TENNESSEE VALLEY AUTHORITY
River System Operations & Environment
River Operations

Hydrothermal Data For Watts Bar Nuclear Plant SCCW Outfall

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Executive Summary

Parts I-A and III-B of the National Pollutant Discharge Elimination System Permit for the Watts Bar Nuclear Plant summarize requirements for monitoring and surveying the impact on the Tennessee River of the thermal effluent from Outfall 113. This outfall includes the discharge from the Supplemental Condenser Cooling Water System. This report includes a summary of the monitoring and survey data and is provided in fulfillment of the requirement that "A report of the surveys will be submitted to the Division within nine months of the end of survey completion." The monitoring data are provided for the months of December 1999 through August 2001. The survey data includes the results from six field tests conducted between February 23, 2000 and December 14, 2000.

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HYDROTHERMAL DATA FOR
WATTS BAR NUCLEAR PLANT SCCW OUTFALL

1.0 INTRODUCTION

The purpose of this report is to summarize hydrothermal data collected as required by National Pollutant Discharge Elimination System (NPDES) Permit No. TN0020168 for the Watts Bar Nuclear (WBN) Plant, for the permit cycle from July 17, 1999 to September 28, 2001. The data includes that for Outfall 113, the Supplemental Condenser Cooling Water (SCCW) System. The specific data requirements for this outfall are as found primarily in the following sections of the permit:

- Part I-A, Permit Limits, Outfall 113

Effluent Characteristics	*Effluent Limitations Daily*	*Monitoring Requirements*	
	Max. Conc.	*Msrmnt. Frqncy.*	*Sample Type*
Flow	*Report*	*Continuous*	*Recorder*
Temperature, Effluent	*Report*	*Hourly*	*Recorder*
Temperature, Edge of mixing zone	*30.5°C* (86.9°F)	*Hourly*	*Recorder*
Temperature, Rise upstream to downstream	*3.0 C°* (5.4 F°)	*Hourly*	*Calculated*
Temperature, Rate-of-change	*2.0 C°/hour* (3.6 F°/hour)	*Hourly*	*Calculated*
Temperature, Receiving stream bottom	*33.5°C* (92.3°F)	*Hourly*	*Recorder*
Stream Flow Direction	*Report data on flow status*	*Hourly*	*Recorder*

- Part III-B

TVA shall conduct routine temperature monitoring of the bottom of the discharge zone of the river along the periphery of the mussel relocation zone. Monitoring will be made by four thermistors wired to a data logger. Temperature data will be recorded for each thermistor on an hourly basis and will be available as unaggregated data for analysis. ··· Flow direction of the water near the Outfall 113 discharge shall be monitored by automatic equipment. Any instream monitoring equipment failures shall be remedied as soon as reasonably practical. Record of the flow direction instream and of the bottom temperatures shall be used to assess the mixing zone and to further characterize the impacts on bottom dwelling organisms within the mixing zone.

TVA shall conduct four separate temperature surveys during the first year of full operation of the Supplemental Condenser Cooling Water project. These surveys are intended to better define the mixing zone and reflect seasonal changes in the mixing zone at Outfall 113. The plant should be operating at the time of the survey and the SCCW be thermally loaded. ··· Each survey shall consist of determining vertical temperature profiles that allow assessment of the predicted mixing zone. The survey area shall include the width of the river and the downstream extent of the predicted mixing zone. The goal of the surveys is to determine the actual effects of the water releases from the dam and periods of no release from the dam upon the predicted mixing zone. The proposal for temperature survey shall be submitted to the division and be approved prior to start of the survey.

A report of the surveys will be submitted to the Division within nine months of the end of survey completion. The report shall summarize all data from the continuous monitoring system as well as the survey results. The assessment must compare 1-hour averaging of temperatures with 24-hour averaging.

As required in the above, TVA submitted a proposal for separate temperature surveys in early 2000 (Smith et al., January 2000). The Tennessee Department of Environment and Conservation (TDEC) accepted the proposal on February 24, 2000. The last of the surveys was completed December 14, 2000. The data given herein, therefore, is in fulfillment of the nine-month reporting requirement for the surveys and monitoring data. It is emphasized that this presentation is solely a data report. Although some minor discussions are provided, no detailed analyses of these data are given in support of establishing specific temperature criteria or monitoring requirements for the SCCW effluent.

The data provided in this report are organized into the two major categories found in Parts I-A and III-B of the NPDES permit—monitoring data and survey data. The monitoring data refers to the continuous and hourly measurements made to monitor compliance with the SCCW effluent limitations. The survey data is that of the separate temperature surveys of the SCCW mixing zone.

2.0 MONITORING DATA

2.1 Timeline

The system used to monitor the SCCW effluent limitations of the NPDES permit changed significantly during the first year of operation of the SCCW system. This is because, when the NPDES permit was issued and the SCCW system commenced operation, the design and installation of the hydrothermal monitoring system were incomplete. Other unforeseen problems with the monitoring system also spurred changes. Under these conditions, and before presenting any data, it is considered valuable to give a timeline summary of the SCCW monitoring system. This summary will be presented with the help of Table 2.1.1, which gives a list of correspondence pertinent to the hydrothermal monitoring system for Outfall 113.

TDEC transmitted the NPDES permit to TVA on July 16, 1999. The basic measurements required to monitor the effluent limitations of the SCCW, given in Part I-A of the permit, include the following:

- River temperature upstream of the SCCW outfall (i.e., ambient temperature),
- River temperature at the downstream edge of the mixing zone of the SCCW outfall,
- River bottom temperature at the SCCW outfall,
- River bottom velocity at the SCCW outfall,

- SCCW effluent flow at the SCCW outfall, and
- SCCW effluent temperature at the SCCW outfall.

The permit specified that *"installation, testing, calibrating and adjusting of the monitoring equipment and system"* should be complete 90 days from the effective date of the permit (Part I-E). Based on the effective date, July 17, 1999, the hydrothermal monitoring system was to be complete by October 15, 1999.

To allow operation of the SCCW system prior to completion of the hydrothermal monitoring system, TDEC specified that the effluent temperature should be monitored continuously, on an hourly basis, and that the maximum effluent temperature shall be limited to 92.3°F. With this, TVA placed the SCCW system in operation on July 19, 1999. The effluent flow and temperature were measured by an annubar in the SCCW system discharge conduit at a station located in an underground concrete vault about 2100 feet from the Unit 1 cooling tower basin. This station is known as Station 31 of the hydrothermal monitoring system.

Table 2.1.1. Correspondence Related to the Hydrothermal Monitoring System for WBN Outfall 113

Date	From	To	Summary
7/16/99	Saya A. Qualls Manager, Permit Section TDEC—DWPC	George E. Vickery Chemistry Superintendent TVA—WBN	TDEC transmittal of NPDES permit, which contained the SCCW hydrothermal monitoring requirements for the permit cycle from 7/17/01 to 9/28/01. Part I-E of the NPDES permit specified that the permittee shall have 90 days from the effective date of the permit to comply with the monitoring requirements. The transmittal letter specified that the SCCW system could be operated with the following minimum operating requirements: • The temperature of the SCCW effluent shall be monitored continuously on an hourly basis. • The maximum SCCW effluent temperature shall be 92.3°F. • The maximum SCCW effluent temperature can be exceeded if the river bottom temperature is measured for at least one site in the mussel relocation zone (MRZ) (i.e., immediate zone of SCCW impact) and monitored on an hourly basis. Note—per the NPDES permit, the maximum MRZ bottom temperature is 92.3°F.
9/28/99	Steven O. Casteel Manager, Radiological & Chem Control TVA—WBN	Philip L. Stewart Manager, DWPC Chattanooga Field Office TDEC—DWPC	TVA submittal of design for SCCW upstream temperature monitoring, and changes in the proposed designs for monitoring the river bottom (MRZ) temperature, monitoring the downstream temperature, and monitoring the effluent discharge and temperature. This letter also summarized the following phases of installation: • Phase 1—Installation of all equipment to allow local data collection of all river monitoring required by the NPDES permit. • Phase 2—Enhancement to radio-link all monitoring stations to one location and to provide access to this location via cell phone. • Phase 3—Enhancement to radio-link all monitoring stations to the WBN Environmental Data Station and Plant Integrated Computer System.
10/11/99	Philip L. Stewart Manager, DWPC Chattanooga Field Office TDEC—DWPC	Steven O. Casteel Manager, Radiological & Chem Control TVA—WBN	TDEC approval of the SCCW hydrothermal monitoring system as proposed in TVA letter of 9/28/99. This approval included some contingencies, the most significant of which included the right of TDEC to request a new location of the downstream monitor, if the proposed location did not provide suitable data.
1/21/00	Edward R. Robinson Environmental/Radwaste Superintendent TVA—WBN	Paul E. Davis Director, DWPC TDEC—DWPC	TVA submittal of proposed changes in SCCW monitoring. These included relocating the measurements for the effluent temperature and flow from the Annubar to the SCCW morning glory weir at Outfall 113.
2/24/00	Philip L. Stewart Manager, DWPC Chattanooga Field Office TDEC—DWPC	Edward R. Robinson Environmental/Radwaste Superintendent TVA—WBN	TDEC approval of a proposed change in the SCCW hydrothermal monitoring system as requested in TVA letter of 1/21/00.
6/6/00	Edward R. Robinson Environmental/Radwaste Superintendent TVA—WBN	Philip L. Stewart Manager, DWPC Chattanooga Field Office TDEC—DWPC	TVA submittal of proposed changes in SCCW monitoring. These included adding additional temperature sensors and a pressure (water level) sensor to the upstream monitoring station. With this arrangement, the upstream temperature will be assigned as that measured by the first temperature sensor below a water depth of 5 feet.
8/8/00	Cynthia M. Anderson Environmental Protection Specialists Chattanooga Field Office TDEC—DWPC	Edward R. Robinson Environmental/Radwaste Superintendent TVA—WBN	TDEC approval of a proposed change in the SCCW hydrothermal monitoring system as requested in TVA letter of 6/6/00.

The TDEC transmittal of July 16 also stipulated that the maximum effluent temperature of 92.3°F could be exceeded if the river bottom temperature at the SCCW outfall were measured for at least one site in the MRZ and monitored on an hourly basis. Since this allowed greater flexibility in operating the SCCW system, TVA installed a temporary temperature sensor on the river bottom on July 30, 1999. The sensor was located on the downstream edge of the MRZ about 75 feet from the river shoreline. The sensor was connected to a data acquisition unit that recorded the bottom temperature every 15 minutes. Temperature data could be viewed and retrieved from the data acquisition unit by cell phone. Later, on August 18, 1999, the data acquisition was upgraded with an alarm system to notify WBN personnel if the bottom temperature or other station parameters exceeded specific action levels.

The design of the "permanent" hydrothermal monitoring system, including the annubar and other stations for instream measurements, was developed in close consultation with TDEC personnel. TVA submitted the first significant summary of the design by letter on September 28, 1999. In this submittal, the monitoring system included four remote stations—the Upstream Monitoring Station (Station 30), the Effluent Monitoring Station (Station 31), the River Bottom or MRZ Monitoring Station (Station 32), and the Downstream Monitoring Station (Station 33). A brief description of these stations is given in Table 2.1.2. The system was approved by TDEC on October 11, 1999, with some minor contingencies.

Table 2.1.2. SCCW Hydrothermal Monitoring System per TVA Letter of September 28, 1999

Station	ID	Location	Sensors
Upstream	30	Watts Bar Hydro Plant at the outlet of the draft tube for Unit 3.	Temperature sensor at elevation 670 feet msl, which is 5 feet below the normal minimum tailwater at the Watts Bar Hydro Plant.
Effluent	31	SCCW discharge conduit, 2100 feet from the Unit 1 cooling tower basin.	Annubar, which contains sensors to measure both the effluent flow and effluent temperature.
MRZ	32	River bottom at the SCCW outfall.	MRZ temperature sensors at four locations and a velocity sensor at one location. The temperature sensors are situated on the periphery of the MRZ, which includes a square area, 150-foot on each side, centered on and directly next to the SCCW river outlet. One temperature sensor is located at the centers of both the upstream and downstream edges of the MRZ. The remaining two temperature sensors are located on the MRZ edge opposite of the SCCW outlet; one 50 feet upstream and one 50 feet downstream of the outlet centerline. The velocity sensor is located at the center of the upstream edge of the MRZ and is used to determine the stream flow direction.
Downstream	33	About 350 feet from the right bank of the river, 1000 feet downstream of the SCCW outfall.	Temperature sensors suspended from a floating buoy at depths 3, 5, and 7 feet below the water surface.

The hydrothermal monitoring system was installed in three phases. Phase 1 included the installation of all equipment to allow local collection of all the monitoring data required by the NPDES permit. The Phase 1 work was completed October 14, 1999, satisfying the 90-day requirement specified in the permit. Phase 2, completed shortly thereafter, included enhancements to radio-link all the monitoring stations to one location accessible by cell phone.

Phase 3 included enhancements to radio-link all the monitoring stations to the WBN Environmental Data Station (EDS). The EDS contains computers and software to record, analyze, and display all of the data in "real time" for all of the monitoring stations. The analyses include computations for the following thermal compliance parameters:

- Hourly average river temperature upstream of the SCCW outfall (Station 30),
- 15-minute SCCW effluent flow (Station 31),
- 15-minute SCCW effluent temperature (Station 31),
- MRZ maximum 15-minute bottom temperature (Station 32),
- MRZ 15-minute bottom velocity (Station 32),
- Hourly average river temperature downstream of the SCCW outfall (Station 33),
- Hourly average temperature rise, upstream to downstream (Station 30 to Station 33), and
- Hourly average temperature rate-of-change (Station 33).

The Phase 3 work was completed on November 19, 1999. On January 12, 2000, a callout system was implemented at the EDS to replace the alarm system installed in August 1999.

Shortly after the SCCW system began operation, problems were encountered with Station 31. First, sporadic losses of station power began causing data outages. Since the effluent temperature was of primary importance in the initial operation of the system, on July 28, 1999, a backup temperature probe was installed in the effluent at the morning glory weir (glory hole) located just before the river outlet for Outfall 113. Second, dye-dilution flow tests conducted in late July indicated that the annubar was not providing flow measurements of suitable accuracy (i.e., within ±10 percent of the true flowrate). In the months that followed it became clear that the annubar was not going to be reliable for measuring the effluent flowrate, primarily due to chronic fouling of pressure taps in the instrument. During the same period, dye-dilution flow tests showed that that the effluent flowrate could be accurately monitored by measuring the water level at the glory hole weir. As such, on November 10, 1999, a temporary water level sensor was installed at the glory hole to monitor the flowrate on a continuous basis. On January 21, 2000, TVA submitted a request to permanently move measurements for the effluent flow and temperature from Station 31 to the glory hole. TDEC approved this change on February 24, 2000. By March 20, 2000, the instrumentation for flow and temperature were upgraded with permanent equipment and incorporated as part of Station 32. Consequently, Station 31 was abandoned. Currently, therefore, Station 32 includes all instrumentation to monitor the effluent flow and temperature, as well as all MRZ parameters.

Beginning in May 2000, problems of a different kind began occurring at Station 30, which is located on the downstream face of the powerhouse at Watts Bar Dam. At that time the station included a single temperature sensor situated at elevation 670 feet msl, 5 feet below the normal minimum tailwater elevation at the dam. In late spring and early summer, stratification develops

in the forebay of Watts Bar Dam. During periods when the powerhouse was idle, cold bottom water from the forebay was found to be leaking through the hydroturbines, which caused artificial cooling of the temperature sensor. Since Station 30 serves as the upstream measurement for the Outfall 113, this, in turn, artificially increased the temperature rise for the SCCW discharge, sometimes threatening the NPDES limit. In late spring and summer the depth of the sensor at Station 30 is typically 12 feet or more below the water surface (e.g., the pool of Chickamauga Reservoir is well above the normal minimum tailwater elevation of 675 feet msl). Subsequent measurements in the tailrace appeared to indicate that the water temperature above the sensor, at the 5-foot depth, remained indicative of the ambient temperature when unaffected by leakage (e.g., when the hydroturbines were operating).

In an attempt to remedy this situation, on June 6, 2000, TVA proposed to TDEC to upgrade Station 30 with a series of additional temperature sensors and a pressure sensor. TDEC approved the request on August 8, 2000. The pressure sensor, installed at elevation 670 feet msl, was added to measure the water surface elevation. The additional temperature sensors were installed at elevations 674, 675, 676, 677, and 678 feet msl. With this arrangement, the upstream temperature for Outfall 113 is taken as the reading from the first temperature sensor at or below the 5-foot depth.

The modification to Station 30, to include multiple temperature sensors, was implemented on February 2, 2001. With this, a summary of the SCCW hydrothermal monitoring system as it exist today is presented in Table 2.1.3. Detailed aspects of the system are provided in TVA drawings, as listed below.

- HTMS-00-G-01, General Layout,
- HTMS-00-M-02, Antenna Mast Details,
- HTMS-00-M-03, Underwater Conduit Details,
- HTMS-30-E-01, Panel Wiring/Connections,
- HTMS-30-G-03, Equipment Locations,
- HTMS-32-E-01, Panel Wiring/Connections,
- HTMS-32-M-03, Thermistor Anchors,
- HTMS-32-M-04, Velocimeter Anchors,
- HTMS-32-M-05, Glory Hole Water Level Sensor Support,
- HTMS-33-E-01, Panel Wiring/Connections, and
- HTMS-33-M-02, Buoy and Anchor Details.

It is important to note that at Station 33 the downstream temperature is taken as the average of the readings of the sensors at the 3-, 5-, and 7-foot depths. If T_u and T_d denote the measured upstream and downstream temperatures, respectively, then the temperature rise for Outfall 113 is given by

$$\Delta T = T_d - T_u \,. \tag{1}$$

The temperature rate-of-change is given by

$$\frac{\delta T_d}{\delta t} = \frac{(T_d)_t - (T_d)_{t-\Delta t}}{\Delta t}, \tag{2}$$

where $(T_d)_t$ is the downstream temperature at time t and $(T_d)_{t-\Delta t}$ is the downstream temperature at time t-Δt. For the WBN hydrothermal monitoring system, Δt is 15 minutes.

The hourly average of any compliance parameter is computed as the average of the current and previous four values of the parameter.

Table 2.1.3. SCCW Hydrothermal Monitoring System as of February 2, 2001

Station	ID	Location	Sensors
Upstream	30	Watts Bar Hydro Plant at the outlet of the draft tube for Unit 3.	Temperature and pressure sensors at elevation 670 feet msl, and temperature sensors at elevations 674, 675, 676, 677, and 678 feet msl.
Effluent	32	Glory hole at the outlet for Outfall 113 .	Water temperature sensor and ultrasonic water level sensor.
MRZ	32	River bottom at the SCCW outfall.	MRZ temperature sensors at four locations, and a velocity sensor at one location. The temperature sensors are situated on the periphery of the MRZ, which includes a square area, 150-foot on each side, centered on and directly next to the SCCW river outlet. One temperature sensor is located at the centers of both the upstream and downstream edges of the MRZ. The remaining two temperature sensors are located on the MRZ edge opposite of the SCCW outlet; one 50 feet upstream and one 50 feet downstream of the outlet centerline. The velocity sensor is located at the center of the upstream edge of the MRZ and is used to determine the stream flow direction.
Downstream	33	About 350 feet from the right bank of the river, 1000 feet downstream of the SCCW outfall.	Temperature sensors suspended from a floating buoy at depths 3, 5, and 7 feet below the water surface.

Despite the modifications to Station 30, as summarized above, subsequent measurements in 2001 show that artificial cooling from leakage at Watts Bar Dam continues to persist, even at the 5-foot depth. It is speculated that this is due to the additional fact that Station 30 is installed next to a solid boundary at the most upstream end of the tailrace. Cold water leaking through the hydroturbines first fills the bottom areas of the tailwater, initially affecting the deepest sensors at Station 30. At the same time, peaking operations at Watts Bar Dam and Chickamauga Dam create small amplitude gravity waves that move back and forth in Chickamauga Reservoir. When such waves travel up the reservoir and strike the boundary created by the powerhouse at Watts Bar Dam, the cold water in the bottom of the tailrace is forced up the wall upon which Station 30 is installed. The entire temperature string thus becomes immersed in leakage water from the bottom. This likely was not detected in the original evaluations, conducted to determine the problem at Station 30, because of the dynamic character of the waves in Chickamauga Reservoir. The original evaluations included the collection of temperature profiles

only at a single point in time, which was likely away from the point in time when the crest of any peaking-induced gravity waves were striking the downstream face of the powerhouse.

To prevent artificial cooling at Station 30 from threatening the NPDES limit for the SCCW temperature rise, special operations currently are required at the Watts Bar Hydroplant (WBH) to flush cold water out of the tailrace. For example, when the temperature of leakage water is significantly cooler than the ambient water, and when the hydroturbines are scheduled to be idle for a long period of time, a special pulse of water must be provided about every five hours to prevent an excessive buildup of cold water in the bottom of the tailrace.

2.2 Station 34 and Station 35

To obtain additional data for the behavior of the thermal plume created by the SCCW outfall, TVA has installed two additional monitoring stations at the downstream end of the mixing zone. Both stations are situated in navigation zones, and thus are best classified as "expendable" study monitors. Station 34 is situated between Station 33 and the right bank of the river and was installed to obtain a better understanding of plume behavior when at least one hydroturbine is operating at Watts Bar Dam. Station 35 is situated on the left bank of the river and was installed to obtain a better understanding of plume behavior when there are no hydroturbines operating at Watts Bar Dam. Stations 34 and 35 are mentioned here only for information and completeness. They are not a formal part of the NPDES hydrothermal monitoring system. The analysis of data for Stations 34 and 35 currently is incomplete and hence is not included in this report.

2.3 NPDES Monitoring Data

The NPDES monitoring data presented herein encompasses the period from December 1999 through August 2001, a total span of twenty-two months. The starting month, December 1999, was selected primarily for convenience, as this is the first full month that EDS data collection and analysis commenced for the SCCW hydrothermal monitoring system. No data are presented for the temporary sensors, backup sensors, and partially established data collection systems used between July 1999, when the SCCW system commenced operation, and November 1999. It is noted that, within the span of this data, changes were yet taking place with the hydrothermal monitoring system—in particular, the previously discussed modifications for Stations 30, 31, and 32.

Plots of the monitoring data are given in Figures 2.3.1 through 2.3.21. Each figure encompasses one month of data and includes two parts, a and b. Plots contained in each part are as follows:

Part a Plots

- Instream water temperatures (°F), including:
  - Intake temperature for WBN Unit 1,
  - Hourly average temperature upstream of the SCCW outfall, T_u,
  - MRZ maximum 15-minute bottom temperature, and
  - Hourly average temperature downstream of the SCCW outfall, T_d.
- Hourly average temperature rise, ΔT, upstream to downstream (F°).
- Hourly average temperature rate-of-change, $\delta T_d/\delta t$ (F°/hour).
- Discharge from Watts Bar Hydroplant (cfs).

Part b Plots

- 15-minute SCCW effluent temperature (Outfall 113, °F) and 15-minute plant diffuser effluent temperature (Outfall 101, °F).
- Plant yard holding pond elevation (feet msl).
- 15-minute SCCW effluent flow (Outfall 113, gpm) and 15-minute plant diffuser effluent flow (Outfall 101, gpm).
- 15-minute MRZ bottom velocity (feet/second, positive=velocity in downstream direction).

Some general observations in the behavior of the data include the following:

- No temperature violations occurred within the span of the data.
- The MRZ, downstream, and Unit 1 temperatures usually are lower when WBH is on, because of dilution by the turbine releases, and higher when WBH is off. The upstream temperature can behave differently depending on the temperature of water in the forebay of Watts Bar Dam and/or leakage through the hydroturbines.
- The temperature rise ΔT is usually lower when WBH is on, because of dilution by the turbine releases, and higher when WBH is off. Leakage of cold water through the hydroturbines at WBH can, at times, reverse this trend.
- The temperature rate-of-change usually exhibits a positive spike when WBH ceases operation, because instream temperatures increase, and exhibits a negative spike when WBH resumes operation, because instream temperatures decrease.
- The effluent temperature for the plant diffusers is measured in the blowdown pipe before entering the diffusers. An interlock from Watts Bar Dam ensures that the diffusers are closed when WBH is off, which diverts the WBN cooling tower blowdown to the yard holding pond (e.g., see plot of diffuser and SCCW effluent flowrates). During these times, even though there is no diffuser discharge, the temperature of the effluent is yet recorded, and represents the temperature of the blowdown flowing to the yard holding pond. When the SCCW system is operating in summertime mode (i.e., with the bypass

closed), the temperature of the SCCW effluent is about the same as the temperature of the blowdown flowing to the yard holding pond. However, when WBH is on and the diffusers are in service, the diffuser discharge includes effluent from both the cooling tower blowdown and the yard holding pond. During these times, since water in the yard holding pond is usually cooled, the temperature of the diffuser discharge will be lower than that of the SCCW discharge.

- Except for short-term events when WBH is off, the MRZ bottom velocity is usually in the downstream direction.
- Due to an outage of the SCCW system in earch November 2000, no data are available for the effluent temperature and flowrate (Figure 2.3.12b).

2.4 Comparison of 1-Hour Averaging and 24-Hour Averaging

Plots of the instream compliance parameters for Outfall 113, including the downstream temperature T_d, temperature rise ΔT, and temperature rate-of-change $\delta T/\delta t$, are given in Figures 2.4.1 through 2.4.21. As before, these include the months of December 1999 through August 2001. In fulfillment of Part III-B of the permit, data are shown for both 1-hour averaging and 24-hour averaging. Note that a 24-hour average is not presented for the temperature rate-of-change. This is because by nature of its definition, a temperature change *per hour*, it is somewhat ambiguous to average this parameter over any period longer than one hour.

3.0 SURVEY DATA

As required in Part III-B of the permit, TVA has conducted instream temperature surveys of the SCCW thermal discharge. To obtain data showing significant seasonal changes in the mixing zone, if any, the surveys were conducted with ambient conditions indigenous of the winter, spring, summer, and fall. In all of the surveys the SCCW system was thermally loaded and included measurements across the full width of the river from Outfall 113 to the end of the mixing zone. The plan for the surveys is summarized by Smith et al. (2000) and includes a description of the survey rationale and measurement specifications. The data presented herein focuses on surface temperature transects obtained using a sidearm array of fixed RTD sensors at 0.5, 1.0, 1.5, and 2.0 meters below the water surface. The RTD array was mounted on a survey vessel that passed through the study area approximately every two hours. Each pass included measurements along multiple transects of sufficient number to define the full lateral and longitudinal extent of the SCCW thermal plume. Analyses of other data containing full depth temperature profiles were taken in the surveys, but currently are not available for this report.

A summary of basic field conditions for each survey is given in Table 3.1. A brief description of each survey follows.

Table 3.1. Basic Field Conditions for SCCW Surveys

Survey No.	Date	Approximate Ambient Water Temperature	Approximate Ambient Air Temperature	River Conditions
1	2/23/2000	46.5°F	67°F	Period of no flow for about 8 hours
2	3/8/2000	51.0°F	66°F	Hydro operation at WBH providing about 7000 cfs
3	5/18/2000	64.4°F	85°F	Period of no flow for about 11 hours
4	8/1/2000	80.6°F	80°F	Period of no flow for about 12 hours
5	12/14/2000	48.5°F	45°F	Period of no flow for about 9 hours

3.1 Survey No. 1

Survey No. 1 was conducted on February 23, 2000. The survey was performed to measure the evolution of the SCCW thermal mixing zone under wintertime conditions with no flow in the river. The ambient water temperature during the test was about 46.5°F. The SCCW system was operating with the bypass open. With an air temperature approaching 67°F, the Outfall 113 effluent temperature was between 10 F° to 15 F° warmer than the ambient water temperature. These types of conditions contribute to a large temperature rise in the river. Five passes were made through the study area during the survey.

Plots of the survey data are given in Figures 3.1.1 through 3.1.3. Each figure contains a series of plots as follows:

Figure 3.1.1a Plots

- WBH discharge (cfs).
- WBH tailwater elevation (feet msl).
- SCCW effluent discharge (gpm).
- MRZ bottom velocity (ft/s).
- Water temperature obtained by temporary study monitors (°F).
- Water temperature obtained by the SCCW hydrothermal monitoring system (°F).

Figure 3.1.1b Plots

- Solar radiation (g-cal/cm^2/min).
- Rainfall (inches).
- Air temperature (°F).
- Wind speed (mph) and direction (azimuth).

Figure 3.1.2a through 3.1.2e Plots

- River temperatures at 0.5-, 1.0-, 1.5-, and 2.0-meter depths for passes 1, 2, 3, 4, and 5, respectively (°F).

Figure 3.1.3a through 3.1.3e Plots

- River temperature *rises* at 0.5-, 1.0-, 1.5-, and 2.0-meter depths for passes 1, 2, 3, 4, and 5, respectively (°F).

3.2 Survey No. 2

Survey No. 2 was conducted on March 8, 2000. The survey was performed to measure the SCCW thermal mixing zone under wintertime conditions with a flow in the river of about 7000 cfs, produced by one hydroturbine at Watts Bar Dam. The ambient water temperature during the test was about 51.0°F. The SCCW system was operating with the bypass open. With an air temperature approaching 67°F, the Outfall 113 effluent temperature was about 16 F° warmer than the ambient water temperature. Since the ambient flow was somewhat steady, only one pass was made through the study area during the survey.

Plots of the survey data are given in Figures 3.2.1 through 3.2.3 in a fashion similar to that of Survey No. 1.

3.3 Survey No. 3

Survey No. 3 was conducted on May 18, 2000. The survey was performed to measure the SCCW thermal mixing zone under springtime conditions. The survey first examined the mixing zone after a long period of no flow, and then with a flow in the river of about 25,000 cfs, produced by four hydroturbines at Watts Bar Dam. The ambient water temperature during the test was about 64.4°F. The SCCW system was operating with the bypass closed. With an air temperature approaching 85°F, the Outfall 113 effluent temperature was between 17 F° to 21 F° warmer than the ambient water temperature. These types of conditions contribute to a large temperature rise in the river. Three passes were made through the study area during the survey, two with essentially no flow and one with a river flow of about 25,000 cfs.

Plots of the survey data are given in Figures 3.3.1 through 3.3.3 in a fashion similar to that of the previous surveys.

3.4 Survey No. 4

Survey No. 4 was conducted on August 1, 2000. The survey was performed to measure the SCCW thermal mixing zone under summertime conditions after a long period of no river flow. The ambient water temperature during the test was about 80.6°F. The SCCW system was operating with the bypass closed. With an air temperature approaching 80°F, the Outfall 113 effluent temperature was only about 7 F° warmer than the ambient water temperature. Two passes were made through the study area during the survey, both with essentially no flow in the river.

Plots of the survey data are given in Figures 3.4.1 through 3.4.3 in a fashion similar to that of the previous surveys.

3.5 Survey No. 5

Survey No. 5 was conducted on December 14, 2000. The survey was performed to measure the SCCW thermal mixing zone under fall conditions. The survey first examined the mixing zone with a river flow of about 16,000 cfs—equivalent to that produced by two hydroturbines at Watts Bar Dam. After this, the survey examined the evolution of the mixing zone with no flow in the river. The ambient water temperature during the test was about 48.5°F. The SCCW system was operating with the bypass open. With an air temperature of only about 45°F, the Outfall 113 effluent temperature was about 12 F° warmer than the ambient water temperature. Three passes were made through the study area during the survey, one with a river flow of 16,000 cfs and two with no river flow.

Plots of the survey data are given in Figures 3.5.1 through 3.5.3 in a fashion similar to that of the previous surveys.

4.0 References

Smith, Brennan T., Paul N. Hopping, and Walter L. Harper, "Instream Temperature Survey Plan for the Watts Bar Nuclear Plant SCCW System Outfall," Report No. WR2000-3-85-144, Tennessee Valley Authority, January 2000.

