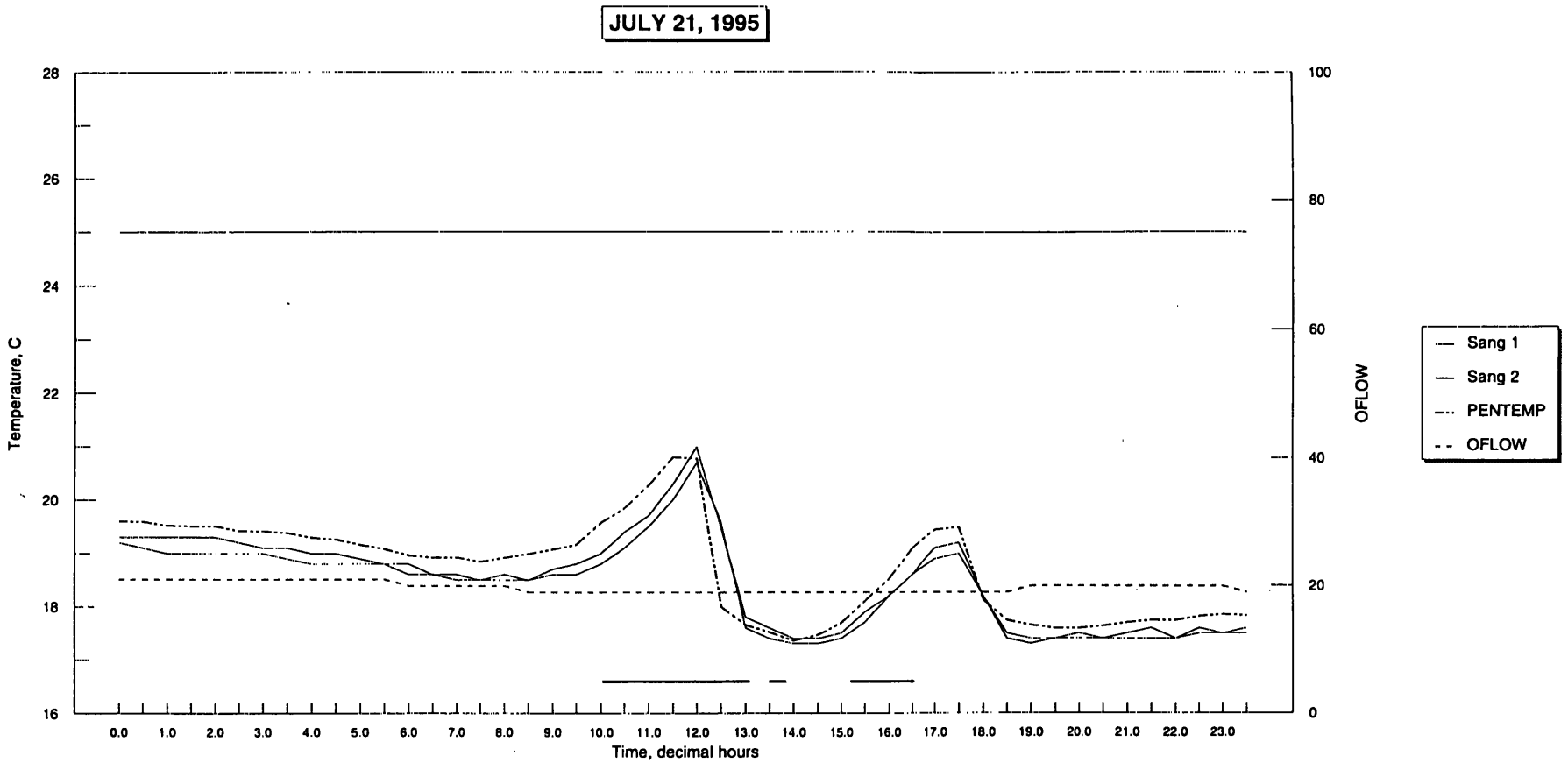
7/19 Release for: None

Oflow	32	Tair	
Omin	12.2	PCLD	
Omax	25	Q	
ECLD	3.8	Swamax	25.8
Smax	25.3	EMAX	27.2
St_max	17.5	St_25	16.8



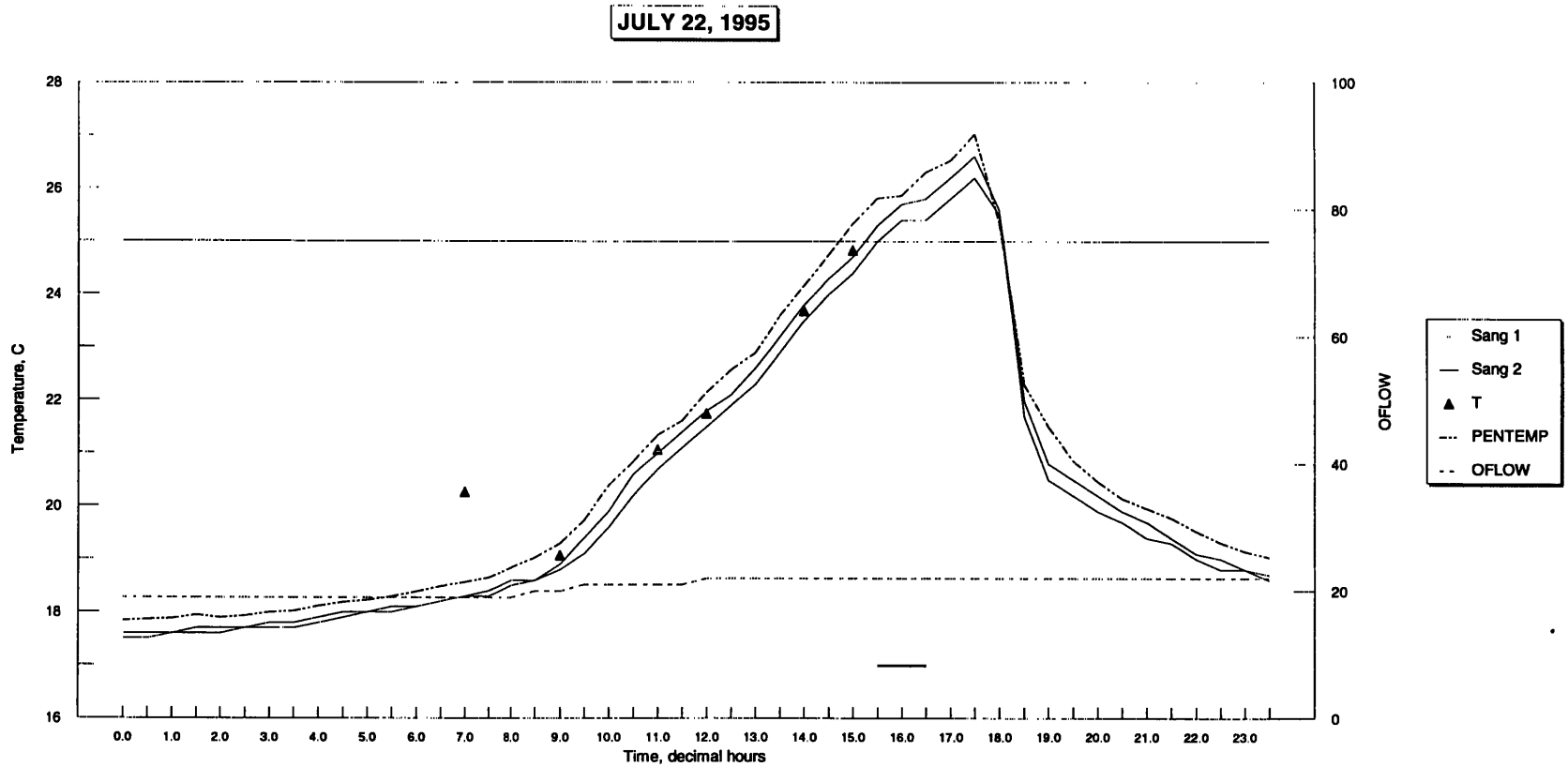
P7	P9	P11	P12	P14	P15
25.6	25.2	25.4			
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
24.3	24.3	24.4			
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
25.6	25.2	25.4			

7/20 Release for: Temperature Enhancement			
Oflow	23	**Tair**	29.4
Omin	8.9	**PCLD**	6
Omax	27.8	**Q**	25
ECLD	2.2	**Swamax**	27.6
Smax	24.7	**EMAX**	30.0
St_max		**St_25**	



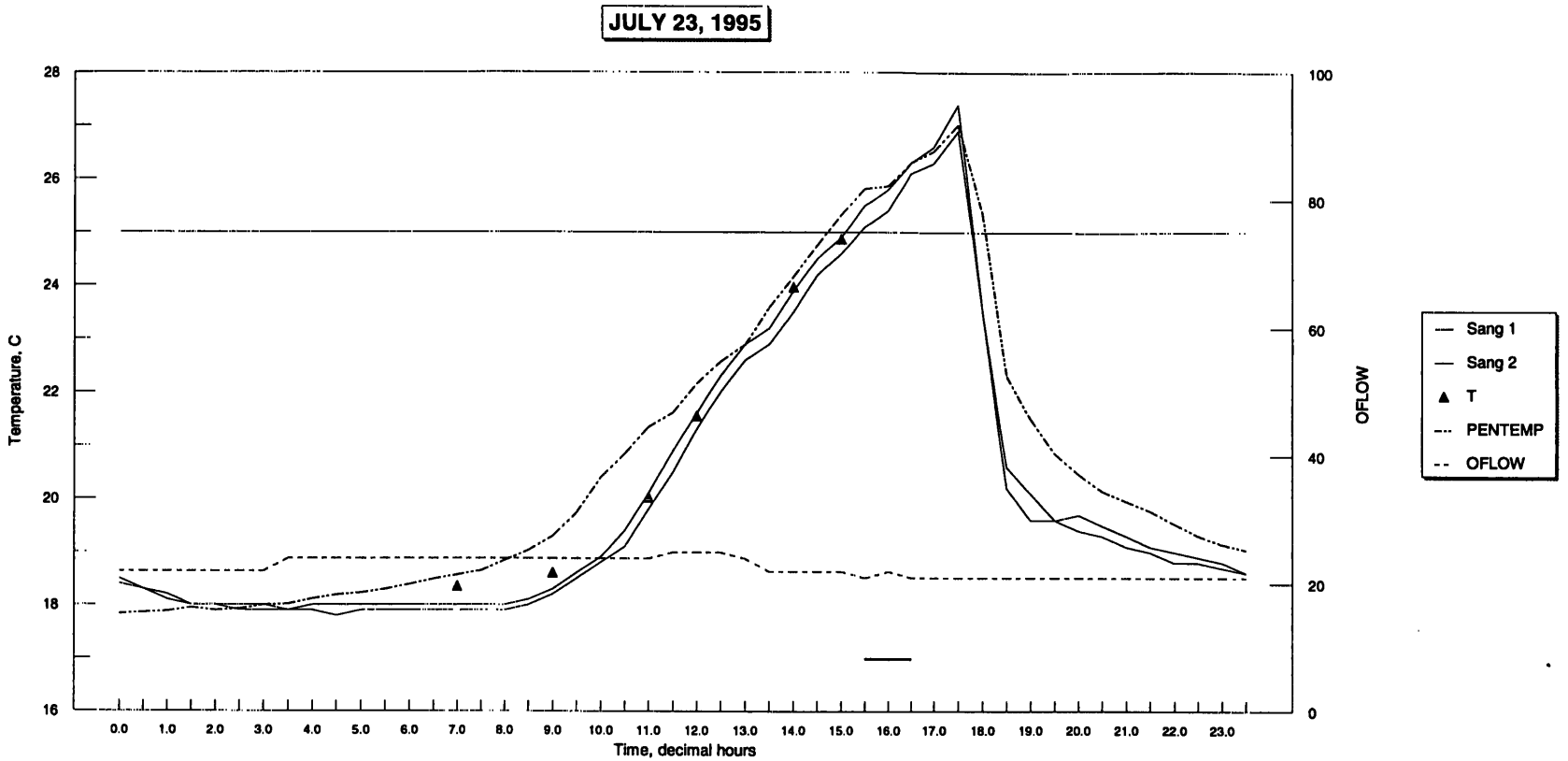
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

7/21 Release for: Schedule Friday WW then Penelec			
Oflow	20	Tair	
Omin	16.1	PCLD	
Omax	27.8	Q	
ECLD	8.6	Swamax	25.8
Smax	20.9	EMAX	29.4
St max		St 25	



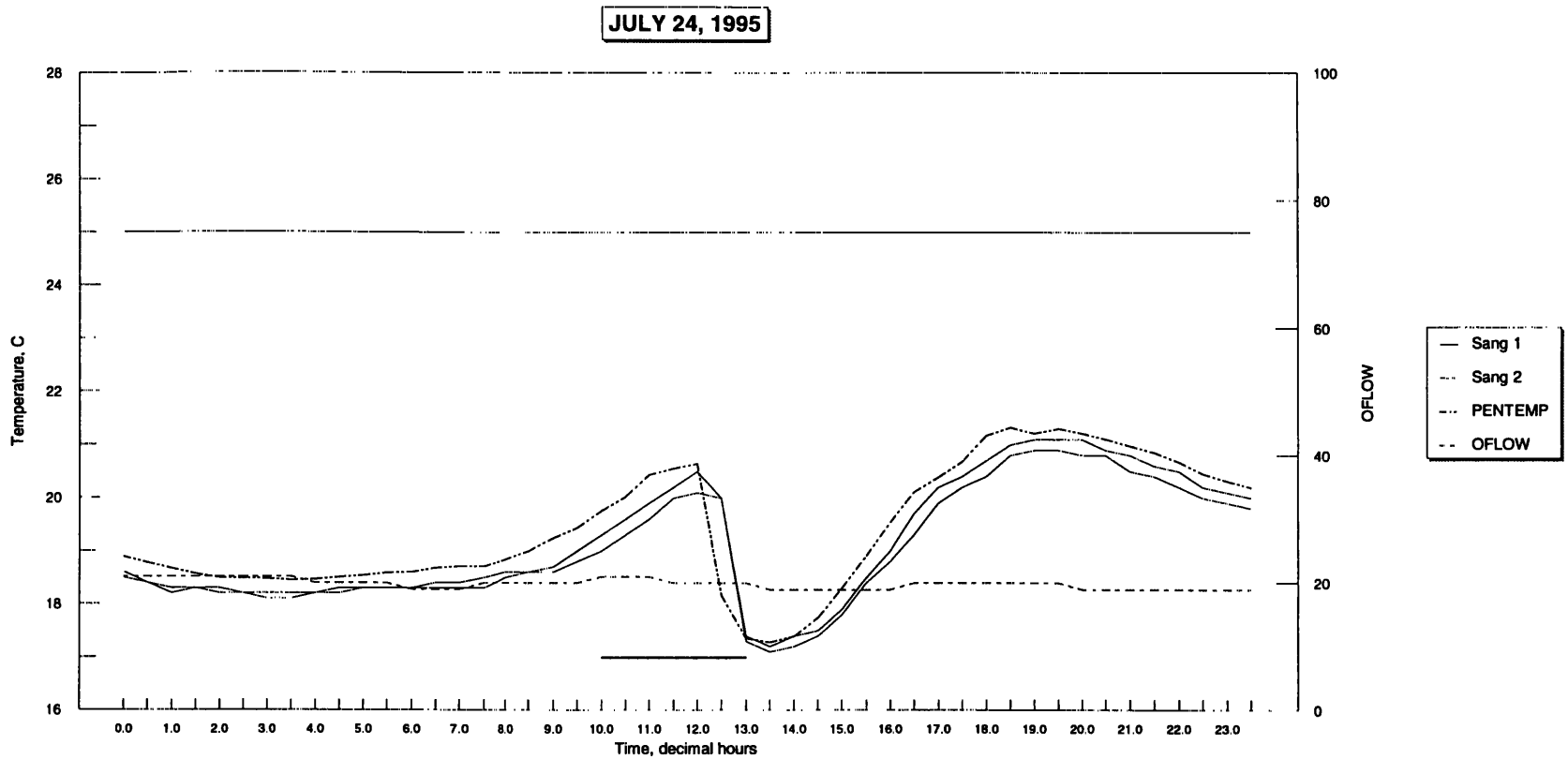
P7	P9	P11	P12	P14	P15
26.0	24.6	26.3	25.7	25.5	26.0
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
25.4	25.7	26.0	25.6	25.4	25.6
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
26.0	24.6	26.3	25.6	25.5	26.0

7/22 Release for: Temperature Enhancement			
Oflow	21	**Tair**	27.8
Omin	19.4	**PCLD**	6
Omax	26.7	**Q**	19
ECLD	6.8	**Swamax**	28.3
Smax	26.4	**EMAX**	28.3
St_max	17.5	**St_25**	15.8



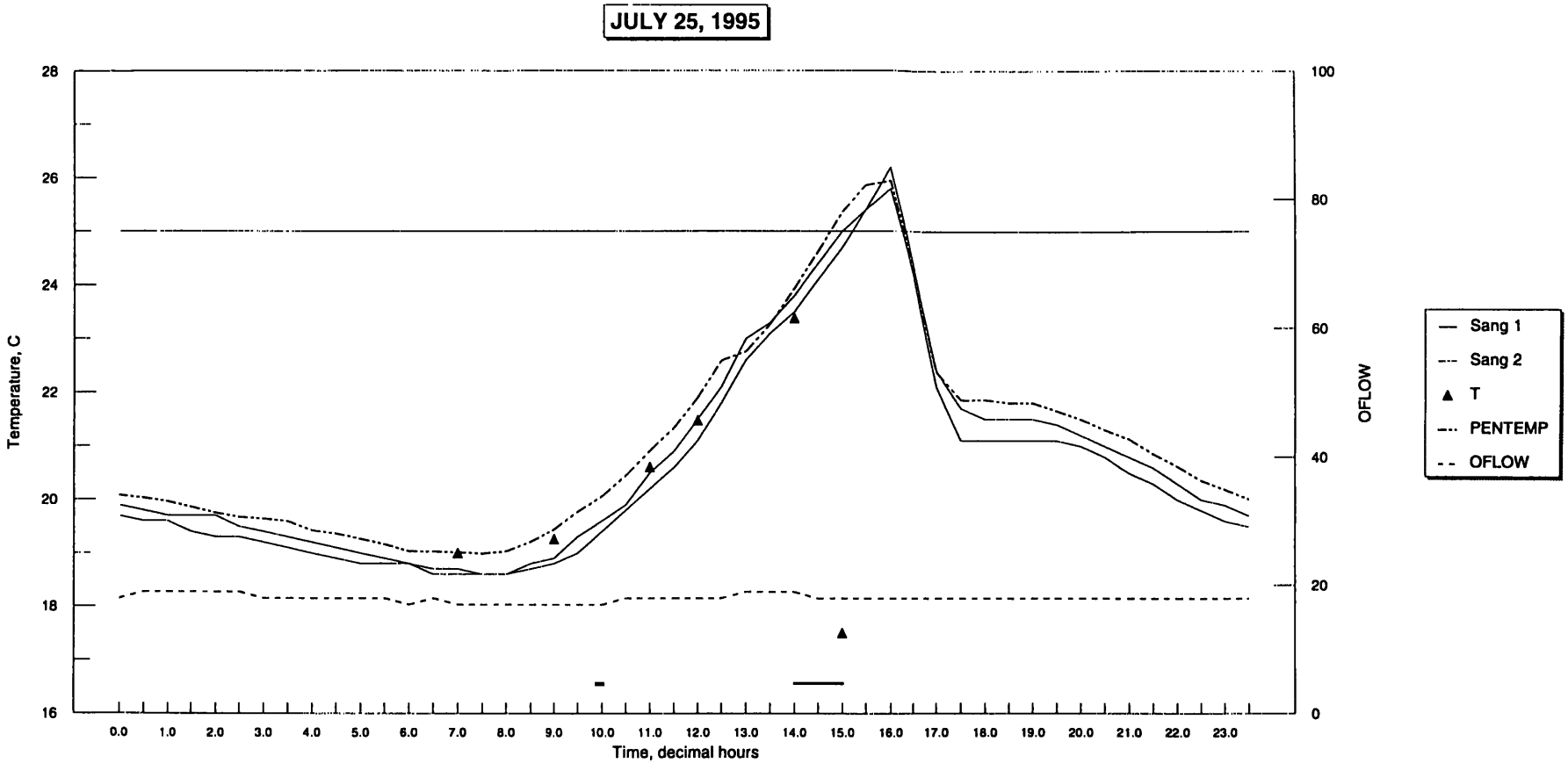
P7	P9	P11	P12	P14	P15
25.4	25.5	25.2	25.7	26.0	26.1
P7A	P9A	P11A	P12A	P14A	P15A
25.1	25.1	25.2	25.7	25.7	25.9
P7B	P9B	P11B	P12B	P14B	P15B
25.4	25.5	25.2	25.4	26.0	26.1

7/23 Release for: Temperature Enhancement			
Oflow	23	Tair	27.8
Omin	15.6	PCLD	6
Omax	27.2	Q	24
ECLD	8.6	Swamax	28.1
Smax	27.2	EMAX	28.9
St_max	17.5	St_25	15.6



