NDOT Research Report

Report No: RDT01-007

A STUDY OF OPEN GRADED BASE COURSE PERFORMANCE

July 2001

Prepared by Research Division
Nevada Department of Transportation
1263 South Stewart Street
Carson City, Nevada 89712

NEVADA DOT

TECHNICAL REPORT DOCUMENTATION PAGE

Report No. RDT ~~00-001~~ 01-007	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle **A Study of Open Graded Base Course Performance**	5. Report Date **December 2000**	
	6. Performing Organization Code	
7. Author(s) **Robert Eaton** **Gary Trachier** **Lynette Barna**	8. Performing Organization Report No. **RDT01-007**	
9. Performing Organization Name and Address **US Army Corp of Engineers** **Engineer Research and Development Center** **Cold Regions Research and Engineering Laboratory** **72 Lyme Road** **Hanover, NH 03755**	10. Work Unit No.	
	11. Contract or Grant No. P418-95	
12. Sponsoring Agency Name and Address **Nevada Department of Transportation** **1263 South Stewart** **Carson City, Nevada 89712**	13. Type or Report and Period Covered **June 1999 through September 2000**	
	14. Sponsoring Agency Code	

15. Supplementary Notes

16. Abstract

The Nevada DOT extended I-395 in Reno, Nevada six miles to the south toward Carson City, in 1995. The new roadway incorporated and open graded asphalt concrete layer beneath a 25 cm Portland cement concrete pavement. The existing pavement consisted of 24 cm PCC over a 15 cm cement stabilized base course. As the U.S. Army Corps of Engineers had recently adopted the use of drainage layers on essentially all new pavements, this project provided an opportunity to gain "real world" performance data on the new design.

This report represents the result of a 5-year cooperative study between the U.S. Army Corp Regions Research and Engineering Laboratory (CRREL) and the Nevada DOT. It compares the existing pavement performance with no open graded drainage layer to the performance of the new cross-section. The open graded drainage layer was thought to perform as an insulated layer which would affect the thermal characteristics of the pavement cross section, i.e. possible differential icing conditions of 0°C and possibly affect the rate of pavement deterioration by accelerating the need for maintenance.

It was desired to monitor the performance of this new pavement cross section to validate their use in frost-prone areas.

17. Key Words	18. Distribution Statement		
open-graded asphalt, PCC pavement, icing conditions, base course	**Unrestricted. This document is available through the National Technical Information Service, Springfield, VA 21161**		
19. Security Classif. (of this report) **Unclassified**	20. Security Classif. (of this page) **Unclassified**	21. No. Of Pages **104**	22. Price

Abstract

The Nevada DOT extended I-395 in Reno, Nevada six miles to the south toward Carson City, in 1995. The new roadway incorporated an open graded asphalt concrete layer beneath a 25 cm Portland cement concrete pavement. The existing pavement consisted of 24 cm PCC over a 15 cm cement stabilized base course. As the U.S. Army Corps of Engineers had recently adopted the use of drainage layers on essentially all new pavements, this project provided an opportunity to gain "real world" performance data on the new design.

This report presents the results of a 5-year cooperative study between the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) and the Nevada DOT. It compares the existing pavement performance with no open graded drainage layer to the performance of the new cross-section. The open graded drainage layer was thought to perform as an insulated layer which would affect the thermal characteristics of the pavement cross section, ie. possible differential icing conditions at 0°C and possibly affect the rate of pavement deterioration by accelerating the need for maintenance.

It was desired to monitor the performance of this new pavement cross section to validate their use in frost-prone areas.

Preface

This report was prepared by Robert Eaton, Research Civil Engineer, Gary Trachier, Electronic Technician, and Lynette Barna, Research Civil Engineer; all of the U.S. Army Cold Regions Research and Engineering Laboratory. Funding for this study was provided by the State of Nevada Department of Transportation.

The authors thank Mr. Greg Dodson and Mr. Hector Quiroga, electronic technicians, and Mr. Richard Nelson, District Engineer, at the Nevada DOT District 2 office for their extensive and invaluable support in the planning and installation of the sensor and datalogger systems.

Conversion factors

Metric (SI) to U.S. Customary units of measurement.
For conversion of SI units to U.S./British customary units of measurement consult ASTM Standard E380-89a, Standard Practice for Use of the International System of Units, published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

Background

In the early 1990's, the US Army Corps of Engineers adopted the use of open graded drainage layers in all new pavements with little field validation work.

In 1995, the State of Nevada Department of Transportation began the extension of Route 395 from South Virginia Street in Reno, southward six miles toward Carson City (Figures 1 and 2). The US Army Cold Regions Research and Engineering Laboratory (CRREL), Hanover, NH was just completing a National Anti-Icing project with the Nevada DOT and asked if they would participate in evaluating the performance of the new open graded drainage layer design in the proposed Portland cement concrete construction with the existing cement treated base course design.

A Cooperative research and development agreement was signed in 1995 and the test sites were instrumented and data collection begun in May 1996 (Figure 3).

Introduction

The Federal Highway Administration had revised their design procedures and required the use of drainage layers beneath newly constructed pavements. This meant the extension of route 395 southward from Reno towards Carson City would incorporate the new drainage layer and slightly change the pavement cross section.

There was a concern that the new design would not perform as well as the existing pavement (Figures 4 and 5) and, in fact, it was reported by neighboring States that the new design was experiencing early degradation and distresses. The CRREL investigator suggested that the open graded drainage layer (with the air voids) would perform as if it were the same as board insulation between the base course and overlying pavement. The pavement would be much more responsive to the ambient air extremes as the subsurface heat and water would be cut off by the trapped air in the voids. The resulting drier pavement would lose the waters ability to absorb and emit heat.

Site description

The test site is located on highway 395 about 6 miles south of Reno, Nevada (Figure 2). There are two test sites just south-east of where 395 crosses over Virginia Avenue (Figure 3). The surrounding terrain is generally flat. The surface of the road is about 20 feet above the surrounding grade. The site receives direct sun for the entire day as there are no trees, buildings, or other obstacles to shade the site. The road is the major north-south route in the region and carries very heavy volumes and loads of both car and truck traffic.

Test site configuration

General layout

There are two data collection sites set up on the southbound lanes of the road (Figures 6 and 8). The sensors are located near the middle of the right hand (travel) lane. In both locations, an approximate 2 ft x 2 ft section of the PCC pavement was sawn and jack hammered out (Figures 7 and 9). The cement and asphalt treated base courses and Type 1 base courses were separated and the fill/subgrade soil removed to a depth of 5 feet. The temperature and moisture sensors were installed at various depths as shown in Figure 10 and the soils replaced in the order they had been removed from the excavation. A 4 inch wide x 6 inch deep trench was cut through the shoulder pavement to the edge of the roadway. The sensor cables were then placed in the trench to the data collection system beside the highway. Quick setting PCC was used to repair the pavement.

Installation

The installation of the sensors and data recording and telemetry system took place on 7-8 May 1996.
The southbound right hand lane was closed by State DOT personnel. A contractor cut the concrete window at the first site and the trench to the side of the road. Soil was removed from the SW corner of the window and the soil moisture sensors were installed in the undisturbed soil on the side of the pit. A 1 inch diameter hole was drilled in the NE corner of the window and a wooden dowel with the temperature sensors attached was inserted. This hole was backfilled with the original soil. A small hole was drilled horizontally into the PCC and a temperature sensor was installed. This was done near the surface and at the midpoint of the slab. Figure 10 shows the actual locations. The sensors were connected to the data logger and checked to make sure they were giving reasonable values.

Work continued at the second site. The process was nearly identical. The State personnel assisted throughout the installation. After all sensors had been installed, connected to the data loggers and tested, the DOT personnel refilled the windows and trenches in the pavement with quick setting concrete.

Site 1 in the old cement treated base design is just south of the Virginia Street bridge at station 670+50 and site 2 is 275 ft (92 m) south at station 666+75 within the ASB section. This location offered an ideal side by side comparison of the two different cross sections.

Figure 4 shows the 9 ½ inch PCC pavement over 6 inches of cement treated base and 4 inches of Type 1 base. Figure 5 shows the new design with 10 inches of PCC pavement over 3 inches of asphalt treated permeable base on 6 inches of Type 1 base.

Monitoring program

Temperature Sensors

The pavement and soil temperatures are being monitored with a data logger and thermistors at various depths. The temperatures are scanned once a minute for 15 minutes and an average for that preceeding 15-minute period is stored. The temperature sensors used were supplied by Campbell Scientific, Inc. They consist of a calibrated thermistor whose resistance is measured by the data logger.

Soil Moisture Sensors

Hydra soil moisture gauges manufactured by Vitel, Inc. were used for the soil moisture measurements. These gauges consist of several stainless steel conductors that contact the soil. The conductors are excited with a radio frequency (RF) voltage. The sensor outputs 4 voltages that characterize the soil's response to the RF excitation. Soil moisture sensors are measured once per minute for 60 minutes and the average for that preceeding 60 minute period is stored.

Air Temperature

The air temperature sensor is a thermistor mounted on a vertical pole at a height of six feet above the roadway. It is housed in a 8 plate gill radiation shield. The radiation shield allows free air movement past the temperature sensor while shielding it from direct sunlight. This gives a true measurement of the air temperature. The air temperature is measured once per minute for 15 minutes and the average for that preceeding 15 minute period is stored.

Data Recording and Telemetry System

The data recording system consists of a model CR10 datalogger manufactured by Campbell Scientific, Inc. The datalogger is powered by a 12 volt deep cycle marine battery that is kept charged by a 10-watt solar panel and a charging regulator. Parameters recorded at each site include 12 soil temperatures (minimum, maximum, average), 12 soil moisture sensor voltages (minimum, maximum, average), air temperatures at 6 feet (minimum, maximum, average), battery voltage (minimum, maximum, average), and the datalogger's internal and external temperature (minimum, maximum, average). The date, time, and station identifier is stored with each data record. Data was transmitted daily from the 2 sites to CRREL. Each site had a 2-way radio and RF modem connected to the datalogger. A directional antenna was mounted on the pole and pointed toward the Nevada DOT building which is about 5.5 miles to the north. At the DOT building, there was a directional antenna mounted on a communication tower at a height of about 30 feet. Inside the building, there was a dedicated telephone line. This package was powered by a gelled-electrolyte battery that was trickle charged by a 110vac charger.

Data Processing System

The data retrieval, entry into the data base, and generation of preliminary plots was fully automated and occurred daily. The data was retrieved daily from the 2 sites via the 2-way radio and telephone line network. The data was retrieved automatically by a windows based computer using Telcom software provided by Campbell Scientific. The data was then transferred to a Unix based Sun SPARC computer system where it was formatted and entered into a database. From the data base, plots of the last seven days data were generated. All of the formatting, entry into the database, generation of plots, etc. were handled by Perl scripts written at CRREL. The scripts run under the Unix cron daemon.

Data collection

Freezing Index

The design air freezing index for Reno, Nevada is 26°C days based on the 30 year average 1965-1995 as shown in Figure 11. The 1998-1999 winter shown in the same figure was the difference between +16°C and -43°C for an air freezing index of 59°C days.

Air Temperatures

Table 1 gives the Reno Airport average monthly air temperatures for 1965-1995, and each year of test site measurements from May 1996 – April 2000 in °C. The airport average monthly precipitation is also given for the airport in mm.

Table 2 gives the air temperatures at site 1 for each of the test years. For both sites, the average daily 2-meter air temperature was determined and compared to see if there was a significant difference in the temperature readings. The time period of May 1996 through April 1997 was reviewed and the results given in Figure 12. This time period was selected to investigate the effects of temperature fluctuations during the winter and spring thaw periods. Installation of the sites took place during May 1996 and data collection began on May 15.

Comparing the data shows little difference in the 2-meter air temperature between Sites 1 and 2. On average, the temperature difference was less than 0.1°C. The maximum temperature difference between the two site locations was 0.6°C. These results tell us that the data collection systems have normal operations. Based on this, it was decided to use the air temperature readings from Site 1 in further comparisons.

Pavement Temperatures

Figures 12-15 show the subsurface temperature profiles beneath Site 1 (CTB) and Site 2 (ASB) for the 1996 – 1997, 1997 – 1998, 1998 – 1999, and 1999 – 2000 years. The plots are the daily average temperature of the 96 measurements the 15 minute averages of the 15 one minute readings at each depth on the first day

of that month. In other words, temperature readings were taken every minute for 15 minutes and then an average of those 15 readings was taken and stored. Ninety-six readings (four times twenty-four hours) were averaged at 2400 hours (midnight) each day. These figures show the temperature profiles every other month.

Tables 3 and 4 give the monthly average temperatures at 1.3 cm below the PCC surface at both sites and bottom of the slabs at 24.1 cm at Site 1, the CTB base section, and 25.4 cm at Site 2, the ASB section. The 96 daily 15 minute averages were averaged for the number of days that month and the results are given in these tables.

It was determined very early that the PCC slab over the asphalt stabilized based (ASB) drainage layer (Site 2) always responded faster to the air temperature changes than site one where the PCC slab is over the dense graded cement treated base (CTB). Figure 16 shows the difference between the surface temperature of the ASB slab minus the PCC surface temperature over the CTB from 16 May 1996 – July 1997. As seen in the figure, the difference in surface temperatures is lower during the colder months (November – January) and up to 6°C difference in the warmer months. For the 1996 – 1997 year the average surface temperature of the PCC slab over the asphalt stabilized base is 1°C warmer than the PCC surface over the cement stabilized base. Possible reasons are that the ASB is drier than the CTB base due to positive drainage. The air in the open graded base courses (ASB) also acts like an insulator i.e. Styrofoam board insulation, which "cuts off" or "insulates" the PCC slab over the ASB from the underlying water and heat.

Differences in PCC slabs

Long term average values of temperature tend to blur actual daily changes June 24 and December 24, 1996 were selected for closer examination.

Figure 17 shows the daily surfaces for the two sites. The ASB PCC surface is cooler than the PCC CTB slab surface until 0815 and warms to a peak of 43.96°C at 1200 noon. It then cools and at 1430 drops below the CTB surface for the rest of the day.

In Figure 18, the bottom of the PCC ASB slab remains cooler than the bottom of the PCC CTB slab all day.

Figure 19 shows the PCC CTB slab temperatures for the day and Figure 20 shows the PCC ASB slab temperatures.

Tables 5 and 6 give the 15 minute average temperatures for June 24, 1996 for the PCC slabs over the CTB and ASB base courses.

The absolute cumulative temperature difference between the CTB PCC slab surface and bottom shown on Table 5 is 654.32°C. Using a coefficient of expansion and contraction for PCC of .00001mm/mm/°C yields a 24 hr. movement of .0065432 mm/mm at Site 1. The Table 6 total slab movement over the ASB was .0074606 mm/mm on June 24, 1996.

Figure 21 shows these values on 24 June.

Doing the same calculations for all 30 days in June 1996 gave a total movement of 0.260 mm/mm for the CTB PCC slab. The comparable movement of the ASB PCC slab was 0.305 mm/mm for the 30 days in June.

This means that the ASB PCC slab expanded and contracted 45 mm/m more than the CTB PCC slab. For each 4 m slab, there was 180 mm more movement in June 1996 in the PCC slabs over the ASB as compared to the CTB slabs.

Going through the same exercise for December 24, 1996, Figures 22 through 26 and Tables 7 and 8 yields a total monthly movement of 0.114 mm/mm for the CTB PCC slab and 0.132 mm/mm movement for the ASB PCC slab.

This means the ASB PCC slabs expanded and contracted 18 mm/m more than the CTB PCC slab. For each 4 m slab, there was 72 mm more movement in December 1996 in the PCC slabs over the ASB as compared to the CTB slabs.

Moisture measurements

The 30 year average monthly precipitation in mm for the Reno airport is given on Table 1 along with monthly measurements for February 1997 through April 2000.

In Appendix B, pages B-1 and B-2, the daily precipitation for the Reno airport is shown 16 May 1996 through December 1997.

The moisture measurements for the test sites are given on pages B-3 through B-40.

The moisture measurements at the bottom of the CTB layer at 36.8 cm is shown vs. the moisture measurements at the bottom of the ASB layer at 31.8 cm on pages B-3 through B-14.

The measurements show that the open graded layer (ASB) is always at a lower moisture content until a precipitation event. When precipitation occurs, the

ASB spikes very rapidly (more than the CTB) and dries out much more quickly. This confirms the design intent of the open graded layer to pass and remove water from beneath the PCC slab quicker than the dense graded cement treated based. These measurements also confirm that the ASB layer is drier than the CTB layer directly beneath the PCC slabs.

Moisture measurements taken at the bottom of the Type 1 Class A layers beneath both sites are shown in Figure B-3, pages B-15 to B-27.

These results show that the Type 1 layer at 44.4 cm at Site 2 beneath the ASB is averaging .03 by volume wetter than the sensor at 45.7 cm beneath the CTB layer. These sensors both react rapidly to precipitation events with the ASB sensor increasing slightly more in magnitude. The ASB sensor reacts to brief or short events, whereas the CTB sensor needs a 2-3 day event to react.

The deeper sensors, 72.4 cm in the ASB section and 74.9 cm sensor in the CTB section results are shown in Figure B-4, pages B-28 through B-40. The ASB sensor generally is at the same moisture content as the one under the CTB. However, the ASB sensor responds very quickly and almost doubles the moisture by volume during the precipitation event. The CTB sensor remains relatively stable with smaller responses to brief events.

In general, the ASB layer transmits moisture very quickly and is drier than the CTB section. The type 1 class A layer beneath the ASB is slightly wetter than the same layer beneath the CTB. The deeper sensors beneath both sections are relatively the same until a brief precipitation event when the ASB deep sensor reacts. The CTB sensor needs a significant event to react. The CTB layer above could be shielding the deeper sensor from the shorter events.

Summary

The PCC slabs over the open graded asphalt stabilized base (ASB) course expand and contract more than the PCC slabs over the cement treated based (CTB).

Based upon temperature measurements selected from June and December 1996, a 4 meter slab over the ASB expanded and contracted 180 mm in June and 72 mm in December 1996 more than the 4 meter PCC slabs over the cement treated base.

Moisture sensors also indicated the ASB drained precipitation much faster from beneath the PCC slabs vs. the cement treated base course.

These results show that the PCC slabs over the asphalt stabilized base course are in fact expanding and contracting more than the PCC slabs over the CTB. This could result in premature failure or increased maintenance costs.

Recommendations

It is suggested that the Nevada DOT take cores adjacent to the test sites and determine actual expansion and contraction coefficients using the new Federal Highway Administration test method to validate these findings.