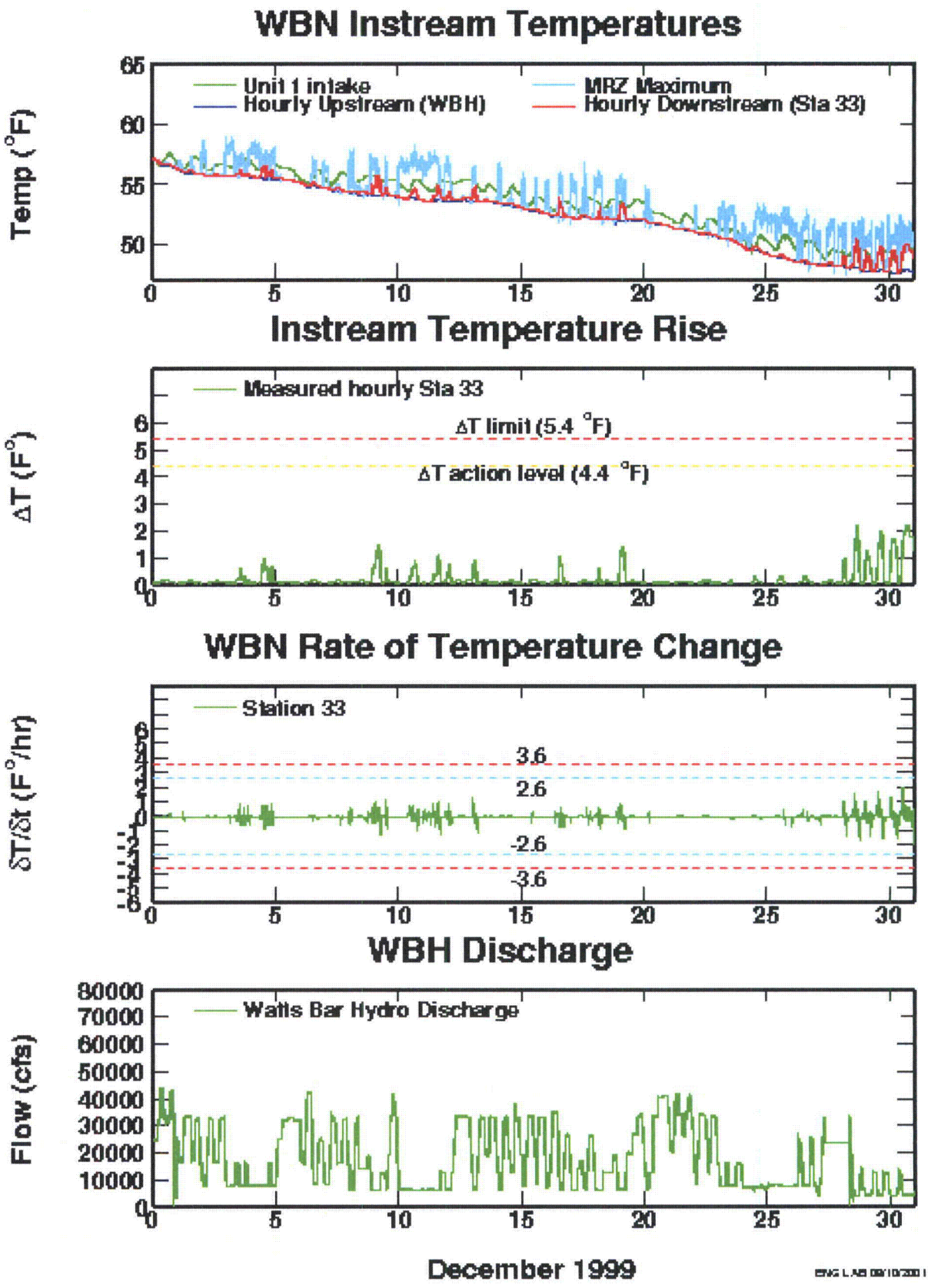


Figure 2.3.1a. SCCW Monitoring Data, December 1999

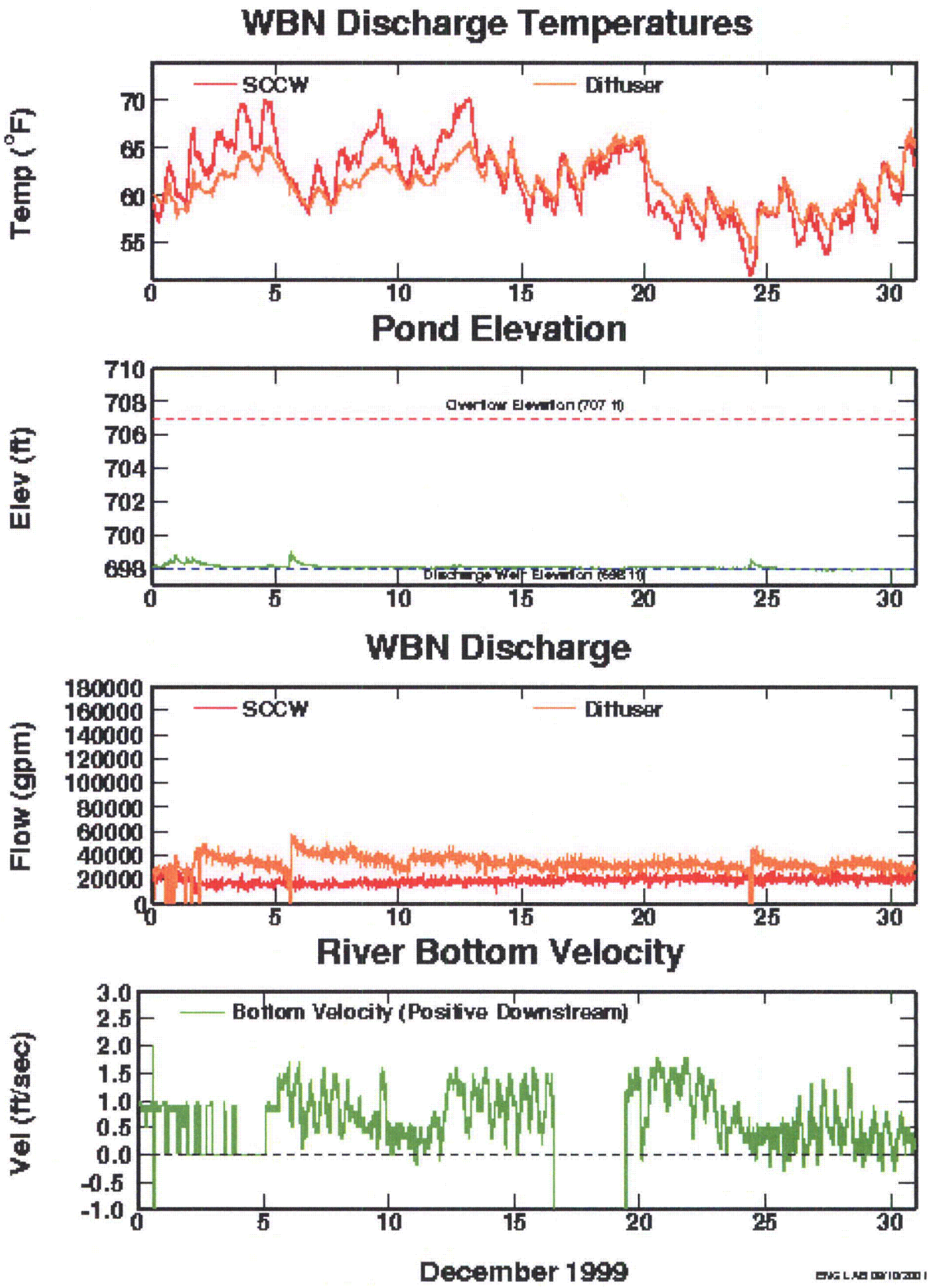


Figure 2.3.1b. SCCW Monitoring Data, December 1999

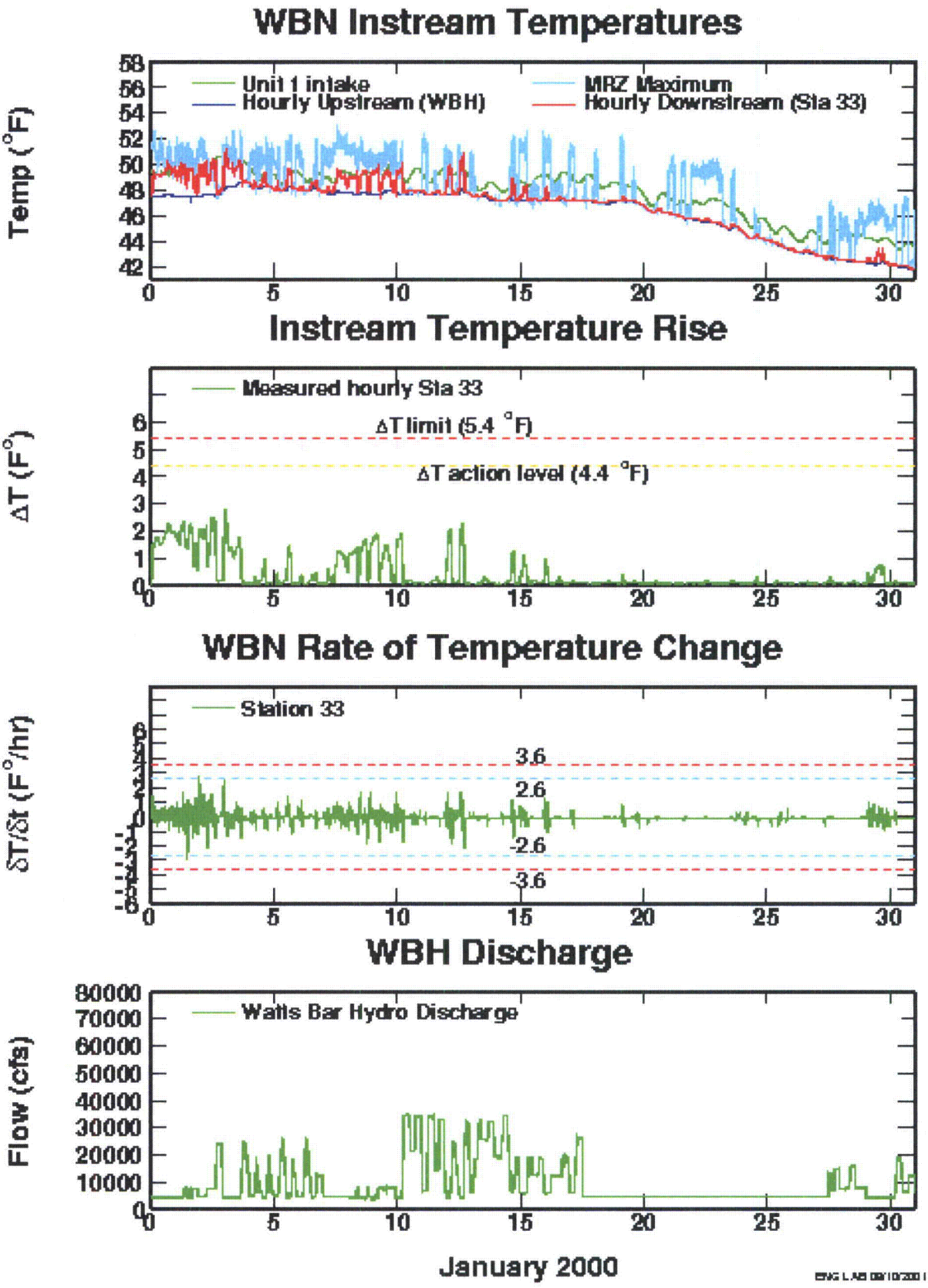


Figure 2.3.2a. SCCW Monitoring Data, January 2000

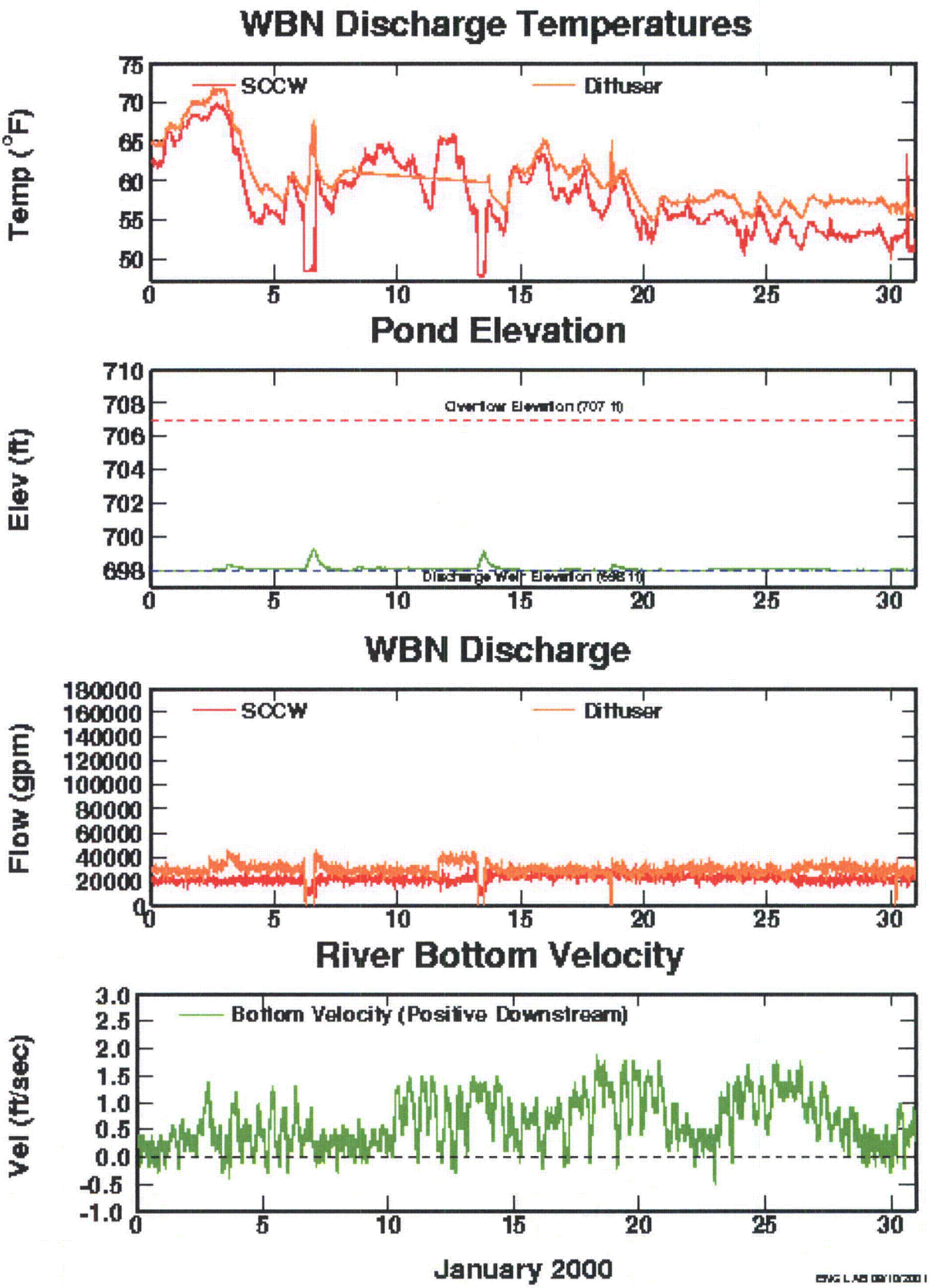


Figure 2.3.2b. SCCW Monitoring Data, January 2000

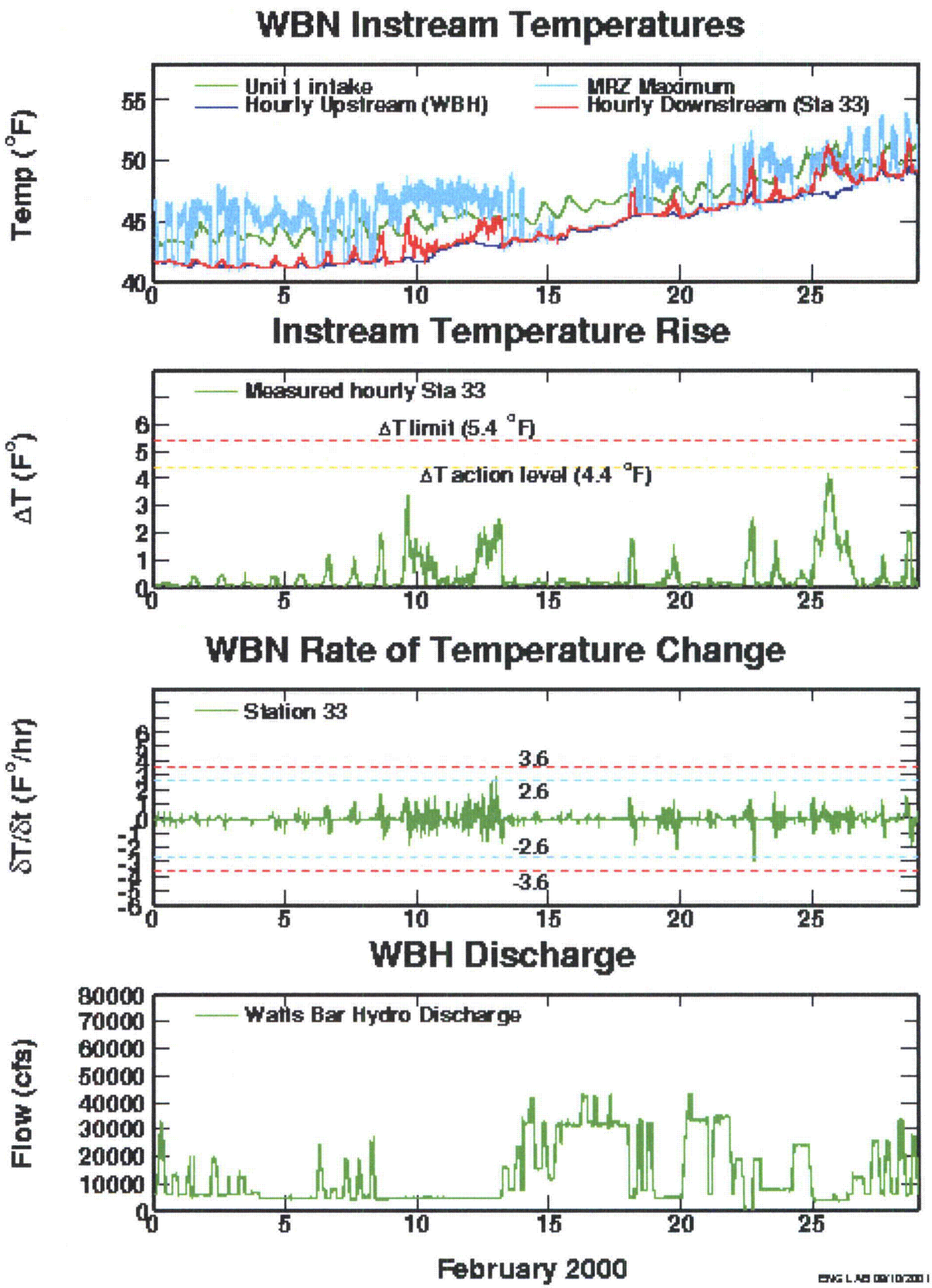


Figure 2.3.3a. SCCW Monitoring Data, February 2000

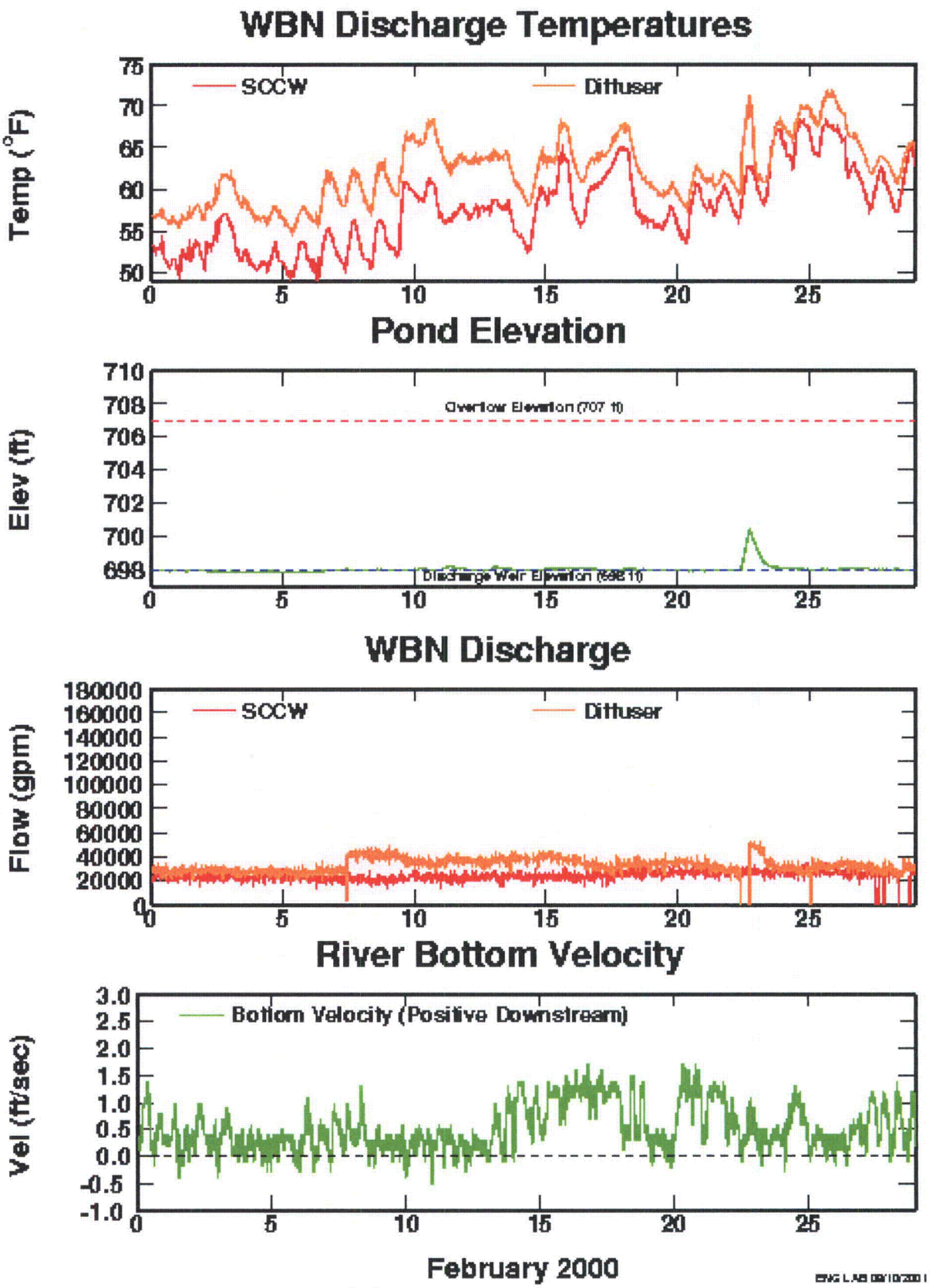


Figure 2.3.3b. SCCW Monitoring Data, February 2000

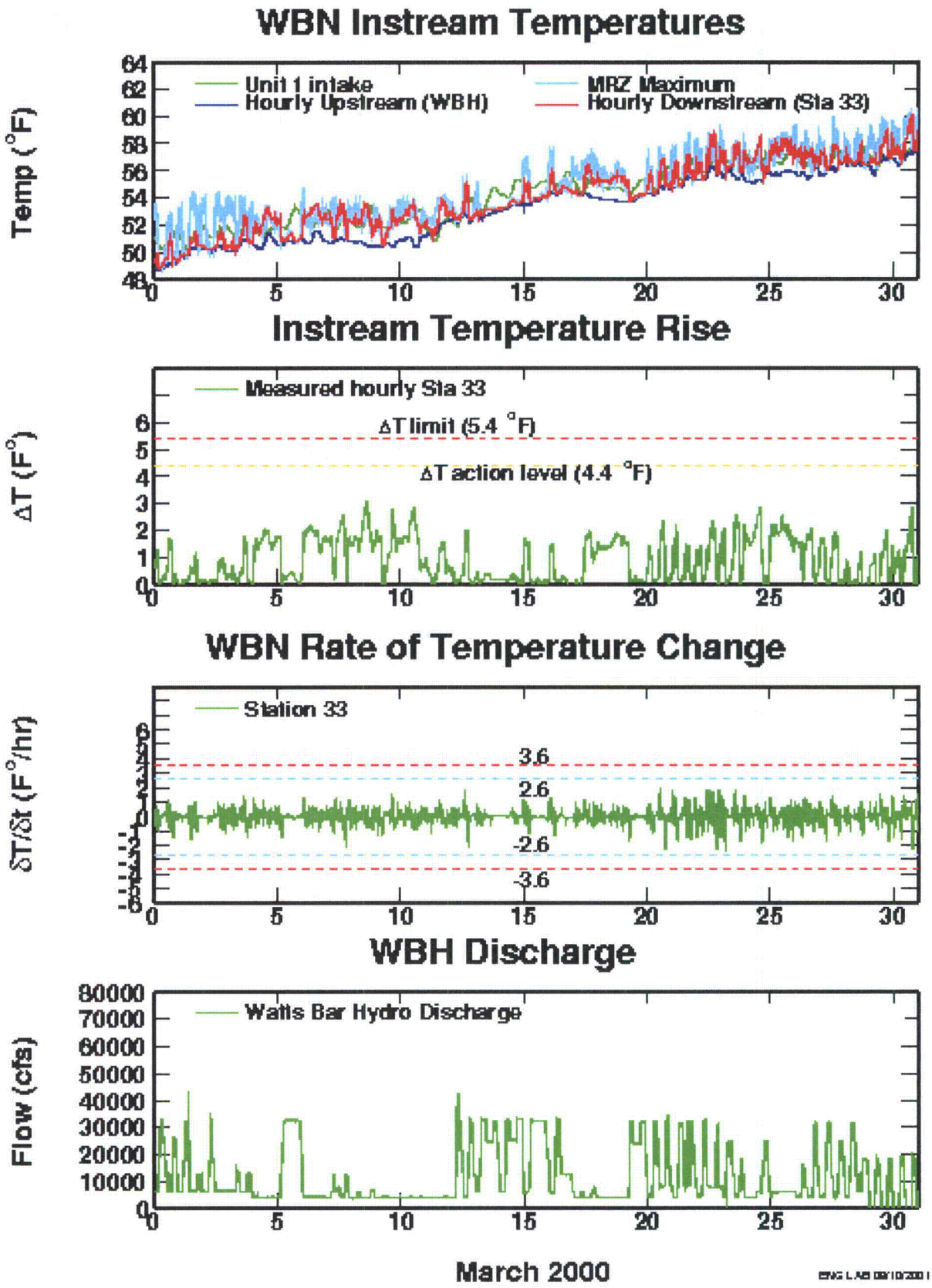


Figure 2.3.4a. SCCW Monitoring Data, March 2000

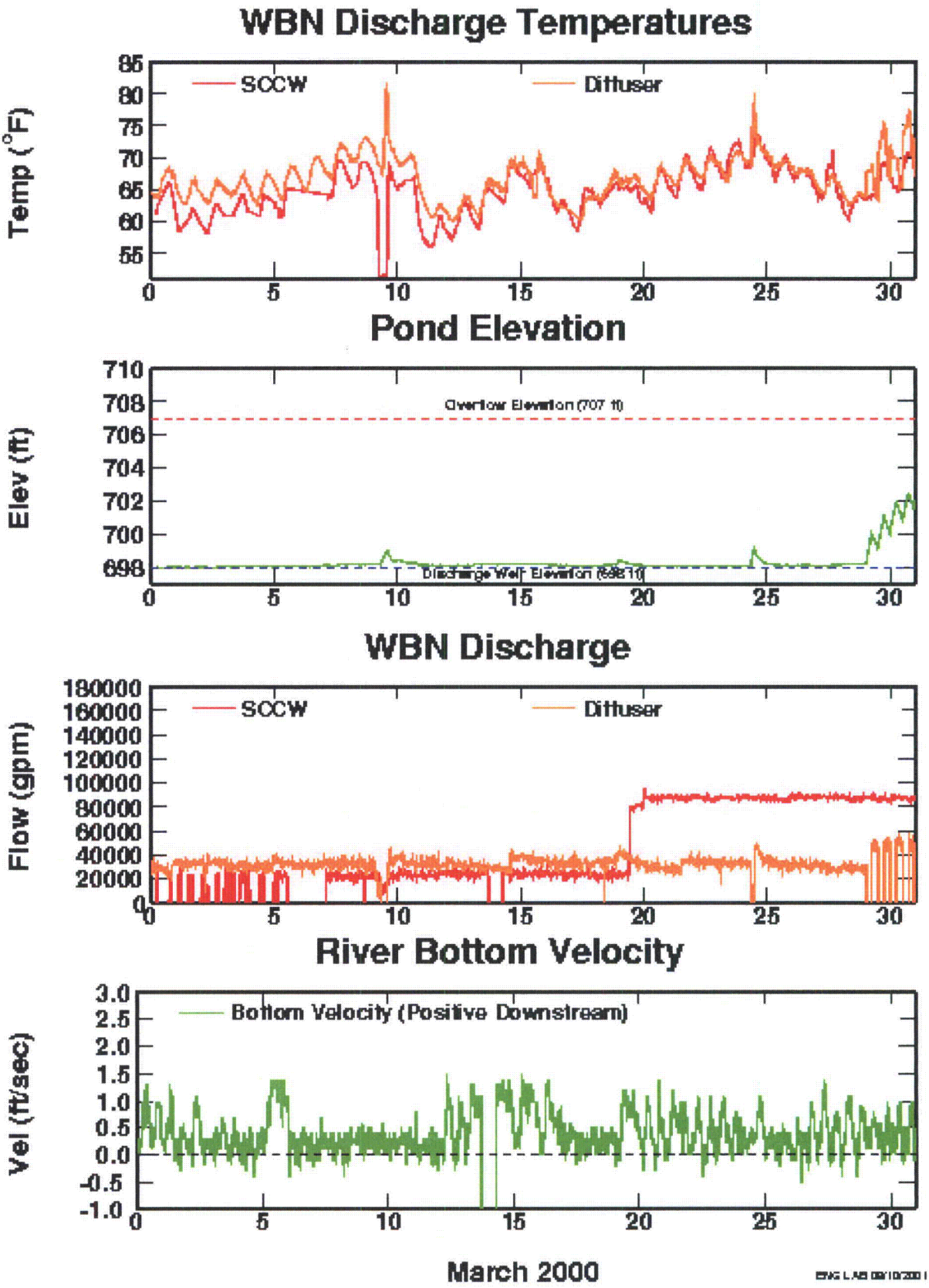


Figure 2.3.4b. SCCW Monitoring Data, March 2000

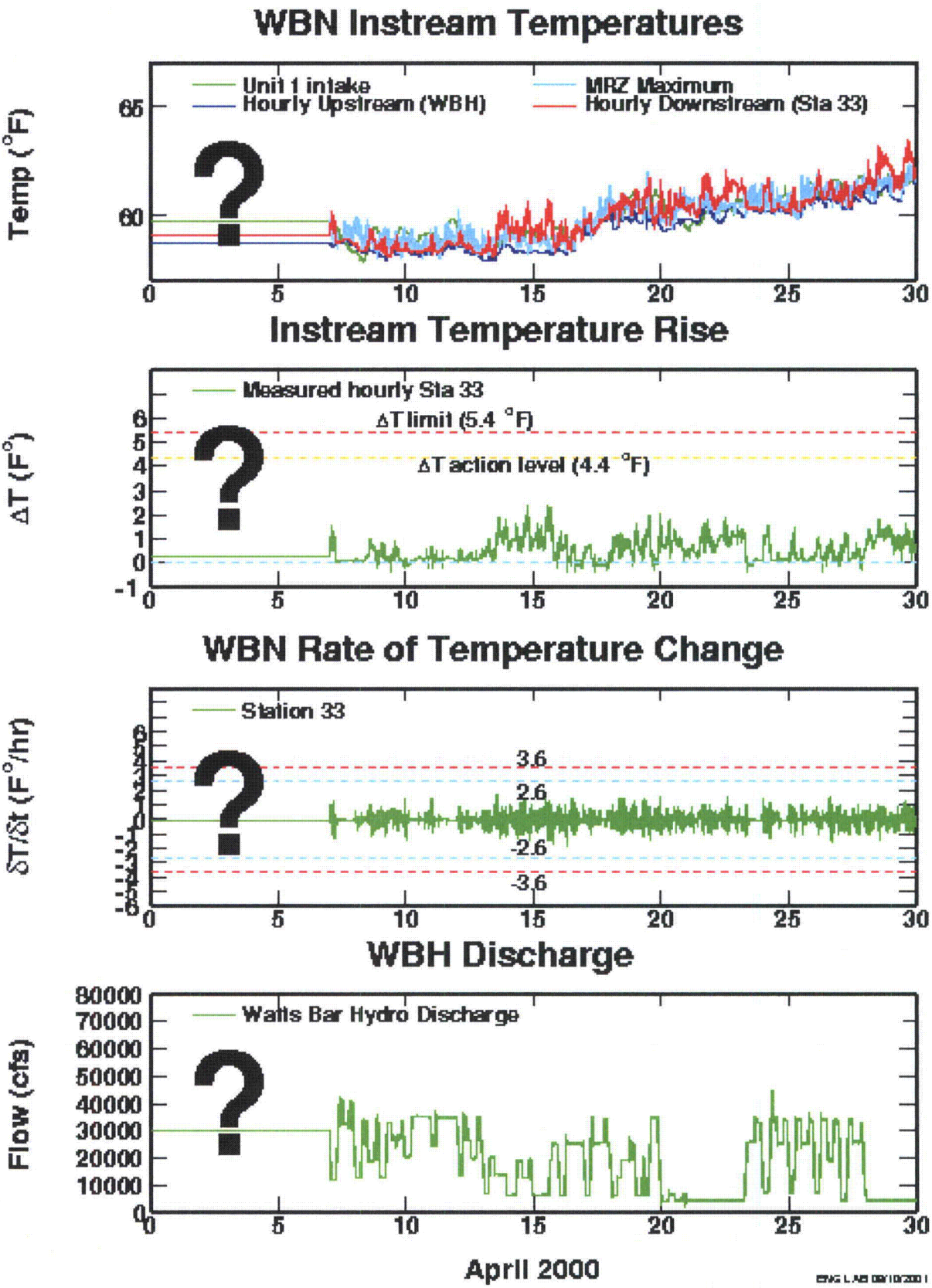


Figure 2.3.5a. SCCW Monitoring Data, April 2000

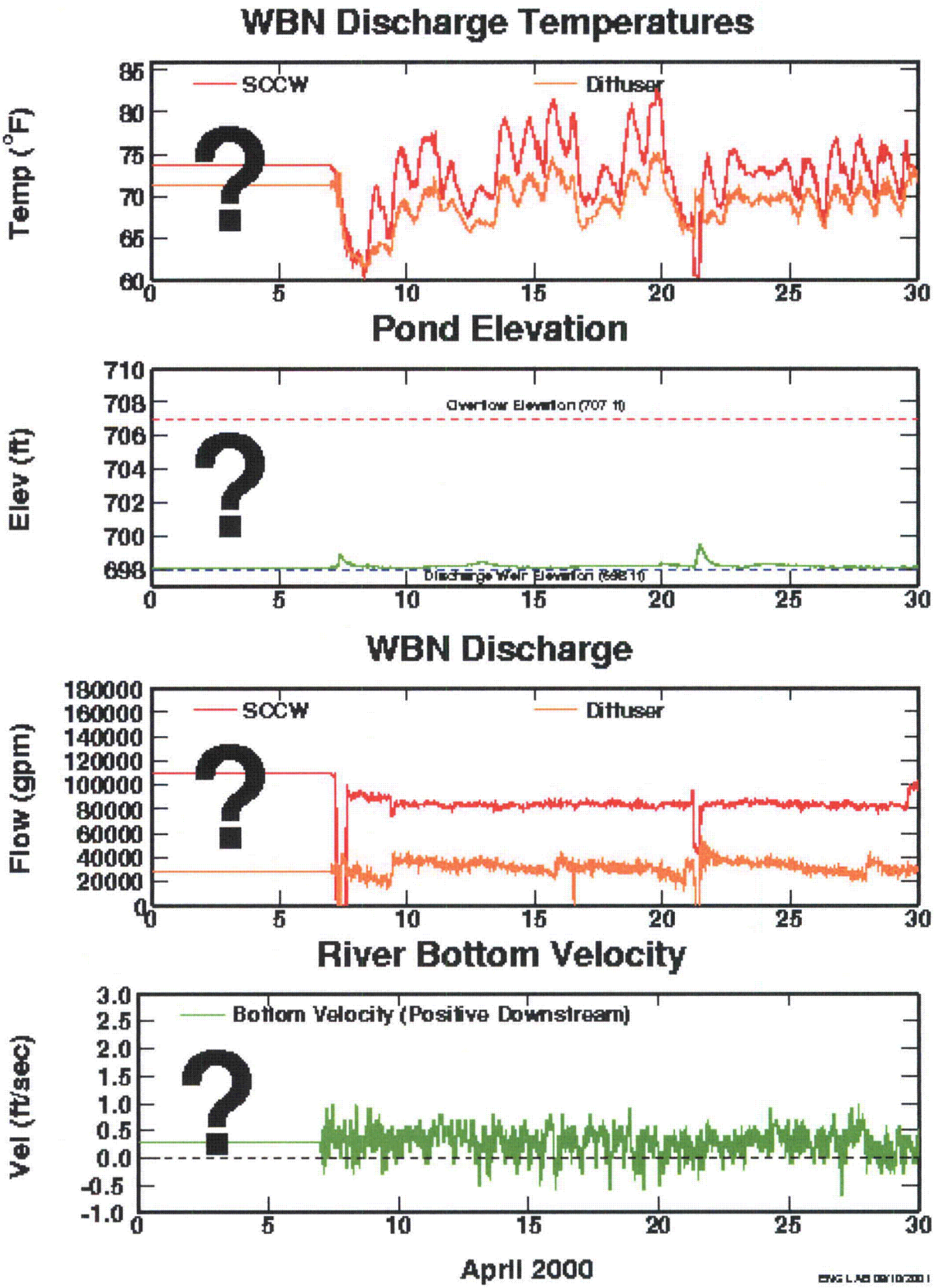


Figure 2.3.5b. SCCW Monitoring Data, April 2000

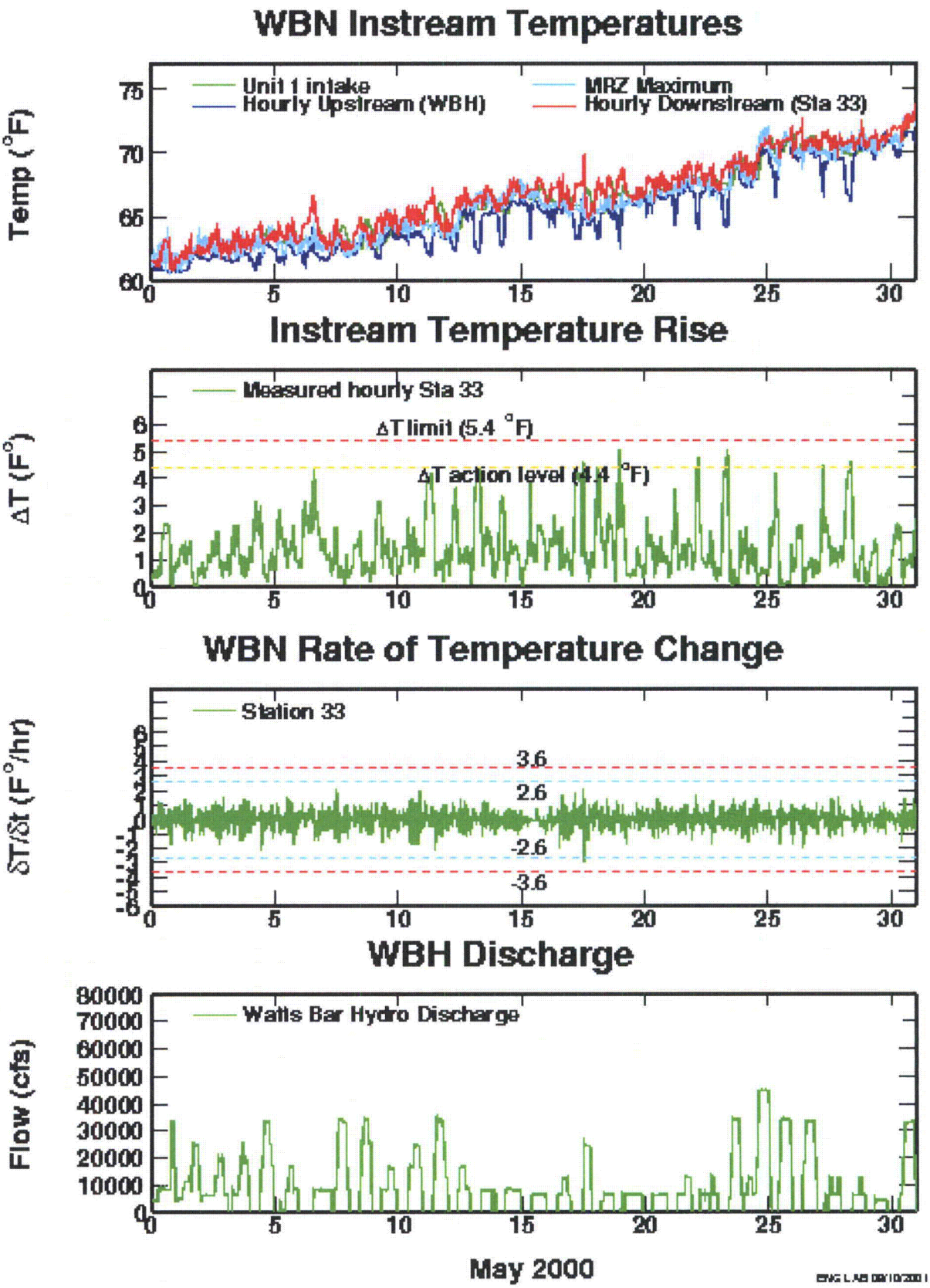


Figure 2.3.6a. SCCW Monitoring Data, May 2000

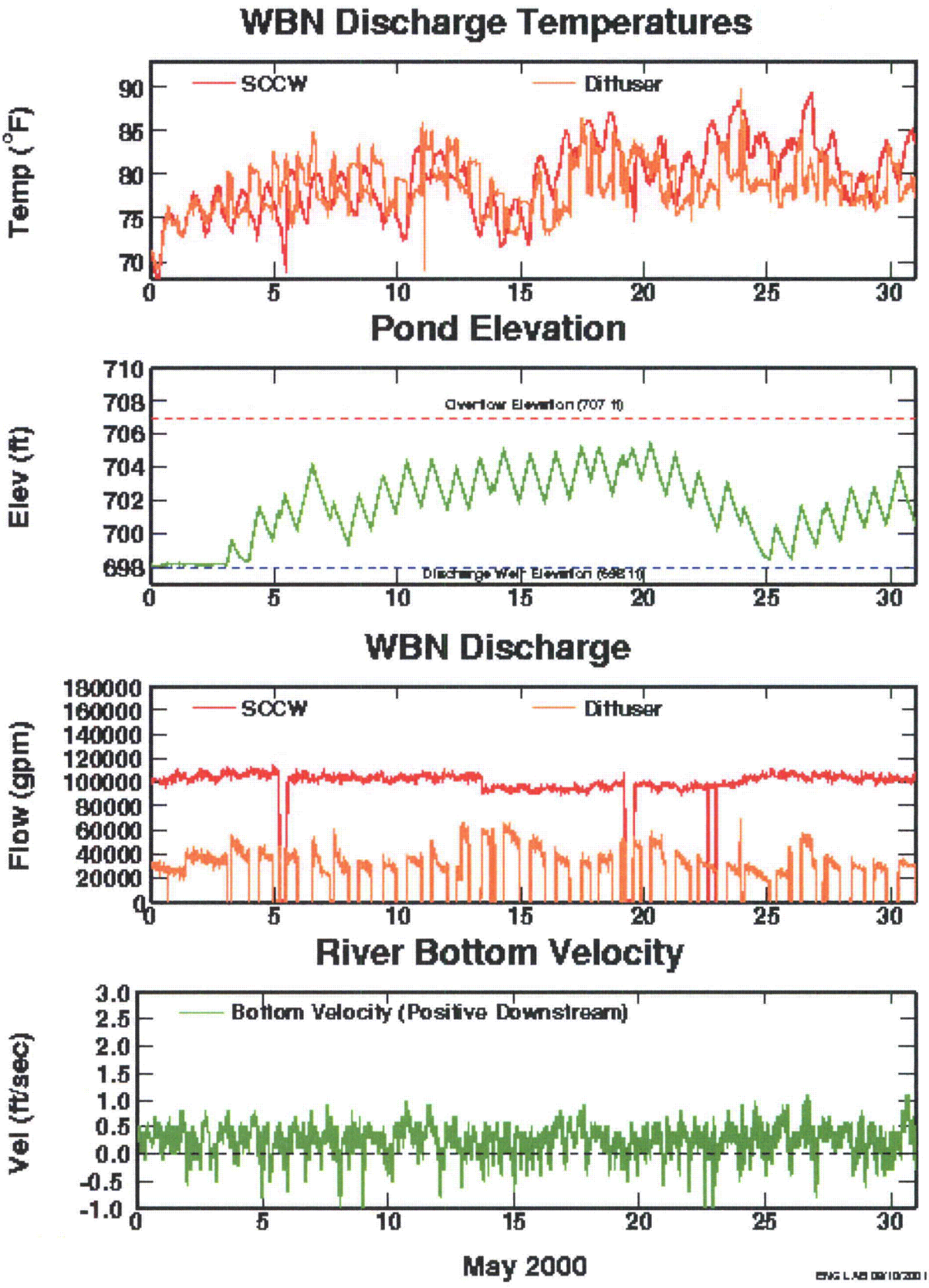


Figure 2.3.6b. SCCW Monitoring Data, May 2000

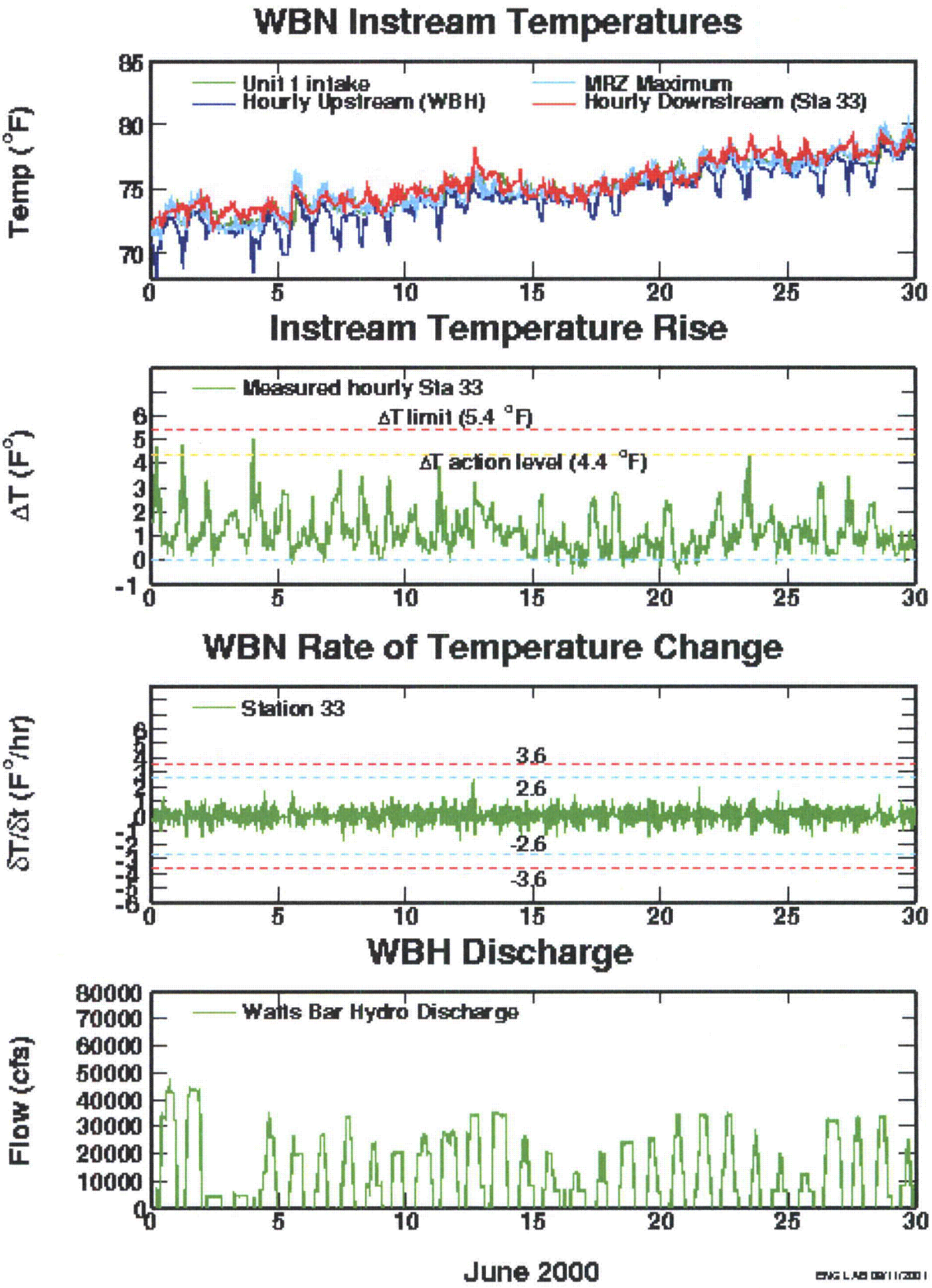


Figure 2.3.7a. SCCW Monitoring Data, June 2000

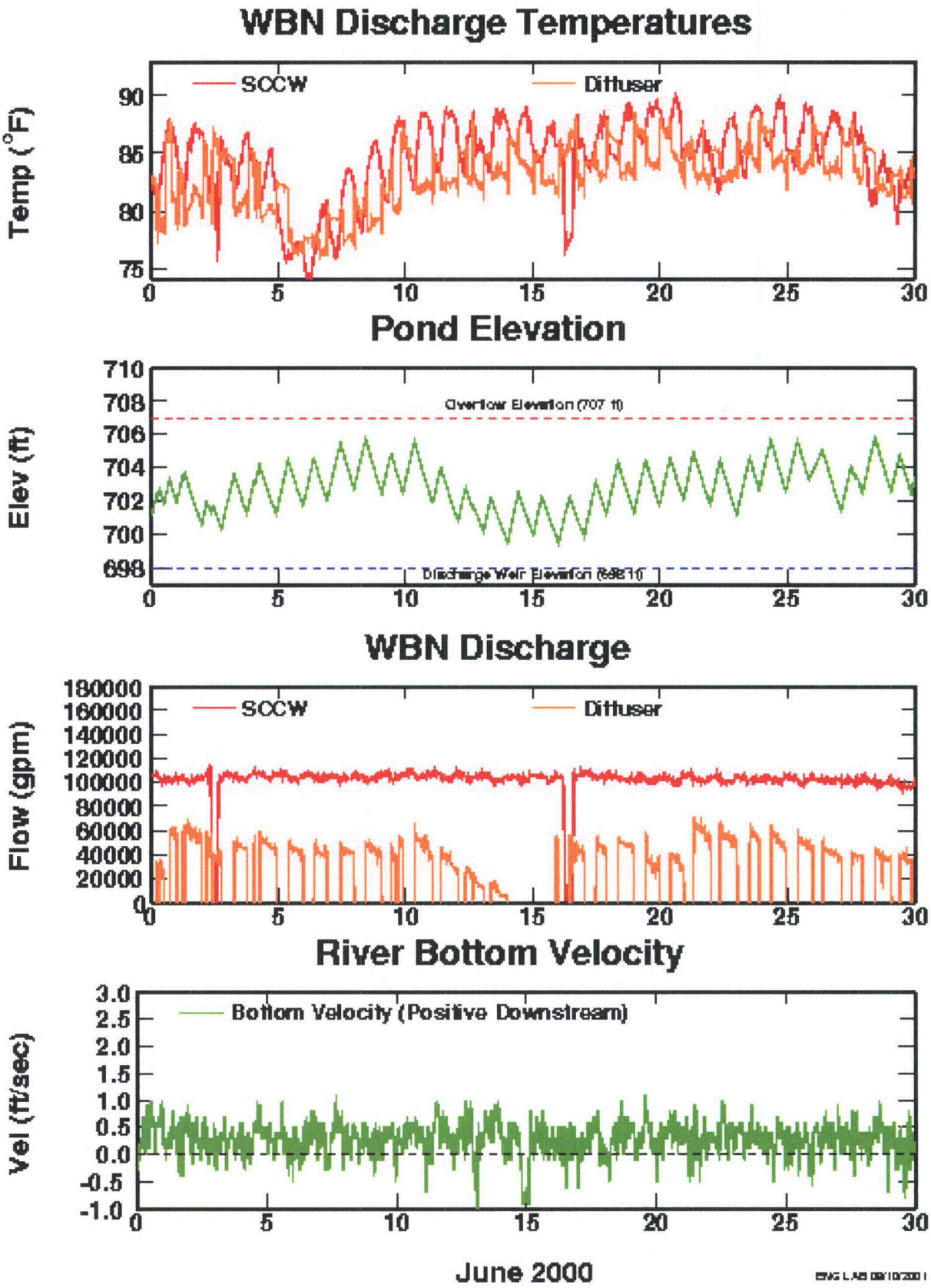


Figure 2.3.7b. SCCW Monitoring Data, June 2000

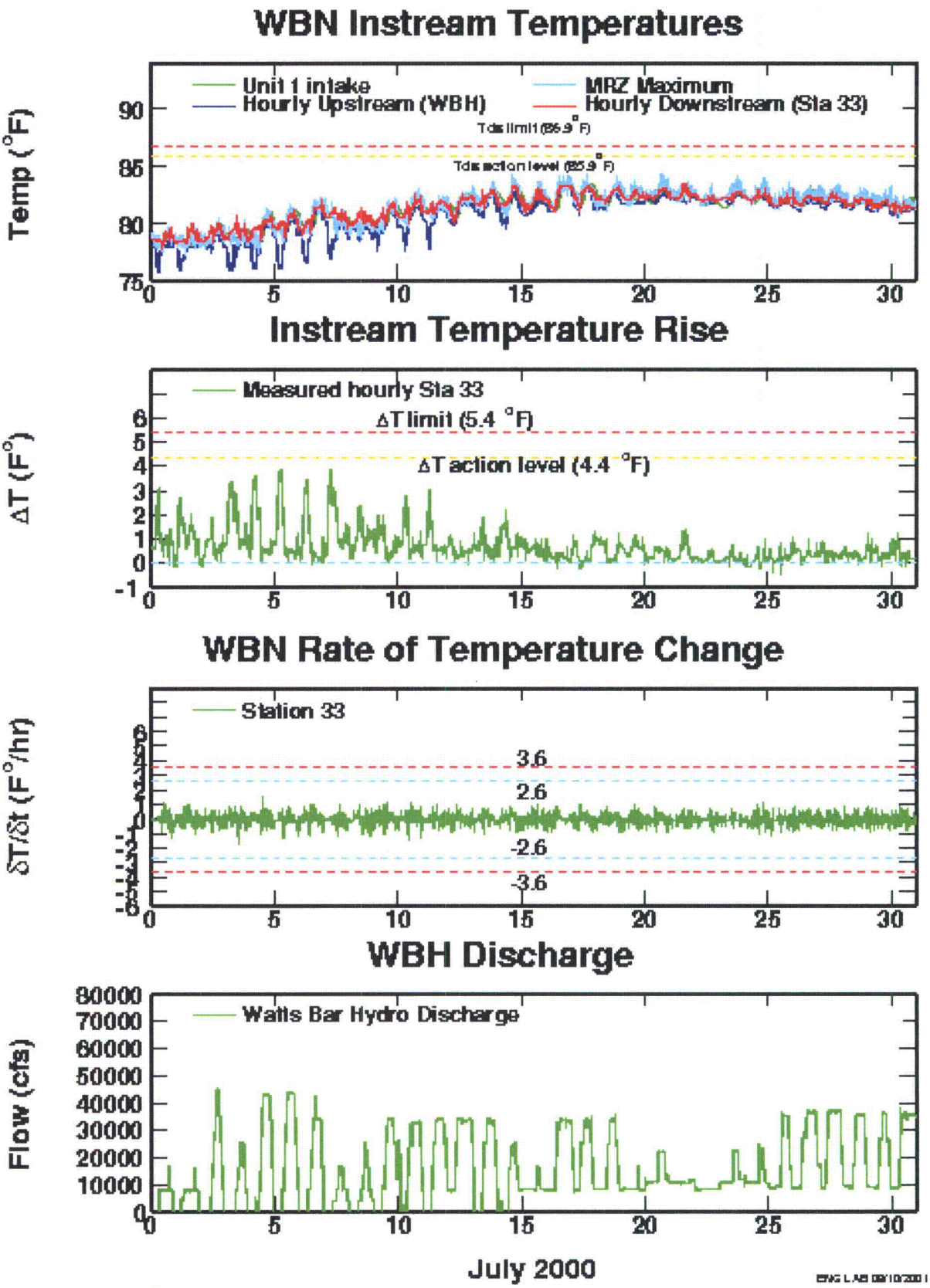


Figure 2.3.8a. SCCW Monitoring Data, July 2000

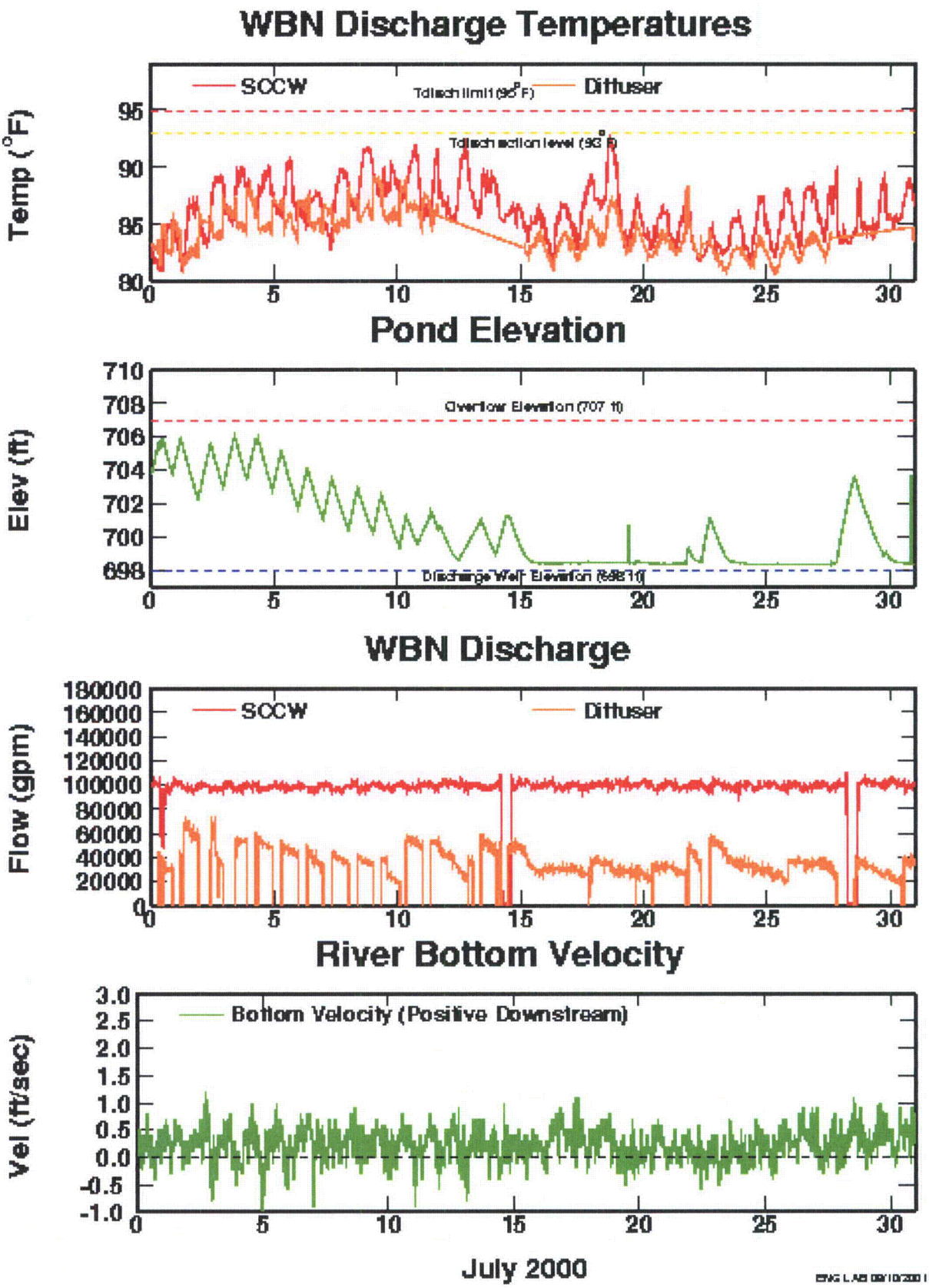


Figure 2.3.8b. SCCW Monitoring Data, July 2000

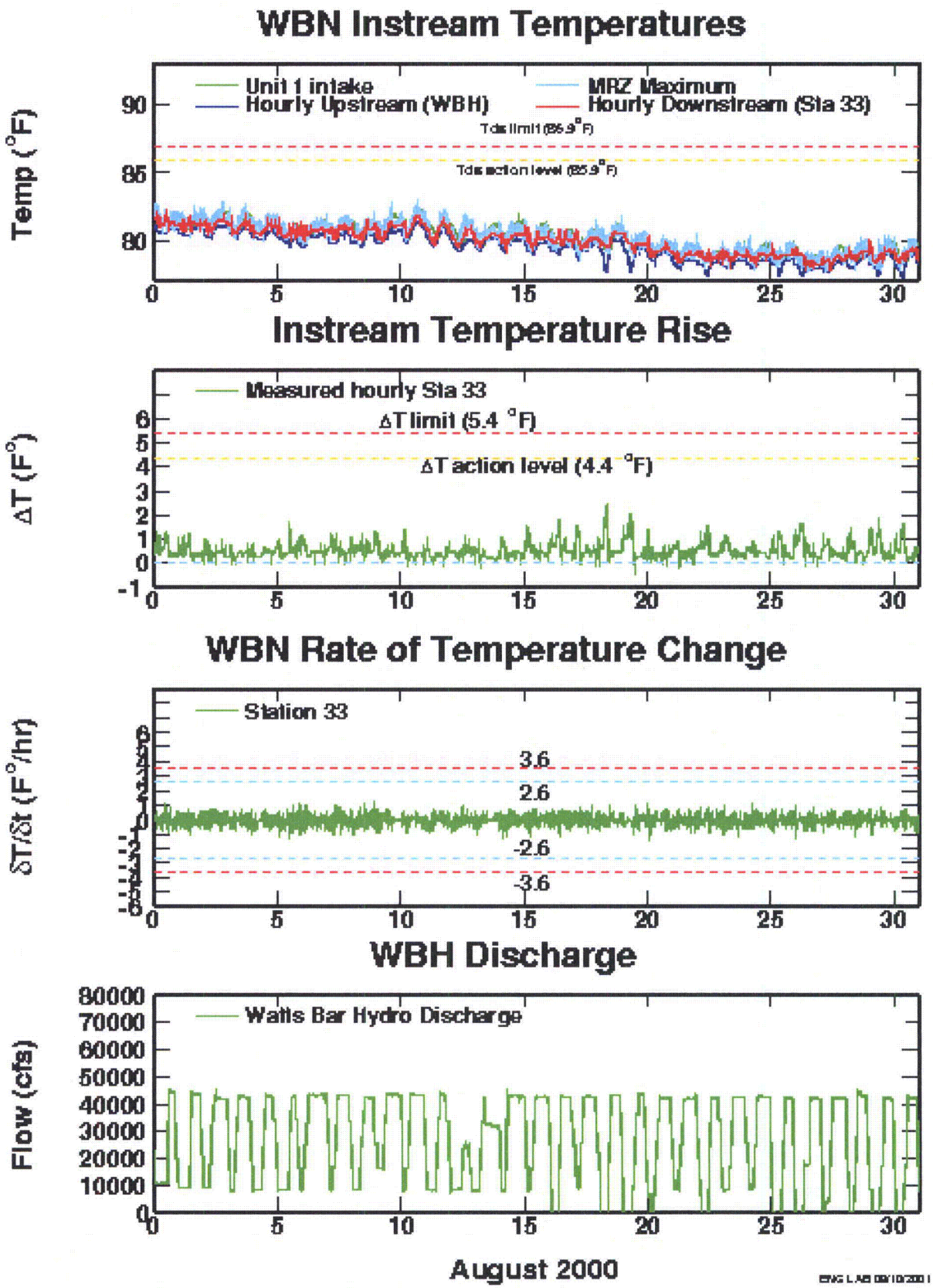


Figure 2.3.9a. SCCW Monitoring Data, August 2000

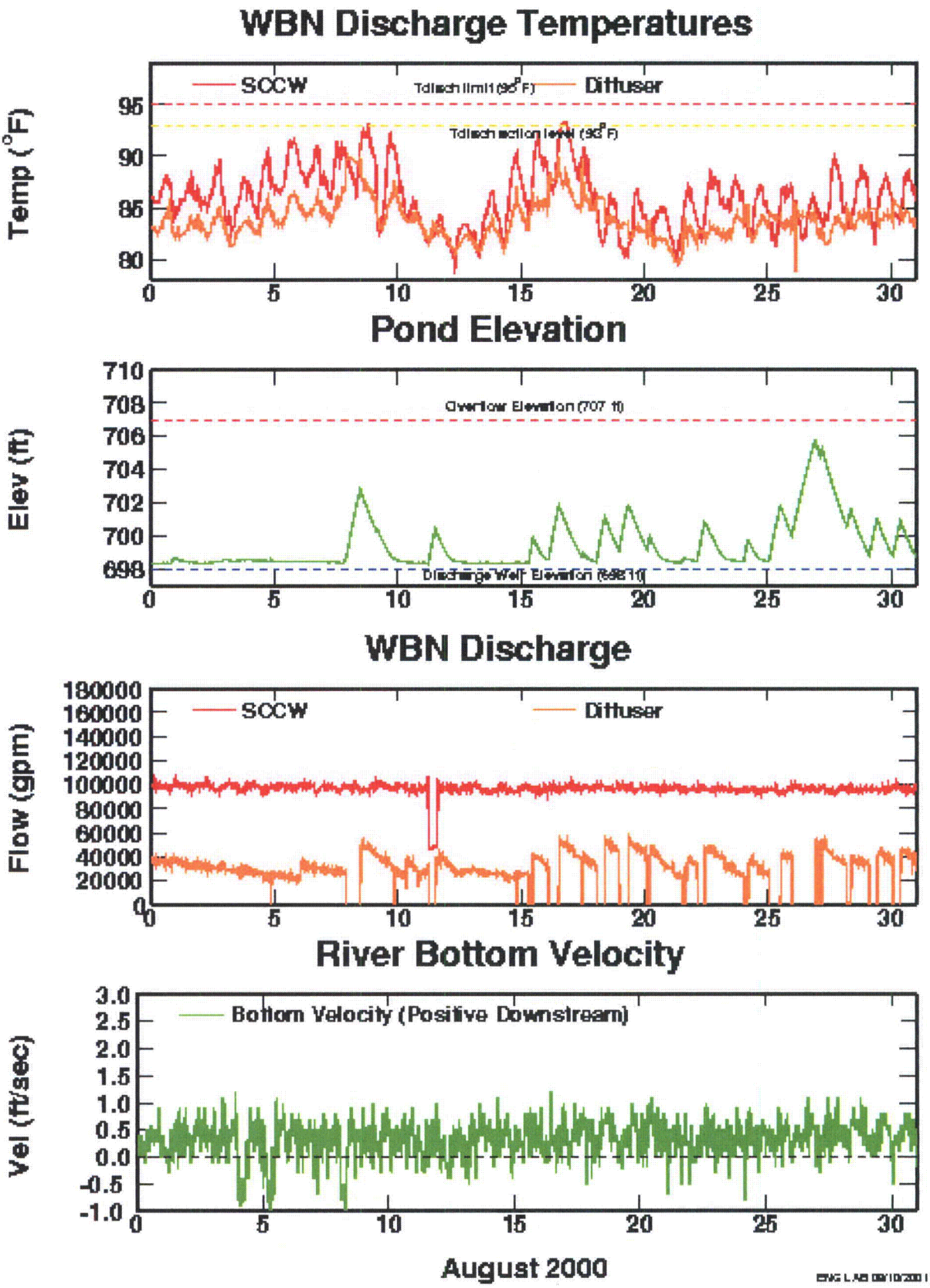


Figure 2.3.9b. SCCW Monitoring Data, August 2000

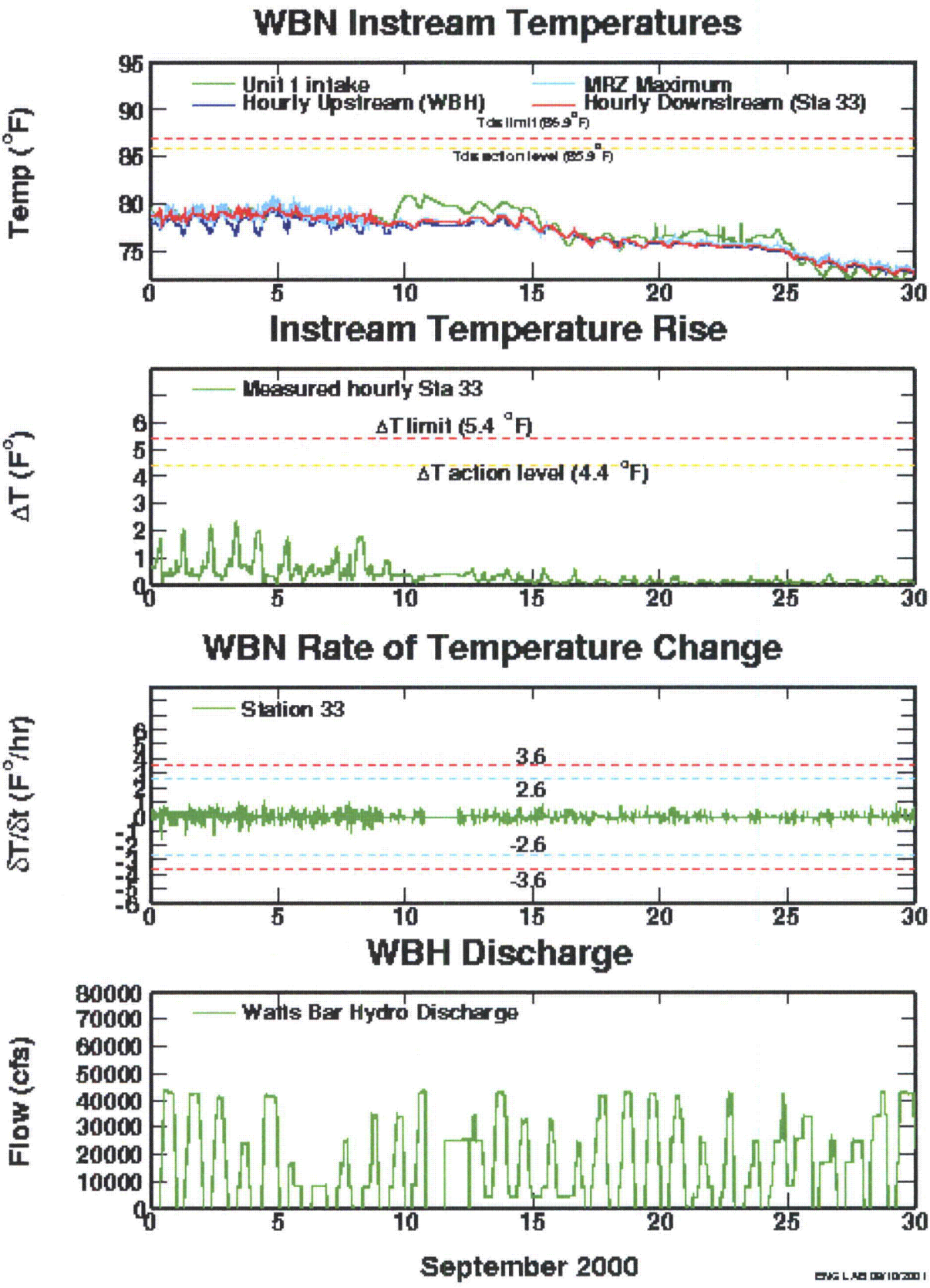


Figure 2.3.10a. SCCW Monitoring Data, September 2000

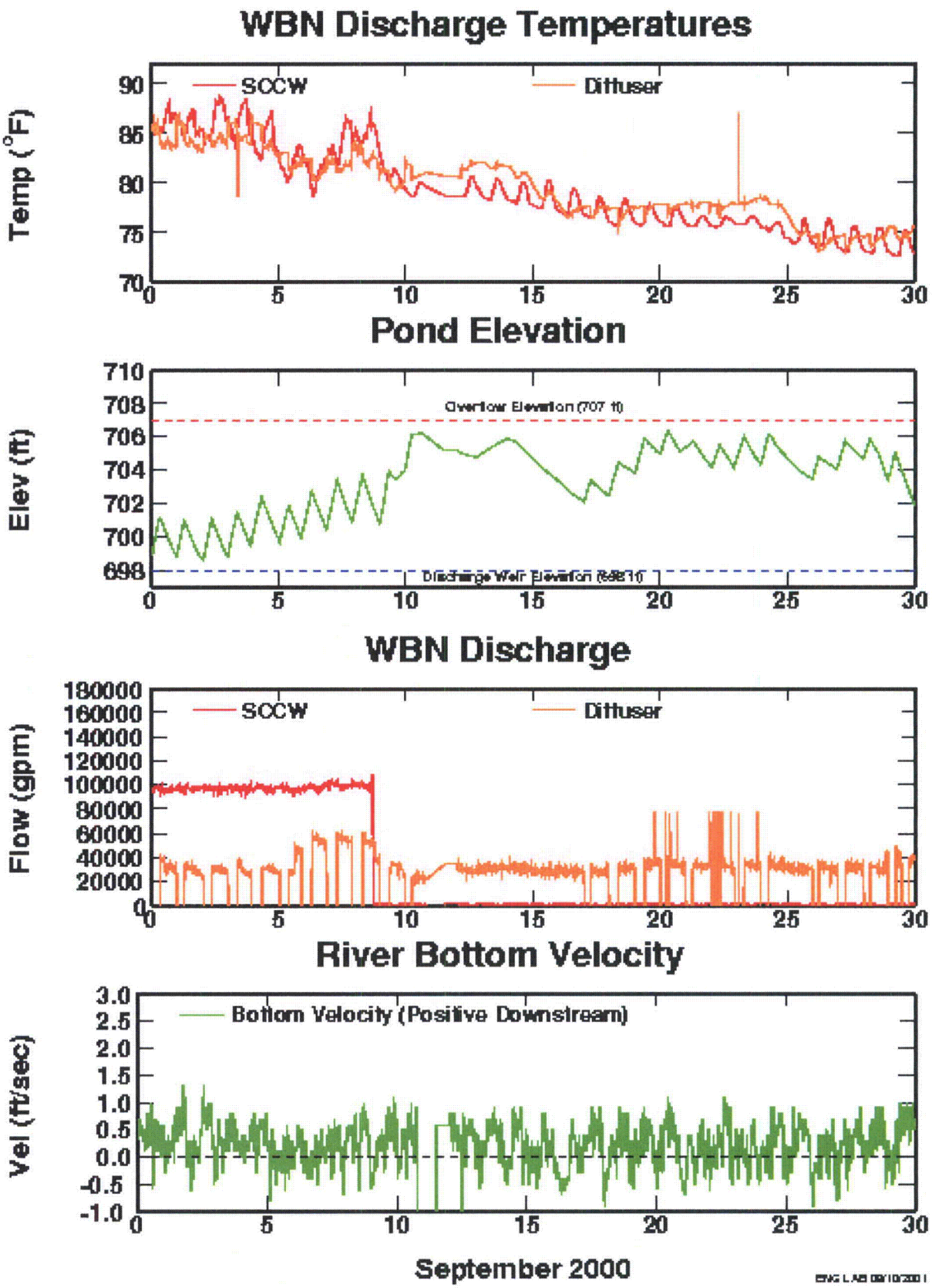


Figure 2.3.10b. SCCW Monitoring Data, September 2000

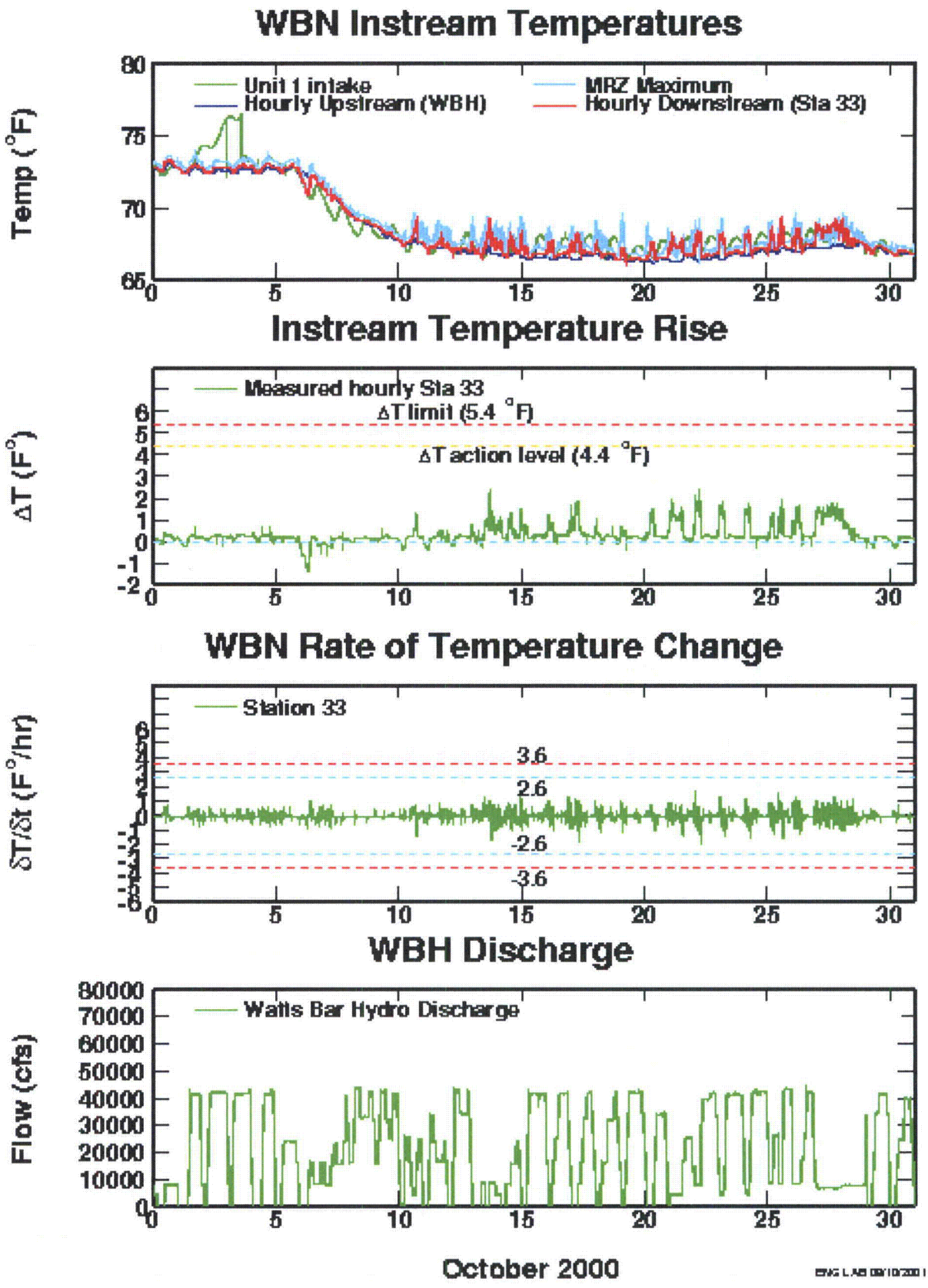


Figure 2.3.11a. SCCW Monitoring Data, October 2000

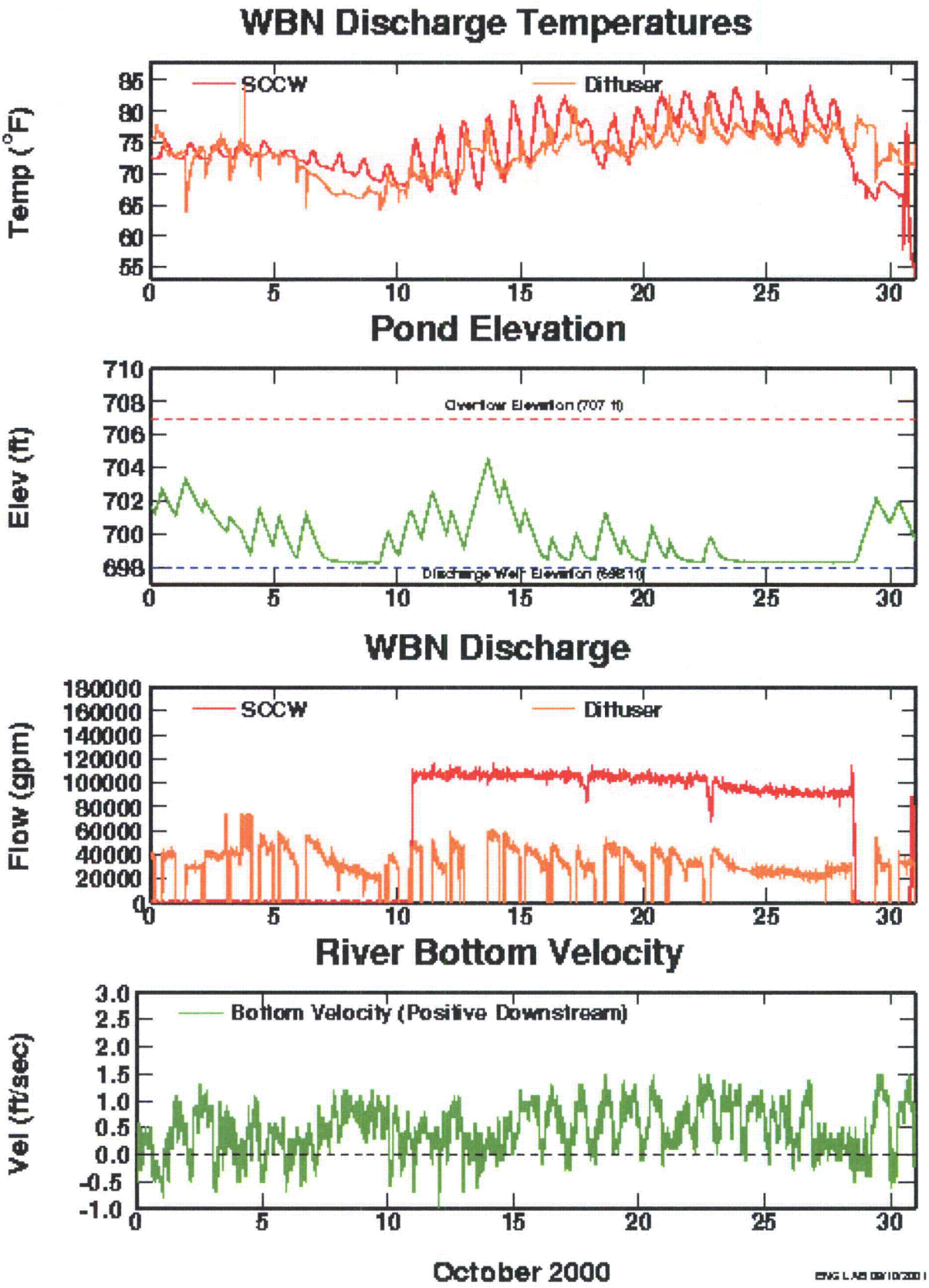


Figure 2.3.11b. SCCW Monitoring Data, October 2000

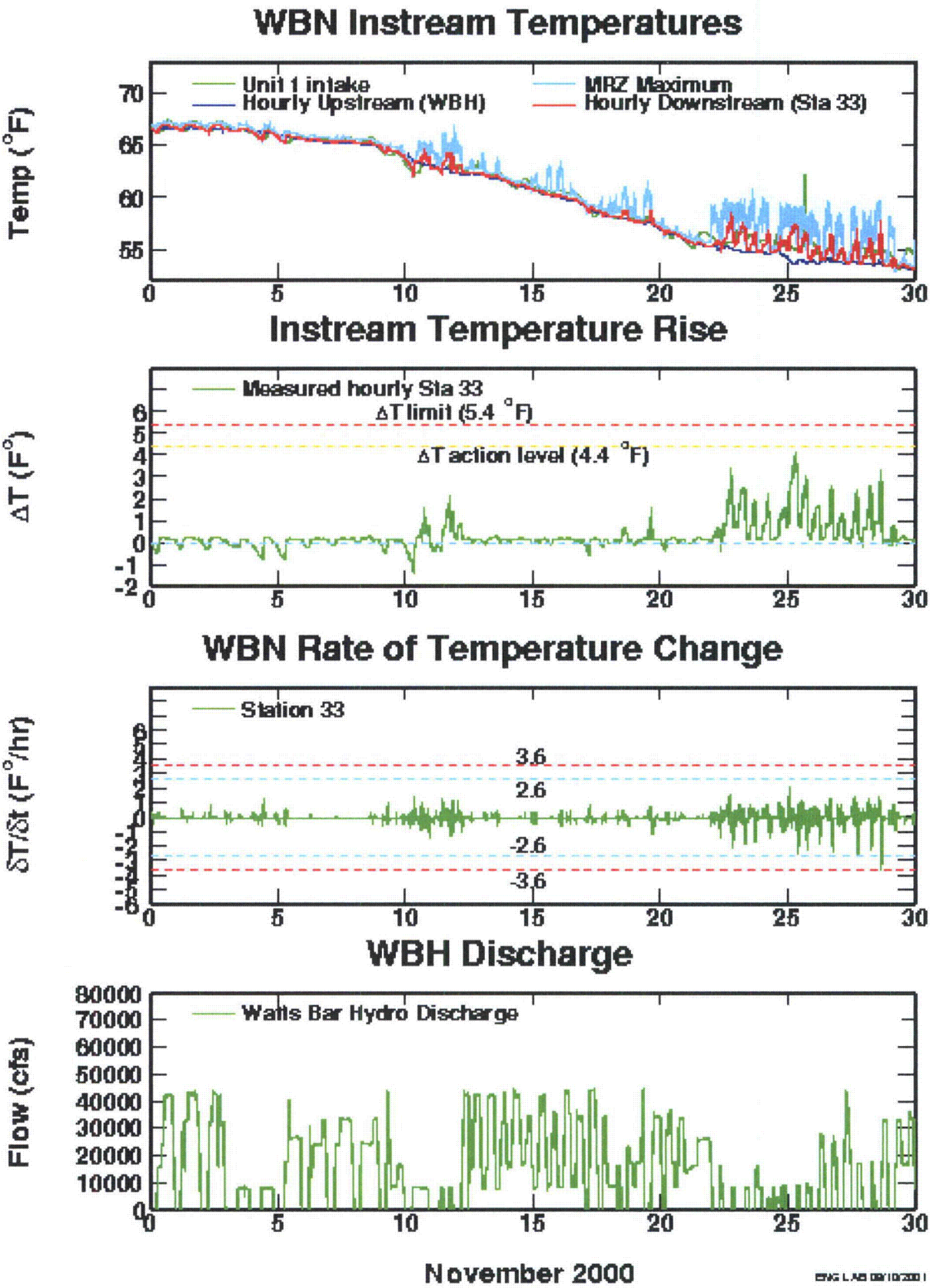
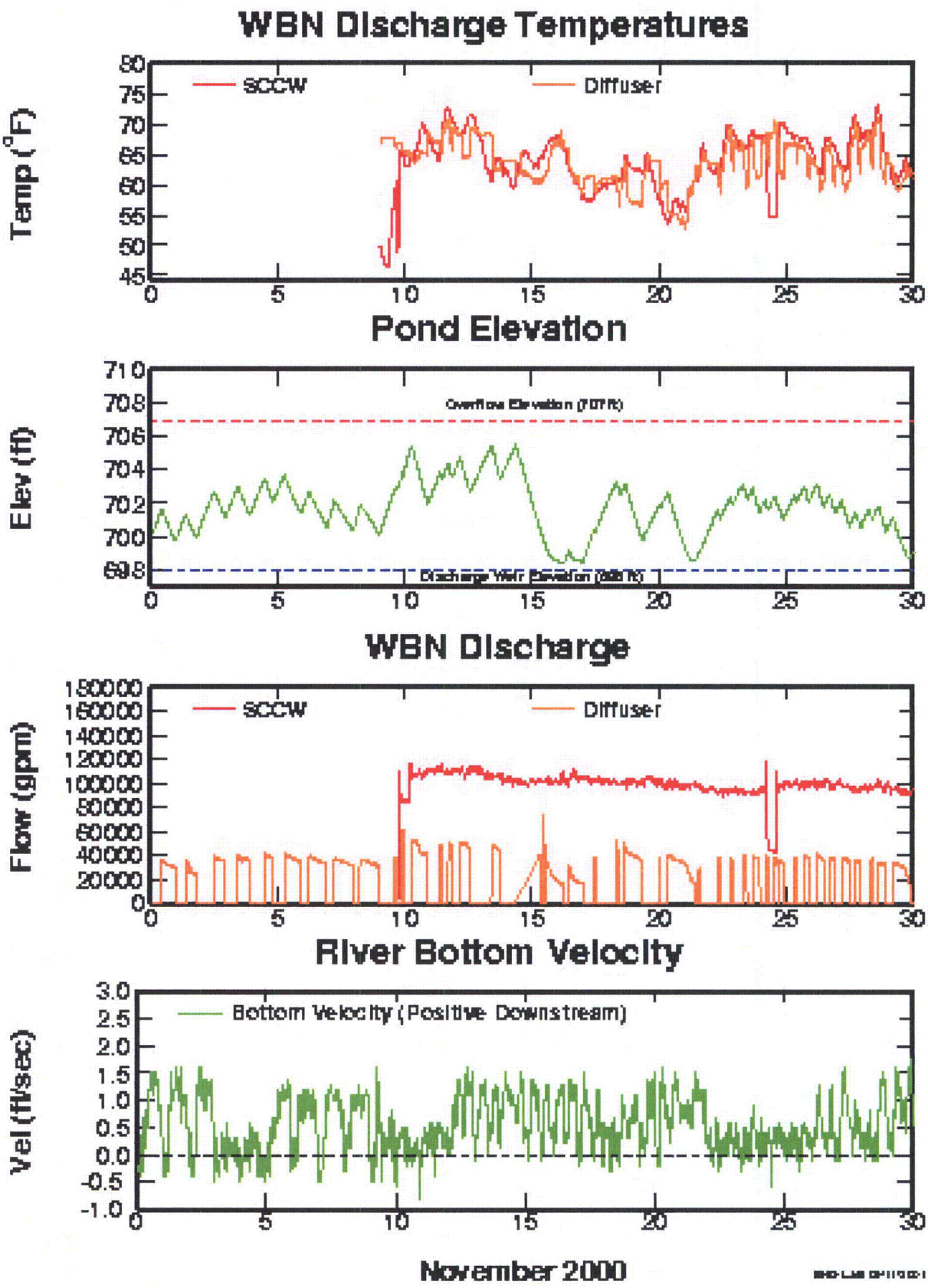


Figure 2.3.12a. SCCW Monitoring Data, November 2000



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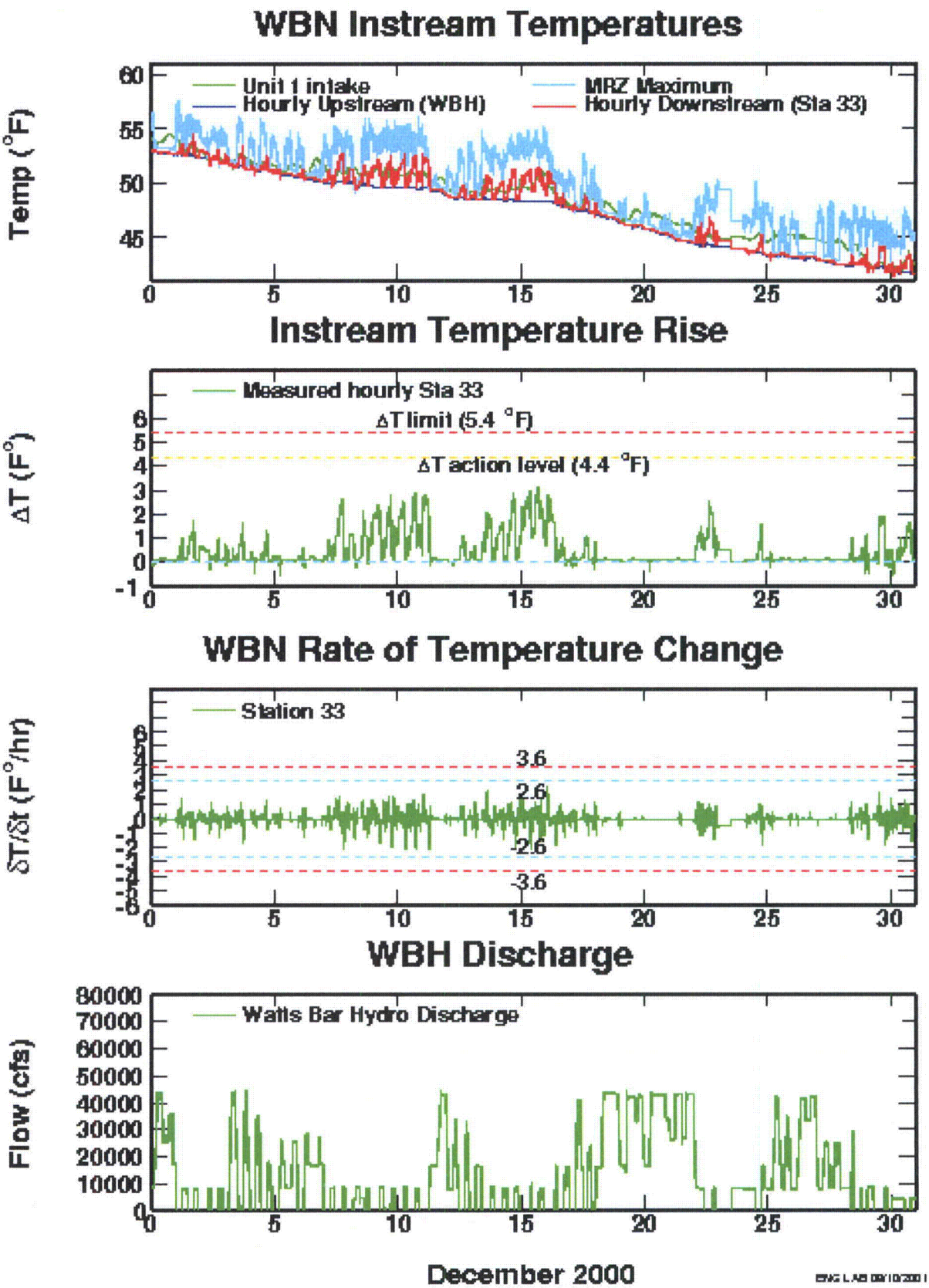
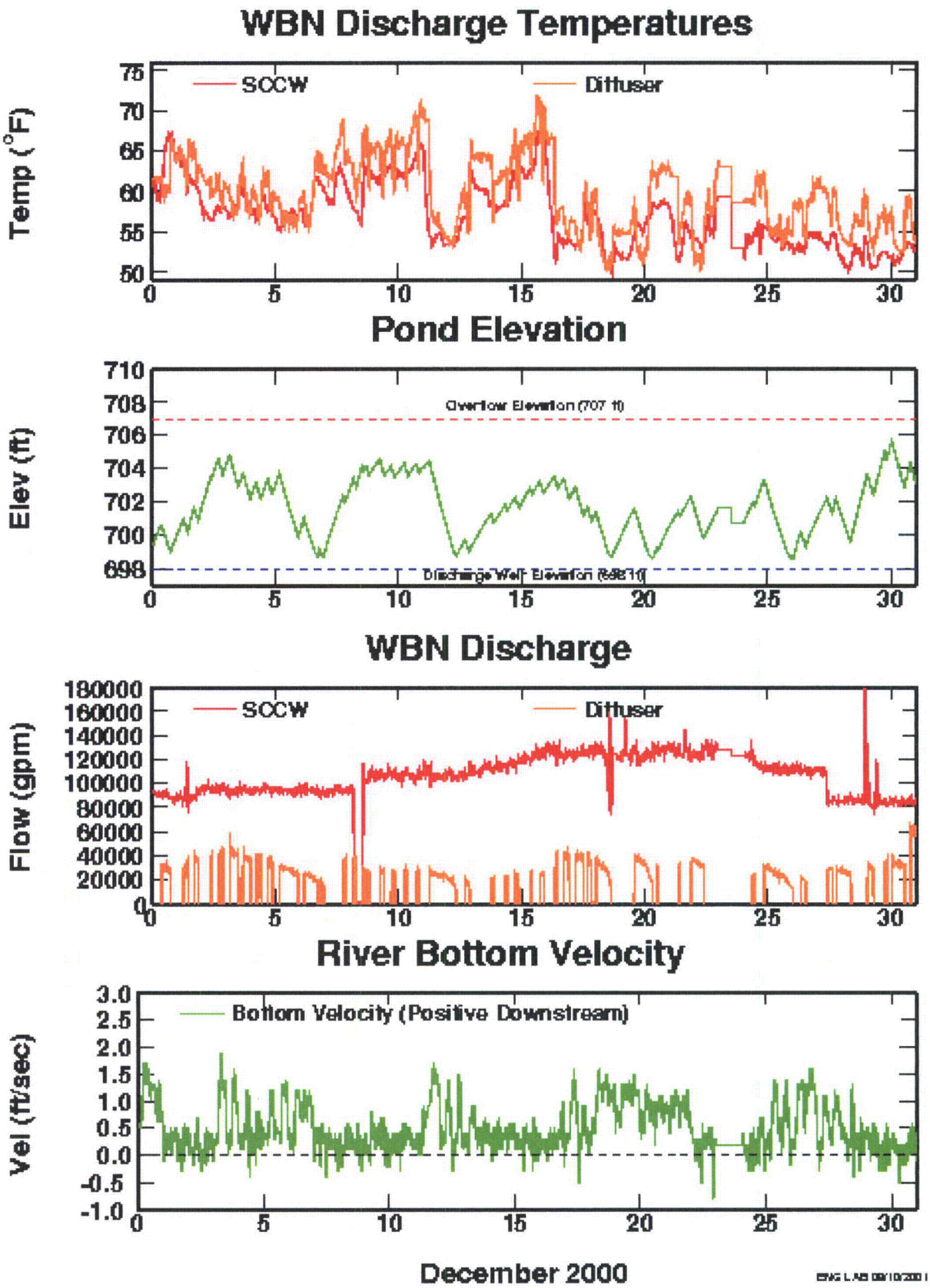


Figure 2.3.13a. SCCW Monitoring Data, December 2000



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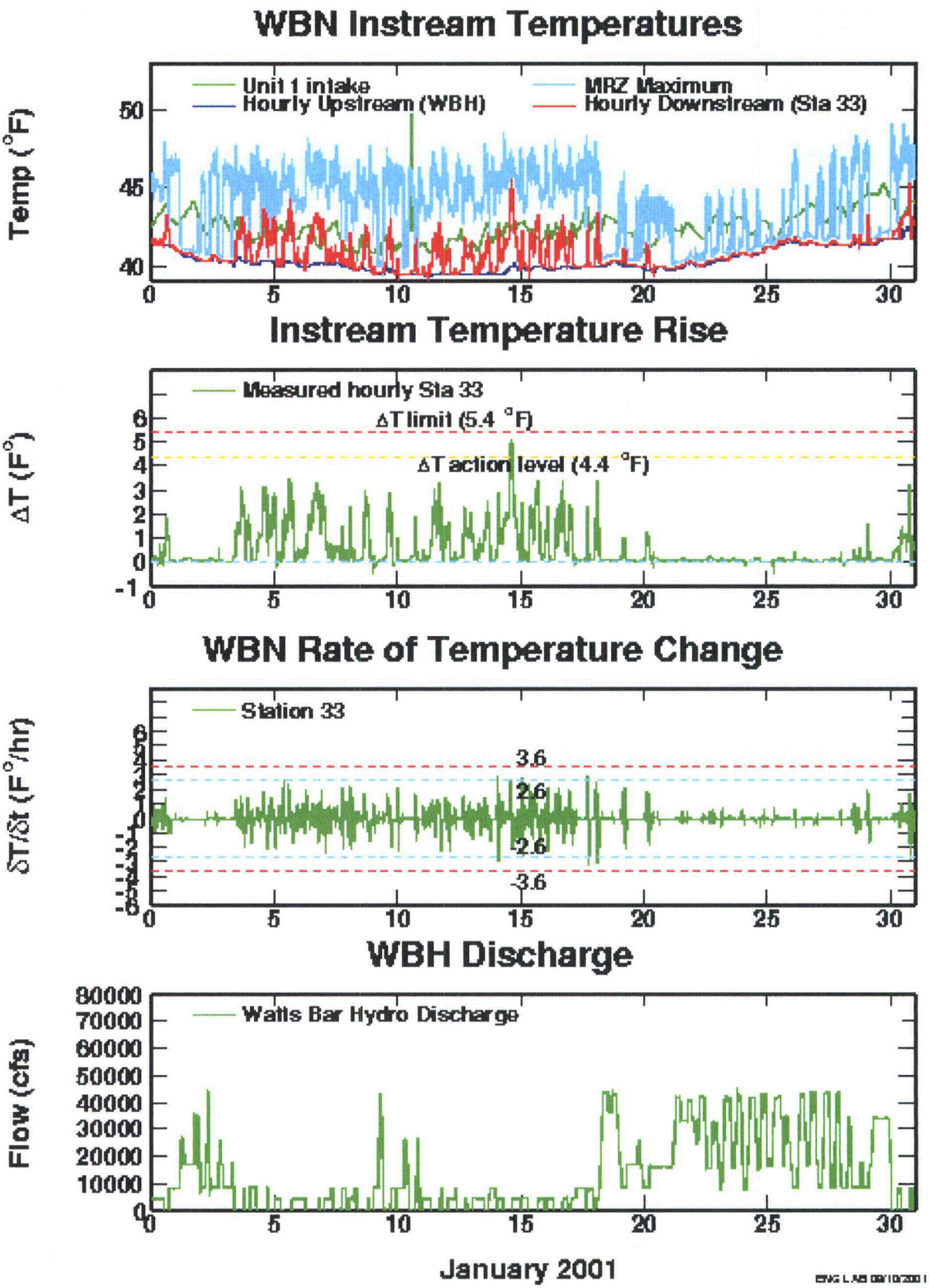
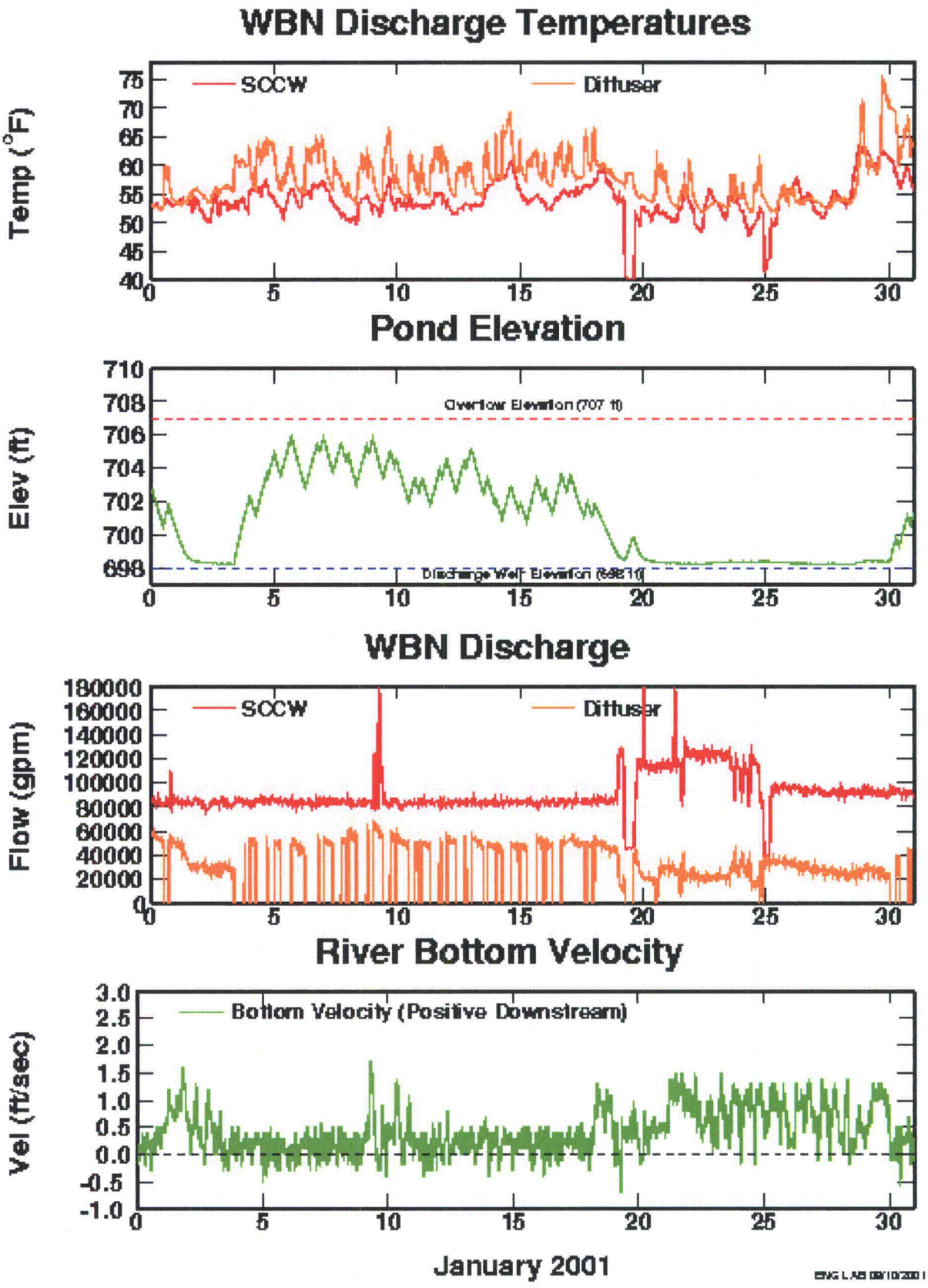