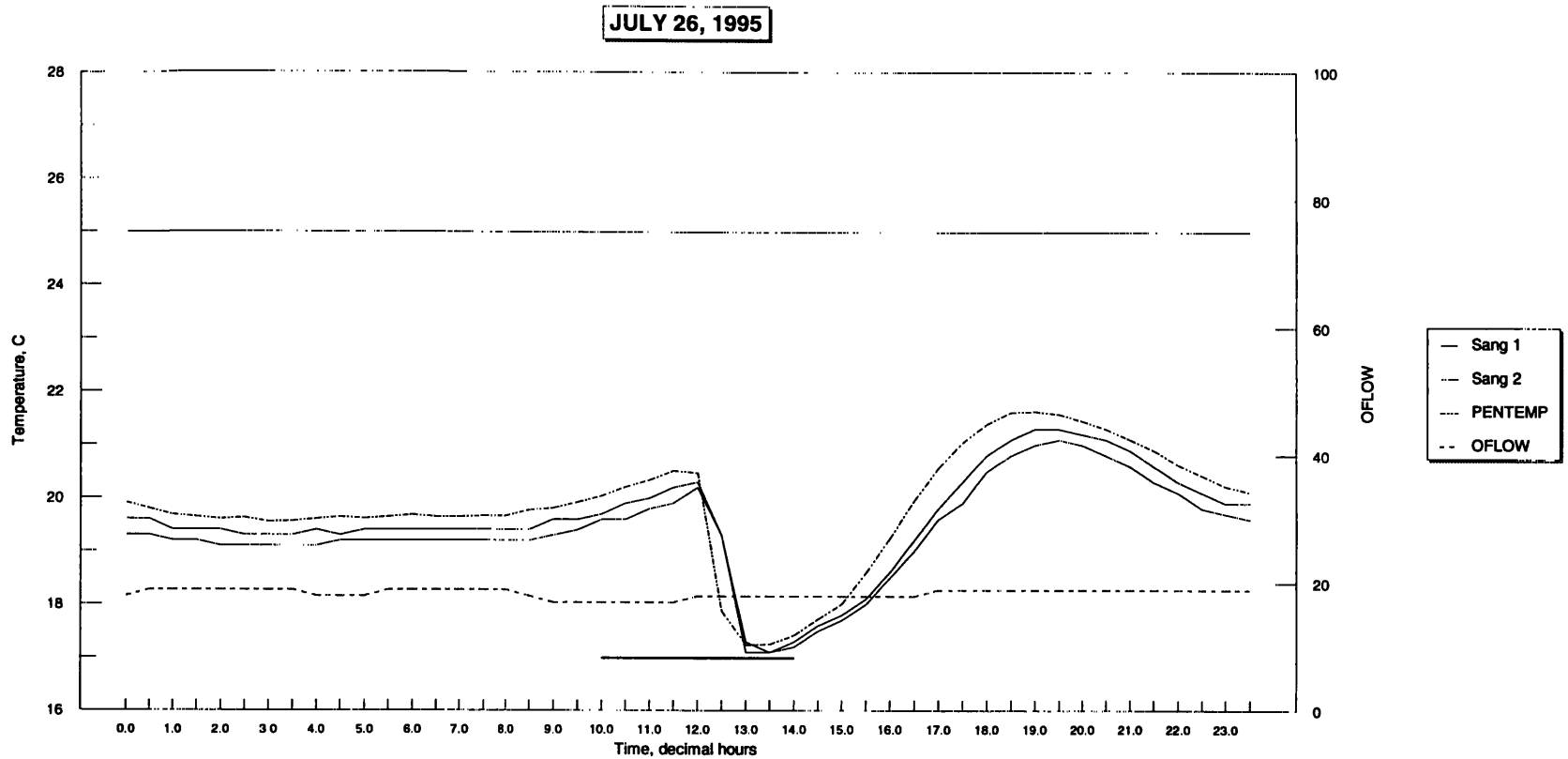
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

7/24 Release for: Scheduled Monday WW			
Oflow	20	Tair	
Omin	16.7	PCLD	
Omax	26.7	Q	
ECLD	10	Swamax	26.5
Smax	21.0	EMAX	27.8
St_max		St_25	



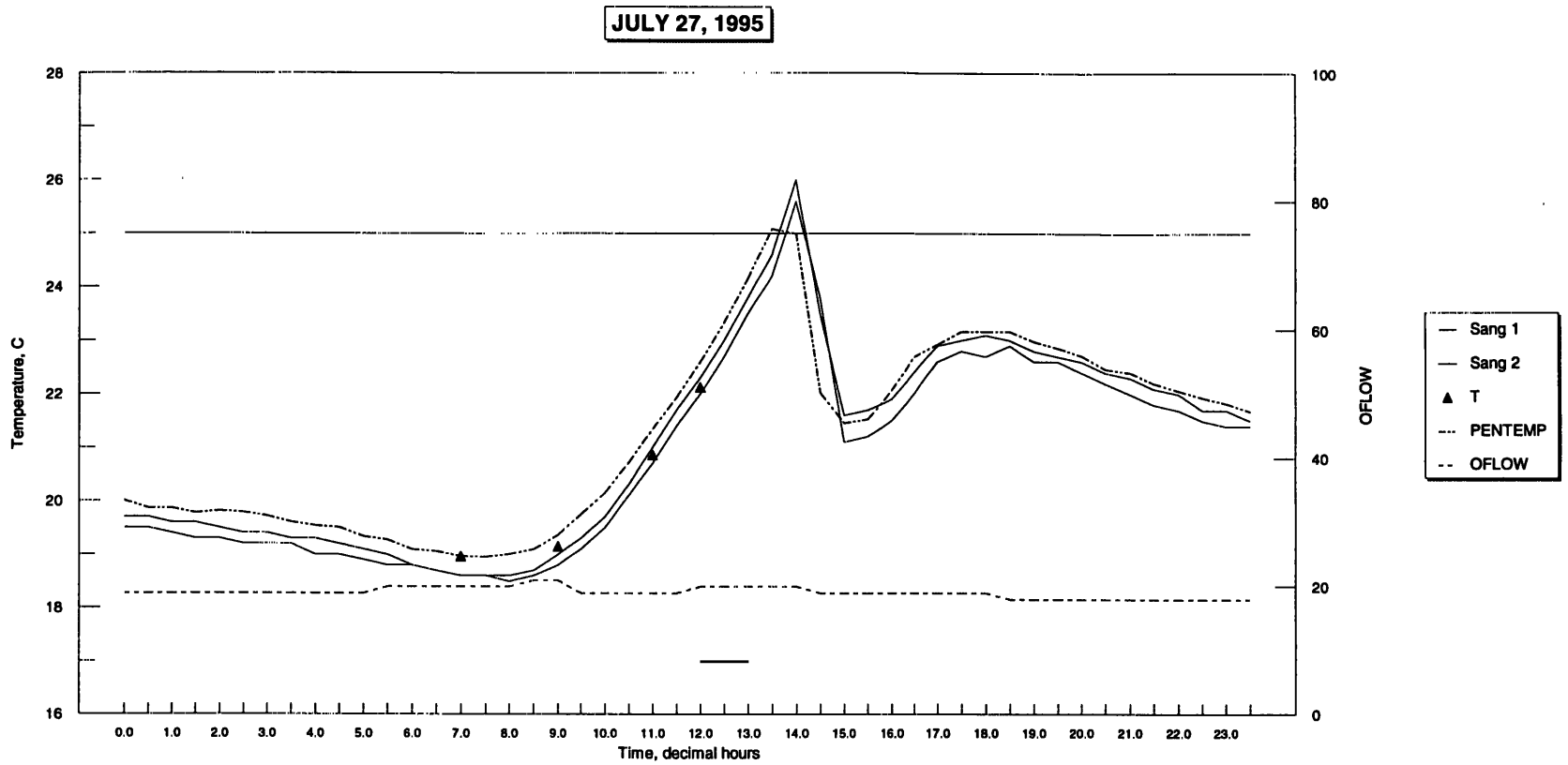
P7	P9	P11	P12	P14	P15
24.6	24.6	25.0	25.0	25.3	
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
24.7	24.7	24.8	24.8	25.6	
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
24.6	24.6	25.0	25.2	25.3	

7/25 Release for: Penelec then Temperature Enhancement			
Oflow	18	**Tair**	28.3
Omin	16.7	**PCLD**	10
Omax	28.9	**Q**	18
ECLD	8.2	**Swamax**	28.1
Smax	26.0	**EMAX**	31.7
St_max	16.1	**St_25**	15.6



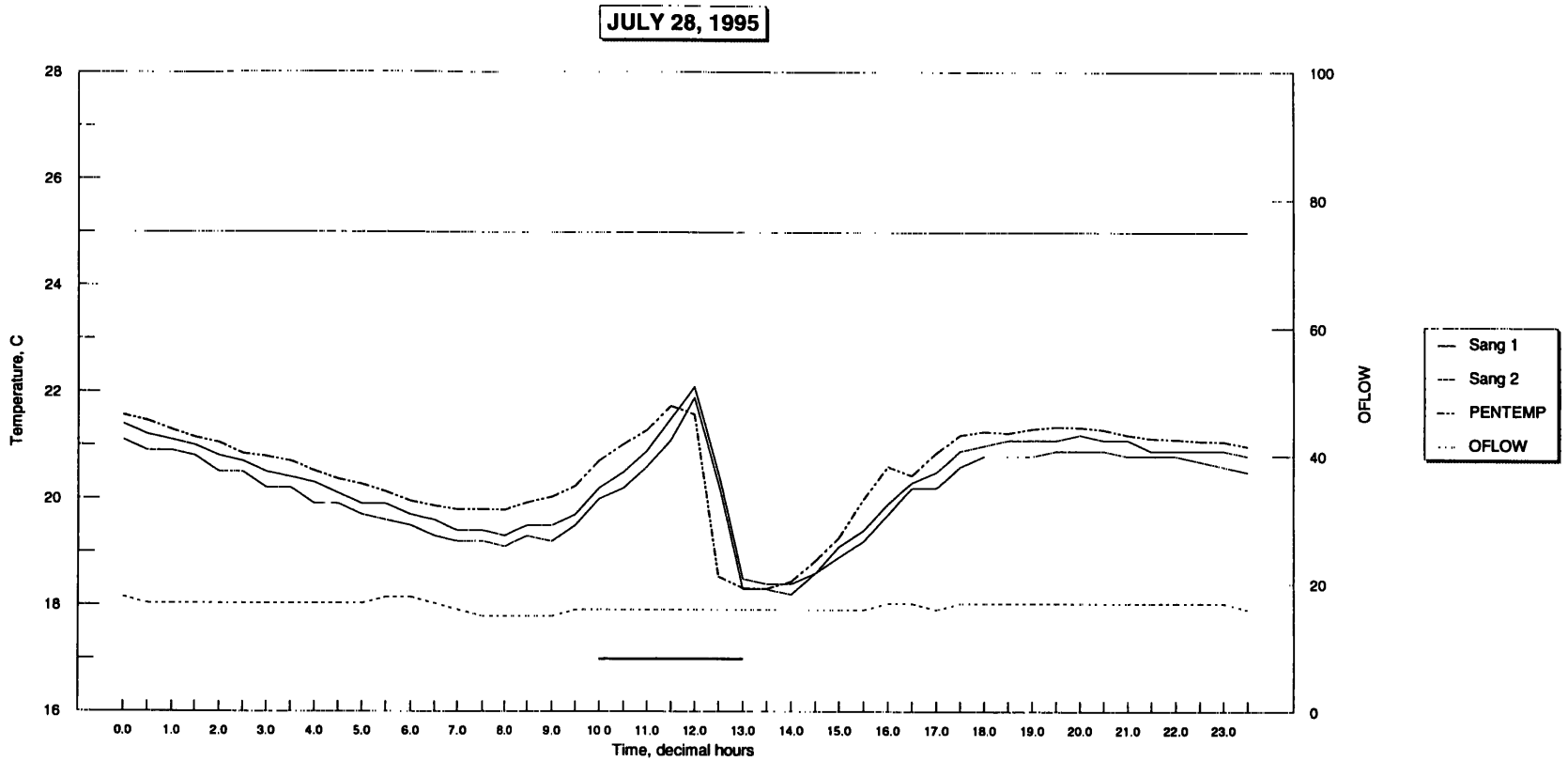
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

7/26 Release for: Scheduled Special WW			
Oflow	19	Tair	
Omin	18.3	PCLD	
Omax	28.9	Q	
ECLD	6.8	Swamax	28.0
Smax	21.2	EMAX	28.9
St_max		St_25	



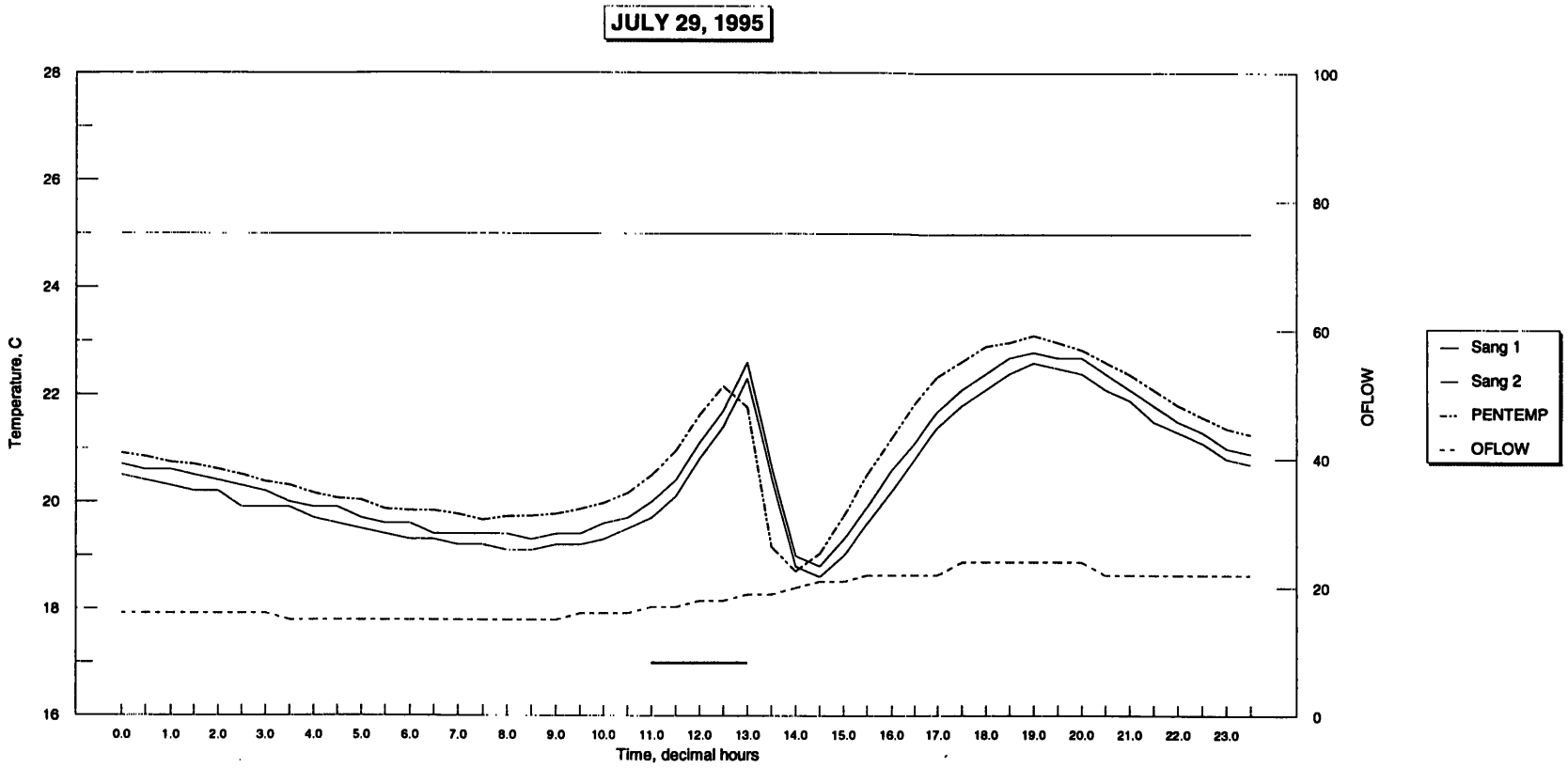
P7	P9	P11	P12	P14	P15
24.4	24.4	25.3	25.6		
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
24.7	24.9	25.5	25.7		
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
24.4	24.4	25.3	26.0		

7/27 Release for: Temperature Enhancement			
Oflow	19	**Tair**	27.8
Omin	15.6	**PCLD**	10
Omax	30	**Q**	19
ECLD	6.8	**Swamax**	30.0
Smax	25.8	**EMAX**	30.0
St_max	13.9	**St_25**	13.9



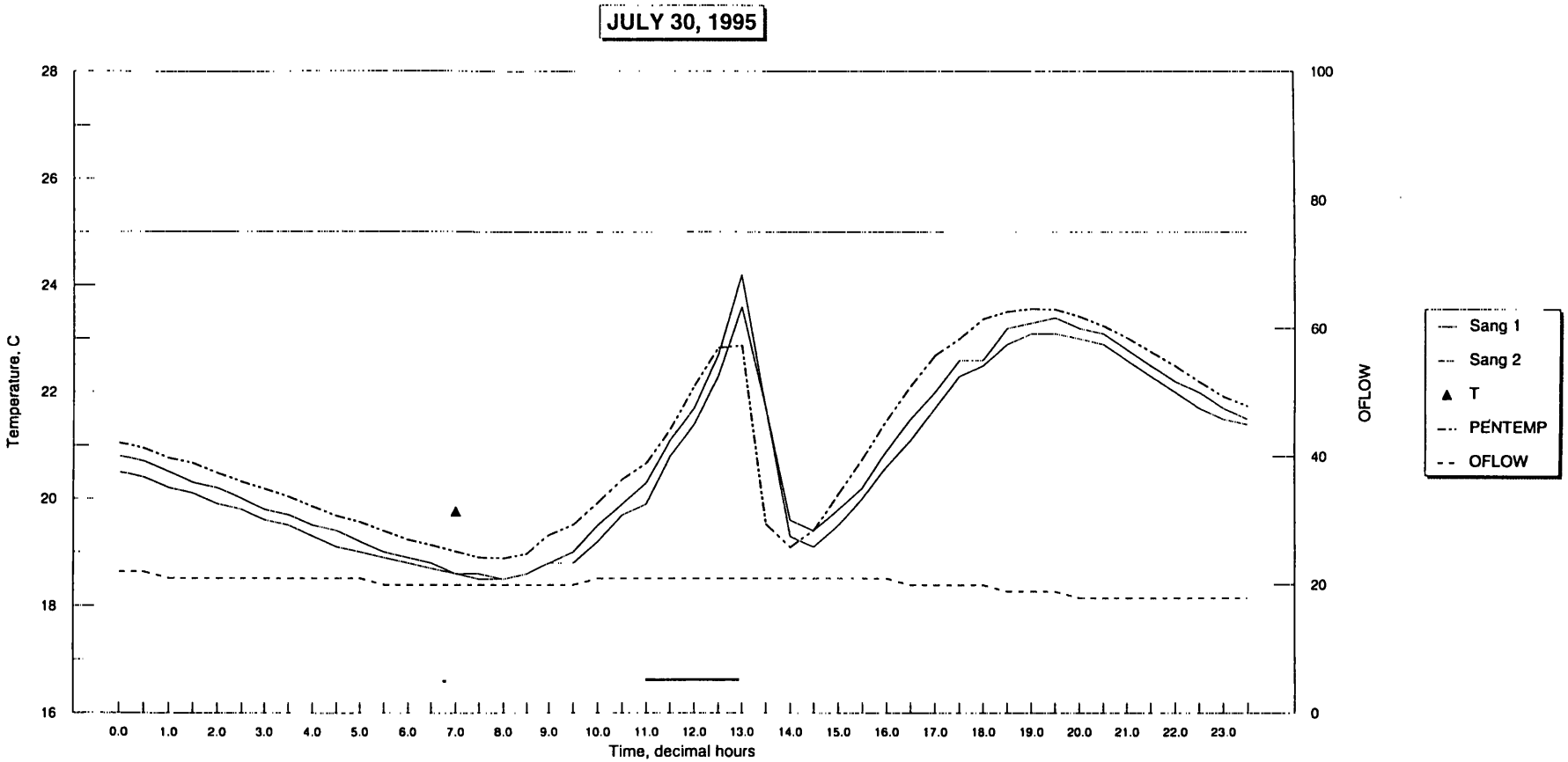
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

7/28 Release for: Scheduled Friday WW			
Oflow	17	Tair	
Omin	16.1	PCLD	
Omax	29.4	Q	
ECLD	8.4	Swamax	29.3
Smax	22.0	EMAX	30.6
St_max		St_25	