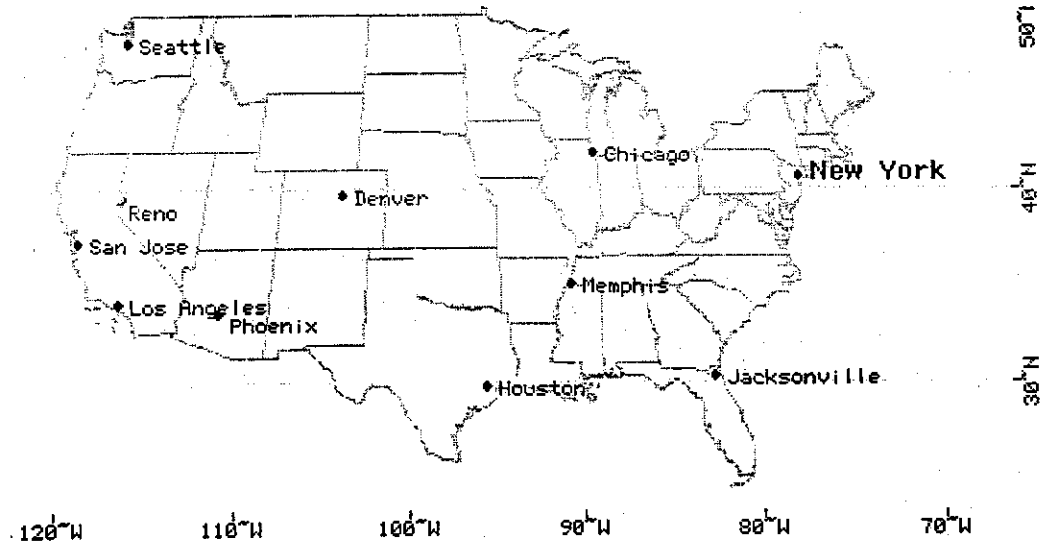


FIGURE 1: Reno, Nevada Location

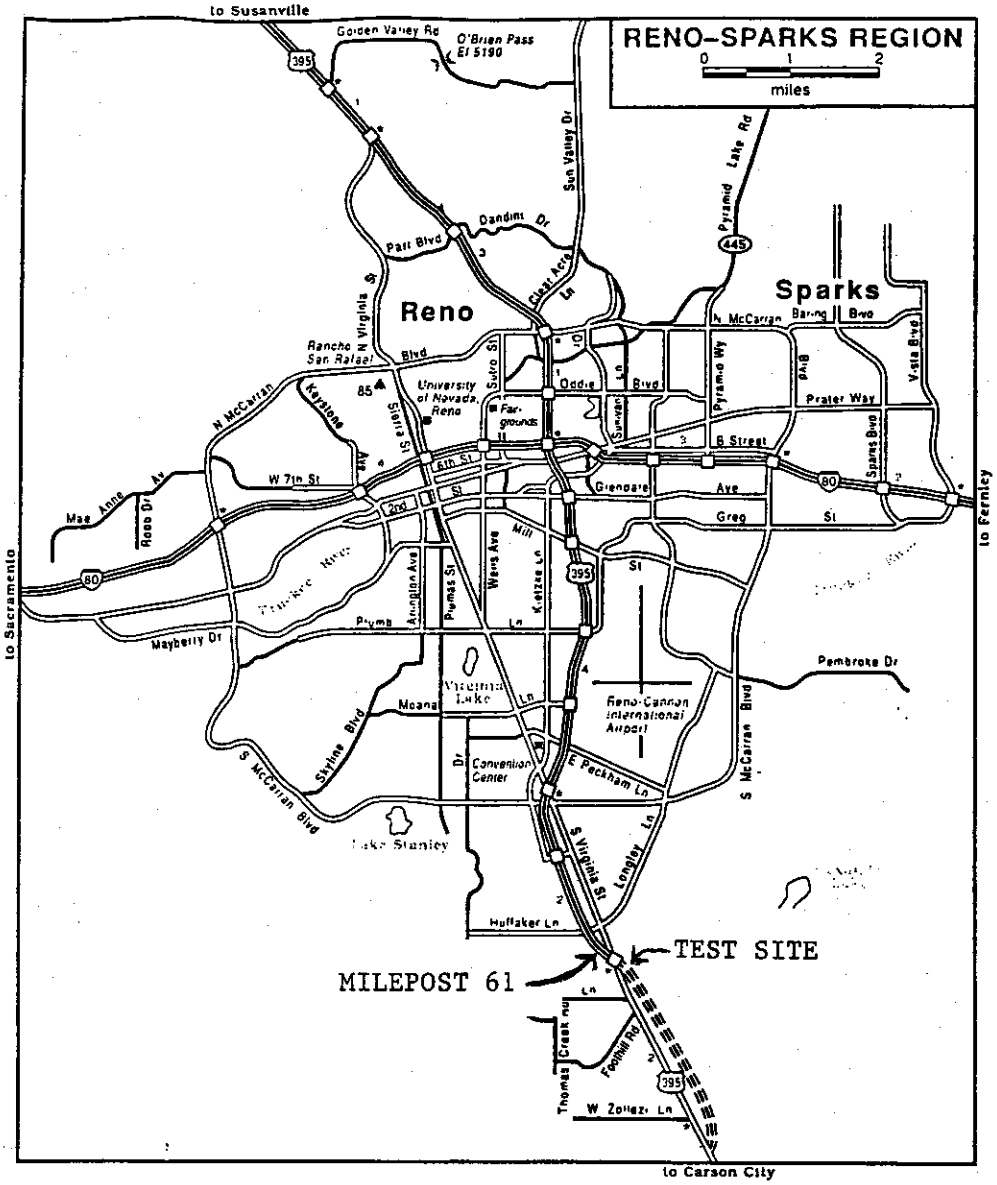
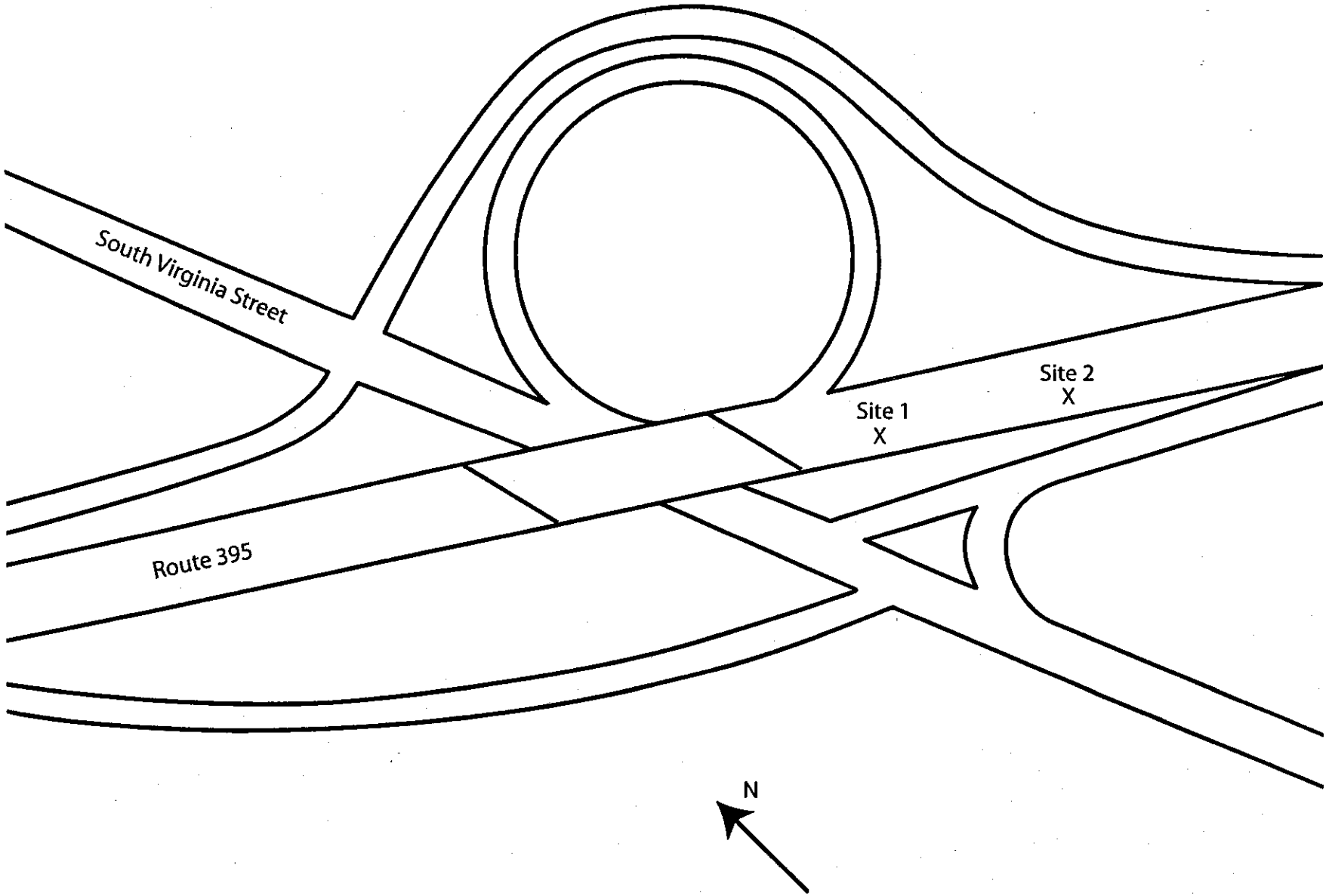
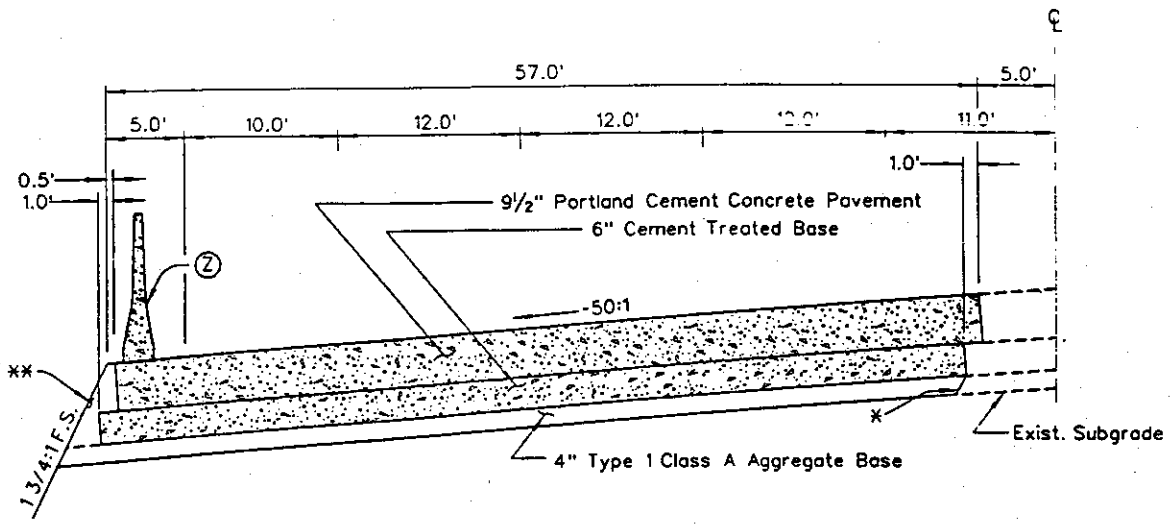


FIGURE 2: Test Site Location



Eaton-001

FIGURE 3: TEST SITES 1 and 2



HALF SECTION OF IMPROVEMENT

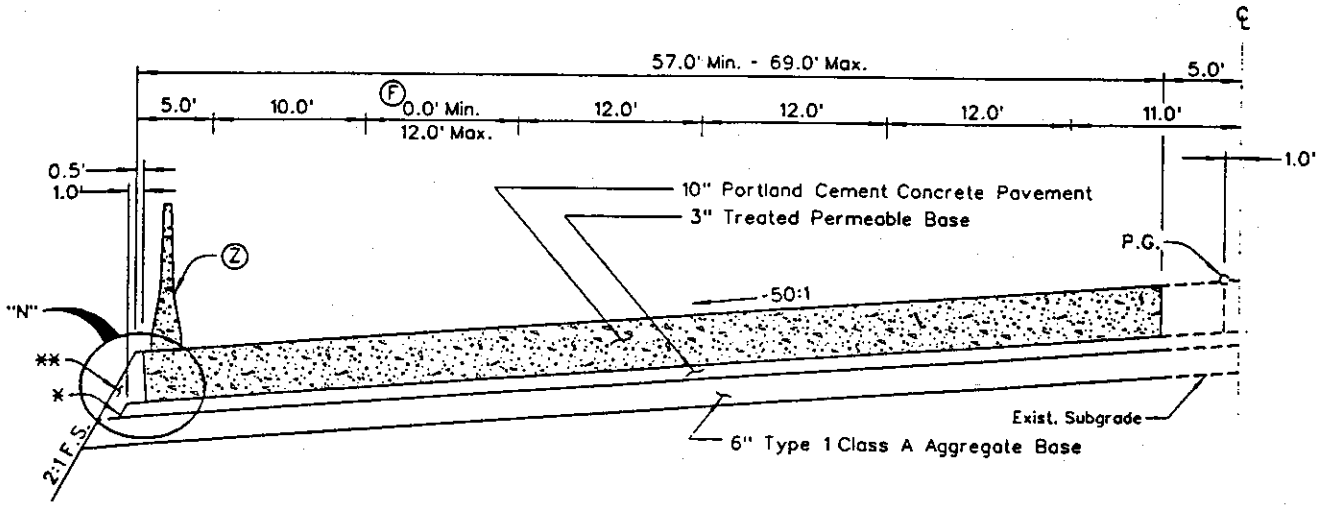
CONSTRUCTION TYPE CODE J000

"P4" 670+00.00 P.O.T. TO "P4" 685+10.00 P.O.C.

BRIDGE EXCEPTION STRUCTURE I-1831

"P4" 672+11.76 P.O.T. TO "P4" 675+81.62 P.O.T.

FIGURE 4: Existing Cement Treated Base Design (CTB)



HALF SECTION OF IMPROVEMENT

CONSTRUCTION TYPE CODE J000

Ⓕ

"H" 644+42.53 P.O.C. TO "P4" 648+50.00 P.O.C. (12.0')
"P4" 662+23.16 P.O.C. TO "P4" 670+00.00 P.O.T. (0.0')

FIGURE 5: "New" Open Graded Asphalt Stabilized Base Design (ASB)

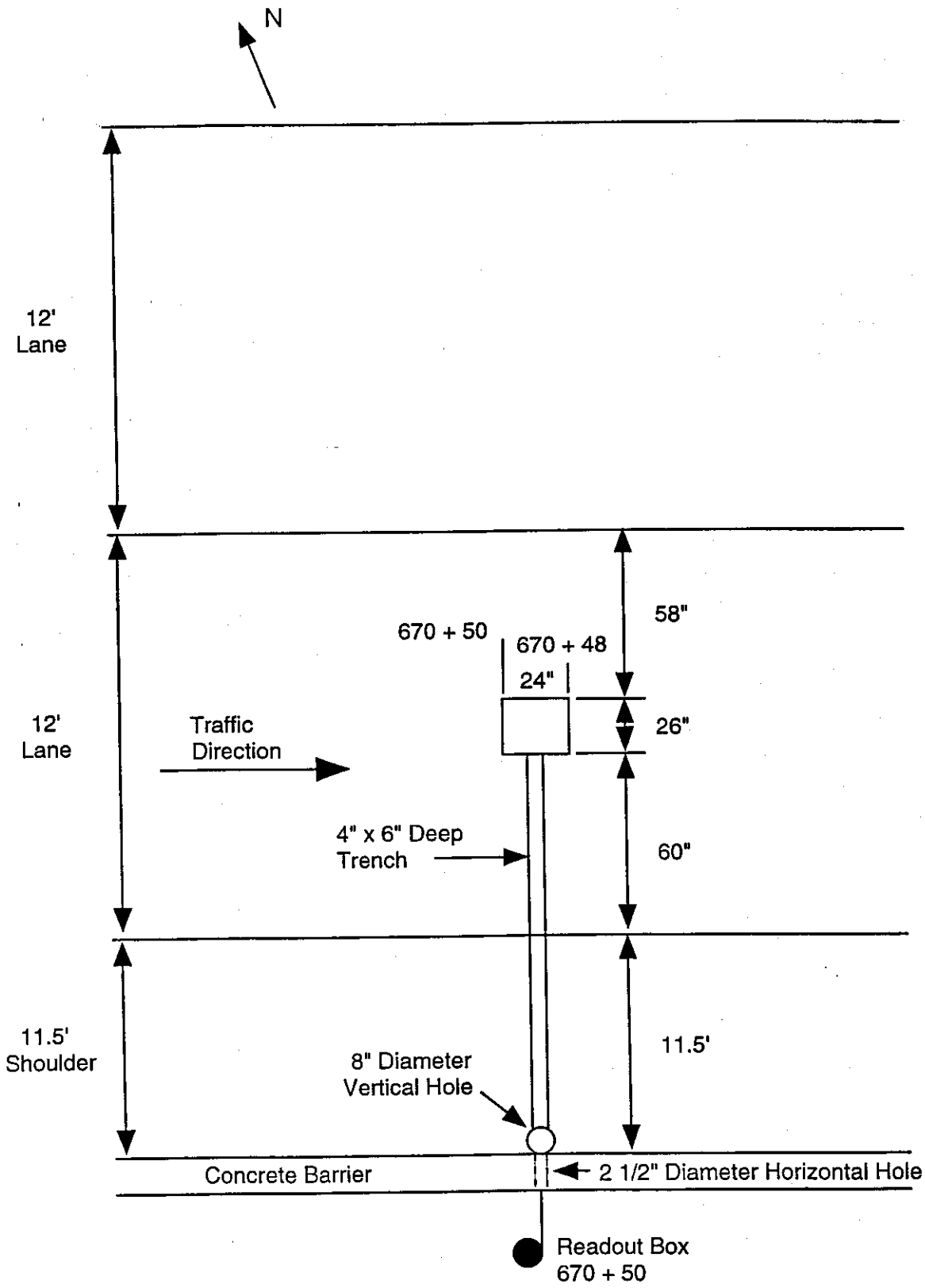


FIGURE 6: Plan View of Site 1 - Cement Treated Base

Eaton-005

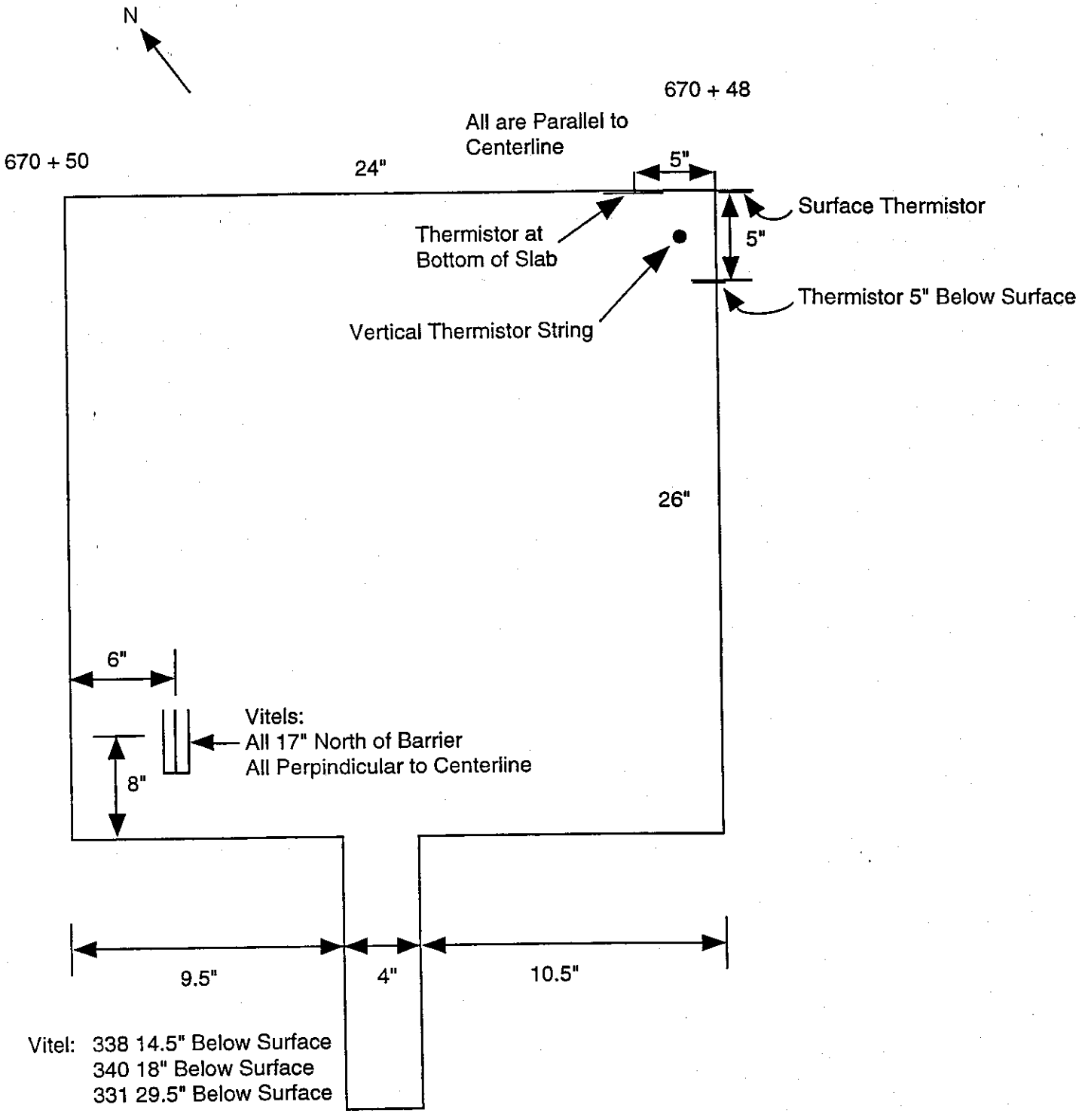


FIGURE 7: Closeup Plan View of Site 1 Instrumentation

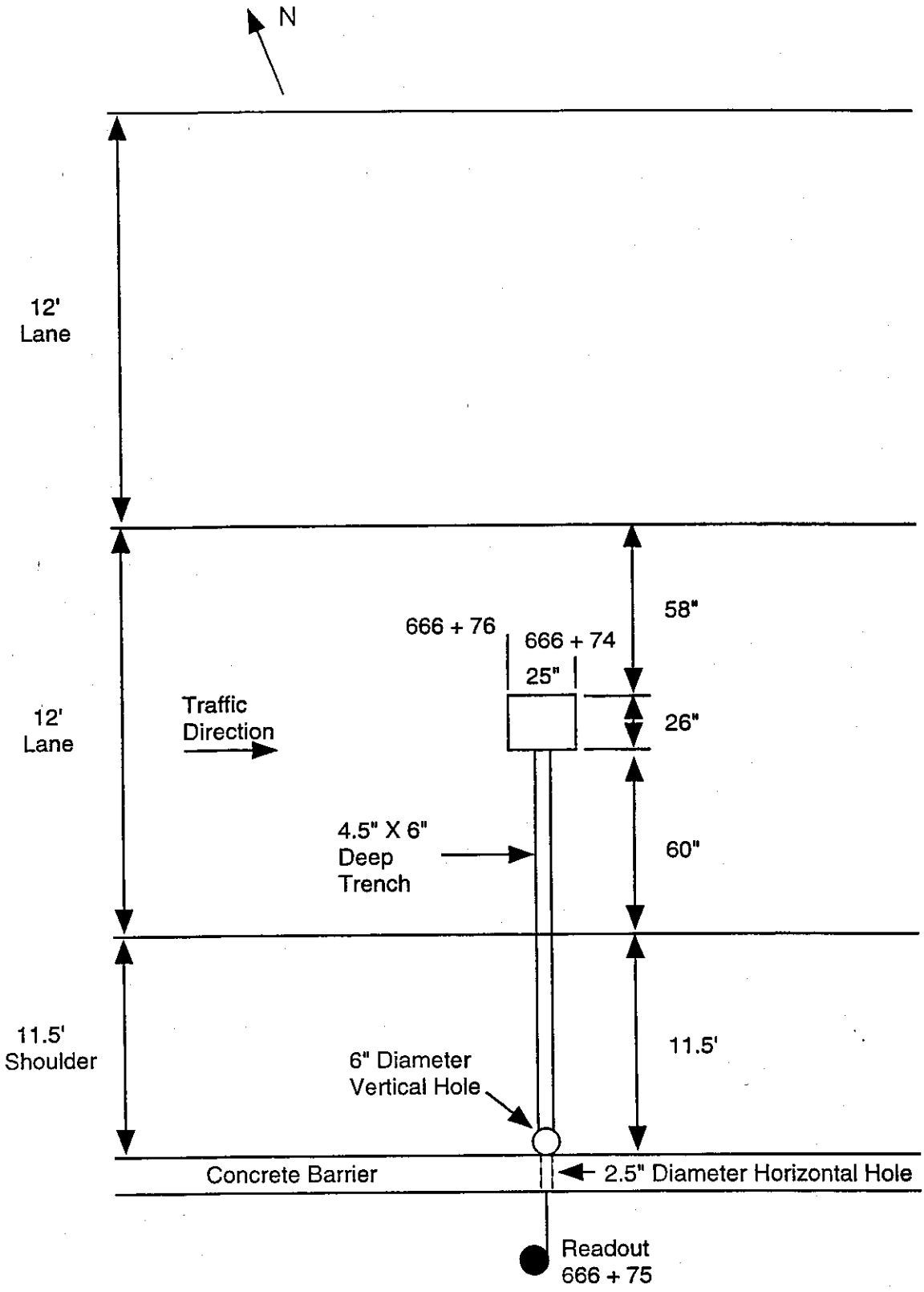
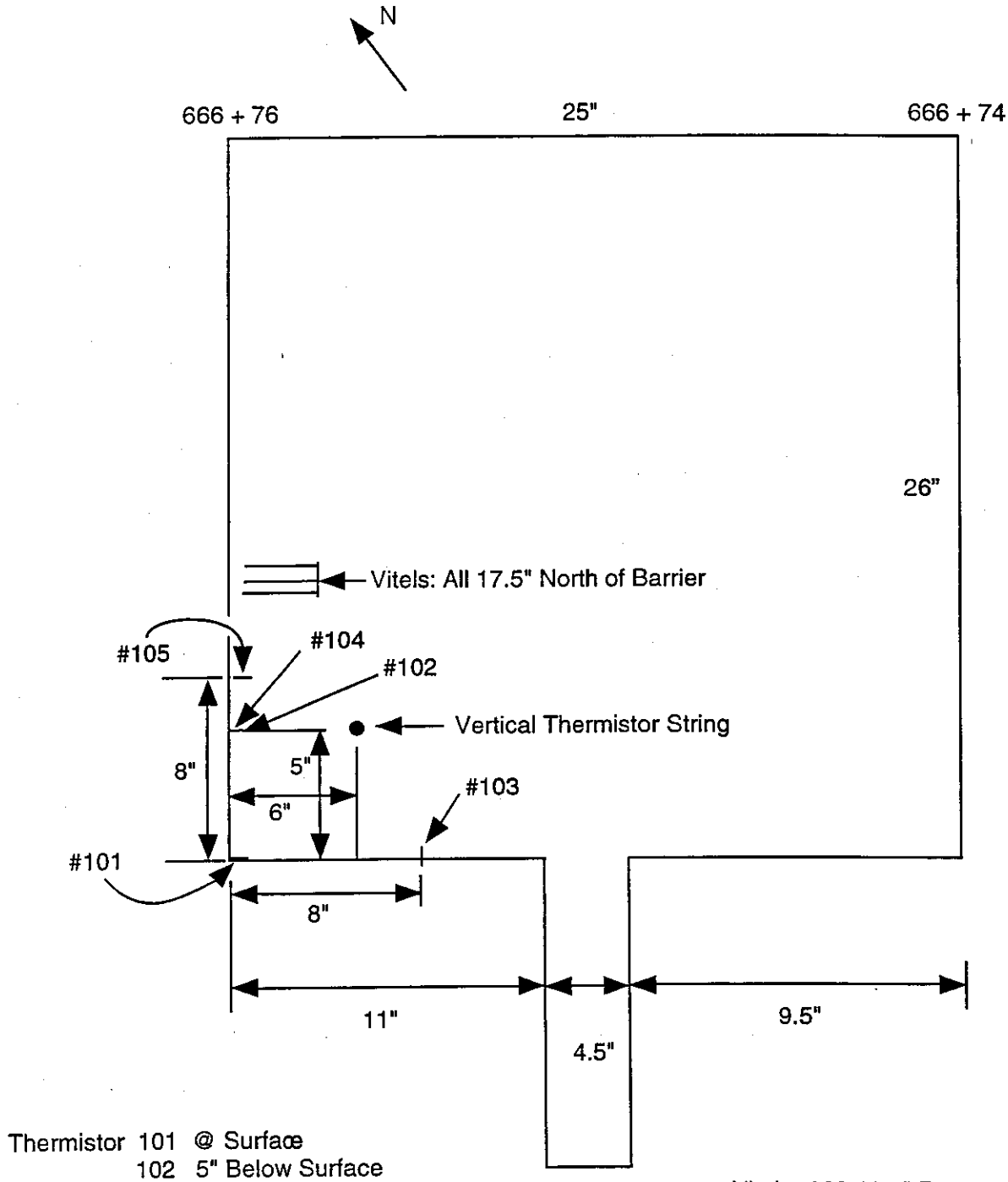