Figure 2.3.14a. SCCW Monitoring Data, January 2001



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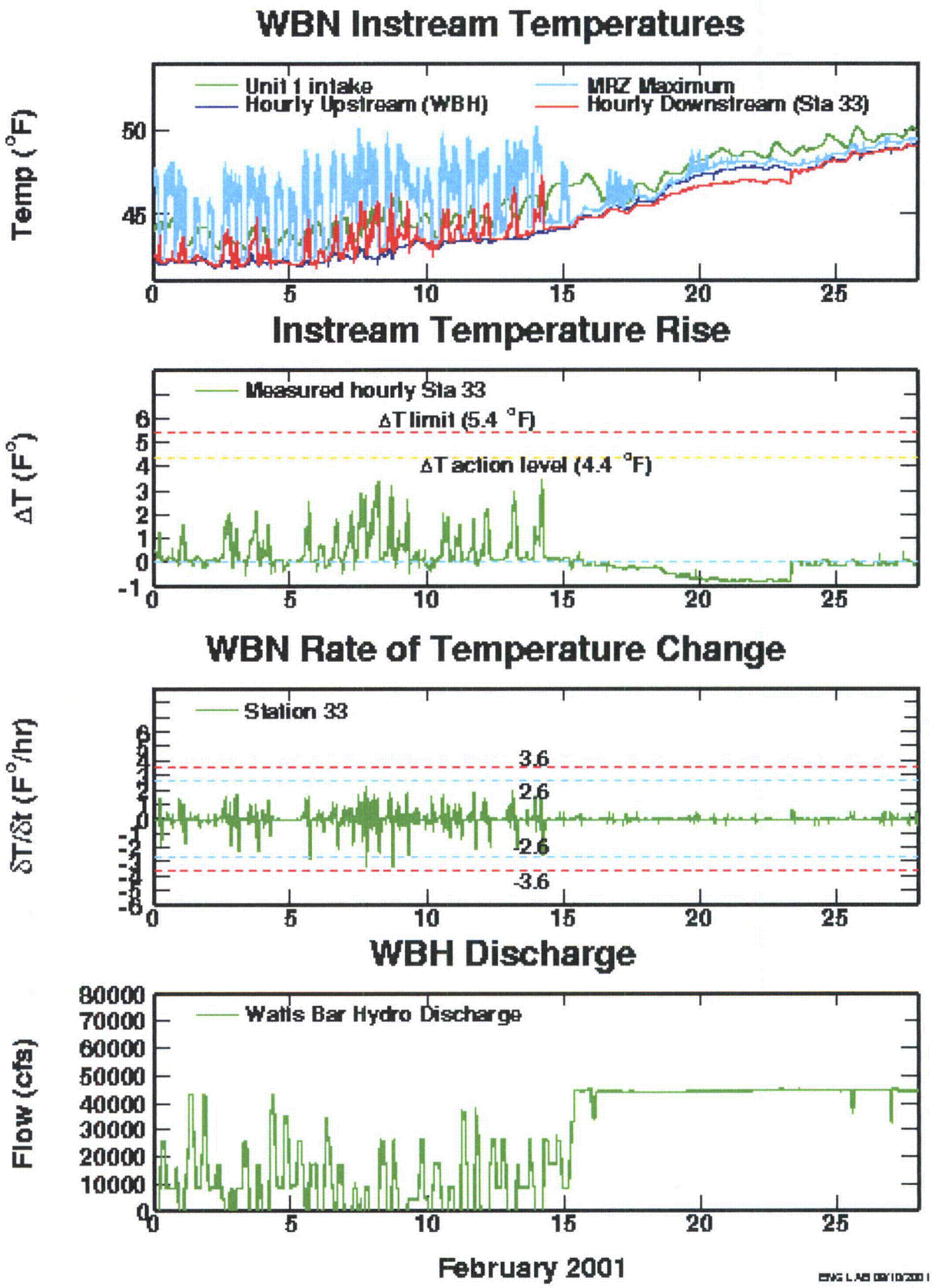