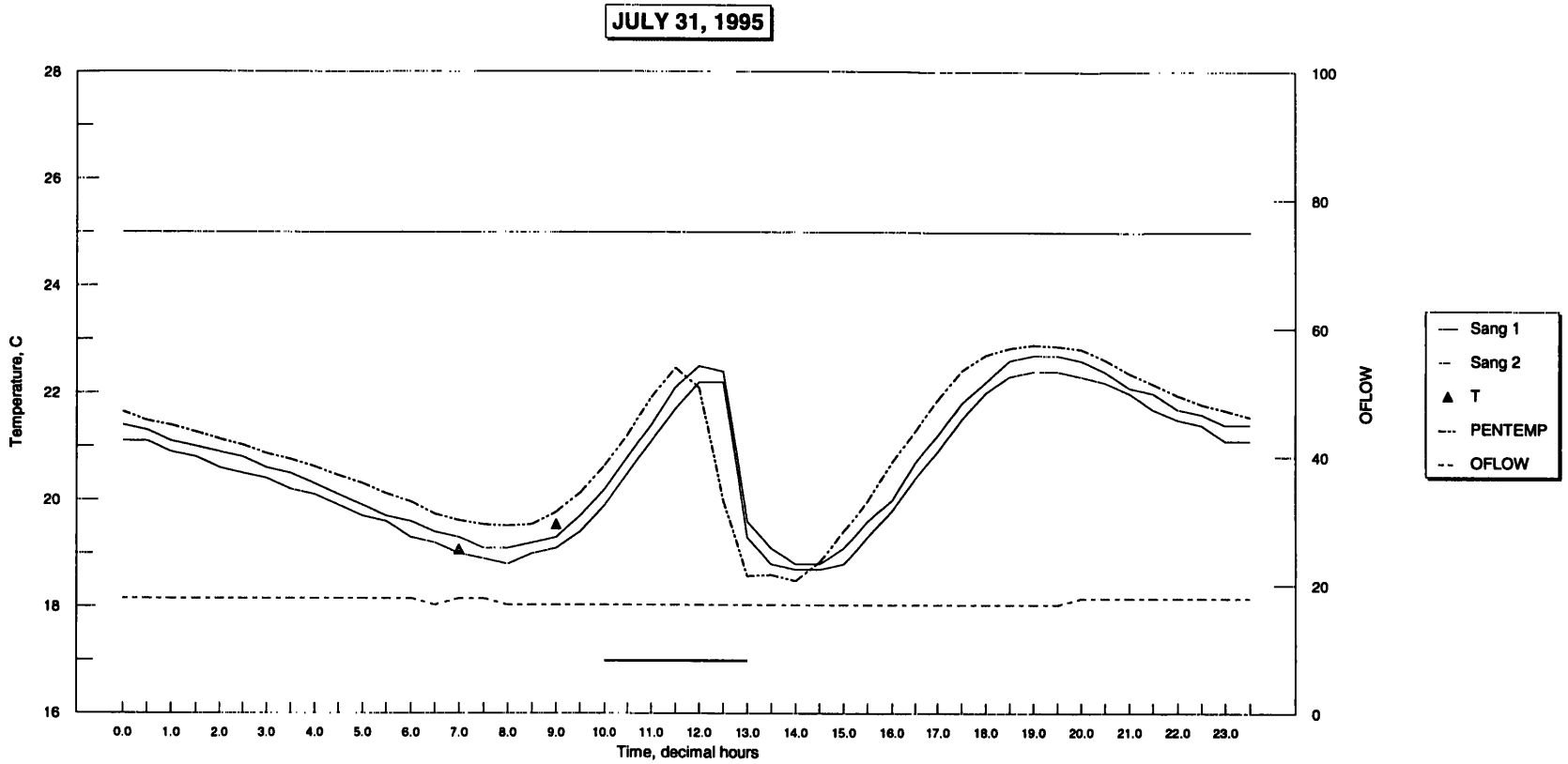
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

7/29 Release for: Temperature Enhancement			
Oflow	19	Tair	
Omin	18.3	PCLD	
Omax	28.3	Q	
ECLD	9.6	Swamax	29.3
Smax	22.7	EMAX	28.9
St_max		St_25	



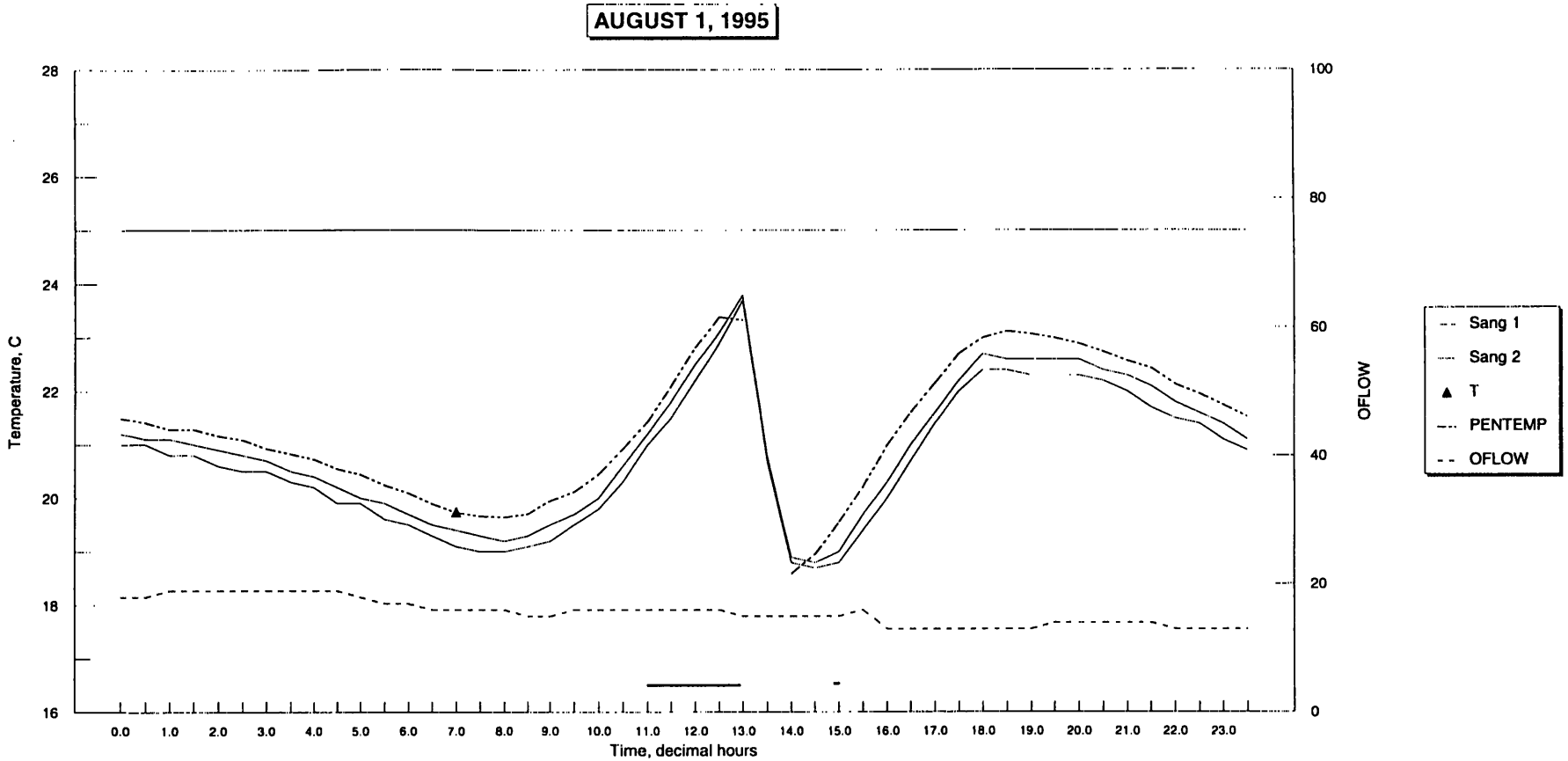
P7	P9	P11	P12	P14	P15
26.4					
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
26.9					
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
26.4					

7/30 Release for: Penelec then Temperature Enhancement			
Oflow	20	**Tair**	29.4
Omin	15	**PCLD**	6
Omax	30	**Q**	16
ECLD	3.2	**Swamax**	29.7
Smax	23.9	**EMAX**	31.1
St_max		**St_25**	



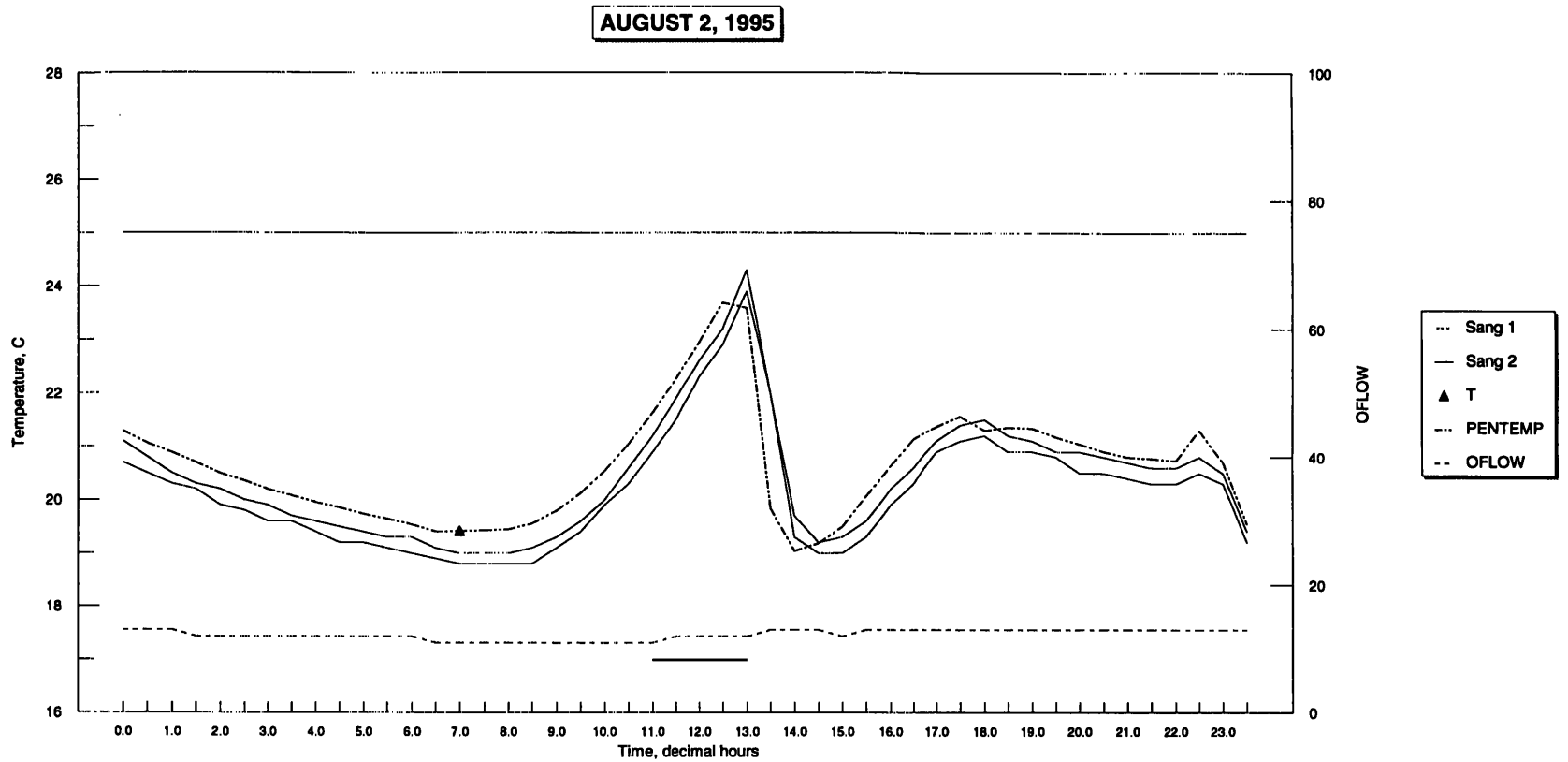
P7	P9	P11	P12	P14	P15
26.2	26.6				
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
27.8	27.7				
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
26.2	26.5				

7/31 Release for: Scheduled Monday WW			
Oflow	18	**Tair**	29.4
Omin	13.9	**PCLD**	6
Omax	30.6	**Q**	22
ECLD	1.8	**Swamax**	31.1
Smax	22.6	**EMAX**	32.2
St_max		**St_25**	



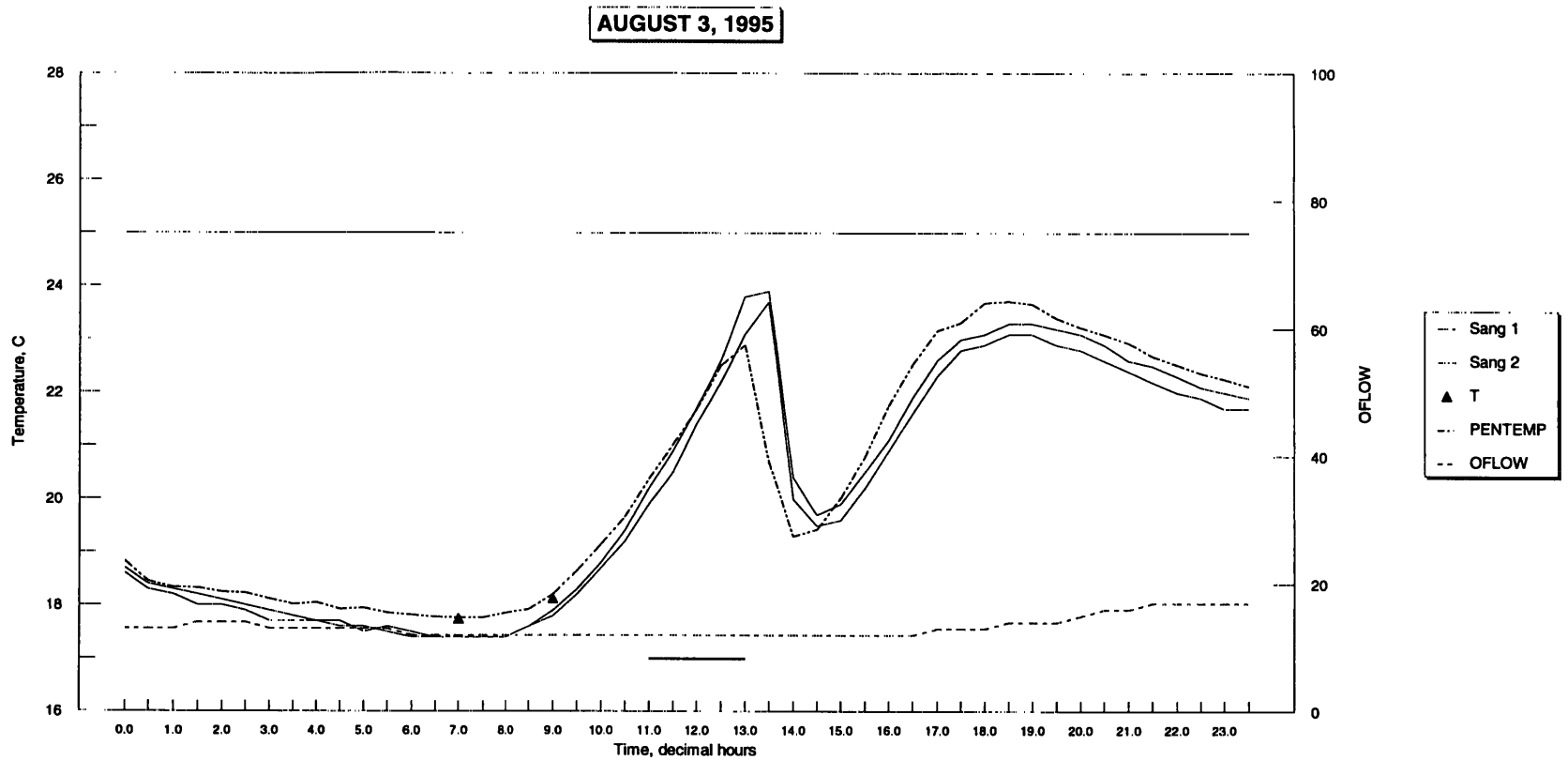
P7	P9	P11	P12	P14	P15
27.8					
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
27.7					
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
27.8					

8/1 Release for: Temperature Enhancement then Penelec			
Oflow	16	**Tair**	31.7
Omin	15	**PCLD**	1
Omax	31.1	**Q**	19
ECLD	3.2	**Swamax**	31.3
Smax	23.8	**EMAX**	32.2
St_max		**St_25**	



P7	P9	P11	P12	P14	P15
26.8					
P7A	P9A	P11A	P12A	P14A	P15A
28.3					
P7B	P9B	P11B	P12B	P14B	P15B
26.8					

8/2 Release for: Temperature Enhancement			
Oflow	12	Tair	31.1
Omin	16.7	PCLD	6
Omax	31.1	Q	13
ECLD	4.6	Swamax	30.6
Smax	24.1	EMAX	34.4
St_max		St_25	



P7	P9	P11	P12	P14	P15
26.3	26.4				
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
26.6	26.8				
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
26.3	26.4				

8/3 Release for: Temperature Enhancement			
Oflow	13	**Tair**	31.1
Omin	14.4	**PCLD**	6
Omax	31.7	**Q**	14
ECLD	3.2	**Swamax**	31.7
Smax	23.8	**EMAX**	33.9
St_max		**St_25**	

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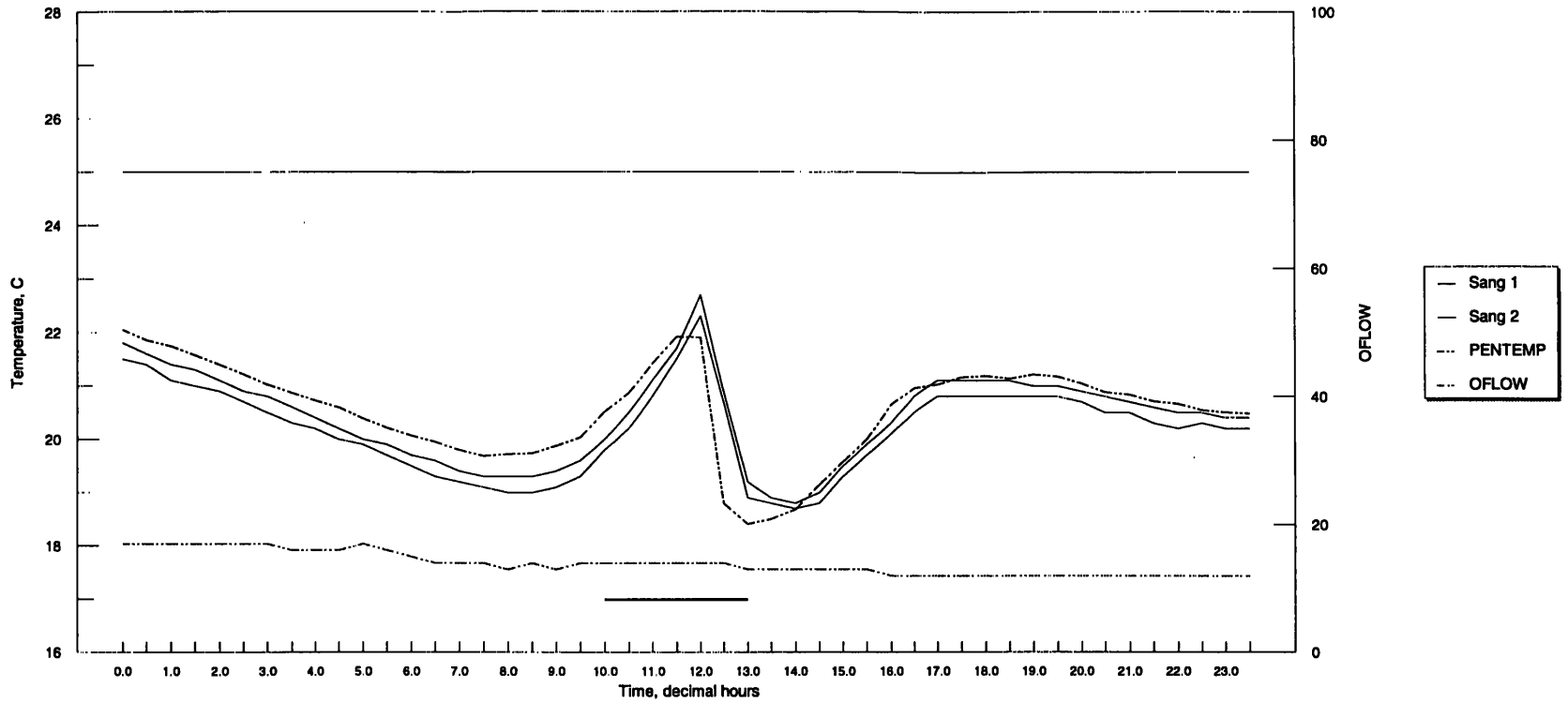
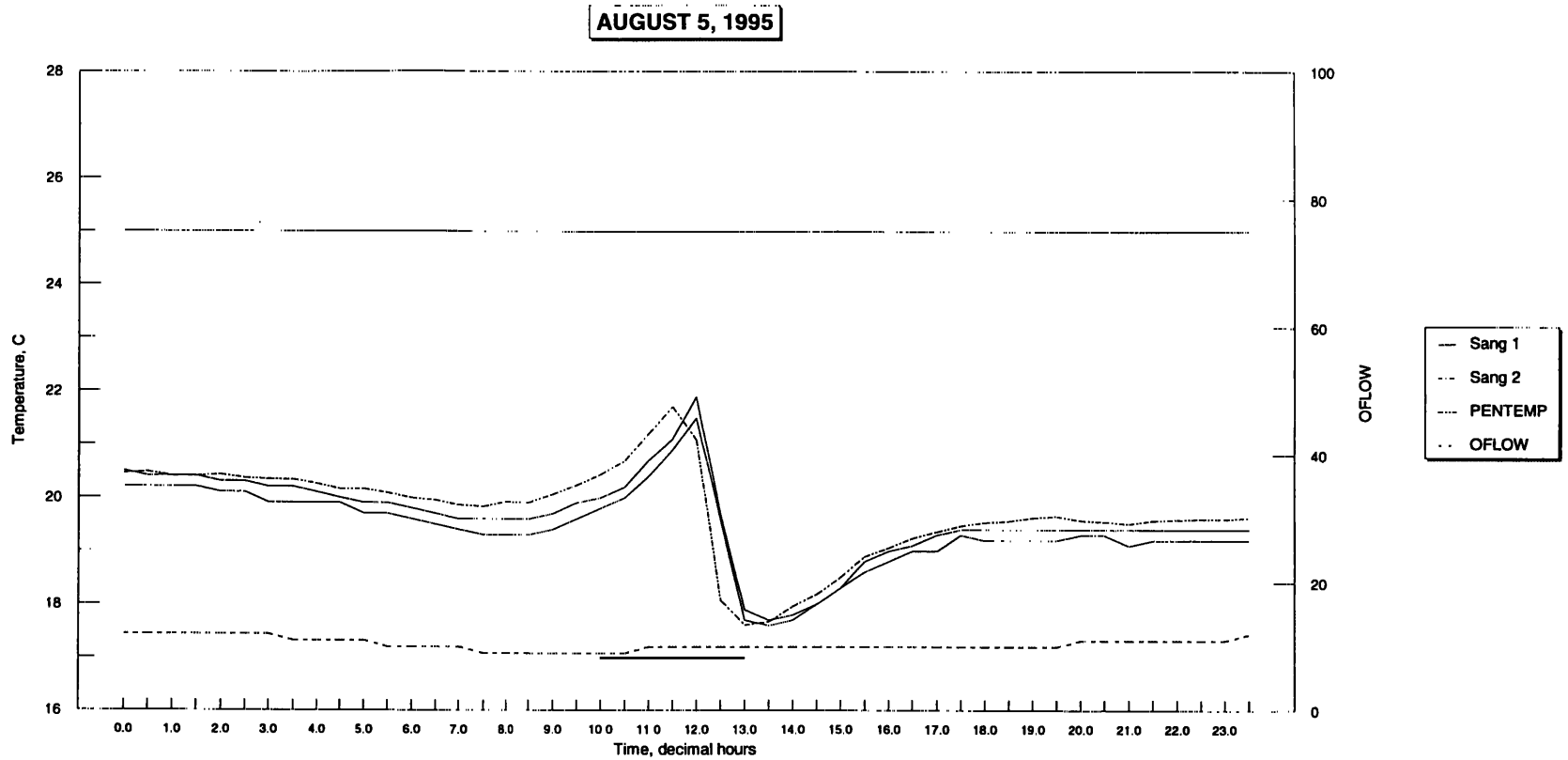