FIGURE 8: Plan View of Site 2 - Asphalt Stabilized Base

Eaton-006



Thermistor 101 @ Surface
102 5" Below Surface
103 10.5" Below Surface- Bottom PCC
104 11.5" Below Surface
105 13" Below Surface - Bottom Porous Asphalt

Vitel: 333 12.5" Deep
335 19" Deep
337 28.5" Deep

FIGURE 9: Closeup Plan View of Site 2 Instrumentation

Eaton-008

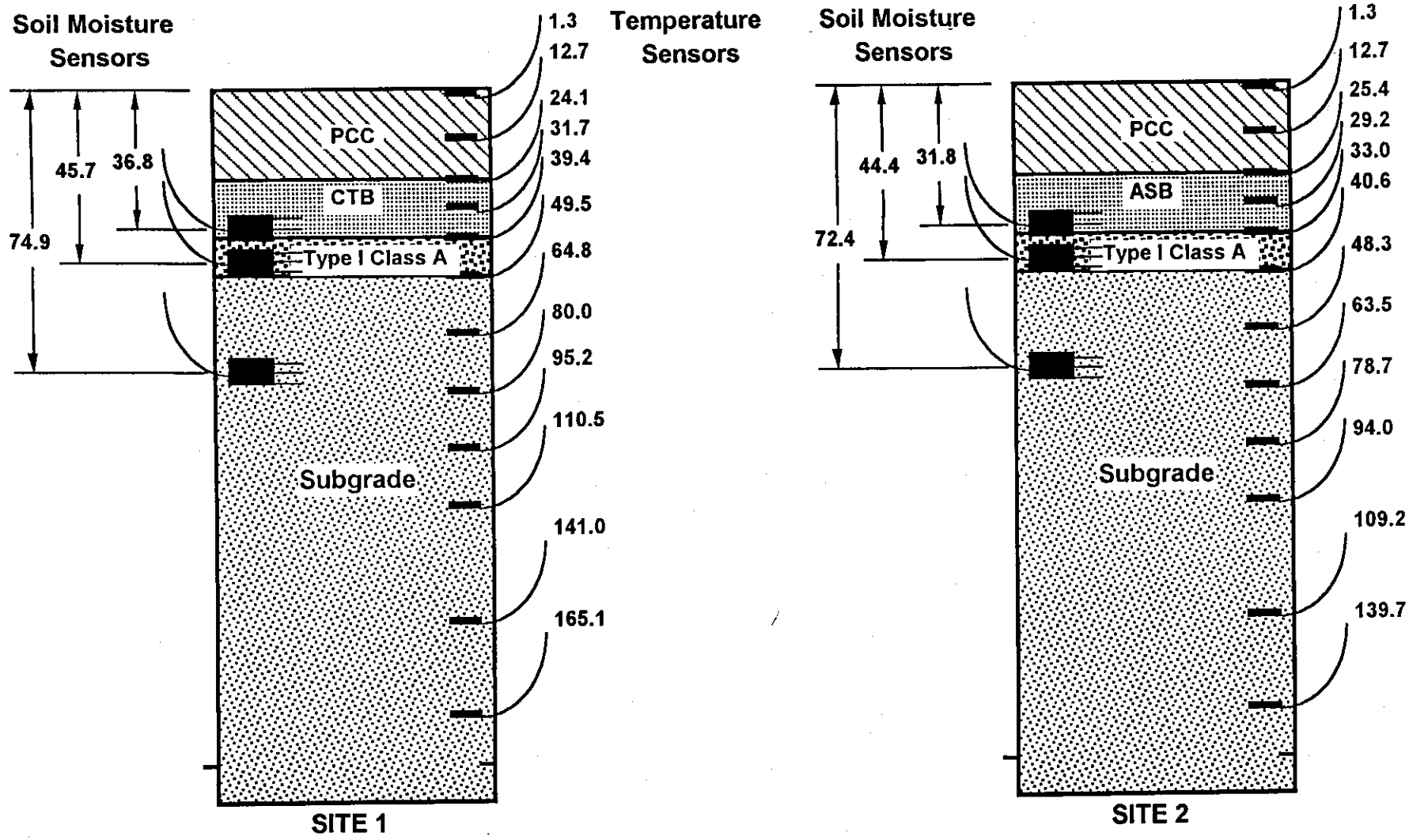


FIGURE 10: Profile View of Sites 1 and 2 Instrumentation

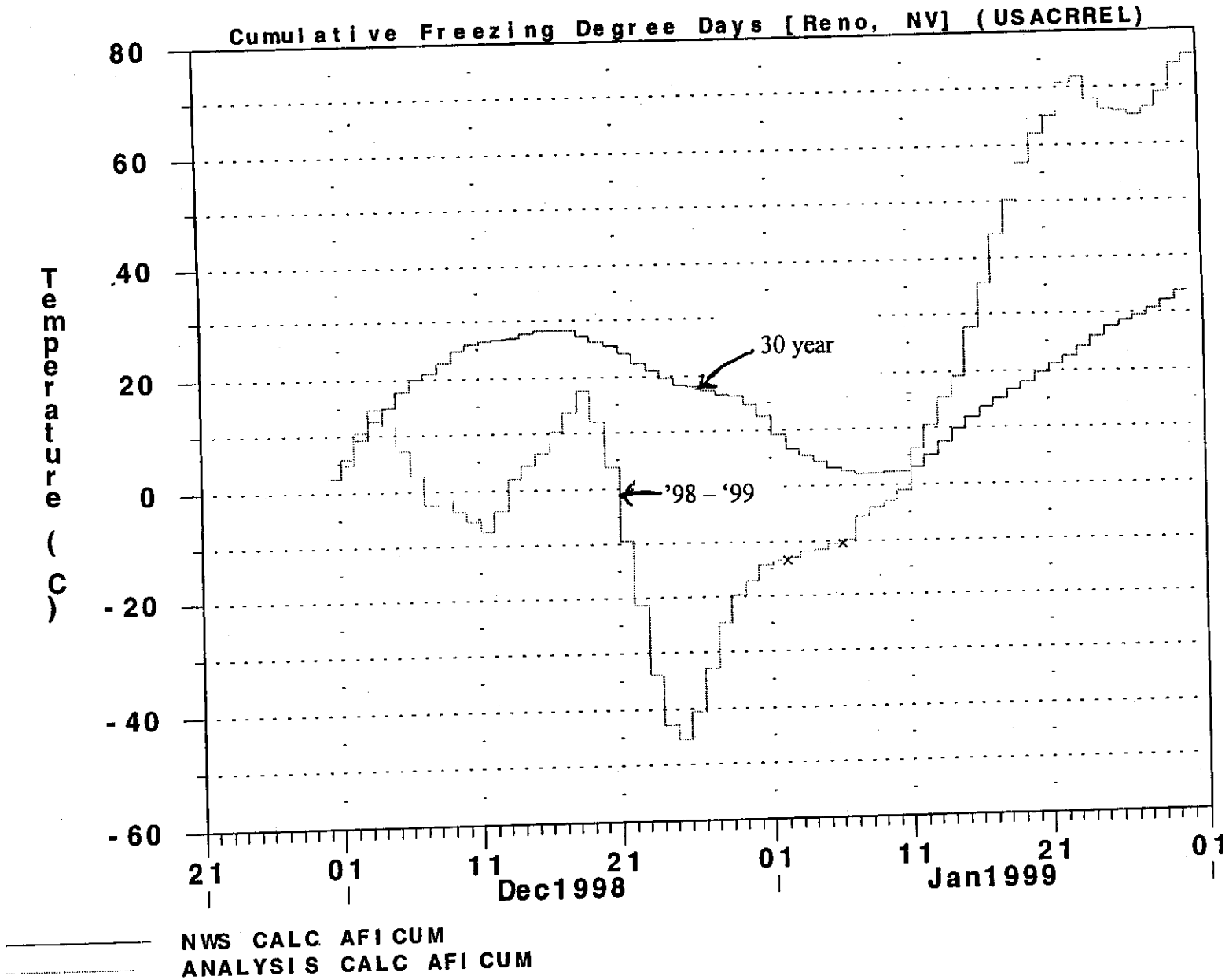


Figure 11: Reno Air Freezing Index

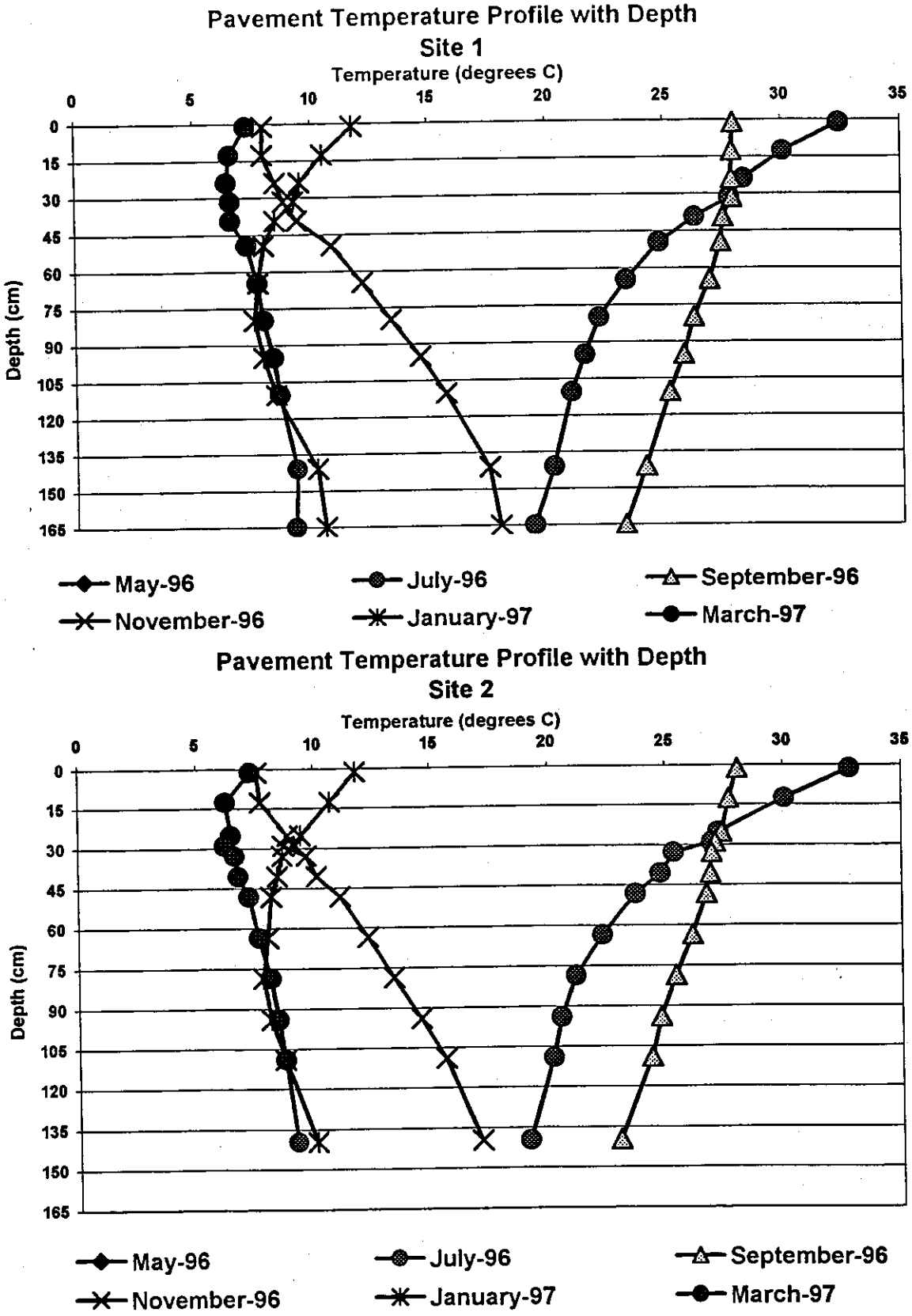


Figure 12: Test Site Temperature Profiles 1996 – 1997

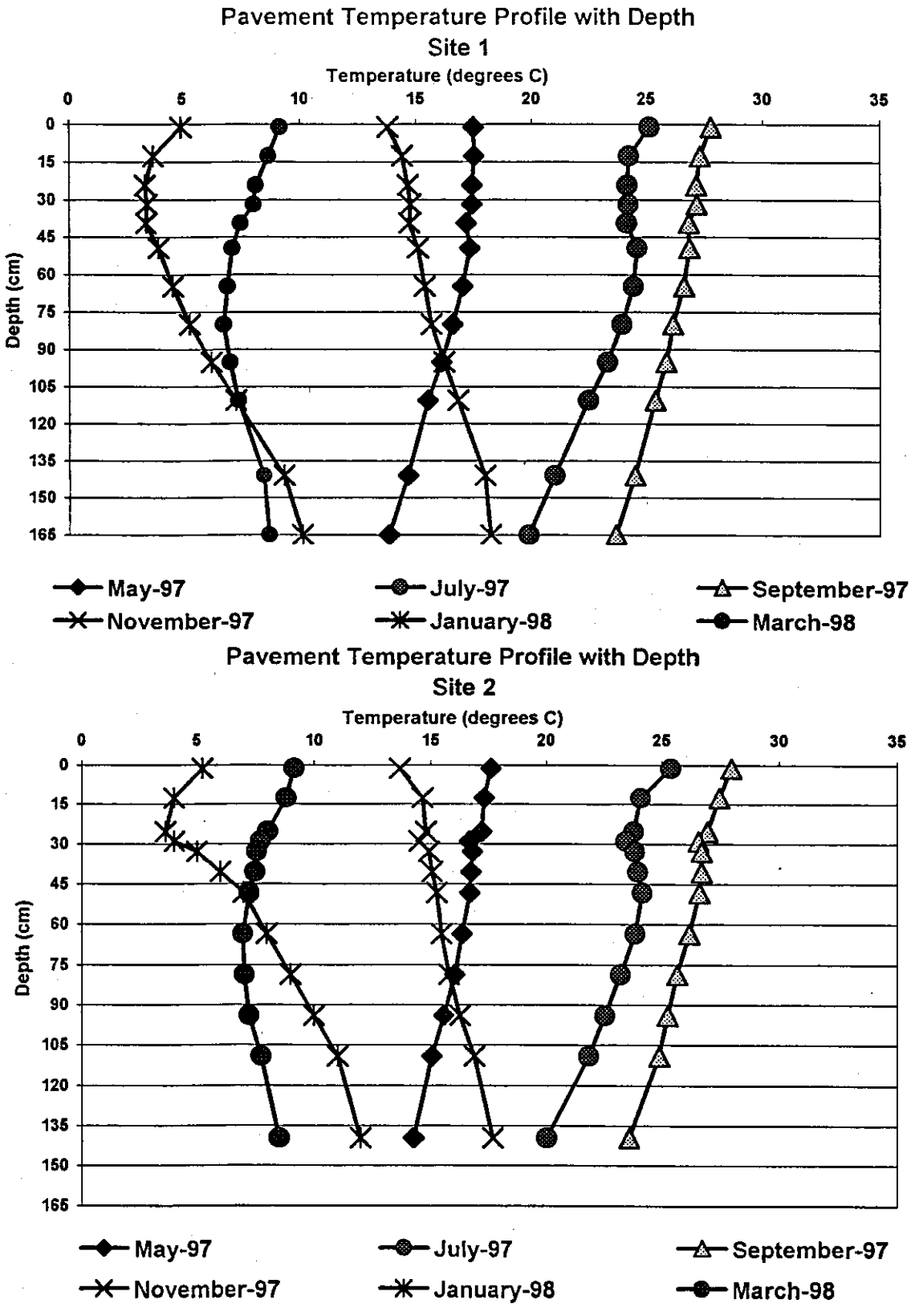
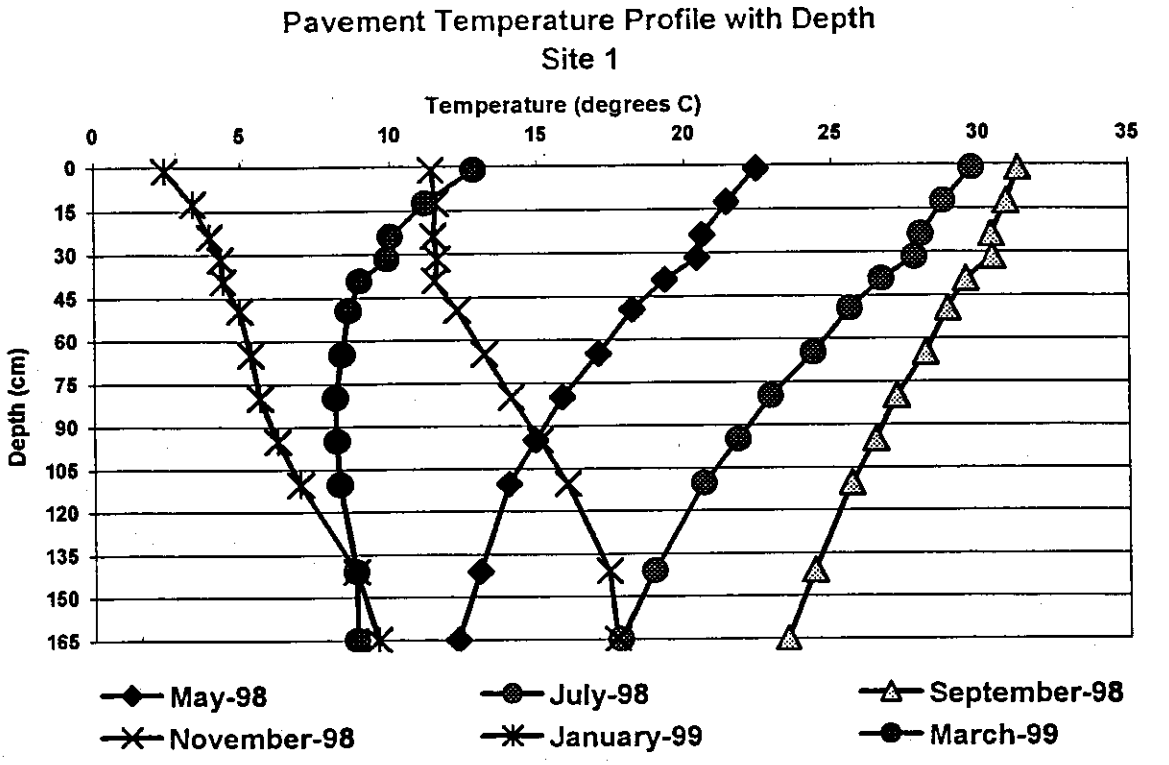