Figure 2.3.15a. SCCW Monitoring Data, February 2001

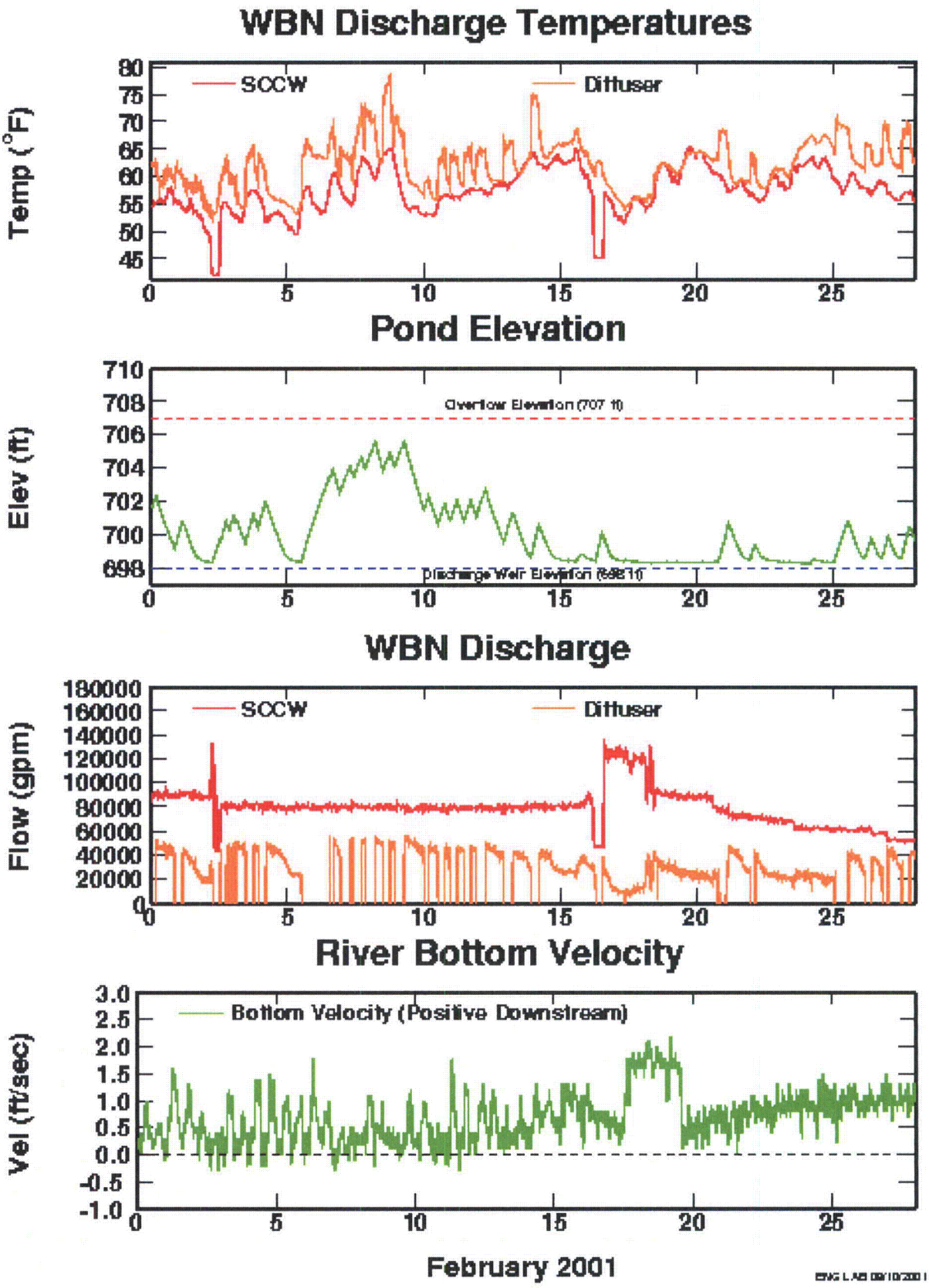


Figure 2.3.15b. SCCW Monitoring Data, February 2001

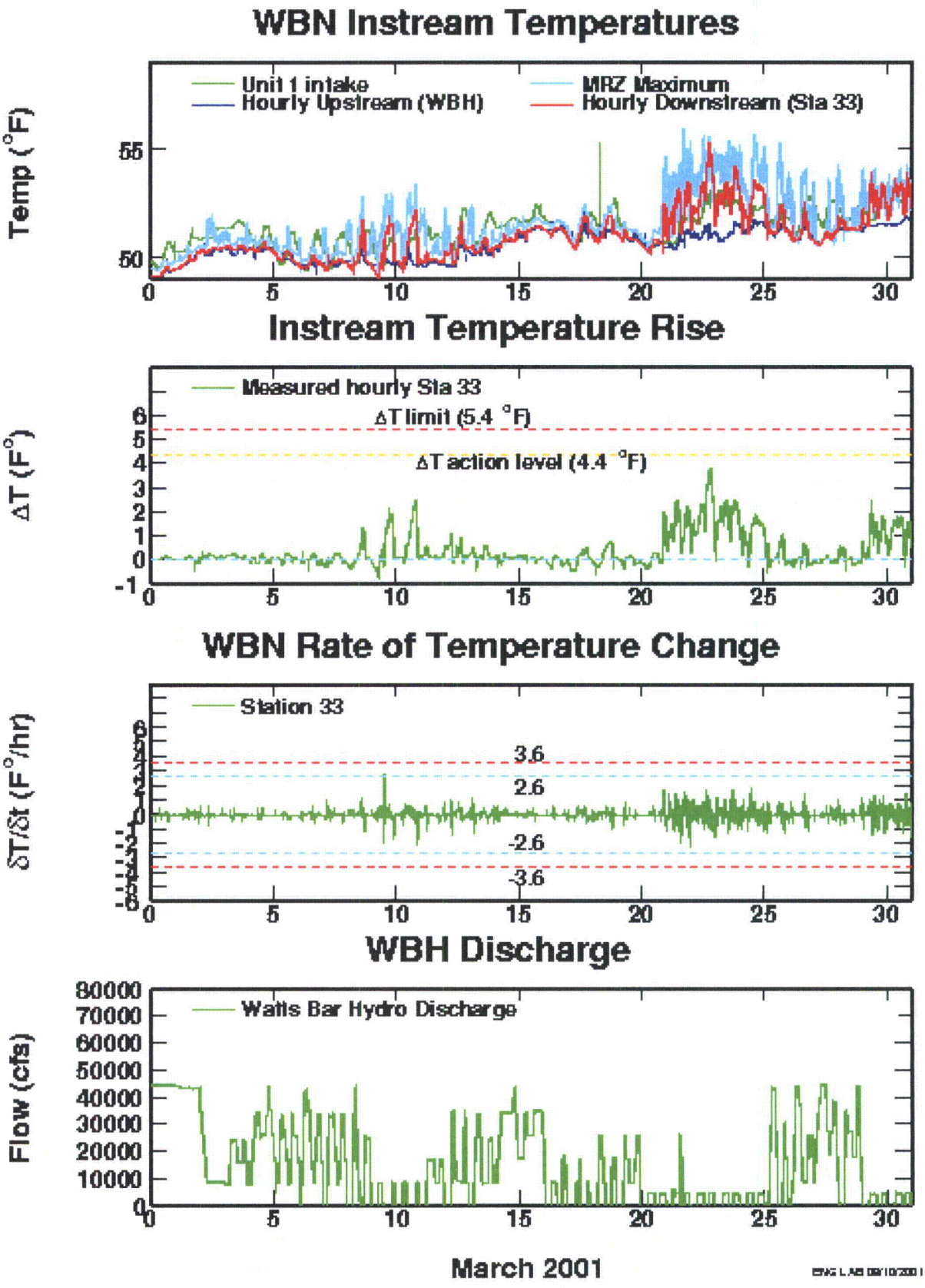


Figure 2.3.16a. SCCW Monitoring Data, March 2001

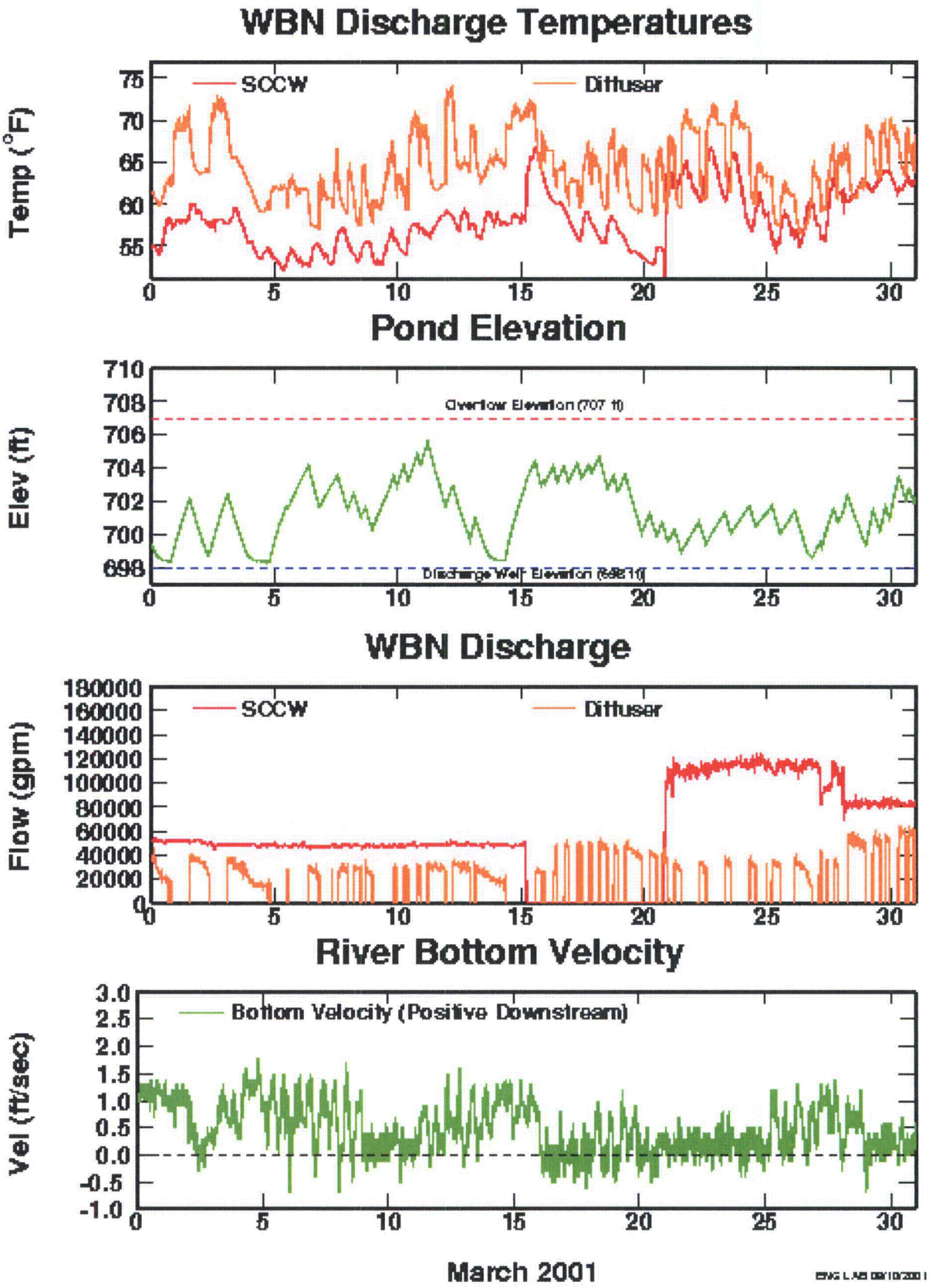


Figure 2.3.16b. SCCW Monitoring Data, March 2001

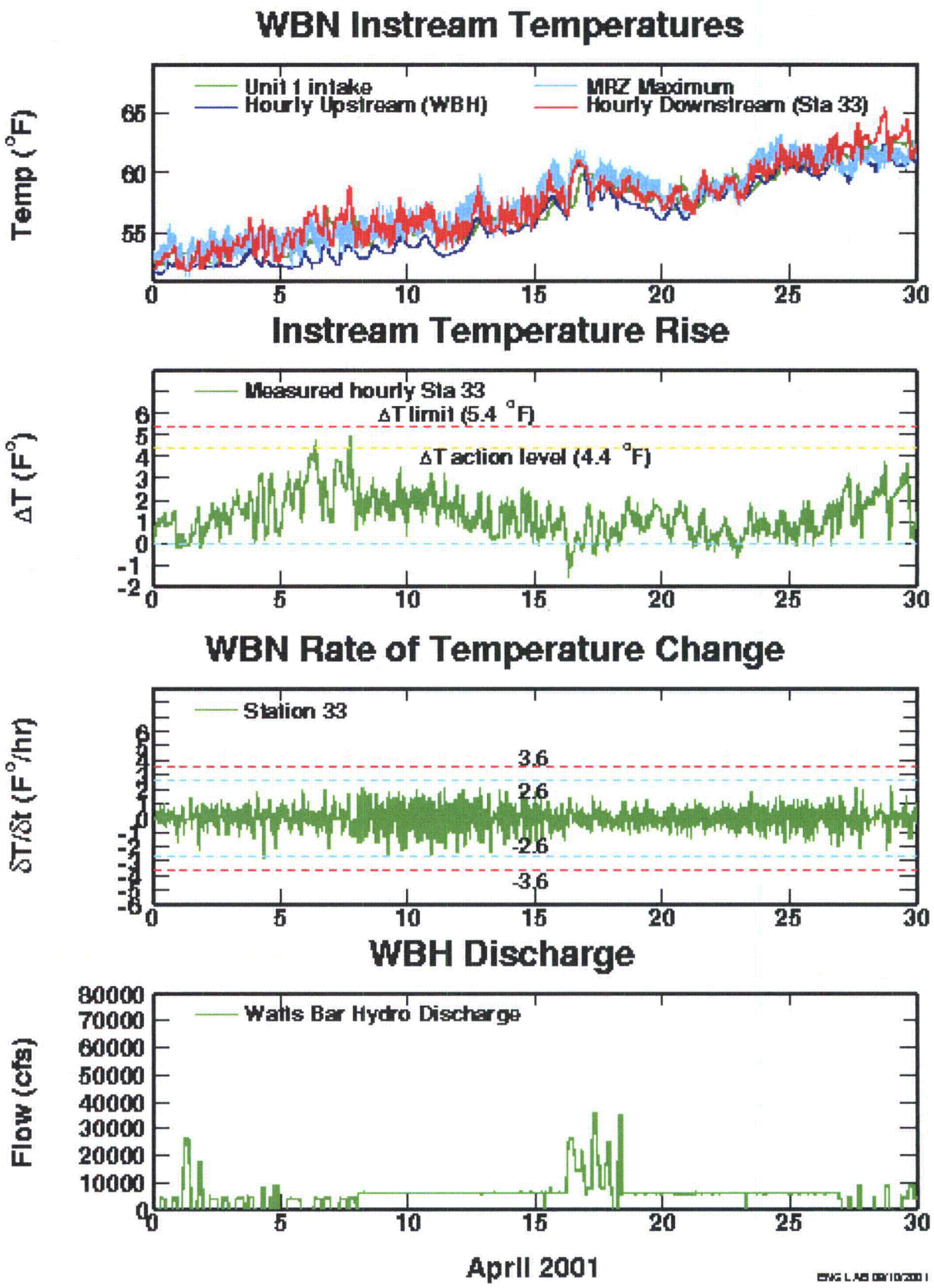


Figure 2.3.17a. SCCW Monitoring Data, April 2001

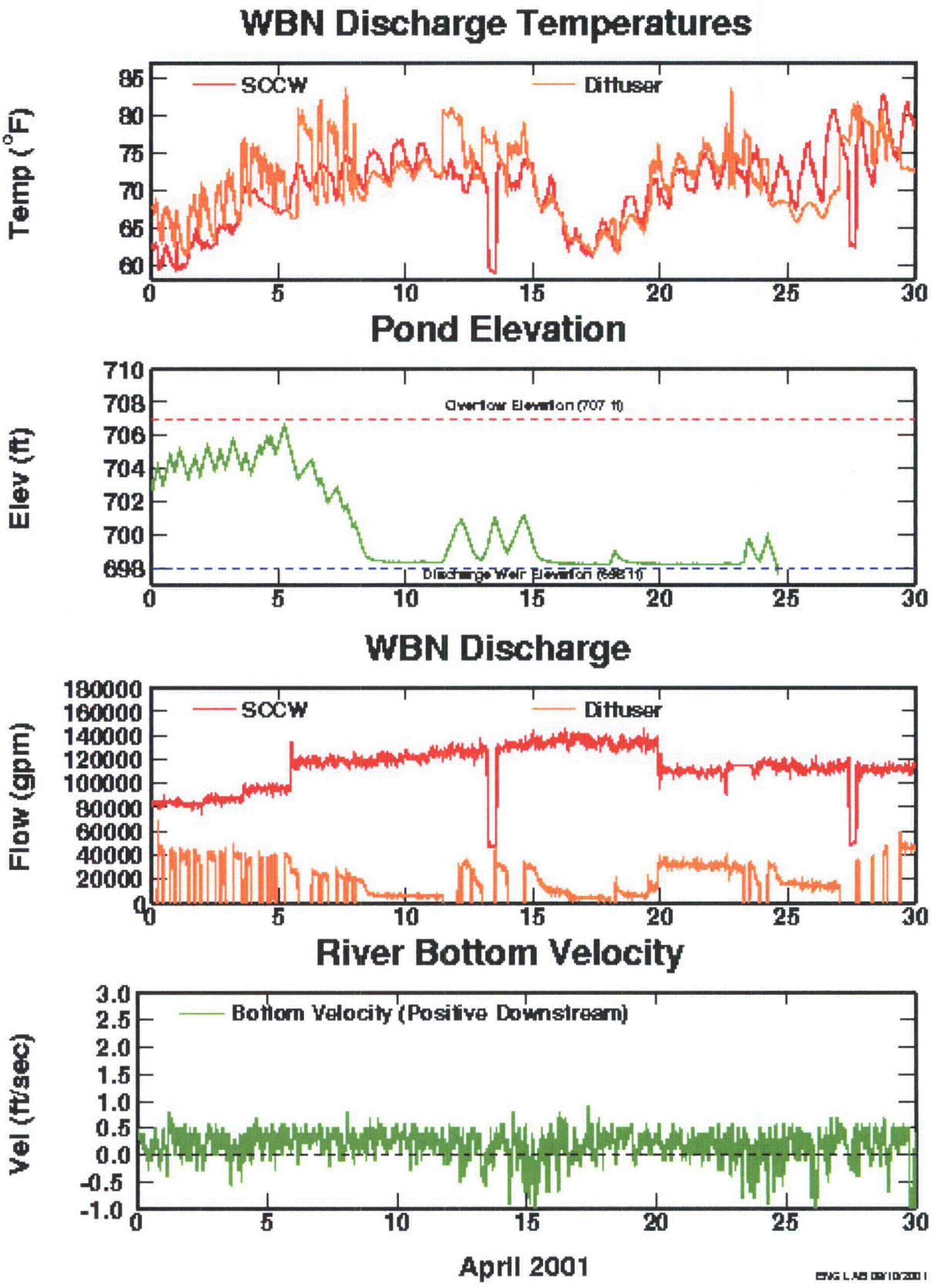


Figure 2.3.17b. SCCW Monitoring Data, April 2001

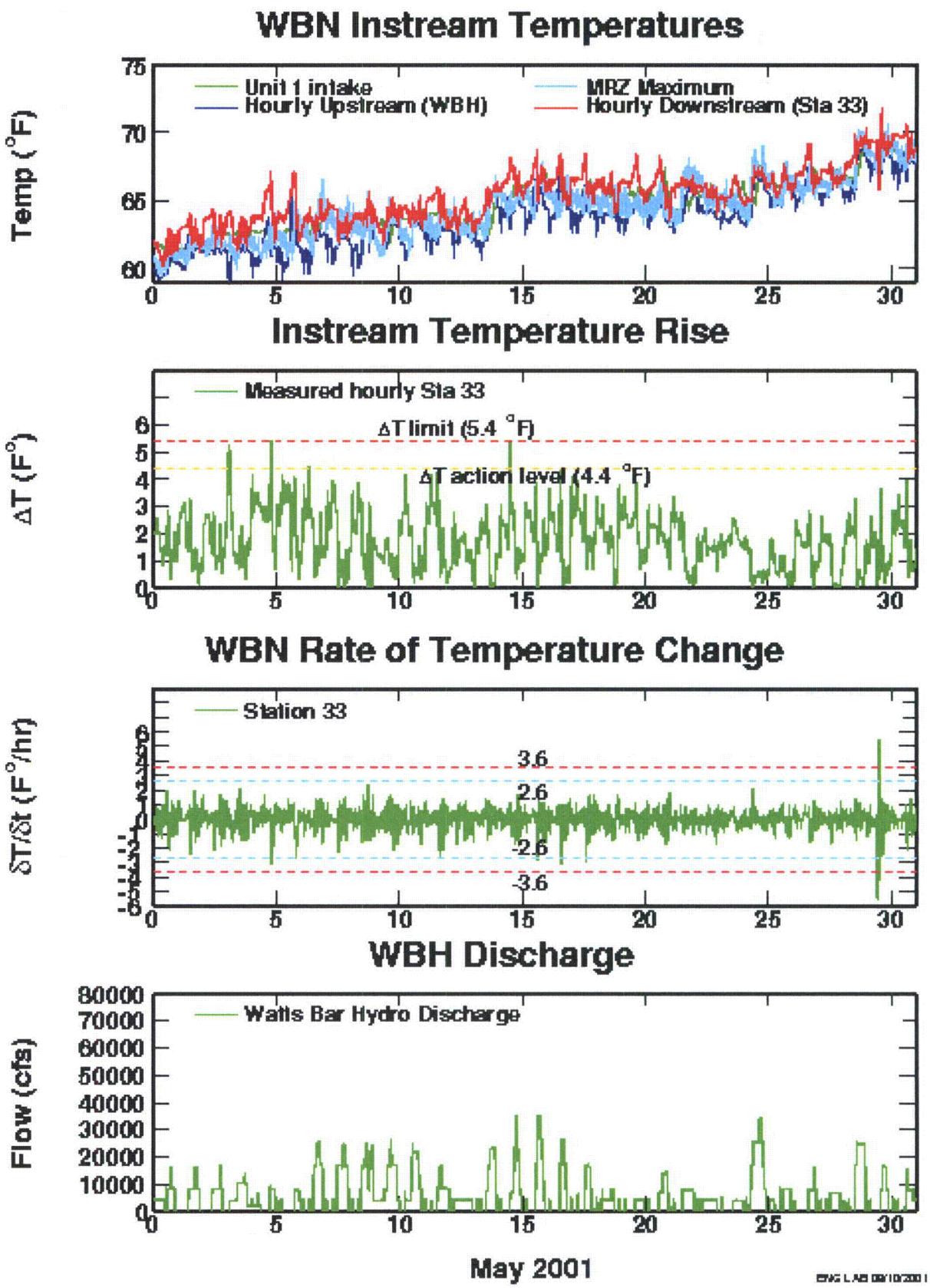


Figure 2.3.18a. SCCW Monitoring Data, May 2001

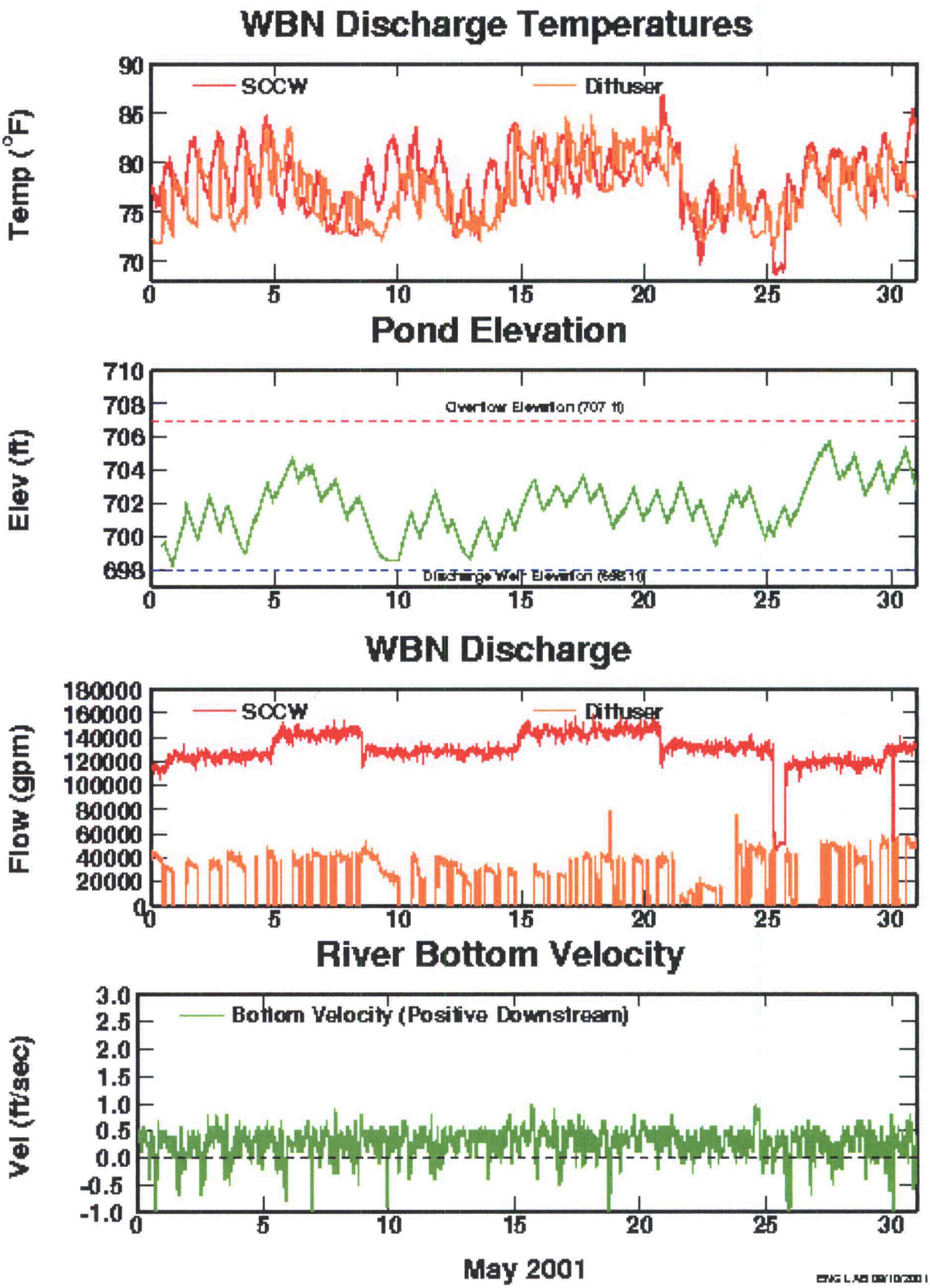


Figure 2.3.18b. SCCW Monitoring Data, May 2001

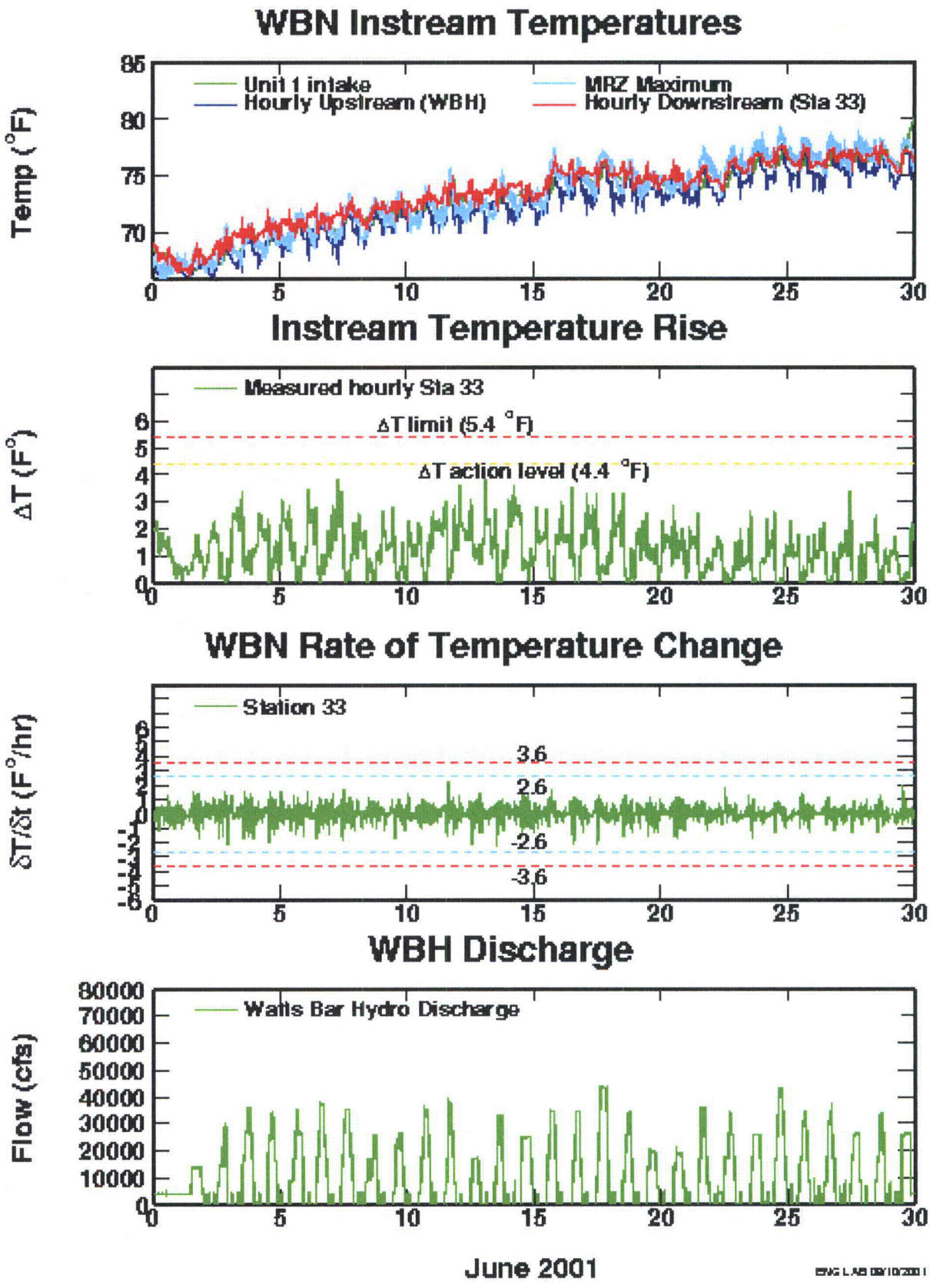


Figure 2.3.19a. SCCW Monitoring Data, June 2001

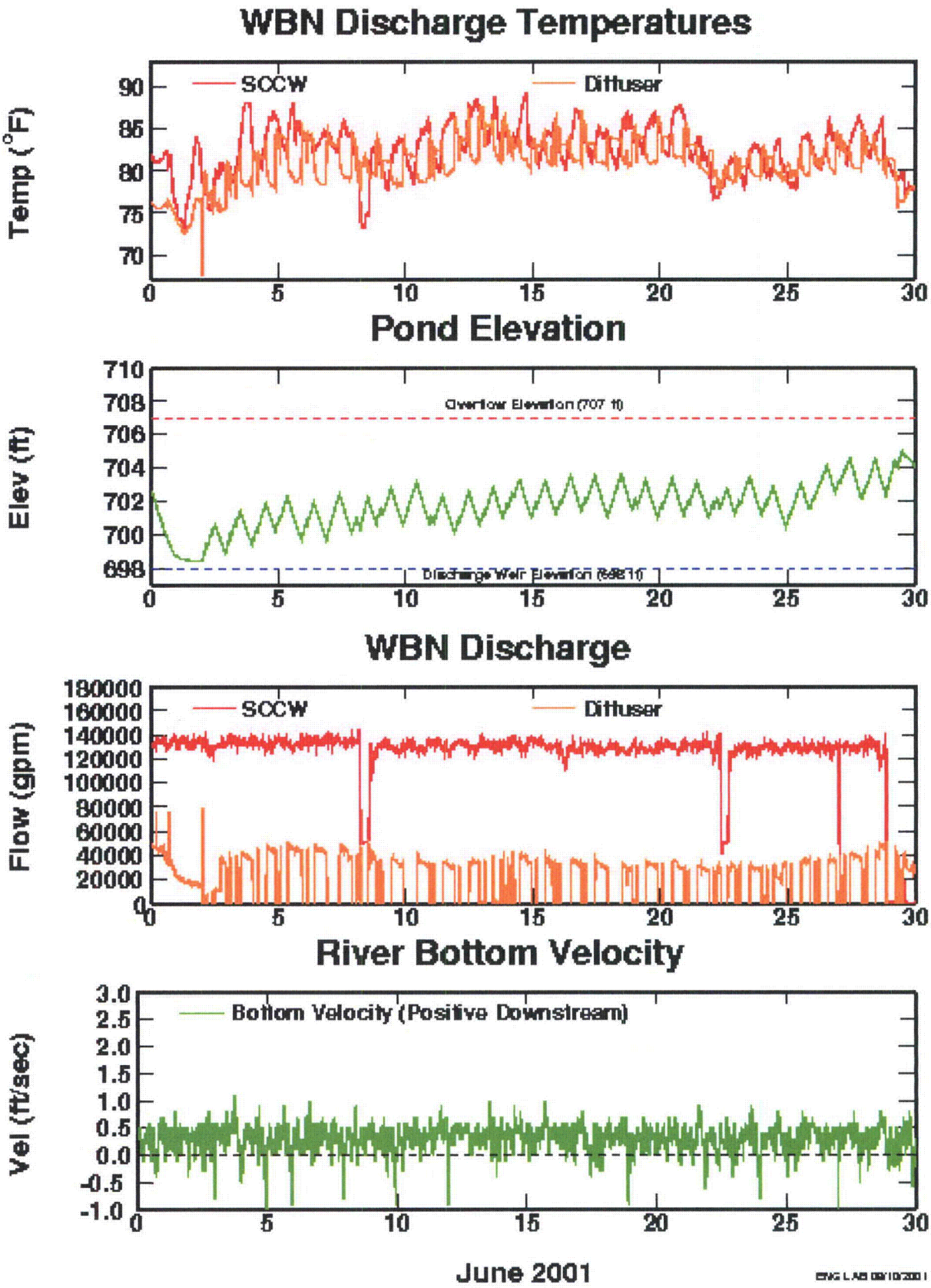


Figure 2.3.19b. SCCW Monitoring Data, June 2001

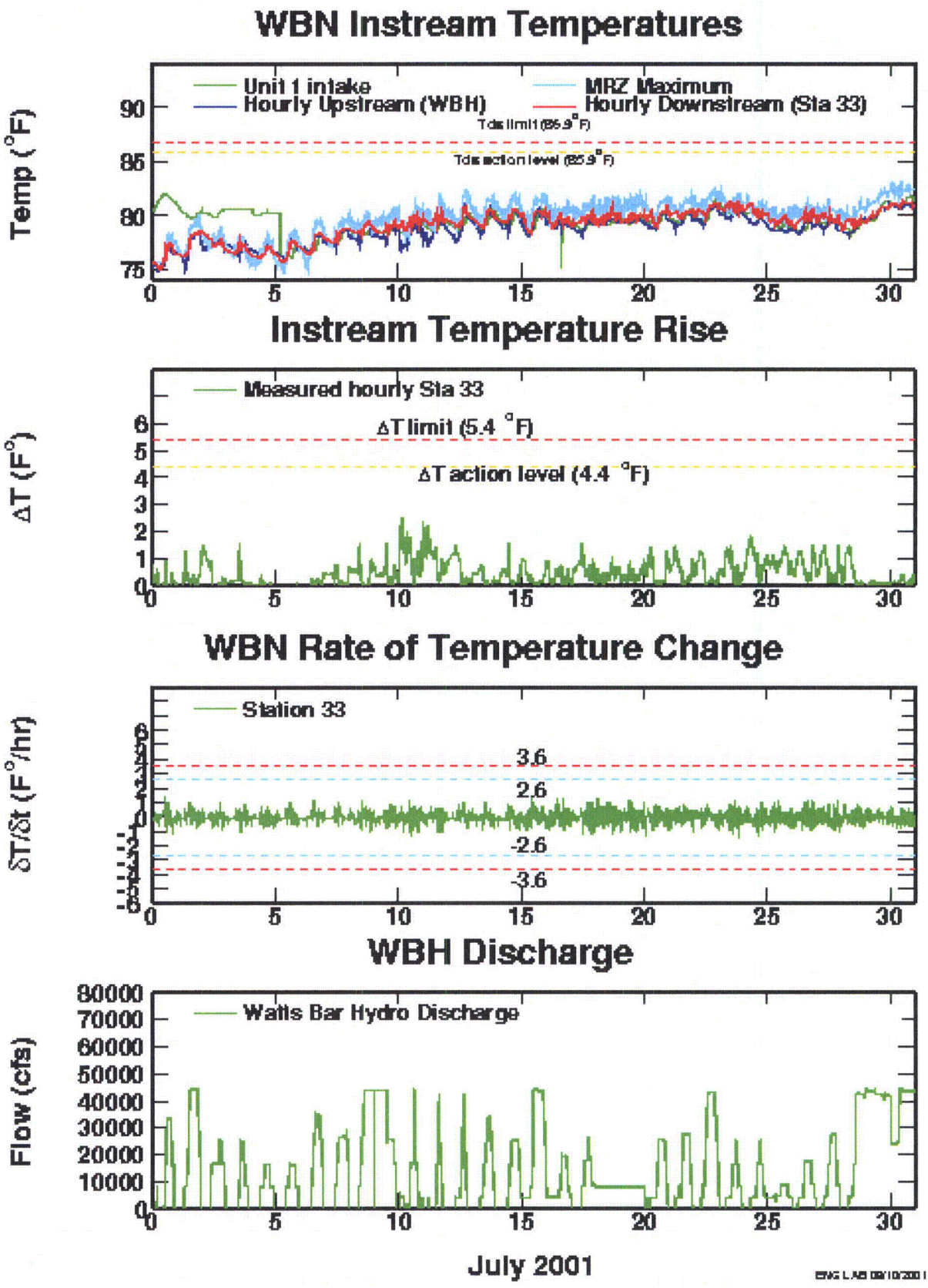


Figure 2.3.20a. SCCW Monitoring Data, July 2001

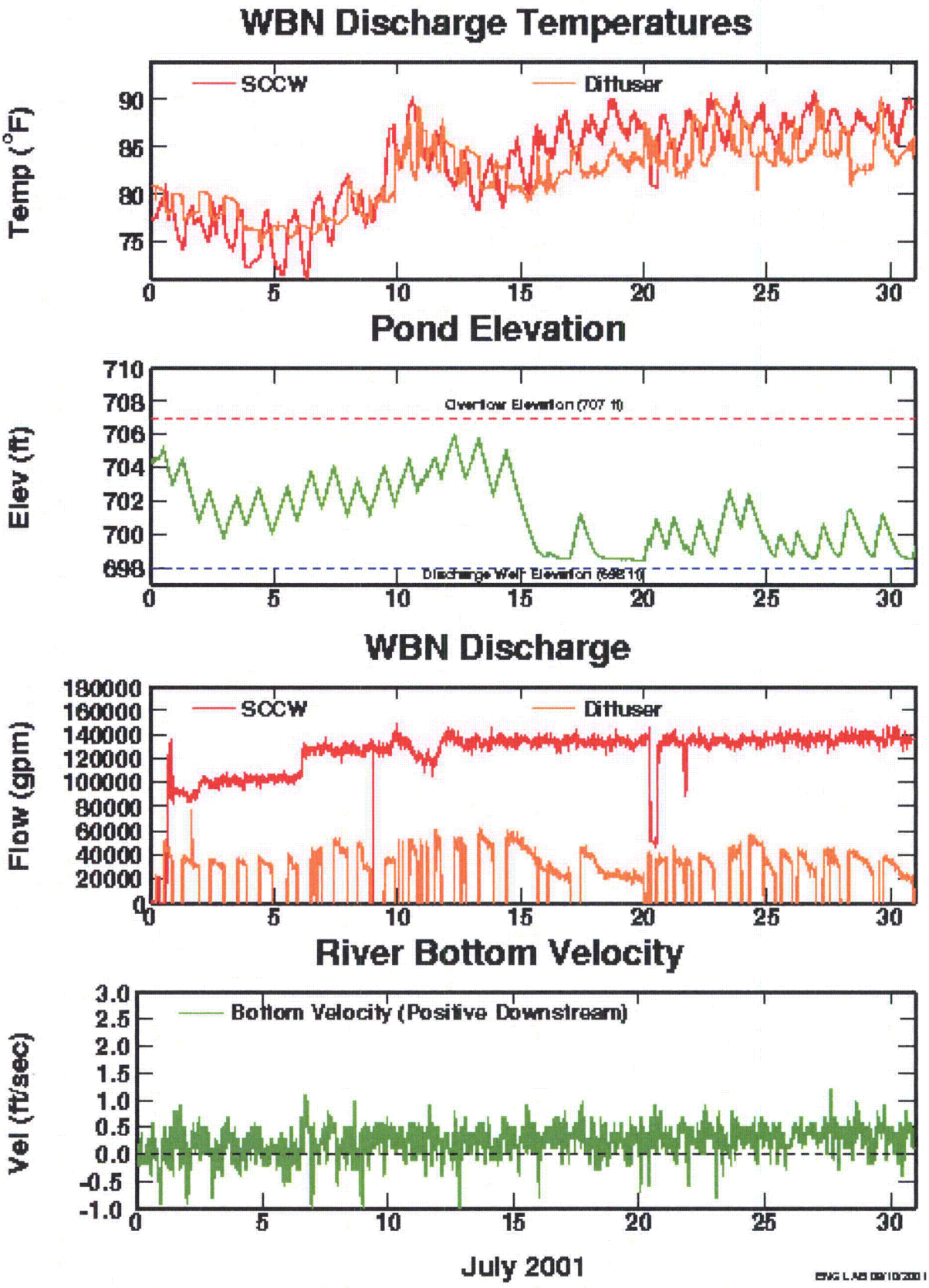


Figure 2.3.20b. SCCW Monitoring Data, July 2001

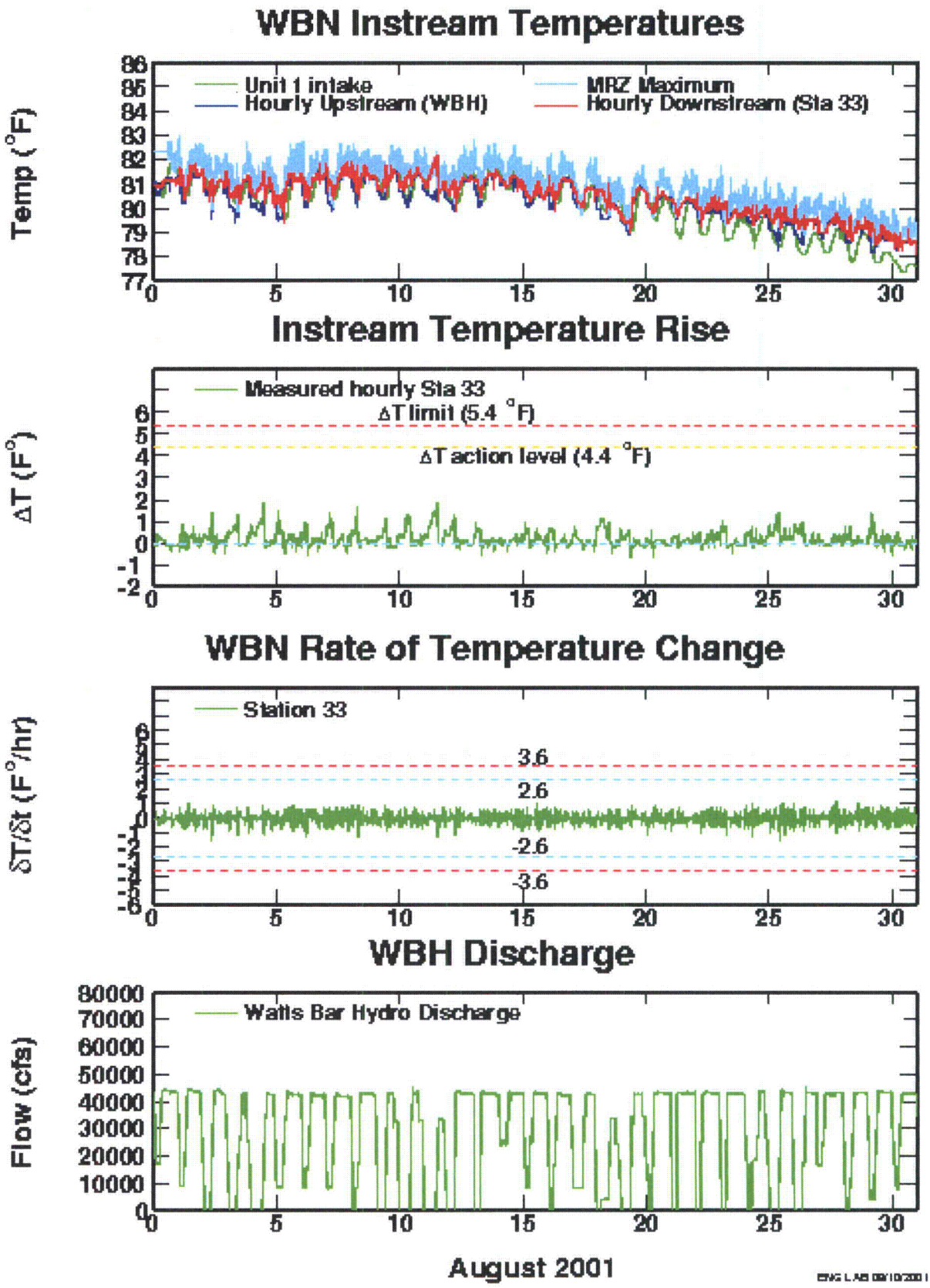


Figure 2.3.21a. SCCW Monitoring Data, August 2001

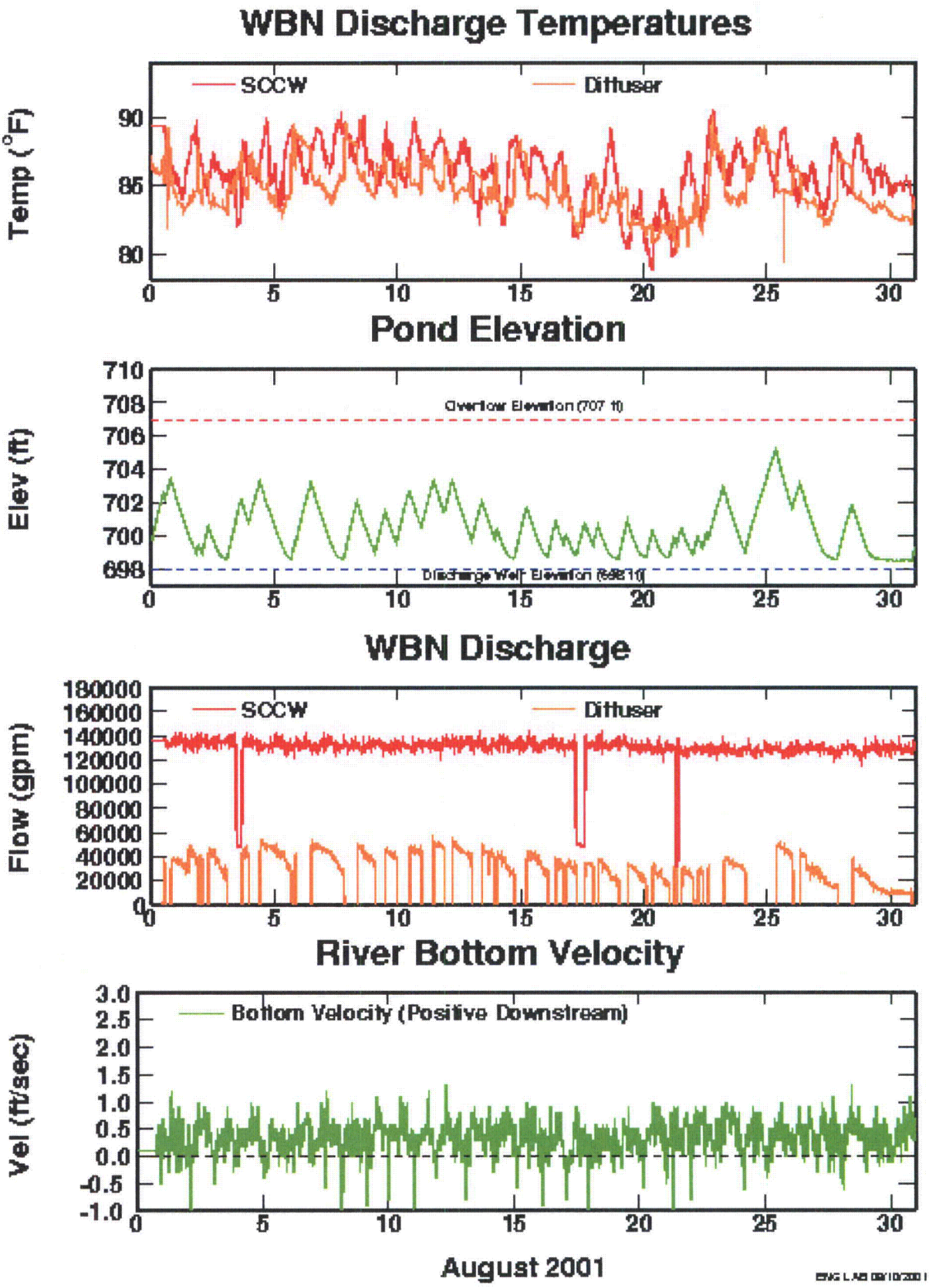


Figure 2.3.21b. SCCW Monitoring Data, August 2001

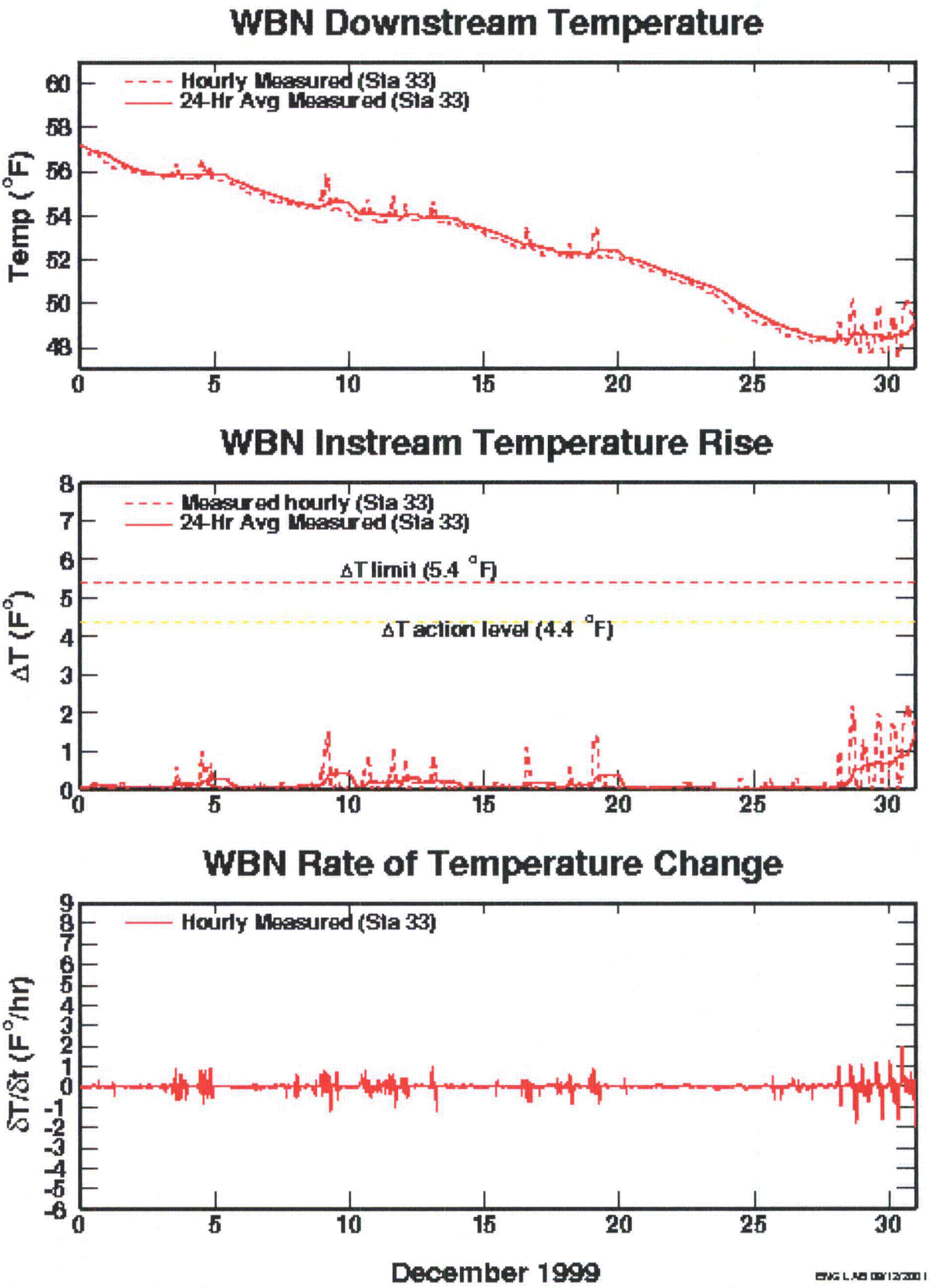


Figure 2.4.1. Comparison of 1-Hour and 24-Hour Averaging, December 1999

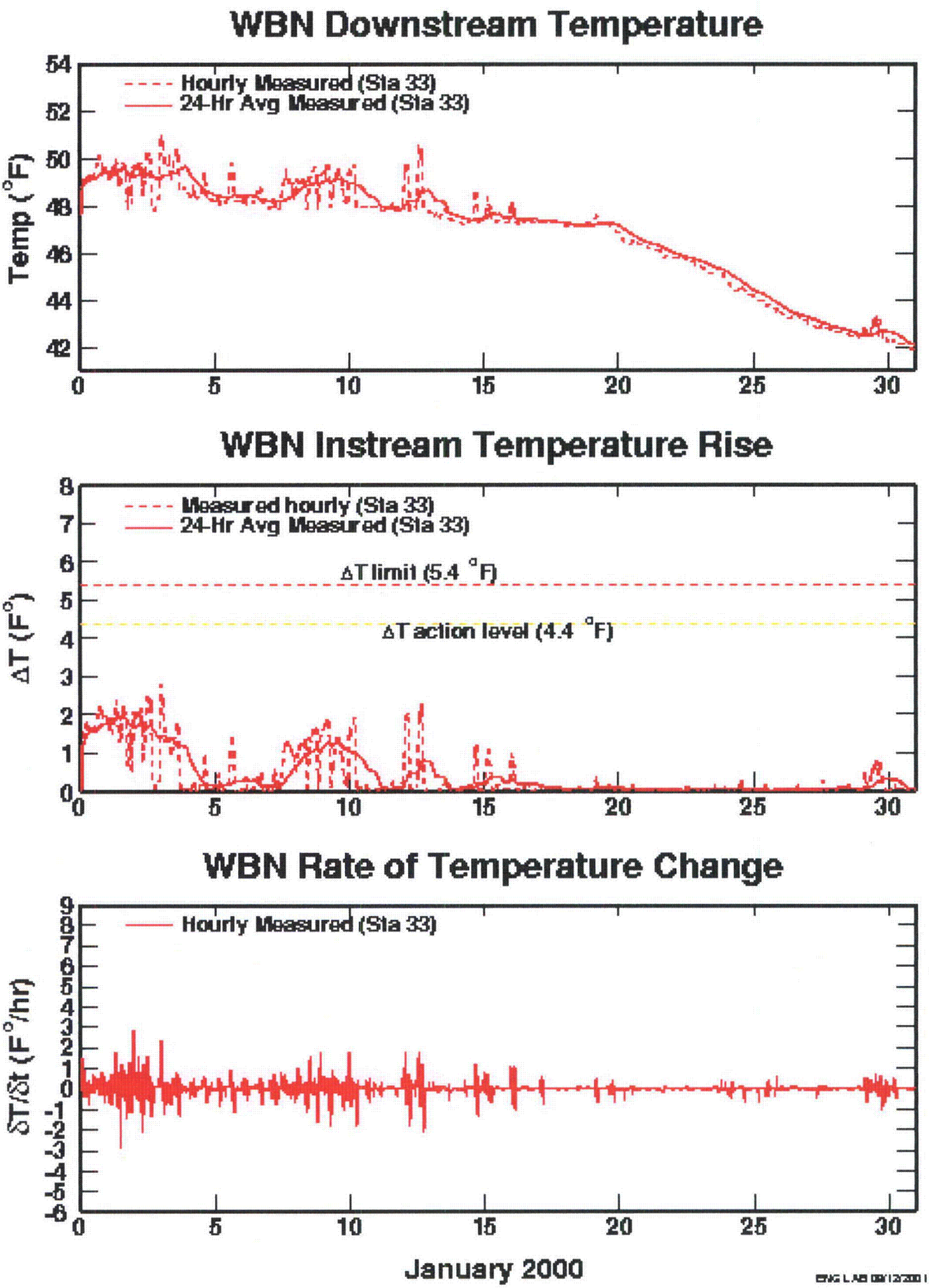


Figure 2.4.2. Comparison of 1-Hour and 24-Hour Averaging, January 2000

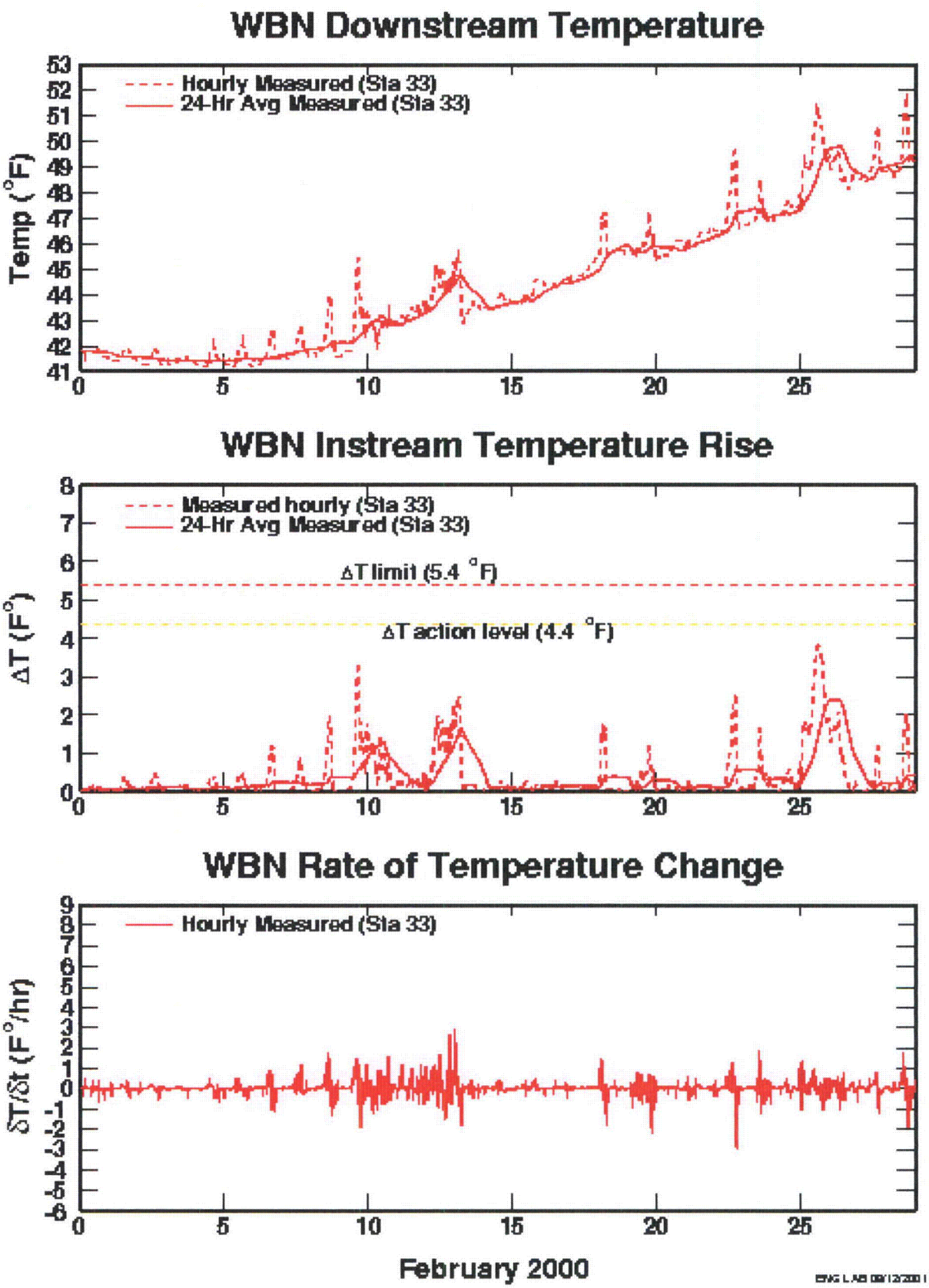


Figure 2.4.3. Comparison of 1-Hour and 24-Hour Averaging, February 2000

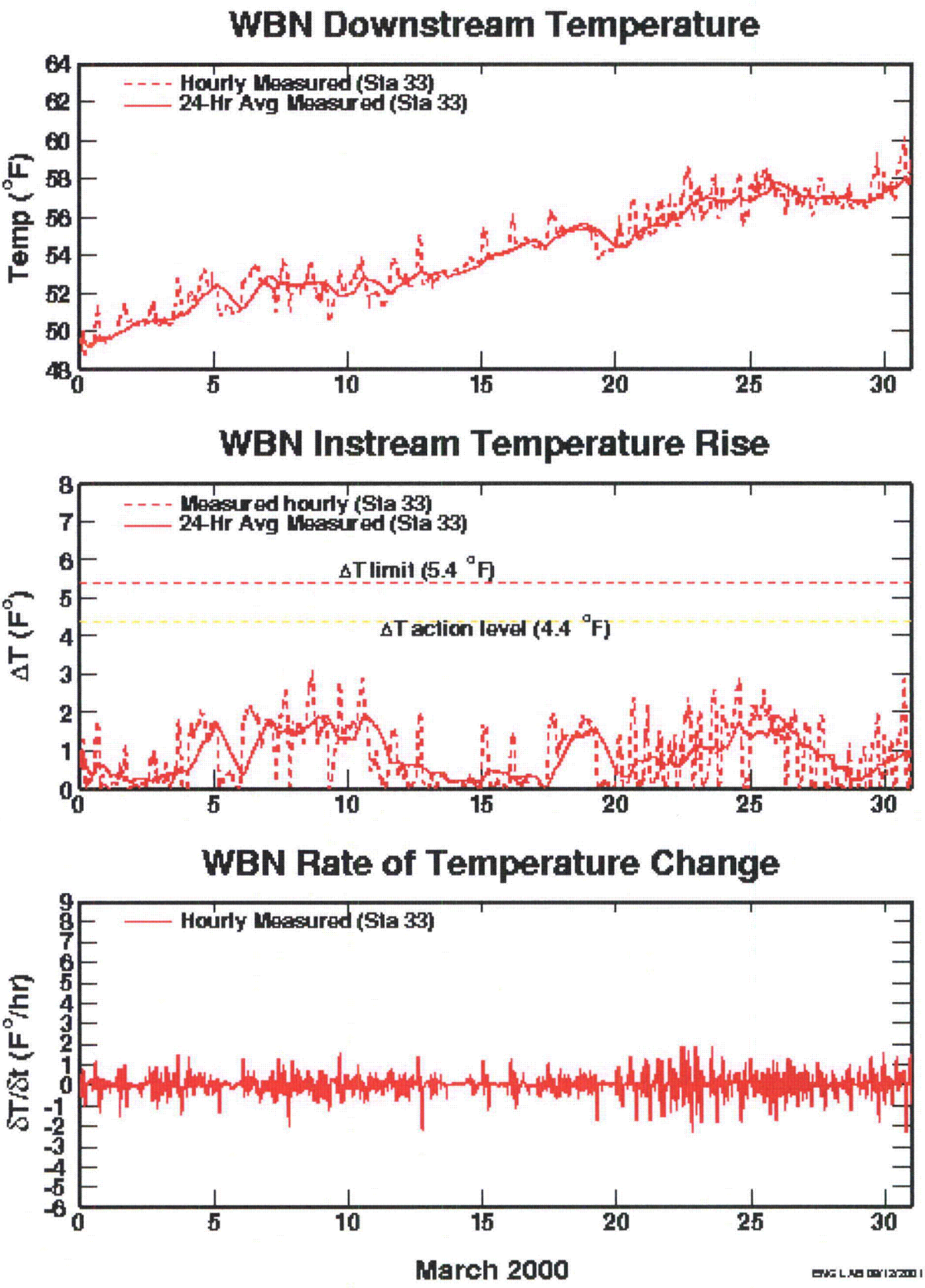


Figure 2.4.4. Comparison of 1-Hour and 24-Hour Averaging, March 2000

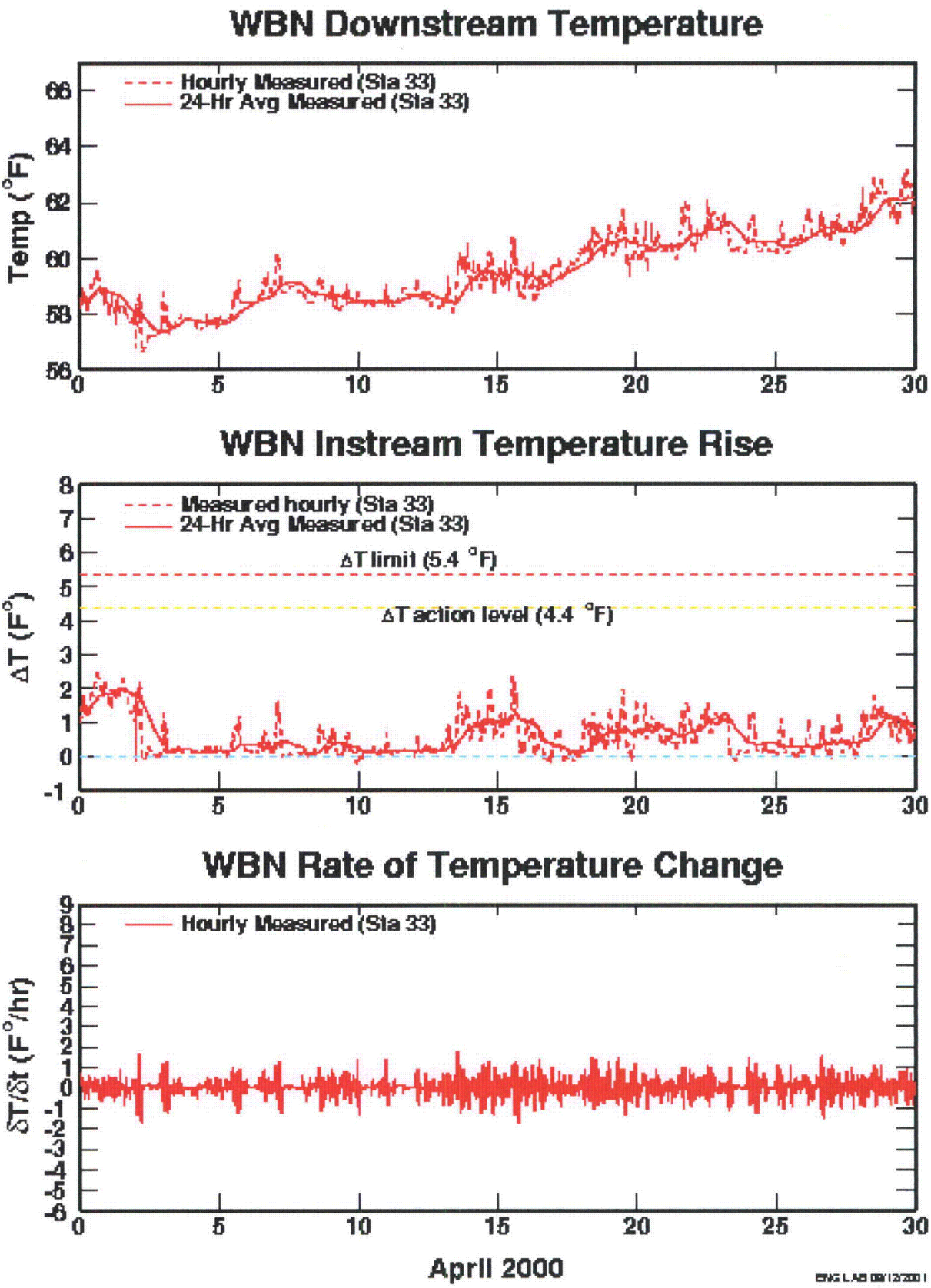


Figure 2.4.5. Comparison of 1-Hour and 24-Hour Averaging, April 2000

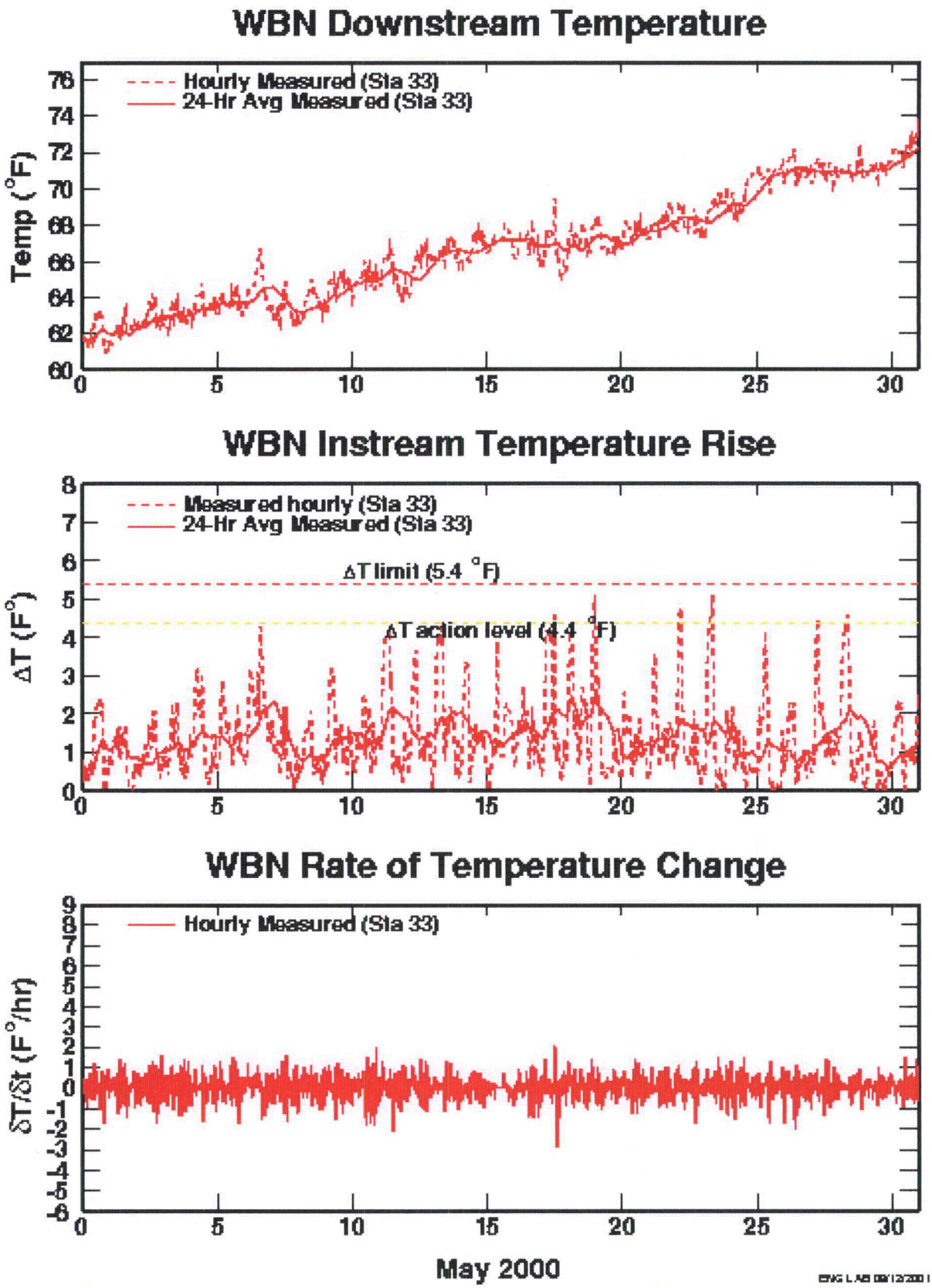


Figure 2.4.6. Comparison of 1-Hour and 24-Hour Averaging, May 2000

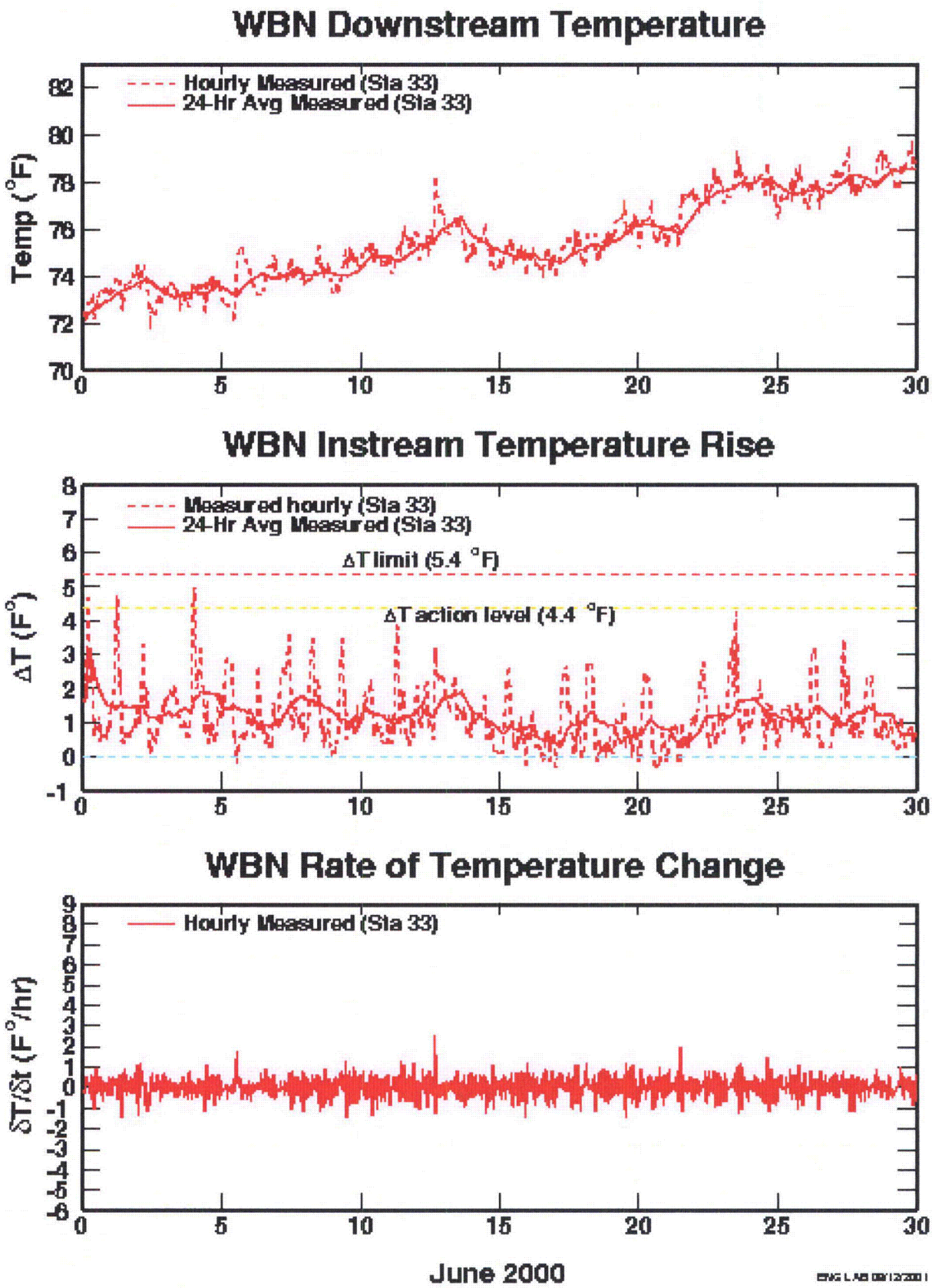


Figure 2.4.7. Comparison of 1-Hour and 24-Hour Averaging, June 2000

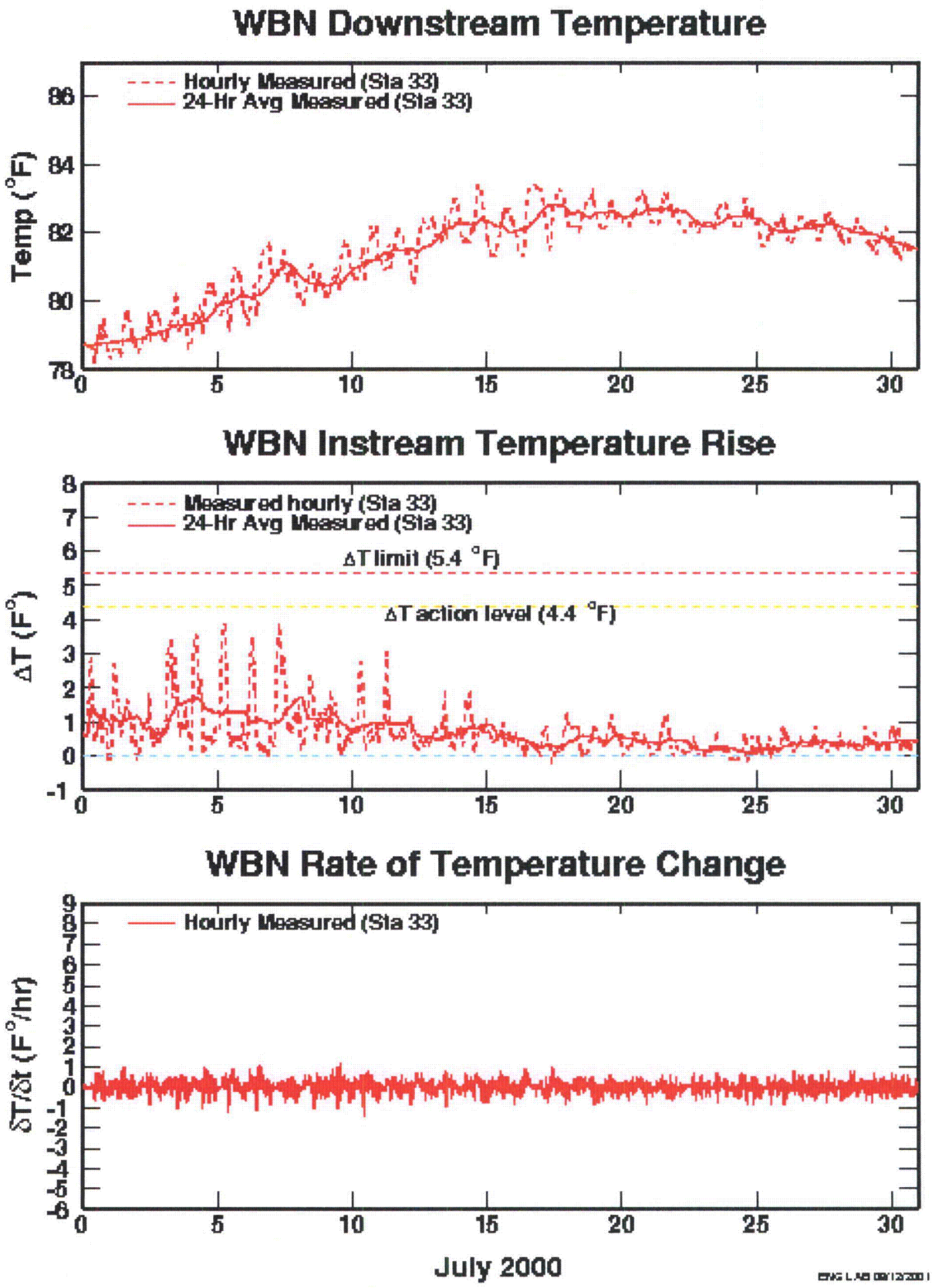


Figure 2.4.8. Comparison of 1-Hour and 24-Hour Averaging, July 2000

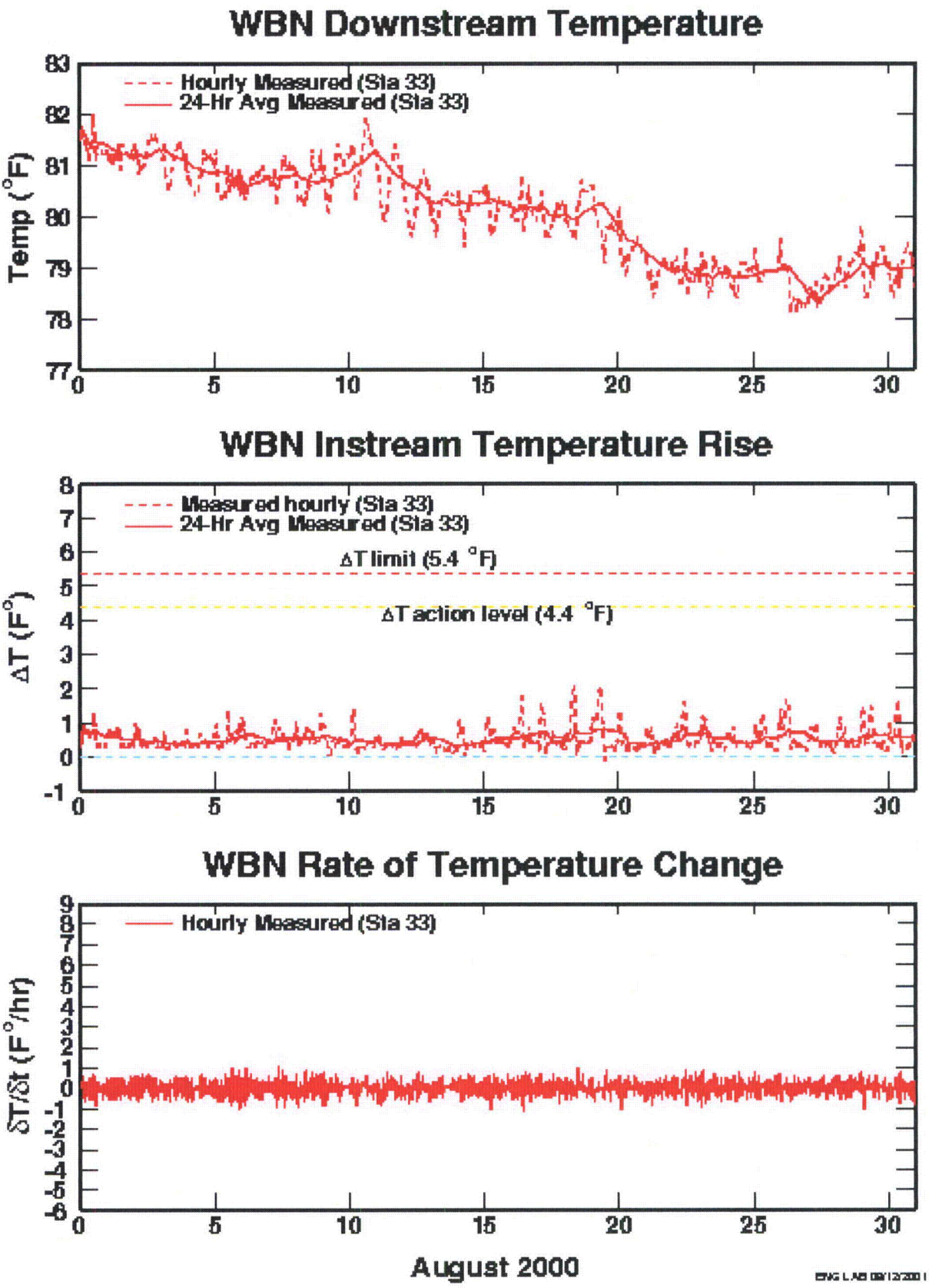


Figure 2.4.9. Comparison of 1-Hour and 24-Hour Averaging, August 2000

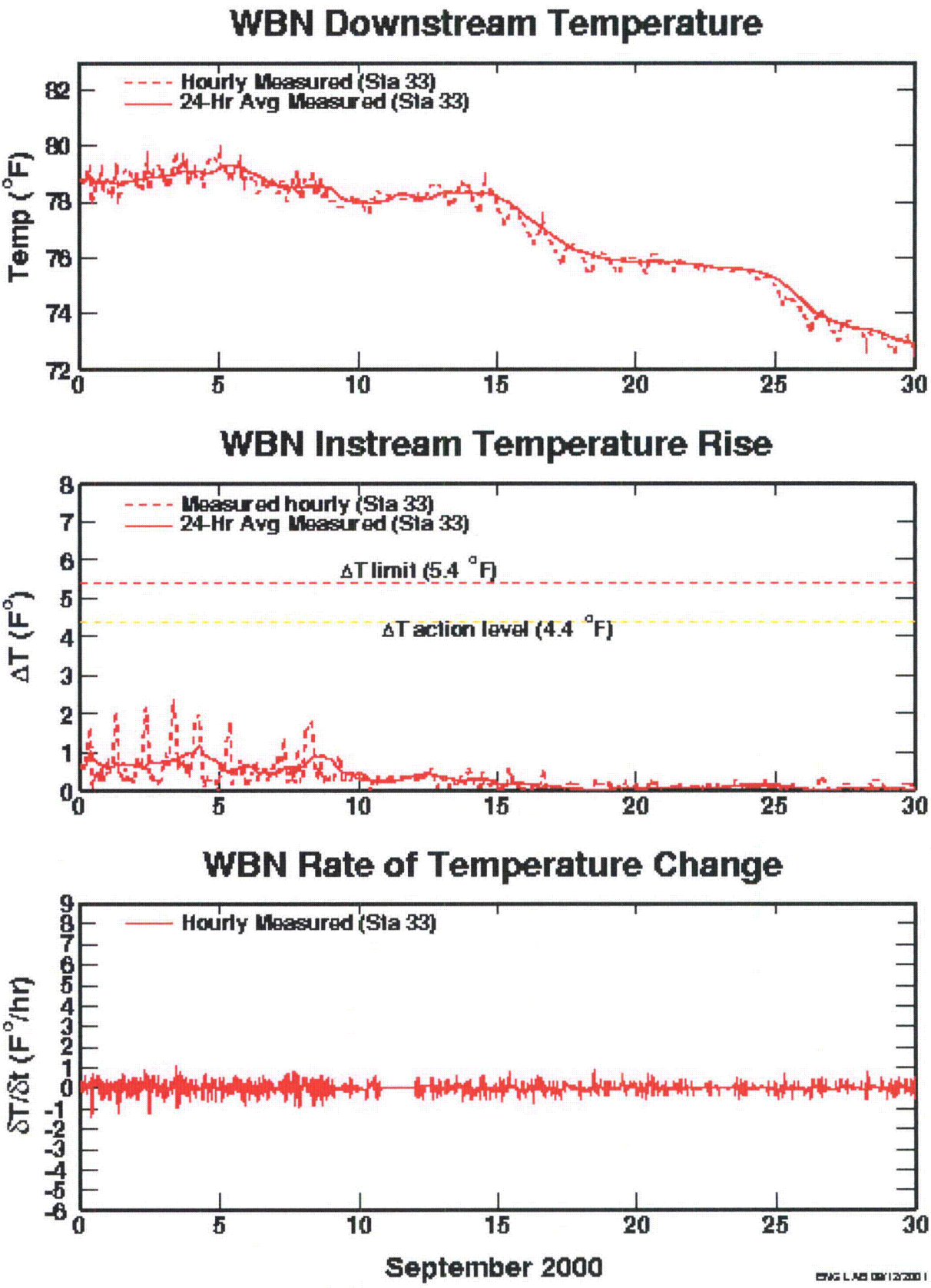


Figure 2.4.10. Comparison of 1-Hour and 24-Hour Averaging, September 2000

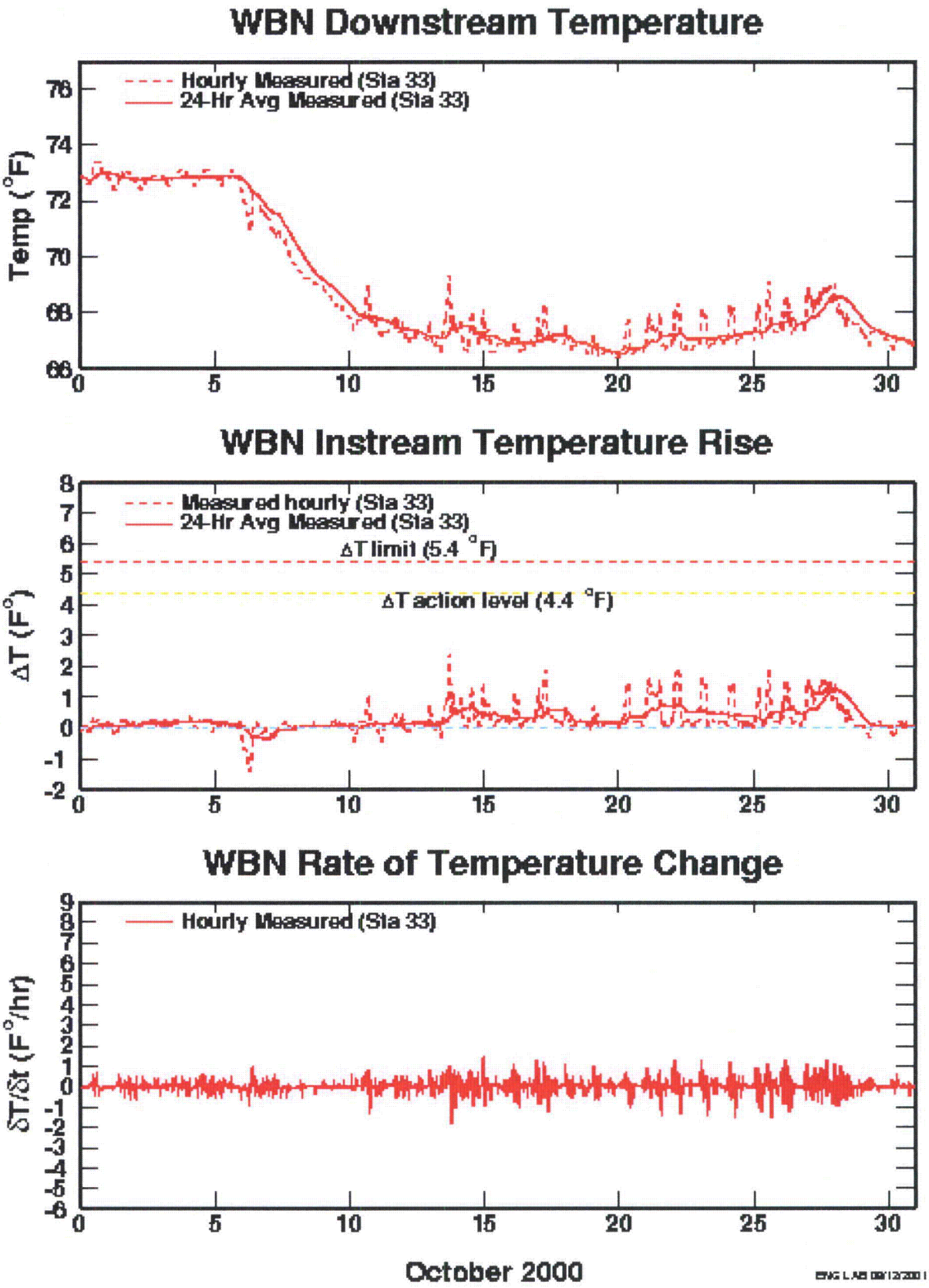


Figure 2.4.11. Comparison of 1-Hour and 24-Hour Averaging, October 2000

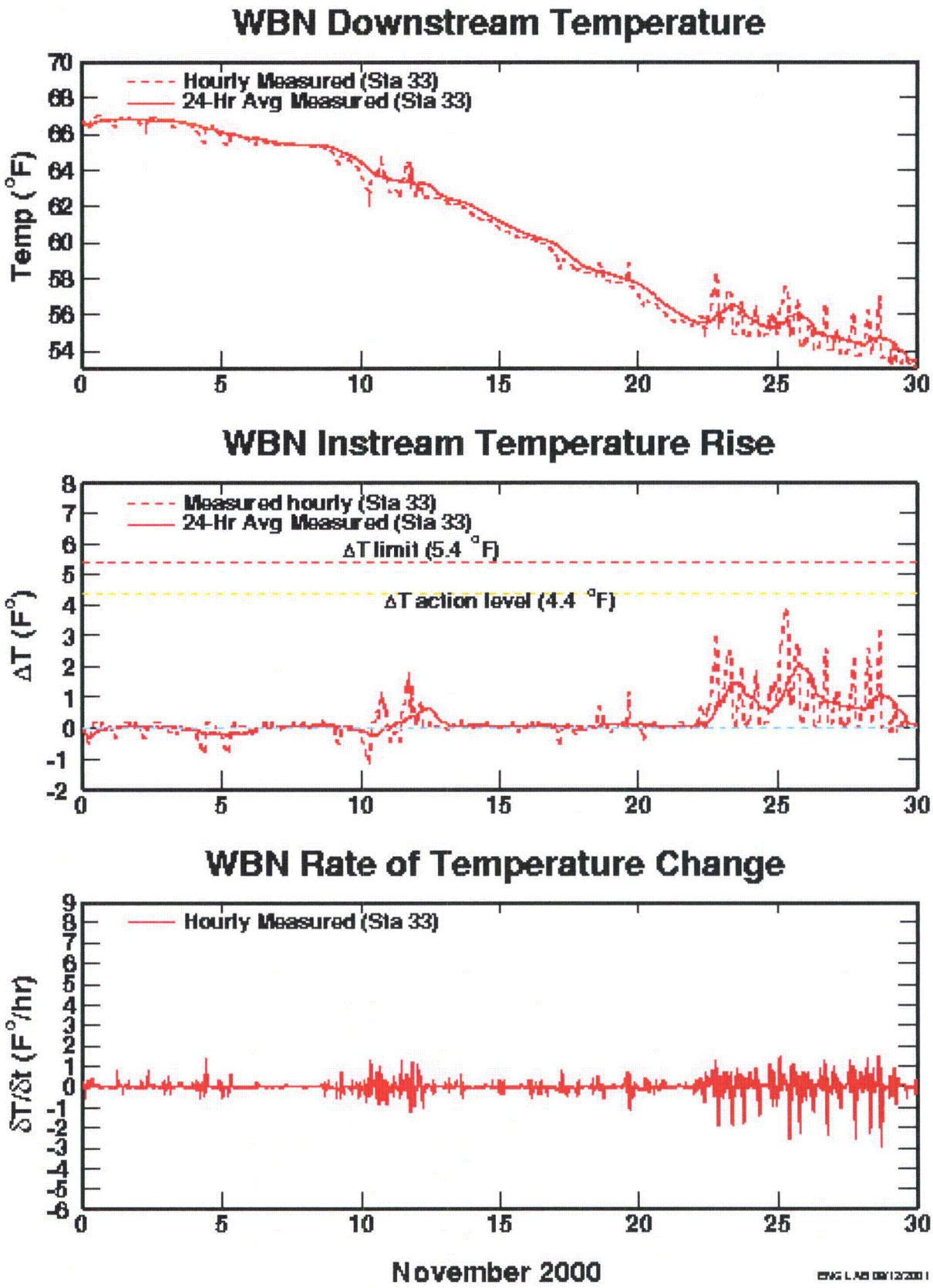


Figure 2.4.12. Comparison of 1-Hour and 24-Hour Averaging, November 2000

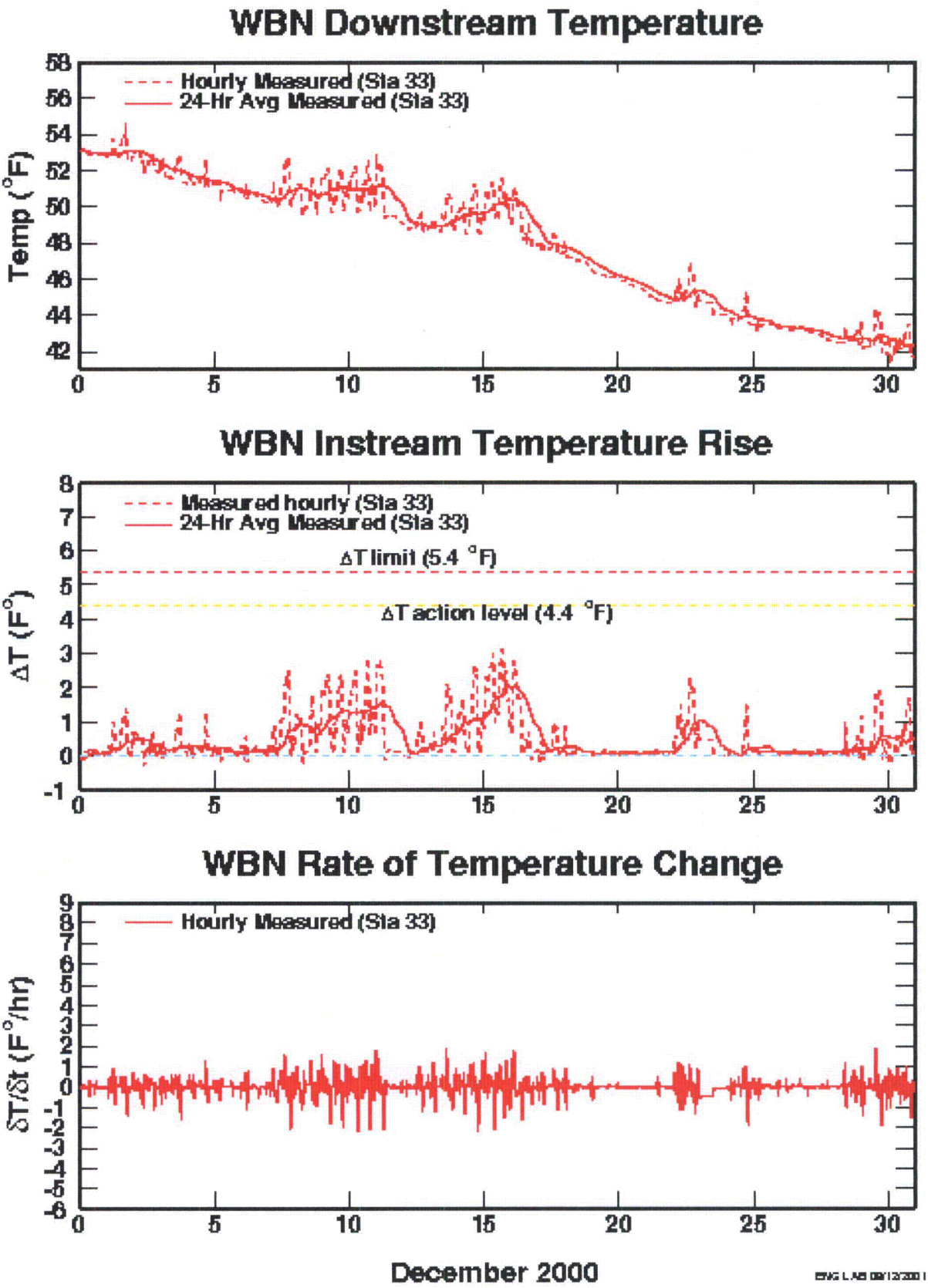


Figure 2.4.13. Comparison of 1-Hour and 24-Hour Averaging, December 2000

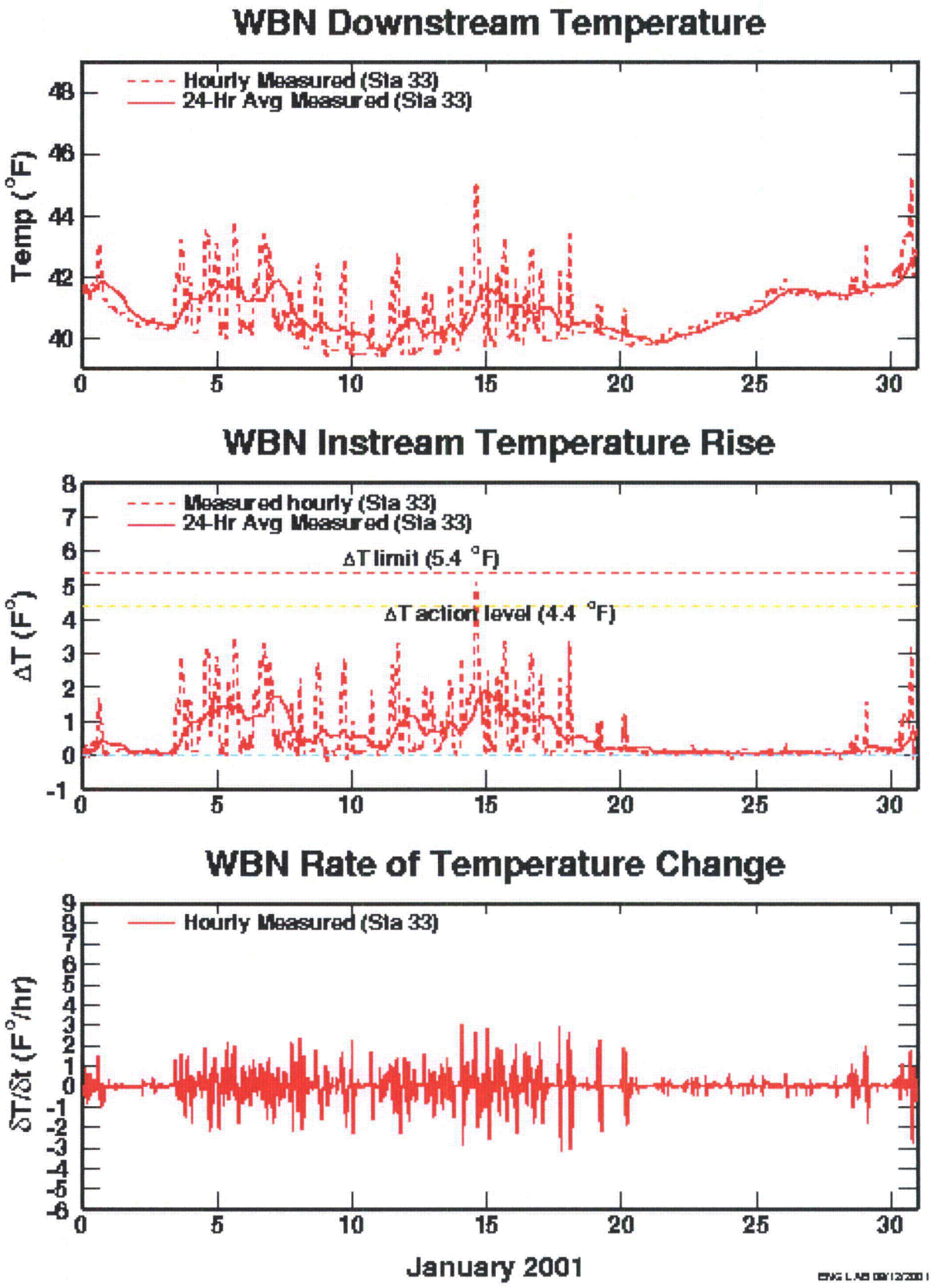


Figure 2.4.14. Comparison of 1-Hour and 24-Hour Averaging, January 2001

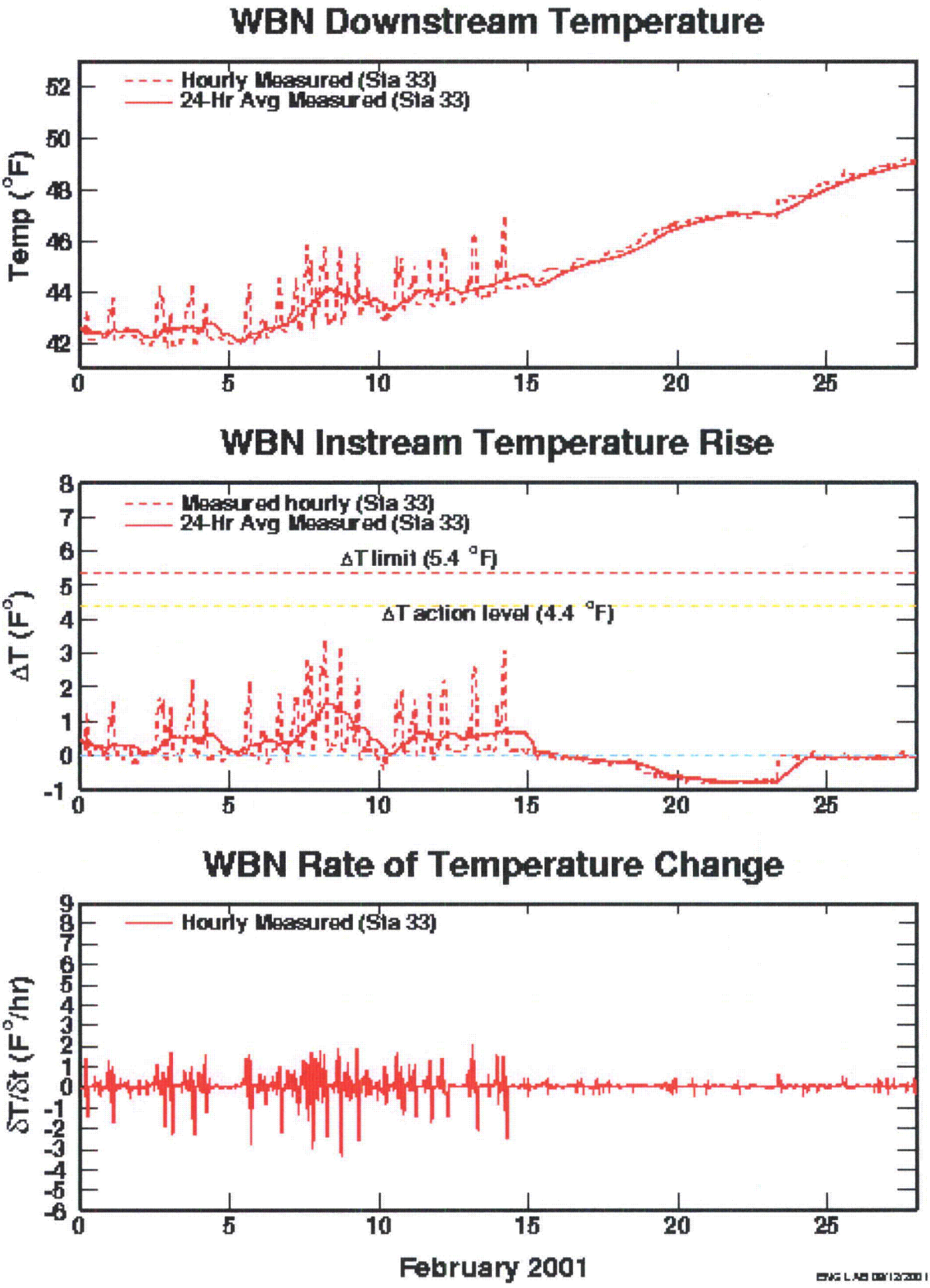


Figure 2.4.15. Comparison of 1-Hour and 24-Hour Averaging, February 2001

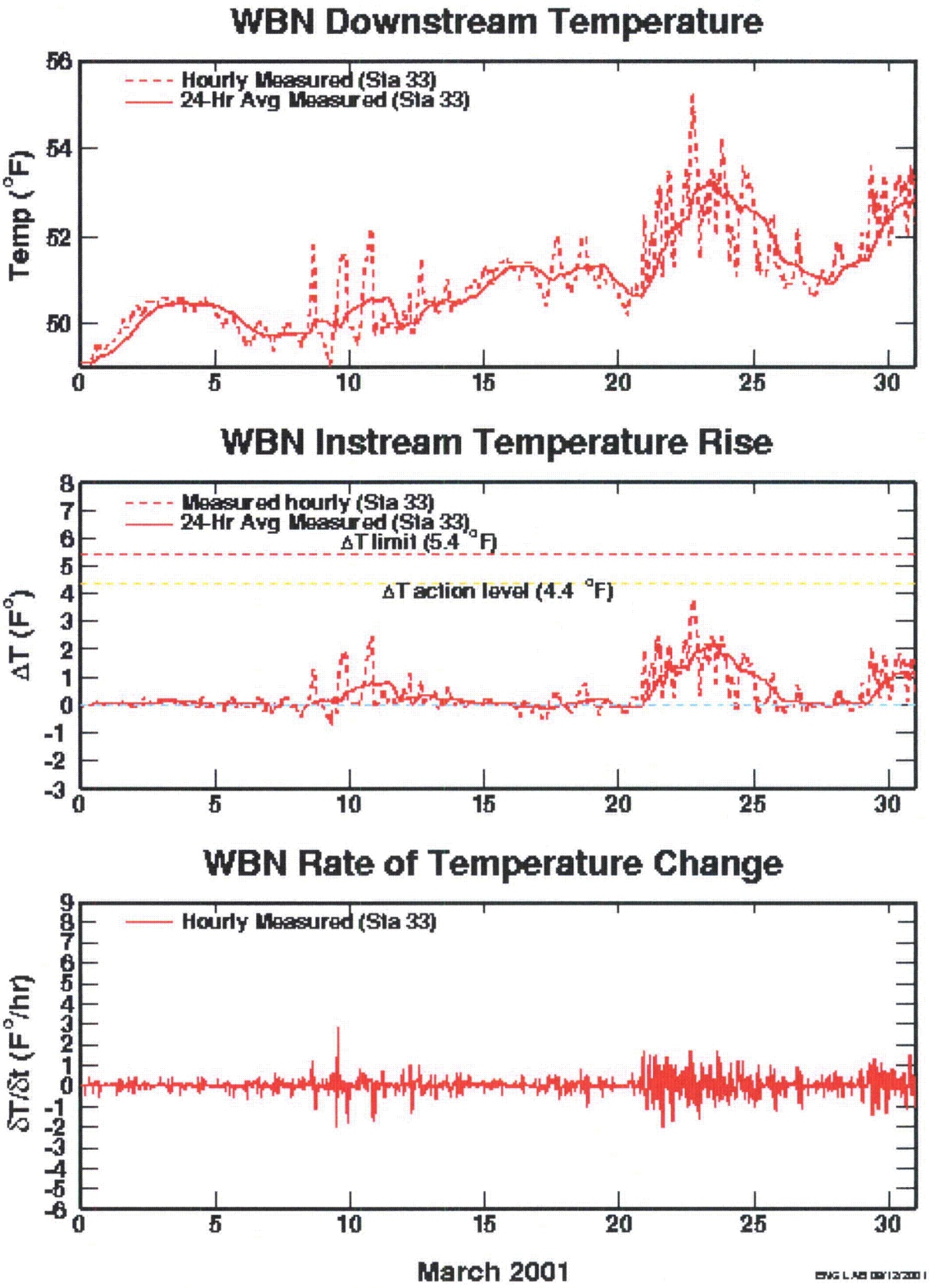


Figure 2.4.16. Comparison of 1-Hour and 24-Hour Averaging, March 2001

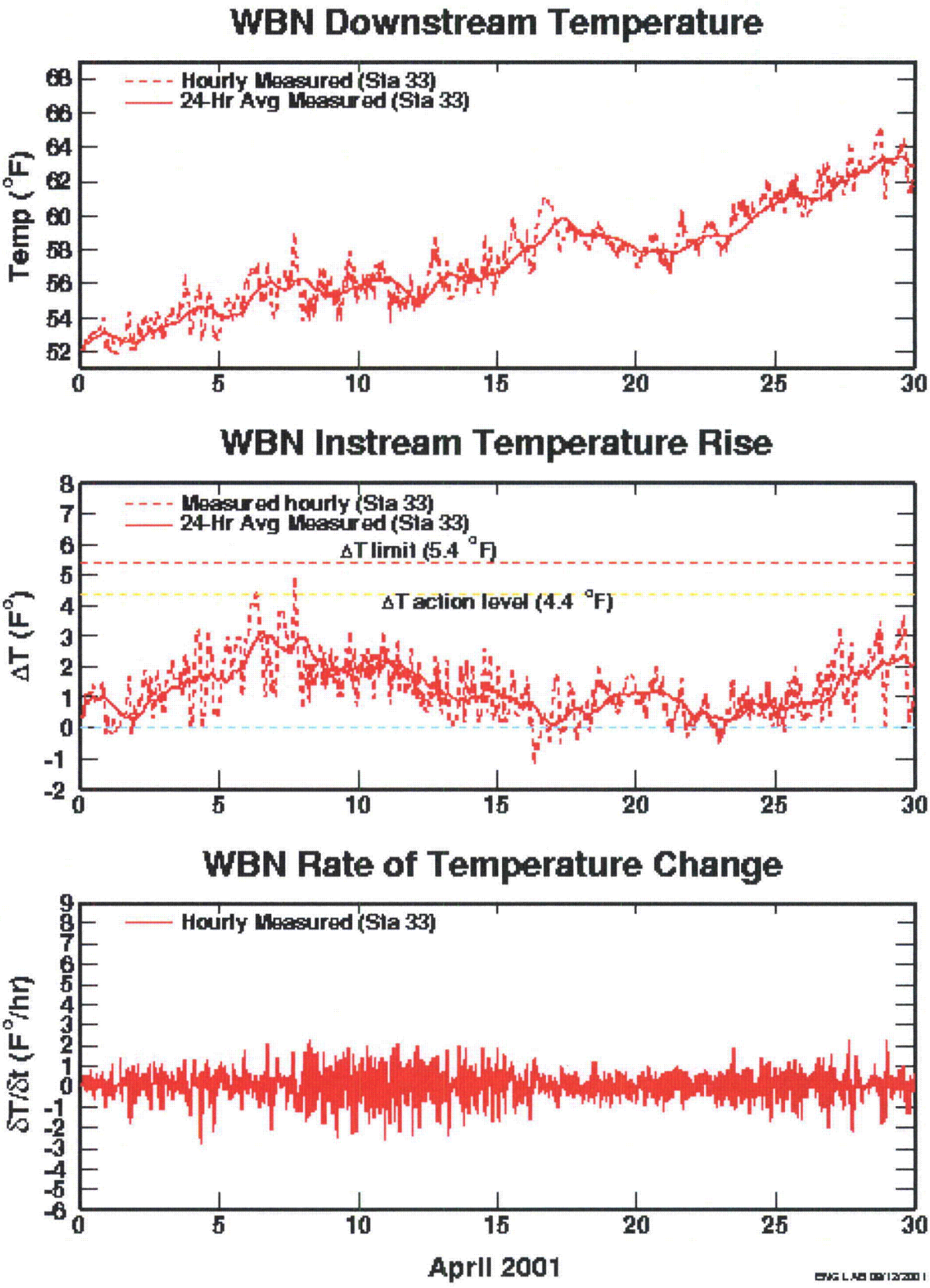


Figure 2.4.17. Comparison of 1-Hour and 24-Hour Averaging, April 2001

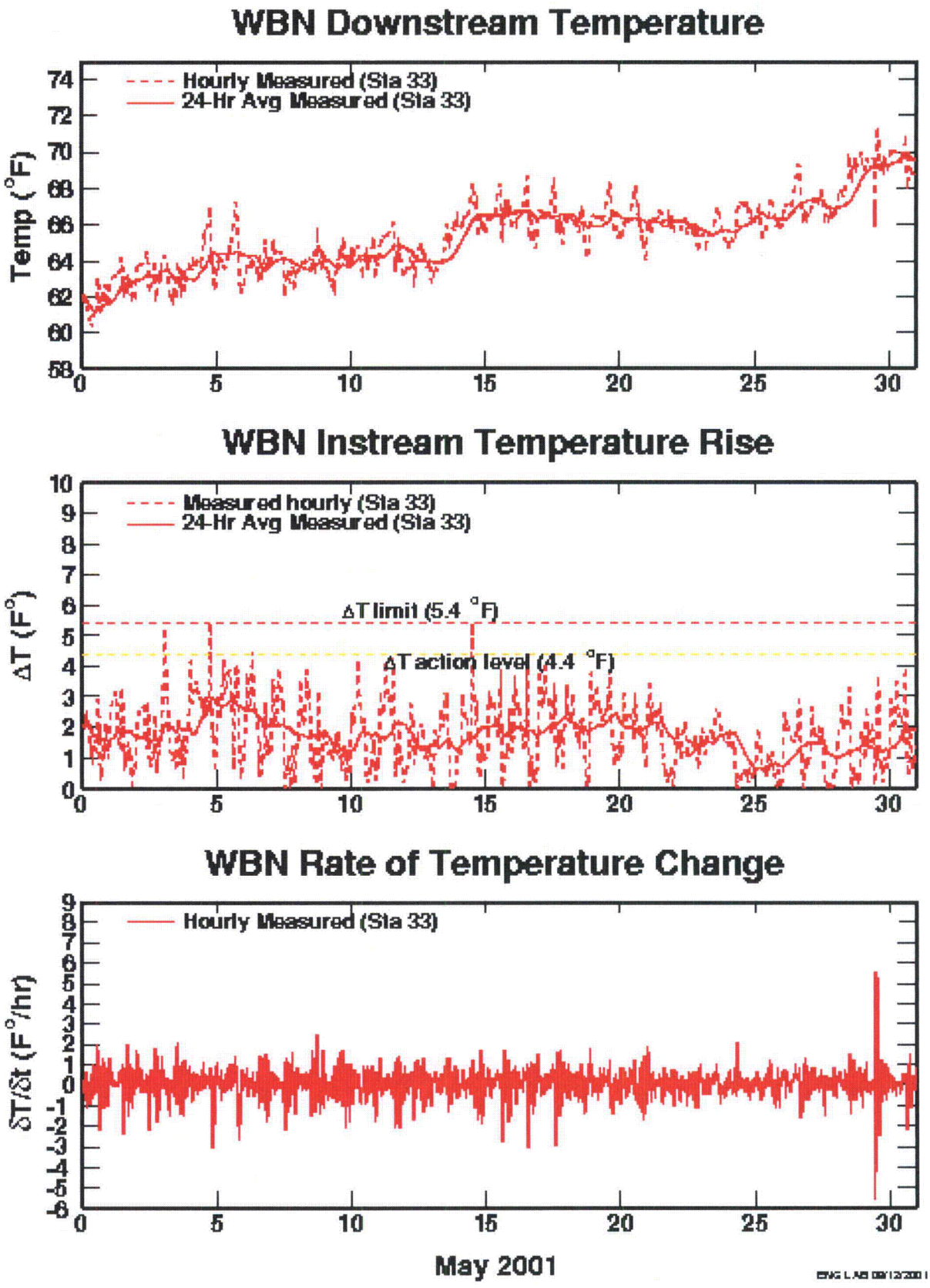


Figure 2.4.18. Comparison of 1-Hour and 24-Hour Averaging, May 2001

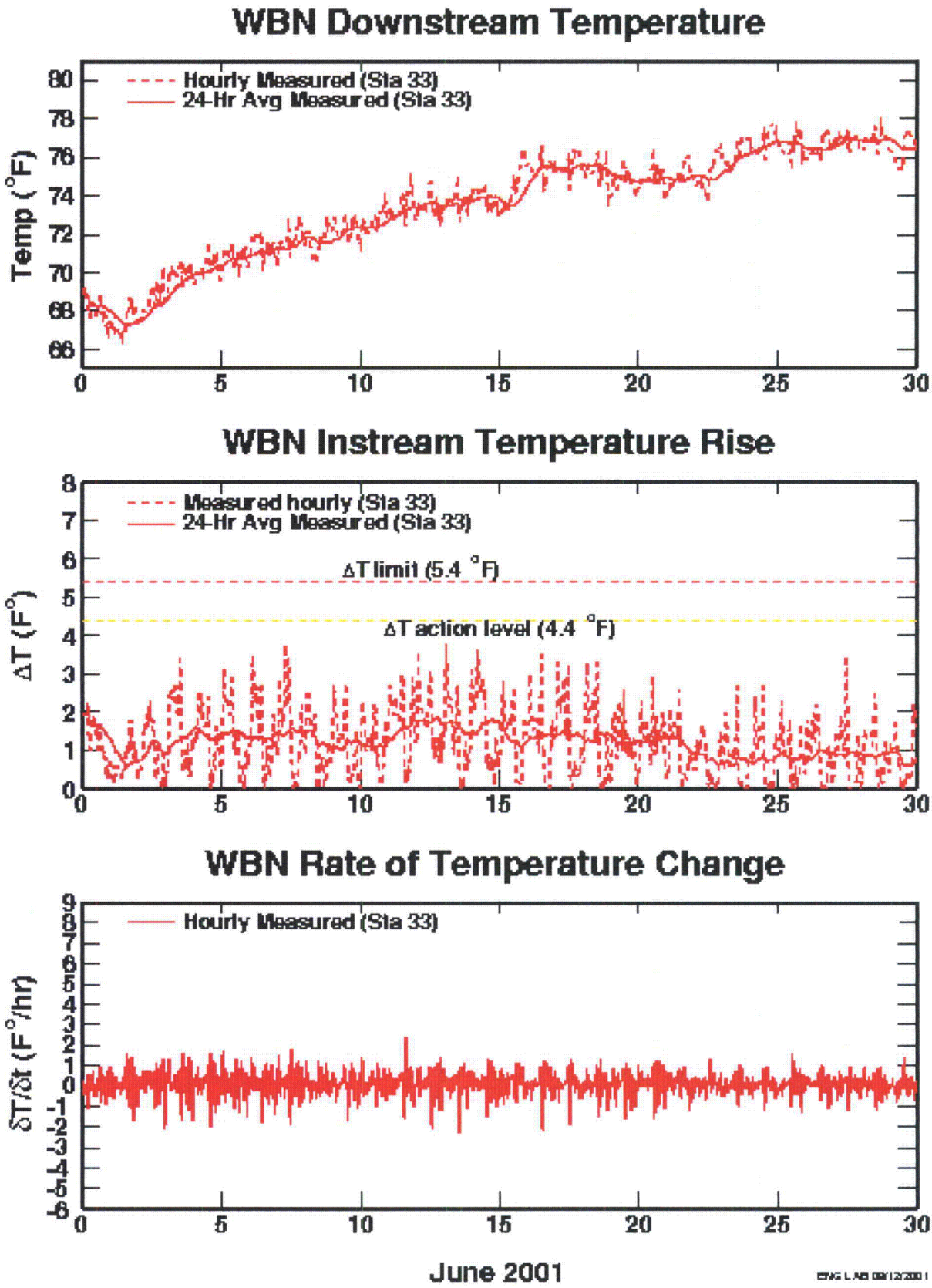


Figure 2.4.19. Comparison of 1-Hour and 24-Hour Averaging, June 2001

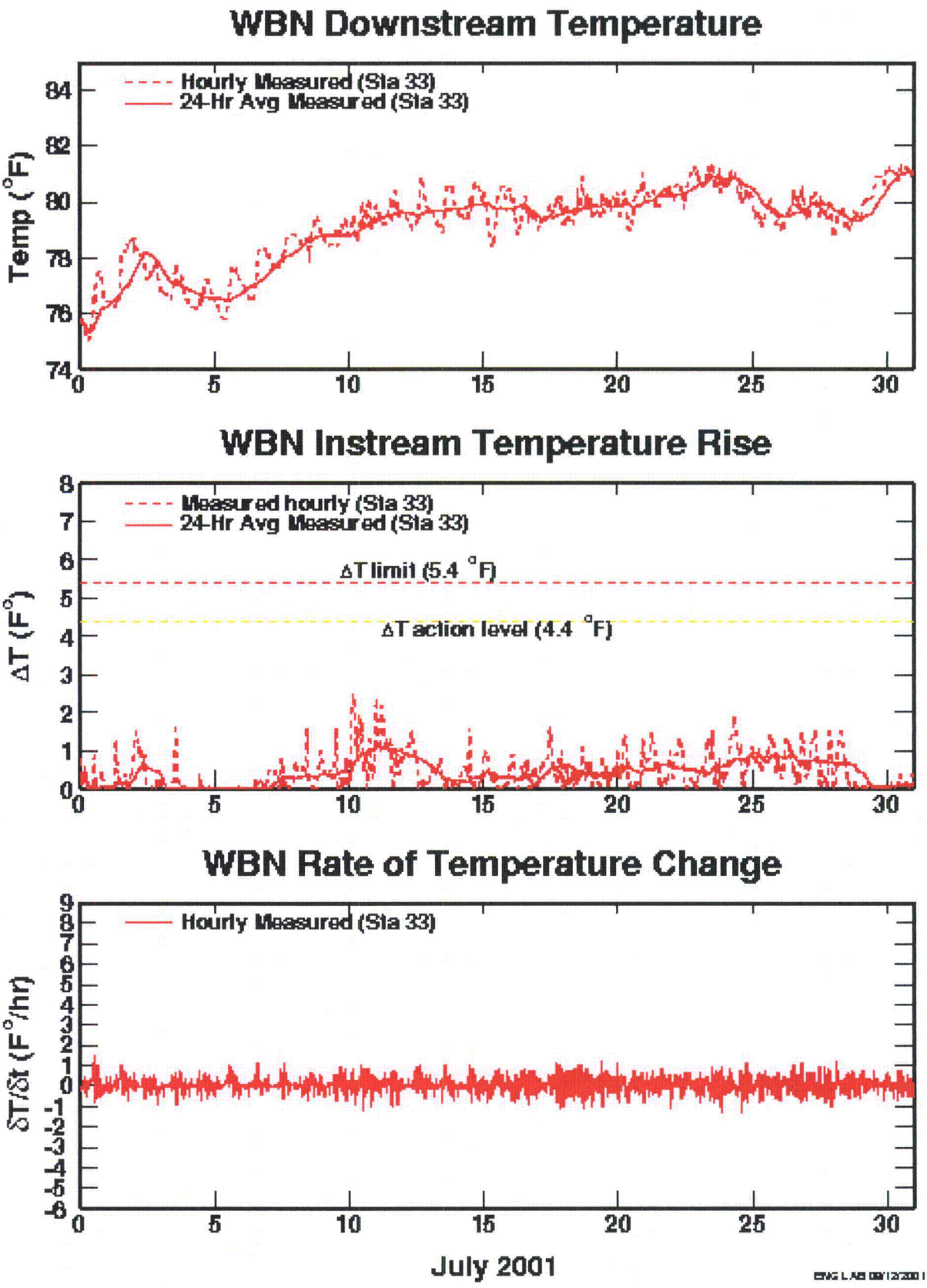


Figure 2.4.20. Comparison of 1-Hour and 24-Hour Averaging, July 2001

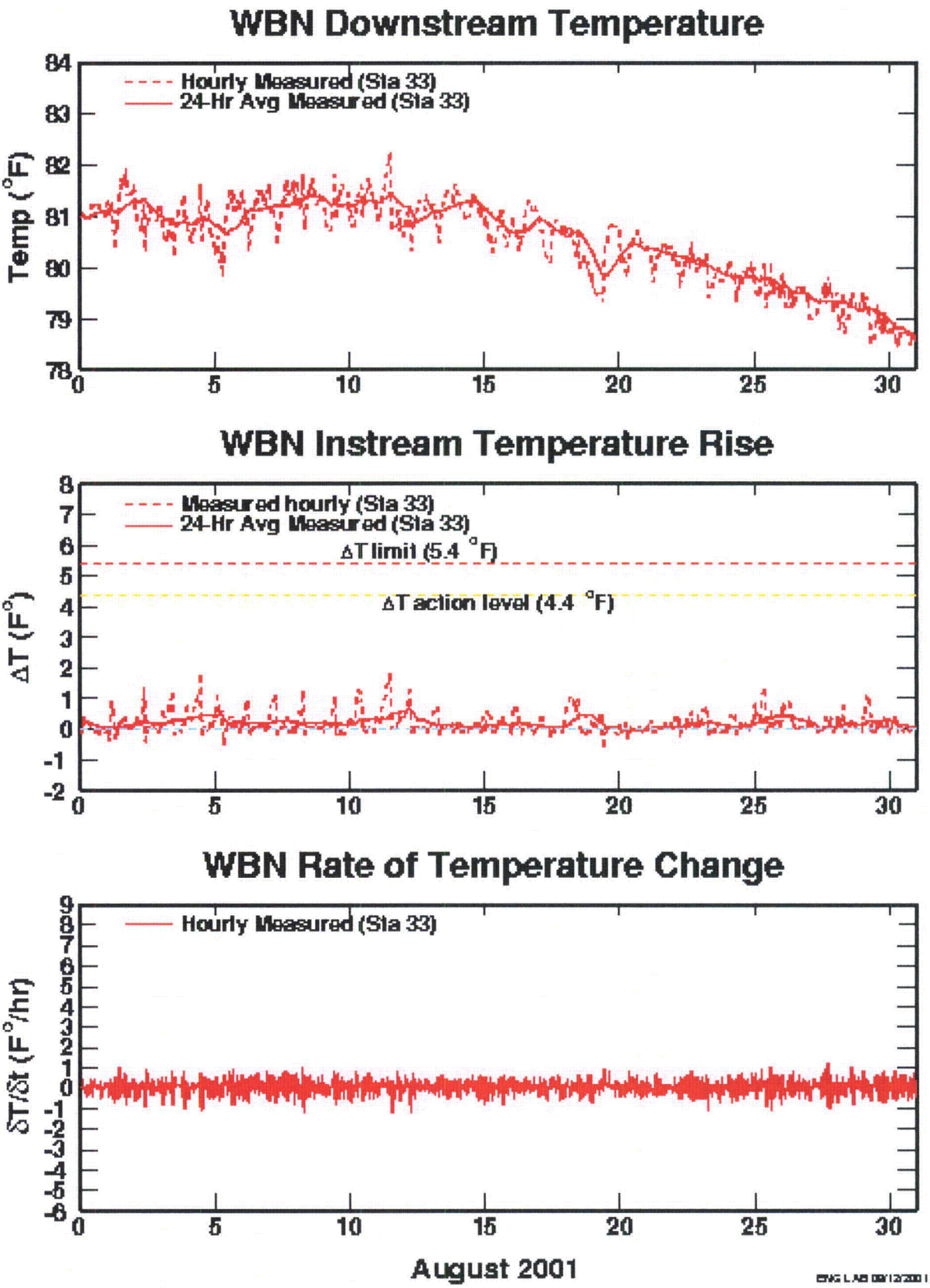


Figure 2.4.21. Comparison of 1-Hour and 24-Hour Averaging, August 2001

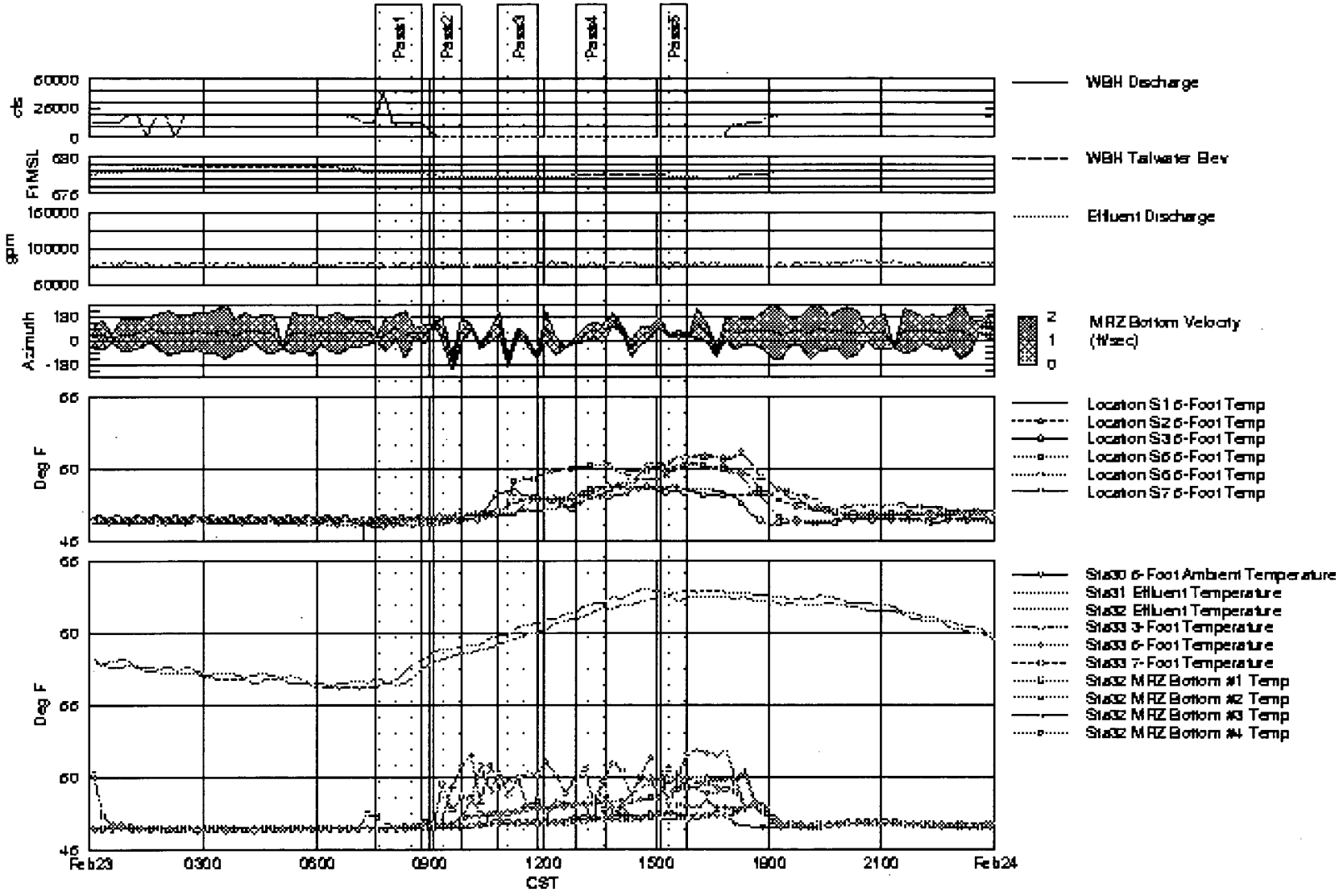


Figure 3.1.1a. SCCW Survey of 2/23/2000—Hydrothermal Data.