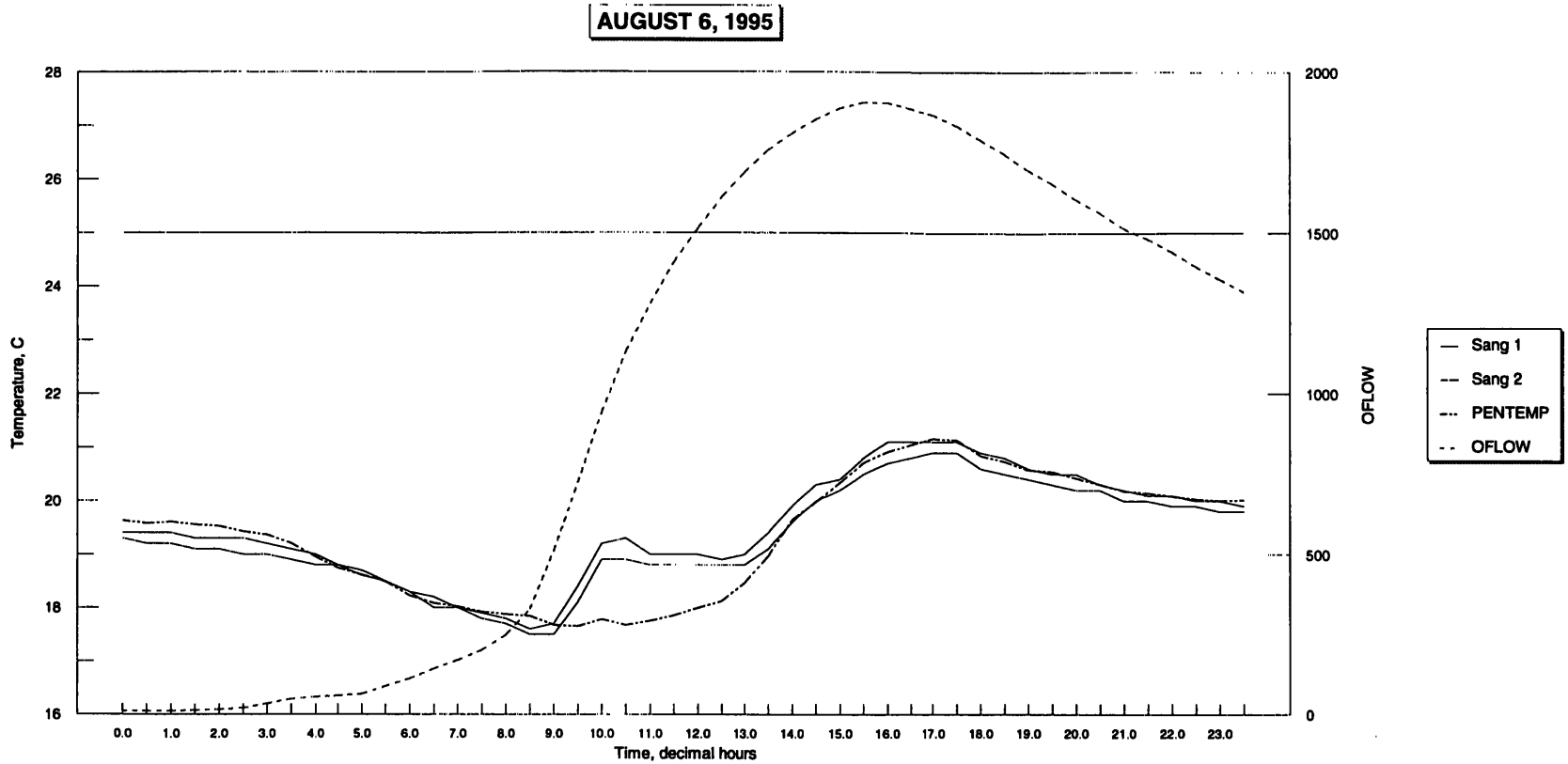
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

8/4 Release for: Scheduled Friday WW			
Oflow	14	Tair	
Omin	16.7	PCLD	
Omax	30.6	Q	
ECLD	5.6	Swamax	30.6
Smax	22.5	EMAX	32.2
St_max		St_25	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

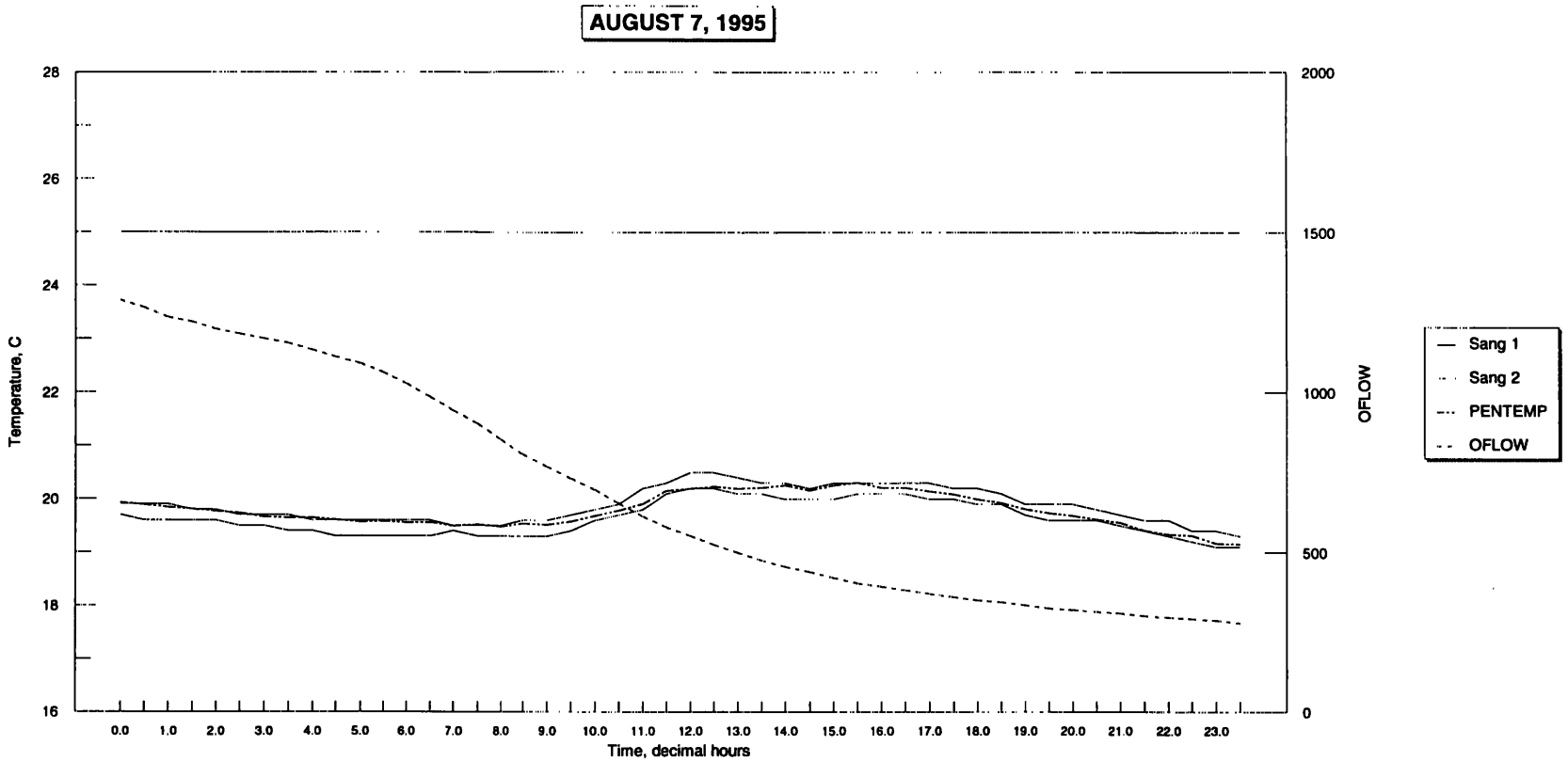
8/5 Release for: Scheduled Saturday WW			
Oflow	11	Tair	
Omin	17.8	PCLD	
Omax	28.3	Q	
ECLD	8.6	Swamax	28.1
Smax	21.7	EMAX	31.7
St_max		St_25	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

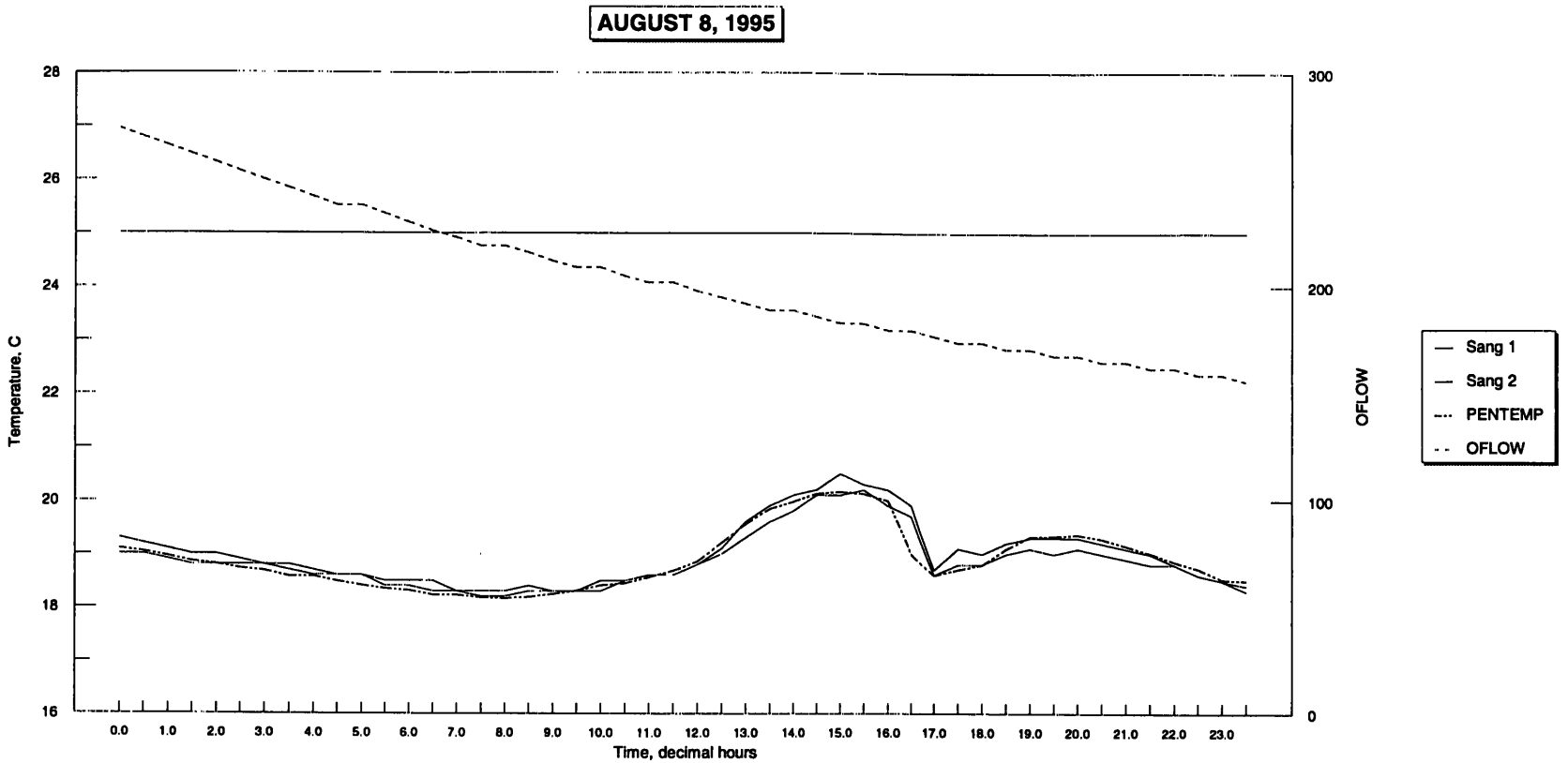
8/6 Release for: None

Oflow	1015	Tair	
Omin	17.8	PCLD	
Omax	26.7	Q	
ECLD	10	Swamax	23.9
Smax	21.0	EMAX	23.9
St_max		St_25	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

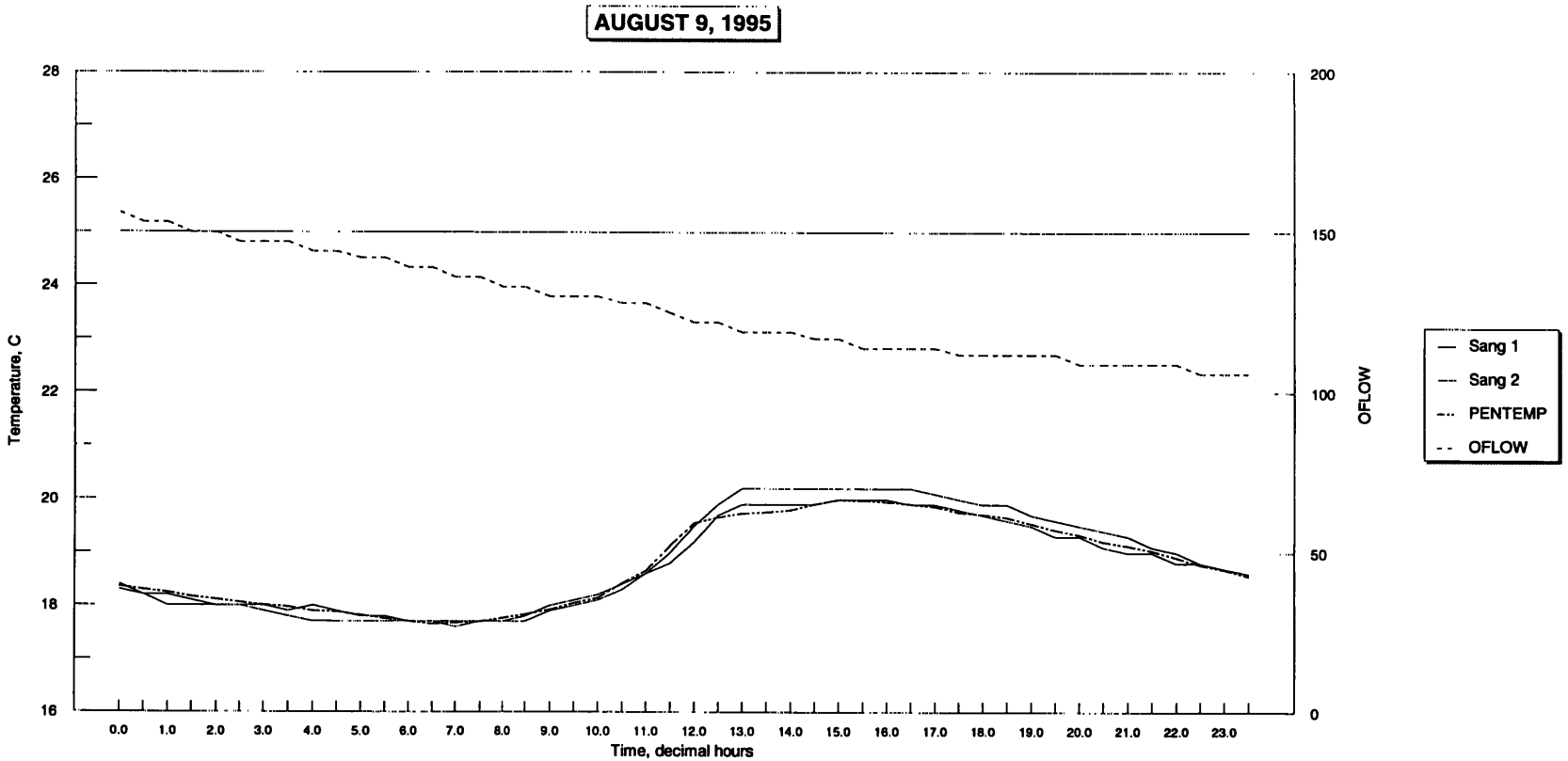
8/7 Release for: None			
Oflow	676	Tair	
Omin	16.7	PCLD	
Omax	23.9	Q	
ECLD	6.4	Swamax	20.3
Smax	20.4	EMAX	28.3
St_max		St_25	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