Figure 13: Test Site Temperature Profiles 1997 – 1998



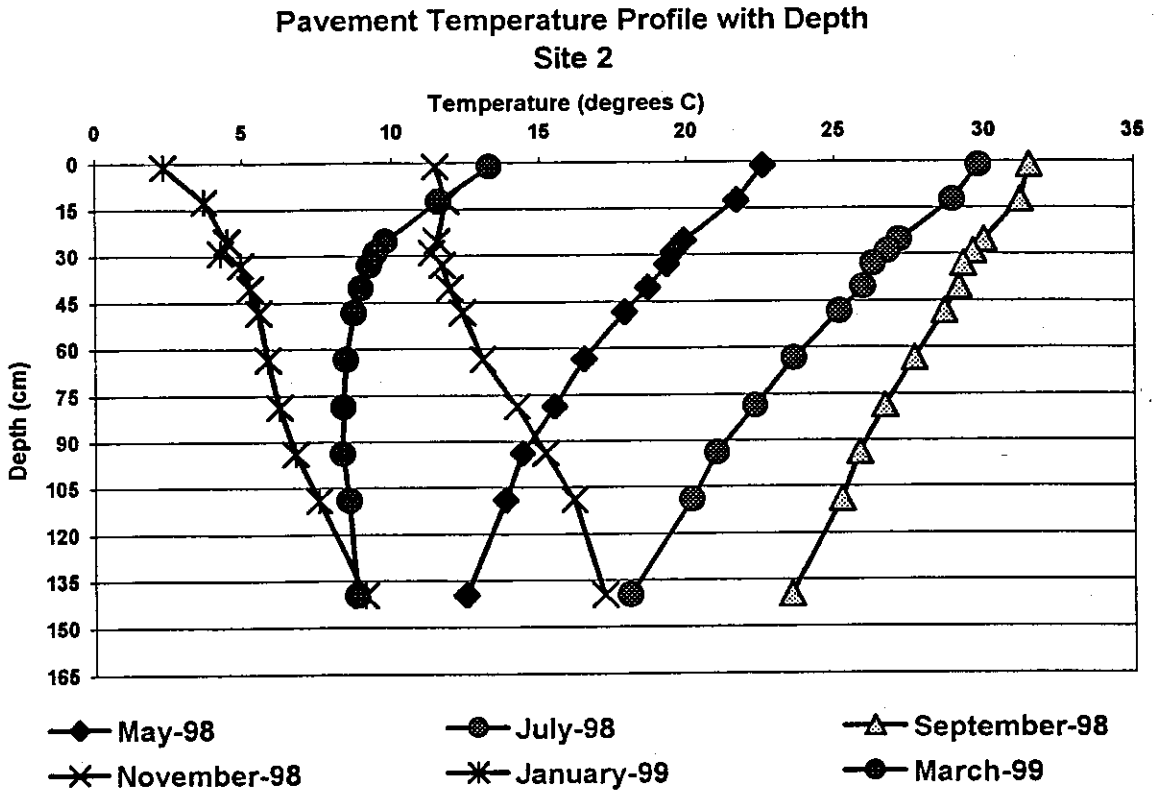
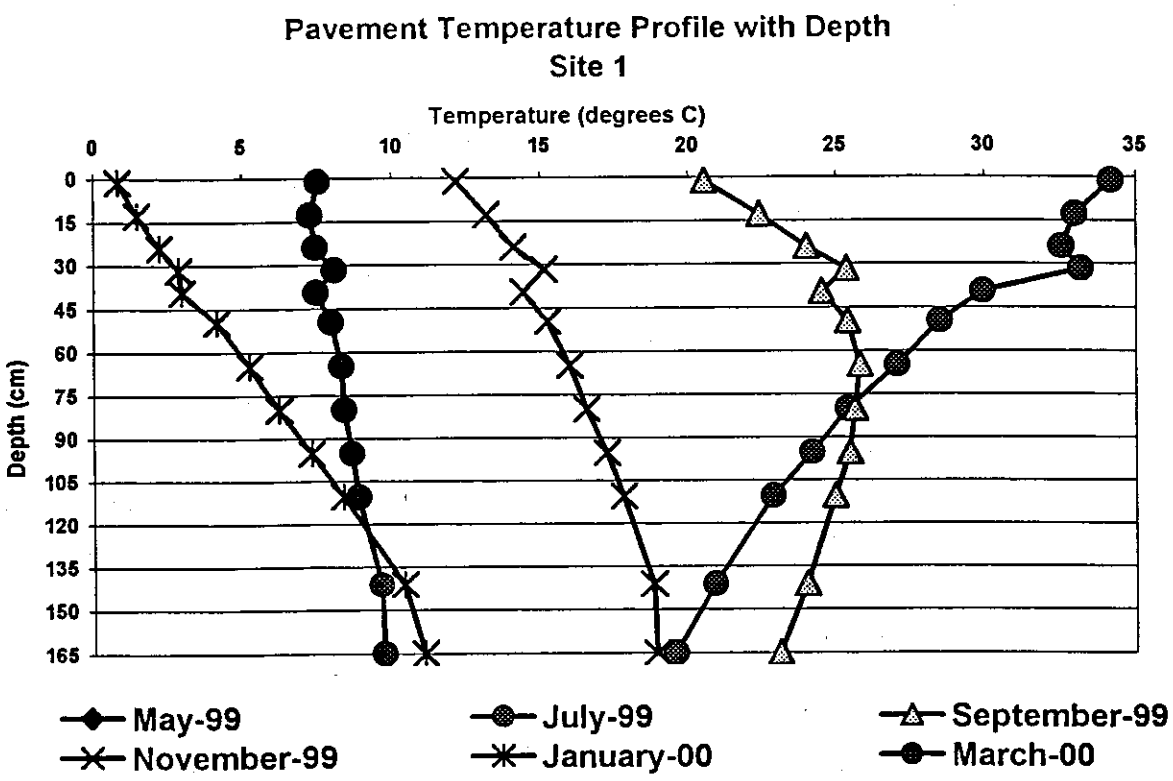