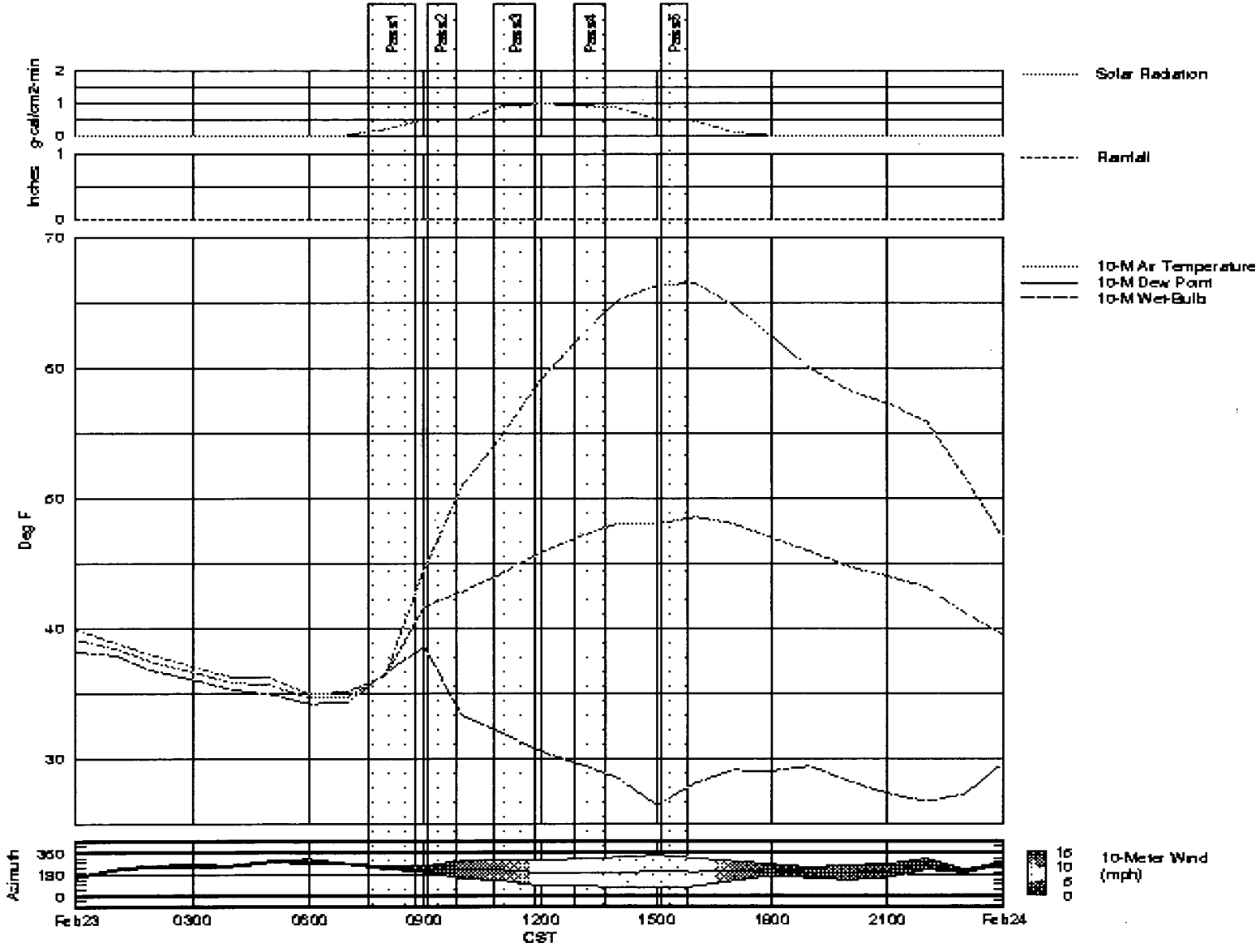


Figure 3.1.1b. SCCW Survey of 2/23/2000—Meteorological Data.

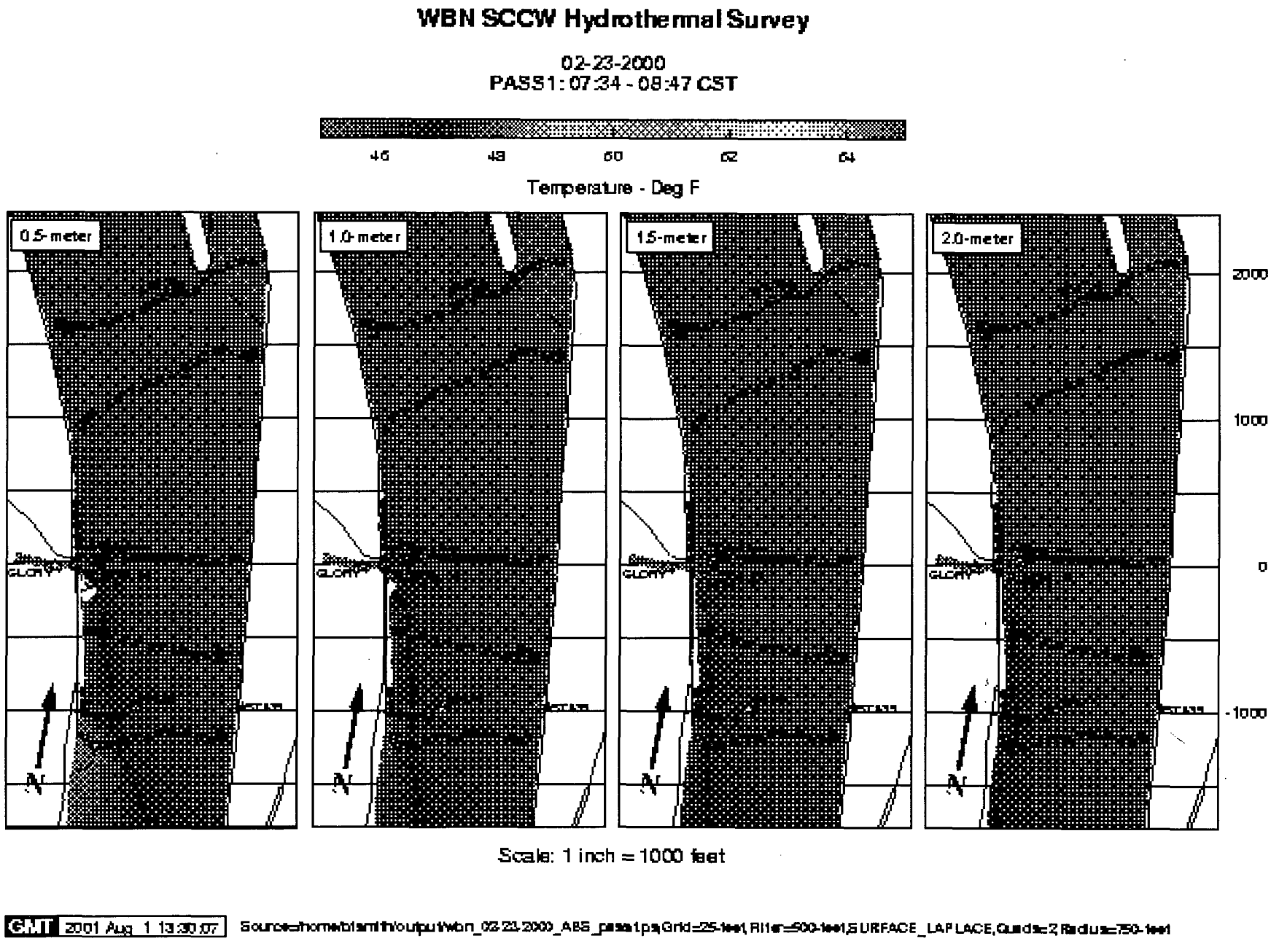


Figure 3.1.2a. SCCW Survey of 2/23/2000—River Temperature, Pass 1.

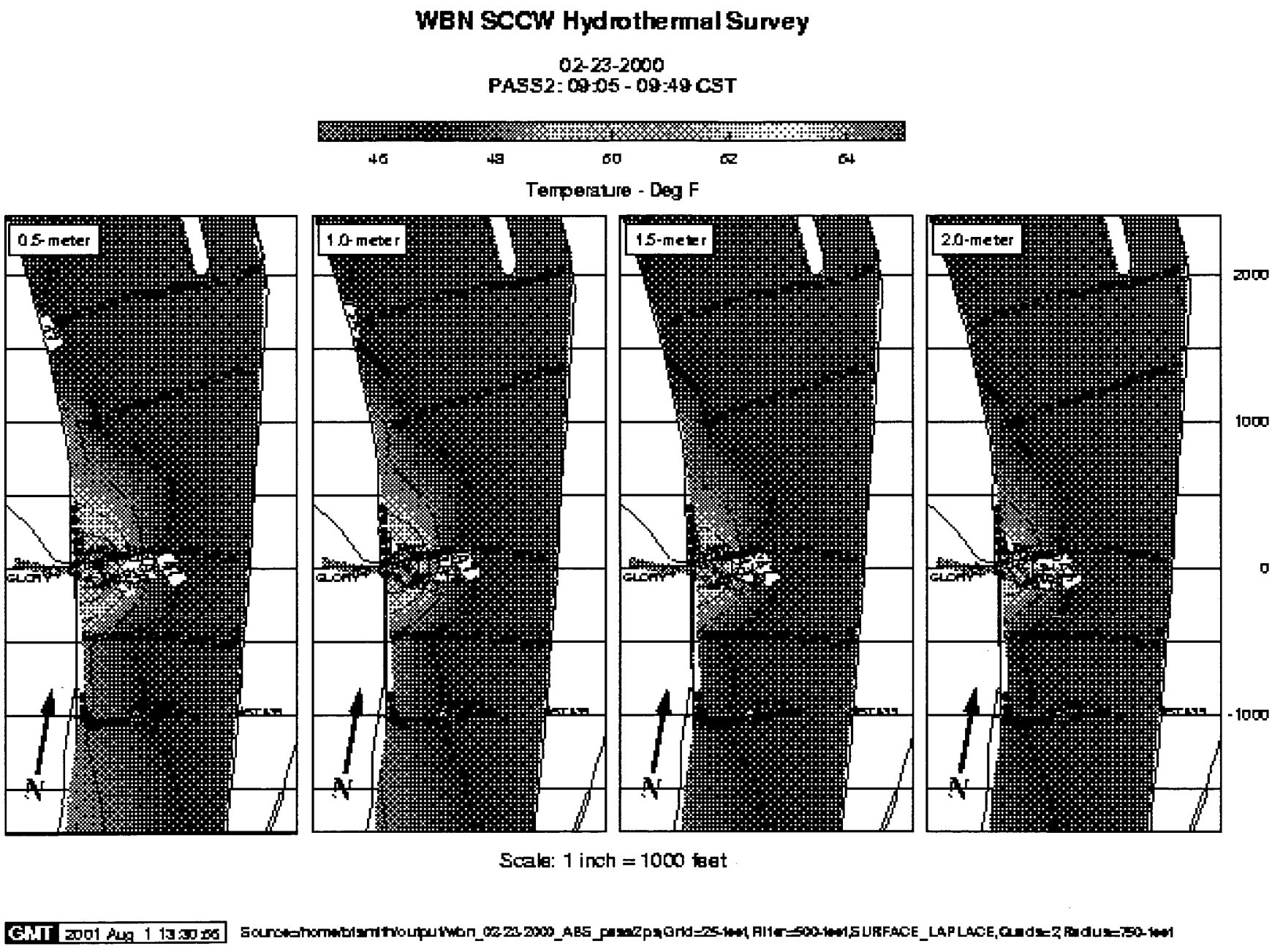


Figure 3.1.2b. SCCW Survey of 2/23/2000—River Temperature, Pass 2.

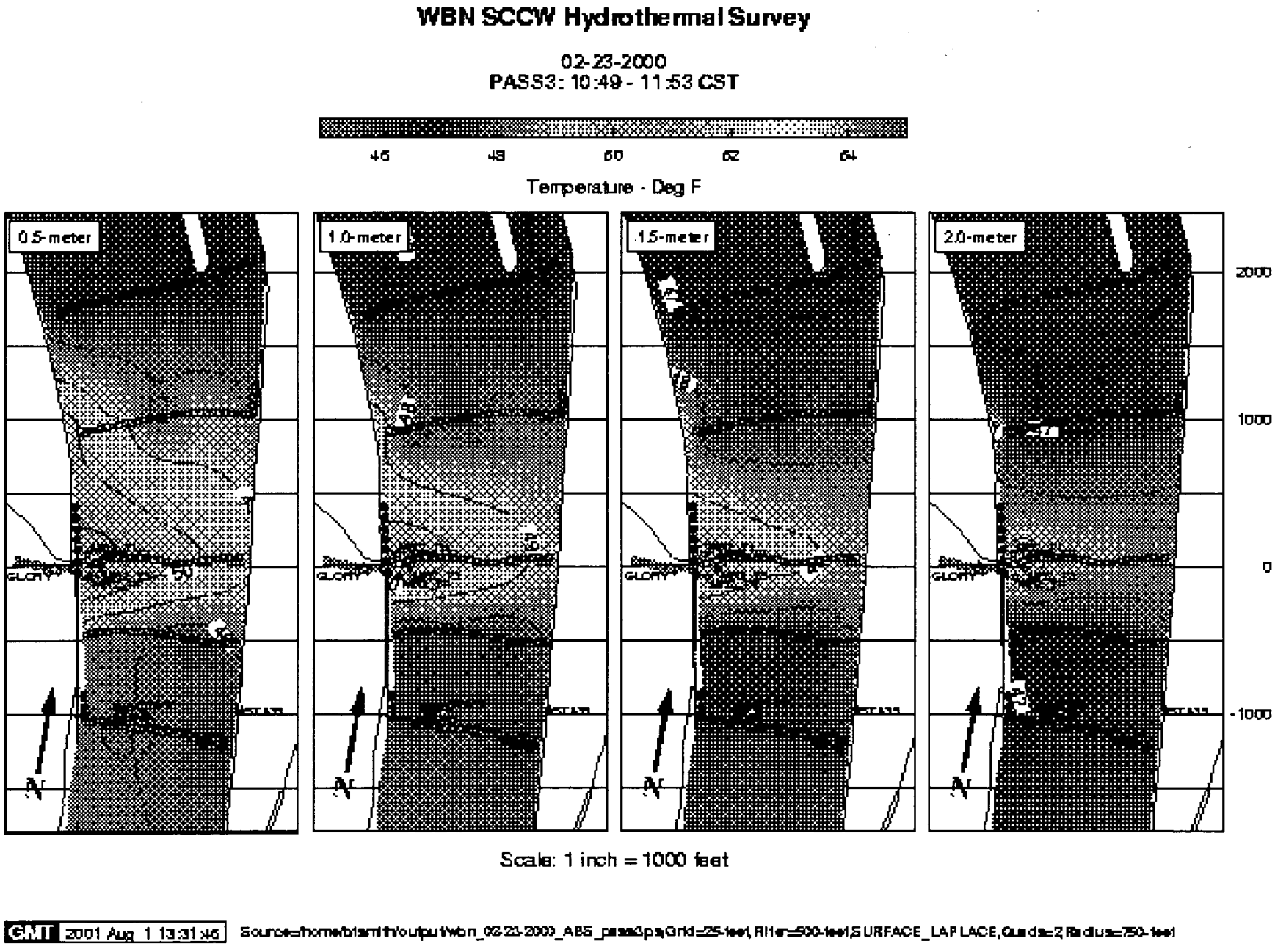


Figure 3.1.2c. SCCW Survey of 2/23/2000—River Temperature, Pass 3.

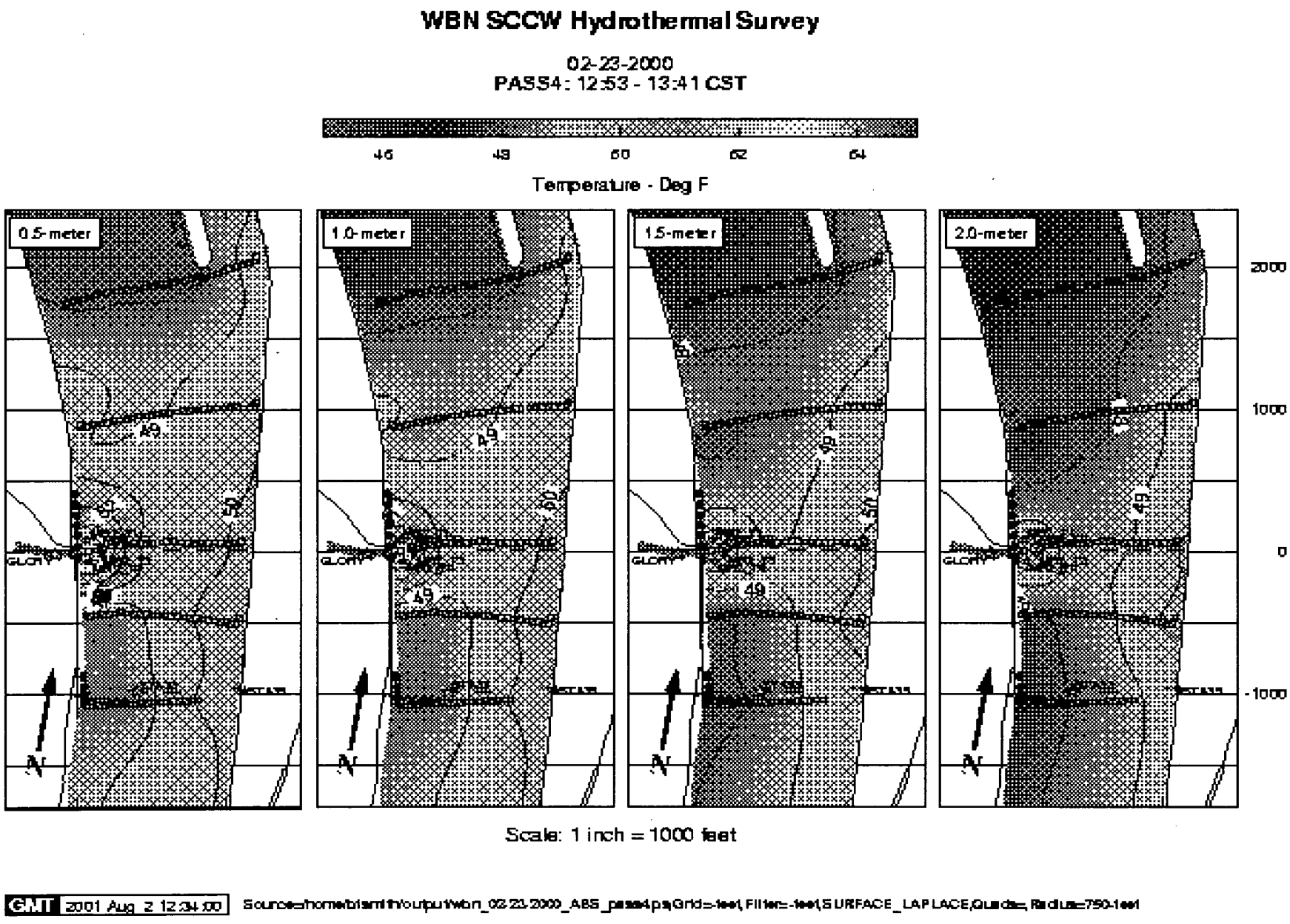


Figure 3.1.2d. SCCW Survey of 2/23/2000—River Temperature, Pass 4.

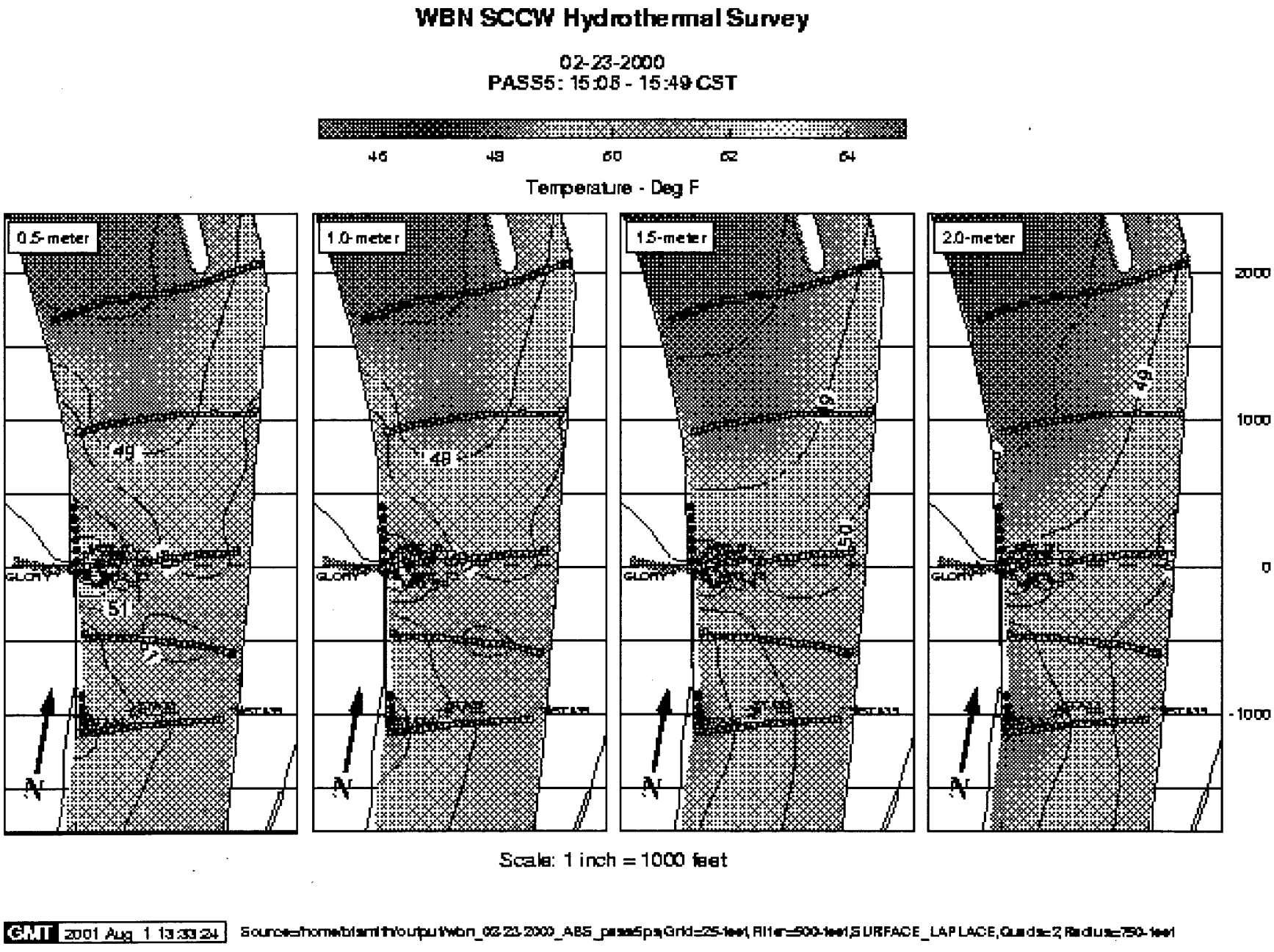


Figure 3.1.2e. SCCW Survey of 2/23/2000—River Temperature, Pass 5.

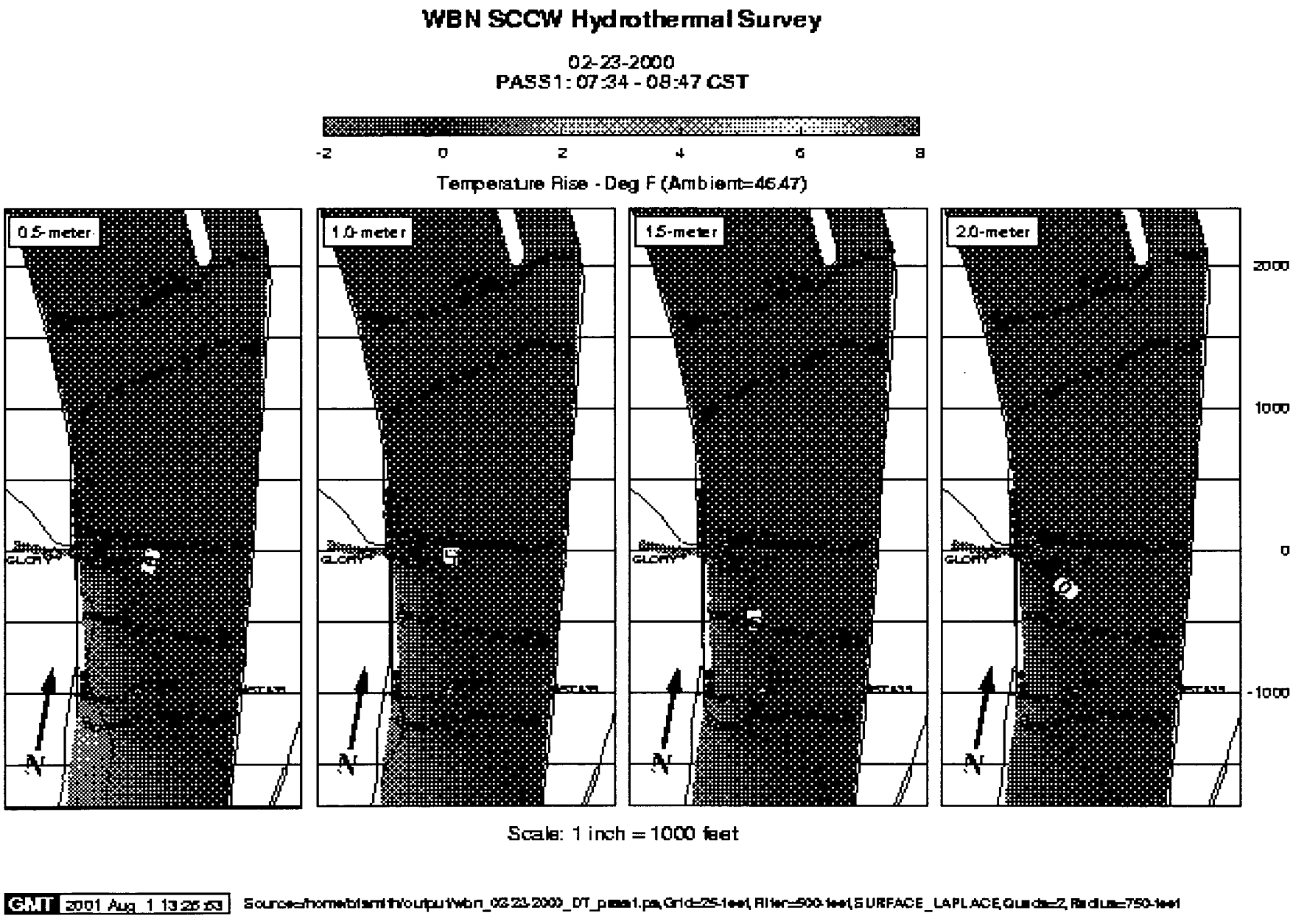


Figure 3.1.3a. SCCW Survey of 2/23/2000—River Temperature Rise, Pass 1.

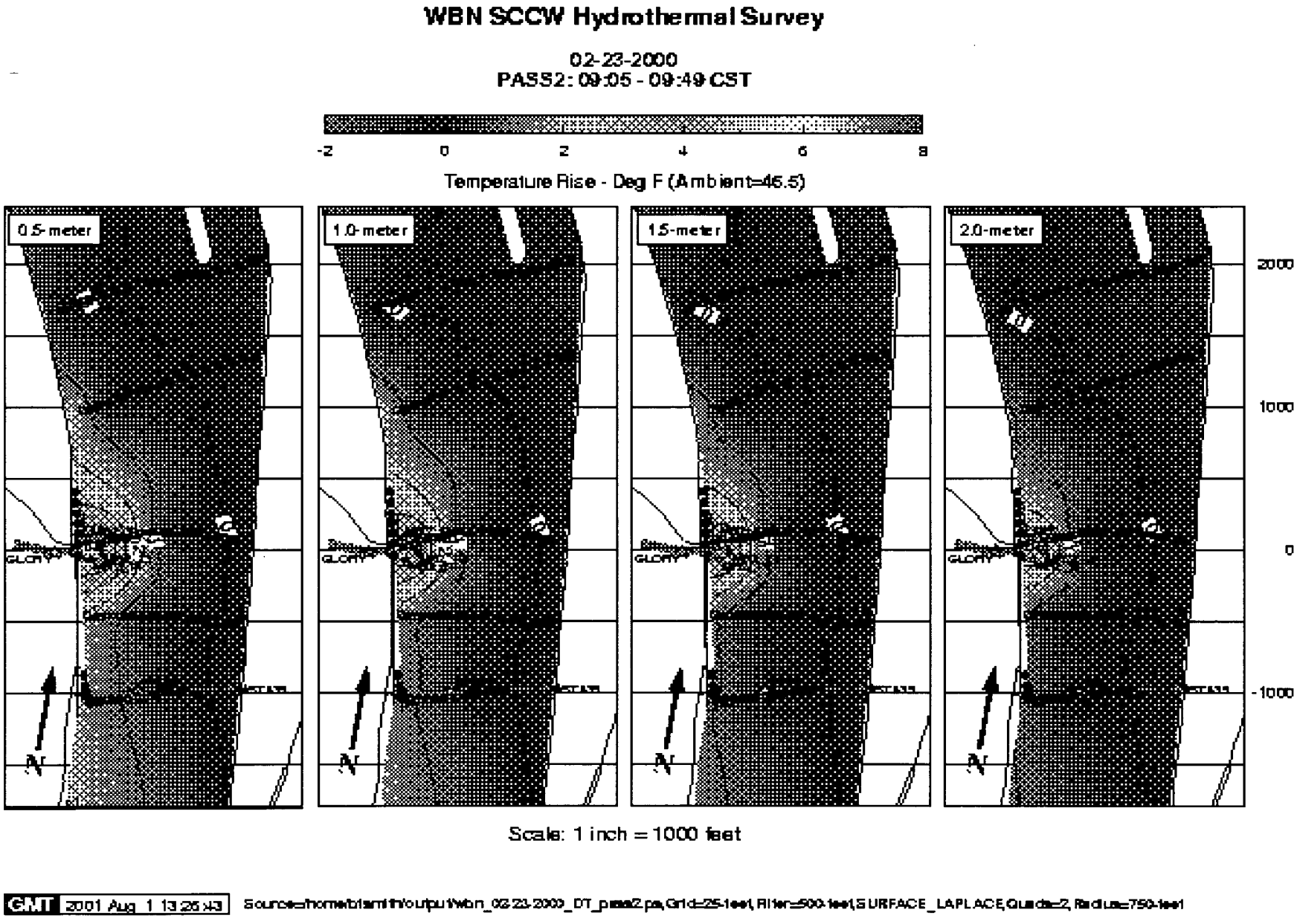


Figure 3.1.3b. SCCW Survey of 2/23/2000—River Temperature Rise, Pass 2.

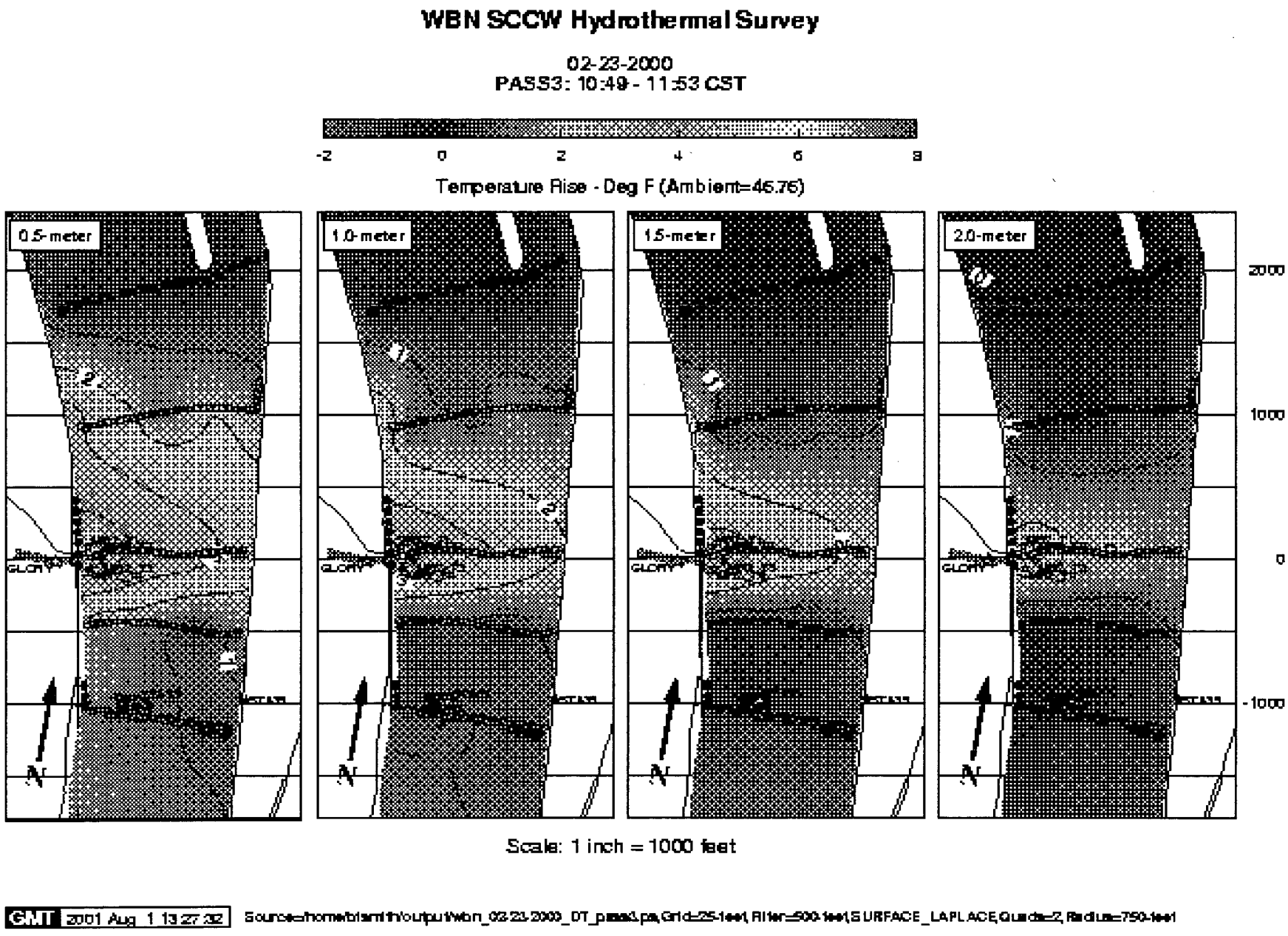


Figure 3.1.3c. SCCW Survey of 2/23/2000—River Temperature Rise, Pass 3.

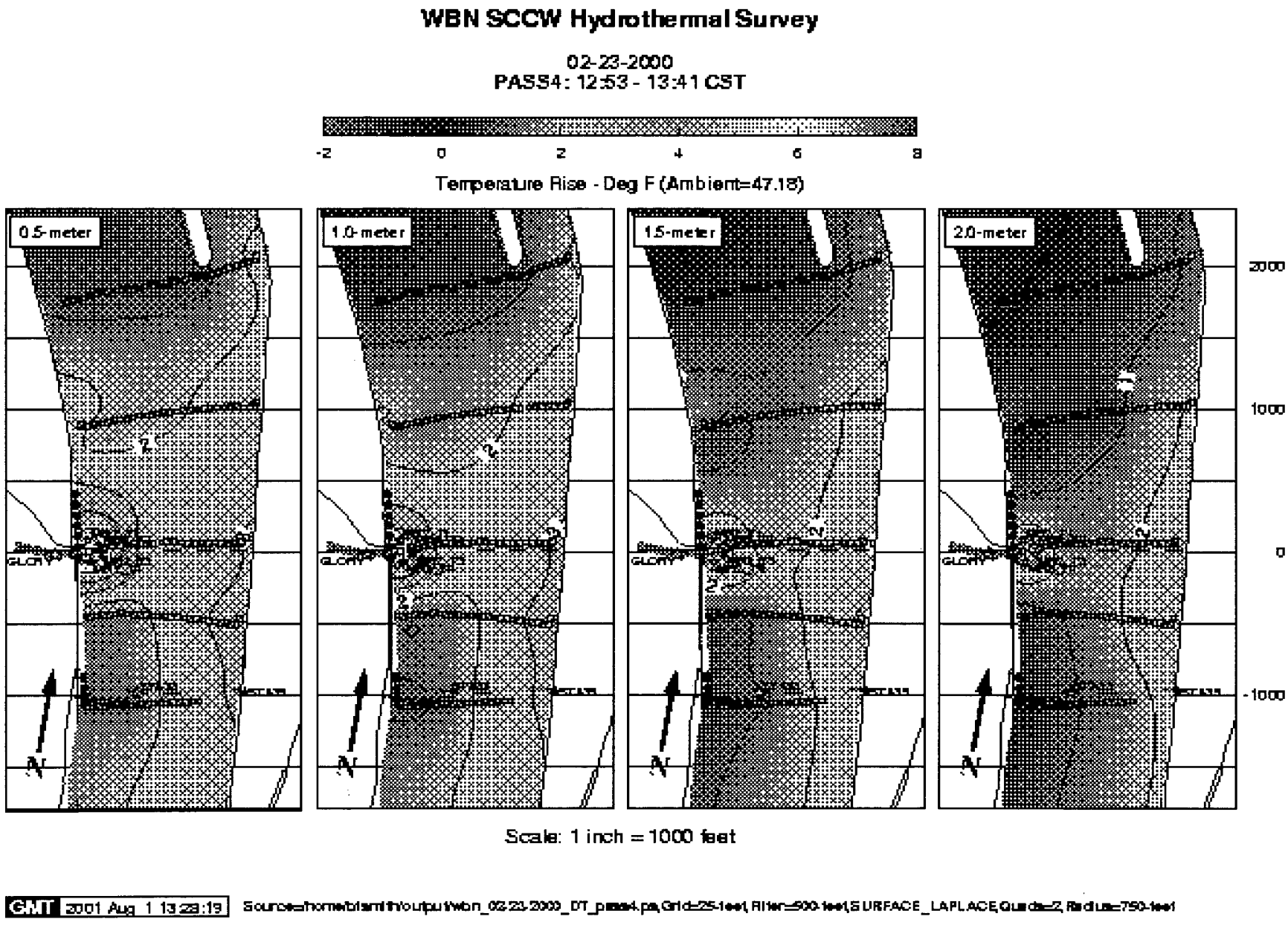


Figure 3.1.3d. SCCW Survey of 2/23/2000—River Temperature Rise, Pass 4.

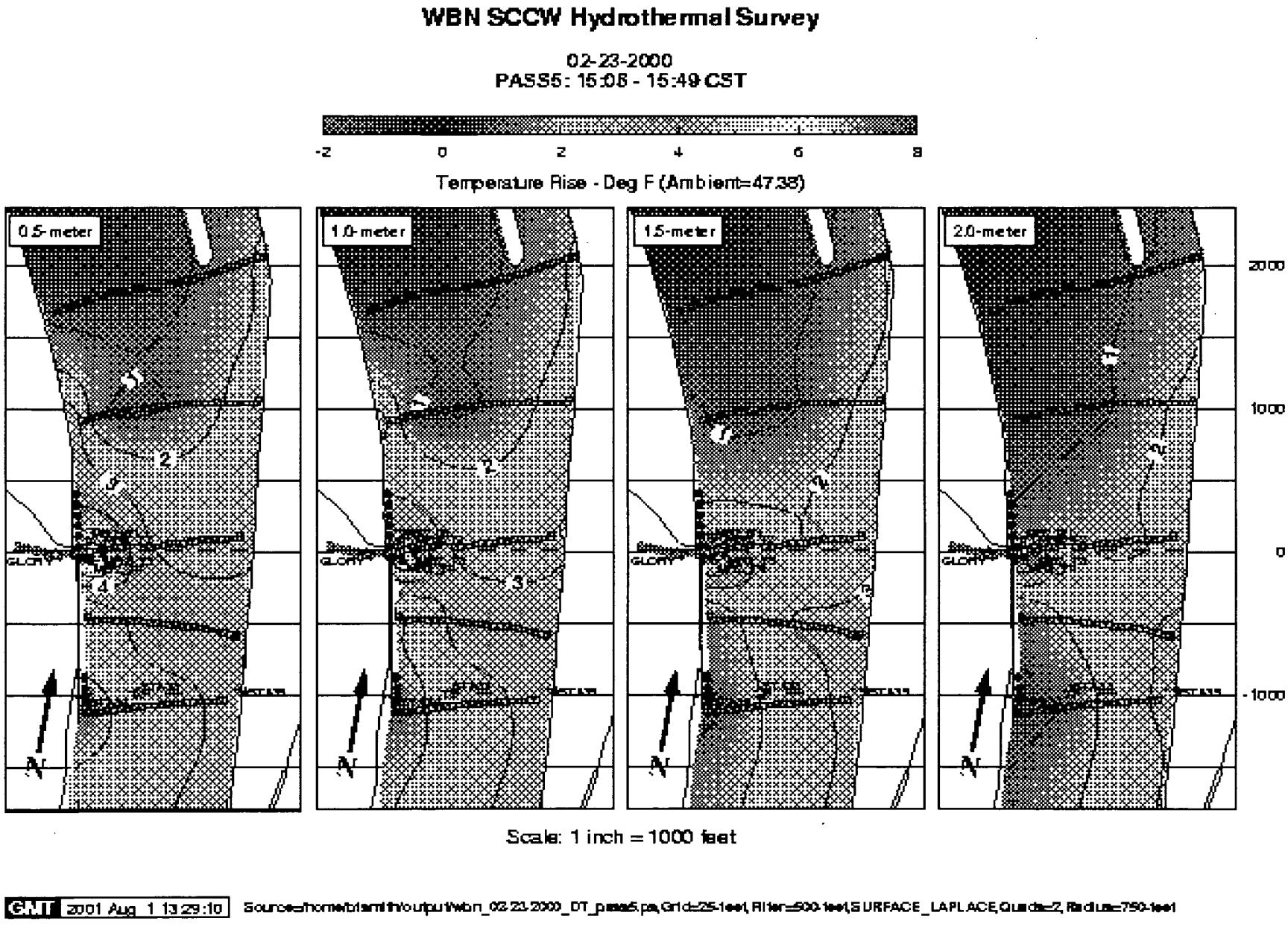


Figure 3.1.3e. SCCW Survey of 2/23/2000—River Temperature Rise, Pass 5.

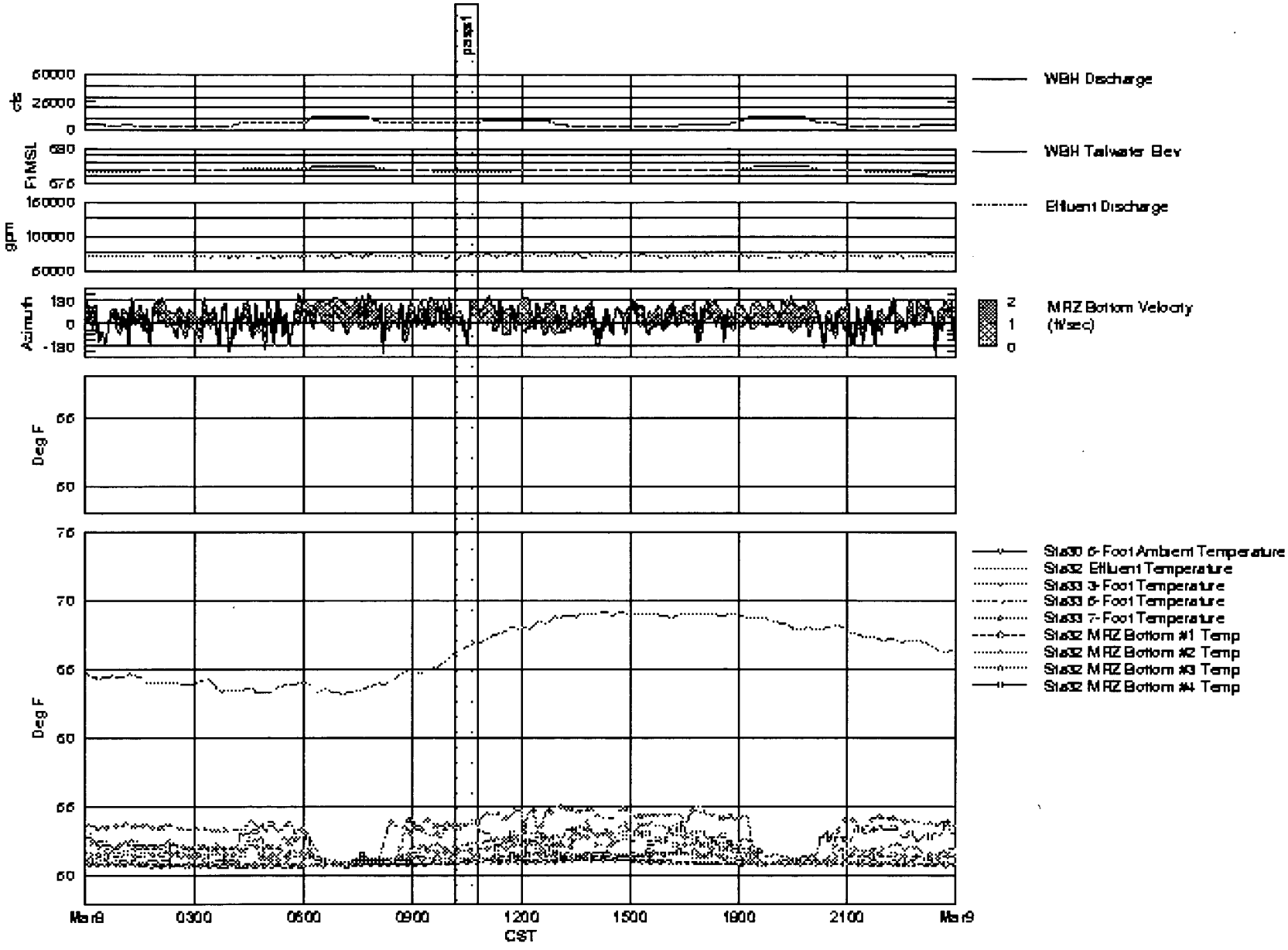


Figure 3.2.1a. SCCW Survey of 3/8/2000—Hydrothermal Data.

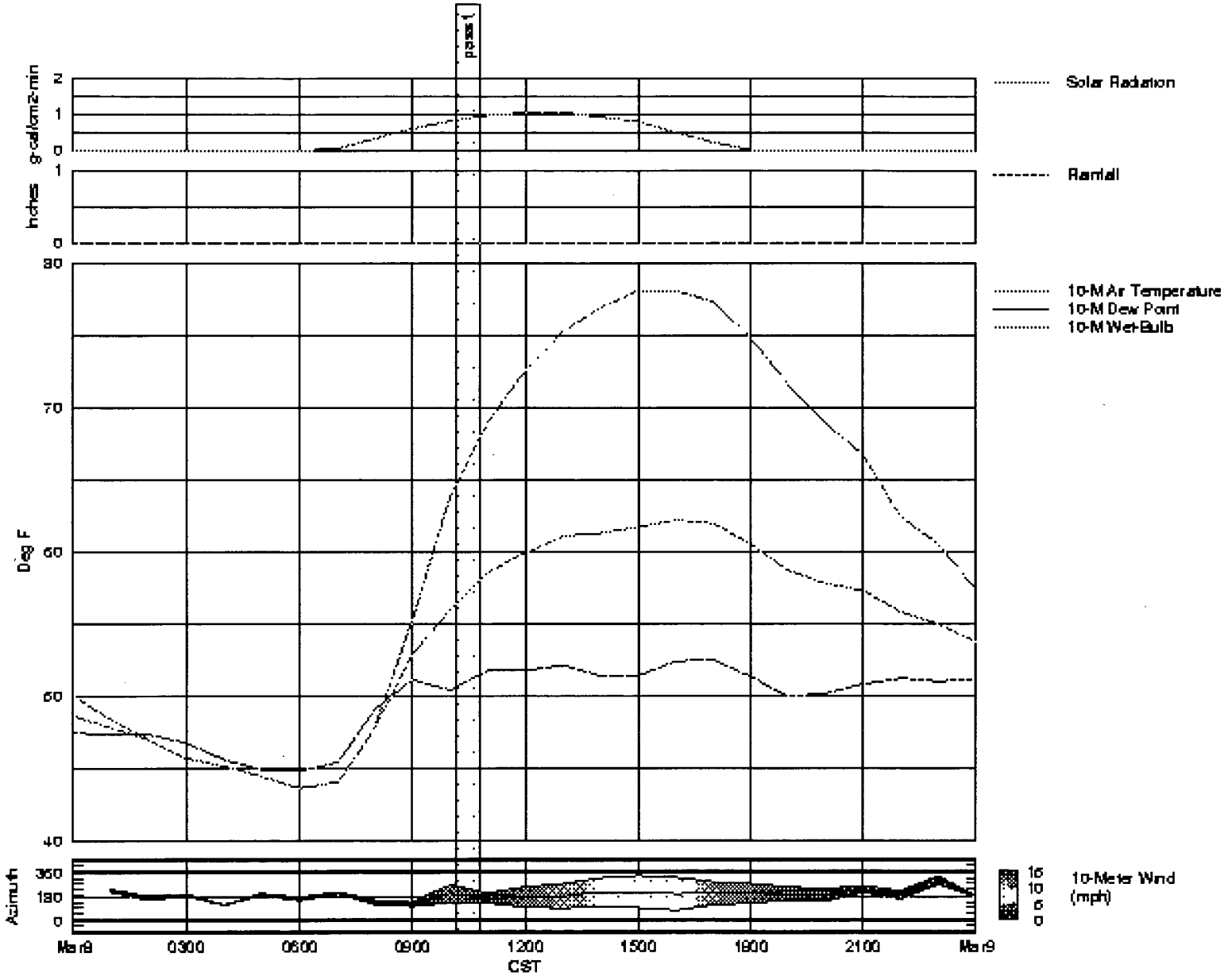


Figure 3.2.1b. SCCW Survey of 3/8/2000—Meteorological Data.

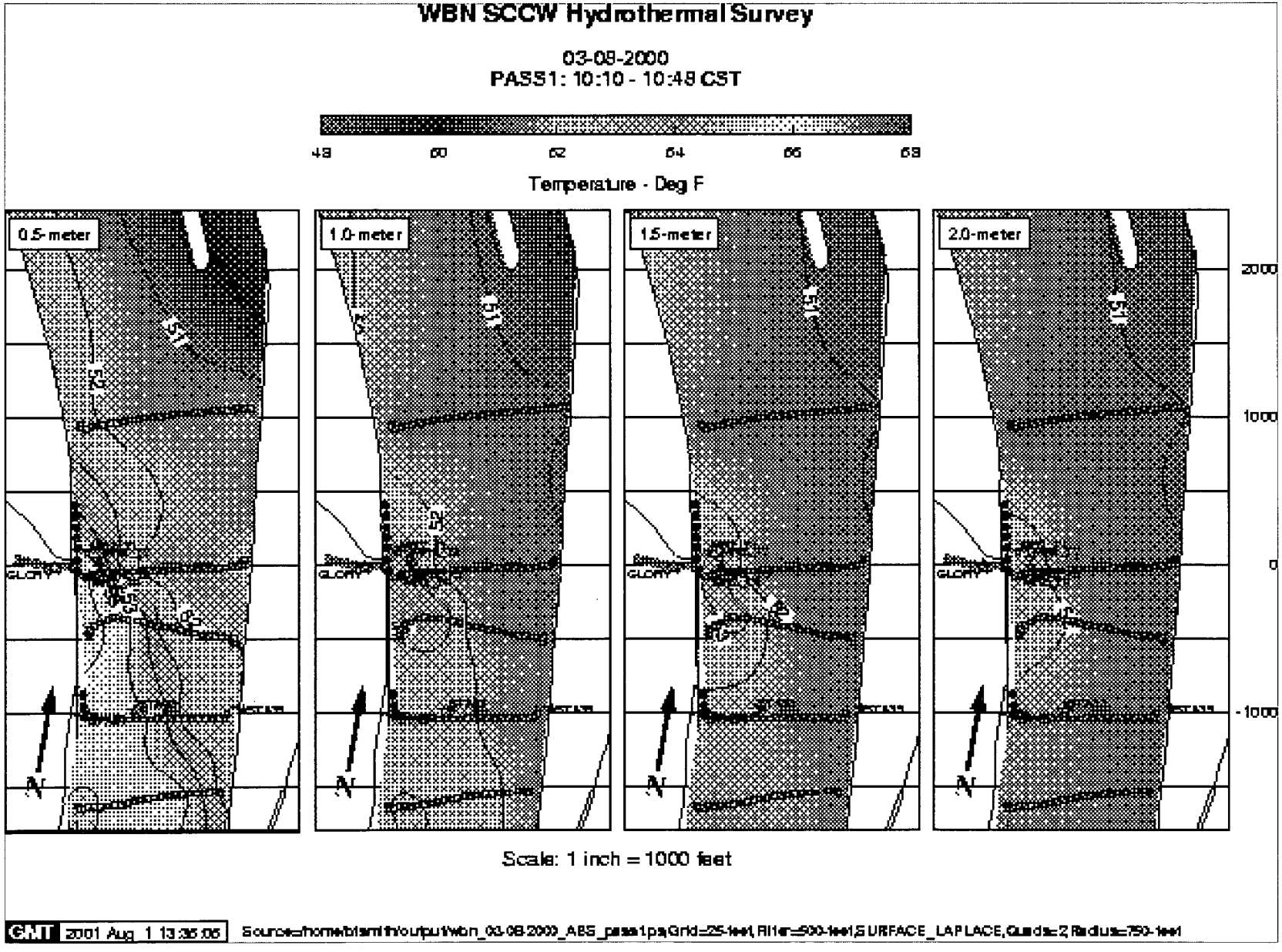


Figure 3.2.2a. SCCW Survey of 3/8/2000—River Temperature, Pass 1.

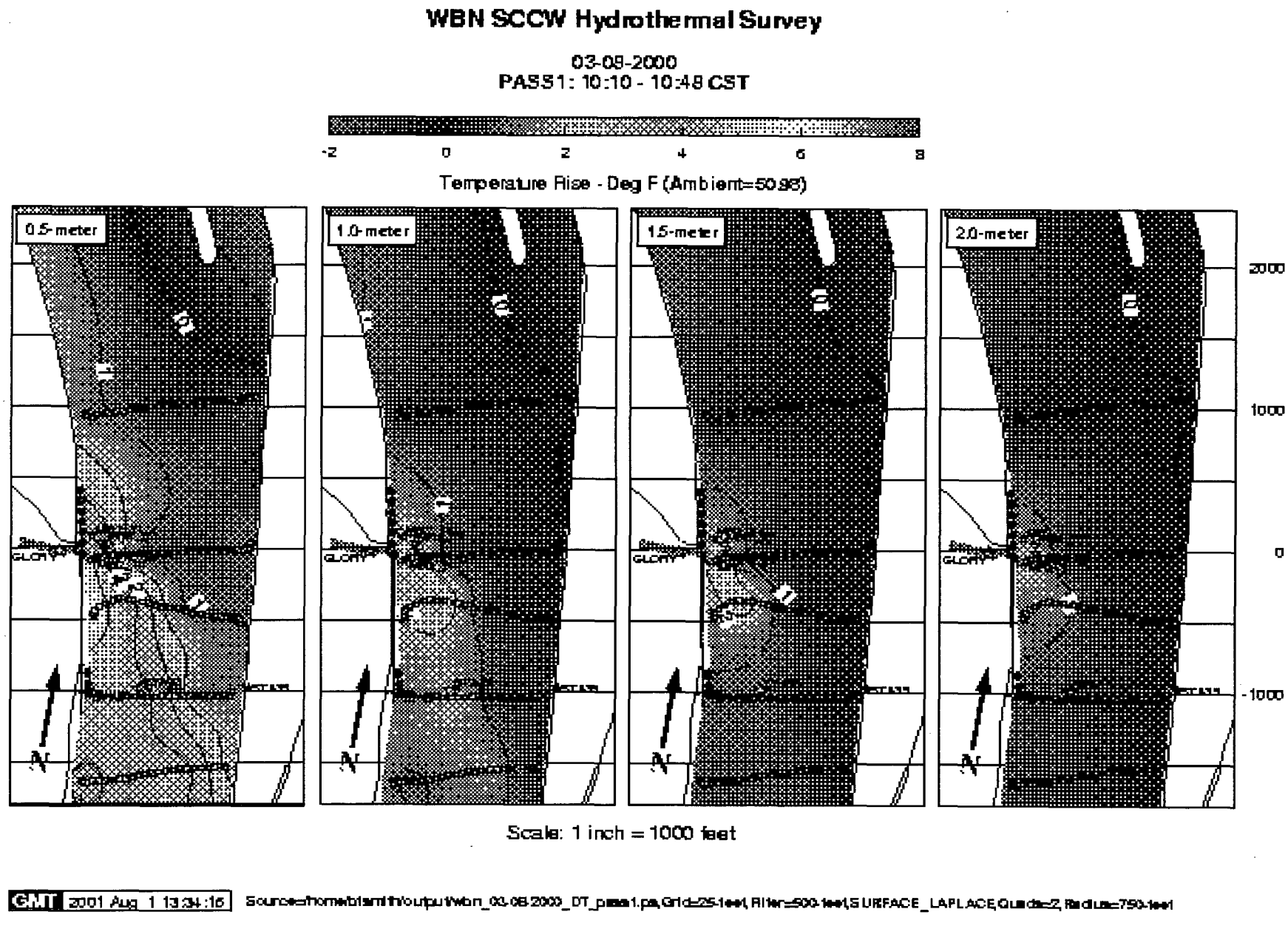


Figure 3.2.3a. SCCW Survey of 3/8/2000—River Temperature Rise, Pass 1.

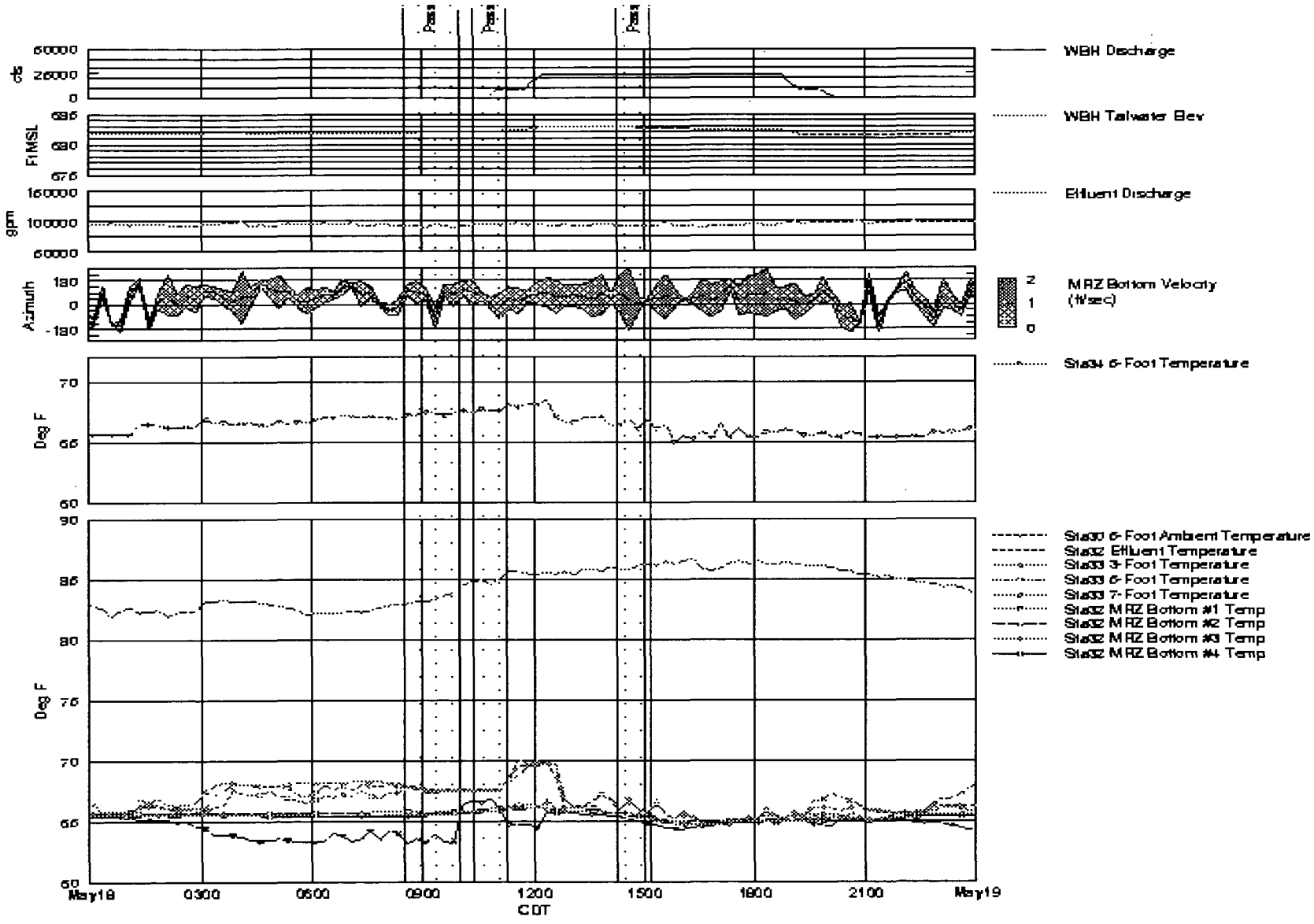


Figure 3.3.1a. SCCW Survey of 5/18/2000—Hydrothermal Data.