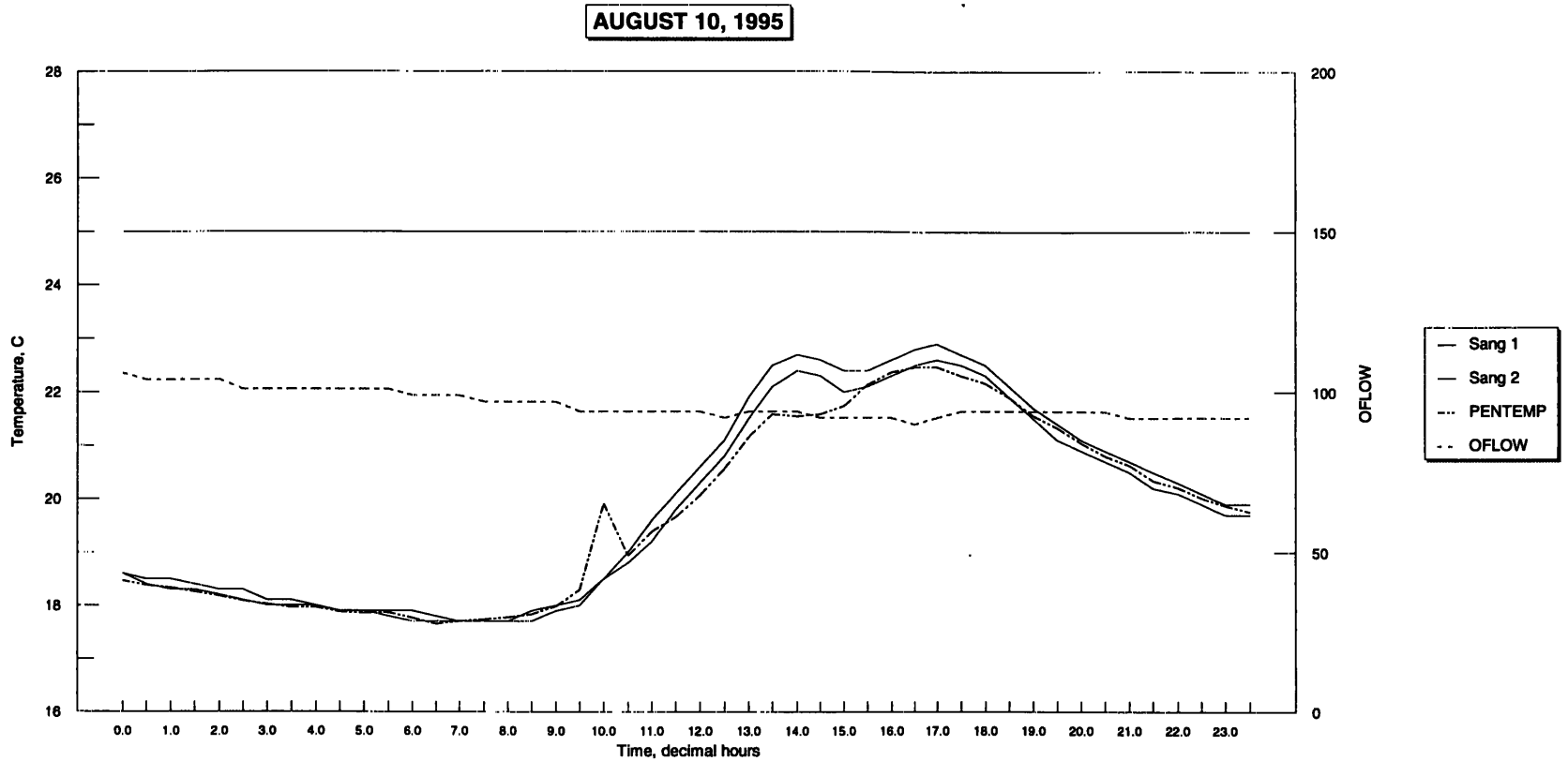
8/8 Release for: None

Oflow	210	Tair	
Omin	15	PCLD	
Omax	19.4	Q	
ECLD	9.8	Swamax	19.8
Smax	20.4	EMAX	23.3
St_max		St_25	



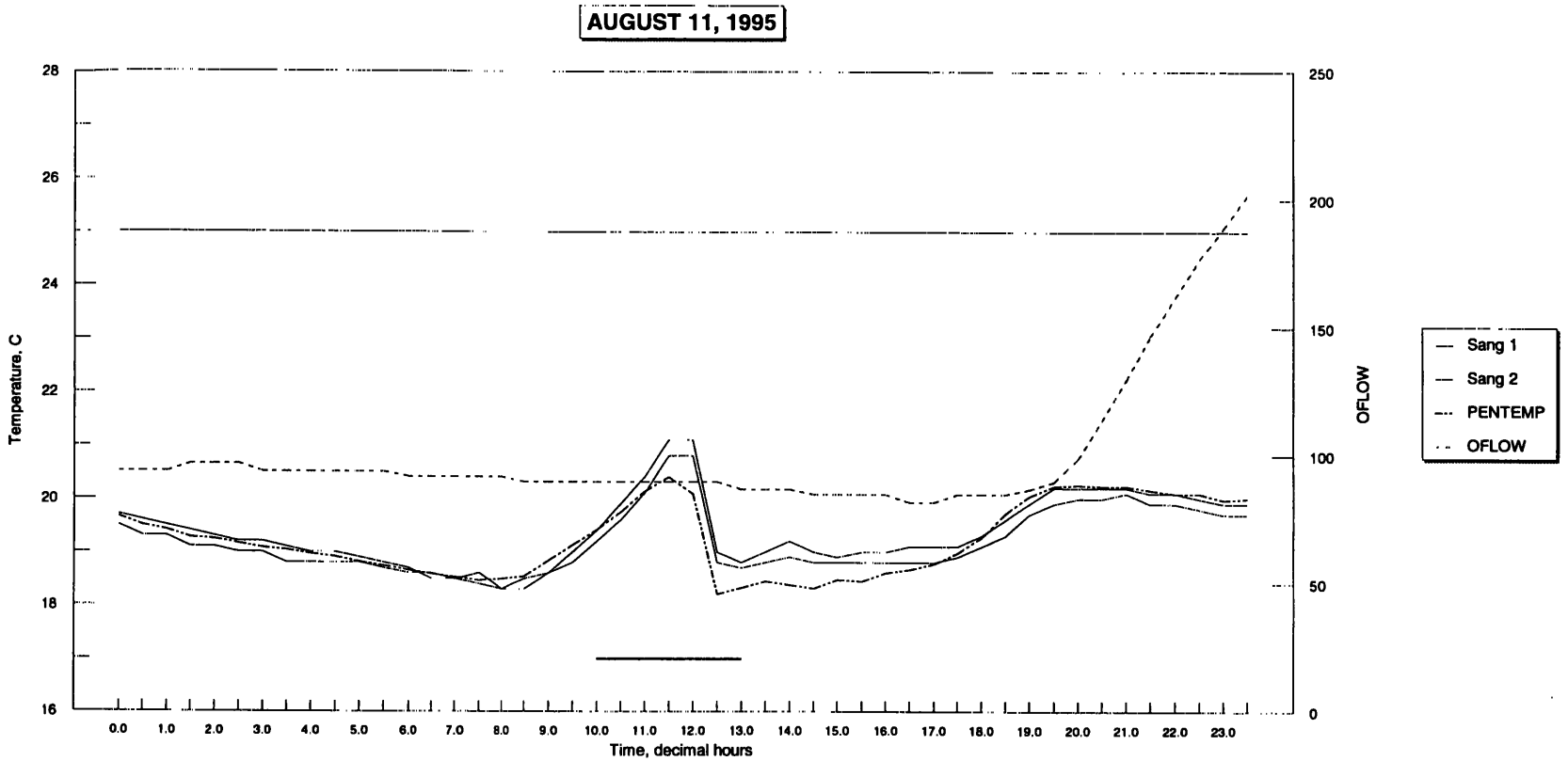
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

8/9 Release for: None			
Oflow	128	Tair	
Omin	15	PCLD	
Omax	21.1	Q	
ECLD	10	Swamax	19.8
Smax	20.1	EMAX	24.4
St_max		St_25	



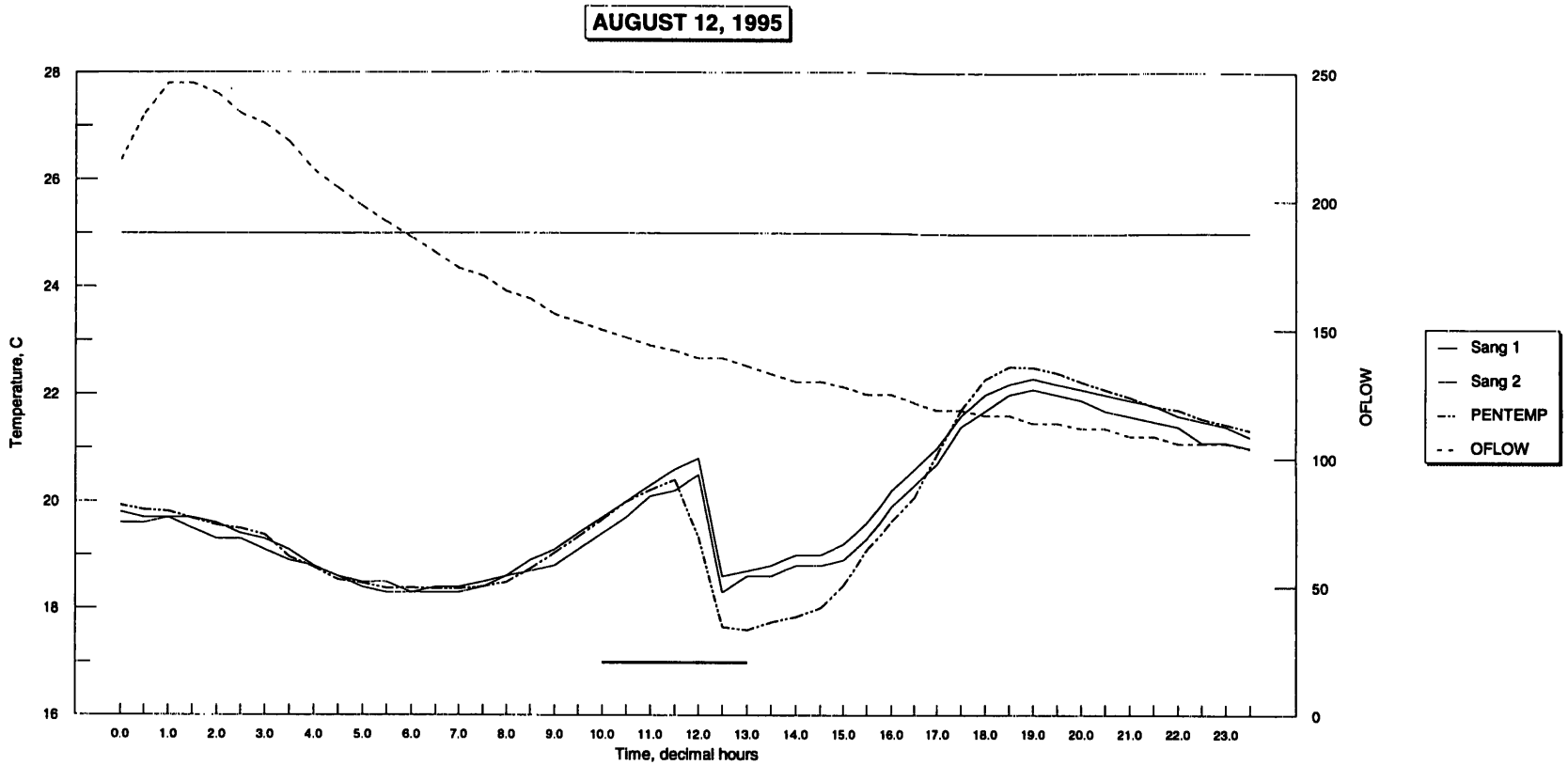
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

8/10 Release for: None			
Oflow	97	Tair	
Omin	14.4	PCLD	
Omax	25	Q	
ECLD	5.2	Swamax	22.0
Smax	22.8	EMAX	28.9
St_max		St_25	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

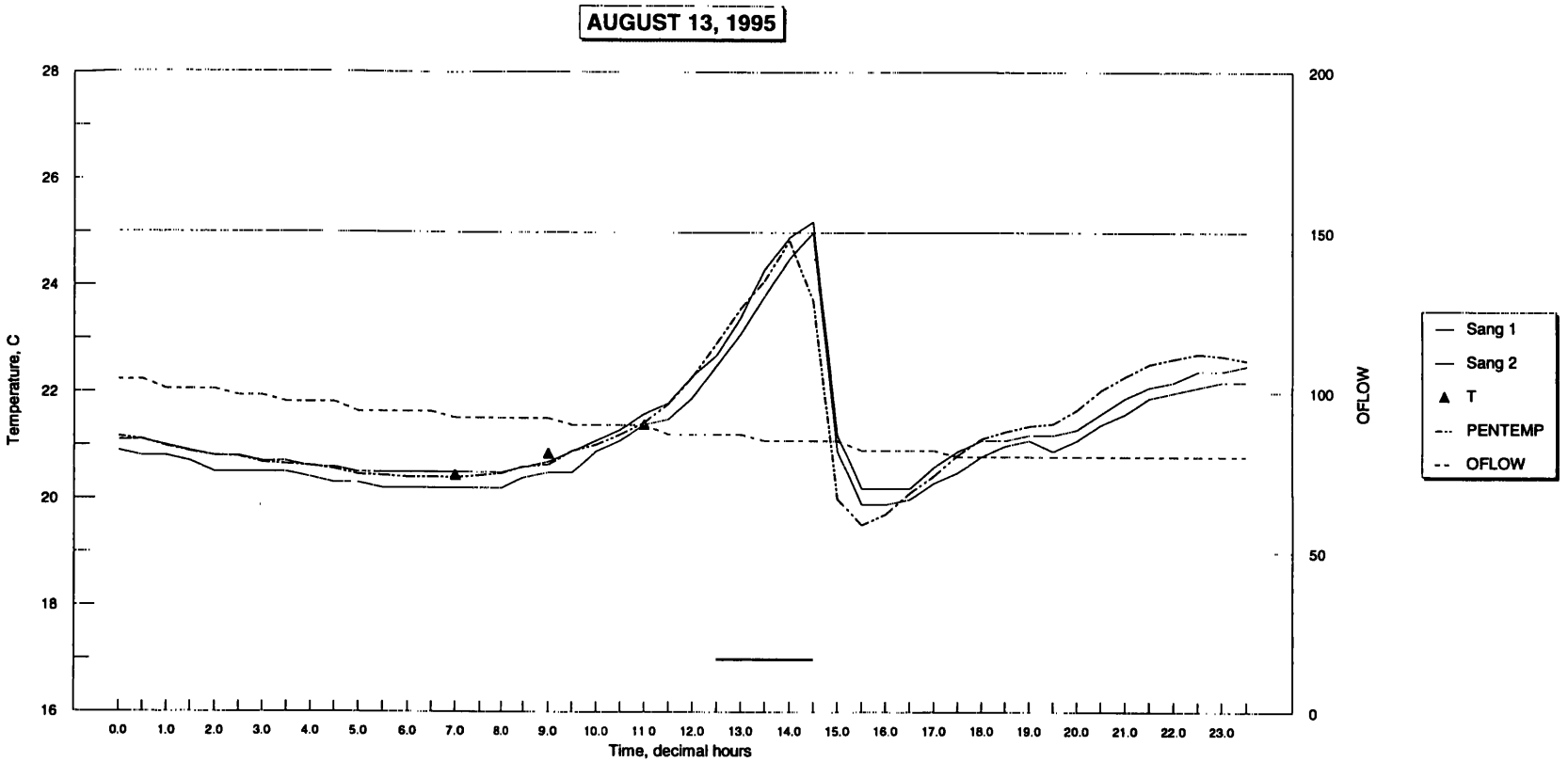
8/11 Release for: Scheduled Friday WW			
Oflow	103	Tair	
Omin	14.4	PCLD	
Omax	27.2	Q	
ECLD	4.2	Swamax	23.3
Smax	21.0	EMAX	29.4
St_max		St_25	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

8/12 Release for: Scheduled Saturday WW

Oflow	155	Tair	
Omin	16.7	PCLD	
Omax	27.8	Q	
ECLD	8.4	Swamax	22.0
Smax	22.2	EMAX	30.0
St_max		St_25	



P7	P9	P11	P12	P14	P15
24.7	25.0	26.3			
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
23.6	23.9	25.6			
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
24.7	25.0	26.3			

8/13 Release for: Temperature Enhancement			
Oflow	90	**Tair**	32.2
Omin	22.8	**PCLD**	6
Omax	30	**Q**	101
ECLD	7.4	**Swamax**	25.3
Smax	25.1	**EMAX**	32.2
St_max	14.4	**St_25**	14.4

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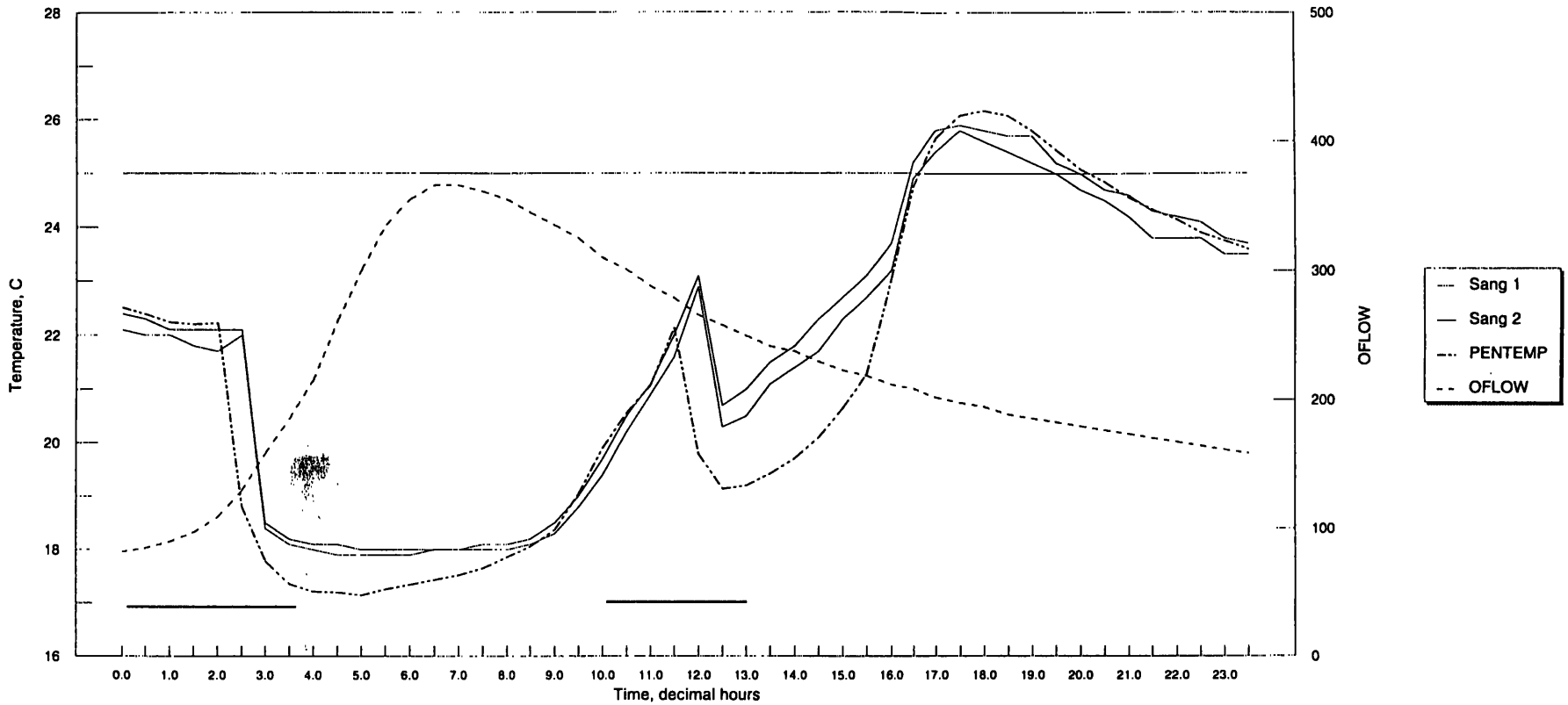
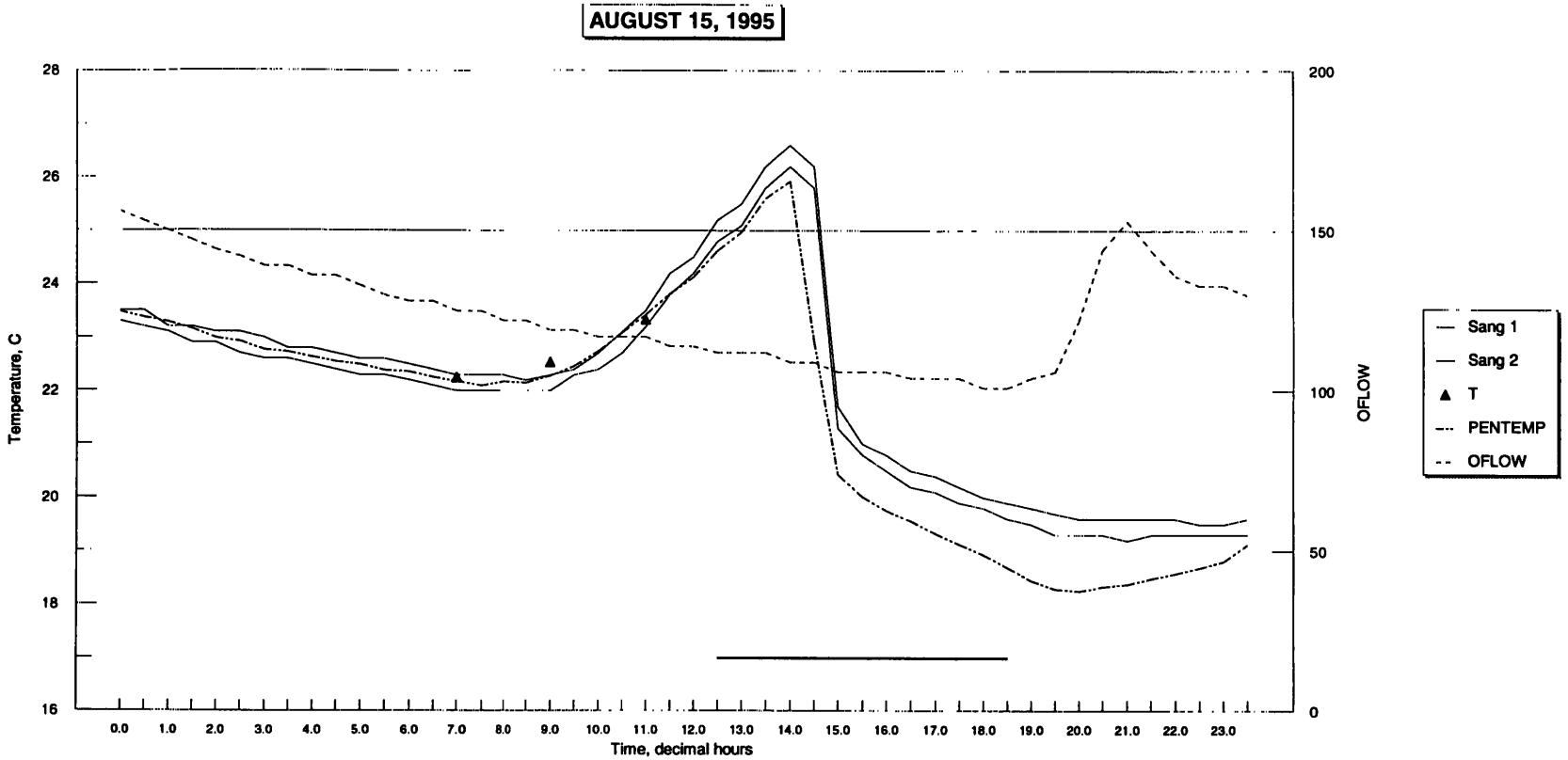