Figure 14: Test Site Temperature Profiles 1998 – 1999



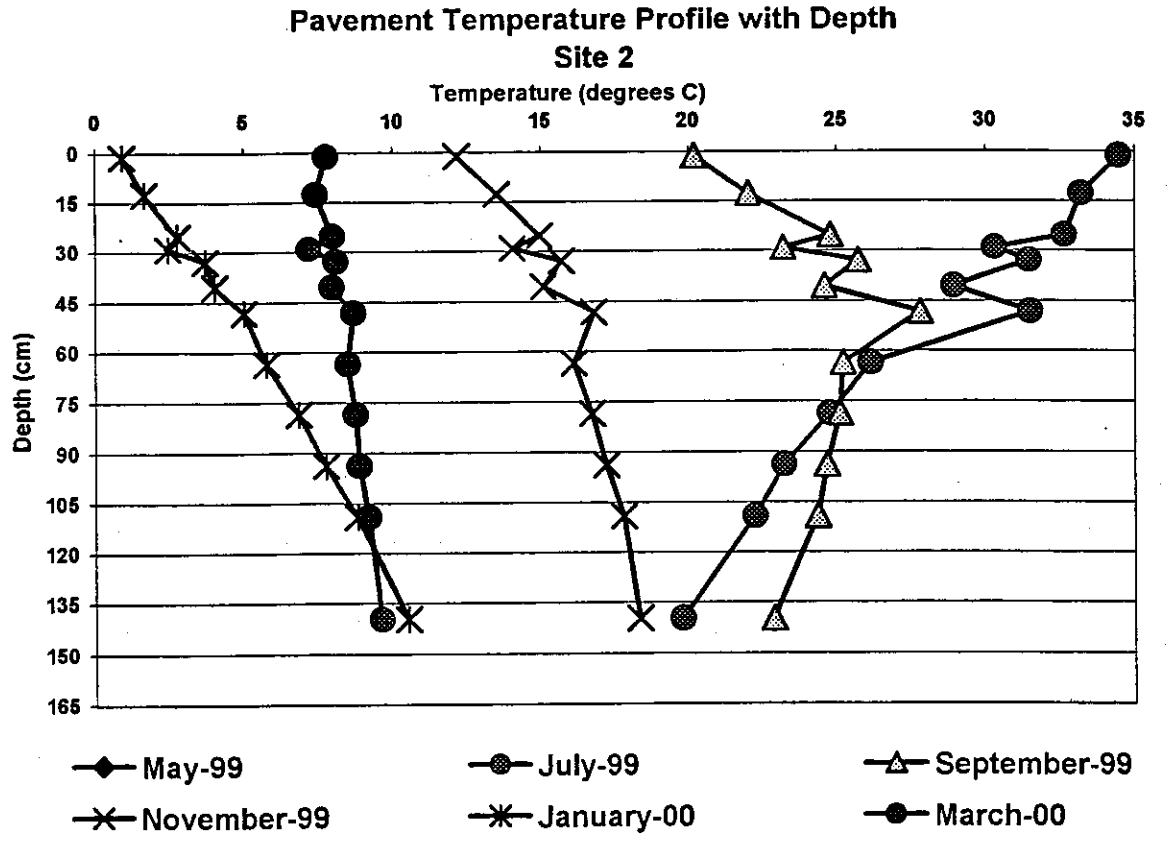


Figure 15: Test Site Temperature Profiles 1999 – 2000

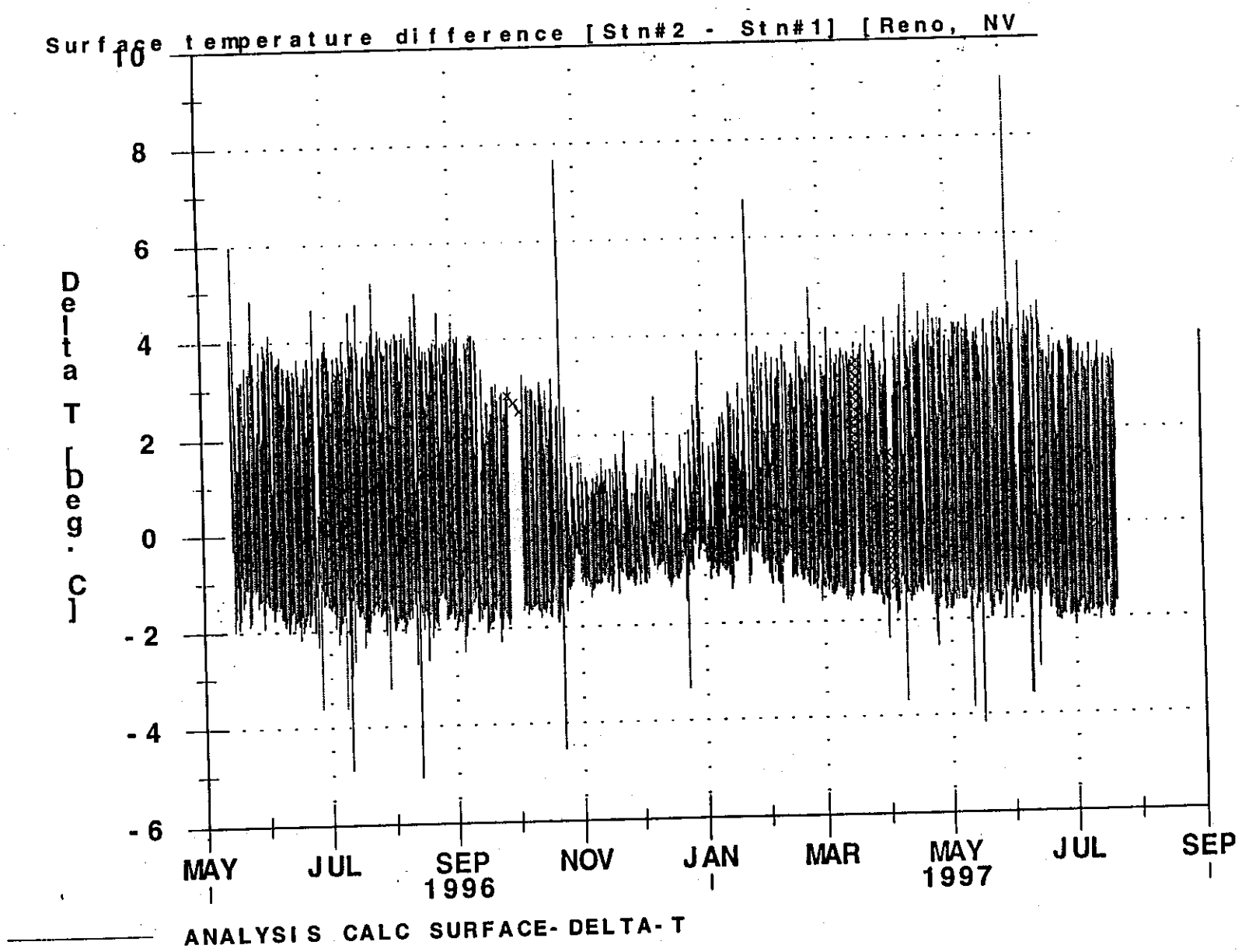


Figure 16: 1996-1997 Differences in Surface Temperatures

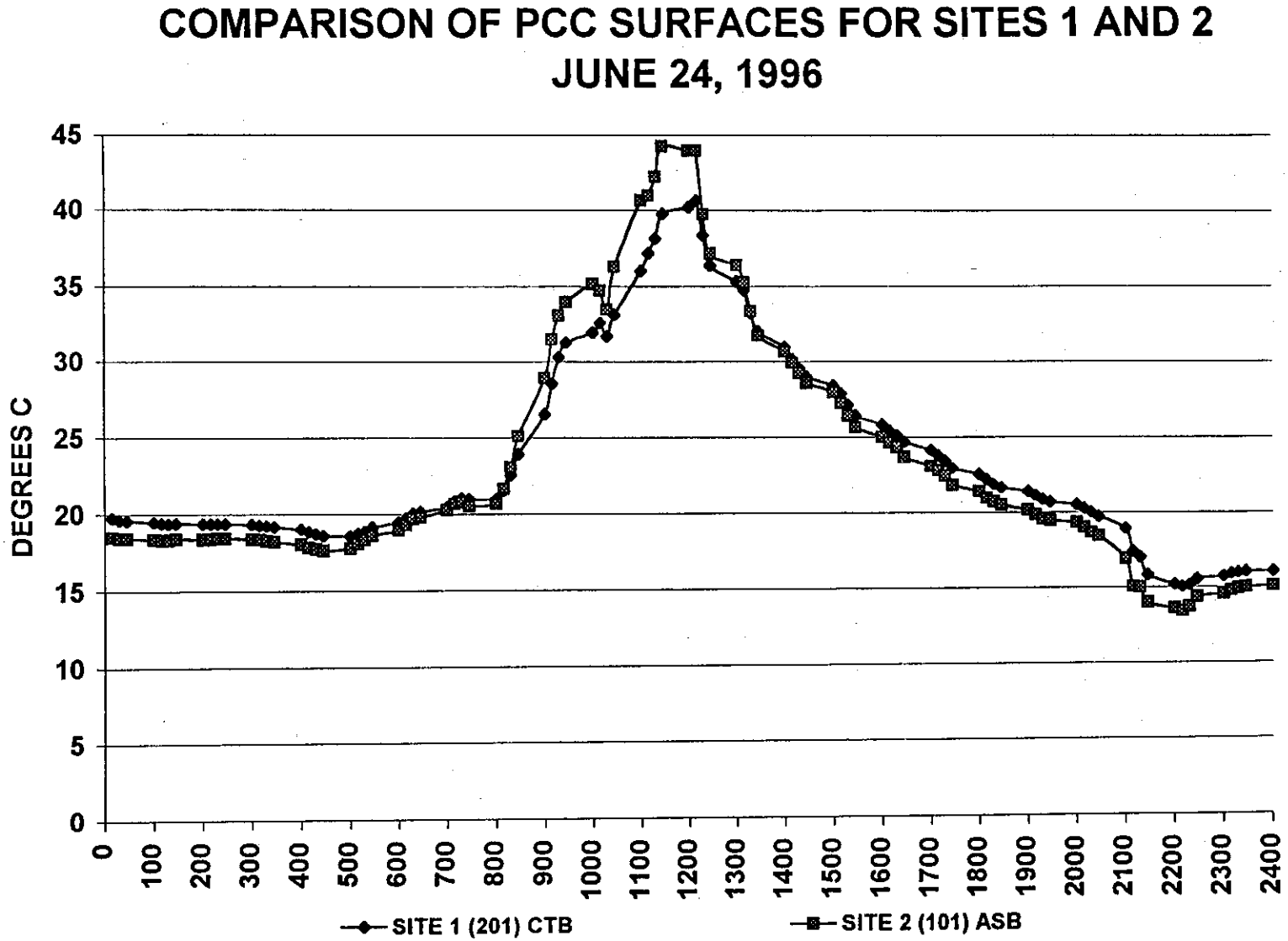


Figure 17: June 24, 1996 Comparison of Surface Temperatures

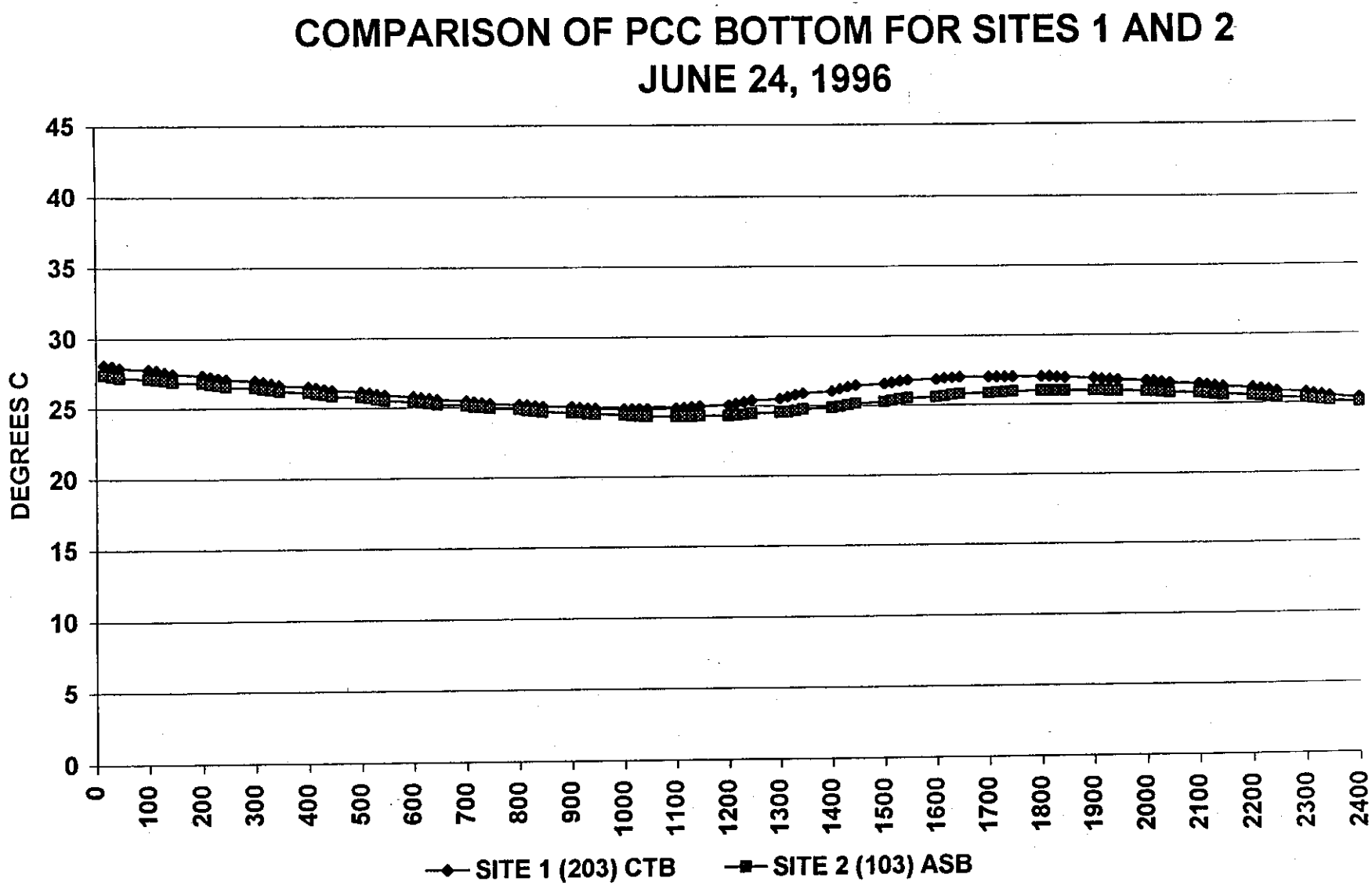


Figure 18: June 24, 1996 Comparison of Bottom Temperatures

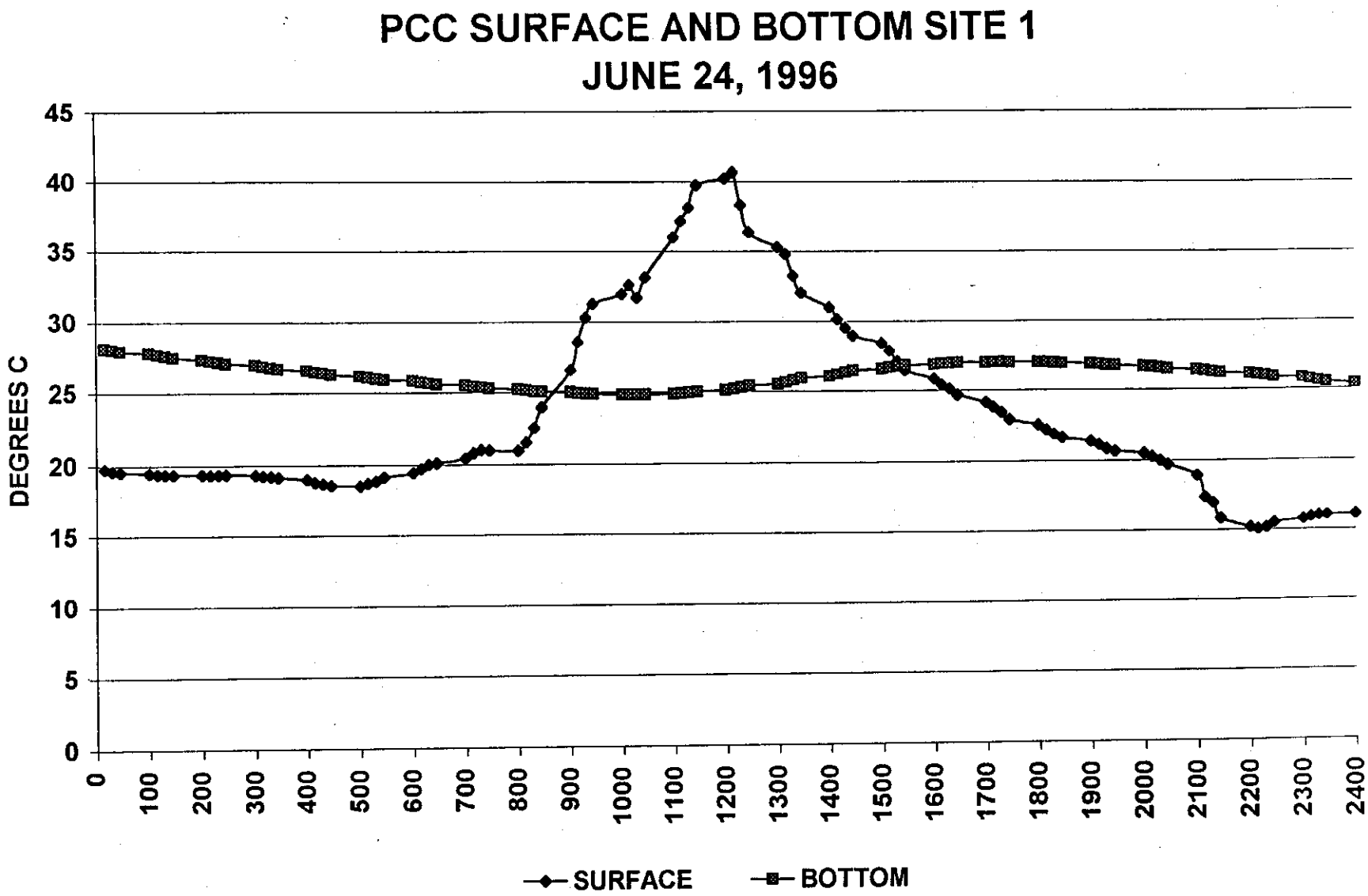


Figure 19: June 24, 1996 PCC Top and Bottom Temperatures Over CTB

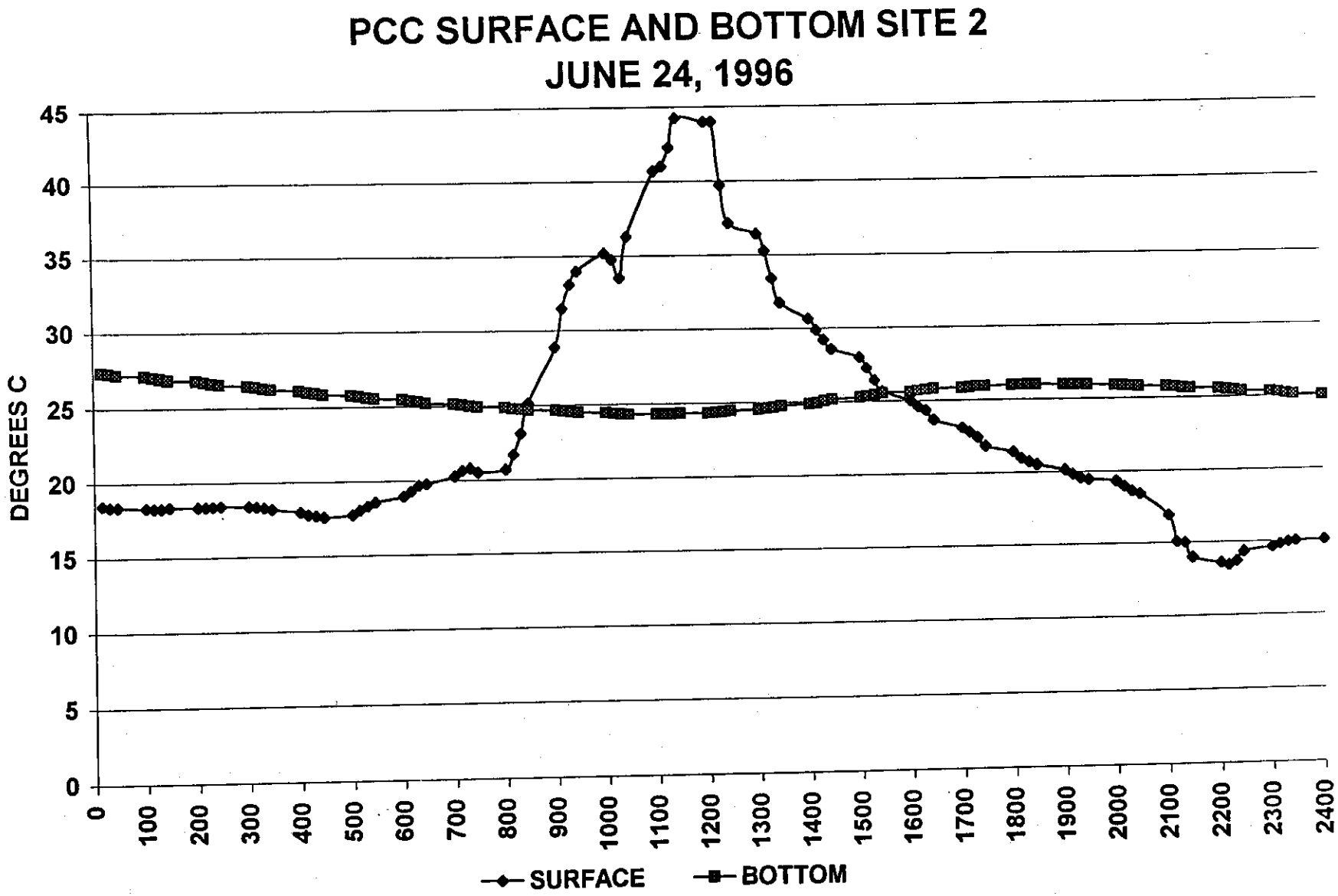


Figure 20: June 24, 1996 PCC Top and Bottom Temperatures Over ASB

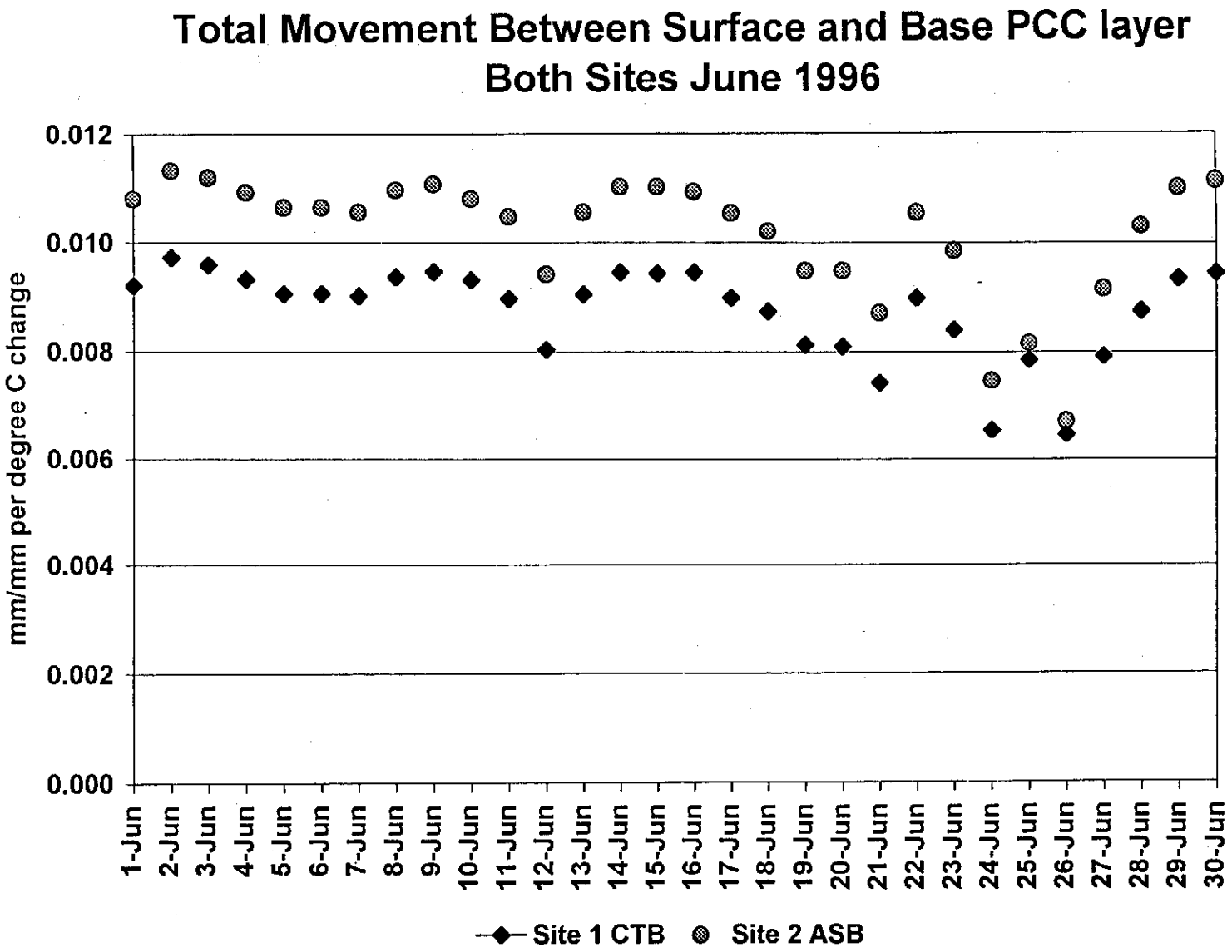


Figure 21: Total Movement Between PCC Surface and Bottom for Both Sites June 1996

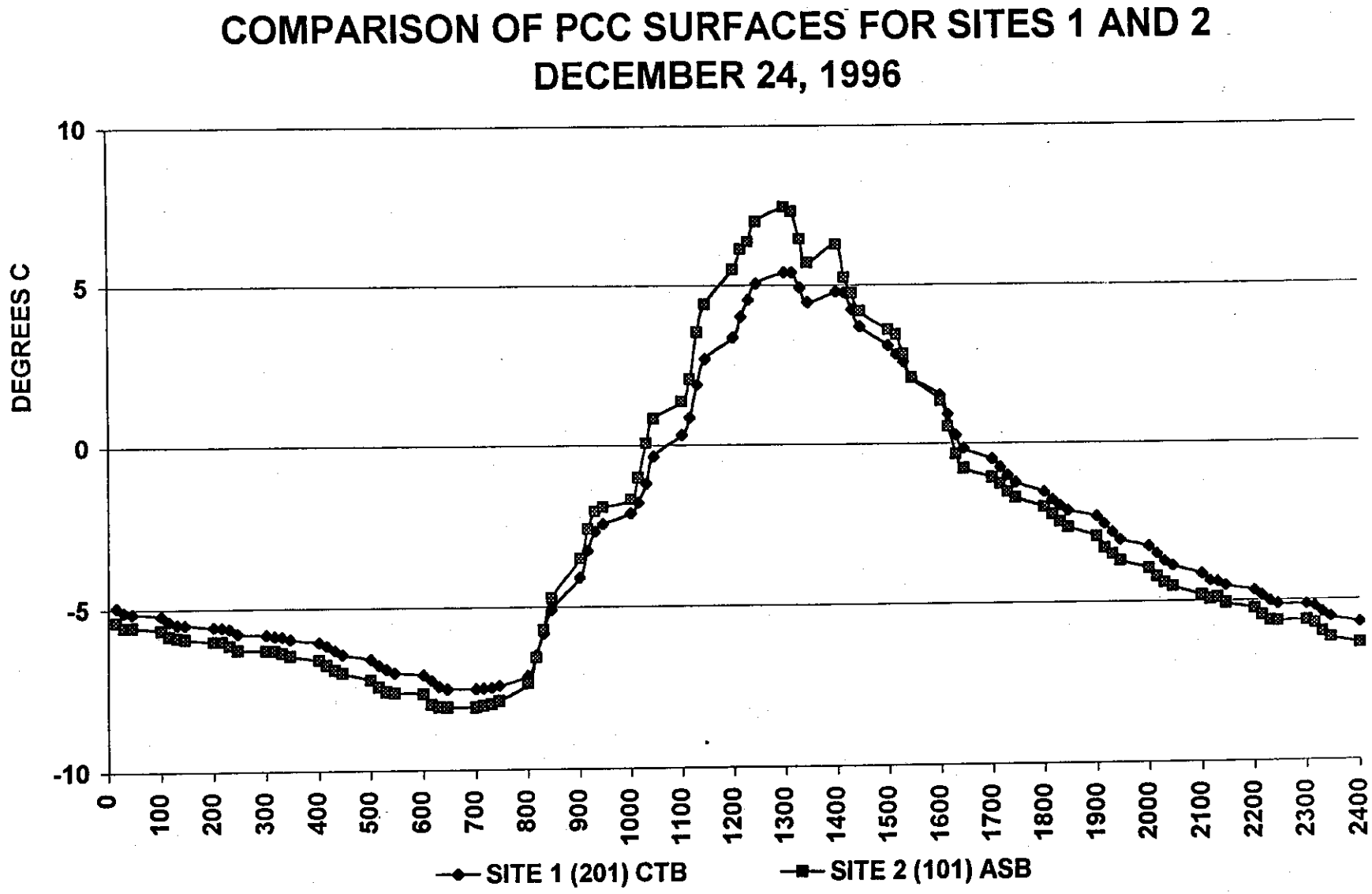


Figure 22: December 24, 1996 Comparison of Surface Temperatures

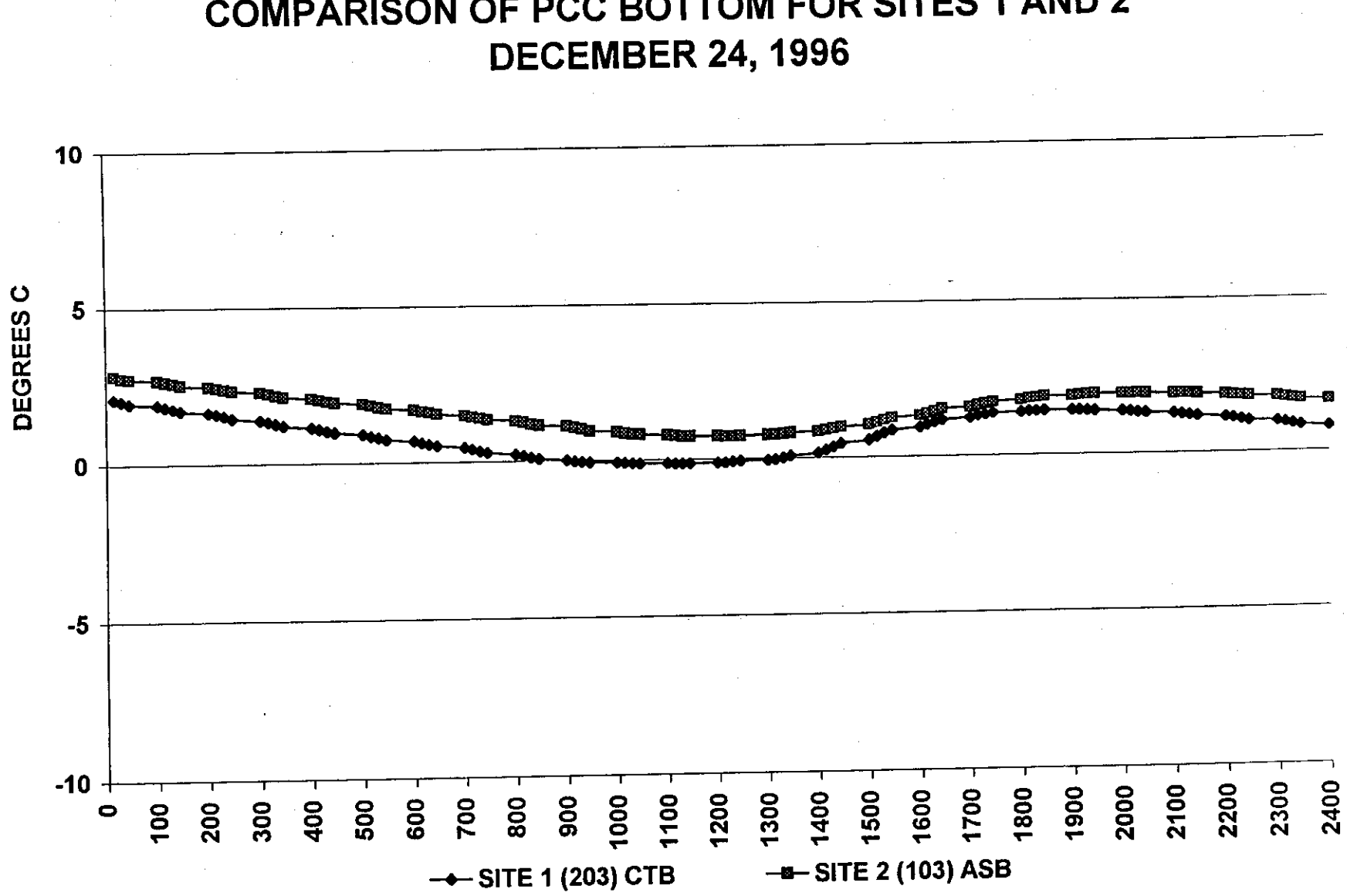


Figure 23: December 24, 1996 Comparison of Bottom Temperatures

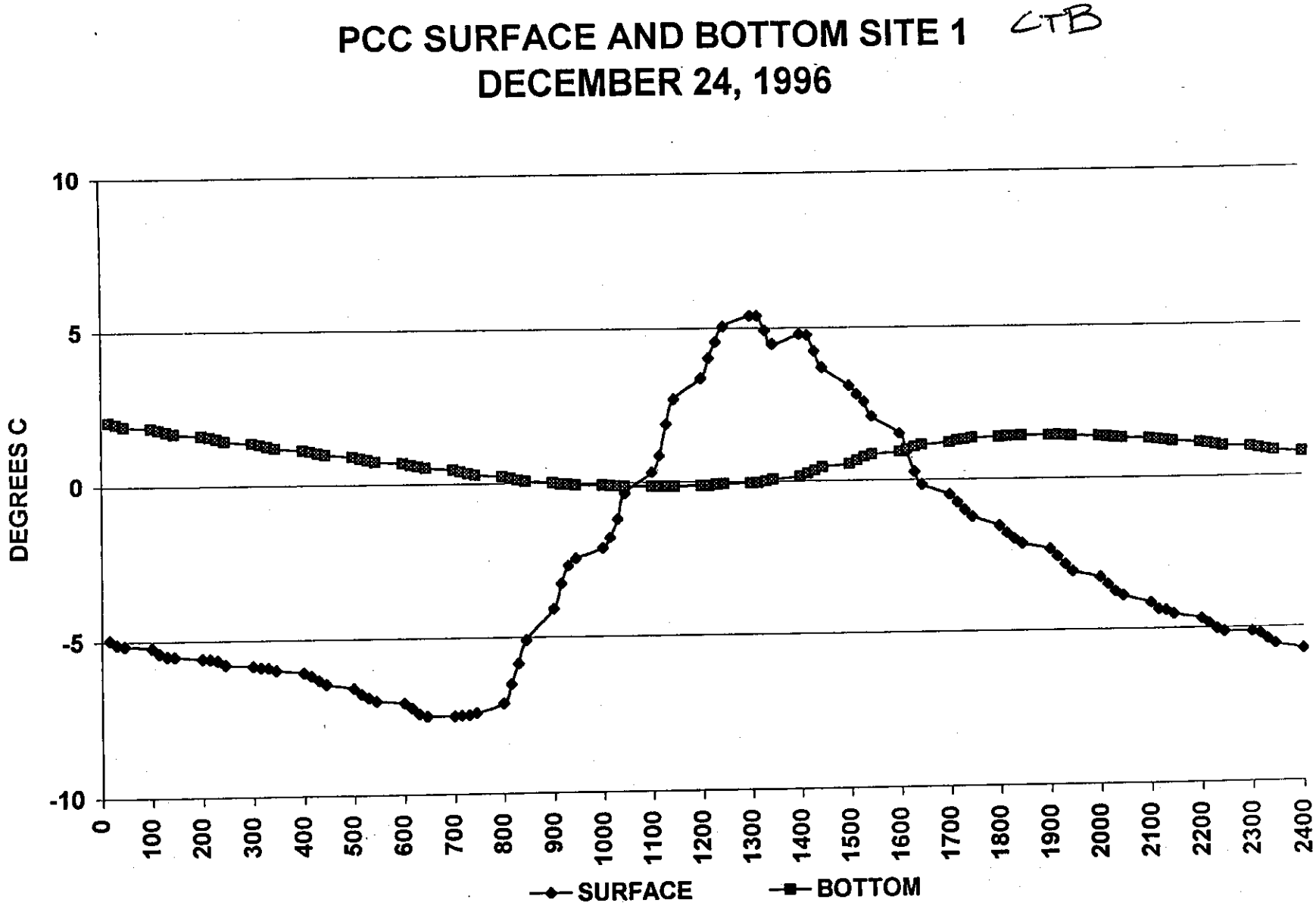


Figure 24: December 24, 1996 PCC Top and Bottom Temperatures Over CTB

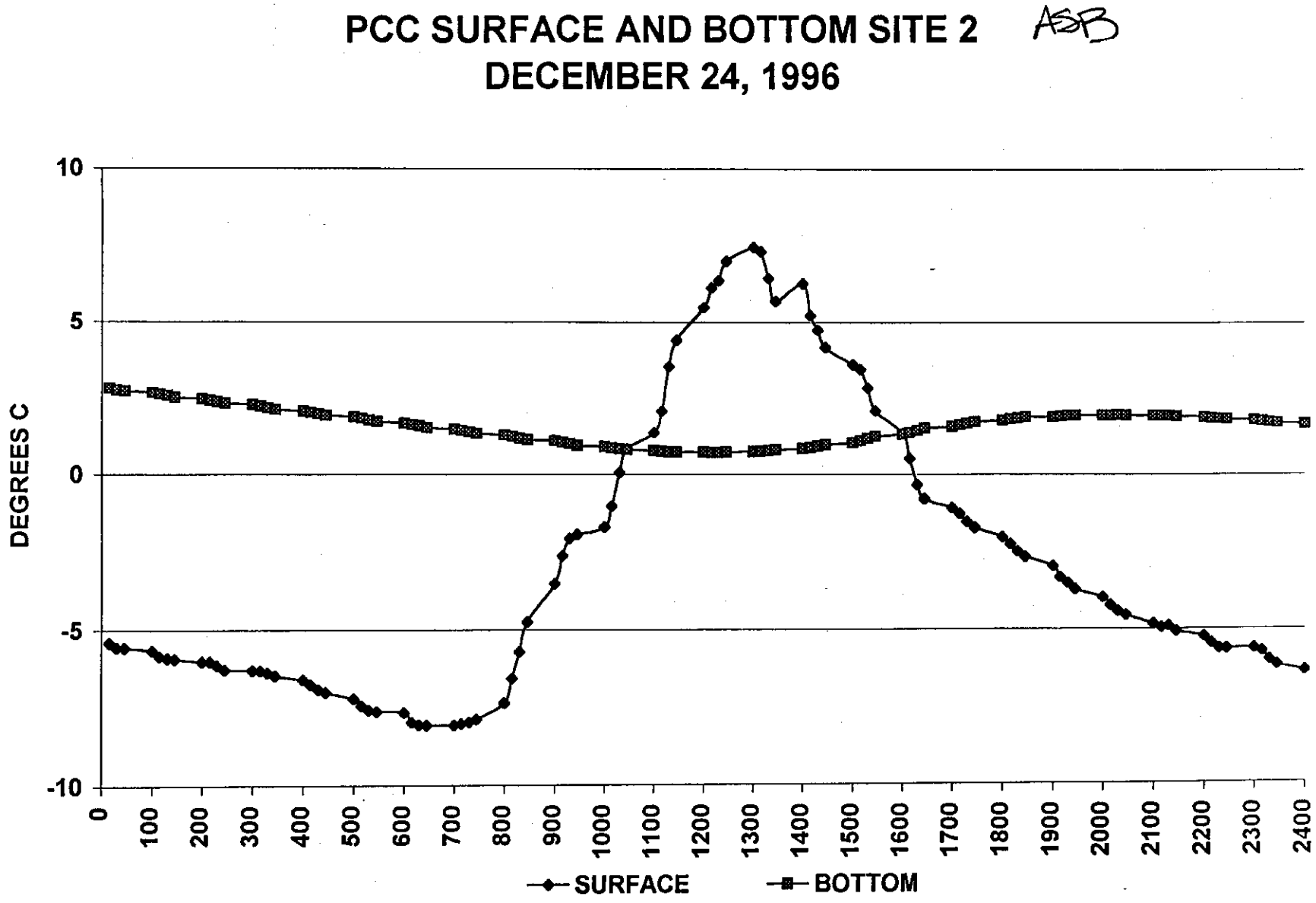


Figure 25: December 24, 1996 PCC Top and Bottom Temperature Over ASB

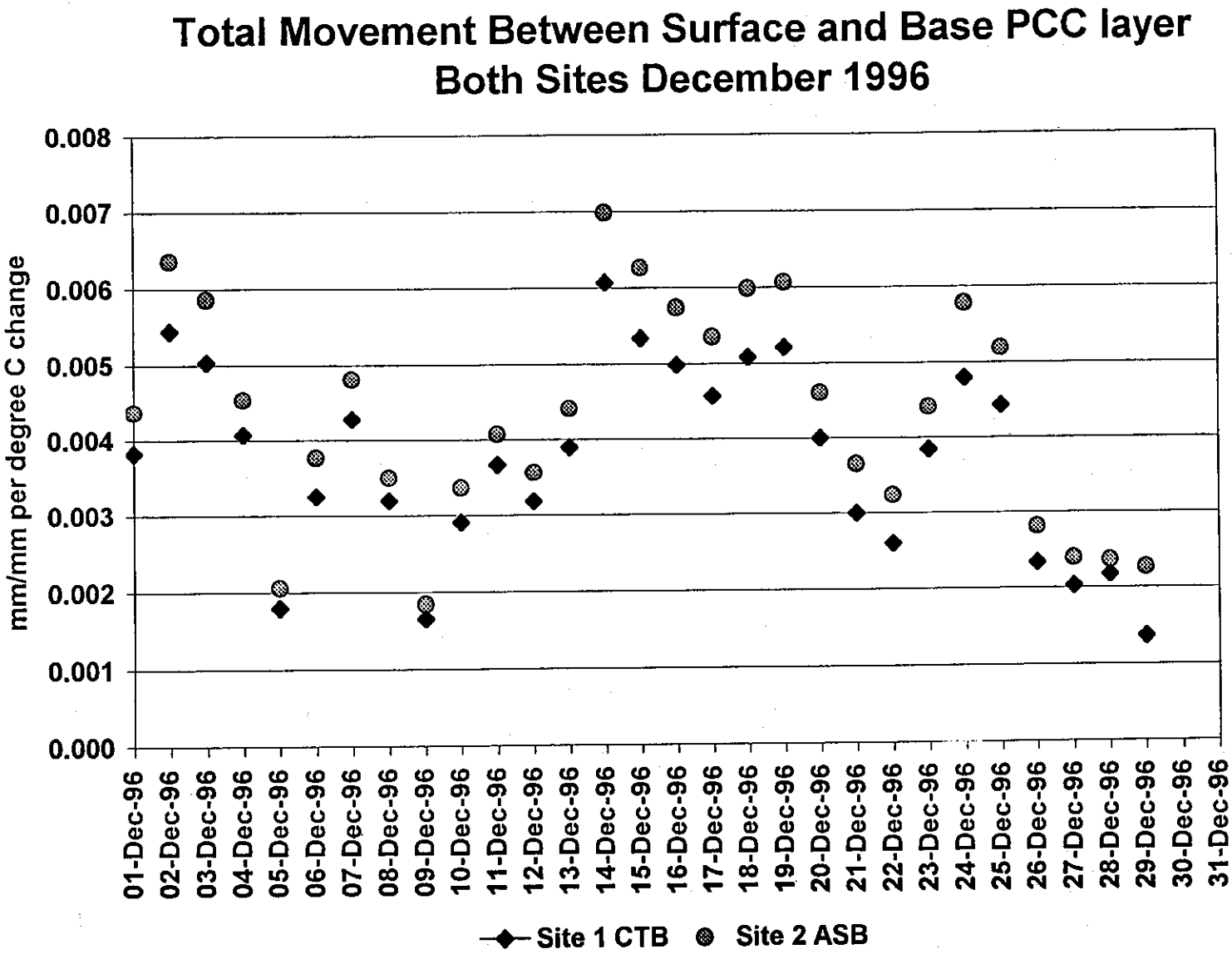


Figure 26: Total Movement Between PCC Surface and Bottom for Both Sites December 1996