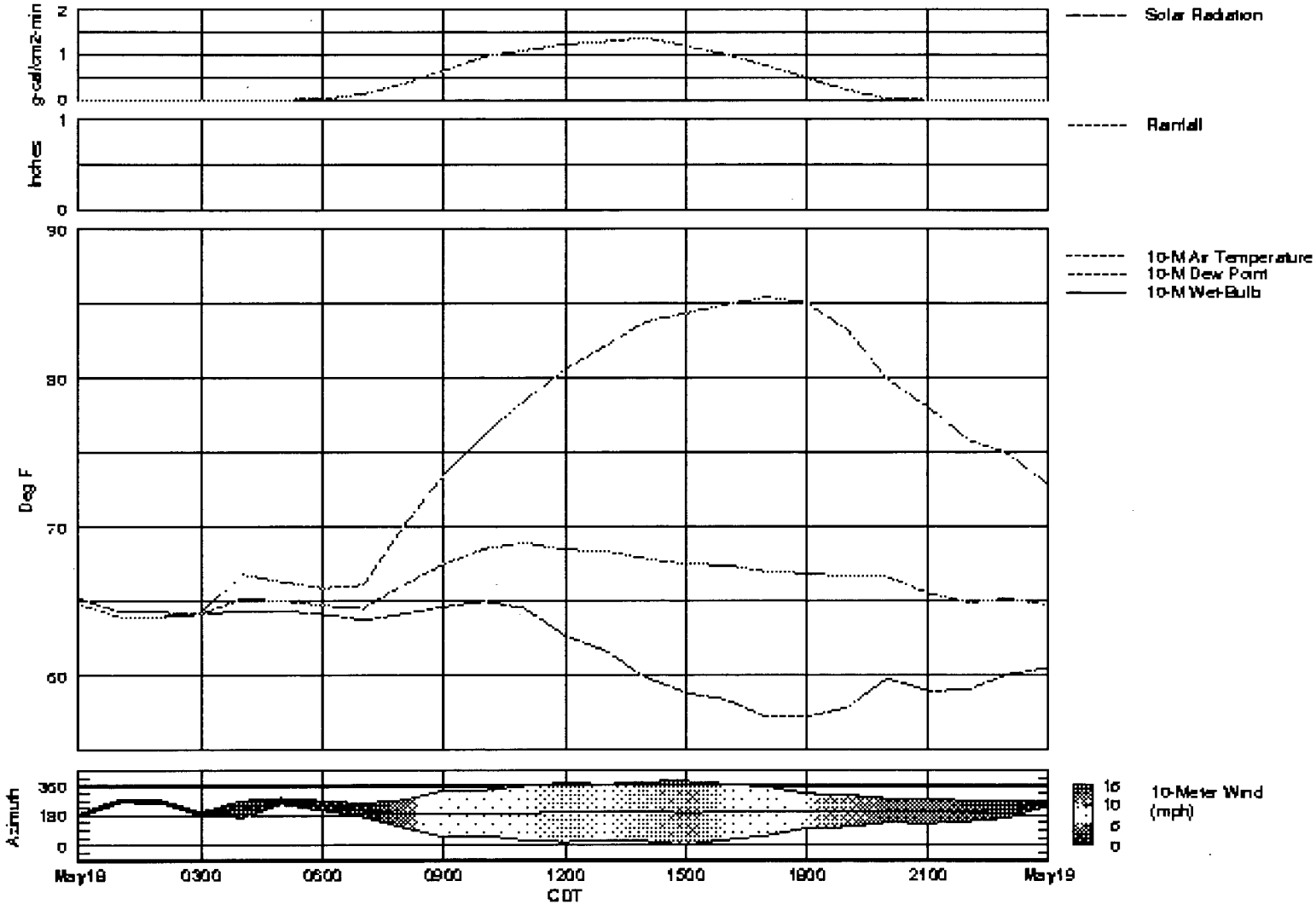


Figure 3.3.1b. SCCW Survey of 5/18/2000—Meteorological Data.

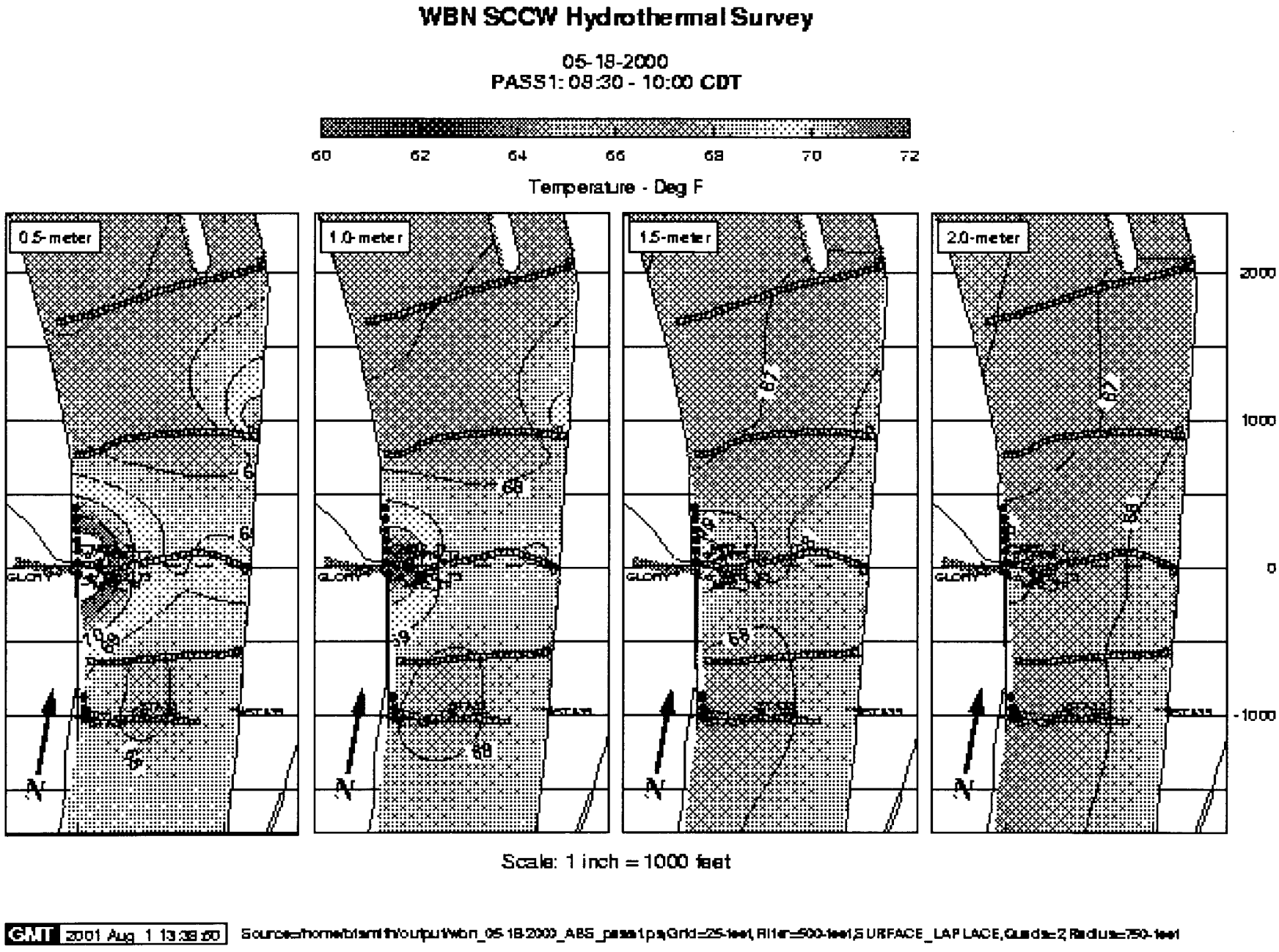


Figure 3.3.2a. SCCW Survey of 5/18/2000—River Temperature, Pass 1.

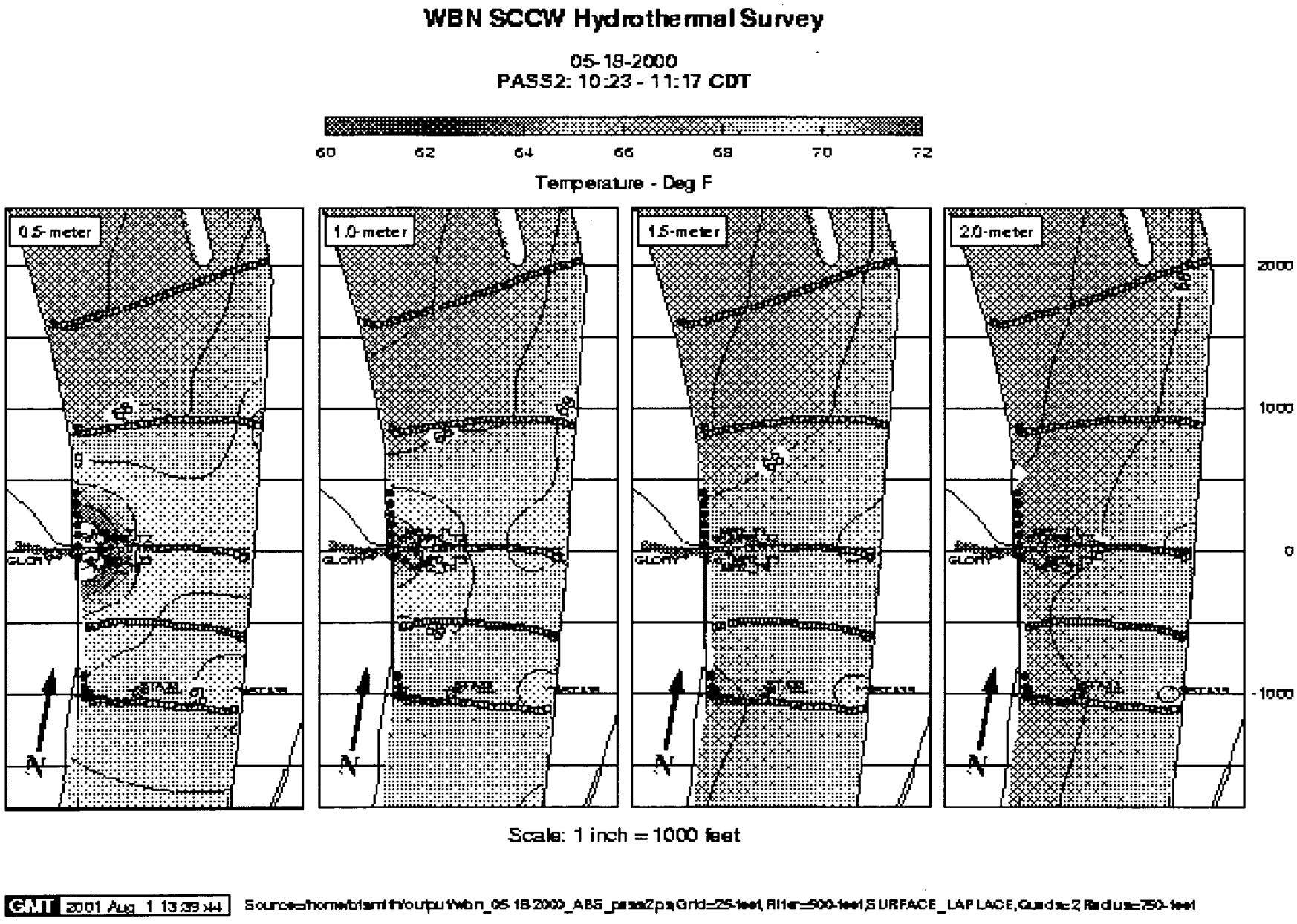


Figure 3.3.2b. SCCW Survey of 5/18/2000—River Temperature, Pass 2.

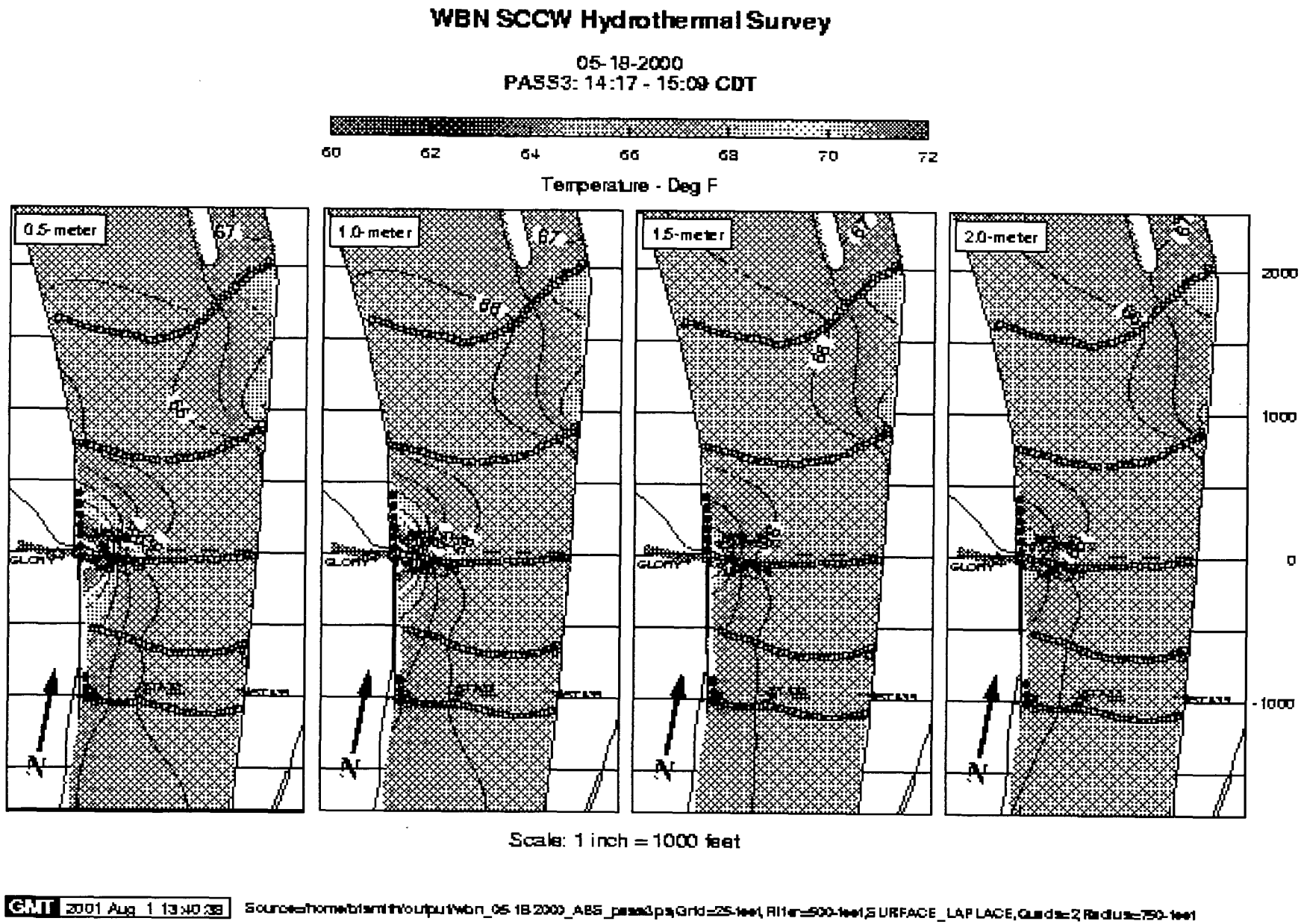


Figure 3.3.2c. SCCW Survey of 5/18/2000—River Temperature, Pass 3.

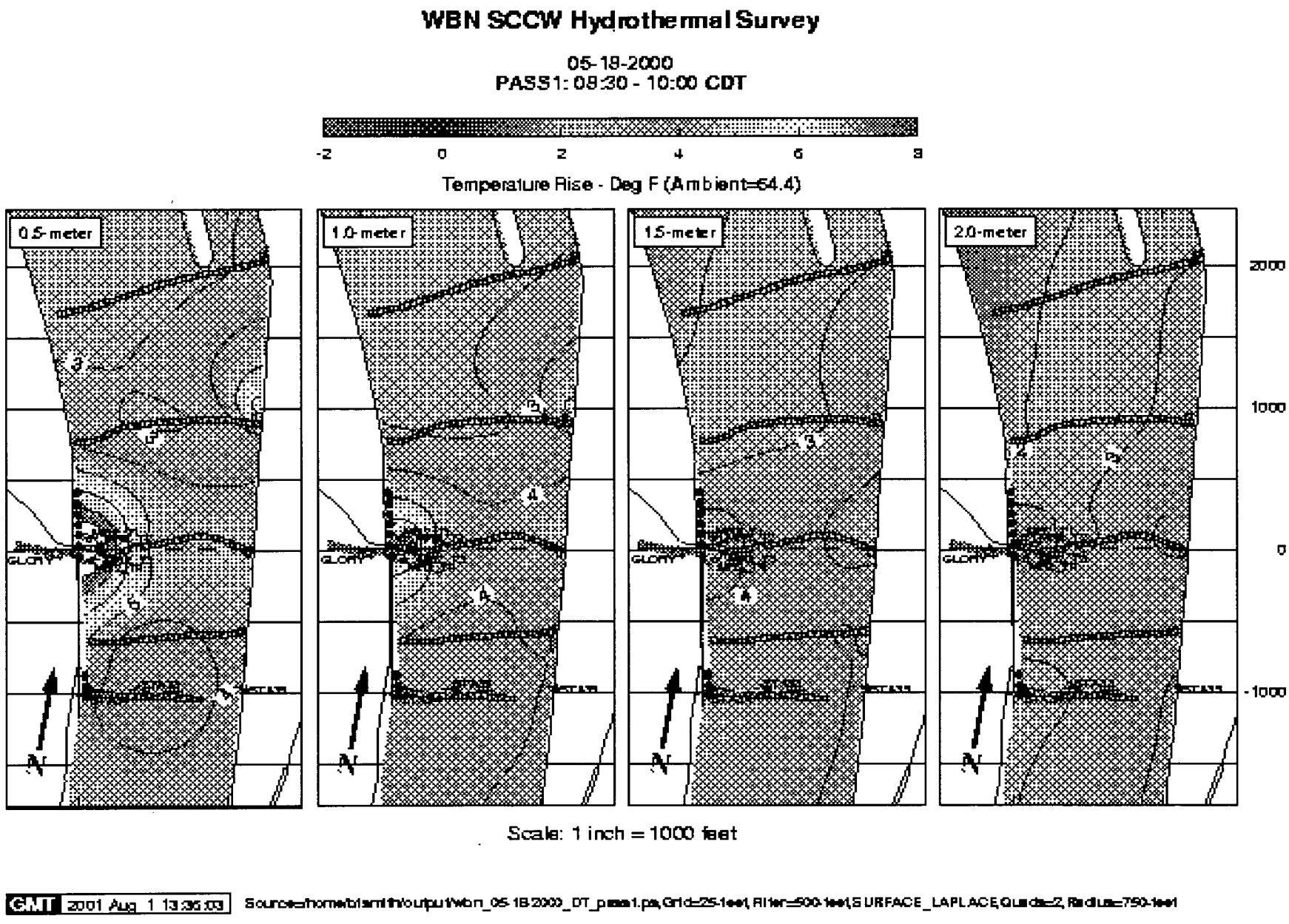


Figure 3.3.3a. SCCW Survey of 5/18/2000—River Temperature Rise, Pass 1.

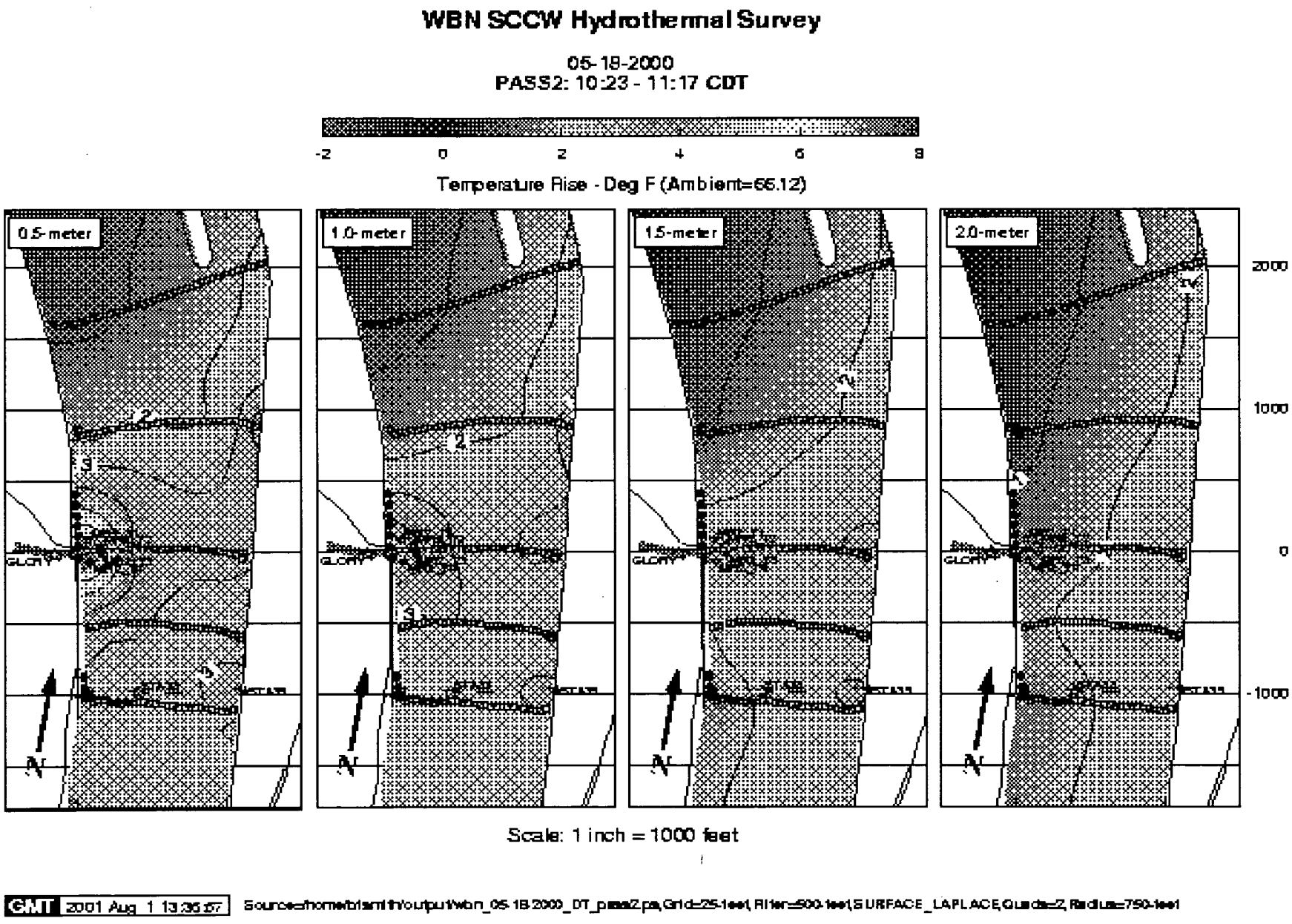
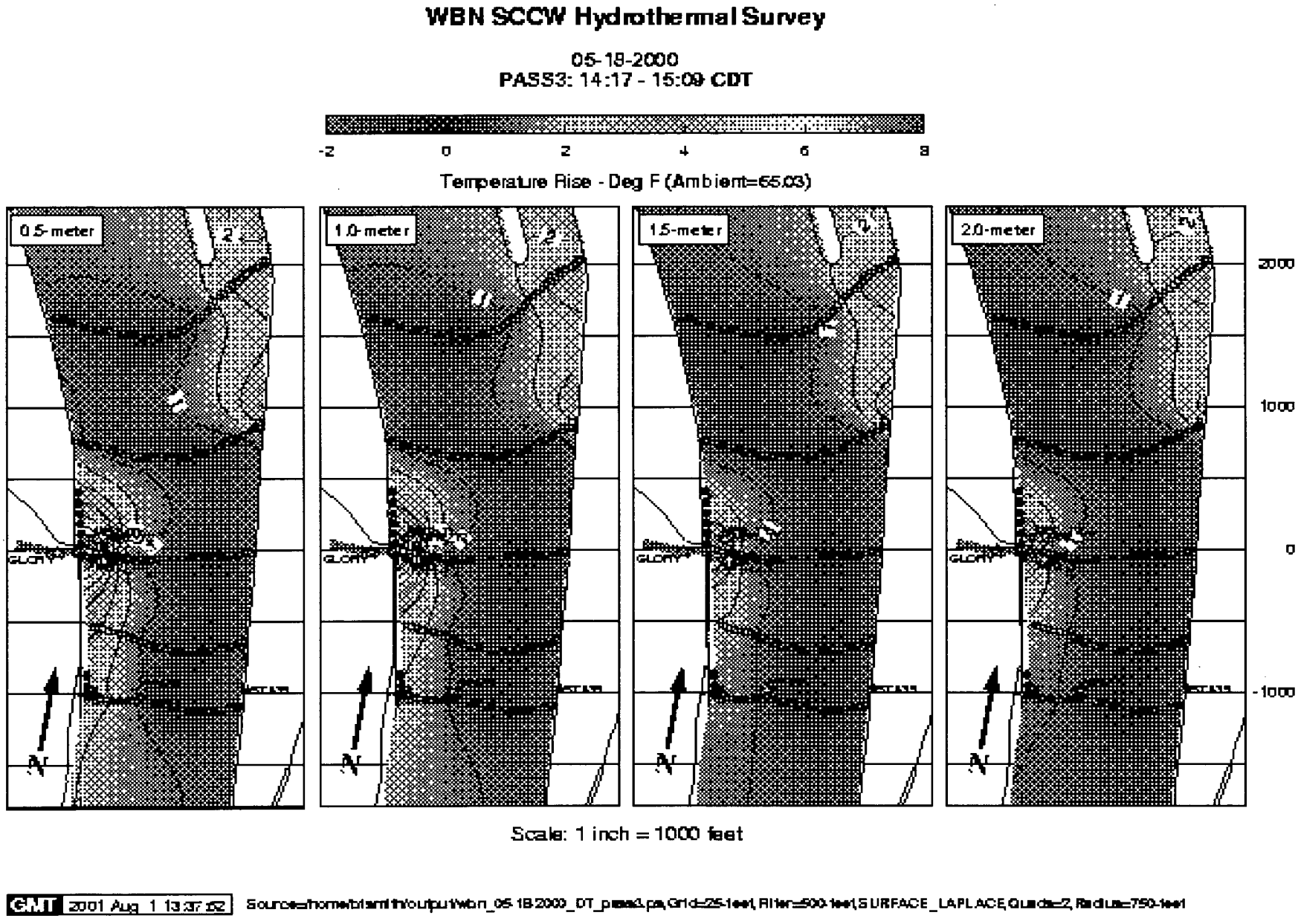


Figure 3.3.3b. SCCW Survey of 5/18/2000—River Temperature Rise, Pass 2.



GMT 2001 Aug 1 13:37:52 Source=/home/bianth/output/wbn_05-18-2000_DT_pass3.pa, Grid=25-feet, Filter=500-feet, SURFACE_LAPLACE, Quadra=2, Radius=750-feet

Figure 3.3.3c. SCCW Survey of 5/18/2000—River Temperature Rise, Pass 3.

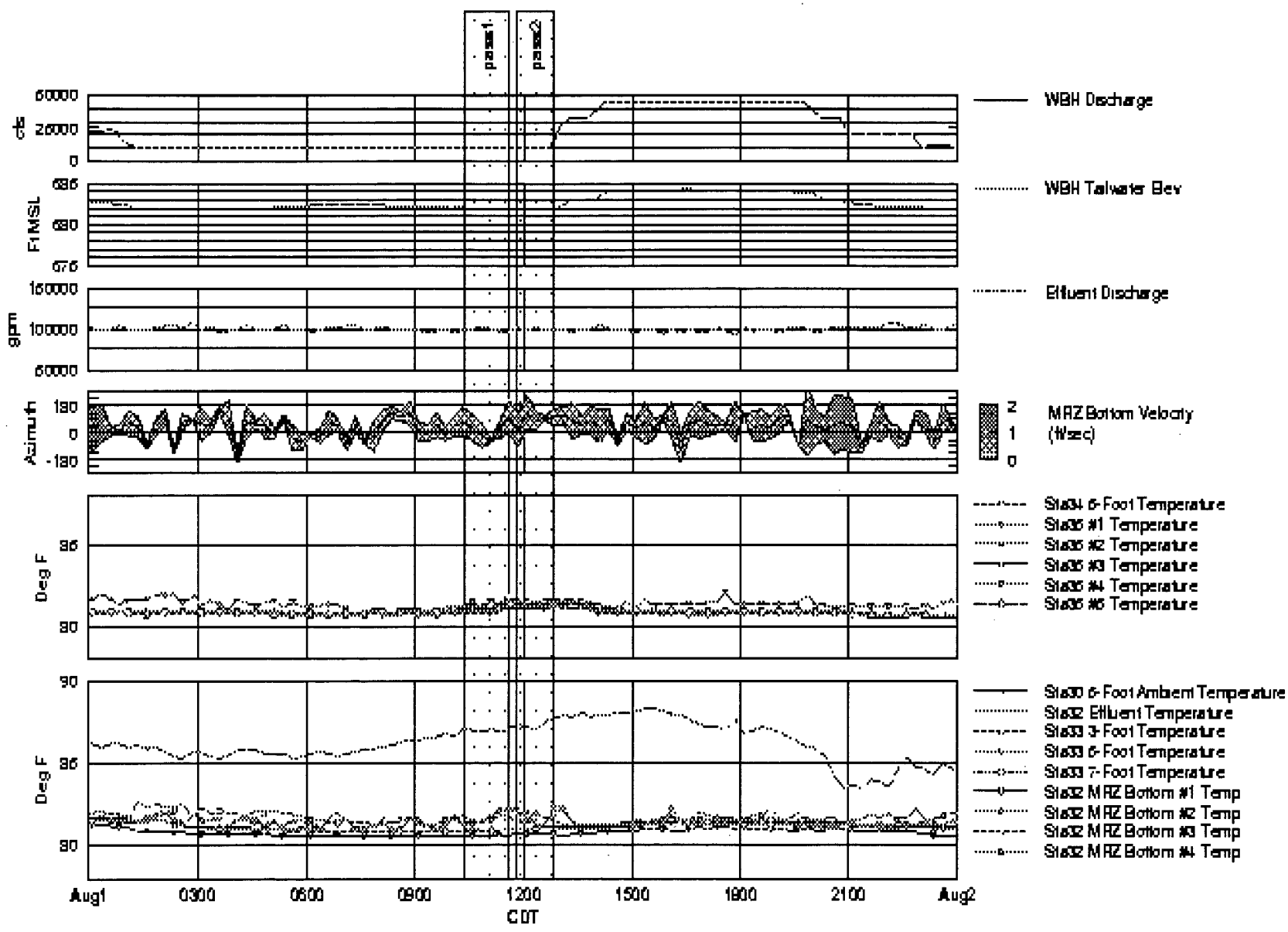


Figure 3.4.1a. SCCW Survey of 8/1/2000—Hydrothermal Data.

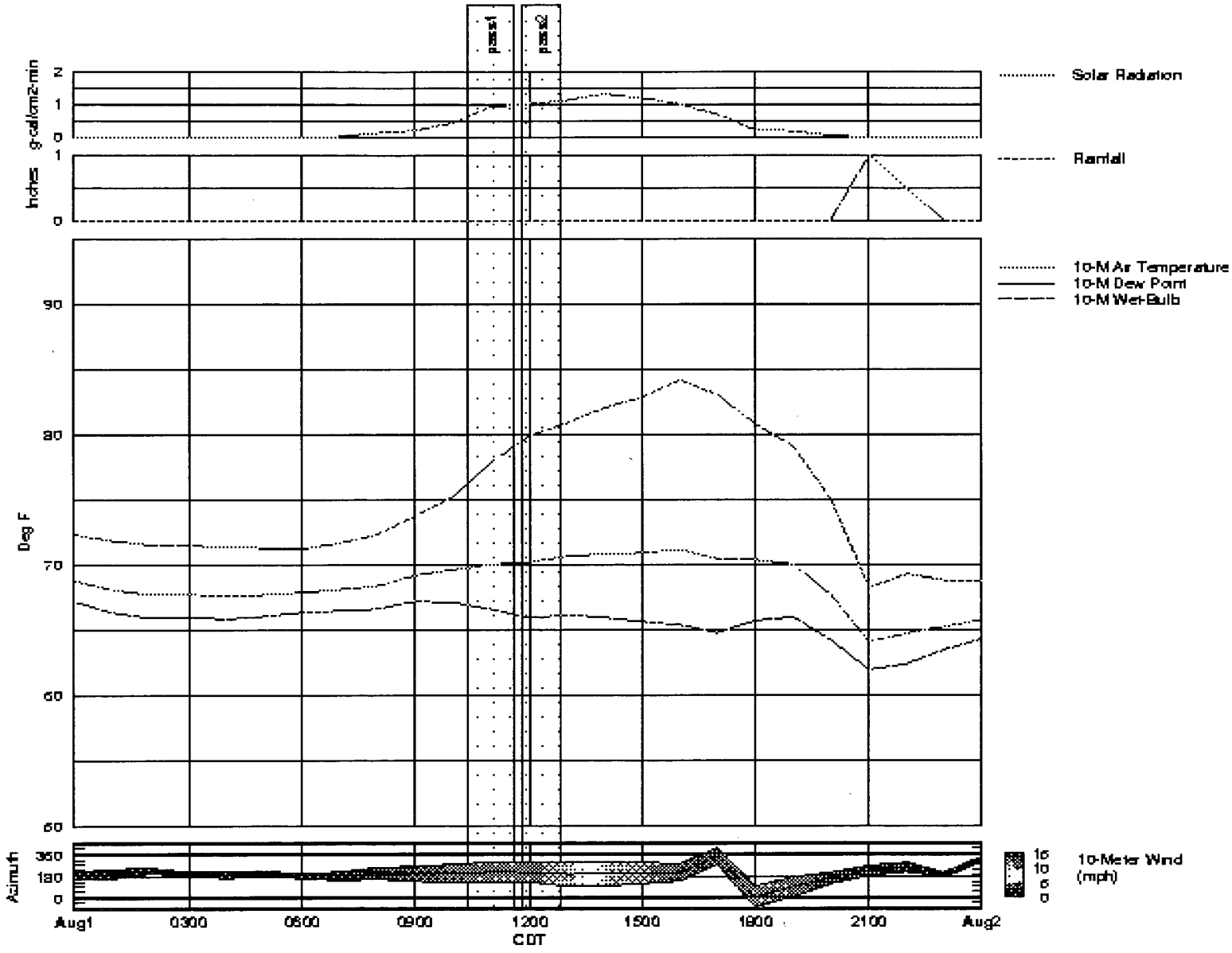


Figure 3.4.1b. SCCW Survey of 8/1/2000—Meteorological Data.

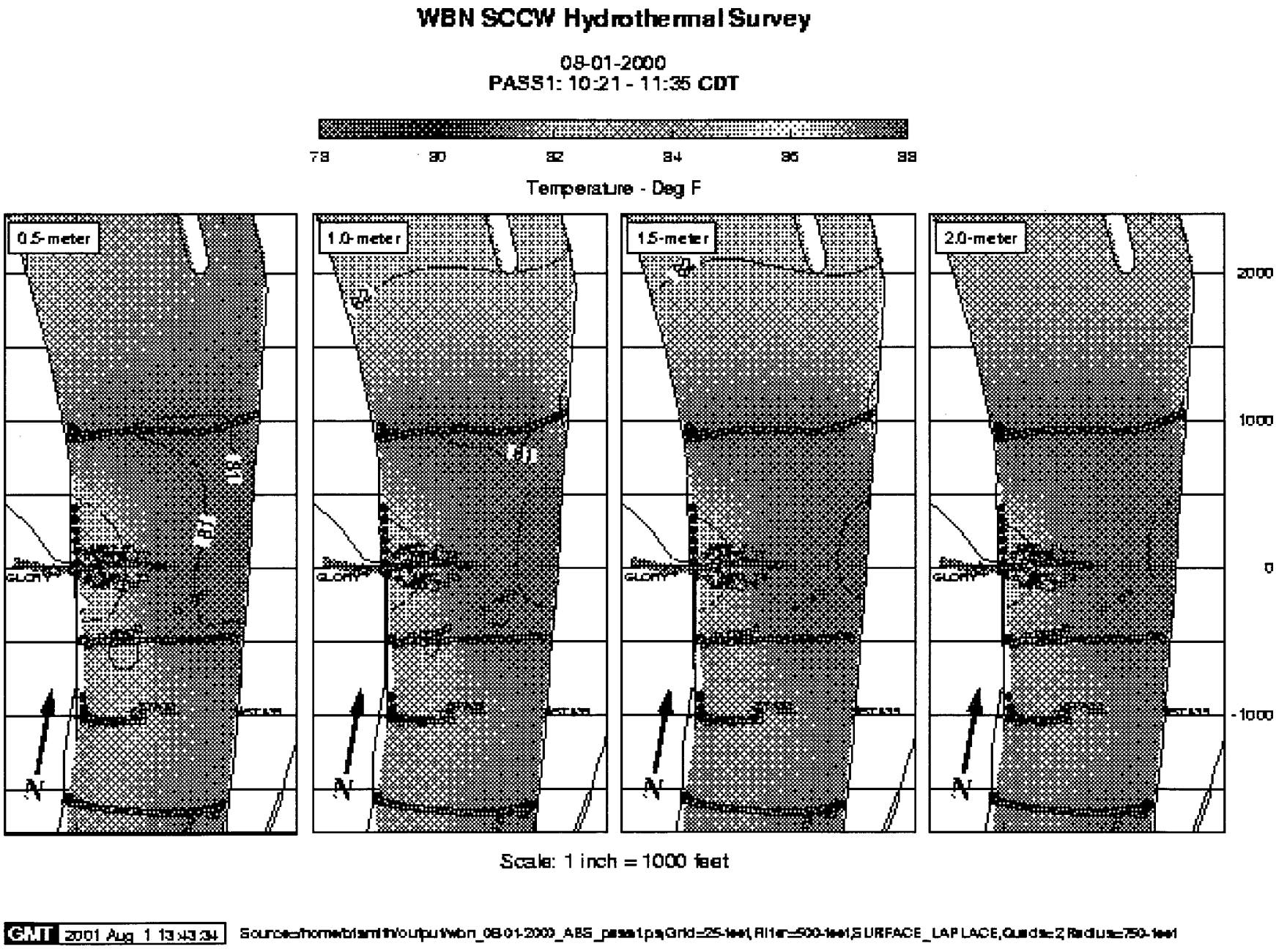


Figure 3.4.2a. SCCW Survey of 8/1/2000—River Temperature, Pass 1.

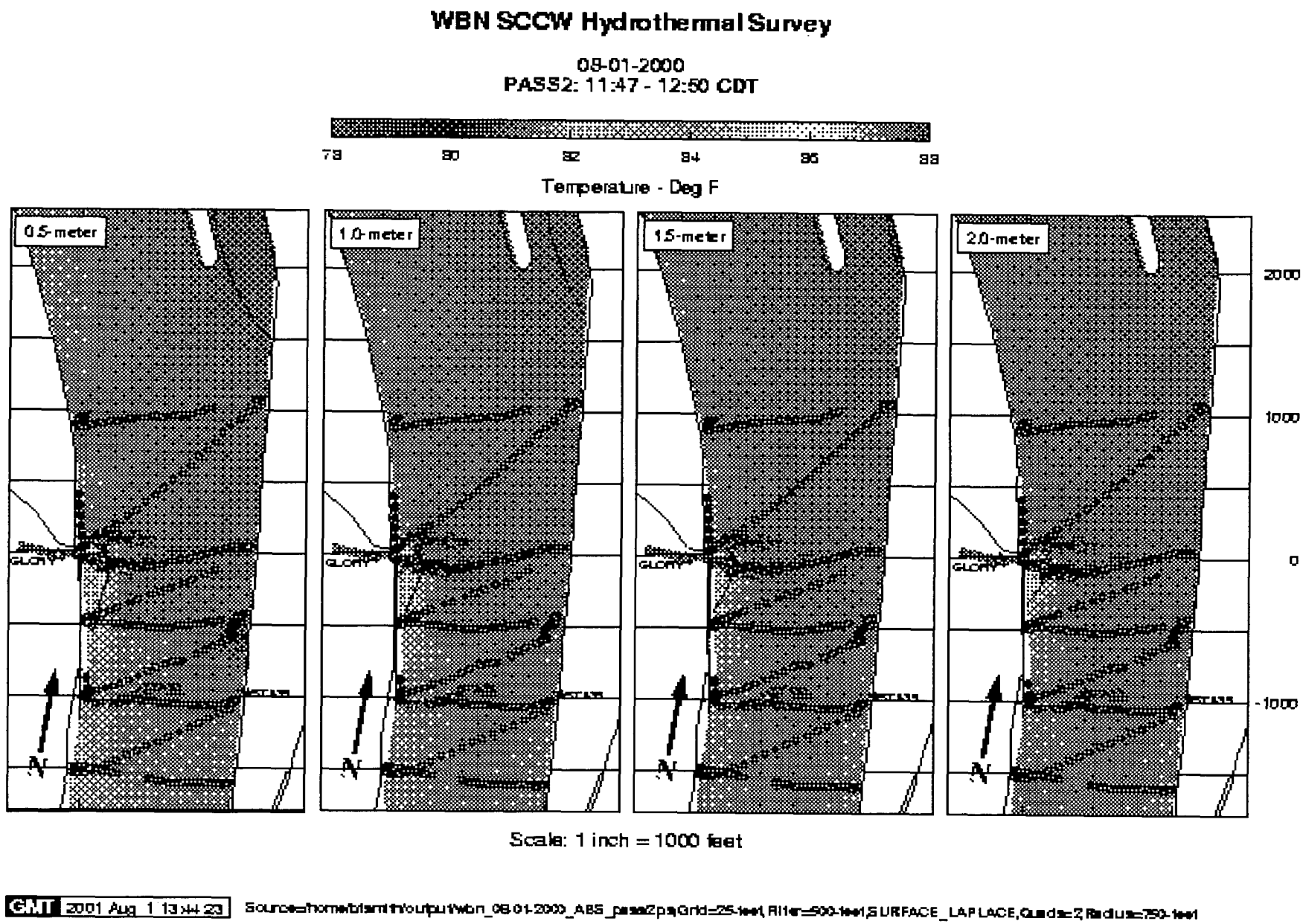


Figure 3.4.2b. SCCW Survey of 8/1/2000—River Temperature, Pass 2.

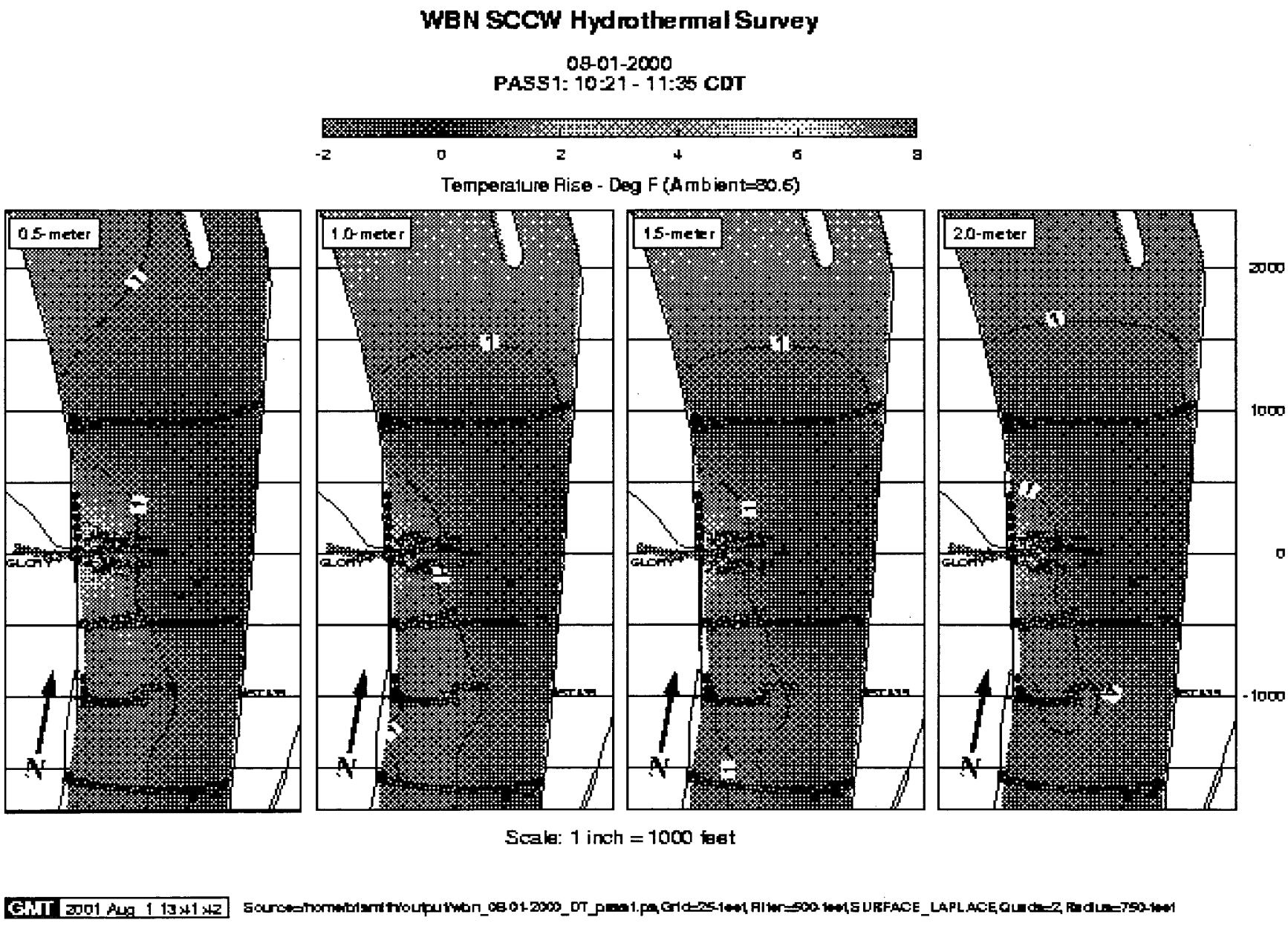


Figure 3.4.3a. SCCW Survey of 8/1/2000—River Temperature Rise, Pass 1.

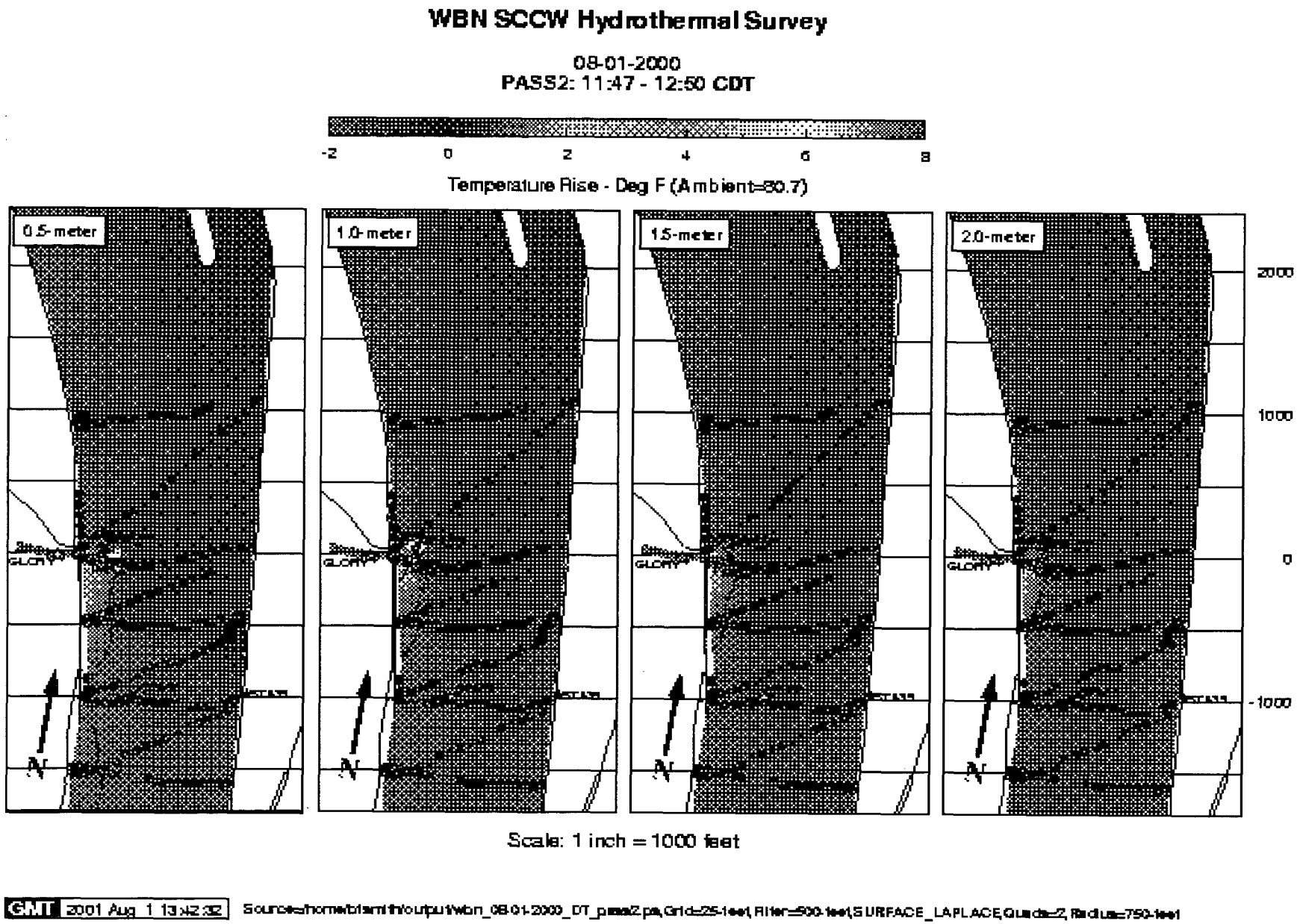


Figure 3.4.3b. SCCW Survey of 8/1/2000—River Temperature Rise, Pass 2.

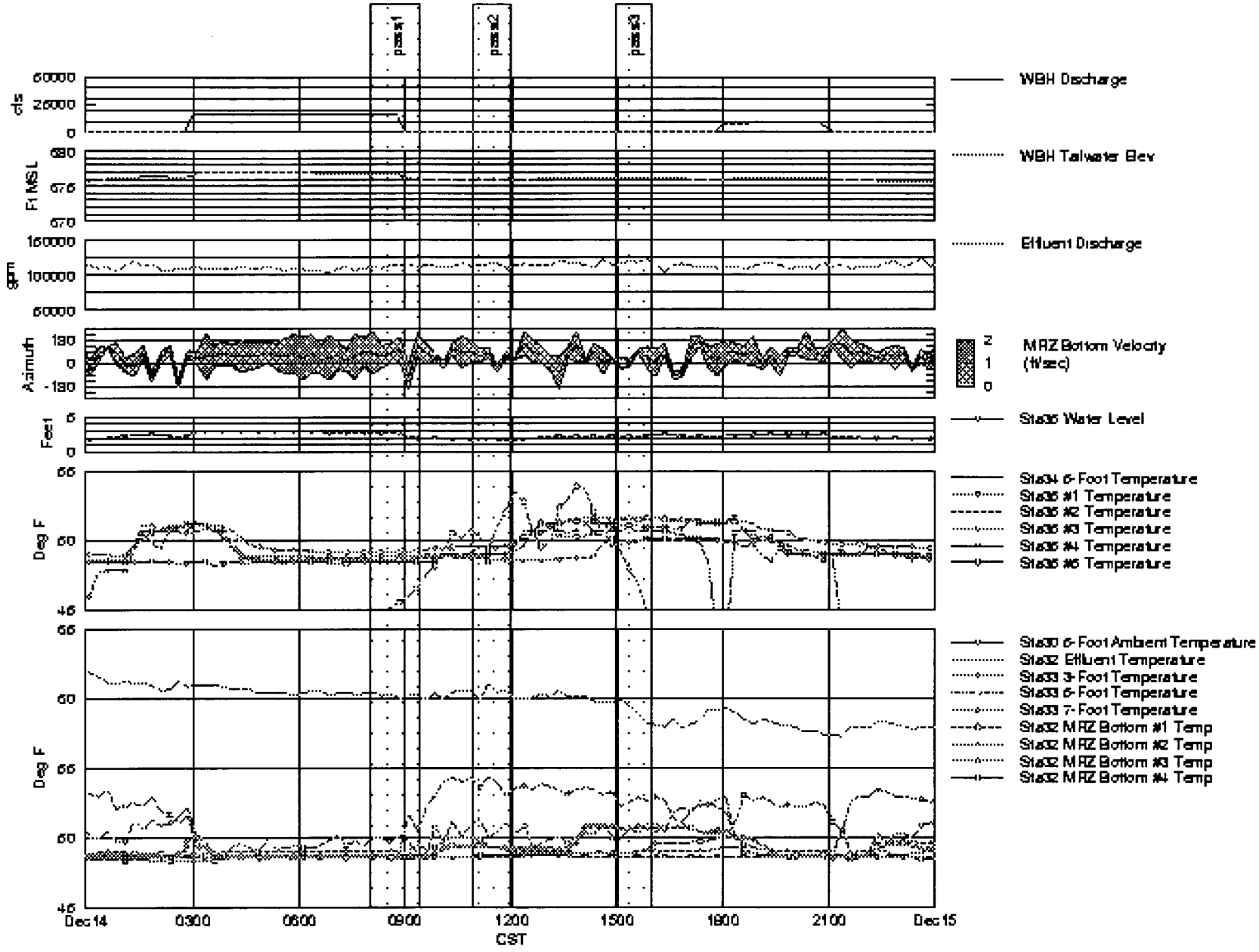


Figure 3.5.1a. SCCW Survey of 12/14/2000—Hydrothermal Data.

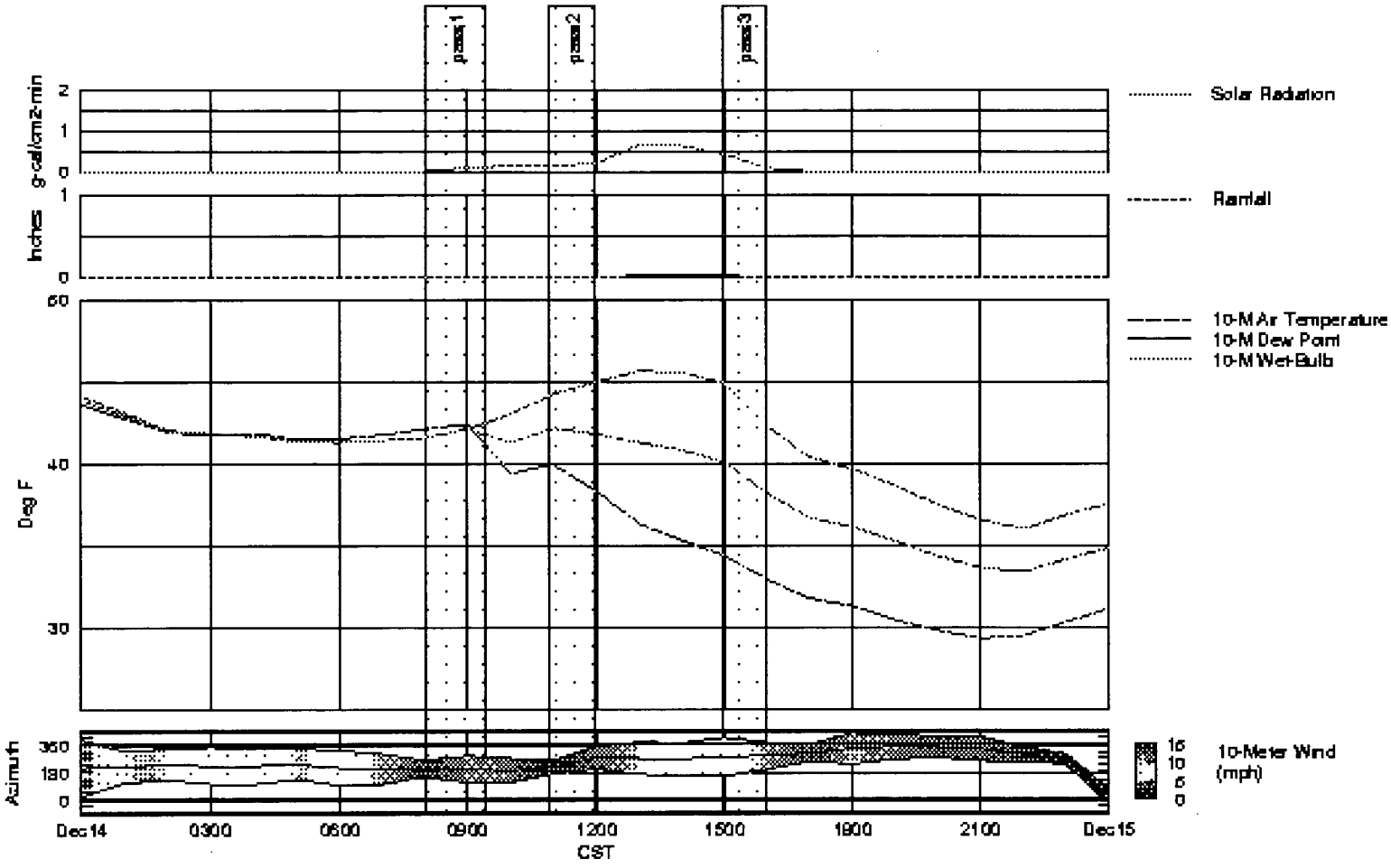


Figure 3.5.1b. SCCW Survey of 12/14/2000—Meteorological Data.

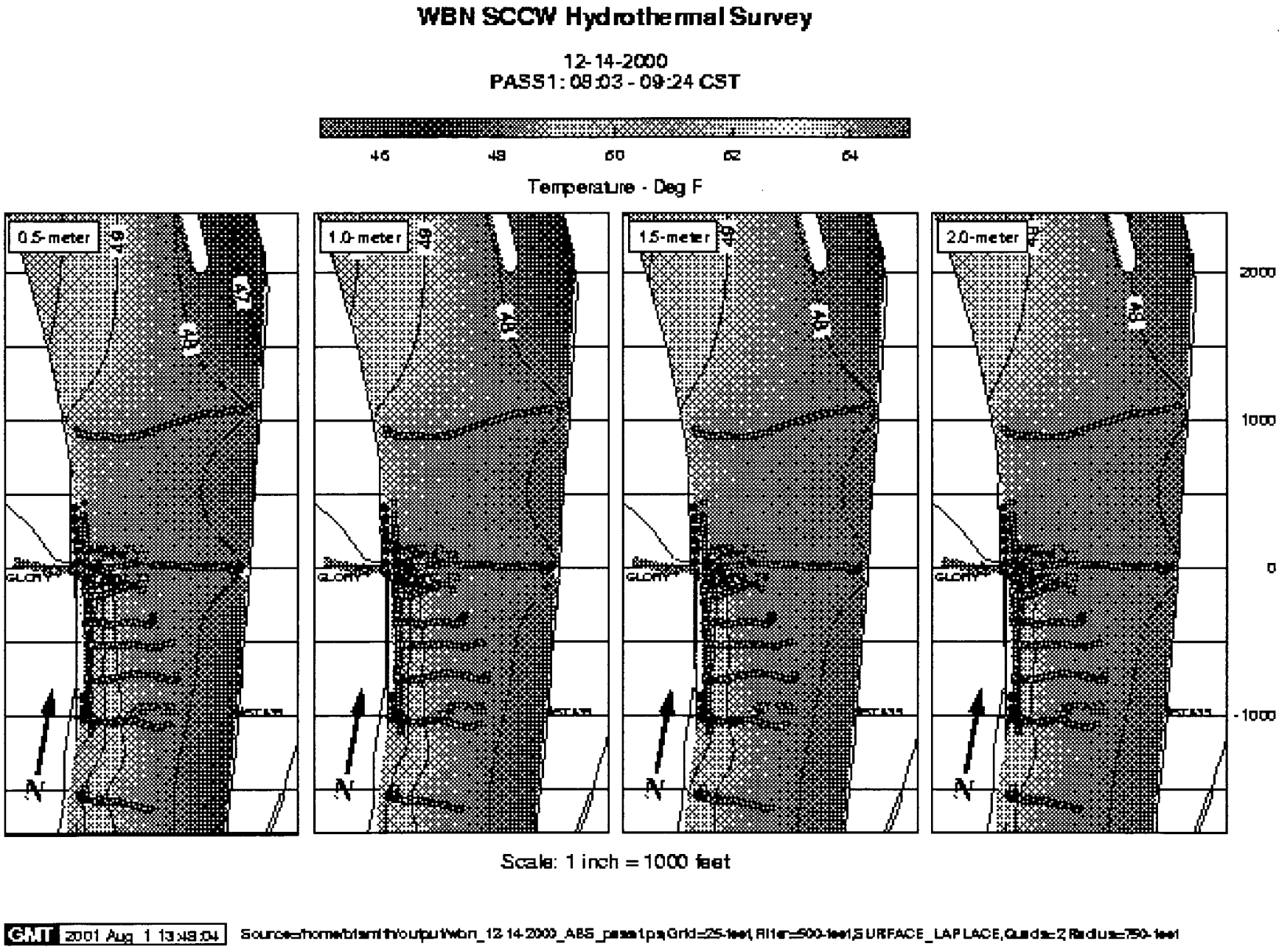


Figure 3.5.2a. SCCW Survey of 12/14/2000—River Temperature, Pass 1.

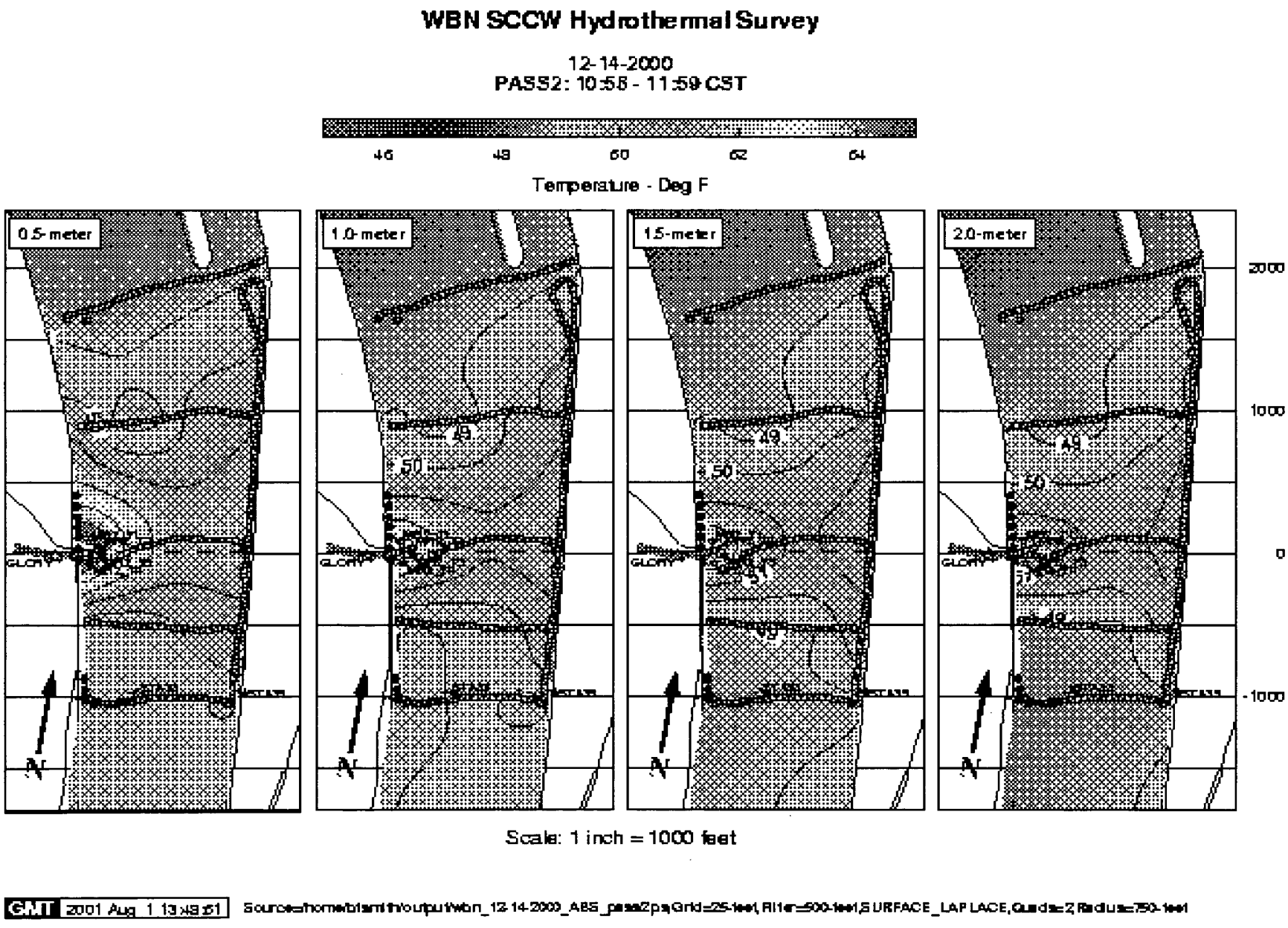


Figure 3.5.2b. SCCW Survey of 12/14/2000—River Temperature, Pass 2.

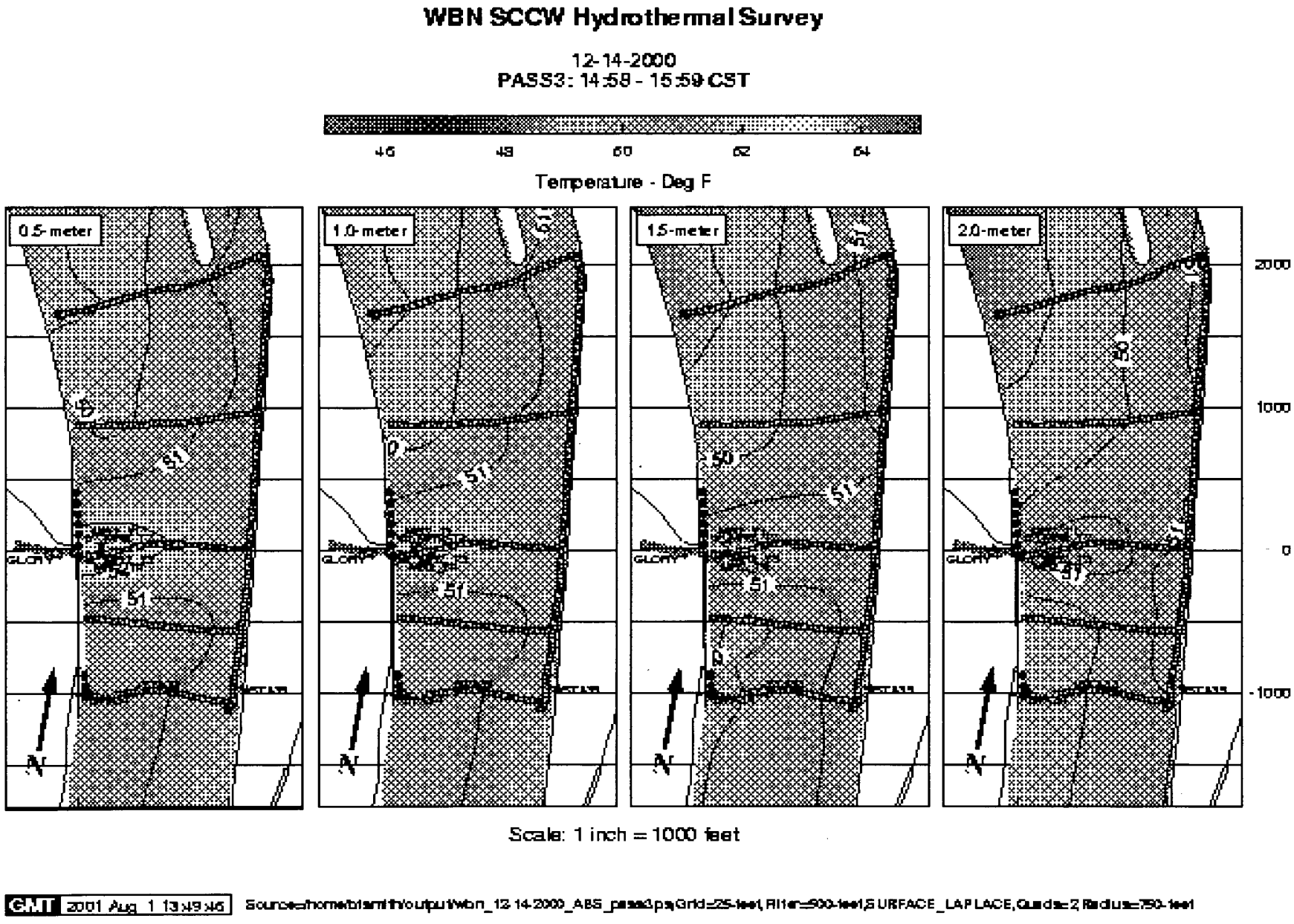


Figure 3.5.2c. SCCW Survey of 12/14/2000—River Temperature, Pass 3.