P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

8/14 Release for: Penelec then Scheduled Monday WW

Oflow	229	Tair	
Omin	18.3	PCLD	
Omax	30.6	Q	308
ECLD	4.4	Swamax	25.2
Smax	25.9	EMAX	32.2
St_max	17.5	St_25	16.8



P7	P9	P11	P12	P14	P15
23.6	24	27.8			
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
24.1	24.2	27.7			
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
23.6	24.0	27.8			

8/15 Release for:	Temperature Enhancement then Penelec		
Oflow	126	**Tair**	32.8
Omin	19.4	**PCLD**	6
Omax	30.6	**Q**	147
ECLD	3.6	**Swamax**	25.8
Smax	26.4	**EMAX**	32.2
St_max	13.9	**St_25**	12.7

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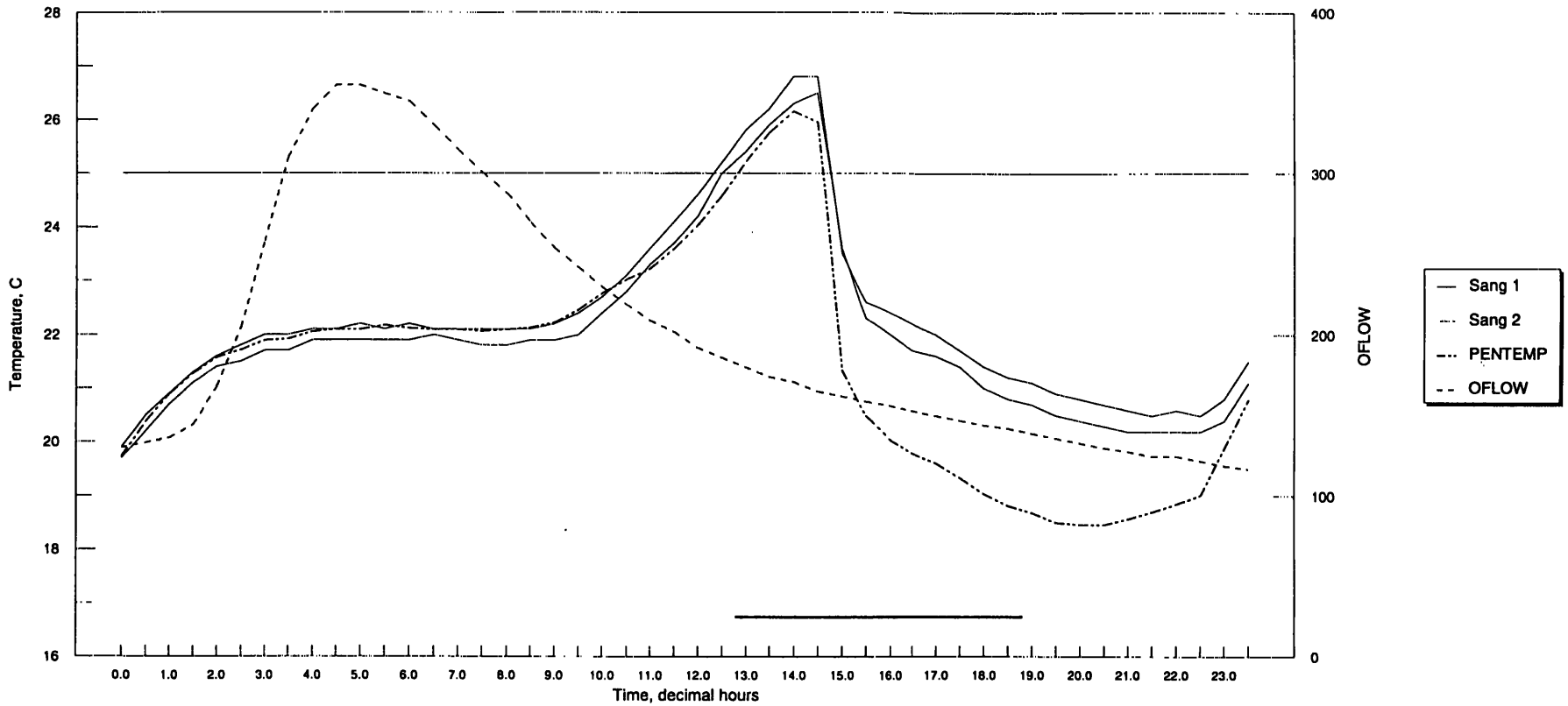
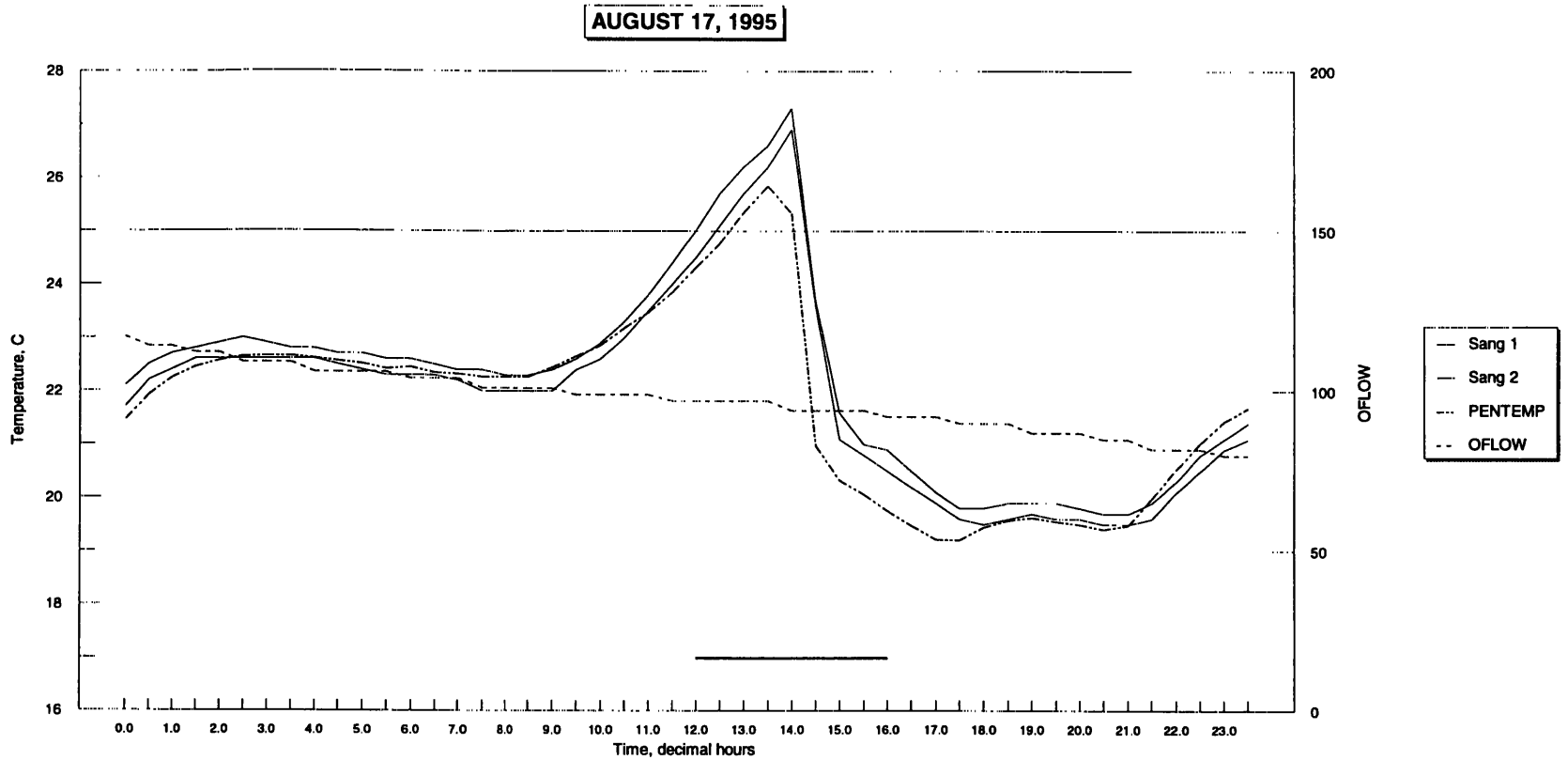


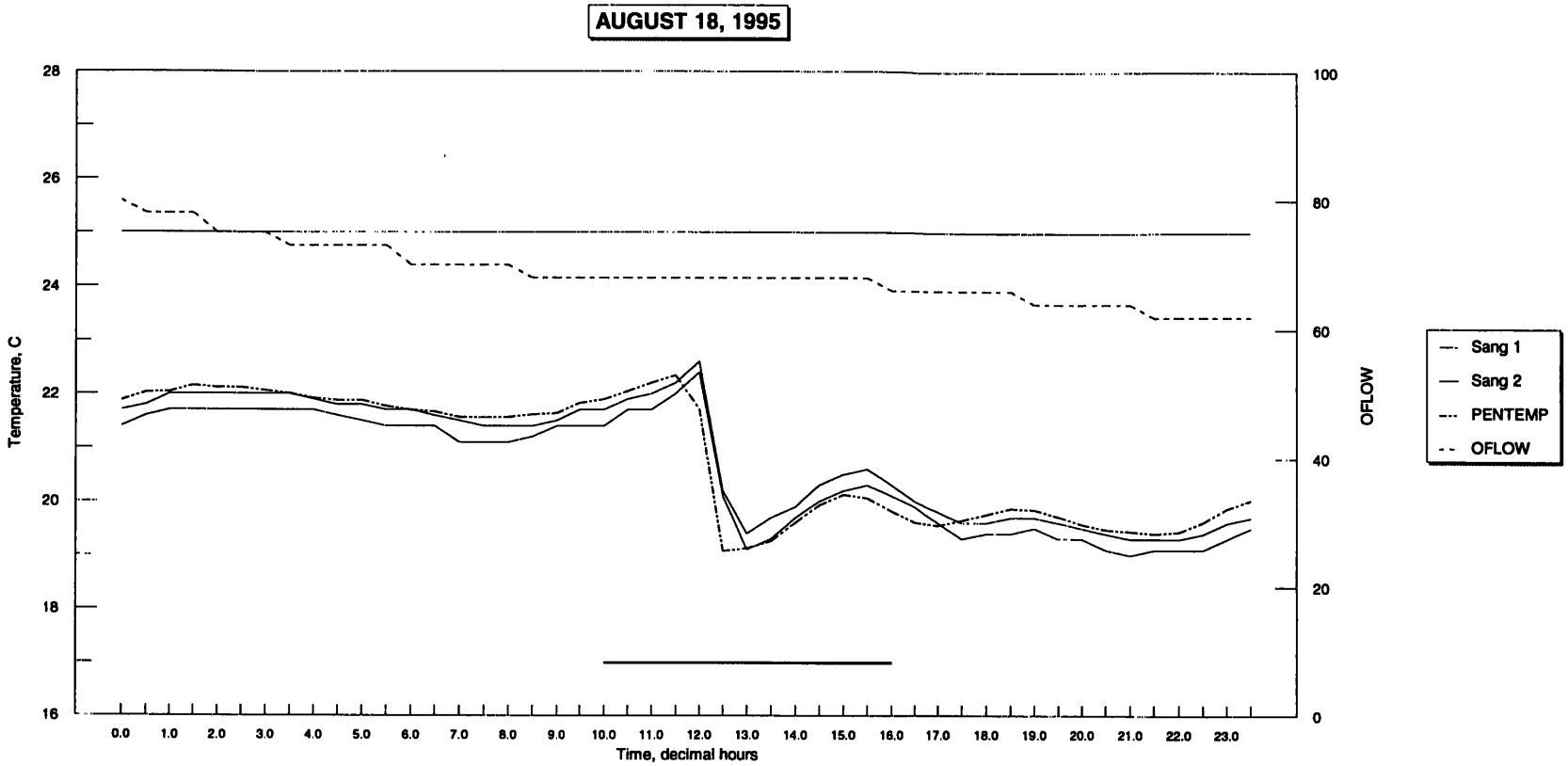
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

8/16 Release for: Unscheduled Penelec			
Oflow	202	Tair	
Omin	19.4	PCLD	
Omax	30	Q	179
ECLD	4.8	Swamax	25.8
Smax	26.7	EMAX	32.2
St_max	14.2	St_25	12.7



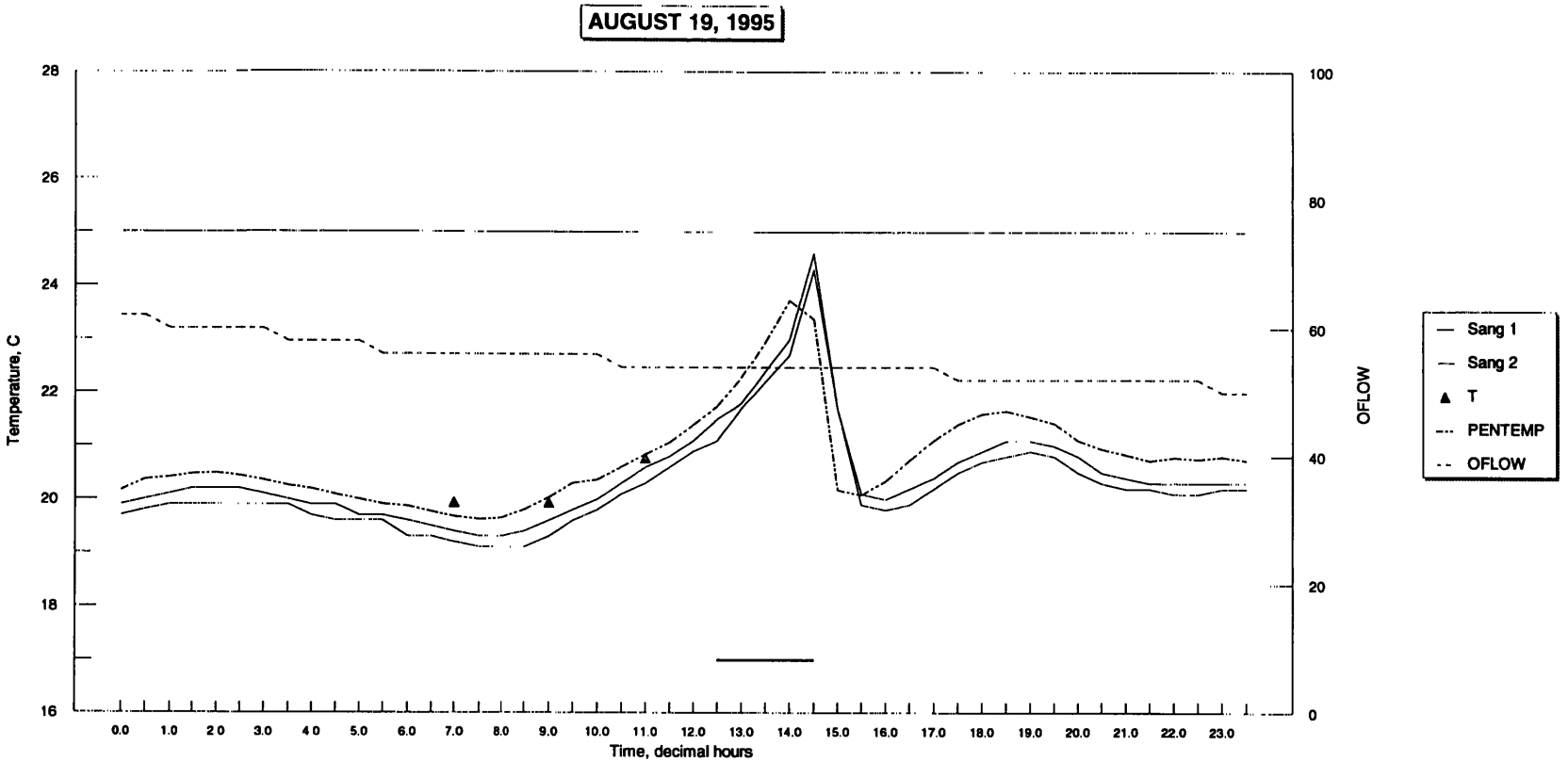
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

8/17 Release for: Unscheduled Penelec			
Oflow	99	Tair	
Omin	18.3	PCLD	
Omax	30	Q	116
ECLD	4.4	Swamax	27.1
Smax	27.1	EMAX	32.2
St_max	13.9	St_25	12.5



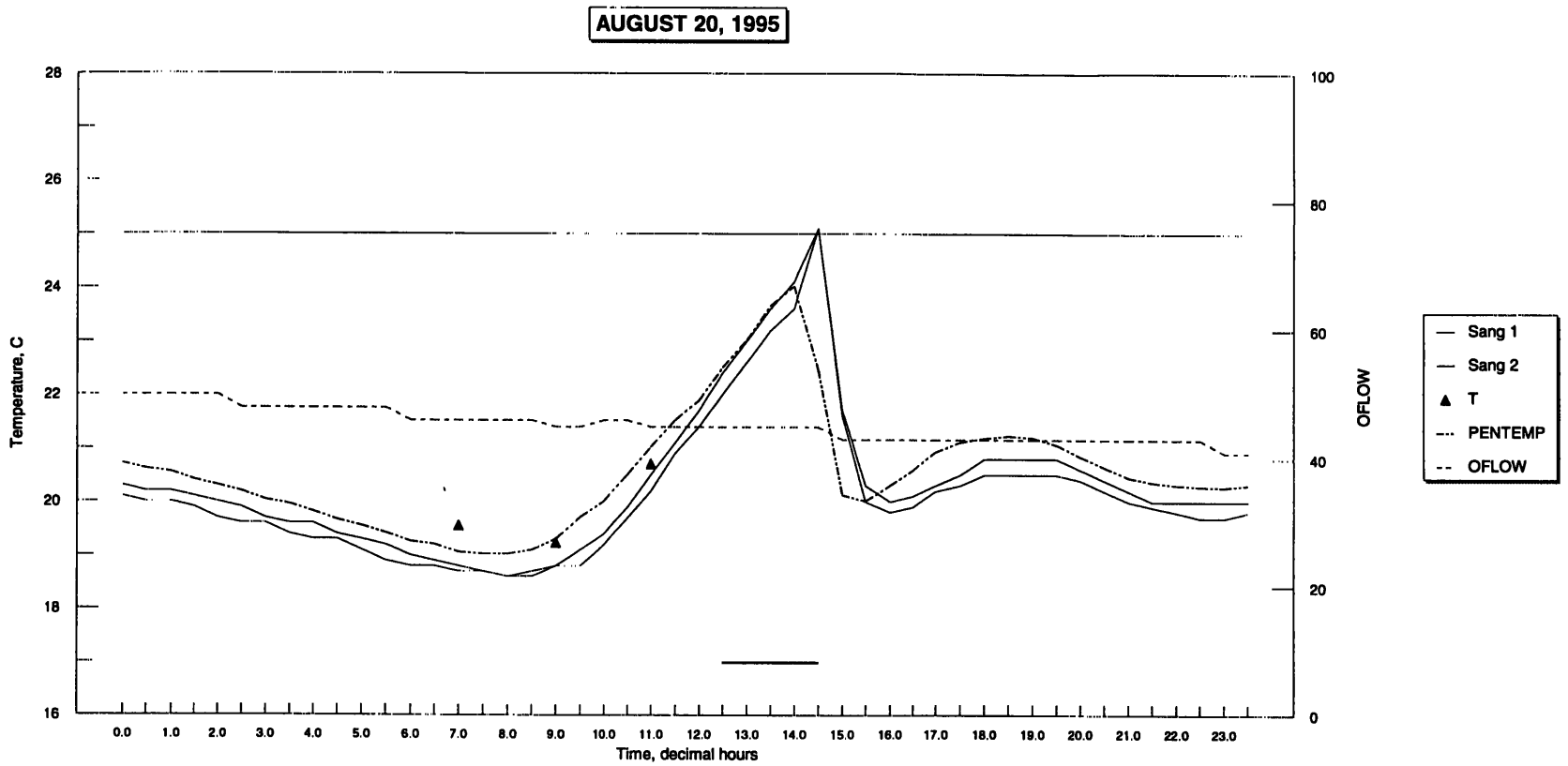
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

8/18 Release for:	Scheduled Friday WW then Penelec		
Oflow	69	Tair	
Omin	17.8	PCLD	
Omax	28.3	Q	
ECLD	9.8	Swamax	27.3
Smax	22.5	EMAX	31.1
St_max		St_25	