Table 1: Reno Airport Air Temperature and Precipitation

Average Air Temperature (deg C) at Reno Airport						Precipitation (mm)				
	1965-1995	1996-1997	1997-1998	1998-1999	1999-2000	1965-1995	1996-1997	1997-1998	1998-1999	1999-2000
May	13.4		16.1	10.5	14.9	0.438		0.127	20.828	5.080
June	17.7		17.5	17.4	19.6	0.397		0.991	35.306	1.524
July	20.2		20.9	24.3	23.2	0.197		0.051	0.000	2.540
August	19.3		21.4	23.8	21.1	0.253		0.000	0.000	20.828
September	15.1		17.3	18.7	18.8	0.303		0.483	55.118	1.778
October	9.8		10.4	9.9	13.3	0.298		0.127	8.636	10.668
November	3.9		5.7	6.0	8.2	0.669		0.737	19.558	0.254
December	-0.1		0.0	-0.2	1.6	0.803		0.508	1.016	1.778
January	0.6		3.4	0.0	3.7	0.900		27.940	19.304	54.356
February	3.4	4.1	2.3	0.0	5.2	0.760	0.610	65.786	31.750	24.892
March	5.8	8.9	5.7	0.0	7.6	0.663	0.025	56.134	2.794	9.652
April	8.9	9.3	7.4	0.0	12.3	0.310	0.203	15.240	13.970	8.636

Air Temperatures (deg C) - Site 1				
	1996-1997	1997-1998	1998-1999	1999-2000
May	12.35	16.76	9.88	14.23
June	19.32	17.35	16.48	18.12
July	23.68	21.72	23.10	22.35
August	21.99	21.81	22.96	20.10
September	16.08	17.15	17.32	17.73
October	9.52	9.88	8.72	8.07
November	5.10	5.54	5.18	6.93
December	3.62	-0.35	-0.86	0.32
January	0.98	3.57	2.32	3.30
February	3.16	2.14	4.67	4.68
March	8.59	5.67	5.73	6.91
April	9.93	7.64	3.27	12.57

Table 2: Test Site Air Temperature

Table 1.xls\Table 1 Report

Table 3: Average Monthly Surface PCC Temperatures (1.3 cm depth)

	PCC Surface Temperatures (deg C) - Site 1				PCC Surface Temperatures (deg C) - Site 2			
	1996-1997	1997-1998	1998-1999	1999-2000	1996-1997	1997-1998	1998-1999	1999-2000
May	18.88	24.85	17.45	22.12	18.90	25.51	17.47	22.30
June	27.75	25.77	24.58	23.68	27.87	25.93	24.68	23.94
July	31.40	30.40	32.06	31.64	31.23	30.52	32.25	31.64
August	28.99	30.22	31.19	27.81	29.09	30.38	31.43	27.74
September	22.50	23.54	23.34	24.21	22.29	23.61	23.34	24.07
October	13.38	14.33	13.29	13.66	13.07	14.15	13.13	13.57
November	7.54	7.93	7.49	9.80	7.13	7.69	7.35	9.77
December	4.43	1.62	0.73	2.60	4.31	1.46	0.75	2.56
January	2.46	4.35	3.86	4.95	2.58	4.31	3.87	5.11
February	6.43	4.40	6.07	7.14	6.59	4.42	6.09	7.24
March	13.75	10.50	10.37	12.32	13.86	10.63	10.45	12.60
April	17.14	14.02	7.79	18.87	17.33	14.15	8.11	19.40

	PCC Bottom Temperatures (deg C) - Site 1				PCC Bottom Temperatures (deg C) - Site 2			
	1996-1997	1997-1998	1998-1999	1999-2000	1996-1997	1997-1998	1998-1999	1999-2000
May	18.40	23.32	17.16	21.45	17.82	23.09	16.75	20.38
June	26.23	25.04	23.17	22.96	25.19	24.48	22.42	22.95
July	30.06	29.18	30.61	31.22	28.77	28.51	29.86	31.32
August	28.54	29.47	30.21	28.36	27.94	29.03	29.77	28.48
September	23.26	24.17	24.08	24.83	22.87	23.99	23.95	25.43
October	15.33	15.91	14.79	14.96	15.47	16.10	15.05	15.69
November	8.68	9.71	8.77	11.43	8.83	10.01	9.10	12.14
December	5.22	3.25	2.47	4.53	5.54	3.82	3.12	5.12
January	3.35	4.78	4.54	5.39	3.90	5.06	4.86	5.77
February	6.80	4.88	6.34	7.48	7.01	5.12	6.45	7.89
March	13.11	10.36	10.12	11.91	12.88	10.34	10.11	12.66
April	16.50	13.15	8.05	17.57	16.30	12.85	8.26	18.76

Table 4: Average Monthly Bottom PCC Slab Temperatures (24.1 cm Site 1 – CTB and 25.4 cm Site 2 – ASB)

	TIME	AIR TEMP	1.3 cm			
Jun-96	30	15.89	19.6	28.04	-8.44	-16.85	16.85
Jun-96	45	15.96	19.54	27.93	-8.39	-25.24	25.24
Jun-96	100	15.82	19.46	27.82	-8.36	-33.60	33.60
Jun-96	115	15.82	19.38	27.72	-8.34	-41.94	41.94
Jun-96	130	15.83	19.33	27.6	-8.27	-50.21	50.21
Jun-96	145	15.85	19.36	27.49	-8.13	-58.34	58.34
Jun-96	200	15.82	19.35	27.38	-8.03	-66.37	66.37
Jun-96	215	15.64	19.32	27.27	-7.95	-74.32	74.32
Jun-96	230	15.73	19.34	27.17	-7.83	-82.15	82.15
Jun-96	245	15.8	19.34	27.07	-7.73	-89.88	89.88
Jun-96	300	15.91	19.3	26.96	-7.66	-97.54	97.54
Jun-96	315	15.85	19.24	26.85	-7.61	-105.15	105.15
Jun-96	330	15.87	19.2	26.76	-7.56	-112.71	112.71
Jun-96	345	15.81	19.12	26.66	-7.54	-120.25	120.25
Jun-96	400	15.64	18.97	26.55	-7.58	-127.83	127.83
Jun-96	415	15.56	18.78	26.46	-7.68	-135.51	135.51
Jun-96	430	15.51	18.65	26.37	-7.72	-143.23	143.23
Jun-96	445	15.36	18.54	26.27	-7.73	-150.96	150.96
Jun-96	500	15.08	18.52	26.18	-7.66	-158.62	158.62
Jun-96	515	15.2	18.68	26.09	-7.41	-166.03	166.03
Jun-96	530	15.35	18.85	26	-7.15	-173.18	173.18
Jun-96	545	15.41	19.11	25.92	-6.81	-179.99	179.99
Jun-96	600	15.34	19.43	25.83	-6.40	-186.39	186.39
Jun-96	615	15.37	19.7	25.74	-6.04	-192.43	192.43
Jun-96	630	15.47	20.01	25.66	-5.65	-198.08	198.08
Jun-96	645	15.45	20.12	25.58	-5.46	-203.54	203.54
Jun-96	700	16.01	20.42	25.5	-5.08	-208.62	208.62
Jun-96	715	15.53	20.8	25.42	-4.62	-213.24	213.24
Jun-96	730	15.72	21.01	25.35	-4.34	-217.58	217.58
Jun-96	745	15.68	20.96	25.28	-4.32	-221.90	221.90
Jun-96	800	15.71	20.94	25.21	-4.27	-226.17	226.17
Jun-96	815	16.03	21.52	25.16	-3.64	-229.81	229.81
Jun-96	830	16.19	22.55	25.09	-2.54	-232.35	232.35
Jun-96	845	16.55	23.94	25.04	-1.10	-233.45	233.45
Jun-96	900	16.89	26.56	25	1.56	-231.89	235.01
Jun-96	915	17.07	28.55	24.94	3.61	-228.28	238.62
Jun-96	930	17.46	30.31	24.9	5.41	-222.87	244.03
Jun-96	945	17.54	31.28	24.86	6.42	-216.45	250.45
Jun-96	1000	17.83	31.97	24.84	7.13	-209.32	257.58
Jun-96	1015	17.82	32.61	24.82	7.79	-201.53	265.37
Jun-96	1030	17.49	31.7	24.82	6.88	-194.65	272.25
Jun-96	1045	18.19	33.15	24.84	8.31	-186.34	280.56
Jun-96	1100	18.7	36	24.86	11.14	-175.20	291.70
Jun-96	1115	18.57	37.17	24.91	12.26	-162.94	303.96
Jun-96	1130	18.69	38.14	24.97	13.17	-149.77	317.13
Jun-96	1145	18.7	39.74	25.02	14.72	-135.05	331.85
Jun-96	1200	18.86	40.21	25.1	15.11	-119.94	346.96
Jun-96	1215	18.79	40.65	25.19	15.46	-104.48	362.42
Jun-96	1230	18.5	38.34	25.29	13.05	-91.43	375.47
Jun-96	1245	18.48	36.38	25.4	10.98	-80.45	386.45
Jun-96	1300	18.46	35.28	25.52	9.76	-70.69	396.21
Jun-96	1315	18.18	34.75	25.65	9.10	-61.59	405.31
Jun-96	1330	17.96	33.25	25.8	7.45	-54.14	412.76
Jun-96	1345	17.81	32.03	25.93	6.10	-48.04	418.86
Jun-96	1400	17.24	30.98	26.07	4.91	-43.13	423.77

Table 5: June 24, 1996 CTB PCC Slab Temperatures

TEST	CTD TIME	TEMP	1.3 CM	29.1 CM	TO BOTTOM			
Jun-96	1430	17.2	29.55	26.34	3.21	-35.97	430.93	
Jun-96	1445	17.35	28.97	26.46	2.51	-33.46	433.44	
Jun-96	1500	16.89	28.41	26.56	1.85	-31.61	435.29	
Jun-96	1515	16.98	27.88	26.66	1.22	-30.39	436.51	
Jun-96	1530	16.81	27.12	26.75	0.37	-30.02	436.88	
Jun-96	1545	16.6	26.44	26.81	-0.37	-30.39	437.25	
Jun-96	1600	16.74	25.84	26.87	-1.03	-31.42	438.28	
Jun-96	1615	16.61	25.4	26.92	-1.52	-32.94	439.80	
Jun-96	1630	16.48	25.12	26.96	-1.84	-34.78	441.64	
Jun-96	1645	16.28	24.68	27	-2.32	-37.10	443.96	
Jun-96	1700	16.43	24.16	27.01	-2.85	-39.95	446.81	
Jun-96	1715	16.3	23.79	27.02	-3.23	-43.18	450.04	
Jun-96	1730	16.44	23.43	27.02	-3.59	-46.77	453.63	
Jun-96	1745	16.26	22.94	27.01	-4.07	-50.84	457.70	
Jun-96	1800	16.09	22.53	27	-4.47	-55.31	462.17	
Jun-96	1815	15.86	22.16	26.99	-4.83	-60.14	467.00	
Jun-96	1830	15.83	21.87	26.96	-5.09	-65.23	472.09	
Jun-96	1845	15.6	21.64	26.93	-5.29	-70.52	477.38	
Jun-96	1900	15.43	21.39	26.89	-5.50	-76.02	482.88	
Jun-96	1915	15.36	21.11	26.84	-5.73	-81.75	488.61	
Jun-96	1930	15.35	20.84	26.79	-5.95	-87.70	494.56	
Jun-96	1945	15.23	20.66	26.74	-6.08	-93.78	500.64	
Jun-96	2000	15.14	20.49	26.68	-6.19	-99.97	506.83	
Jun-96	2015	15.02	20.25	26.63	-6.38	-106.35	513.21	
Jun-96	2030	14.72	19.98	26.56	-6.58	-112.93	519.79	
Jun-96	2045	14.36	19.69	26.49	-6.80	-119.73	526.59	
Jun-96	2100	13.76	18.91	26.43	-7.52	-127.25	534.11	
Jun-96	2115	12.92	17.36	26.36	-9.00	-136.25	543.11	
Jun-96	2130	12.73	16.96	26.28	-9.32	-145.57	552.43	
Jun-96	2145	12.78	15.83	26.21	-10.38	-155.95	562.81	
Jun-96	2200	12.83	15.17	26.14	-10.97	-166.92	573.78	
Jun-96	2215	12.48	15.02	26.06	-11.04	-177.96	584.82	
Jun-96	2230	12.47	15.13	25.98	-10.85	-188.81	595.67	
Jun-96	2245	12.03	15.51	25.88	-10.37	-199.18	606.04	
Jun-96	2300	11.83	15.7	25.79	-10.09	-209.27	616.13	
Jun-96	2315	11.63	15.87	25.68	-9.81	-219.08	625.94	
Jun-96	2330	11.59	15.97	25.58	-9.61	-228.69	635.55	
Jun-96	2345	11.62	16.02	25.47	-9.45	-238.14	645.00	
Jun-96	2400	11.33	16.04	25.36	-9.32	-247.46	654.32	0.01

Jun 24, 1996 SITE 2 ASB

	TIME	AIR TEMP.	SURF. 1.3 cm	BOTTOM 25.4 cm	DIFF. TOP TO BOTTOM	CUM. TOTAL	CUM. ABSOLUTE TOTAL
24-Jun-96	15	15.96	18.45	27.39	-8.94	-8.94	8.94
24-Jun-96	30	15.95	18.35	27.31	-8.96	-17.90	17.90
24-Jun-96	45	16	18.35	27.23	-8.88	-26.78	26.78
24-Jun-96	100	15.91	18.29	27.16	-8.87	-35.65	35.65
24-Jun-96	115	15.89	18.25	27.07	-8.82	-44.47	44.47
24-Jun-96	130	15.95	18.25	26.99	-8.74	-53.21	53.21
24-Jun-96	145	15.92	18.33	26.9	-8.57	-61.78	61.78
24-Jun-96	200	15.89	18.31	26.81	-8.50	-70.28	70.28
24-Jun-96	215	15.73	18.32	26.73	-8.41	-78.69	78.69
24-Jun-96	230	15.86	18.36	26.63	-8.27	-86.96	86.96
24-Jun-96	245	15.91	18.38	26.54	-8.16	-95.12	95.12
24-Jun-96	300	16	18.34	26.46	-8.12	-103.24	103.24
24-Jun-96	315	15.86	18.3	26.37	-8.07	-111.31	111.31
24-Jun-96	330	15.92	18.24	26.29	-8.05	-119.36	119.36
24-Jun-96	345	15.89	18.14	26.2	-8.06	-127.42	127.42
24-Jun-96	400	15.72	17.96	26.11	-8.15	-135.57	135.57
24-Jun-96	415	15.63	17.75	26.02	-8.27	-143.84	143.84
24-Jun-96	430	15.64	17.67	25.94	-8.27	-152.11	152.11
24-Jun-96	445	15.43	17.59	25.86	-8.27	-160.38	160.38
24-Jun-96	500	15.23	17.72	25.77	-8.05	-168.43	168.43
24-Jun-96	515	15.32	18	25.7	-7.70	-176.13	176.13
24-Jun-96	530	15.44	18.27	25.61	-7.34	-183.47	183.47
24-Jun-96	545	15.45	18.54	25.53	-6.99	-190.46	190.46
24-Jun-96	600	15.37	18.92	25.46	-6.54	-197.00	197.00
24-Jun-96	615	15.46	19.27	25.37	-6.10	-203.10	203.10
24-Jun-96	630	15.73	19.65	25.3	-5.65	-208.75	208.75
24-Jun-96	645	15.65	19.76	25.22	-5.46	-214.21	214.21
24-Jun-96	700	16.04	20.25	25.15	-4.90	-219.11	219.11
24-Jun-96	715	15.68	20.63	25.07	-4.44	-223.55	223.55
24-Jun-96	730	15.92	20.78	25	-4.22	-227.77	227.77
24-Jun-96	745	15.84	20.5	24.93	-4.43	-232.20	232.20
24-Jun-96	800	15.86	20.66	24.86	-4.20	-236.40	236.40
24-Jun-96	815	16.08	21.63	24.78	-3.15	-239.55	239.55
24-Jun-96	830	16.37	23.06	24.72	-1.66	-241.21	241.21
24-Jun-96	845	16.9	25.14	24.67	0.47	-240.74	241.68
24-Jun-96	900	17.41	28.88	24.62	4.26	-236.48	245.94
24-Jun-96	915	17.62	31.47	24.57	6.90	-229.58	252.84
24-Jun-96	930	17.7	33.05	24.52	8.53	-221.05	261.37
24-Jun-96	945	18.12	33.95	24.46	9.49	-211.56	270.86
24-Jun-96	1000	18.18	35.15	24.42	10.73	-200.83	281.59
24-Jun-96	1015	18.15	34.72	24.38	10.34	-190.49	291.93
24-Jun-96	1030	17.92	33.46	24.33	9.13	-181.36	301.06
24-Jun-96	1045	18.42	36.27	24.31	11.96	-169.40	313.02
24-Jun-96	1100	19.05	40.66	24.3	16.36	-153.04	329.38
24-Jun-96	1115	19.08	40.97	24.29	16.68	-136.36	346.06
24-Jun-96	1130	19.17	42.23	24.3	17.93	-118.43	363.99
24-Jun-96	1145	19.37	44.24	24.32	19.92	-98.51	383.91
24-Jun-96	1200	19.2	43.96	24.34	19.62	-78.89	403.53

Table 6: June 24, 1996 ASB PCC Slab Temperatures

SITE 2 ASB

	TIME	AIR TEMP	SURF. 1,3 cm	BOTTOM 25,4 cm	DIFF. TOP TO BOTTOM	CUM TOTAL	CUM ABSOLUTE	
24-Jun-96	1215	19.2	43.95	24.37	19.58	-59.31	423.11	
24-Jun-96	1230	18.44	39.73	24.4	15.33	-43.98	438.44	
24-Jun-96	1245	18.41	37.14	24.46	12.68	-31.30	451.12	
24-Jun-96	1300	18.55	36.39	24.53	11.86	-19.44	462.98	
24-Jun-96	1315	18.29	35.24	24.59	10.65	-8.79	473.63	
24-Jun-96	1330	18.07	33.37	24.67	8.70	-0.09	482.33	
24-Jun-96	1345	17.81	31.74	24.77	6.97	6.88	489.30	
24-Jun-96	1400	17.32	30.65	24.86	5.79	12.67	495.09	
24-Jun-96	1415	17.01	29.89	24.95	4.94	17.61	500.03	
24-Jun-96	1430	17.24	29.22	25.06	4.16	21.77	504.19	
24-Jun-96	1445	17.34	28.57	25.16	3.41	25.18	507.60	
24-Jun-96	1500	16.94	27.98	25.26	2.72	27.90	510.32	
24-Jun-96	1515	16.96	27.26	25.35	1.91	29.81	512.23	
24-Jun-96	1530	16.92	26.42	25.44	0.98	30.79	513.21	
24-Jun-96	1545	16.77	25.68	25.53	0.15	30.94	513.36	
24-Jun-96	1600	16.78	25.02	25.61	-0.59	30.35	513.95	
24-Jun-96	1615	16.69	24.61	25.68	-1.07	29.28	515.02	
24-Jun-96	1630	16.62	24.32	25.75	-1.43	27.85	516.45	
24-Jun-96	1645	16.46	23.67	25.81	-2.14	25.71	518.59	
24-Jun-96	1700	16.53	23.08	25.86	-2.78	22.93	521.37	
24-Jun-96	1715	16.33	22.79	25.89	-3.10	19.83	524.47	
24-Jun-96	1730	16.38	22.42	25.93	-3.51	16.32	527.98	
24-Jun-96	1745	16.36	21.82	25.96	-4.14	12.18	532.12	
24-Jun-96	1800	16.14	21.39	25.98	-4.59	7.59	536.71	
24-Jun-96	1815	15.94	20.95	25.99	-5.04	2.55	541.75	
24-Jun-96	1830	15.82	20.7	26	-5.30	-2.75	547.05	
24-Jun-96	1845	15.51	20.49	26	-5.51	-8.26	552.56	
24-Jun-96	1900	15.36	20.14	25.99	-5.85	-14.11	558.41	
24-Jun-96	1915	15.35	19.83	25.98	-6.15	-20.26	564.56	
24-Jun-96	1930	15.34	19.57	25.97	-6.40	-26.66	570.96	
24-Jun-96	1945	15.31	19.45	25.94	-6.49	-33.15	577.45	
24-Jun-96	2000	15.27	19.31	25.92	-6.61	-39.76	584.06	
24-Jun-96	2015	15.08	18.97	25.89	-6.92	-46.68	590.98	
24-Jun-96	2030	14.73	18.63	25.86	-7.23	-53.91	598.21	
24-Jun-96	2045	14.21	18.41	25.82	-7.41	-61.32	605.62	
24-Jun-96	2100	13.76	16.89	25.78	-8.89	-70.21	614.51	
24-Jun-96	2115	13.04	15.04	25.73	-10.69	-80.90	625.20	
24-Jun-96	2130	12.96	14.98	25.68	-10.70	-91.60	635.90	
24-Jun-96	2145	12.73	13.97	25.63	-11.66	-103.26	647.56	
24-Jun-96	2200	12.83	13.59	25.58	-11.99	-115.25	659.55	
24-Jun-96	2215	12.53	13.42	25.51	-12.09	-127.34	671.64	
24-Jun-96	2230	12.4	13.69	25.46	-11.77	-139.11	683.41	
24-Jun-96	2245	11.98	14.33	25.39	-11.06	-150.17	694.47	
24-Jun-96	2300	11.76	14.57	25.33	-10.76	-160.93	705.23	
24-Jun-96	2315	11.63	14.78	25.26	-10.48	-171.41	715.71	
24-Jun-96	2330	11.67	14.92	25.18	-10.26	-181.67	725.97	
24-Jun-96	2345	11.69	14.99	25.11	-10.12	-191.79	736.09	
24-Jun-96	2400	11.36	15.06	25.03	-9.97	-201.76	746.06	0.00746