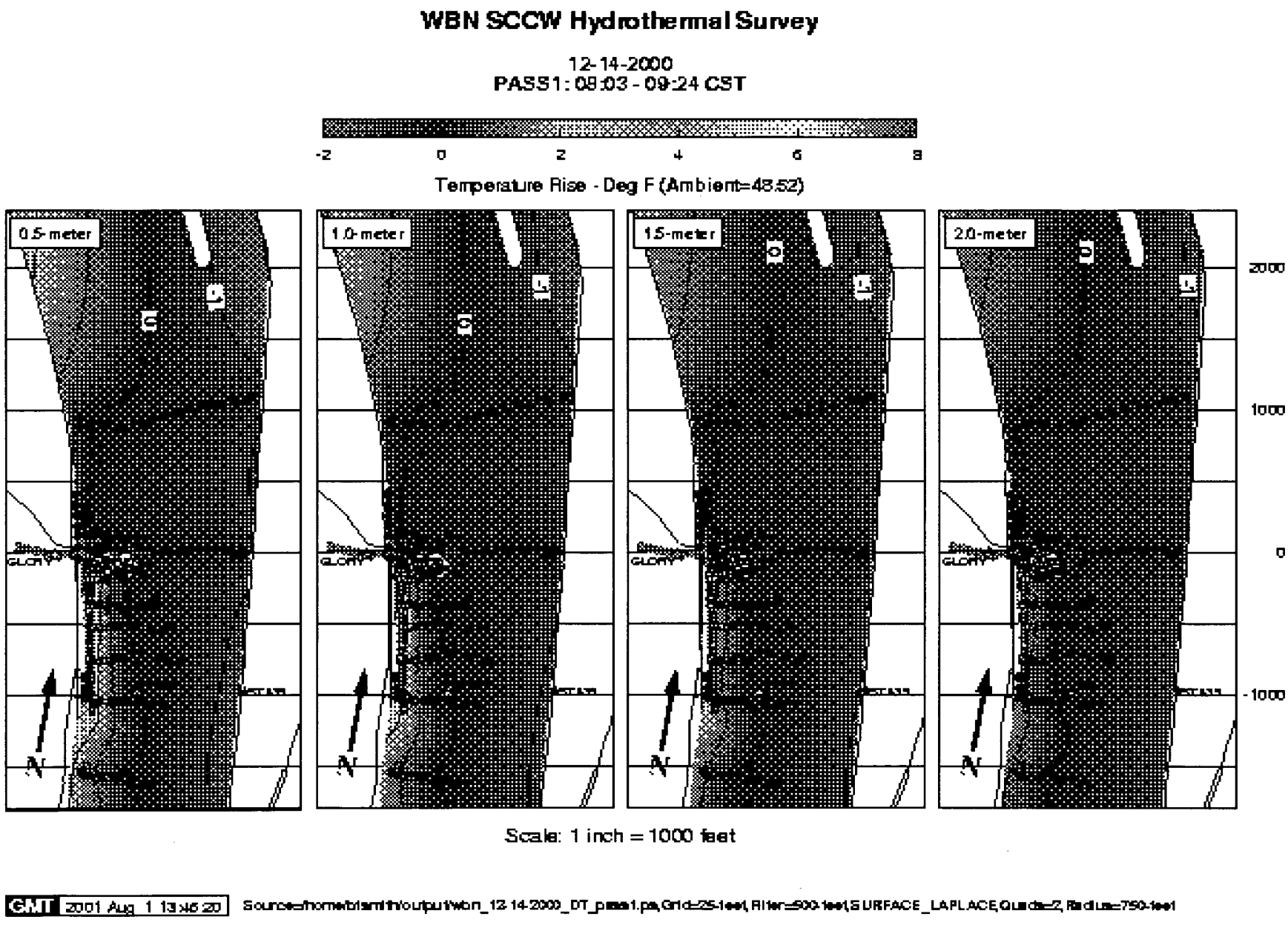


Figure 3.5.3a. SCCW Survey of 12/14/2000—River Temperature Rise, Pass 1.

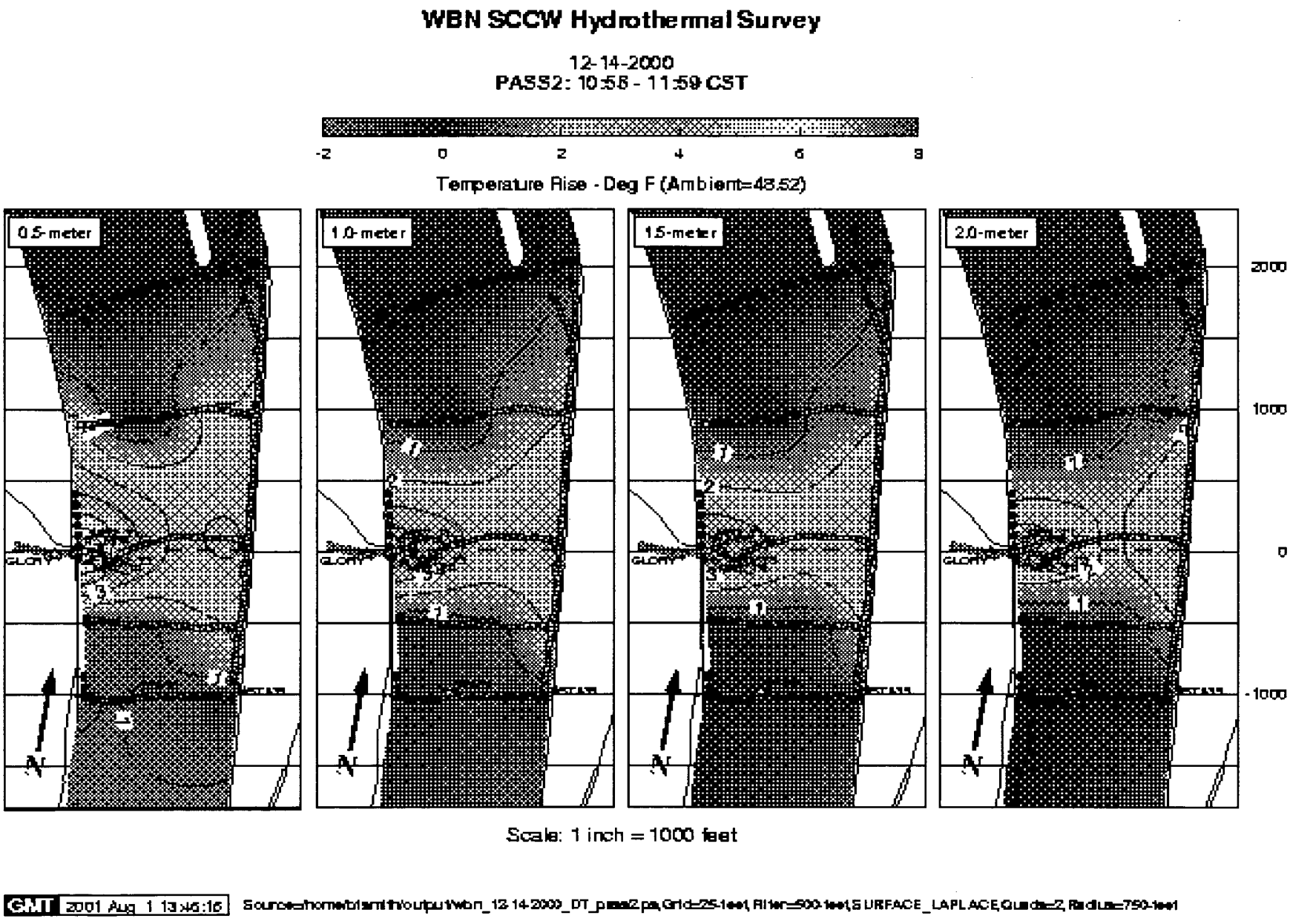


Figure 3.5.3b. SCCW Survey of 12/14/2000—River Temperature Rise, Pass 2.

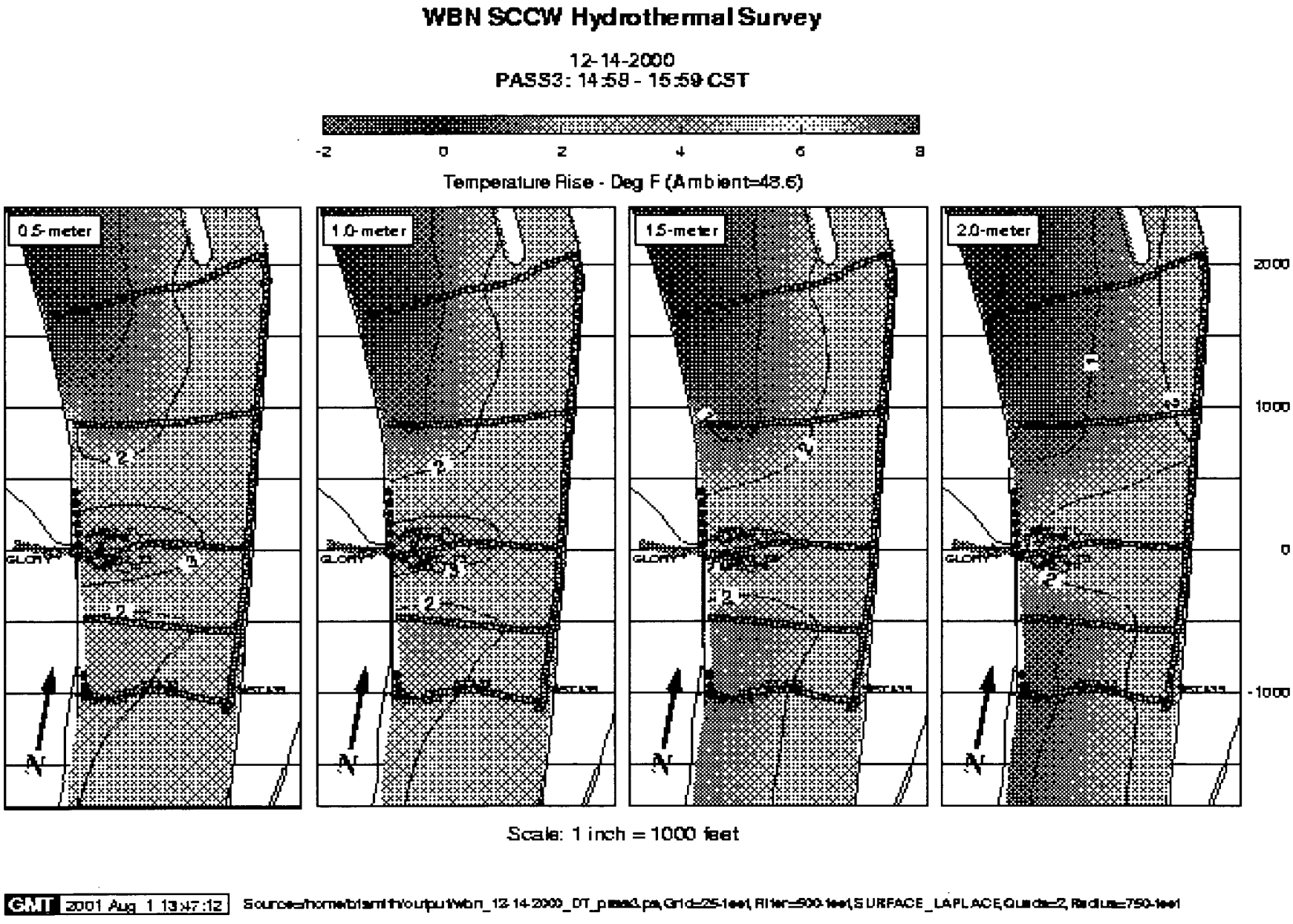


Figure 3.5.3c. SCCW Survey of 12/14/2000—River Temperature Rise, Pass 3.

RFP 103006 REPORT Rev1
WATTS BAR UNIT 2
THERMAL EFFLUENT STUDY

prepared by:

Dynamic Solutions LLC

February 9, 2007

EXECUTIVE SUMMARY

The TVA Board recently announced its intention to evaluate the feasibility of completing Watts Bar Unit 2 (WBN U2) as part of its new generation strategy. As part of the Environmental Impact Study, TVA must determine the impact of the thermal effluent from WBN U2 on the Tennessee River. The construction and operation of the SCCW system has fundamentally altered the flow and heat balance characteristics of WBN. In order to conduct a thermal analysis similar to that completed for the 1998 Environmental Assessment, the WBN Simulation Model must be revised to account for two-unit operation and the accompanying changes in the SCCW system. The Unit 1 steam generator is also being replaced. This project encompasses making those changes to the Model and running the Model with 30 years of data for 3 scenarios: Unit 1 only (with the old steam generator), Unit 1 only (with the new steam generator), and Units 1 and 2 (Unit 1 with the new steam generator and Unit 2 with the old steam generator). The results of these model runs are summarized in tables by month, by year, and for the total period. The code modifications are also listed by category (e.g., those only involving the steam generator characteristics and those only involving the change from one unit- to two-unit operation) and are shown as color-coded deleted lines (in red) and inserted lines (in green). A glossary of terms is also included.

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INTRODUCTION

The TVA Board recently announced its intention to evaluate the feasibility of completing Watts Bar Unit 2 (WBN U2) as part of its new generation strategy. As part of the Environmental Impact Study, TVA must determine the impact of the thermal effluent from WBN U2 on the Tennessee River. The construction and operation of the SCCW system has fundamentally altered the flow and heat balance characteristics of WBN. In order to conduct a thermal analysis similar to that completed for the 1998 Environmental Assessment, the WBN Simulation Model must be revised to account for two-unit operation and the accompanying changes in the SCCW system. The Unit 1 steam generator is also being replaced. This project encompasses making those changes to the Model and running the Model with 30 years of data.

UPDATE INPUT DATA SET

The input data set includes hourly values of meteorology (dry-bulb and wet-bulb temperature), upstream river temperature, release from and tailwater elevation at Watts Bar Dam (upstream), release from and headwater elevation at Chickamauga Dam (downstream), and target plant operation. The data cover January 1, 1976 through December 31, 2005. Several revisions of this data set were supplied by TVA. Each one was examined and tested before continuing with the project.

DISCHARGE LIMITS

The discharge limits are part of the NPDES permit. These are applied at Outfall 113 (the SCCW discharge), Outfall 101 (the yard holding pond discharge) and Outfall 102 (the pond overflow discharge).

Discharge Limits at Outfall 113

All of the limits at Outfall 113 are 1-hour averages. These include the mixed downstream temperautre, Td≤89.9°F (30.5°C), rise, ΔT≤5.4°F (3.0°C), and rate of change, TROC≤3.6°F/hr (2.0°C/hr). The mixing zone for Outfall 113 is defined as either active or passive. The active mixing zone is half the width of the river and extends for 2000 feet. The passive mixing zone is across the whole river, but extends for only 1000 feet. The passive mixing zone is to be used when the upstream release is less than 3500 cfs.

Discharge Limit at Outfall 101

The limit at Outfall 101 is a 24-hour average taken from midnight-to-midnight. This is the discharge, Tdis≤95.0°F (35.0°C).

Discharge Limit at Outfall 102

The limit at Outfall 102 is a manually-taken sample and is supposed to represent the hottest discharge temperature. The value is the same as that at Outfall 101, or, Tdis≤95.0°F (35.0°C).

CODE MODIFICATIONS

There are three major areas of modifications to the Code: the addition of new steam generator characteristics, switching between active and passive mixing zones, and two-unit operation. There are also a few minor areas of modifications which were made to improve the compilation or function of the Code. The modifications to the Code have been separated into steps designated by version numbers as follows:

- Code changes from Version 2.17 to Version 2.20: those required for the Code to run on the Windows XP platform plus a few other minor code modifications.

- Code changes from Version 2.20 to Version 2.21: only those associated with the new steam generator characteristics.

- Code changes from Version 2.21 to Version 2.22: only those associated with the separate active and passive mixing zone calculations at Outfall 113.

- Code changes from Version 2.22 to Version 2.23: only those associated with bringing the calculations into conformance with the current NPDES compliance requirements.

- Code changes from Version 2.23 to Version 2.24: only those associated with two-unit operation.

The description of the other modifications have been separated into categories for clarity.

New Steam Generator Characteristics

The new steam generator characteristics were handled by adding an index to the `t_unit` structure which indicates the characteristics to be used (option 1=original, 2=revised original, and 3=new steam generator). Details of the characteristics themselves are listed in Appendix 2. An additional section (*performance curves*) was also added to the auxillary input data file where this index must be specified for each unit. The details of this are listed in the subsequent section showing the changes from Version 2.20 to Version 2.21.

The original turbo-generator performance curves were created at least 14 years ago. Several studies have been conducted since then by the author using this same information for WBN which have resulted in superior approximations. The form of these approximations is used for the new steam generator

characteristics. Option 2 (revised original) provides the old characteristics with the new form of the approximations. Options 1 and 2 provide the flexibility of being more consistent with previous analyses or subsequent analyses. The difference between options 1 and 2 are small except at high backpressures and deep load reductions. Option 2 was selected for the current analysis so that the differences between the two one-unit cases would be solely due to the old vs. new steam generators.

Passive and Active Mixing Zones

In order to switch between passive and active mixing zone calculations at Outfall 113, both tables are now read in as the Code is initializing. Previously, only one table was available in the .pkg file. Both a 1000 foot and a 2000 foot table are now embedded in the .pkg file. Details of this are listed in the subsequent section showing the changes from Version 2.21 to Version 2.22. Originally, the Model used one or the other calculation. The variable indicating this choice was read from the *mixing option* section of the auxillary input data file. A value of 1 indicated a choice of passive and a value of 2 indicated a choice of active. A third option, 3, indicating automatic switching based on Qupstream_release<3500 cfs has been added.

Zero values were added to these tables so that the interpolation algorithm would return a zero computed rise as the discharge temperature approaches the ambient.

Two-Unit Operation

Which unit(s) use(s) the SCCW system is read from the (*specify which unit uses SCCW*) section of the auxillary input data file. This section was optional, but is now required. The code has been modified so that either unit can have exclusive use of the SCCW system or it can be shared equally. Although there is no plan to use the system for both units at this time, it is was a simple code modification to allow for this and provides flexibility should this ever be considered. Further details are listed in the subsequent section showing the changes from Version 2.23 to Version 2.24.

Prototyping

A prototype is a statement providing the compiler with information about objects which will be defined subsequently. Prototype statements range from weak (revealing only the bare minimum details) to strong (providing a complete description). Weak prototypes may be interpreted differently depending on the order in which files are read. They may also be interpreted differently by different

compilers and on different operating systems. Weak prototypes are by definition ambiguous and should be avoided. With one exception (detailed below) the Code followed this principle. This is an important Quality Assurance Checklist Item.

One case of weak prototyping was found throughout the Code. This was used when a procedure was passed to another procedure. The called procedures were:

```
getMeasuredData
getMulSteadyData
getSteadyData
getUnsteadyData
mulSteady
outMulSteady
outSteady
outUnsteady
outUnsteadyComputedCompliance
readAllData
readMeasuredComplianceData
readMeasuredPlantData
readMulSteadyData
readSteadyData
readUnsteadyData
steady
tlu
unsteady
unsteadyComputedCompliance
```

The passed procedures were:

```
computeRiverFlow
damReleaseIsRiverFlow
getBothDamsAllData
getBothDamsQandHonly
getComplianceLimits
getUpstreamDam
mulSteady
outMulSteady
outSteady
outUnsteady
outUnsteadyComputedCompliance
readMeasuredPlantData
readMulSteadyData
readPumps
readSteadyData
readUnsteadyData
riverFlowIsDamRelease
steady
unsteady
unsteadyComputedCompliance
```

The typical prototype was as follows:

```
int readAllData(char*input,int num_steps,t_date**date,
```

```
        t_plant**plant,t_river**river,t_ambient**ambient,
        int(*read_proc)(),t_river*(*get_river_dat_proc)(),
        t_plant*(*get_pump_gate_proc)())
```

In the procedure declaration above there are three weak prototypes defining three procedures as follows:

```
int(*read_proc)()
t_river*(*get_river_dat_proc)()
t_plant*(*get_pump_gate_proc)()
```

These three procedures are weakly declared as having no arguments by the set of empty parentheses () following each. The procedures are referenced by the following statement:

```
while(read_proc(luin,i,*date,*plant,*river,*ambient,
      get_river_dat_proc,get_pump_gate_proc))
```

The procedure whose alias is `read_proc` actually has eight arguments; but no checking can be performed; because no information was provided in the declaration. No information about the arguments for `get_river_dat_proc` and `get_pump_gate_proc` are available for checking either.

In the case cited above a missing argument was not caught by the compiler and resulted in a fatal program error. The procedure, `readAllData`, is called with one of the following four procedures in the place of `read_proc`:

```
readMeasuredPlantData
readMulSteadyData
readSteadyData
readUnsteadyData
```

All four of these procedures have the same arguments:

```
int readSteadyData(FILE*lu,int i,t_date*date,t_plant*plant,
      t_river*river,t_ambient*ambient,t_compliance*comp,
      t_river*(*get_river_dat_proc)(),
      t_plant*(*get_pump_gate_proc)())
```

Notice that there are only eight arguments in the calling statement above, `while(read_proc(luin,...))`; whereas, there are nine in the procedure that is actually called, `readSteadyData(FILE*lu,...)`. The compliance structure, `t_compliance*comp`, is missing. The compliance structure is not passed to `readAllData`; so it is not available to be passed to the procedure whose alias is `read_proc`. The Code in this form may run on one operating system or when compiled with one compiler and not another. There were approximately fifty occurrences of this type of weak procedure argument prototyping throughout the Code. All were changed to strong prototyping and all resulting compiler warnings

resolved. The compliance structure is now passed to `readAllData` and on to the procedure whose alias is `read_proc`.

When the compiler encounters a reference to an object it looks to see if the object has already been defined. If it has not been defined either by a prototype or by the object itself, the compiler checks to see if auto-prototyping is enabled (or alternately strict prototyping is disabled). If this is the case the compiler will internally generate a prototype based on this first appearance of the object. If auto prototyping is disabled (or alternately strict prototyping is enabled) an error is generated. A compiler may not auto-generate the correct prototype. Different compilers and compilers running on different operating systems may auto-generate different prototypes. Auto-prototyping, while not necessarily ambiguous, is not necessarily certain either. It is safe practice to avoid auto-prototyping or, to put it positively, to require strict prototyping. The Code consistently followed this principle. This is an important Quality Assurance Checklist Item.

When the compiler encounters a reference to an object which has already been defined it checks to see if this reference conforms to the previous one(s). The checking can be strict or relaxed. Relaxed type checking can result in fatal runtime errors and system crashes that are very hard to track down. Relaxed type checking should be avoided. Strict type checking did not reveal any inconsistencies in the Code. This is an important Quality Assurance Checklist Item.

Object Order

The ANSI C language, while providing considerable flexibility, does place some restrictions on the order in which objects may appear in source files. Code is often written in natural order, that is, beginning with the first instructions and proceeding to the last and/or beginning with the big picture items and working downward to the finer details. This order is natural from a human perspective but reverse from a compiler perspective.

As a compiler is building a machine language representation of a software program for the target hardware processor it begins by gathering information about objects in the code. Basically, a compiler needs to know the vocabulary and the characters before reading the story. The logical order for objects to appear for a compiler is opposite of the natural order. Logically every object should appear before it is referenced; thus, there are no ambiguities and the need for most or all prototypes is eliminated. The compiler has all the information about every object before it needs to use any of that information; therefore, it can perform the strictest type checking. When programming it is more efficient and makes more sense to put the glossary up front than to put a list of vocabulary words up front and the glossary at the end. Two lists of the same thing invites inconsistencies. Likewise, it makes more sense for procedures to appear before

they are called. The Code was reordered in this manner. This is an important Quality Assurance Checklist Item.

RESULTS

The updated TVA WBN Simulation Model was run with the updated input data set (30 years of hourly data from 1976 through 2005) for three separate cases: one unit with the old steam generator characteristics, one unit with the new steam generator characteristics, and two units (Unit 1 with the new steam generator characteristics and Unit 2 with the old steam generator characteristics). Statistical summaries of the results of these runs are listed in the tables in the following sections.

Methodology Used in Making Runs

The objective in each of these cases was to determine a sequence of operations which would result in the maximum generation while meeting all constraints (NPDES discharge, NRC intake temperature, and LP turbine backpressure). This was accomplished by setting the unit load to 1270 MWe, activating the SCCW system with no bypass, and running the Model for 30 years in 1 hour steps. The model output was then checked for predicted deltaT violations. The SCCW system was then set to 30% bypass for at least a 24-hour window surrounding any of these predicted violations and the Model was run again.

This time the output was checked for any predicted Tdis, deltaT, orTdns violations. The SCCW system was then shut off for at least a 24-hour window surrounding any of these predicted violations and the Model was run again. This time the output was again checked for any predicted Tdis, deltaT, or Tdns violations. None were found. If there had been an additional strategy would have had to be developed.

The output was then checked for TROC violations. If these occurred under any circumstances other than bringing the SCCW system into service or out of service some other strategy would have had to be developed. None were found. All of the remaining predicted TROC violations were eliminated by gradually bringing the SCCW system into service in 3 steps over 3 hours (90%, 60%, and then 30% bypass) or gradually taking it out of service in 3 steps over 3 hours (30%, 60%, 90% bypass).

The maximum LP turbine backpressure constraint was handled internally by the Model (the load was reduced as necessary); so predicted violations of this never appeared in the output files and no special strategy was required for handling this case.

The maximum discharge temperature (24-hour average at midnight) limitation at Outfall 113 was never encountered for any of these runs (with the second cooling tower rebuilt); therefore, no special strategy was required for handling this case.

There were no predicted occurrences of the holding pond overflowing; therefore, no special strategy was required for handling this case.

There were instances where the intake temperature (which is corrected internally for the impact of Outfall 113) exceeded the NRC limit; therefore, no special strategy was required for handling this case.

This methodology is neither strictly rigorous nor exhaustive in its testing of all possible operations. The sequence of operations isn't unique. There may be some other sequence of operations that might yield a slightly higher generation. There are probably times when the SCCW system could be turned back on for brief periods without violating any of the constraints. There may also be times when it would be more convenient to just leave the SCCW system off for an extra day or two. However, this methodology is reasonable and adequate for the present study.

Statistics: Input Parameters

The input parameters are characterized by the statistics listed in the following tables:

Upstream Release [cfs]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	0	0	36,941	61,032	122,404
Feb	0	6,121	43,030	83,746	115,311
Mar	0	0	36,593	69,130	156,599
Apr	0	0	21,026	46,328	156,599
May	0	0	17,322	46,240	119,306
Jun	0	0	21,615	46,240	81,291
Jul	0	0	19,333	46,240	60,179
Aug	0	0	22,587	46,240	49,140
Sep	0	0	22,420	46,214	81,288
Oct	0	0	20,984	46,111	70,603
Nov	0	0	29,654	57,917	84,984
Dec	0	0	32,343	61,251	102,251
1976	0	0	24,897	46,330	47,859
1977	0	0	32,146	74,244	97,551
1978	0	0	25,742	46,330	88,725
1979	0	6,121	40,073	66,626	104,228
1980	0	0	25,068	46,330	114,860
1981	0	0	17,317	46,240	46,330
1982	0	0	32,497	67,320	94,946
1983	0	0	27,724	46,330	76,674
1984	0	0	29,422	46,330	119,306
1985	0	0	17,130	46,318	54,392
1986	0	0	15,212	46,294	49,162
1987	0	0	19,505	46,330	84,612
1988	0	0	13,466	40,041	48,736
1989	0	0	35,440	63,712	81,291
1990	0	0	32,726	68,794	99,155
1991	0	0	31,852	58,837	113,127
1992	0	0	26,293	46,330	80,420
1993	0	0	25,740	48,190	89,467
1994	0	0	39,667	89,895	156,599
1995	0	0	26,424	46,330	82,308
1996	0	0	32,938	68,159	87,258
1997	0	0	30,008	50,123	109,503
1998	0	0	30,963	58,878	145,644
1999	0	0	20,341	46,330	61,549
2000	0	0	15,658	43,186	48,753
2001	0	0	16,396	46,240	54,720
2002	0	0	24,695	53,111	122,404
2003	0	6,121	39,498	72,538	115,311
2004	0	0	33,839	68,719	102,251
2005	0	0	24,468	46,330	46,970
all	0	0	26,904	49,726	156,599

Downstream Release [cfs]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	0	14,633	46,483	76,431	147,760
Feb	0	21,949	53,297	100,201	148,021
Mar	0	7,334	46,720	83,818	206,505
Apr	0	0	26,356	52,219	206,505
May	0	0	22,065	44,830	148,187
Jun	0	0	26,719	45,148	116,022
Jul	0	0	23,696	43,501	72,256
Aug	0	0	26,878	43,501	48,441
Sep	0	0	27,531	44,365	107,307
Oct	0	0	26,255	44,953	103,240
Nov	0	7,467	36,089	67,855	103,482
Dec	0	7,316	39,828	78,480	118,263
1976	0	0	30,462	44,953	57,248
1977	0	0	38,336	82,327	122,371
1978	0	0	30,149	44,953	107,856
1979	0	15,292	47,545	81,554	126,921
1980	0	0	30,846	47,922	160,882
1981	0	0	19,616	43,894	46,509
1982	0	0	38,157	80,458	122,911
1983	0	0	33,606	49,809	89,572
1984	0	0	36,701	53,383	148,187
1985	0	0	21,191	43,894	69,152
1986	0	0	19,029	43,894	48,217
1987	0	0	24,221	44,729	108,653
1988	0	0	16,652	43,501	59,284
1989	0	15,132	45,811	78,984	116,022
1990	0	0	42,554	93,168	141,021
1991	0	7,549	40,409	74,530	148,021
1992	0	0	34,137	46,741	106,019
1993	0	0	32,184	58,863	110,399
1994	0	14,666	49,804	105,528	206,505
1995	0	0	33,303	58,059	104,272
1996	0	7,591	41,289	79,998	112,503
1997	0	0	38,108	64,131	140,390
1998	0	0	38,857	69,354	175,067
1999	0	0	26,014	56,767	79,937
2000	0	0	20,296	43,640	69,061
2001	0	0	21,466	43,894	69,033
2002	0	0	30,284	61,456	147,760
2003	0	15,319	47,808	85,045	134,022
2004	0	0	41,919	90,770	118,263
2005	0	7,333	31,049	44,753	53,406
all	0	0	33,392	61,449	206,505

Upstream Elevation [ft]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	736.0	736.0	736.0	736.0	736.0
Feb	736.0	736.0	736.0	736.0	736.0
Mar	736.0	736.0	736.0	736.1	736.3
Apr	736.3	736.6	738.2	739.4	739.7
May	737.1	739.8	740.3	740.8	740.8
Jun	738.2	740.8	740.7	740.8	740.8
Jul	739.5	740.8	740.8	740.8	740.8
Aug	740.2	740.8	740.8	740.8	740.8
Sep	740.8	740.8	740.8	740.8	740.8
Oct	740.5	740.8	740.8	740.8	740.8
Nov	736.2	736.6	738.4	740.2	740.5
Dec	736.0	736.0	736.0	736.0	736.2
1976	736.0	736.0	738.8	740.8	740.8
1977	736.0	736.0	738.8	740.8	740.8
1978	736.0	736.0	738.8	740.8	740.8
1979	736.0	736.0	738.8	740.8	740.8
1980	736.0	736.0	738.8	740.8	740.8
1981	736.0	736.0	738.8	740.8	740.8
1982	736.0	736.0	738.8	740.8	740.8
1983	736.0	736.0	738.8	740.8	740.8
1984	736.0	736.0	738.8	740.8	740.8
1985	736.0	736.0	738.8	740.8	740.8
1986	736.0	736.0	738.2	740.8	740.8
1987	736.0	736.0	738.7	740.8	740.8
1988	736.0	736.0	738.7	740.8	740.8
1989	736.0	736.0	738.8	740.8	740.8
1990	736.0	736.0	738.8	740.8	740.8
1991	736.0	736.0	738.8	740.8	740.8
1992	736.0	736.0	738.8	740.8	740.8
1993	736.0	736.0	738.8	740.8	740.8
1994	736.0	736.0	738.8	740.8	740.8
1995	736.0	736.0	738.7	740.8	740.8
1996	736.0	736.0	738.8	740.8	740.8
1997	736.0	736.0	738.8	740.8	740.8
1998	736.0	736.0	738.8	740.8	740.8
1999	736.0	736.0	738.8	740.8	740.8
2000	736.0	736.0	738.8	740.8	740.8
2001	736.0	736.0	738.8	740.8	740.8
2002	736.0	736.0	738.8	740.8	740.8
2003	736.0	736.0	738.8	740.8	740.8
2004	736.0	736.0	738.8	740.8	740.8
2005	736.0	736.0	738.8	740.8	740.8
all	736.0	736.0	738.8	740.8	740.8

Downstream Elevation [ft]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	676.0	676.0	676.0	676.0	676.0
Feb	676.0	676.0	676.0	676.0	676.0
Mar	676.0	676.0	676.0	676.2	676.4
Apr	676.4	676.9	679.1	680.7	681.0
May	678.6	681.2	681.8	682.2	682.3
Jun	680.4	682.2	682.2	682.2	682.3
Jul	681.9	682.2	682.2	682.2	682.3
Aug	682.2	682.2	682.2	682.2	682.3
Sep	681.0	681.1	681.7	682.2	682.2
Oct	678.4	678.7	679.7	680.7	681.0
Nov	676.1	676.3	677.2	678.2	678.5
Dec	676.0	676.0	676.0	676.0	676.1
1976	676.0	676.0	679.2	682.2	682.3
1977	676.0	676.0	679.2	682.2	682.2
1978	676.0	676.0	679.1	682.2	682.2
1979	676.0	676.0	679.2	682.2	682.3
1980	676.0	676.0	679.2	682.2	682.2
1981	676.0	676.0	679.2	682.2	682.3
1982	676.0	676.0	679.1	682.2	682.2
1983	676.0	676.0	679.2	682.2	682.3
1984	676.0	676.0	679.2	682.2	682.3
1985	676.0	676.0	679.2	682.2	682.2
1986	676.0	676.0	678.8	682.2	682.2
1987	676.0	676.0	679.2	682.2	682.2
1988	676.0	676.0	679.1	682.2	682.2
1989	676.0	676.0	679.2	682.2	682.3
1990	676.0	676.0	679.2	682.2	682.2
1991	676.0	676.0	679.2	682.2	682.2
1992	676.0	676.0	679.2	682.2	682.2
1993	676.0	676.0	679.2	682.2	682.2
1994	676.0	676.0	679.2	682.2	682.3
1995	676.0	676.0	679.1	682.2	682.2
1996	676.0	676.0	679.2	682.2	682.3
1997	676.0	676.0	679.2	682.2	682.3
1998	676.0	676.0	679.2	682.2	682.3
1999	676.0	676.0	679.2	682.2	682.3
2000	676.0	676.0	679.2	682.2	682.2
2001	676.0	676.0	679.2	682.2	682.2
2002	676.0	676.0	679.2	682.2	682.2
2003	676.0	676.0	679.2	682.2	682.3
2004	676.0	676.0	679.2	682.2	682.3
2005	676.0	676.0	679.2	682.2	682.3
all	676.0	676.0	679.2	682.2	682.3

Upstream River Temperature [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	36.6	39.7	44.0	48.0	52.0
Feb	36.3	39.0	43.8	48.0	52.2
Mar	38.9	44.6	48.9	53.7	60.0
Apr	47.8	51.6	56.3	60.6	65.4
May	54.4	60.2	63.9	68.0	73.2
Jun	61.6	67.1	71.3	75.1	79.1
Jul	68.7	73.0	76.4	79.7	83.9
Aug	72.4	75.5	78.0	80.7	84.6
Sep	69.6	73.3	76.2	78.6	82.7
Oct	57.5	63.4	68.3	73.3	79.2
Nov	47.1	53.4	58.5	63.6	68.1
Dec	37.7	45.0	49.3	54.4	59.5
1976	39.8	43.0	59.5	75.0	79.3
1977	36.3	39.1	60.7	78.1	81.0
1978	37.3	39.6	60.5	76.5	79.8
1979	38.6	43.2	60.0	75.4	78.3
1980	38.1	42.4	60.2	78.0	81.7
1981	37.0	38.7	59.4	76.2	79.4
1982	39.6	42.9	60.1	75.8	77.7
1983	39.7	42.9	59.8	77.3	79.1
1984	38.9	40.5	58.8	74.5	77.7
1985	37.4	43.1	60.7	76.3	77.9
1986	39.0	41.6	61.9	78.7	83.2
1987	40.9	42.5	60.0	76.3	78.7
1988	41.5	43.0	60.3	77.2	80.1
1989	37.7	44.6	59.6	76.1	78.7
1990	38.9	46.8	61.3	76.4	78.6
1991	43.4	46.3	62.1	77.4	79.8
1992	43.2	45.4	60.1	75.1	78.5
1993	43.0	45.2	61.7	77.9	83.2
1994	39.6	44.2	61.6	76.5	78.5
1995	40.8	45.6	62.3	79.1	81.8
1996	40.2	42.9	61.0	78.2	80.2
1997	43.3	46.4	62.5	78.3	81.9
1998	44.3	46.8	64.5	81.1	83.9
1999	44.5	48.1	63.9	79.9	83.0
2000	41.6	46.2	63.4	78.6	82.8
2001	38.8	41.8	62.4	79.0	81.9
2002	45.0	47.3	63.8	78.8	84.6
2003	41.0	45.2	62.9	79.4	82.5
2004	42.5	44.6	62.2	77.4	82.0
2005	44.1	45.9	62.4	79.1	81.5
all	36.3	44.4	61.3	77.5	84.6

Dry-Bulb Temperature [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	-9.9	24.1	38.9	54.0	77.0
Feb	3.0	28.0	43.6	60.1	79.0
Mar	10.0	36.0	51.6	68.0	84.9
Apr	26.1	45.0	60.3	75.9	91.0
May	37.9	55.0	68.0	81.0	93.0
Jun	46.9	64.9	75.3	87.1	100.9
Jul	57.0	70.0	79.0	90.0	105.1
Aug	54.0	69.1	77.8	89.1	104.0
Sep	41.0	59.0	71.4	84.0	100.0
Oct	26.1	45.0	59.9	73.9	89.1
Nov	16.0	35.1	50.5	66.0	82.9
Dec	-2.0	28.0	41.9	57.9	77.0
1976	8.1	33.1	57.2	79.0	93.9
1977	-2.0	32.0	60.1	84.0	102.0
1978	8.1	30.9	59.2	82.0	98.1
1979	10.0	33.1	58.4	80.1	93.9
1980	10.0	34.0	58.9	82.9	105.1
1981	9.0	34.0	58.9	82.0	97.0
1982	-2.0	36.0	59.5	81.0	95.0
1983	-2.0	35.1	58.3	82.0	102.9
1984	8.1	34.0	58.7	80.1	98.1
1985	-9.9	32.0	59.2	80.1	96.1
1986	6.1	37.0	61.3	84.0	99.0
1987	15.1	37.0	60.3	82.9	100.0
1988	8.1	33.1	59.1	82.0	100.9
1989	3.9	36.0	59.2	80.1	95.0
1990	19.9	41.0	62.2	82.9	100.0
1991	12.0	37.0	61.4	82.0	96.1
1992	12.0	37.9	58.3	78.1	93.9
1993	10.9	37.9	61.2	84.9	102.9
1994	1.9	37.9	60.1	80.1	93.0
1995	10.9	35.1	59.9	82.0	97.0
1996	3.0	34.0	58.6	81.0	95.0
1997	10.0	37.0	59.2	80.1	95.0
1998	19.0	39.9	62.6	84.0	99.0
1999	15.1	39.0	62.1	82.9	100.0
2000	15.1	35.1	60.8	82.0	99.0
2001	16.0	37.9	60.8	81.0	93.9
2002	19.0	37.0	61.8	84.0	97.0
2003	7.0	36.0	59.6	80.1	91.9
2004	16.0	37.0	60.7	80.1	93.9
2005	17.1	37.9	60.6	82.0	95.0
all	-9.9	36.0	59.9	82.0	105.1

Wet-Bulb Temperature [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	-10.7	21.0	35.3	50.0	67.2
Feb	2.5	25.0	39.2	53.9	67.2
Mar	8.2	32.3	45.9	59.1	72.9
Apr	24.7	41.1	53.6	64.6	77.2
May	36.4	51.5	62.1	71.0	78.5
Jun	41.7	61.9	69.1	75.3	82.3
Jul	47.0	67.7	72.6	77.2	86.5
Aug	53.4	66.4	71.6	76.5	84.8
Sep	40.6	55.9	65.9	73.5	79.9
Oct	25.3	42.7	55.1	66.6	76.8
Nov	15.2	32.3	46.2	60.4	72.6
Dec	-3.0	24.7	38.2	53.0	69.7
1976	6.2	29.7	52.3	71.0	79.6
1977	-3.4	27.8	54.8	75.1	81.6
1978	7.6	28.1	54.1	74.0	81.9
1979	9.7	29.4	53.8	72.7	80.3
1980	8.2	30.1	53.3	73.7	86.5
1981	6.9	30.1	52.8	72.6	80.5
1982	-4.1	32.0	54.1	72.1	78.8
1983	-3.0	31.4	52.5	72.4	81.9
1984	6.3	31.4	53.4	71.8	79.0
1985	-10.7	28.4	54.1	72.4	79.9
1986	4.1	33.2	55.9	74.2	80.6
1987	14.1	33.5	54.7	74.3	82.8
1988	7.6	29.6	53.1	72.6	81.6
1989	2.2	33.2	54.5	73.3	81.1
1990	17.8	37.6	56.6	73.3	81.2
1991	10.0	33.6	56.2	74.6	80.3
1992	9.8	34.4	54.0	71.5	79.3
1993	10.5	34.0	55.6	75.5	83.2
1994	0.5	35.0	55.9	73.3	79.6
1995	8.7	31.5	54.7	73.9	81.2
1996	2.5	30.4	53.6	72.5	79.9
1997	8.0	33.9	54.4	73.0	81.3
1998	16.5	37.2	57.3	74.4	82.3
1999	13.1	35.4	56.1	73.7	83.0
2000	13.1	32.6	55.1	73.1	80.9
2001	15.5	33.9	55.2	73.2	80.9
2002	16.8	33.5	56.0	73.4	79.5
2003	5.3	32.3	54.9	72.9	79.3
2004	13.1	33.2	55.3	72.1	79.2
2005	14.7	33.6	54.9	73.2	79.9
all	-10.7	32.2	54.6	73.3	86.5

Statistics: Computed Parameters

The following are computed parameters and they are characterized by the statistics listed in the following tables:

Computed River Flow [cfs]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	-1,564	684	37,041	61,140	122,404
Feb	-1,737	7,156	43,122	82,353	115,311
Mar	-2,607	94	36,691	69,189	156,599
Apr	-2,705	-847	21,052	46,601	156,599
May	-1,963	-715	17,351	46,265	129,713
Jun	-2,112	-752	21,642	46,285	83,675
Jul	-2,232	-834	19,353	46,254	60,850
Aug	-2,031	-613	22,613	46,439	49,103
Sep	-2,044	-602	22,446	46,293	84,402
Oct	-2,090	-790	21,003	46,047	73,244
Nov	-1,639	-403	29,716	57,981	85,072
Dec	-1,896	-135	32,430	61,273	102,251
1976	-2,081	-466	24,953	46,328	47,802
1977	-2,607	-337	32,199	74,356	97,551
1978	-2,450	-687	25,777	46,475	88,781
1979	-2,036	4,762	40,128	66,729	104,228
1980	-2,088	-714	25,110	46,396	114,860
1981	-2,029	-797	17,344	46,114	46,922
1982	-2,031	-358	32,536	67,403	94,946
1983	-2,112	-511	27,784	46,503	77,946
1984	-2,232	-278	29,496	46,703	129,713
1985	-1,996	-769	17,166	46,110	56,724
1986	-2,024	-802	15,256	45,461	48,998
1987	-1,995	-814	19,540	46,270	84,612
1988	-2,048	-825	13,494	40,442	48,624
1989	-1,978	257	35,532	63,805	83,675
1990	-2,705	-472	32,775	68,794	99,155
1991	-2,031	-472	31,895	58,929	113,127
1992	-1,951	-441	26,358	46,461	80,420
1993	-1,967	-711	25,789	48,261	89,467
1994	-2,390	249	39,731	89,895	156,599
1995	-1,947	-499	26,472	46,785	82,308
1996	-1,979	-201	32,989	68,159	87,360
1997	-1,950	-589	30,063	50,207	109,503
1998	-2,335	-626	31,025	58,985	145,644
1999	-2,079	-787	20,389	46,361	63,532
2000	-2,074	-835	15,699	43,552	49,900
2001	-2,024	-768	16,442	46,123	56,967
2002	-2,033	-702	24,735	53,174	122,404
2003	-1,944	4,931	39,564	72,599	115,311
2004	-1,966	-58	33,902	68,849	102,251
2005	-2,547	-512	24,530	46,318	47,076
all	-2,705	-587	26,954	49,775	156,599

Computed River Elevation [ft]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	674.5	675.9	678.6	681.3	686.1
Feb	674.5	676.0	678.4	680.8	686.7
Mar	674.4	675.8	678.3	681.2	687.1
Apr	674.9	677.1	679.8	681.9	687.7
May	677.6	681.0	682.1	683.4	695.5
Jun	679.8	681.5	682.6	683.7	688.8
Jul	680.2	681.5	682.5	683.6	685.6
Aug	680.4	681.5	682.6	683.6	684.0
Sep	679.6	681.0	682.1	683.4	688.9
Oct	677.2	678.6	680.3	682.0	687.6
Nov	674.8	676.6	679.1	681.6	686.4
Dec	674.5	675.5	678.1	680.7	685.3
1976	674.7	677.3	680.4	683.1	683.9
1977	674.7	677.3	681.0	683.6	686.4
1978	674.7	676.6	680.2	683.0	684.5
1979	674.8	678.5	681.4	683.7	686.7
1980	675.0	676.6	680.3	682.9	683.9
1981	674.7	676.0	679.8	683.0	684.1
1982	675.0	678.4	681.1	683.2	685.2
1983	674.5	677.2	680.6	683.4	687.4
1984	674.4	676.9	680.7	683.7	695.5
1985	674.8	676.2	679.9	682.4	684.0
1986	674.6	676.0	679.3	682.1	683.8
1987	674.6	676.1	679.9	682.8	684.0
1988	674.7	675.9	679.5	682.4	683.9
1989	674.5	677.2	681.1	683.8	688.8
1990	674.8	676.0	680.4	683.2	684.8
1991	675.2	676.6	680.4	683.2	684.9
1992	674.5	676.7	680.3	682.9	684.3
1993	674.6	677.7	680.5	682.7	684.3
1994	674.6	676.1	680.6	683.4	687.7
1995	674.5	676.0	680.0	682.6	684.0
1996	674.5	676.0	680.4	683.2	684.5
1997	674.8	676.7	680.5	683.4	686.0
1998	674.6	677.0	680.8	683.6	685.1
1999	674.6	676.4	680.1	682.9	684.9
2000	674.5	675.8	679.7	682.6	683.9
2001	674.6	676.1	679.8	682.5	684.0
2002	674.5	676.8	680.4	682.6	687.1
2003	674.6	676.8	681.0	683.8	688.8
2004	674.7	676.6	680.8	683.5	688.9
2005	674.5	676.7	680.3	683.3	683.9
all	674.4	676.4	680.4	683.3	695.5

Statistics: One Unit Old Steam Generator

Over the 30 year study period there are a total of 262,992 possible hours of operation. In this case , according to the Model calculations, the unit was able to maintain operation throughout this entire period while meeting all EPA (NPDES discharge temperature), NRC (intake temperature), and mechanical (backpressure) constraints. The SCCW system was operated for 262,673 hours, or all but 319 hours of the total period. The SCCW system was operated in bypass mode for a total of 15,733 hours, of which 15,711 of these were at 30%, 11 were at 60%, and 11 were at 90%. The total generation for this period was 318,548,674 MW-hrs. The total *requested* generation was 333,999,840 MW-hrs. The difference of 4.63% is due to thermal efficiency alone; as no load reductions were required to meet operating constraints other than the 5.5 in.Hg backpressure. No occurrences of overflow were predicted for the holding pond during these operations. Note that statistics for discharge temperatures and associated rise, mixed temperature, and rate of change only consider those times when there is some discharge flow.

Unit 1 Load [MWe]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	1202	1221	1224	1227	1229
Feb	1201	1220	1224	1227	1228
Mar	1201	1215	1221	1225	1228
Apr	1200	1210	1216	1222	1226
May	1192	1203	1210	1216	1222
Jun	1183	1194	1201	1208	1219
Jul	1162	1187	1194	1201	1210
Aug	1170	1187	1194	1200	1210
Sep	1182	1192	1200	1208	1217
Oct	1189	1204	1211	1218	1225
Nov	1203	1213	1219	1224	1227
Dec	1205	1219	1223	1226	1229
1976	1186	1198	1213	1226	1228
1977	1179	1191	1210	1226	1229
1978	1183	1193	1211	1226	1228
1979	1186	1197	1213	1226	1228
1980	1170	1192	1212	1226	1228
1981	1183	1195	1212	1226	1228
1982	1185	1196	1212	1225	1229
1983	1179	1195	1213	1225	1229
1984	1189	1198	1213	1226	1228
1985	1186	1196	1212	1226	1229
1986	1175	1191	1210	1225	1228
1987	1182	1194	1212	1225	1228
1988	1181	1195	1212	1226	1228
1989	1185	1196	1212	1225	1228
1990	1184	1195	1211	1224	1227
1991	1182	1193	1210	1224	1228
1992	1186	1197	1213	1225	1228
1993	1162	1190	1210	1225	1228
1994	1187	1195	1211	1225	1228
1995	1179	1191	1210	1225	1228
1996	1183	1194	1212	1226	1228
1997	1180	1194	1211	1224	1228
1998	1178	1189	1208	1224	1227
1999	1166	1190	1209	1224	1227
2000	1170	1192	1210	1225	1227
2001	1183	1192	1210	1225	1228
2002	1179	1191	1209	1224	1227
2003	1182	1193	1211	1225	1228
2004	1185	1195	1211	1225	1227
2005	1181	1193	1211	1224	1227
all	1162	1194	1211	1225	1229

Unit 1 Backpressure [in.Hg]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	1.43	1.89	2.25	2.65	4.12
Feb	1.56	1.96	2.36	2.80	4.18
Mar	1.65	2.22	2.67	3.18	4.16
Apr	2.08	2.59	3.08	3.58	4.24
May	2.59	3.10	3.56	4.02	4.68
Jun	2.86	3.73	4.16	4.59	5.18
Jul	3.56	4.20	4.59	5.00	5.50
Aug	3.55	4.25	4.61	5.00	5.50
Sep	3.07	3.70	4.23	4.70	5.25
Oct	2.27	2.92	3.45	3.99	4.86
Nov	1.85	2.39	2.86	3.36	4.07
Dec	1.53	2.05	2.44	2.90	3.93
1976	1.66	2.11	3.20	4.36	5.05
1977	1.46	2.04	3.39	4.79	5.40
1978	1.61	2.02	3.34	4.63	5.18
1979	1.64	2.10	3.26	4.43	5.04
1980	1.65	2.11	3.30	4.72	5.50
1981	1.58	2.12	3.27	4.53	5.21
1982	1.48	2.20	3.29	4.46	5.09
1983	1.53	2.17	3.23	4.56	5.41
1984	1.59	2.14	3.22	4.35	4.90
1985	1.43	2.09	3.32	4.46	5.05
1986	1.57	2.23	3.47	4.77	5.50
1987	1.73	2.23	3.33	4.60	5.27
1988	1.67	2.12	3.30	4.55	5.34
1989	1.56	2.21	3.29	4.47	5.11
1990	1.89	2.39	3.40	4.56	5.14
1991	1.72	2.31	3.42	4.67	5.26
1992	1.74	2.28	3.25	4.39	5.06
1993	1.71	2.26	3.42	4.81	5.50
1994	1.54	2.26	3.38	4.52	5.02
1995	1.71	2.20	3.41	4.74	5.42
1996	1.56	2.14	3.32	4.58	5.18
1997	1.72	2.28	3.36	4.61	5.35
1998	1.87	2.36	3.57	4.85	5.49
1999	1.81	2.35	3.50	4.80	5.50
2000	1.80	2.24	3.46	4.69	5.50
2001	1.75	2.27	3.43	4.70	5.23
2002	1.88	2.29	3.51	4.75	5.40
2003	1.61	2.20	3.40	4.62	5.25
2004	1.82	2.21	3.40	4.53	5.11
2005	1.85	2.28	3.40	4.67	5.30
all	1.43	2.21	3.36	4.62	5.50

Outfall 113 Flow [cfs]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	222	222	222	222	223
Feb	222	222	222	222	222
Mar	222	222	223	224	227
Apr	226	232	256	273	277
May	240	278	286	292	292
Jun	257	291	291	292	292
Jul	275	292	292	292	293
Aug	284	292	292	292	293
Sep	291	292	292	292	292
Oct	287	291	291	292	292
Nov	226	231	258	283	288
Dec	222	222	222	222	226
1976	222	222	263	292	292
1977	222	222	263	292	293
1978	222	222	262	292	292
1979	222	222	263	292	292
1980	222	222	263	292	293
1981	222	222	263	292	292
1982	222	222	263	292	292
1983	222	222	263	292	293
1984	222	222	263	292	292
1985	222	222	263	292	292
1986	222	222	255	292	292
1987	222	222	262	292	292
1988	222	222	262	292	292
1989	222	222	263	292	292
1990	222	222	263	292	292
1991	222	222	263	292	292
1992	222	222	262	292	292
1993	222	222	263	292	293
1994	222	222	263	292	292
1995	222	222	262	292	293
1996	222	222	263	292	292
1997	222	222	263	292	293
1998	222	222	263	292	293
1999	222	222	262	292	293
2000	222	222	263	292	293
2001	222	222	263	292	292
2002	222	222	263	292	293
2003	222	222	263	292	292
2004	222	222	262	292	292
2005	222	222	263	292	292
all	222	222	262	292	293

Outfall 113 Discharge Temperature (hourly) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	39.5	55.1	62.7	70.7	82.7
Feb	40.7	56.8	64.8	73.4	82.8
Mar	45.9	61.1	68.3	76.1	86.1
Apr	57.5	66.2	72.7	79.4	90.2
May	63.6	72.6	79.3	85.3	90.9
Jun	68.6	78.9	83.8	88.6	94.2
Jul	71.6	82.3	86.1	90.2	97.3
Aug	73.2	81.5	85.5	89.6	94.9
Sep	65.7	75.2	81.7	87.2	92.6
Oct	57.7	67.3	75.0	82.2	89.7
Nov	52.7	61.7	69.7	77.9	85.7
Dec	44.5	57.7	64.7	72.4	84.4
1976	48.7	60.3	73.3	84.9	91.8
1977	42.7	57.5	74.7	88.2	94.2
1978	49.2	59.3	74.3	87.4	94.2
1979	50.2	60.4	74.4	86.0	92.1
1980	49.6	60.2	74.1	87.3	97.3
1981	39.5	57.8	72.9	86.4	92.7
1982	44.1	61.7	74.5	85.8	91.9
1983	44.5	61.1	73.6	86.4	94.6
1984	48.7	60.3	73.4	85.8	92.2
1985	41.2	59.6	74.2	85.9	92.6
1986	40.7	59.9	74.8	87.6	93.1
1987	52.1	61.5	74.3	87.4	93.4
1988	49.2	59.0	73.1	86.4	93.5
1989	46.8	61.4	74.2	86.4	92.6
1990	54.1	64.4	75.8	87.0	93.1
1991	50.4	62.6	75.9	87.5	93.0
1992	50.4	62.2	73.8	85.2	91.2
1993	50.5	62.6	75.6	88.4	95.0
1994	46.0	63.0	75.5	86.4	91.2
1995	49.9	61.4	74.8	87.0	93.5
1996	46.9	60.6	74.1	86.2	91.9
1997	49.5	62.5	74.6	86.2	93.0
1998	47.1	64.0	76.2	87.9	93.7
1999	51.9	63.1	75.6	87.2	94.4
2000	51.5	61.4	74.8	86.7	93.3
2001	43.9	60.7	74.5	86.4	92.4
2002	53.9	61.9	75.4	87.2	92.3
2003	48.2	61.9	75.0	86.1	91.2
2004	52.1	62.2	75.2	85.8	91.6
2005	52.9	62.3	75.0	86.6	92.3
all	39.5	61.2	74.6	86.7	97.3

Outfall 113 Rise (hourly) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	0.0	0.8	1.8	3.1	5.4
Feb	0.3	0.6	1.8	3.0	5.4
Mar	0.0	0.7	1.9	3.5	5.4
Apr	0.0	1.0	2.3	3.9	5.4
May	0.0	1.0	2.4	3.8	5.4
Jun	0.0	0.8	1.8	3.0	5.2
Jul	0.0	0.6	1.4	2.4	4.3
Aug	0.0	0.3	0.9	1.6	3.5
Sep	0.0	0.0	0.7	1.4	2.9
Oct	0.0	0.0	1.0	2.2	4.8
Nov	0.0	0.3	1.3	2.7	5.4
Dec	0.0	0.7	1.7	3.2	5.4
1976	0.0	0.6	1.6	2.9	5.4
1977	0.0	0.4	1.6	3.1	5.4
1978	0.0	0.6	1.7	3.1	5.3
1979	0.0	0.4	1.3	2.3	5.3
1980	0.0	0.5	1.7	3.1	5.4
1981	0.0	0.6	2.0	3.6	5.4
1982	0.0	0.4	1.5	2.9	5.3
1983	0.0	0.6	1.6	2.8	5.4
1984	0.0	0.5	1.7	3.2	5.4
1985	0.0	0.6	1.9	3.3	5.4
1986	0.0	0.5	1.8	3.4	5.4
1987	0.0	0.6	2.0	3.6	5.4
1988	0.0	0.7	2.0	3.6	5.4
1989	0.0	0.5	1.5	2.9	5.4
1990	0.0	0.5	1.5	3.0	5.4
1991	0.0	0.4	1.5	2.9	5.4
1992	0.0	0.6	1.6	3.0	5.4
1993	0.0	0.5	1.6	2.9	5.3
1994	0.0	0.3	1.3	2.5	5.3
1995	0.0	0.4	1.5	2.8	5.4
1996	0.0	0.4	1.3	2.7	5.4
1997	0.0	0.3	1.3	2.5	5.3
1998	0.0	0.3	1.2	2.4	5.4
1999	0.0	0.3	1.6	3.1	5.4
2000	0.0	0.4	1.8	3.4	5.4
2001	0.0	0.4	1.8	3.5	5.4
2002	0.0	0.3	1.5	3.0	5.4
2003	0.0	0.3	1.1	2.2	5.3
2004	0.0	0.3	1.4	3.1	5.4
2005	0.0	0.4	1.5	2.9	5.4
all	0.0	0.4	1.6	3.0	5.4

Outfall 113 Mixed Temperature (hourly) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	38.1	41.7	45.8	49.7	53.7
Feb	37.8	41.2	45.6	49.6	55.3
Mar	40.2	46.4	50.9	55.6	62.0
Apr	48.9	54.0	58.6	62.8	68.5
May	56.8	62.4	66.3	70.1	74.6
Jun	62.7	69.1	73.1	76.6	79.8
Jul	70.2	74.6	77.8	80.8	84.5
Aug	73.6	76.6	78.9	81.4	84.7
Sep	69.6	73.8	76.9	79.3	83.0
Oct	58.3	64.4	69.3	74.0	80.4
Nov	47.9	54.8	59.8	64.8	70.9
Dec	39.1	46.8	51.0	56.1	63.2
1976	41.0	45.1	61.2	76.4	80.0
1977	37.8	41.5	62.4	79.3	82.3
1978	38.4	41.4	62.2	77.7	81.5
1979	39.8	44.0	61.3	76.4	79.1
1980	39.3	44.8	61.9	79.1	82.4
1981	38.1	42.2	61.4	77.7	80.8
1982	40.9	43.9	61.6	77.0	79.5
1983	41.2	44.8	61.4	78.3	80.6
1984	40.1	43.1	60.5	75.7	78.6
1985	38.8	45.2	62.7	77.3	79.5
1986	39.5	45.1	64.0	79.9	83.4
1987	42.0	44.7	62.0	77.6	80.3
1988	42.9	45.3	62.3	78.2	81.0
1989	39.1	46.1	61.2	77.1	79.3
1990	39.9	47.3	62.8	77.5	80.0
1991	43.9	47.7	63.6	78.4	81.1
1992	44.4	47.2	61.7	76.1	80.0
1993	43.6	46.7	63.3	79.3	83.4
1994	40.7	45.2	62.9	77.5	79.3
1995	41.6	47.1	63.7	80.3	82.5
1996	40.8	44.3	62.4	79.0	81.3
1997	44.7	48.1	63.8	79.2	82.1
1998	45.3	48.2	65.8	81.7	84.5
1999	45.8	49.4	65.5	80.7	83.7
2000	44.1	48.3	65.2	79.6	83.0
2001	40.4	45.0	64.3	79.9	82.5
2002	45.5	49.1	65.3	79.9	84.7
2003	42.1	46.3	64.0	79.9	82.6
2004	43.1	46.5	63.6	78.1	82.0
2005	45.3	48.1	64.0	79.9	81.9
all	37.8	46.1	62.9	78.5	84.7

Outfall 113 Rate of Change (hourly) [°F/hr]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	-3.4	-0.2	0.0	0.2	2.7
Feb	-3.6	-0.2	0.0	0.2	2.4
Mar	-3.6	-0.2	0.0	0.2	2.5
Apr	-3.6	-0.3	0.0	0.4	2.4
May	-3.0	-0.2	0.0	0.3	1.8
Jun	-2.8	-0.3	0.0	0.4	1.7
Jul	-2.2	-0.3	0.0	0.3	1.7
Aug	-2.0	-0.3	0.0	0.3	1.5
Sep	-1.7	-0.2	0.0	0.2	1.3
Oct	-2.8	-0.3	0.0	0.2	2.0
Nov	-3.4	-0.2	0.0	0.2	2.1
Dec	-3.5	-0.2	0.0	0.2	2.1
1976	-3.1	-0.3	0.0	0.3	2.4
1977	-3.6	-0.2	0.0	0.3	2.3
1978	-3.4	-0.2	0.0	0.3	2.4
1979	-3.1	-0.2	0.0	0.2	2.0
1980	-3.3	-0.3	0.0	0.3	2.0
1981	-3.3	-0.3	0.0	0.3	2.3
1982	-3.1	-0.2	0.0	0.2	1.9
1983	-3.4	-0.3	0.0	0.3	2.1
1984	-3.6	-0.2	0.0	0.3	2.7
1985	-3.5	-0.3	0.0	0.3	2.1
1986	-3.4	-0.3	0.0	0.3	2.2
1987	-3.0	-0.3	0.0	0.4	2.3
1988	-3.2	-0.3	0.0	0.3	1.8
1989	-3.5	-0.2	0.0	0.2	2.3
1990	-3.4	-0.2	0.0	0.3	2.0
1991	-3.2	-0.2	0.0	0.3	2.1
1992	-3.4	-0.3	0.0	0.3	1.8
1993	-3.4	-0.3	0.0	0.3	1.9
1994	-3.1	-0.2	0.0	0.2	2.0
1995	-3.4	-0.2	0.0	0.3	2.1
1996	-3.3	-0.2	0.0	0.2	1.9
1997	-3.4	-0.2	0.0	0.2	1.8
1998	-3.5	-0.2	0.0	0.2	2.0
1999	-3.4	-0.2	0.0	0.3	2.4
2000	-3.4	-0.3	0.0	0.3	2.0
2001	-3.5	-0.3	0.0	0.3	2.0
2002	-3.4	-0.2	0.0	0.3	2.1
2003	-3.6	-0.2	0.0	0.2	2.0
2004	-3.6	-0.2	0.0	0.2	2.0
2005	-3.3	-0.3	0.0	0.3	2.5
all	-3.6	-0.2	0.0	0.3	2.7

Holding Pond Elevation (hourly) [ft]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	698.0	698.0	698.3	699.0	700.0
Feb	698.0	698.0	698.2	698.8	700.0
Mar	698.0	698.0	698.4	699.2	700.0
Apr	698.0	698.0	698.8	699.6	700.8
May	698.0	698.0	699.1	700.4	700.8
Jun	698.0	698.0	698.9	700.3	700.7
Jul	698.0	698.0	699.1	700.4	700.7
Aug	698.0	698.0	698.7	699.9	700.7
Sep	698.0	698.0	698.8	700.2	700.7
Oct	698.0	698.0	698.7	699.5	700.0
Nov	698.0	698.0	698.5	699.4	700.0
Dec	698.0	698.0	698.4	699.4	700.0
1976	698.0	698.0	698.6	699.8	700.8
1977	698.0	698.0	698.5	699.8	700.7
1978	698.0	698.0	698.7	699.8	700.8
1979	698.0	698.0	698.2	699.0	700.8
1980	698.0	698.0	698.7	699.9	700.8
1981	698.0	698.0	698.9	699.9	700.8
1982	698.0	698.0	698.5	699.8	700.8
1983	698.0	698.0	698.6	699.8	700.7
1984	698.0	698.0	698.4	699.4	700.7
1985	698.0	698.0	699.0	700.2	700.8
1986	698.0	698.0	699.0	700.0	700.7
1987	698.0	698.0	698.9	700.0	700.7
1988	698.0	698.2	699.1	700.0	700.8
1989	698.0	698.0	698.4	699.4	700.8
1990	698.0	698.0	698.6	699.8	700.8
1991	698.0	698.0	698.5	699.8	700.8
1992	698.0	698.0	698.6	699.8	700.8
1993	698.0	698.0	698.8	700.0	700.8
1994	698.0	698.0	698.4	699.4	700.7
1995	698.0	698.0	698.6	699.9	700.8
1996	698.0	698.0	698.4	699.6	700.8
1997	698.0	698.0	698.6	699.8	700.7
1998	698.0	698.0	698.7	699.8	700.7
1999	698.0	698.0	698.9	700.0	700.8
2000	698.0	698.1	699.0	700.0	700.8
2001	698.0	698.0	699.0	700.0	700.8
2002	698.0	698.0	698.8	700.0	700.7
2003	698.0	698.0	698.2	698.9	700.7
2004	698.0	698.0	698.4	699.6	700.8
2005	698.0	698.0	698.6	699.7	700.8
all	698.0	698.0	698.7	699.8	700.8

Outfall 101 Flow [cfs]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	0	0	44	62	102
Feb	0	44	44	48	102
Mar	0	0	43	82	102
Apr	0	0	43	98	108
May	0	0	43	102	108
Jun	0	0	43	102	108
Jul	0	0	43	102	108
Aug	0	0	43	96	108
Sep	0	0	43	98	108
Oct	0	0	43	96	102
Nov	0	0	43	96	102
Dec	0	0	43	88	102
1976	0	0	43	96	108
1977	0	0	43	94	108
1978	0	0	43	96	108
1979	0	44	44	54	108
1980	0	0	43	98	108
1981	0	0	43	98	108
1982	0	0	43	94	108
1983	0	0	43	96	108
1984	0	0	43	82	108
1985	0	0	43	100	108
1986	0	0	43	100	108
1987	0	0	43	100	108
1988	0	0	43	100	108
1989	0	0	43	72	108
1990	0	0	43	96	108
1991	0	0	43	94	108
1992	0	0	43	96	108
1993	0	0	43	98	108
1994	0	0	43	70	108
1995	0	0	43	96	108
1996	0	0	44	80	108
1997	0	0	43	96	108
1998	0	0	43	96	108
1999	0	0	43	100	108
2000	0	0	43	100	108
2001	0	0	43	100	108
2002	0	0	43	98	108
2003	0	44	44	54	108
2004	0	0	44	82	108
2005	0	0	43	96	108
all	0	0	43	96	108

Outfall 101 Daily Average Discharge Temperature (at Midnight) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	49.0	56.9	64.0	70.7	79.4
Feb	49.2	59.0	65.9	72.9	78.4
Mar	53.2	63.1	69.6	76.3	82.1
Apr	62.5	68.5	74.2	79.3	84.6
May	70.7	73.7	78.9	83.4	85.8
Jun	75.3	79.5	83.6	86.9	89.0
Jul	80.2	82.7	85.6	87.7	89.1
Aug	77.4	82.8	85.6	87.9	89.8
Sep	71.6	76.9	81.8	85.9	88.2
Oct	63.6	69.2	75.3	81.2	83.9
Nov	56.2	62.8	69.5	76.8	83.3
Dec	49.4	59.2	65.2	72.3	81.2
1976	52.5	59.7	70.1	81.8	85.5
1977	49.6	58.5	72.8	87.2	89.1
1978	51.9	57.7	69.8	86.0	88.9
1979	54.2	59.4	73.1	86.0	89.0
1980	53.2	58.8	70.6	86.7	89.1
1981	53.5	63.8	76.0	86.1	88.0
1982	49.0	61.4	71.6	84.5	88.1
1983	51.8	60.7	71.4	85.3	89.0
1984	52.8	61.4	73.7	84.8	87.6
1985	56.0	58.4	67.1	75.5	81.7
1986	56.3	60.9	72.9	84.6	86.8
1987	55.6	61.9	72.3	86.8	89.3
1988	53.1	56.7	72.4	87.7	88.2
1989	49.4	61.7	74.4	86.5	88.4
1990	56.6	64.5	73.0	85.1	87.8
1991	54.4	61.9	73.0	86.4	89.0
1992	54.1	62.8	71.9	84.2	87.0
1993	56.2	61.4	68.8	77.5	89.3
1994	51.0	63.0	74.0	85.5	87.1
1995	53.7	61.0	71.5	85.9	89.8
1996	49.2	60.6	71.8	84.1	87.5
1997	53.0	62.9	73.9	86.1	89.0
1998	57.5	63.1	73.3	85.4	89.0
1999	54.5	62.6	70.2	84.8	88.0
2000	64.4	67.7	78.3	86.6	89.1
2001	59.8	63.6	74.6	86.4	88.1
2002	59.0	62.2	69.7	80.4	86.0
2003	55.4	62.4	74.8	85.9	88.2
2004	55.6	61.7	73.8	85.1	87.2
2005	55.3	63.0	75.3	86.6	88.1
all	49.0	61.3	72.6	85.5	89.8

Outfall 101 Rise (hourly) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	0.0	0.0	0.1	0.2	1.1
Feb	0.0	0.0	0.1	0.2	1.1
Mar	0.0	0.0	0.1	0.3	1.1
Apr	0.0	0.0	0.2	0.5	1.3
May	0.0	0.0	0.2	0.4	0.9
Jun	0.0	0.0	0.1	0.3	0.8
Jul	-0.2	0.0	0.1	0.2	0.5
Aug	-0.1	0.0	0.0	0.2	0.5
Sep	-0.3	0.0	0.0	0.1	0.5
Oct	-0.3	0.0	0.0	0.2	0.6
Nov	-0.1	0.0	0.0	0.2	1.0
Dec	-0.1	0.0	0.1	0.2	1.2
1976	0.0	0.0	0.1	0.3	0.8
1977	-0.2	0.0	0.1	0.2	0.8
1978	-0.2	0.0	0.1	0.2	0.9
1979	-0.2	0.0	0.0	0.2	0.9
1980	-0.1	0.0	0.1	0.3	1.0
1981	-0.1	0.0	0.2	0.4	1.2
1982	-0.2	0.0	0.1	0.2	1.1
1983	0.0	0.0	0.1	0.2	1.1
1984	-0.2	0.0	0.1	0.3	1.0
1985	-0.1	0.0	0.2	0.4	1.0
1986	-0.3	0.0	0.2	0.4	1.0
1987	-0.1	0.0	0.1	0.4	1.1
1988	-0.2	0.0	0.2	0.4	1.1
1989	-0.1	0.0	0.1	0.2	1.1
1990	-0.3	0.0	0.1	0.2	1.0
1991	-0.3	0.0	0.1	0.2	0.9
1992	0.0	0.0	0.1	0.3	1.0
1993	-0.1	0.0	0.1	0.2	0.9
1994	0.0	0.0	0.0	0.2	0.8
1995	0.0	0.0	0.1	0.3	0.7
1996	-0.2	0.0	0.1	0.2	0.9
1997	0.0	0.0	0.0	0.2	0.7
1998	-0.2	0.0	0.0	0.2	1.0
1999	-0.1	0.0	0.1	0.3	1.3
2000	-0.2	0.0	0.1	0.3	1.0
2001	-0.3	0.0	0.1	0.4	0.9
2002	-0.1	0.0	0.1	0.3	1.0
2003	-0.2	0.0	0.0	0.1	0.7
2004	0.0	0.0	0.1	0.2	1.0
2005	-0.1	0.0	0.1	0.2	0.8
all	-0.3	0.0	0.1	0.3	1.3

Outfall 101 Mixed Temperature (hourly) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	38.2	41.7	45.8	49.6	53.8
Feb	37.9	41.3	45.6	49.5	55.7
Mar	40.3	46.2	50.5	55.3	61.0
Apr	48.9	53.4	58.2	62.4	66.9
May	57.3	62.1	66.1	70.0	73.8
Jun	62.7	68.7	72.8	76.6	79.6
Jul	70.2	74.2	77.5	80.7	84.6
Aug	73.8	76.5	78.8	81.2	84.7
Sep	69.9	73.7	76.8	79.3	83.0
Oct	58.3	64.0	68.8	73.5	79.3
Nov	47.9	54.3	59.3	64.5	69.7
Dec	38.2	46.6	50.7	55.6	61.7
1976	41.1	44.5	59.3	75.8	80.1
1977	37.9	41.6	61.2	78.9	81.9
1978	38.5	40.6	59.9	77.4	80.7
1979	39.8	43.9	60.4	76.2	78.9
1980	39.3	44.0	59.5	79.1	82.1
1981	38.2	42.0	61.3	77.7	80.1
1982	41.0	43.4	60.0	76.7	79.1
1983	41.2	44.5	59.3	78.2	80.1
1984	40.2	42.7	59.9	75.7	78.0
1985	38.9	41.2	60.4	77.1	78.5
1986	39.2	44.1	62.2	79.7	83.4
1987	42.0	44.2	60.1	77.7	79.7
1988	42.9	44.7	61.4	78.7	80.5
1989	38.2	46.1	61.0	77.1	78.9
1990	39.0	46.7	61.0	77.5	79.0
1991	43.9	47.2	61.7	78.4	80.5
1992	44.5	46.8	60.4	75.9	79.1
1993	43.6	46.3	59.7	78.9	83.5
1994	40.8	44.9	61.6	77.4	78.9
1995	41.6	46.6	61.7	80.1	82.5
1996	40.9	44.0	60.9	78.9	80.6
1997	44.7	47.6	62.3	78.9	82.1
1998	45.1	47.6	63.4	81.4	84.6
1999	45.8	48.9	63.6	80.5	83.4
2000	44.4	47.8	64.9	79.8	83.2
2001	40.5	43.8	63.5	80.2	82.6
2002	45.5	48.9	63.0	79.7	84.7
2003	42.1	46.2	63.6	79.9	82.6
2004	43.2	46.1	62.9	78.0	82.0
2005	45.4	47.8	63.4	79.9	81.9
all	37.9	45.5	61.4	78.2	84.7

Statistics: One Unit New Steam Generator

Over the 30 year study period there are a total of 262,992 possible hours of operation. In this case , according to the Model calculations, the unit was able to maintain operation throughout this entire period while meeting all EPA (NPDES discharge temperature), NRC (intake temperature), and mechanical (backpressure) constraints. The SCCW system was operated for 262,673 hours, or all but 310 hours of the total period. The SCCW system was operated in bypass mode for a total of 15,758 hours, of which 15,736 of these were at 30%, 11 were at 60%, and 11 were at 90%. The total generation for this period was 318,063,179 MW-hrs. The total *requested* generation was 333,999,840 MW-hrs. The difference of 4.77% is due to thermal efficiency alone; as no load reductions were required to meet operating constraints other than the 5.5 in.Hg backpressure. No occurrences of overflow were predicted for the holding pond during these operations. Note that the requested generation is the same as that for the old steam generators as this the way the Model is set up to run (that is, specifying a requested generation rather than a reactor power level). Note also that statistics for discharge temperatures and associated rise, mixed temperature, and rate of change only consider those times when there is some discharge flow.