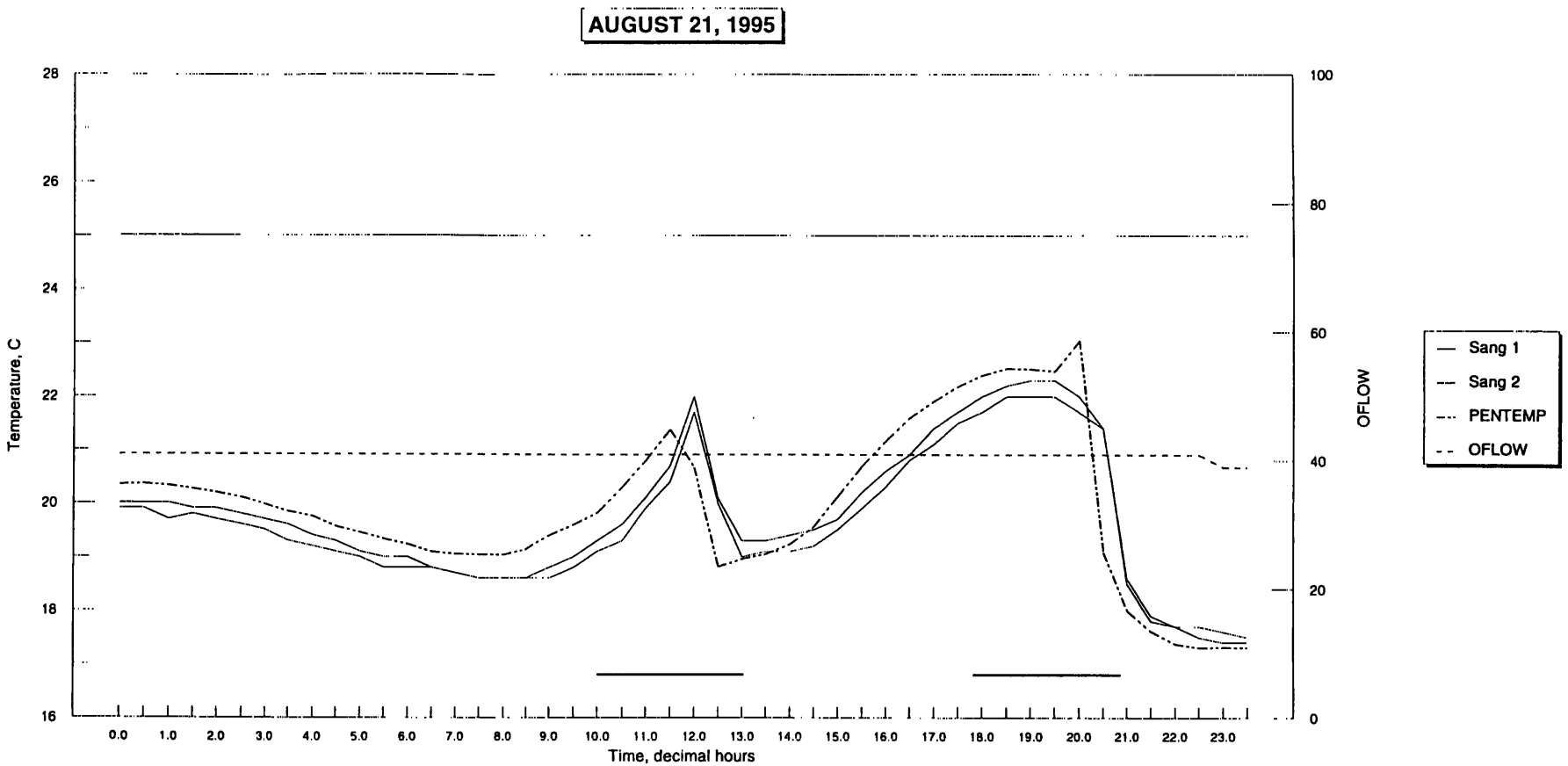
P7	P9	P11	P12	P14	P15
25.6	25.5	26.0			
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
27.3	27.1	27.1			
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
25.7	25.5	26.0			

8/19 Release for: Temperature Enhancement			
Oflow	56	**Tair**	30.6
Omin	12.8	**PCLD**	4
Omax	27.8	**Q**	69
ECLD	3.2	**Swamax**	26.2
Smax	24.5	**EMAX**	31.1
St_max		**St_25**	



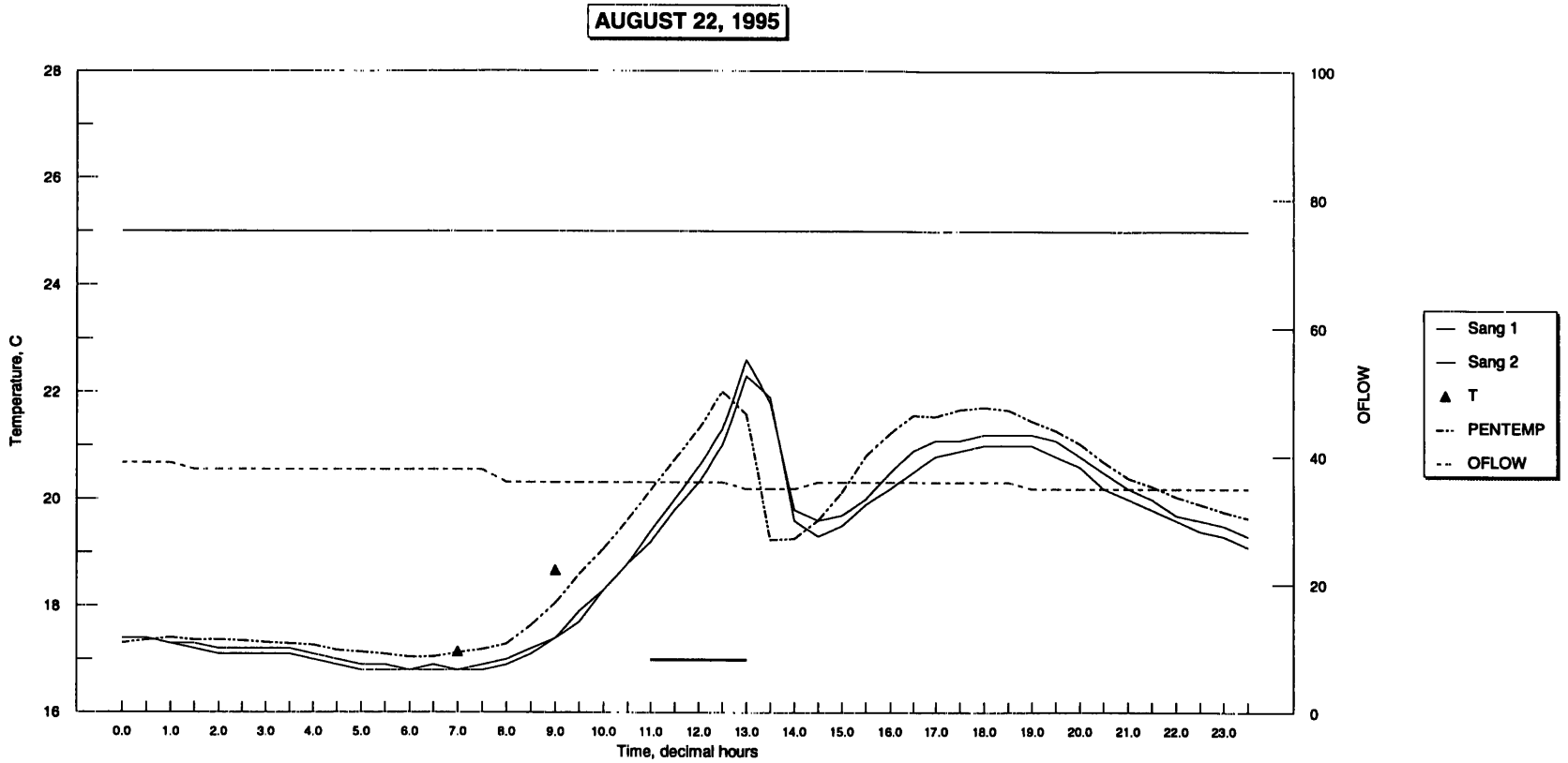
P7	P9	P11	P12	P14	P15
26.0	25.4	26.5			
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
27.3	27.1	27.1			
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
26.0	25.4	26.5			

8/20 Release for: Temperature Enhancement			
Oflow	46	**Tair**	30.6
Omin	14.4	**PCLD**	4
Omax	27.2	**Q**	58
ECLD	4.4	**Swamax**	26.2
Smax	25.1	**EMAX**	30.0
St_max	14.4	**St_25**	14.4



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

8/21 Release for:	Scheduled Monday WW then Penelec		
Oflow	41	Tair	
Omin	13.3	PCLD	
Omax	28.3	Q	
ECLD	4.2	Swamax	26.9
Smax	22.2	EMAX	29.4
St_max		St_25	



P7	P9	P11	P12	P14	P15
24.8	26.5				
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
26.6	26.9				
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
24.8	26.5				

8/22 Release for: Temperature Enhancement			
Oflow	37	**Tair**	26.7
Omin	11.7	**PCLD**	1
Omax	27.8	**Q**	42
ECLD	2.2	**Swamax**	26.7
Smax	22.5	**EMAX**	26.7
St_max		**St_25**	

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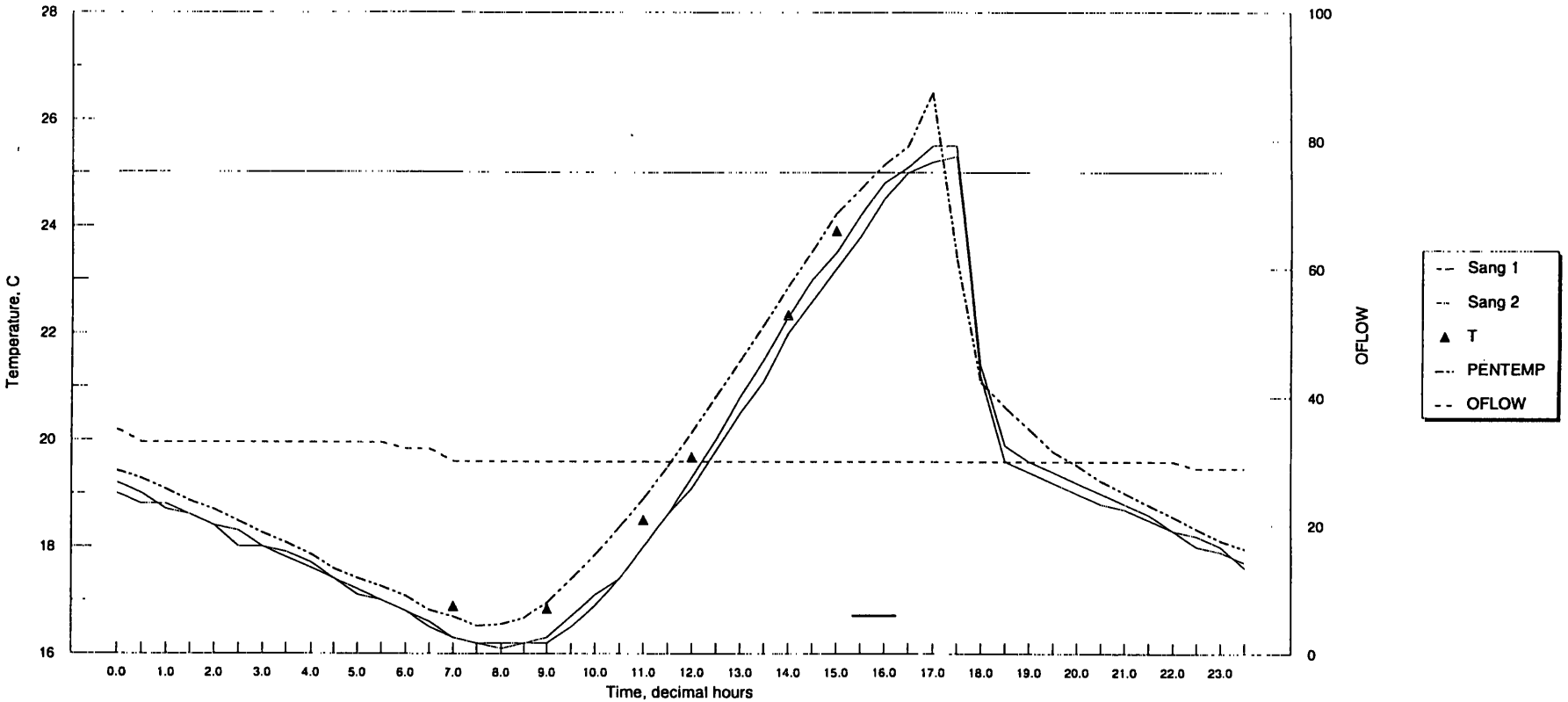
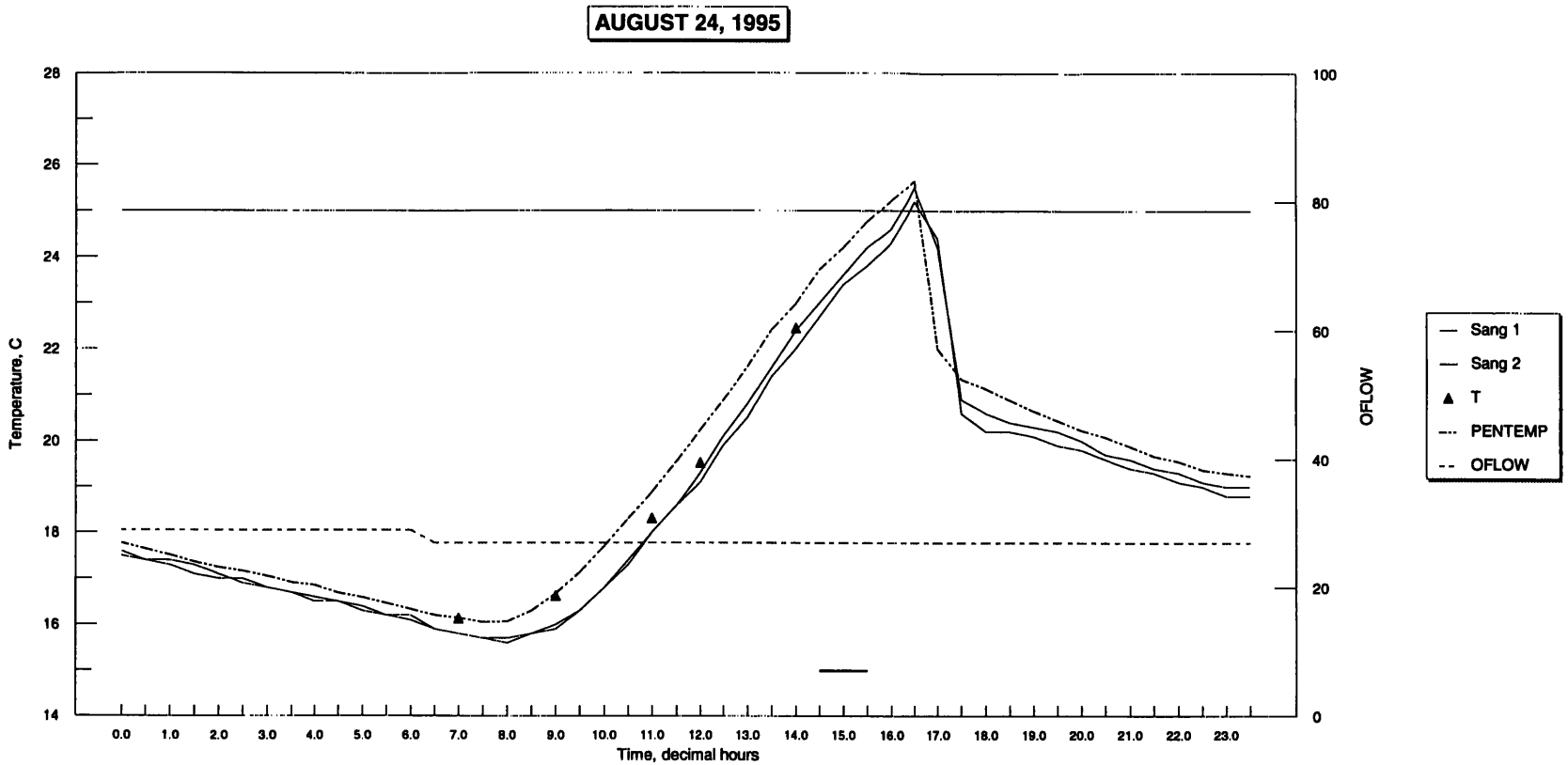


P7	P9	P11	P12	P14	P15
24.8	24.4	24.7	24.7	25.0	25.6
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
26.6	26.0	25.7	25.3	25.2	25.1
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
24.8	24.4	24.7	24.9	25.0	25.6

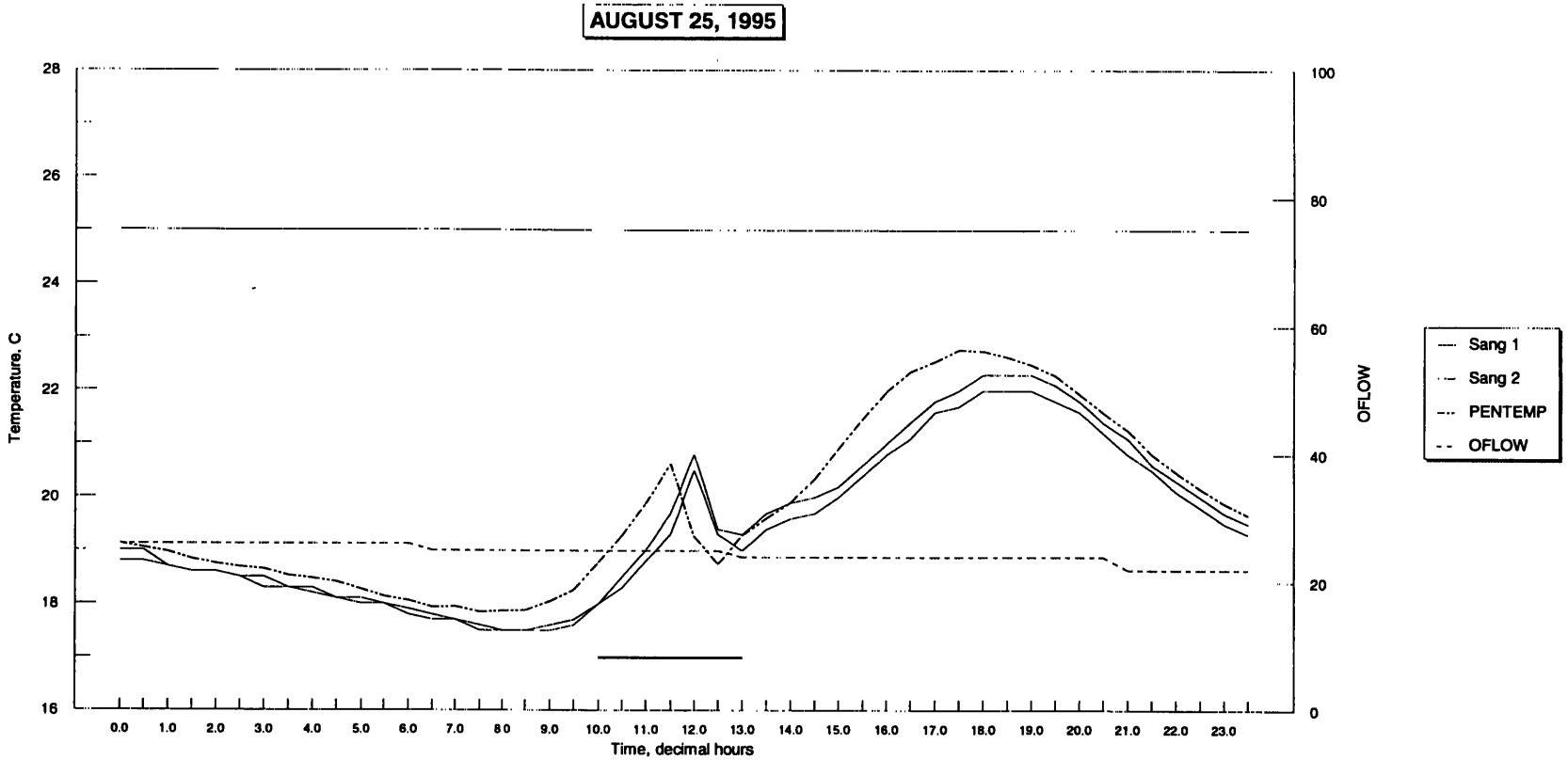
8/23 Release for: Temperature Enhancement

Oflow	31	**Tair**	28.3
Omin	7.2	**PCLD**	6
Omax	26.7	**Q**	36
ECLD	0.6	**Swamax**	26.7
Smax	25.4	**EMAX**	29.4
St_max	17.3	**St_25**	16.8