	TIME	AIR TEMP.	SURF. 1.3 cm	BOTTOM 24.1 cm	DIFF. TOP TO BOTTOM	CUM. TOTAL	CUM. ABSOLUTE TOTAL
24-Dec-96	15	-8.9	-4.96	2.07	-7.03	-7.03	7.03
24-Dec-96	30	-9.01	-5.09	2.01	-7.10	-14.13	14.13
24-Dec-96	45	-7.94	-5.14	1.94	-7.08	-21.21	21.21
24-Dec-96	100	-8.71	-5.21	1.88	-7.09	-28.30	28.30
24-Dec-96	115	-9.69	-5.39	1.82	-7.21	-35.51	35.51
24-Dec-96	130	-9.24	-5.48	1.75	-7.23	-42.74	42.74
24-Dec-96	145	-9.51	-5.5	1.69	-7.19	-49.93	49.93
24-Dec-96	200	-9.26	-5.56	1.63	-7.19	-57.12	57.12
24-Dec-96	215	-8.57	-5.58	1.58	-7.16	-64.28	64.28
24-Dec-96	230	-9.06	-5.63	1.51	-7.14	-71.42	71.42
24-Dec-96	245	-10.01	-5.76	1.44	-7.20	-78.62	78.62
24-Dec-96	300	-9.85	-5.82	1.38	-7.20	-85.82	85.82
24-Dec-96	315	-9.77	-5.86	1.33	-7.19	-93.01	93.01
24-Dec-96	330	-9.39	-5.88	1.26	-7.14	-100.15	100.15
24-Dec-96	345	-9.64	-5.96	1.2	-7.16	-107.31	107.31
24-Dec-96	400	-9.61	-6.06	1.14	-7.20	-114.51	114.51
24-Dec-96	415	-9.87	-6.17	1.08	-7.25	-121.76	121.76
24-Dec-96	430	-10	-6.31	1.03	-7.34	-129.10	129.10
24-Dec-96	445	-9.78	-6.43	0.97	-7.40	-136.50	136.50
24-Dec-96	500	-10.66	-6.58	0.91	-7.49	-143.99	143.99
24-Dec-96	515	-10.83	-6.77	0.85	-7.62	-151.61	151.61
24-Dec-96	530	-11	-6.9	0.8	-7.70	-159.31	159.31
24-Dec-96	545	-10.12	-7.02	0.74	-7.76	-167.07	167.07
24-Dec-96	600	-9.81	-7.08	0.68	-7.76	-174.83	174.83
24-Dec-96	615	-11.43	-7.25	0.63	-7.88	-182.71	182.71
24-Dec-96	630	-11.45	-7.44	0.58	-8.02	-190.73	190.73
24-Dec-96	645	-11.3	-7.52	0.52	-8.04	-198.77	198.77
24-Dec-96	700	-11.08	-7.53	0.46	-7.99	-206.76	206.76
24-Dec-96	715	-10.66	-7.51	0.4	-7.91	-214.67	214.67
24-Dec-96	730	-10.53	-7.49	0.34	-7.83	-222.50	222.50
24-Dec-96	745	-11.12	-7.43	0.29	-7.72	-230.22	230.22
24-Dec-96	800	-10.54	-7.13	0.23	-7.36	-237.58	237.58
24-Dec-96	815	-9.55	-6.5	0.17	-6.67	-244.25	244.25
24-Dec-96	830	-8.46	-5.83	0.11	-5.94	-250.19	250.19
24-Dec-96	845	-7.47	-5.09	0.06	-5.15	-255.34	255.34
24-Dec-96	900	-6.73	-4.11	0.02	-4.13	-259.47	259.47
24-Dec-96	915	-6.16	-3.27	-0.03	-3.24	-262.71	262.71
24-Dec-96	930	-6.19	-2.68	-0.05	-2.63	-265.34	265.34
24-Dec-96	945	-6.44	-2.45	-0.07	-2.38	-267.72	267.72
24-Dec-96	1000	-7.47	-2.11	-0.08	-2.03	-269.75	269.75
24-Dec-96	1015	-6.33	-1.78	-0.1	-1.68	-271.43	271.43
24-Dec-96	1030	-4.65	-1.19	-0.11	-1.08	-272.51	272.51
24-Dec-96	1045	-4.5	-0.35	-0.13	-0.22	-272.73	272.73
24-Dec-96	1100	-5.05	0.32	-0.13	0.45	-272.28	273.18
24-Dec-96	1115	-4.78	0.87	-0.14	1.01	-271.27	274.19
24-Dec-96	1130	-3.68	1.9	-0.14	2.04	-269.23	276.23
24-Dec-96	1145	-2.97	2.72	-0.14	2.86	-266.37	279.09
24-Dec-96	1200	-2.82	3.39	-0.13	3.52	-262.85	282.61

Table 7: December 24, 1996 CTB PCC Slab Temperatures

SITE 1 CTB

24-Dec-96	1215	-1.89	4.02	-0.12	4.14	-258.71	286.75	
24-Dec-96	1230	-2.11	4.55	-0.1	4.65	-254.06	291.40	
24-Dec-96	1245	-2.16	5.04	-0.08	5.12	-248.94	296.52	
24-Dec-96	1300	-1.95	5.4	-0.06	5.46	-243.48	301.98	
24-Dec-96	1315	-1.03	5.4	-0.04	5.44	-238.04	307.42	
24-Dec-96	1330	-0.85	4.92	0	4.92	-233.12	312.34	
24-Dec-96	1345	-0.69	4.47	0.06	4.41	-228.71	316.75	
24-Dec-96	1400	-0.77	4.79	0.14	4.65	-224.06	321.40	
24-Dec-96	1415	-1.29	4.76	0.24	4.52	-219.54	325.92	
24-Dec-96	1430	-1.2	4.23	0.33	3.90	-215.64	329.82	
24-Dec-96	1445	-0.9	3.7	0.44	3.26	-212.38	333.08	
24-Dec-96	1500	-1.12	3.12	0.55	2.57	-209.81	335.65	
24-Dec-96	1515	-1.17	2.83	0.65	2.18	-207.63	337.83	
24-Dec-96	1530	-1.54	2.59	0.76	1.83	-205.80	339.66	
24-Dec-96	1545	-1.83	2.11	0.85	1.26	-204.54	340.92	
24-Dec-96	1600	-2.28	1.53	0.93	0.60	-203.94	341.52	
24-Dec-96	1615	-2.83	0.93	1.01	-0.08	-204.02	341.60	
24-Dec-96	1630	-3.43	0.26	1.09	-0.83	-204.85	342.43	
24-Dec-96	1645	-3.82	-0.16	1.15	-1.31	-206.16	343.74	
24-Dec-96	1700	-4.24	-0.5	1.21	-1.71	-207.87	345.45	
24-Dec-96	1715	-4.35	-0.75	1.27	-2.02	-209.89	347.47	
24-Dec-96	1730	-5.13	-1.01	1.31	-2.32	-212.21	349.79	
24-Dec-96	1745	-4.71	-1.23	1.35	-2.58	-214.79	352.37	
24-Dec-96	1800	-5.51	-1.54	1.37	-2.91	-217.70	355.28	
24-Dec-96	1815	-5.88	-1.77	1.4	-3.17	-220.87	358.45	
24-Dec-96	1830	-5.8	-1.97	1.41	-3.38	-224.25	361.83	
24-Dec-96	1845	-5.06	-2.13	1.42	-3.55	-227.80	365.38	
24-Dec-96	1900	-5.54	-2.31	1.42	-3.73	-231.53	369.11	
24-Dec-96	1915	-6.69	-2.56	1.42	-3.98	-235.51	373.09	
24-Dec-96	1930	-6.77	-2.82	1.41	-4.23	-239.74	377.32	
24-Dec-96	1945	-7.05	-3.06	1.39	-4.45	-244.19	381.77	
24-Dec-96	2000	-7.35	-3.28	1.37	-4.65	-248.84	386.42	
24-Dec-96	2015	-7.67	-3.51	1.36	-4.87	-253.71	391.29	
24-Dec-96	2030	-7.23	-3.75	1.33	-5.08	-258.79	396.37	
24-Dec-96	2045	-7.61	-3.9	1.31	-5.21	-264.00	401.58	
24-Dec-96	2100	-8.97	-4.16	1.28	-5.44	-269.44	407.02	
24-Dec-96	2115	-8.72	-4.38	1.25	-5.63	-275.07	412.65	
24-Dec-96	2130	-8.24	-4.41	1.21	-5.62	-280.69	418.27	
24-Dec-96	2145	-8.68	-4.54	1.18	-5.72	-286.41	423.99	
24-Dec-96	2200	-8.68	-4.7	1.14	-5.84	-292.25	429.83	
24-Dec-96	2215	-8.56	-4.86	1.1	-5.96	-298.21	435.79	
24-Dec-96	2230	-9.24	-5.03	1.06	-6.09	-304.30	441.88	
24-Dec-96	2245	-8.86	-5.13	1.01	-6.14	-310.44	448.02	
24-Dec-96	2300	-8.74	-5.14	0.97	-6.11	-316.55	454.13	
24-Dec-96	2315	-8.14	-5.2	0.92	-6.12	-322.67	460.25	
24-Dec-96	2330	-8.93	-5.39	0.88	-6.27	-328.94	466.52	
24-Dec-96	2345	-8.94	-5.55	0.83	-6.38	-335.32	472.90	
24-Dec-96	2400	-9.38	-5.72	0.78	-6.50	-341.82	479.40	0.005

	TIME	AIR TEMP.	SURF. 1.3 cm	BOTTOM 25.4 cm	DIFF. TOP TO BOTTOM	CUM TOTAL	CUM ABSOLUTE TOTAL
24-Dec-96	15	-8.75	-5.4	2.82	-8.22	-8.22	8.22
24-Dec-96	30	-8.99	-5.56	2.77	-8.33	-16.55	16.55
24-Dec-96	45	-8.5	-5.56	2.73	-8.29	-24.84	24.84
24-Dec-96	100	-8.39	-5.65	2.68	-8.33	-33.17	33.17
24-Dec-96	115	-9.05	-5.83	2.63	-8.46	-41.63	41.63
24-Dec-96	130	-9.45	-5.89	2.58	-8.47	-50.10	50.10
24-Dec-96	145	-9.44	-5.93	2.53	-8.46	-58.56	58.56
24-Dec-96	200	-9.53	-6	2.48	-8.48	-67.04	67.04
24-Dec-96	215	-9.07	-6.01	2.43	-8.44	-75.48	75.48
24-Dec-96	230	-9.09	-6.13	2.38	-8.51	-83.99	83.99
24-Dec-96	245	-9.82	-6.28	2.33	-8.61	-92.60	92.60
24-Dec-96	300	-9.81	-6.29	2.28	-8.57	-101.17	101.17
24-Dec-96	315	-9.78	-6.31	2.23	-8.54	-109.71	109.71
24-Dec-96	330	-9.46	-6.38	2.18	-8.56	-118.27	118.27
24-Dec-96	345	-9.41	-6.47	2.12	-8.59	-126.86	126.86
24-Dec-96	400	-9.52	-6.6	2.08	-8.68	-135.54	135.54
24-Dec-96	415	-9.54	-6.75	2.03	-8.78	-144.32	144.32
24-Dec-96	430	-9.85	-6.91	1.98	-8.89	-153.21	153.21
24-Dec-96	445	-9.89	-7.02	1.93	-8.95	-162.16	162.16
24-Dec-96	500	-10.21	-7.22	1.88	-9.10	-171.26	171.26
24-Dec-96	515	-10.76	-7.45	1.83	-9.28	-180.54	180.54
24-Dec-96	530	-10.88	-7.58	1.78	-9.36	-189.90	189.90
24-Dec-96	545	-10.6	-7.64	1.73	-9.37	-199.27	199.27
24-Dec-96	600	-10	-7.66	1.68	-9.34	-208.61	208.61
24-Dec-96	615	-11.11	-7.98	1.63	-9.61	-218.22	218.22
24-Dec-96	630	-11.3	-8.06	1.59	-9.65	-227.87	227.87
24-Dec-96	645	-11.25	-8.08	1.54	-9.62	-237.49	237.49
24-Dec-96	700	-11.14	-8.08	1.49	-9.57	-247.06	247.06
24-Dec-96	715	-10.86	-8.04	1.44	-9.48	-256.54	256.54
24-Dec-96	730	-10.68	-7.99	1.39	-9.38	-265.92	265.92
24-Dec-96	745	-10.81	-7.89	1.34	-9.23	-275.15	275.15
24-Dec-96	800	-10.43	-7.36	1.29	-8.65	-283.80	283.80
24-Dec-96	815	-9.57	-6.56	1.24	-7.80	-291.60	291.60
24-Dec-96	830	-8.43	-5.7	1.19	-6.89	-298.49	298.49
24-Dec-96	845	-7.34	-4.75	1.14	-5.89	-304.38	304.38
24-Dec-96	900	-6.41	-3.51	1.1	-4.61	-308.99	308.99
24-Dec-96	915	-6.02	-2.6	1.05	-3.65	-312.64	312.64
24-Dec-96	930	-5.92	-2.05	1	-3.05	-315.69	315.69
24-Dec-96	945	-6.48	-1.91	0.95	-2.86	-318.55	318.55
24-Dec-96	1000	-7.68	-1.68	0.91	-2.59	-321.14	321.14
24-Dec-96	1015	-6.75	-1.01	0.87	-1.88	-323.02	323.02
24-Dec-96	1030	-5.18	0.07	0.83	-0.76	-323.78	323.78
24-Dec-96	1045	-4.9	0.83	0.81	0.02	-323.76	323.80
24-Dec-96	1100	-5.02	1.37	0.78	0.59	-323.17	324.39
24-Dec-96	1115	-5.15	2.07	0.76	1.31	-321.86	325.70
24-Dec-96	1130	-4.32	3.55	0.74	2.81	-319.05	328.51
24-Dec-96	1145	-3.35	4.41	0.73	3.68	-315.37	332.19
24-Dec-96	1200	-3.41	5.49	0.73	4.76	-310.61	336.95

Table 8: December 24, 1996 ASB PCC Slab Temperatures

SITE 2 ASB

24-Dec-96	1215	-2.65	6.13	0.72	5.41	-305.20	342.36	
24-Dec-96	1230	-2.84	6.38	0.72	5.66	-299.54	348.02	
24-Dec-96	1245	-2.92	7.02	0.73	6.29	-293.25	354.31	
24-Dec-96	1300	-2.78	7.47	0.75	6.72	-286.53	361.03	
24-Dec-96	1315	-1.76	7.34	0.76	6.58	-279.95	367.61	
24-Dec-96	1330	-1.57	6.45	0.79	5.66	-274.29	373.27	
24-Dec-96	1345	-1.51	5.7	0.81	4.89	-269.40	378.16	
24-Dec-96	1400	-1.75	6.27	0.84	5.43	-263.97	383.59	
24-Dec-96	1415	-2.24	5.22	0.88	4.34	-259.63	387.93	
24-Dec-96	1430	-2.11	4.75	0.93	3.82	-255.81	391.75	
24-Dec-96	1445	-1.86	4.19	0.98	3.21	-252.60	394.96	
24-Dec-96	1500	-1.92	3.61	1.04	2.57	-250.03	397.53	
24-Dec-96	1515	-2.1	3.45	1.11	2.34	-247.69	399.87	
24-Dec-96	1530	-2.45	2.85	1.18	1.67	-246.02	401.54	
24-Dec-96	1545	-2.59	2.1	1.24	0.86	-245.16	402.40	
24-Dec-96	1600	-3.04	1.34	1.31	0.03	-245.13	402.43	
24-Dec-96	1615	-3.44	0.52	1.38	-0.86	-245.99	403.29	
24-Dec-96	1630	-3.92	-0.33	1.44	-1.77	-247.76	405.06	
24-Dec-96	1645	-4.24	-0.78	1.51	-2.29	-250.05	407.35	
24-Dec-96	1700	-4.74	-1.07	1.57	-2.64	-252.69	409.99	
24-Dec-96	1715	-5.17	-1.26	1.63	-2.89	-255.58	412.88	
24-Dec-96	1730	-5.46	-1.52	1.68	-3.20	-258.78	416.08	
24-Dec-96	1745	-5.25	-1.71	1.73	-3.44	-262.22	419.52	
24-Dec-96	1800	-5.89	-2.02	1.78	-3.80	-266.02	423.32	
24-Dec-96	1815	-6.07	-2.23	1.82	-4.05	-270.07	427.37	
24-Dec-96	1830	-6.11	-2.48	1.85	-4.33	-274.40	431.70	
24-Dec-96	1845	-5.61	-2.65	1.88	-4.53	-278.93	436.23	
24-Dec-96	1900	-6.22	-2.95	1.89	-4.84	-283.77	441.07	
24-Dec-96	1915	-7.11	-3.32	1.92	-5.24	-289.01	446.31	
24-Dec-96	1930	-7.09	-3.51	1.94	-5.45	-294.46	451.76	
24-Dec-96	1945	-7.18	-3.73	1.95	-5.68	-300.14	457.44	
24-Dec-96	2000	-7.53	-3.98	1.95	-5.93	-306.07	463.37	
24-Dec-96	2015	-7.73	-4.23	1.95	-6.18	-312.25	469.55	
24-Dec-96	2030	-7.46	-4.42	1.96	-6.38	-318.63	475.93	
24-Dec-96	2045	-7.47	-4.55	1.95	-6.50	-325.13	482.43	
24-Dec-96	2100	-8.3	-4.84	1.94	-6.78	-331.91	489.21	
24-Dec-96	2115	-8.51	-4.95	1.94	-6.89	-338.80	496.10	
24-Dec-96	2130	-8.3	-4.9	1.93	-6.83	-345.63	502.93	
24-Dec-96	2145	-8.43	-5.08	1.91	-6.99	-352.62	509.92	
24-Dec-96	2200	-8.63	-5.25	1.89	-7.14	-359.76	517.06	
24-Dec-96	2215	-8.68	-5.47	1.86	-7.33	-367.09	524.39	
24-Dec-96	2230	-8.95	-5.64	1.83	-7.47	-374.56	531.86	
24-Dec-96	2245	-9.12	-5.66	1.82	-7.48	-382.04	539.34	
24-Dec-96	2300	-9.03	-5.64	1.79	-7.43	-389.47	546.77	
24-Dec-96	2315	-8.55	-5.73	1.76	-7.49	-396.96	554.26	
24-Dec-96	2330	-8.74	-6	1.73	-7.73	-404.69	561.99	
24-Dec-96	2345	-8.97	-6.18	1.7	-7.88	-412.57	569.87	
24-Dec-96	2400	-9.23	-6.37	1.66	-8.03	-420.60	577.90	0.006