Unit 1 Load [MWe]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	1200	1219	1223	1225	1227
Feb	1199	1218	1222	1225	1227
Mar	1199	1213	1219	1223	1226
Apr	1198	1208	1214	1220	1224
May	1191	1202	1208	1214	1220
Jun	1182	1192	1199	1206	1217
Jul	1157	1185	1192	1199	1208
Aug	1165	1185	1192	1198	1208
Sep	1180	1190	1198	1206	1215
Oct	1187	1202	1210	1216	1223
Nov	1201	1211	1217	1222	1225
Dec	1203	1217	1221	1224	1227
1976	1184	1196	1212	1224	1226
1977	1178	1189	1209	1224	1227
1978	1182	1192	1209	1224	1226
1979	1184	1195	1211	1224	1226
1980	1165	1190	1210	1224	1226
1981	1181	1193	1211	1224	1227
1982	1183	1194	1211	1223	1227
1983	1177	1193	1211	1223	1227
1984	1187	1196	1211	1224	1226
1985	1184	1194	1210	1224	1227
1986	1171	1189	1208	1223	1227
1987	1180	1192	1210	1223	1226
1988	1179	1193	1210	1224	1226
1989	1183	1194	1210	1223	1227
1990	1182	1193	1209	1222	1225
1991	1180	1191	1209	1222	1226
1992	1184	1196	1211	1223	1226
1993	1157	1188	1208	1223	1226
1994	1185	1193	1209	1223	1227
1995	1177	1190	1209	1223	1226
1996	1182	1192	1210	1224	1227
1997	1178	1192	1210	1223	1226
1998	1176	1188	1207	1222	1225
1999	1162	1188	1208	1222	1226
2000	1165	1190	1208	1223	1226
2001	1181	1190	1209	1223	1226
2002	1178	1189	1207	1223	1225
2003	1180	1192	1209	1223	1226
2004	1183	1193	1209	1223	1226
2005	1179	1191	1209	1223	1225
all	1157	1192	1209	1223	1227

Unit 1 Backpressure [in.Hg]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	1.43	1.90	2.26	2.65	4.12
Feb	1.57	1.96	2.36	2.80	4.18
Mar	1.65	2.22	2.68	3.19	4.17
Apr	2.08	2.59	3.09	3.58	4.25
May	2.59	3.10	3.56	4.02	4.69
Jun	2.86	3.73	4.17	4.59	5.19
Jul	3.57	4.20	4.59	5.00	5.50
Aug	3.56	4.25	4.62	5.01	5.50
Sep	3.07	3.71	4.24	4.70	5.25
Oct	2.27	2.92	3.45	3.99	4.87
Nov	1.85	2.39	2.86	3.36	4.07
Dec	1.53	2.05	2.44	2.90	3.94
1976	1.66	2.11	3.20	4.37	5.06
1977	1.46	2.04	3.39	4.79	5.40
1978	1.61	2.02	3.34	4.63	5.19
1979	1.64	2.10	3.26	4.43	5.04
1980	1.65	2.11	3.30	4.72	5.49
1981	1.58	2.12	3.27	4.53	5.22
1982	1.48	2.21	3.29	4.47	5.10
1983	1.53	2.17	3.24	4.56	5.42
1984	1.60	2.14	3.23	4.35	4.90
1985	1.43	2.10	3.33	4.46	5.06
1986	1.58	2.24	3.48	4.77	5.50
1987	1.73	2.23	3.33	4.60	5.27
1988	1.67	2.13	3.30	4.55	5.35
1989	1.56	2.21	3.30	4.47	5.12
1990	1.89	2.39	3.40	4.56	5.15
1991	1.72	2.31	3.43	4.67	5.26
1992	1.74	2.28	3.26	4.39	5.06
1993	1.72	2.27	3.42	4.82	5.50
1994	1.54	2.27	3.38	4.53	5.02
1995	1.71	2.20	3.41	4.75	5.43
1996	1.57	2.14	3.32	4.58	5.19
1997	1.72	2.29	3.36	4.61	5.36
1998	1.87	2.36	3.57	4.86	5.49
1999	1.82	2.35	3.51	4.81	5.50
2000	1.81	2.24	3.46	4.70	5.49
2001	1.76	2.27	3.43	4.71	5.23
2002	1.89	2.29	3.51	4.76	5.41
2003	1.62	2.20	3.41	4.63	5.25
2004	1.83	2.21	3.40	4.54	5.11
2005	1.85	2.28	3.41	4.68	5.31
all	1.43	2.21	3.36	4.62	5.50

Outfall 113 Flow (hourly) [cfs]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	222	222	222	222	223
Feb	222	222	222	222	223
Mar	222	222	223	224	227
Apr	226	233	256	274	277
May	240	278	286	292	292
Jun	257	291	291	292	292
Jul	275	292	292	292	293
Aug	284	292	292	292	293
Sep	291	292	292	292	293
Oct	287	291	291	292	292
Nov	226	231	258	284	288
Dec	222	222	222	222	226
1976	222	222	263	292	292
1977	222	222	263	292	293
1978	222	222	262	292	292
1979	222	222	263	292	292
1980	222	222	263	292	293
1981	222	222	263	292	292
1982	222	222	263	292	292
1983	222	222	263	292	293
1984	222	222	263	292	292
1985	222	222	263	292	292
1986	222	222	255	292	292
1987	222	222	262	292	293
1988	222	222	262	292	293
1989	222	222	263	292	292
1990	222	222	263	292	292
1991	222	222	263	292	293
1992	222	222	262	292	292
1993	222	222	263	292	293
1994	222	222	263	292	292
1995	222	222	262	292	293
1996	222	222	263	292	292
1997	222	222	263	292	293
1998	222	222	263	292	293
1999	222	222	262	292	293
2000	222	222	263	292	293
2001	222	222	263	292	292
2002	222	222	263	292	293
2003	222	222	263	292	293
2004	222	222	263	292	292
2005	222	222	263	292	293
all	222	222	262	292	293

Outfall 113 Discharge Temperature (hourly) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	39.5	55.1	62.7	70.7	82.7
Feb	40.7	56.8	64.8	73.4	82.8
Mar	45.9	61.1	68.3	76.1	86.1
Apr	57.5	66.2	72.7	79.4	90.2
May	63.6	72.6	79.3	85.3	90.9
Jun	68.6	78.9	83.8	88.6	94.2
Jul	71.6	82.3	86.1	90.2	97.3
Aug	73.2	81.5	85.5	89.6	94.9
Sep	65.7	75.2	81.7	87.2	92.6
Oct	57.7	67.3	75.0	82.2	89.7
Nov	52.7	61.7	69.7	77.9	85.7
Dec	44.5	57.7	64.7	72.4	84.4
1976	48.7	60.3	73.3	84.9	91.8
1977	42.7	57.5	74.7	88.2	94.2
1978	49.2	59.3	74.3	87.4	94.2
1979	50.2	60.4	74.4	86.0	92.1
1980	49.6	60.2	74.1	87.3	97.3
1981	39.5	57.8	72.9	86.4	92.7
1982	44.1	61.7	74.5	85.8	91.9
1983	44.5	61.1	73.6	86.4	94.6
1984	48.7	60.3	73.4	85.8	92.2
1985	41.2	59.6	74.2	85.9	92.6
1986	40.7	59.9	74.8	87.6	93.1
1987	52.1	61.5	74.3	87.4	93.4
1988	49.2	59.0	73.1	86.4	93.5
1989	46.8	61.4	74.2	86.4	92.6
1990	54.1	64.4	75.8	87.0	93.1
1991	50.4	62.6	75.9	87.5	93.0
1992	50.4	62.2	73.8	85.2	91.2
1993	50.5	62.6	75.6	88.4	95.0
1994	46.0	63.0	75.5	86.4	91.2
1995	49.9	61.4	74.8	87.0	93.5
1996	46.9	60.6	74.1	86.2	91.9
1997	49.5	62.5	74.6	86.2	93.0
1998	47.1	64.0	76.2	87.9	93.7
1999	51.9	63.1	75.6	87.2	94.4
2000	51.5	61.4	74.8	86.7	93.3
2001	43.9	60.7	74.6	86.4	92.4
2002	54.0	61.9	75.4	87.2	92.3
2003	48.2	61.9	75.0	86.1	91.2
2004	52.1	62.2	75.2	85.8	91.6
2005	52.9	62.3	75.0	86.6	92.3
all	39.5	61.2	74.6	86.7	97.3

Outfall 113 Rise (hourly) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	0.0	0.8	1.8	3.1	5.4
Feb	0.3	0.6	1.8	3.0	5.4
Mar	0.0	0.7	1.9	3.5	5.4
Apr	0.0	1.0	2.3	3.9	5.4
May	0.0	1.0	2.4	3.8	5.4
Jun	0.0	0.8	1.8	3.0	5.2
Jul	0.0	0.6	1.4	2.4	4.3
Aug	0.0	0.3	0.9	1.6	3.5
Sep	0.0	0.0	0.7	1.4	2.9
Oct	0.0	0.0	1.0	2.2	4.8
Nov	0.0	0.3	1.3	2.7	5.4
Dec	0.0	0.7	1.7	3.2	5.4
1976	0.0	0.6	1.6	2.9	5.4
1977	0.0	0.4	1.6	3.1	5.4
1978	0.0	0.6	1.7	3.1	5.3
1979	0.0	0.4	1.3	2.3	5.3
1980	0.0	0.5	1.7	3.1	5.4
1981	0.0	0.6	2.0	3.6	5.4
1982	0.0	0.4	1.5	2.9	5.3
1983	0.0	0.6	1.6	2.8	5.4
1984	0.0	0.5	1.7	3.2	5.4
1985	0.0	0.6	1.9	3.3	5.4
1986	0.0	0.5	1.8	3.4	5.4
1987	0.0	0.6	2.0	3.6	5.4
1988	0.0	0.7	2.0	3.6	5.4
1989	0.0	0.5	1.5	2.9	5.4
1990	0.0	0.5	1.5	3.0	5.4
1991	0.0	0.4	1.5	2.9	5.4
1992	0.0	0.6	1.6	3.0	5.4
1993	0.0	0.5	1.6	2.9	5.3
1994	0.0	0.3	1.3	2.5	5.3
1995	0.0	0.4	1.5	2.8	5.4
1996	0.0	0.4	1.3	2.7	5.4
1997	0.0	0.3	1.3	2.5	5.3
1998	0.0	0.3	1.2	2.4	5.4
1999	0.0	0.3	1.6	3.1	5.4
2000	0.0	0.4	1.8	3.4	5.4
2001	0.0	0.4	1.8	3.5	5.4
2002	0.0	0.3	1.5	3.0	5.4
2003	0.0	0.3	1.1	2.2	5.3
2004	0.0	0.3	1.4	3.1	5.4
2005	0.0	0.4	1.5	2.9	5.4
all	0.0	0.4	1.6	3.0	5.4

Outfall 113 Mixed Temperature (hourly) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	38.1	41.7	45.8	49.7	53.7
Feb	37.8	41.2	45.6	49.6	55.3
Mar	40.2	46.4	50.9	55.6	62.0
Apr	48.9	54.0	58.6	62.8	68.5
May	56.8	62.4	66.3	70.1	74.6
Jun	62.7	69.1	73.1	76.6	79.8
Jul	70.2	74.6	77.8	80.8	84.5
Aug	73.6	76.6	78.9	81.4	84.7
Sep	69.6	73.8	76.9	79.3	83.0
Oct	58.3	64.4	69.3	74.0	80.4
Nov	47.9	54.8	59.8	64.8	70.9
Dec	39.1	46.8	51.0	56.1	63.2
1976	41.0	45.1	61.2	76.4	80.0
1977	37.8	41.5	62.4	79.3	82.3
1978	38.4	41.4	62.2	77.7	81.5
1979	39.8	44.0	61.3	76.4	79.1
1980	39.3	44.8	61.9	79.1	82.4
1981	38.1	42.2	61.4	77.7	80.8
1982	40.9	43.9	61.6	77.0	79.5
1983	41.2	44.8	61.4	78.3	80.6
1984	40.1	43.1	60.5	75.7	78.6
1985	38.8	45.2	62.7	77.3	79.5
1986	39.5	45.1	64.0	79.9	83.4
1987	42.0	44.7	62.0	77.6	80.3
1988	42.9	45.3	62.3	78.2	81.0
1989	39.1	46.1	61.2	77.1	79.3
1990	39.9	47.3	62.8	77.5	80.0
1991	43.9	47.7	63.6	78.4	81.1
1992	44.4	47.2	61.7	76.1	80.0
1993	43.6	46.7	63.3	79.3	83.4
1994	40.7	45.2	62.9	77.5	79.3
1995	41.6	47.1	63.7	80.3	82.5
1996	40.8	44.3	62.4	79.0	81.3
1997	44.7	48.1	63.8	79.2	82.1
1998	45.3	48.2	65.8	81.7	84.5
1999	45.8	49.4	65.5	80.7	83.7
2000	44.1	48.3	65.2	79.6	83.0
2001	40.4	45.0	64.3	79.9	82.5
2002	45.5	49.1	65.3	79.9	84.7
2003	42.1	46.3	64.0	79.9	82.6
2004	43.1	46.5	63.6	78.1	82.0
2005	45.3	48.1	64.0	79.9	81.9
all	37.8	46.1	62.9	78.5	84.7

Outfall 113 Rate of Change (hourly) [°F/hr]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	-3.4	-0.2	0.0	0.2	2.7
Feb	-3.6	-0.2	0.0	0.2	2.4
Mar	-3.6	-0.2	0.0	0.2	2.5
Apr	-3.6	-0.3	0.0	0.4	2.4
May	-3.0	-0.2	0.0	0.3	1.8
Jun	-2.8	-0.3	0.0	0.4	1.7
Jul	-2.2	-0.3	0.0	0.3	1.7
Aug	-2.0	-0.3	0.0	0.3	1.5
Sep	-1.7	-0.2	0.0	0.2	1.3
Oct	-2.8	-0.3	0.0	0.2	2.0
Nov	-3.4	-0.3	0.0	0.2	2.1
Dec	-3.5	-0.2	0.0	0.2	2.1
1976	-3.1	-0.3	0.0	0.3	2.4
1977	-3.6	-0.2	0.0	0.3	2.3
1978	-3.4	-0.2	0.0	0.3	2.4
1979	-3.1	-0.2	0.0	0.2	2.0
1980	-3.3	-0.3	0.0	0.3	2.0
1981	-3.3	-0.3	0.0	0.3	2.3
1982	-3.1	-0.2	0.0	0.2	1.9
1983	-3.4	-0.3	0.0	0.3	2.1
1984	-3.6	-0.2	0.0	0.3	2.7
1985	-3.5	-0.3	0.0	0.3	2.1
1986	-3.4	-0.3	0.0	0.3	2.2
1987	-3.0	-0.3	0.0	0.4	2.3
1988	-3.2	-0.3	0.0	0.3	1.8
1989	-3.5	-0.2	0.0	0.2	2.3
1990	-3.4	-0.2	0.0	0.3	2.0
1991	-3.2	-0.2	0.0	0.3	2.1
1992	-3.4	-0.3	0.0	0.3	1.8
1993	-3.4	-0.3	0.0	0.3	1.9
1994	-3.1	-0.2	0.0	0.2	2.0
1995	-3.4	-0.2	0.0	0.3	2.1
1996	-3.3	-0.2	0.0	0.2	1.9
1997	-3.5	-0.2	0.0	0.2	1.8
1998	-3.5	-0.2	0.0	0.2	2.0
1999	-3.4	-0.2	0.0	0.3	2.4
2000	-3.4	-0.3	0.0	0.3	2.0
2001	-3.5	-0.3	0.0	0.3	2.0
2002	-3.4	-0.2	0.0	0.3	2.1
2003	-3.6	-0.2	0.0	0.2	2.0
2004	-3.6	-0.2	0.0	0.2	2.0
2005	-3.3	-0.3	0.0	0.3	2.5
all	-3.6	-0.2	0.0	0.3	2.7

Holding Pond Elevation (hourly) [ft]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	698.0	698.0	698.3	699.0	700.0
Feb	698.0	698.0	698.2	698.8	700.0
Mar	698.0	698.0	698.4	699.2	700.0
Apr	698.0	698.0	698.8	699.6	700.8
May	698.0	698.0	699.1	700.4	700.8
Jun	698.0	698.0	698.9	700.3	700.7
Jul	698.0	698.0	699.1	700.4	700.7
Aug	698.0	698.0	698.7	699.9	700.7
Sep	698.0	698.0	698.8	700.2	700.7
Oct	698.0	698.0	698.7	699.5	700.0
Nov	698.0	698.0	698.5	699.4	700.0
Dec	698.0	698.0	698.4	699.4	700.0
1976	698.0	698.0	698.6	699.8	700.8
1977	698.0	698.0	698.5	699.8	700.7
1978	698.0	698.0	698.7	699.8	700.8
1979	698.0	698.0	698.2	699.0	700.8
1980	698.0	698.0	698.7	699.9	700.8
1981	698.0	698.0	698.9	699.9	700.8
1982	698.0	698.0	698.5	699.8	700.8
1983	698.0	698.0	698.6	699.8	700.7
1984	698.0	698.0	698.4	699.4	700.7
1985	698.0	698.0	699.0	700.2	700.8
1986	698.0	698.0	699.0	700.0	700.7
1987	698.0	698.0	698.9	700.0	700.7
1988	698.0	698.2	699.1	700.0	700.8
1989	698.0	698.0	698.4	699.4	700.8
1990	698.0	698.0	698.6	699.8	700.8
1991	698.0	698.0	698.5	699.8	700.8
1992	698.0	698.0	698.6	699.8	700.8
1993	698.0	698.0	698.8	700.0	700.8
1994	698.0	698.0	698.4	699.4	700.7
1995	698.0	698.0	698.6	699.9	700.8
1996	698.0	698.0	698.4	699.6	700.8
1997	698.0	698.0	698.6	699.8	700.7
1998	698.0	698.0	698.7	699.8	700.7
1999	698.0	698.0	698.9	700.0	700.8
2000	698.0	698.1	699.0	700.0	700.8
2001	698.0	698.0	699.0	700.0	700.8
2002	698.0	698.0	698.8	700.0	700.7
2003	698.0	698.0	698.2	698.9	700.7
2004	698.0	698.0	698.4	699.6	700.8
2005	698.0	698.0	698.6	699.7	700.8
all	698.0	698.0	698.7	699.8	700.8

Outfall 101 Flow (hourly) [cfs]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	0	0	44	62	102
Feb	0	44	44	48	102
Mar	0	0	43	82	102
Apr	0	0	43	98	108
May	0	0	43	102	108
Jun	0	0	43	102	108
Jul	0	0	43	102	108
Aug	0	0	43	96	108
Sep	0	0	43	98	108
Oct	0	0	43	96	102
Nov	0	0	43	96	102
Dec	0	0	43	88	102
1976	0	0	43	96	108
1977	0	0	43	94	108
1978	0	0	43	96	108
1979	0	44	44	54	108
1980	0	0	43	98	108
1981	0	0	43	98	108
1982	0	0	43	94	108
1983	0	0	43	96	108
1984	0	0	43	82	108
1985	0	0	43	100	108
1986	0	0	43	100	108
1987	0	0	43	100	108
1988	0	0	43	100	108
1989	0	0	43	72	108
1990	0	0	43	96	108
1991	0	0	43	94	108
1992	0	0	43	96	108
1993	0	0	43	98	108
1994	0	0	43	70	108
1995	0	0	43	96	108
1996	0	0	44	80	108
1997	0	0	43	96	108
1998	0	0	43	96	108
1999	0	0	43	100	108
2000	0	0	43	100	108
2001	0	0	43	100	108
2002	0	0	43	98	108
2003	0	44	44	54	108
2004	0	0	44	82	108
2005	0	0	43	96	108
all	0	0	43	96	108

Outfall 101 Daily Average Discharge Temperature (at Midnight) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	49.0	56.9	64.0	70.7	79.4
Feb	49.2	59.0	65.9	72.9	78.4
Mar	53.2	63.1	69.6	76.3	82.1
Apr	62.5	68.5	74.2	79.3	84.6
May	70.7	73.7	78.9	83.4	85.8
Jun	75.3	79.5	83.6	86.9	89.0
Jul	80.2	82.7	85.6	87.7	89.1
Aug	77.4	82.8	85.6	87.9	89.8
Sep	71.6	76.9	81.8	85.9	88.2
Oct	63.7	69.2	75.3	81.2	83.9
Nov	56.2	62.8	69.5	76.8	83.3
Dec	49.4	59.2	65.2	72.3	81.2
1976	52.5	59.7	70.1	81.8	85.5
1977	49.6	58.5	72.8	87.2	89.1
1978	51.9	57.7	69.8	86.0	88.9
1979	54.2	59.4	73.1	86.0	89.0
1980	53.2	58.8	70.6	86.7	89.1
1981	53.5	63.8	76.0	86.1	88.0
1982	49.0	61.4	71.6	84.5	88.1
1983	51.8	60.7	71.4	85.3	89.0
1984	52.8	61.4	73.7	84.8	87.6
1985	56.0	58.4	67.1	75.5	81.7
1986	56.3	60.9	72.9	84.6	86.8
1987	55.6	61.9	72.3	86.8	89.3
1988	53.1	56.7	72.4	87.7	88.2
1989	49.4	61.7	74.4	86.5	88.4
1990	56.6	64.5	73.0	85.1	87.8
1991	54.4	61.9	73.0	86.4	89.0
1992	54.1	62.8	71.9	84.2	87.0
1993	56.2	61.4	68.8	77.5	89.3
1994	51.0	63.0	74.0	85.5	87.1
1995	53.7	61.0	71.5	85.9	89.8
1996	49.2	60.6	71.8	84.1	87.5
1997	53.0	62.9	73.9	86.1	89.0
1998	57.5	63.1	73.3	85.4	89.0
1999	54.5	62.6	70.2	84.8	88.0
2000	64.4	67.7	78.3	86.6	89.1
2001	59.8	63.6	74.6	86.4	88.1
2002	59.1	62.2	69.7	80.4	86.0
2003	55.5	62.4	74.8	85.9	88.2
2004	55.6	61.7	73.8	85.1	87.2
2005	55.3	63.0	75.3	86.6	88.1
all	49.0	61.3	72.6	85.5	89.8

Outfall 101 Rise (hourly) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	0.0	0.0	0.1	0.2	1.1
Feb	0.0	0.0	0.1	0.2	1.1
Mar	0.0	0.0	0.1	0.3	1.1
Apr	0.0	0.0	0.2	0.5	1.3
May	0.0	0.0	0.2	0.4	0.9
Jun	0.0	0.0	0.1	0.3	0.8
Jul	-0.2	0.0	0.1	0.2	0.5
Aug	-0.1	0.0	0.0	0.2	0.5
Sep	-0.3	0.0	0.0	0.1	0.5
Oct	-0.3	0.0	0.0	0.2	0.6
Nov	-0.1	0.0	0.0	0.2	1.0
Dec	-0.1	0.0	0.1	0.2	1.2
1976	0.0	0.0	0.1	0.3	0.8
1977	-0.2	0.0	0.1	0.2	0.8
1978	-0.2	0.0	0.1	0.2	0.9
1979	-0.2	0.0	0.0	0.2	0.9
1980	-0.1	0.0	0.1	0.3	1.0
1981	-0.1	0.0	0.2	0.4	1.2
1982	-0.2	0.0	0.1	0.2	1.1
1983	0.0	0.0	0.1	0.2	1.1
1984	-0.2	0.0	0.1	0.3	1.0
1985	-0.1	0.0	0.2	0.4	1.0
1986	-0.3	0.0	0.2	0.4	1.0
1987	-0.1	0.0	0.1	0.4	1.1
1988	-0.2	0.0	0.2	0.4	1.1
1989	-0.1	0.0	0.1	0.2	1.1
1990	-0.3	0.0	0.1	0.2	1.0
1991	-0.3	0.0	0.1	0.2	0.9
1992	0.0	0.0	0.1	0.3	1.0
1993	-0.1	0.0	0.1	0.2	0.9
1994	0.0	0.0	0.0	0.2	0.8
1995	0.0	0.0	0.1	0.3	0.7
1996	-0.2	0.0	0.1	0.2	0.9
1997	0.0	0.0	0.0	0.2	0.7
1998	-0.2	0.0	0.0	0.2	1.0
1999	-0.1	0.0	0.1	0.3	1.3
2000	-0.2	0.0	0.1	0.3	1.0
2001	-0.3	0.0	0.1	0.4	0.9
2002	-0.1	0.0	0.1	0.3	1.0
2003	-0.2	0.0	0.0	0.1	0.7
2004	0.0	0.0	0.1	0.2	1.0
2005	-0.1	0.0	0.1	0.2	0.8
all	-0.3	0.0	0.1	0.3	1.3

Outfall 101 Mixed Temperature (hourly) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	38.2	41.7	45.8	49.6	53.8
Feb	37.9	41.3	45.6	49.5	55.7
Mar	40.3	46.2	50.5	55.3	61.0
Apr	48.9	53.4	58.2	62.4	66.9
May	57.3	62.1	66.1	70.0	73.8
Jun	62.7	68.7	72.8	76.6	79.6
Jul	70.2	74.2	77.5	80.7	84.6
Aug	73.8	76.5	78.8	81.2	84.7
Sep	69.9	73.7	76.8	79.3	83.0
Oct	58.3	64.0	68.8	73.5	79.3
Nov	47.9	54.3	59.3	64.5	69.7
Dec	38.2	46.6	50.7	55.6	61.7
1976	41.1	44.5	59.3	75.8	80.1
1977	37.9	41.6	61.2	78.9	81.9
1978	38.5	40.6	59.9	77.4	80.7
1979	39.8	43.9	60.4	76.2	78.9
1980	39.3	44.0	59.5	79.1	82.1
1981	38.2	42.0	61.3	77.7	80.1
1982	41.0	43.4	60.0	76.7	79.1
1983	41.2	44.5	59.3	78.2	80.1
1984	40.2	42.7	59.9	75.7	78.0
1985	38.9	41.2	60.4	77.1	78.5
1986	39.2	44.1	62.2	79.7	83.4
1987	42.0	44.2	60.1	77.7	79.7
1988	42.9	44.7	61.4	78.7	80.5
1989	38.2	46.1	61.0	77.1	78.9
1990	39.0	46.7	61.0	77.5	79.0
1991	43.9	47.2	61.7	78.4	80.5
1992	44.5	46.8	60.4	75.9	79.1
1993	43.6	46.3	59.7	78.9	83.5
1994	40.8	44.9	61.6	77.4	78.9
1995	41.6	46.6	61.7	80.1	82.5
1996	40.9	44.0	60.9	78.9	80.6
1997	44.7	47.6	62.3	78.9	82.1
1998	45.1	47.6	63.4	81.4	84.6
1999	45.8	48.9	63.6	80.5	83.4
2000	44.4	47.8	64.9	79.8	83.2
2001	40.5	43.8	63.5	80.2	82.6
2002	45.5	48.9	63.0	79.7	84.7
2003	42.1	46.2	63.6	79.9	82.6
2004	43.2	46.1	62.9	78.0	82.0
2005	45.4	47.8	63.4	79.9	81.9
all	37.9	45.5	61.4	78.2	84.7

Statistics: Two Units

Over the 30 year study period there are a total of 262,992 possible hours of operation. In this case , according to the Model calculations, the unit was able to maintain operation throughout this entire period while meeting all EPA (NPDES discharge temperature), NRC (intake temperature), and mechanical (backpressure) constraints. The SCCW system was operated for 262,699 hours, or all but 293 hours of the total period. The SCCW system was operated in bypass mode for a total of 15,459 hours, of which 15,439 of these were at 30%, 10 were at 60%, and 10 were at 90%. The total generation for this period was 635,459,803 MW-hrs. The total *requested* generation was 667,999,680 MW-hrs. The difference of 4.87% is due to thermal efficiency alone; as no load reductions were required to meet operating constraints other than the 5.5 in.Hg backpressure. No occurrences of overflow were predicted for the holding pond during these operations. Note that statistics for discharge temperatures and associated rise, mixed temperature, and rate of change only consider those times when there is some discharge flow.

Unit 1 Load [MWe]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	1197	1214	1219	1224	1227
Feb	1197	1211	1218	1223	1226
Mar	1189	1205	1214	1221	1226
Apr	1177	1198	1208	1217	1223
May	1146	1189	1200	1211	1219
Jun	1028	1179	1189	1201	1215
Jul	921	1149	1178	1194	1211
Aug	993	1168	1181	1195	1209
Sep	1074	1182	1193	1206	1217
Oct	1165	1195	1206	1216	1223
Nov	1188	1204	1213	1221	1225
Dec	1193	1211	1218	1223	1227
1976	1101	1188	1206	1222	1226
1977	1018	1179	1200	1223	1227
1978	1028	1182	1203	1223	1226
1979	1097	1186	1205	1222	1226
1980	921	1182	1201	1222	1226
1981	1070	1185	1204	1222	1226
1982	1095	1186	1205	1221	1227
1983	1007	1185	1205	1222	1227
1984	1111	1186	1206	1222	1226
1985	1077	1186	1204	1222	1227
1986	1046	1181	1201	1221	1226
1987	1047	1182	1203	1221	1225
1988	1052	1185	1204	1222	1226
1989	1077	1185	1204	1221	1226
1990	1060	1183	1202	1219	1224
1991	1069	1182	1201	1221	1226
1992	1119	1188	1206	1221	1226
1993	988	1179	1199	1221	1226
1994	1121	1185	1204	1220	1226
1995	1039	1182	1202	1221	1226
1996	1093	1185	1205	1222	1226
1997	1055	1185	1204	1221	1226
1998	1043	1180	1200	1220	1225
1999	1007	1182	1201	1220	1225
2000	1040	1183	1202	1221	1225
2001	1077	1184	1203	1221	1225
2002	1098	1182	1202	1221	1225
2003	1110	1185	1204	1221	1226
2004	1114	1186	1204	1221	1225
2005	1079	1184	1203	1221	1225
all	921	1184	1203	1221	1227

Unit 1 Backpressure [in.Hg]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	1.41	2.08	2.59	3.17	4.30
Feb	1.63	2.19	2.74	3.39	4.28
Mar	1.75	2.47	3.08	3.77	4.79
Apr	2.20	2.85	3.55	4.25	5.44
May	2.65	3.40	4.11	4.80	5.50
Jun	3.03	4.07	4.69	5.31	5.50
Jul	3.40	4.51	5.00	5.49	5.50
Aug	3.52	4.43	4.94	5.49	5.50
Sep	2.87	3.73	4.48	5.16	5.50
Oct	2.25	2.96	3.69	4.45	5.50
Nov	1.93	2.50	3.15	3.89	4.84
Dec	1.54	2.21	2.73	3.36	4.57
1976	1.72	2.35	3.58	4.82	5.50
1977	1.52	2.29	3.78	5.32	5.50
1978	1.73	2.28	3.73	5.16	5.50
1979	1.78	2.34	3.67	4.95	5.50
1980	1.75	2.37	3.67	5.18	5.50
1981	1.71	2.38	3.64	5.03	5.50
1982	1.52	2.45	3.69	4.95	5.50
1983	1.54	2.41	3.61	5.03	5.50
1984	1.70	2.40	3.64	4.92	5.50
1985	1.41	2.33	3.71	4.96	5.50
1986	1.66	2.48	3.82	5.22	5.50
1987	1.87	2.50	3.73	5.17	5.50
1988	1.74	2.36	3.66	5.03	5.50
1989	1.63	2.48	3.70	5.01	5.50
1990	2.02	2.66	3.82	5.10	5.50
1991	1.80	2.53	3.83	5.19	5.50
1992	1.80	2.53	3.64	4.86	5.50
1993	1.80	2.51	3.80	5.34	5.50
1994	1.60	2.55	3.77	5.03	5.50
1995	1.79	2.43	3.75	5.14	5.50
1996	1.63	2.38	3.68	5.02	5.50
1997	1.76	2.52	3.70	5.03	5.50
1998	1.98	2.63	3.90	5.26	5.50
1999	1.88	2.58	3.83	5.18	5.50
2000	1.89	2.46	3.79	5.10	5.50
2001	1.91	2.52	3.77	5.07	5.50
2002	1.99	2.51	3.84	5.17	5.50
2003	1.69	2.46	3.74	5.01	5.50
2004	1.89	2.48	3.77	4.96	5.50
2005	1.94	2.53	3.76	5.08	5.50
all	1.41	2.45	3.73	5.09	5.50

Unit 2 Load [MWe]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	1208	1222	1225	1227	1229
Feb	1204	1221	1224	1227	1229
Mar	1204	1217	1222	1226	1228
Apr	1203	1212	1218	1223	1227
May	1196	1206	1212	1218	1223
Jun	1188	1197	1204	1210	1220
Jul	1181	1191	1197	1203	1212
Aug	1181	1191	1197	1203	1212
Sep	1186	1196	1203	1210	1218
Oct	1193	1206	1213	1220	1225
Nov	1205	1215	1220	1224	1228
Dec	1208	1220	1224	1227	1229
1976	1190	1201	1215	1226	1228
1977	1184	1194	1212	1227	1229
1978	1188	1197	1213	1227	1228
1979	1190	1200	1214	1226	1228
1980	1181	1195	1214	1226	1228
1981	1187	1198	1214	1226	1229
1982	1189	1199	1214	1226	1229
1983	1184	1198	1215	1226	1229
1984	1192	1201	1215	1226	1229
1985	1190	1199	1214	1226	1229
1986	1182	1194	1212	1226	1229
1987	1186	1197	1214	1226	1228
1988	1185	1198	1214	1226	1228
1989	1189	1199	1214	1226	1229
1990	1188	1198	1213	1224	1228
1991	1186	1196	1212	1225	1228
1992	1190	1200	1215	1225	1228
1993	1181	1194	1212	1225	1228
1994	1190	1198	1213	1225	1229
1995	1183	1195	1212	1226	1228
1996	1188	1197	1214	1226	1229
1997	1185	1197	1213	1225	1228
1998	1182	1193	1211	1225	1228
1999	1181	1194	1211	1225	1228
2000	1181	1196	1212	1226	1228
2001	1187	1195	1212	1225	1228
2002	1184	1195	1211	1225	1228
2003	1186	1197	1213	1226	1228
2004	1189	1198	1213	1226	1228
2005	1185	1196	1213	1225	1228
all	1181	1197	1213	1226	1229

Unit 2 Backpressure [in.Hg]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	1.36	1.81	2.16	2.54	3.72
Feb	1.49	1.87	2.25	2.68	4.01
Mar	1.58	2.13	2.56	3.05	3.99
Apr	1.99	2.48	2.96	3.43	4.07
May	2.49	2.97	3.41	3.85	4.49
Jun	2.74	3.58	3.99	4.40	4.97
Jul	3.43	4.03	4.40	4.79	5.34
Aug	3.42	4.08	4.43	4.80	5.31
Sep	2.95	3.56	4.07	4.51	5.03
Oct	2.18	2.80	3.31	3.83	4.66
Nov	1.77	2.29	2.74	3.22	3.90
Dec	1.45	1.96	2.33	2.78	3.74
1976	1.58	2.02	3.07	4.19	4.84
1977	1.39	1.94	3.25	4.59	5.17
1978	1.53	1.93	3.20	4.44	4.97
1979	1.57	2.01	3.13	4.25	4.83
1980	1.58	2.02	3.16	4.53	5.30
1981	1.51	2.03	3.13	4.35	5.00
1982	1.41	2.11	3.15	4.28	4.88
1983	1.45	2.08	3.10	4.37	5.18
1984	1.52	2.04	3.09	4.17	4.69
1985	1.36	2.00	3.19	4.28	4.84
1986	1.50	2.14	3.33	4.58	5.28
1987	1.65	2.13	3.19	4.41	5.05
1988	1.60	2.03	3.16	4.36	5.12
1989	1.49	2.12	3.16	4.29	4.90
1990	1.80	2.29	3.26	4.37	4.93
1991	1.64	2.21	3.28	4.48	5.04
1992	1.66	2.18	3.12	4.21	4.85
1993	1.64	2.16	3.28	4.62	5.34
1994	1.47	2.17	3.24	4.34	4.81
1995	1.63	2.10	3.27	4.55	5.20
1996	1.49	2.05	3.18	4.39	4.97
1997	1.64	2.19	3.22	4.42	5.13
1998	1.79	2.26	3.42	4.66	5.26
1999	1.73	2.25	3.36	4.61	5.32
2000	1.72	2.14	3.32	4.50	5.31
2001	1.67	2.17	3.29	4.51	5.01
2002	1.80	2.19	3.36	4.56	5.18
2003	1.54	2.11	3.26	4.44	5.03
2004	1.74	2.11	3.26	4.35	4.90
2005	1.77	2.18	3.26	4.48	5.08
all	1.36	2.11	3.22	4.43	5.34

Outfall 113 Flow (hourly) [cfs]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	222	222	222	222	222
Feb	222	222	222	222	222
Mar	222	222	222	224	227
Apr	226	232	256	273	277
May	240	278	285	292	292
Jun	257	291	291	292	292
Jul	275	292	291	292	294
Aug	284	292	292	292	292
Sep	291	291	292	292	292
Oct	287	291	291	292	292
Nov	226	231	258	283	288
Dec	222	222	222	222	226
1976	222	222	263	292	292
1977	222	222	263	292	292
1978	222	222	262	292	292
1979	222	222	263	292	292
1980	222	222	263	292	294
1981	222	222	263	292	292
1982	222	222	263	292	292
1983	222	222	263	292	292
1984	222	222	263	292	292
1985	222	222	262	292	292
1986	222	222	255	292	292
1987	222	222	262	292	292
1988	222	222	262	292	292
1989	222	222	263	292	292
1990	222	222	262	292	292
1991	222	222	263	292	292
1992	222	222	262	292	292
1993	222	222	263	292	292
1994	222	222	263	292	292
1995	222	222	262	292	292
1996	222	222	263	292	292
1997	222	222	263	292	292
1998	222	222	263	292	292
1999	222	222	262	292	292
2000	222	222	263	292	292
2001	222	222	262	292	292
2002	222	222	263	292	292
2003	222	222	263	292	292
2004	222	222	262	292	292
2005	222	222	263	292	292
all	222	222	262	292	294

Outfall 113 Discharge Temperature (hourly) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	39.5	55.0	62.6	70.6	82.6
Feb	40.7	56.8	64.7	73.3	82.7
Mar	45.9	61.0	68.2	76.0	86.0
Apr	57.3	66.1	72.6	79.4	90.2
May	63.5	72.5	79.2	85.2	90.8
Jun	68.5	78.8	83.7	88.5	94.1
Jul	71.5	82.2	86.0	90.1	97.2
Aug	73.1	81.4	85.4	89.5	94.8
Sep	65.5	75.1	81.6	87.1	92.5
Oct	57.5	67.2	74.8	82.1	89.6
Nov	52.6	61.6	69.6	77.8	85.7
Dec	44.3	57.6	64.6	72.3	84.3
1976	48.5	60.2	73.2	84.8	91.7
1977	42.7	57.5	74.6	88.2	94.1
1978	49.1	59.3	74.3	87.3	94.1
1979	50.1	60.3	74.3	85.9	92.0
1980	49.4	60.1	74.0	87.2	97.2
1981	39.5	57.7	72.8	86.3	92.6
1982	44.0	61.6	74.4	85.7	91.8
1983	44.3	61.0	73.5	86.3	94.5
1984	48.6	60.2	73.3	85.7	92.1
1985	41.0	59.5	74.1	85.8	92.5
1986	40.7	59.8	74.7	87.5	93.1
1987	52.0	61.4	74.2	87.3	93.4
1988	49.1	58.9	73.0	86.3	93.4
1989	46.7	61.3	74.1	86.3	92.5
1990	54.0	64.3	75.7	86.9	93.0
1991	50.3	62.5	75.8	87.4	92.9
1992	50.3	62.1	73.7	85.1	91.1
1993	50.4	62.5	75.5	88.3	94.9
1994	45.9	62.9	75.4	86.3	91.1
1995	49.7	61.3	74.7	86.9	93.4
1996	46.8	60.5	74.0	86.1	91.8
1997	49.4	62.3	74.5	86.1	92.9
1998	53.5	63.9	76.1	87.8	93.6
1999	51.8	63.0	75.5	87.1	94.3
2000	51.5	61.3	74.7	86.7	93.2
2001	43.9	60.7	74.5	86.3	92.4
2002	53.8	61.7	75.3	87.1	92.2
2003	48.1	61.8	74.9	86.0	91.2
2004	52.0	62.1	75.1	85.7	91.5
2005	52.8	62.1	74.9	86.5	92.2
all	39.5	61.1	74.5	86.6	97.2

Outfall 113 Rise (hourly) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	0.0	0.8	1.8	3.1	5.4
Feb	0.3	0.6	1.8	3.0	5.4
Mar	0.0	0.7	1.9	3.5	5.4
Apr	0.0	1.0	2.3	3.9	5.4
May	0.0	1.0	2.3	3.7	5.3
Jun	0.0	0.8	1.7	3.0	5.2
Jul	0.0	0.6	1.4	2.3	4.3
Aug	0.0	0.3	0.9	1.6	3.4
Sep	0.0	0.0	0.7	1.3	2.9
Oct	0.0	0.0	0.9	2.2	4.8
Nov	0.0	0.3	1.3	2.7	5.4
Dec	0.0	0.7	1.7	3.2	5.4
1976	0.0	0.6	1.6	2.9	5.4
1977	0.0	0.4	1.5	3.1	5.4
1978	0.0	0.6	1.7	3.1	5.4
1979	0.0	0.4	1.3	2.3	5.3
1980	0.0	0.5	1.7	3.1	5.4
1981	0.0	0.6	2.0	3.6	5.4
1982	0.0	0.4	1.5	2.9	5.4
1983	0.0	0.6	1.6	2.8	5.3
1984	0.0	0.5	1.6	3.2	5.4
1985	0.0	0.6	1.9	3.3	5.4
1986	0.0	0.5	1.8	3.4	5.4
1987	0.0	0.6	2.0	3.6	5.4
1988	0.0	0.7	2.0	3.5	5.4
1989	0.0	0.5	1.5	2.9	5.4
1990	0.0	0.5	1.5	2.9	5.3
1991	0.0	0.4	1.5	2.9	5.4
1992	0.0	0.6	1.6	3.0	5.4
1993	0.0	0.5	1.6	2.9	5.3
1994	0.0	0.3	1.2	2.5	5.3
1995	0.0	0.4	1.4	2.8	5.3
1996	0.0	0.4	1.3	2.7	5.3
1997	0.0	0.3	1.3	2.5	5.3
1998	0.0	0.3	1.2	2.4	5.4
1999	0.0	0.3	1.6	3.1	5.3
2000	0.0	0.4	1.7	3.3	5.4
2001	0.0	0.4	1.8	3.5	5.4
2002	0.0	0.3	1.4	3.0	5.4
2003	0.0	0.3	1.1	2.2	5.3
2004	0.0	0.3	1.4	3.1	5.4
2005	0.0	0.4	1.5	2.9	5.4
all	0.0	0.4	1.6	3.0	5.4

Outfall 113 Mixed Temperature (hourly) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	38.1	41.7	45.8	49.7	53.7
Feb	37.8	41.2	45.6	49.6	55.3
Mar	40.2	46.4	50.9	55.6	62.0
Apr	48.9	54.0	58.6	62.8	68.4
May	56.7	62.3	66.2	70.0	74.6
Jun	62.7	69.1	73.0	76.6	79.8
Jul	70.2	74.6	77.8	80.8	84.5
Aug	73.6	76.6	78.9	81.4	84.7
Sep	69.6	73.8	76.8	79.3	83.0
Oct	58.3	64.4	69.3	74.0	80.4
Nov	47.9	54.8	59.8	64.8	70.9
Dec	39.1	46.8	51.0	56.1	63.3
1976	41.0	45.1	61.2	76.4	80.0
1977	37.8	41.6	62.4	79.3	82.3
1978	38.4	41.4	62.2	77.7	81.5
1979	39.8	44.0	61.3	76.4	79.0
1980	39.3	44.8	61.9	79.1	82.4
1981	38.1	42.2	61.4	77.6	80.7
1982	40.9	43.9	61.6	76.9	79.5
1983	41.2	44.8	61.4	78.2	80.6
1984	40.1	43.1	60.5	75.7	78.6
1985	38.8	45.2	62.7	77.3	79.5
1986	39.5	45.0	64.0	79.8	83.4
1987	42.0	44.7	62.0	77.6	80.3
1988	42.9	45.3	62.3	78.2	80.9
1989	39.1	46.1	61.2	77.1	79.3
1990	39.9	47.3	62.8	77.5	79.9
1991	43.9	47.7	63.6	78.4	81.1
1992	44.4	47.2	61.7	76.1	80.0
1993	43.6	46.7	63.3	79.3	83.4
1994	40.7	45.1	62.9	77.4	79.3
1995	41.6	47.1	63.7	80.3	82.5
1996	40.8	44.3	62.4	79.0	81.3
1997	44.7	48.1	63.8	79.2	82.1
1998	45.9	48.1	65.7	81.7	84.5
1999	45.7	49.4	65.5	80.6	83.7
2000	44.1	48.2	65.2	79.6	83.0
2001	40.4	45.0	64.2	79.9	82.4
2002	45.5	49.1	65.3	79.9	84.7
2003	42.0	46.3	63.9	79.9	82.6
2004	43.1	46.5	63.6	78.1	82.0
2005	45.3	48.1	63.9	79.9	81.9
all	37.8	46.1	62.9	78.5	84.7

Outfall 113 Rate of Change (hourly) [°F/hr]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	-3.6	-0.2	0.0	0.2	2.7
Feb	-3.5	-0.2	0.0	0.2	2.4
Mar	-3.5	-0.2	0.0	0.2	2.5
Apr	-3.5	-0.3	0.0	0.4	2.6
May	-3.0	-0.2	0.0	0.3	1.8
Jun	-2.8	-0.3	0.0	0.4	1.7
Jul	-2.2	-0.3	0.0	0.3	1.7
Aug	-2.0	-0.3	0.0	0.3	1.5
Sep	-1.7	-0.2	0.0	0.2	1.3
Oct	-2.7	-0.3	0.0	0.2	2.0
Nov	-3.4	-0.2	0.0	0.2	2.1
Dec	-3.5	-0.2	0.0	0.2	2.1
1976	-3.1	-0.3	0.0	0.3	2.3
1977	-3.5	-0.2	0.0	0.3	2.3
1978	-3.4	-0.2	0.0	0.3	2.6
1979	-3.1	-0.2	0.0	0.2	2.0
1980	-3.3	-0.3	0.0	0.3	2.0
1981	-3.3	-0.3	0.0	0.3	2.3
1982	-3.1	-0.2	0.0	0.2	2.0
1983	-3.4	-0.3	0.0	0.3	2.1
1984	-3.5	-0.2	0.0	0.3	2.7
1985	-3.5	-0.3	0.0	0.3	2.1
1986	-3.3	-0.3	0.0	0.3	2.1
1987	-2.9	-0.3	0.0	0.4	2.3
1988	-3.2	-0.3	0.0	0.3	1.8
1989	-3.4	-0.2	0.0	0.2	2.3
1990	-3.4	-0.2	0.0	0.3	2.0
1991	-3.2	-0.2	0.0	0.3	2.1
1992	-3.4	-0.3	0.0	0.3	1.8
1993	-3.4	-0.3	0.0	0.3	1.9
1994	-3.1	-0.2	0.0	0.2	2.0
1995	-3.4	-0.2	0.0	0.3	2.1
1996	-3.3	-0.2	0.0	0.2	1.9
1997	-3.4	-0.2	0.0	0.2	1.8
1998	-3.6	-0.2	0.0	0.2	2.0
1999	-3.3	-0.2	0.0	0.3	2.4
2000	-3.4	-0.3	0.0	0.3	2.0
2001	-3.5	-0.3	0.0	0.3	2.0
2002	-3.4	-0.2	0.0	0.3	2.1
2003	-3.5	-0.2	0.0	0.2	2.0
2004	-3.5	-0.2	0.0	0.2	2.0
2005	-3.3	-0.3	0.0	0.3	2.5
all	-3.6	-0.2	0.0	0.3	2.7

Holding Pond Elevation (hourly) [ft]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	698.0	698.0	699.2	703.8	705.4
Feb	698.0	698.0	698.8	702.9	705.4
Mar	698.0	698.0	699.7	703.9	705.4
Apr	698.0	698.0	702.1	704.8	706.8
May	698.0	698.0	703.2	705.8	706.7
Jun	698.0	698.0	702.1	705.7	706.5
Jul	698.0	698.0	703.1	705.9	706.8
Aug	698.0	698.0	700.3	704.0	706.6
Sep	698.0	698.0	700.9	705.1	706.5
Oct	698.0	698.0	701.5	704.9	705.7
Nov	698.0	698.0	700.6	704.6	705.6
Dec	698.0	698.0	700.1	704.2	705.4
1976	698.0	698.0	700.2	704.3	706.6
1977	698.0	698.0	700.4	704.7	706.6
1978	698.0	698.0	701.2	705.0	706.6
1979	698.0	698.0	698.9	702.2	706.3
1980	698.0	698.0	701.3	705.1	706.8
1981	698.0	698.0	702.1	705.0	706.7
1982	698.0	698.0	700.4	705.0	706.6
1983	698.0	698.0	700.5	704.7	706.5
1984	698.0	698.0	699.4	702.4	706.0
1985	698.0	698.0	702.8	705.5	706.7
1986	698.0	698.0	702.7	705.3	706.6
1987	698.0	698.0	702.4	705.3	706.6
1988	698.0	698.8	703.3	705.4	706.6
1989	698.0	698.0	699.5	704.0	706.8
1990	698.0	698.0	700.5	704.8	706.7
1991	698.0	698.0	700.3	704.7	706.6
1992	698.0	698.0	700.5	704.7	706.6
1993	698.0	698.0	701.7	705.5	706.7
1994	698.0	698.0	699.3	703.2	706.4
1995	698.0	698.0	700.8	705.2	706.6
1996	698.0	698.0	699.8	704.4	706.5
1997	698.0	698.0	700.8	704.7	706.5
1998	698.0	698.0	701.3	705.0	706.5
1999	698.0	698.0	702.4	705.3	706.7
2000	698.0	698.8	703.2	705.3	706.6
2001	698.0	698.0	702.8	705.3	706.7
2002	698.0	698.0	701.7	705.2	706.5
2003	698.0	698.0	698.8	701.4	705.5
2004	698.0	698.0	699.9	704.6	706.7
2005	698.0	698.0	700.3	704.4	706.5
all	698.0	698.0	701.0	705.0	706.8

Outfall 101 Flow (hourly) [cfs]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	0	0	80	140	165
Feb	0	78	80	100	165
Mar	0	0	79	151	166
Apr	0	0	79	160	171
May	0	0	80	164	170
Jun	0	0	80	163	171
Jul	0	0	81	165	175
Aug	0	0	81	148	172
Sep	0	0	80	157	170
Oct	0	0	80	160	166
Nov	0	0	80	158	166
Dec	0	0	79	156	166
1976	0	0	80	153	170
1977	0	0	80	156	172
1978	0	0	80	159	171
1979	0	78	80	125	169
1980	0	0	80	159	175
1981	0	0	80	160	172
1982	0	0	80	158	170
1983	0	0	80	157	171
1984	0	0	80	140	167
1985	0	0	80	162	171
1986	0	0	80	161	173
1987	0	0	80	161	171
1988	0	0	80	162	172
1989	0	0	80	145	171
1990	0	0	80	156	171
1991	0	0	80	156	172
1992	0	0	80	156	170
1993	0	0	80	162	174
1994	0	0	80	137	169
1995	0	0	80	159	172
1996	0	0	80	151	171
1997	0	0	80	157	170
1998	0	0	80	160	170
1999	0	0	80	161	172
2000	0	0	80	162	171
2001	0	0	80	162	171
2002	0	0	80	160	170
2003	0	78	80	127	165
2004	0	0	80	155	170
2005	0	0	80	154	169
all	0	0	80	159	175

Outfall 101 Daily Average Discharge Temperature (at Midnight) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	48.9	56.8	64.0	70.7	79.3
Feb	49.1	58.9	65.9	72.9	78.3
Mar	53.1	63.1	69.6	76.3	82.1
Apr	62.5	68.5	74.2	79.3	84.5
May	70.6	73.7	78.9	83.4	85.8
Jun	75.3	79.4	83.6	86.8	88.9
Jul	80.1	82.7	85.5	87.6	89.0
Aug	77.3	82.8	85.5	87.8	89.8
Sep	71.6	76.8	81.7	85.9	88.2
Oct	63.6	69.1	75.2	81.1	83.8
Nov	56.1	62.7	69.4	76.8	83.2
Dec	49.3	59.1	65.1	72.2	81.1
1976	52.4	59.6	70.1	81.7	85.4
1977	49.5	58.5	72.7	87.1	89.0
1978	51.8	57.6	69.7	86.0	88.9
1979	54.1	59.4	73.0	86.0	88.9
1980	53.1	58.7	70.5	86.6	89.0
1981	53.4	63.7	75.9	86.0	88.0
1982	48.9	61.3	71.6	84.4	88.0
1983	51.7	60.6	71.3	85.2	89.0
1984	52.7	61.3	73.6	84.8	87.5
1985	55.9	58.3	67.0	75.4	81.6
1986	56.2	60.8	72.9	84.5	86.8
1987	55.6	61.9	72.3	86.7	89.2
1988	53.0	56.7	72.3	87.6	88.2
1989	49.3	61.6	74.4	86.5	88.4
1990	56.6	64.5	72.9	85.1	87.7
1991	54.4	61.8	72.9	86.3	89.0
1992	54.0	62.7	71.8	84.2	86.9
1993	56.1	61.4	68.7	77.5	89.3
1994	51.0	62.9	74.0	85.4	87.1
1995	53.6	60.9	71.4	85.9	89.8
1996	49.1	60.5	71.7	84.0	87.5
1997	52.9	62.9	73.9	86.1	88.9
1998	57.4	63.1	73.2	85.4	88.9
1999	54.5	62.5	70.2	84.8	88.0
2000	64.4	67.7	78.3	86.6	89.0
2001	59.7	63.6	74.6	86.4	88.0
2002	59.0	62.2	69.7	80.3	86.0
2003	55.4	62.3	74.7	85.8	88.2
2004	55.5	61.6	73.8	85.0	87.2
2005	55.2	62.9	75.2	86.6	88.1
all	48.9	61.2	72.6	85.5	89.8

Outfall 101 Rise (hourly) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	0.0	0.0	0.2	0.4	1.4
Feb	0.0	0.0	0.2	0.4	1.6
Mar	0.0	0.0	0.2	0.5	1.5
Apr	0.0	0.0	0.3	0.7	1.6
May	0.0	0.0	0.3	0.6	1.0
Jun	0.0	0.0	0.2	0.4	0.9
Jul	-0.2	0.0	0.2	0.3	0.6
Aug	-0.2	0.0	0.1	0.3	0.6
Sep	-0.4	0.0	0.1	0.2	0.6
Oct	-0.4	0.0	0.1	0.3	0.9
Nov	-0.2	0.0	0.1	0.3	1.1
Dec	-0.2	0.0	0.2	0.4	1.5
1976	-0.1	0.0	0.2	0.4	1.1
1977	-0.2	0.0	0.2	0.4	1.1
1978	-0.2	0.0	0.2	0.4	1.2
1979	-0.2	0.0	0.1	0.3	1.0
1980	-0.2	0.0	0.2	0.4	1.4
1981	-0.2	0.0	0.3	0.7	1.6
1982	-0.2	0.0	0.1	0.4	1.4
1983	-0.1	0.0	0.2	0.3	1.4
1984	-0.2	0.0	0.2	0.4	1.5
1985	-0.2	0.0	0.3	0.6	1.2
1986	-0.4	0.0	0.3	0.6	1.4
1987	-0.2	0.0	0.3	0.6	1.3
1988	-0.3	0.0	0.3	0.7	1.4
1989	-0.2	0.0	0.1	0.4	1.5
1990	-0.3	0.0	0.2	0.4	1.3
1991	-0.4	0.0	0.1	0.3	1.2
1992	-0.1	0.0	0.2	0.4	1.3
1993	-0.2	0.0	0.2	0.4	1.2
1994	-0.1	0.0	0.1	0.3	1.0
1995	-0.1	0.0	0.2	0.4	1.1
1996	-0.2	0.0	0.1	0.3	1.2
1997	-0.1	0.0	0.1	0.3	1.0
1998	-0.3	0.0	0.1	0.3	1.2
1999	-0.2	0.0	0.2	0.4	1.6
2000	-0.3	0.0	0.2	0.5	1.4
2001	-0.4	0.0	0.3	0.6	1.4
2002	-0.2	0.0	0.2	0.5	1.3
2003	-0.3	0.0	0.1	0.2	1.0
2004	-0.1	0.0	0.1	0.4	1.2
2005	-0.2	0.0	0.2	0.4	1.1
all	-0.4	0.0	0.2	0.4	1.6

Outfall 101 Mixed Temperature (hourly) [°F]					
	minimum	10th percentile	mean	90th percentile	maximum
Jan	38.3	41.8	45.9	49.7	53.9
Feb	38.0	41.4	45.7	49.6	56.0
Mar	40.3	46.2	50.6	55.3	61.2
Apr	48.9	53.6	58.3	62.5	67.3
May	57.4	62.2	66.2	70.1	73.9
Jun	62.7	68.7	72.8	76.6	79.6
Jul	70.2	74.2	77.6	80.8	84.6
Aug	73.9	76.6	78.8	81.3	84.7
Sep	69.9	73.7	76.8	79.3	83.1
Oct	58.4	64.1	68.9	73.5	79.3
Nov	47.9	54.3	59.4	64.5	69.8
Dec	38.4	46.7	50.8	55.6	61.8
1976	41.1	44.6	59.4	75.8	80.1
1977	38.0	41.7	61.2	79.0	82.0
1978	38.5	40.7	60.0	77.5	80.8
1979	39.9	44.0	60.5	76.2	78.9
1980	39.4	44.1	59.6	79.2	82.1
1981	38.4	42.2	61.4	77.8	80.2
1982	41.0	43.4	60.0	76.7	79.3
1983	41.3	44.6	59.4	78.2	80.2
1984	40.2	42.9	60.0	75.7	78.0
1985	38.9	41.3	60.5	77.1	78.6
1986	39.5	44.4	62.3	79.8	83.5
1987	42.0	44.3	60.2	77.7	79.8
1988	43.0	44.8	61.5	78.7	80.5
1989	38.4	46.1	61.0	77.2	78.9
1990	39.1	46.7	61.1	77.5	79.1
1991	44.0	47.3	61.8	78.4	80.6
1992	44.5	47.0	60.5	75.9	79.1
1993	43.7	46.4	59.7	78.9	83.5
1994	40.8	44.9	61.7	77.4	78.9
1995	41.7	46.6	61.8	80.2	82.6
1996	40.9	44.0	61.0	78.9	80.6
1997	44.8	47.6	62.4	78.9	82.1
1998	46.1	47.7	63.4	81.4	84.6
1999	45.9	48.9	63.7	80.5	83.4
2000	44.5	47.9	65.0	79.8	83.2
2001	40.7	44.0	63.6	80.2	82.6
2002	45.5	49.0	63.1	79.7	84.7
2003	42.2	46.3	63.6	79.9	82.6
2004	43.2	46.2	62.9	78.1	82.0
2005	45.4	47.9	63.5	80.0	81.9
all	38.0	45.5	61.5	78.3	84.7