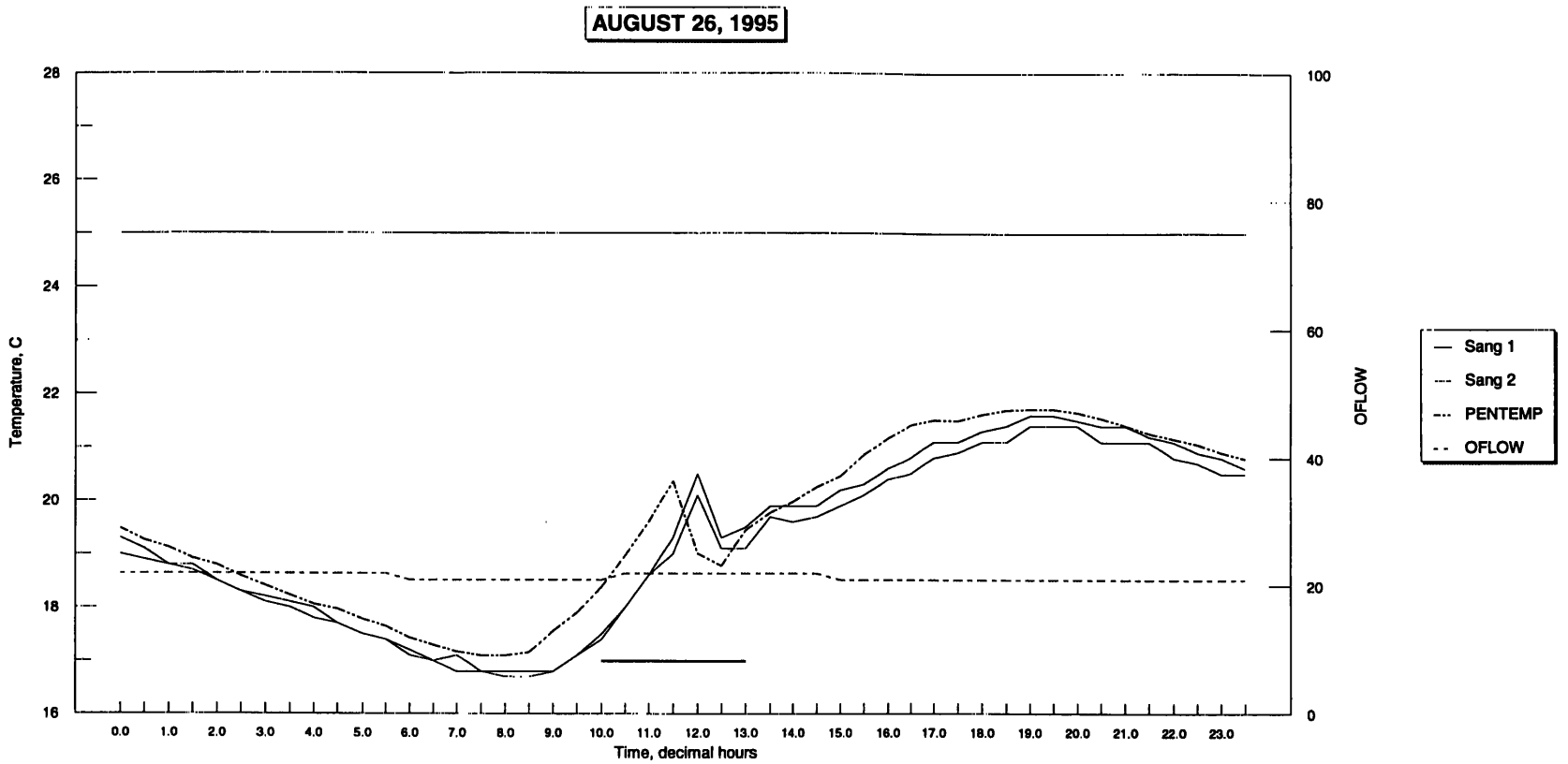
P7	P9	P11	P12	P14	P15
25.6	25.7	25.1	25.0	25.3	
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
24.0	23.9	24.0	23.8	24.4	
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
25.5	25.7	25.0	25.1	25.3	

8/24 Release for: Temperature Enhancement			
Oflow	28	**Tair**	29.4
Omin	9.4	**PCLD**	4
Omax	27.8	**Q**	29
ECLD	0.2	**Swamax**	26.8
Smax	25.4	**EMAX**	31.1
St_max	16.6	**St_25**	16.6



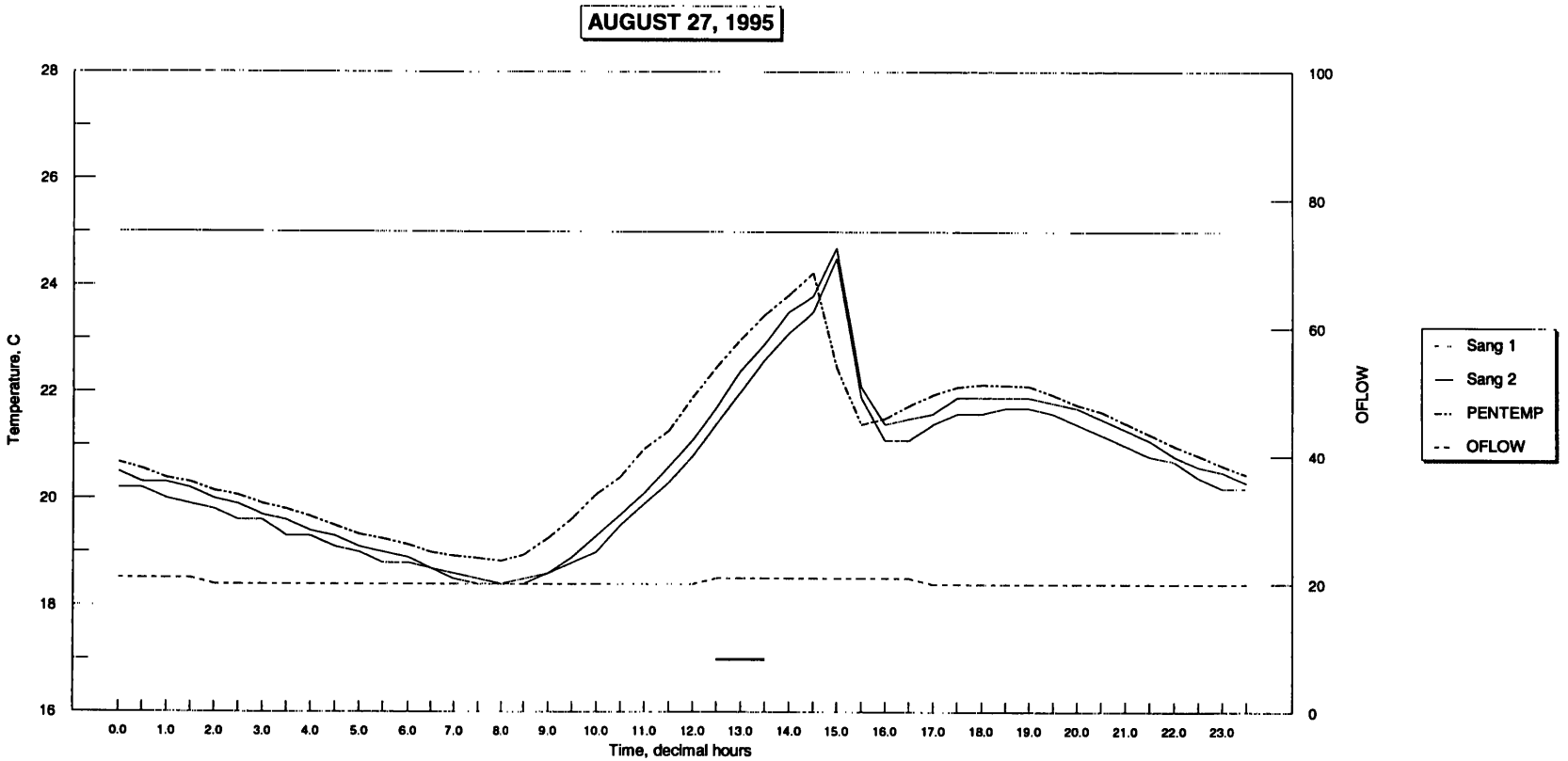
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

8/25 Release for: Scheduled Friday WW			
Oflow	25	Tair	
Omin	12.8	PCLD	
Omax	27.2	Q	
ECLD	2	Swamax	27.0
Smax	22.2	EMAX	31.1
St_max		St_25	



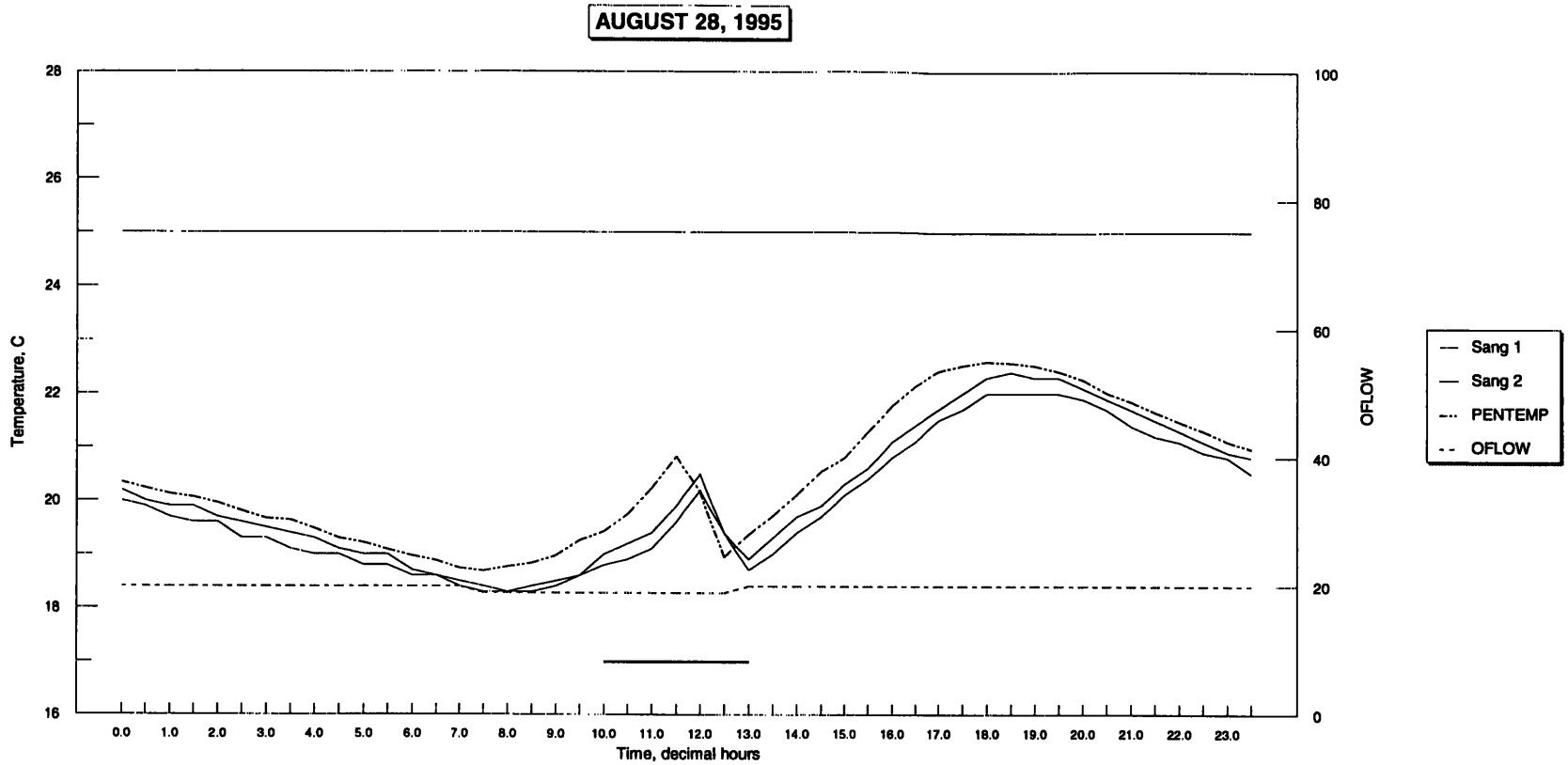
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

8/26 Release for: Scheduled Saturday WW			
Oflow	22	Tair	
Omin	12.8	PCLD	
Omax	26.7	Q	
ECLD	6.4	Swamax	27.2
Smax	21.5	EMAX	30.0
St_max		St_25	



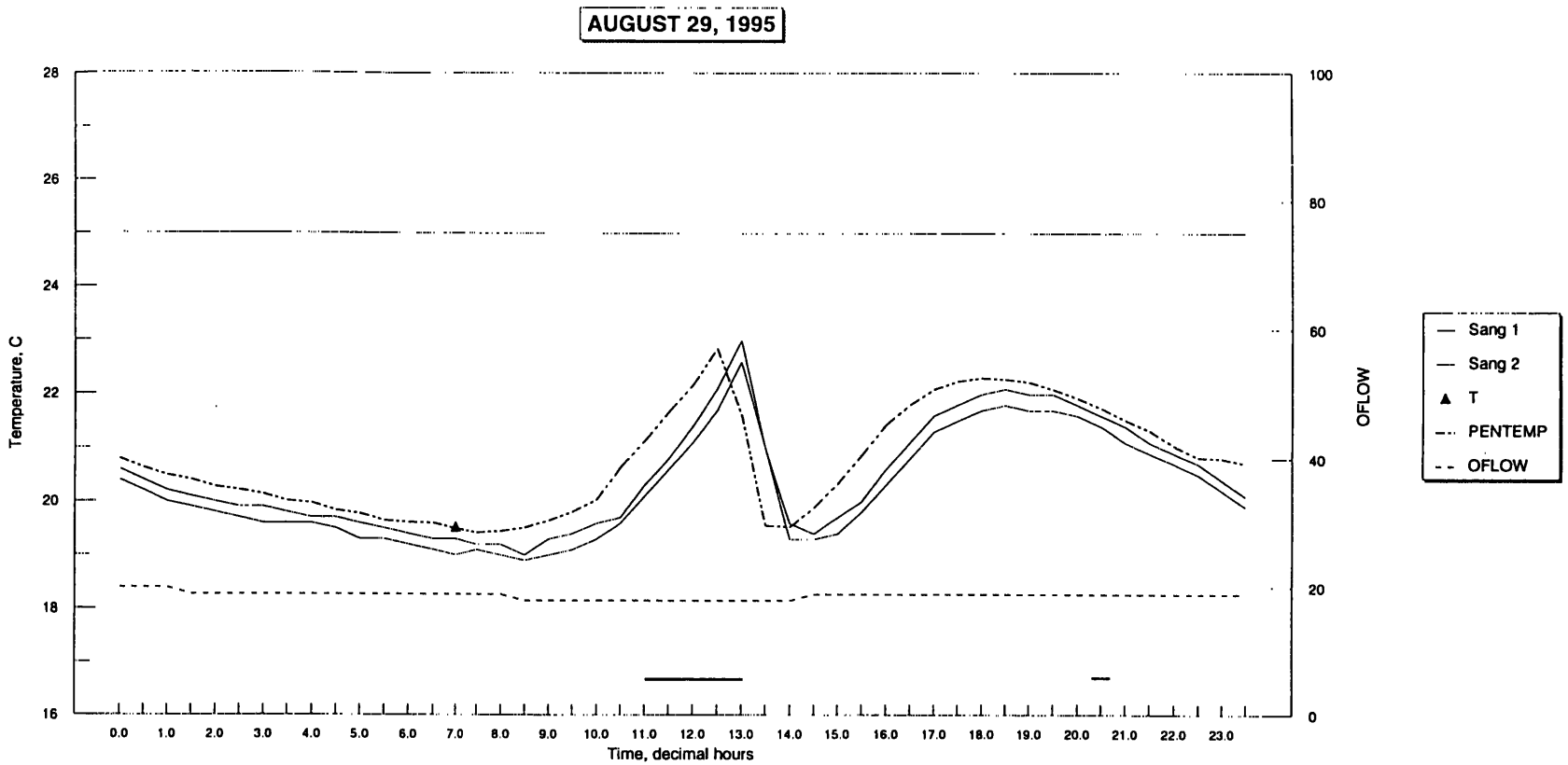
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

8/27 Release for: Temperature Enhancement			
Oflow	20	Tair	
Omin	14.4	PCLD	
Omax	28.3	Q	
ECLD	8.6	Swamax	26.9
Smax	24.6	EMAX	27.8
St_max		St_25	



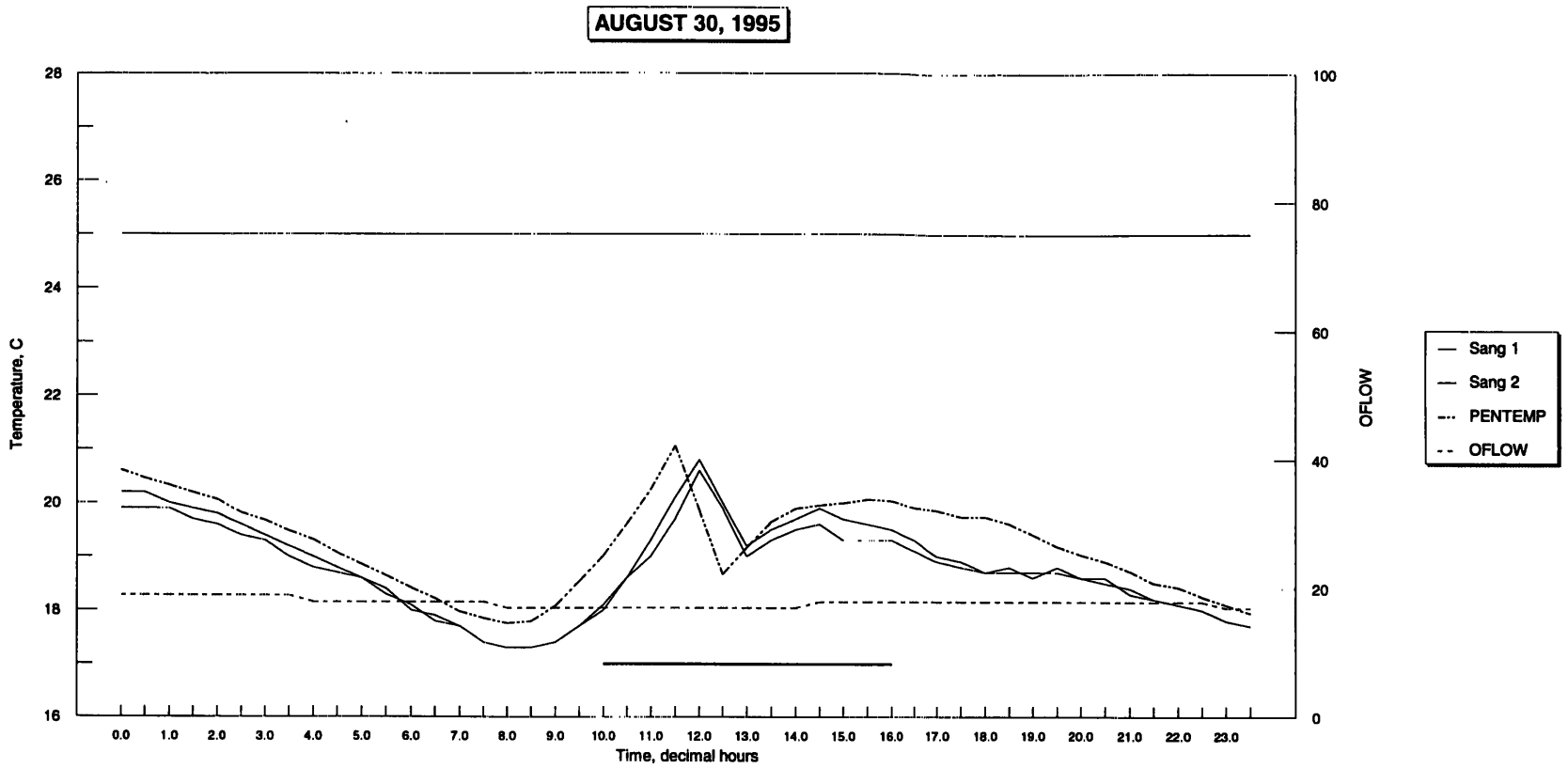
P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

8/28 Release for: Scheduled Monday WW			
Oflow	20	Tair	
Omin	14.4	PCLD	
Omax	26.7	Q	
ECLD	1.0	Swamax	27.2
Smax	22.2	EMAX	31.1
St_max		St_25	



P7	P9	P11	P12	P14	P15
26.7					
P7A	**P9A**	**P11A**	**P12A**	**P14A**	**P15A**
26.0					
P7B	**P9B**	**P11B**	**P12B**	**P14B**	**P15B**
26.7					

8/29 Release for: Temperature Enhancement then Penelec			
Oflow	19	**Tair**	29.4
Omin	16.1	**PCLD**	4
Omax	26.7	**Q**	20
ECLD	6.6	**Swamax**	26.9
Smax	22.8	**EMAX**	28.9
St_max		**St_25**	



P7	P9	P11	P12	P14	P15
P7A	P9A	P11A	P12A	P14A	P15A
P7B	P9B	P11B	P12B	P14B	P15B

8/30 Release for: Scheduled Special WW			
Oflow	18	Tair	
Omin	13.3	PCLD	
Omax	27.8	Q	
ECLD	1.4	Swamax	28.1
Smax	20.7	EMAX	31.1
St_max		St_25	