APPENDIX A

TEST SITE PHOTOGRAPHS

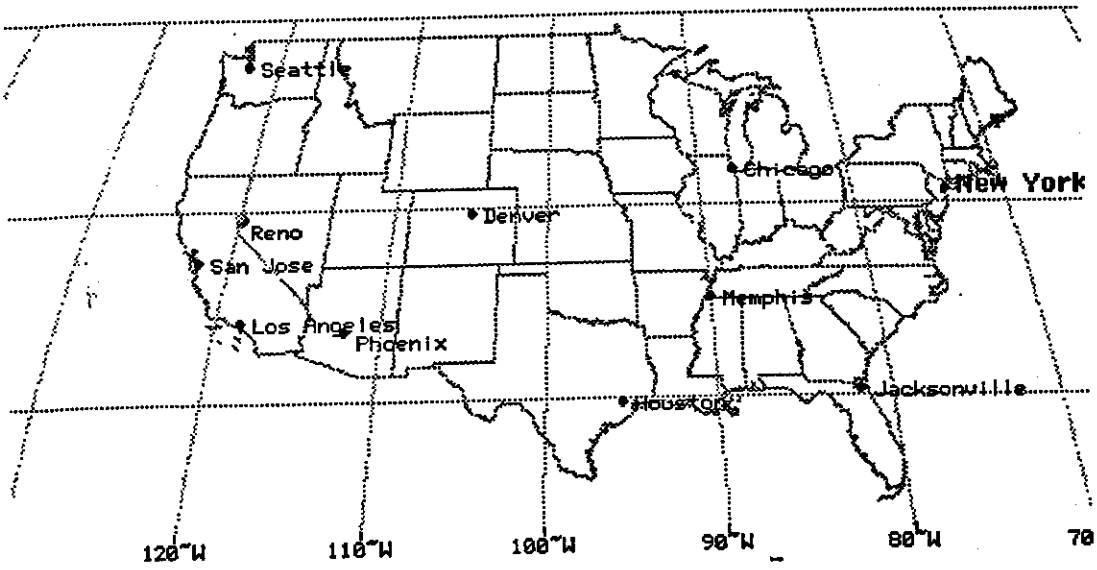


FIGURE A-1: Reno, Nevada Location

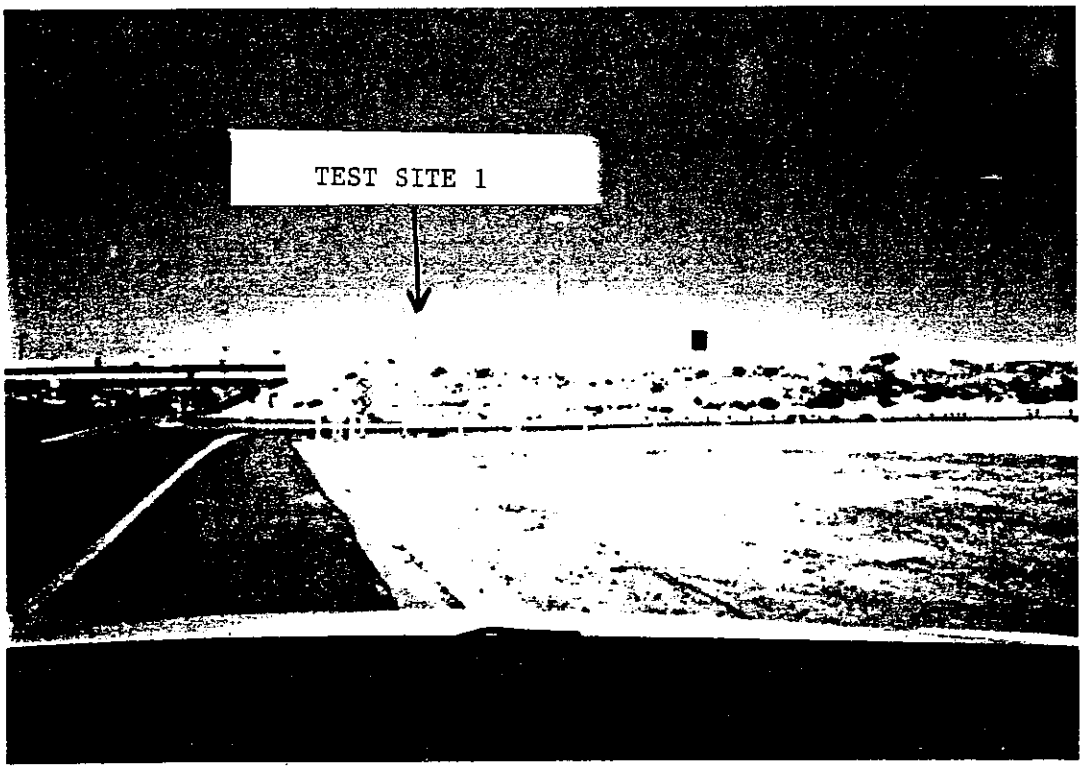


FIGURE A-2: Site 1

FIGURE A-3: Site 2

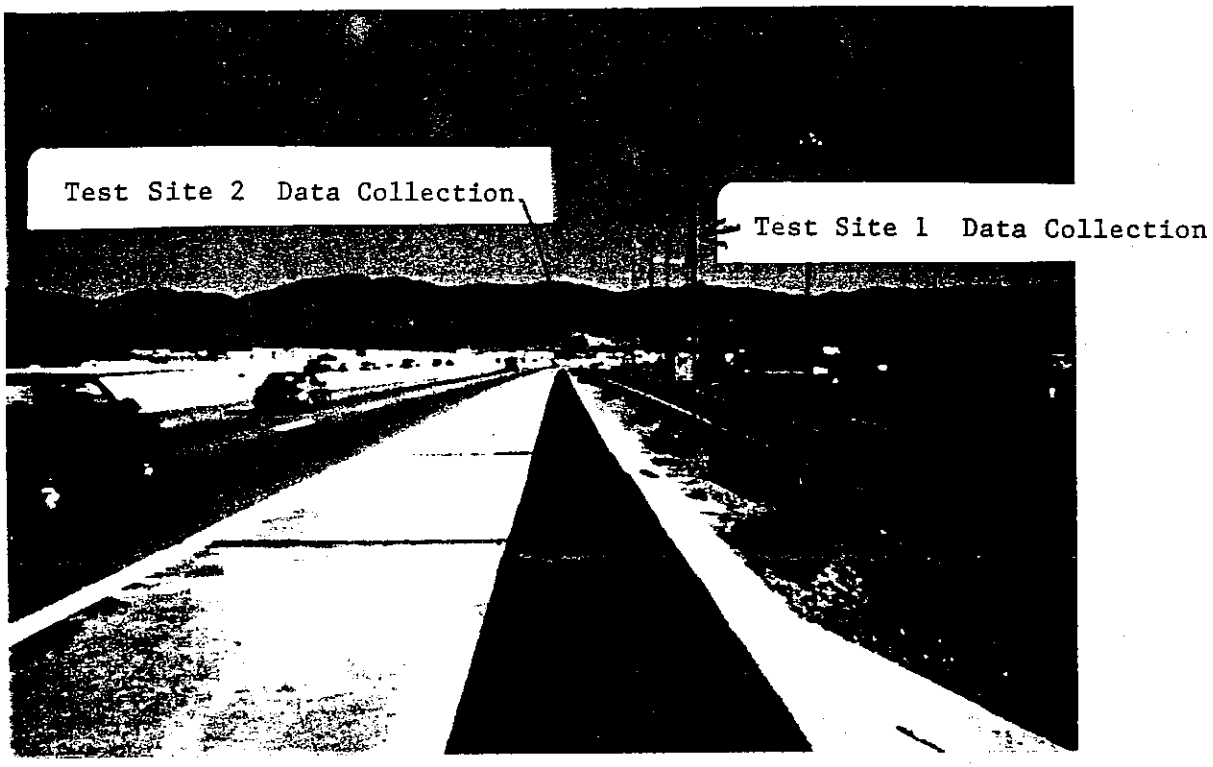


FIGURE A-4: Data Collection Sites

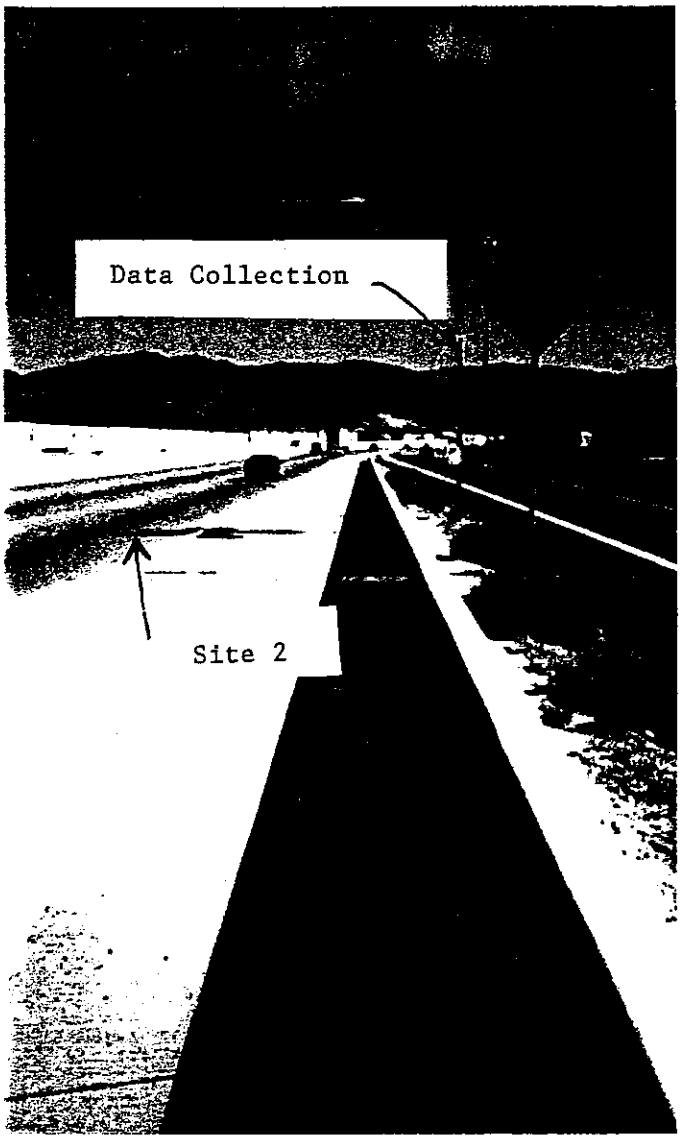


FIGURE A-5: Site 2

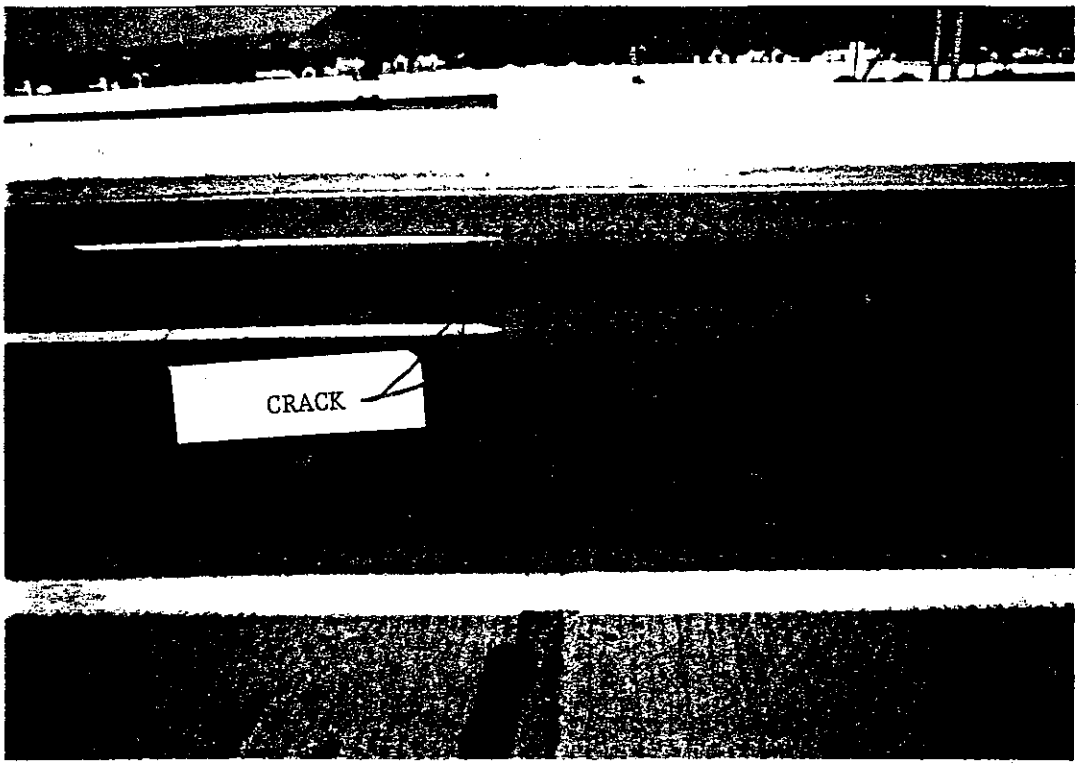


FIGURE A-6: Site 1 Closeup

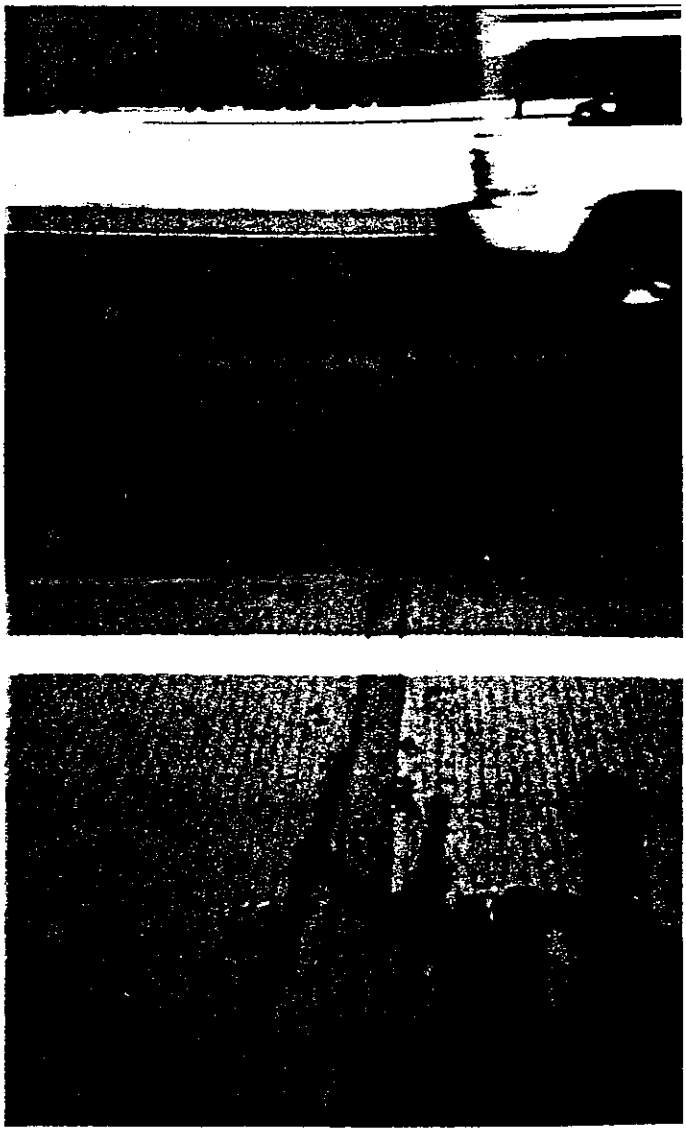


FIGURE A-7: Site 2 Closeup

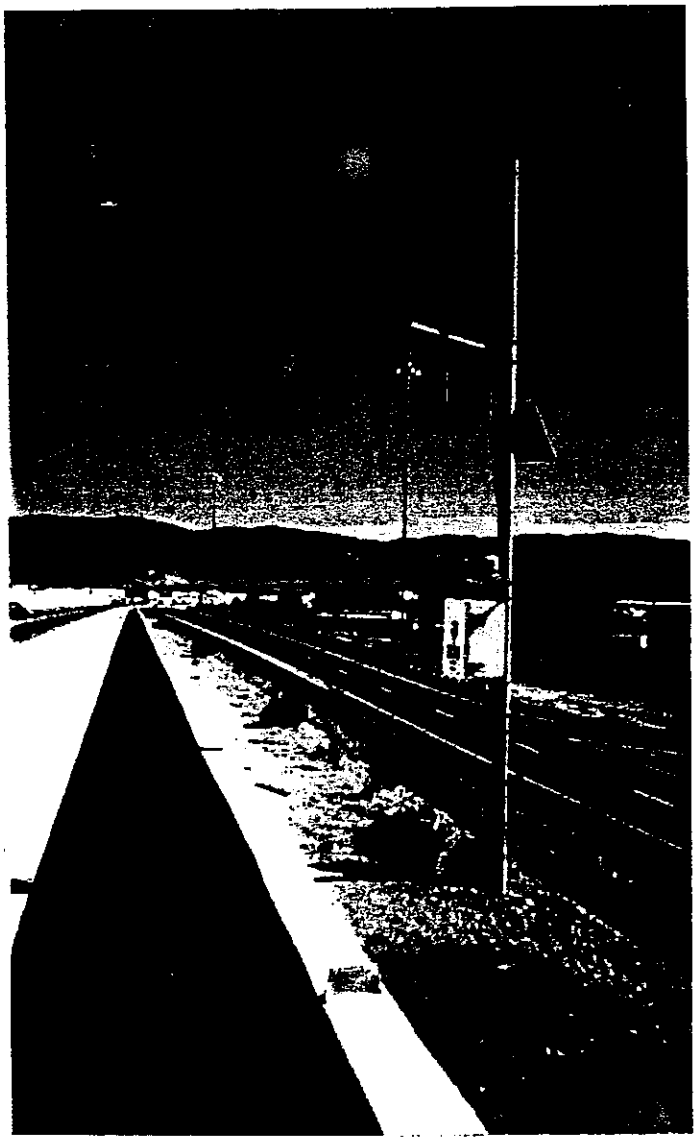


FIGURE A-8: Test Site 1 Data Collection

FIGURE A-9: Closeup of Air Temperature Location, Site 2

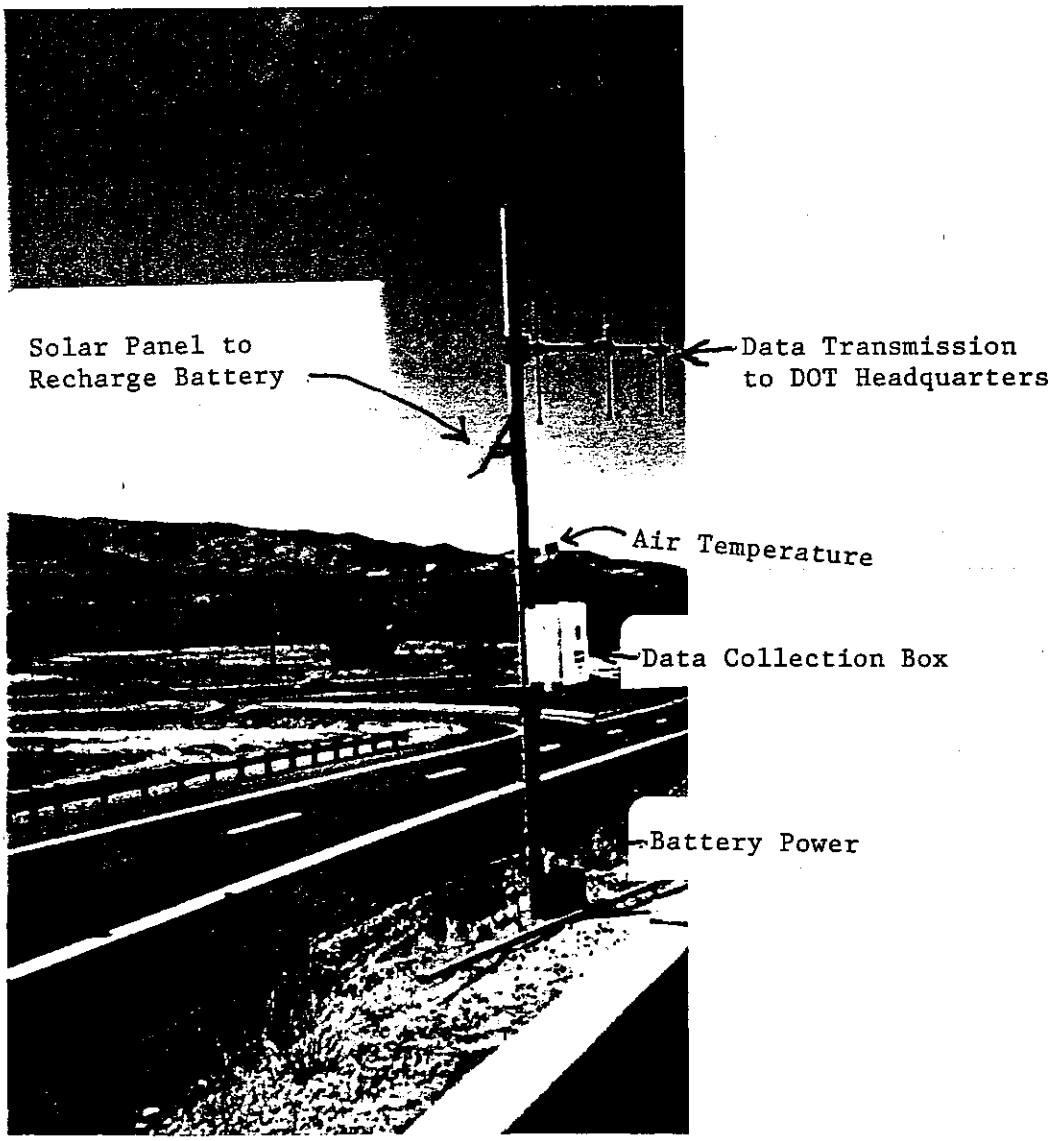


FIGURE A-10: Overall Data Collection System at Site 2

Appendix B

Moisture Measurements

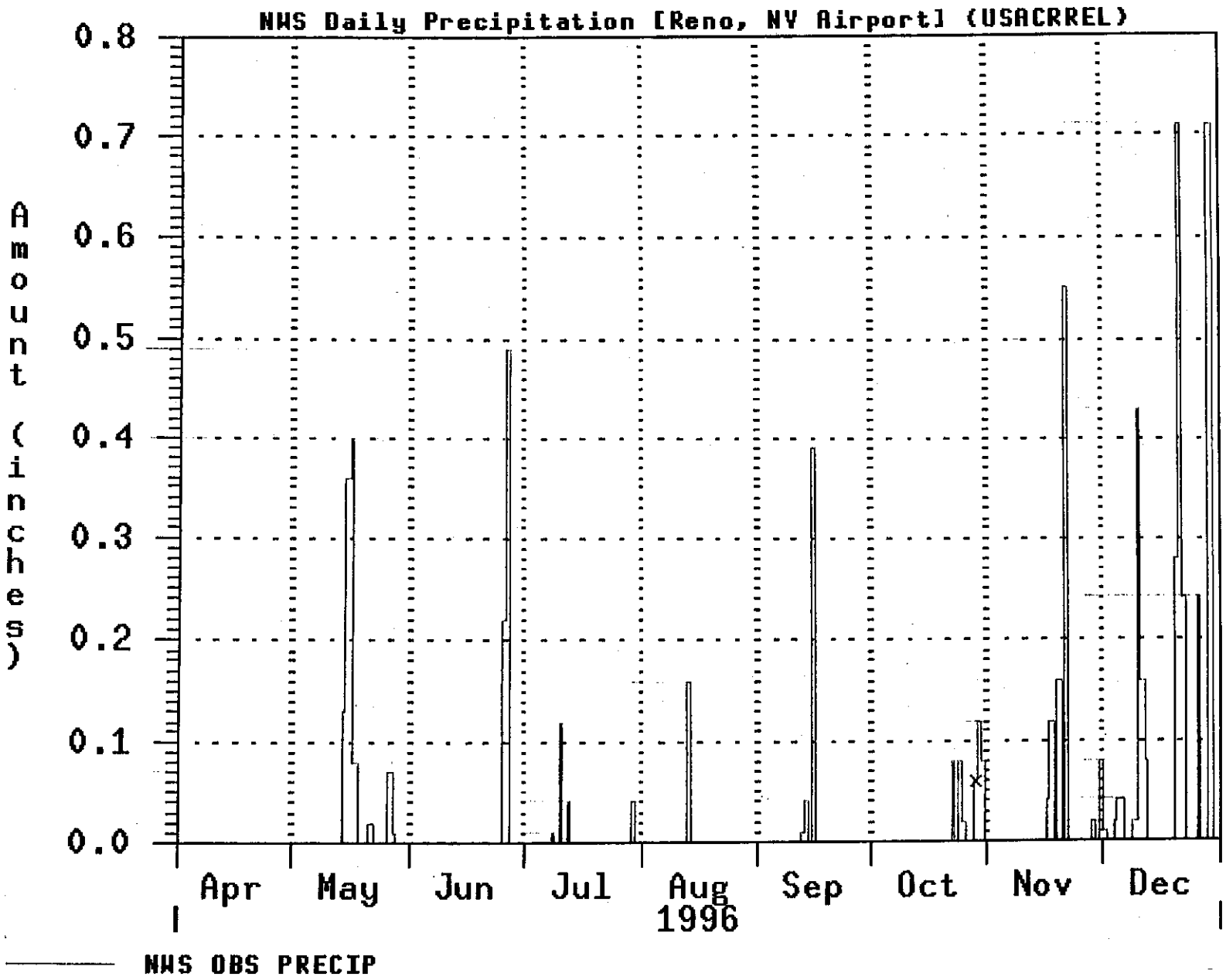
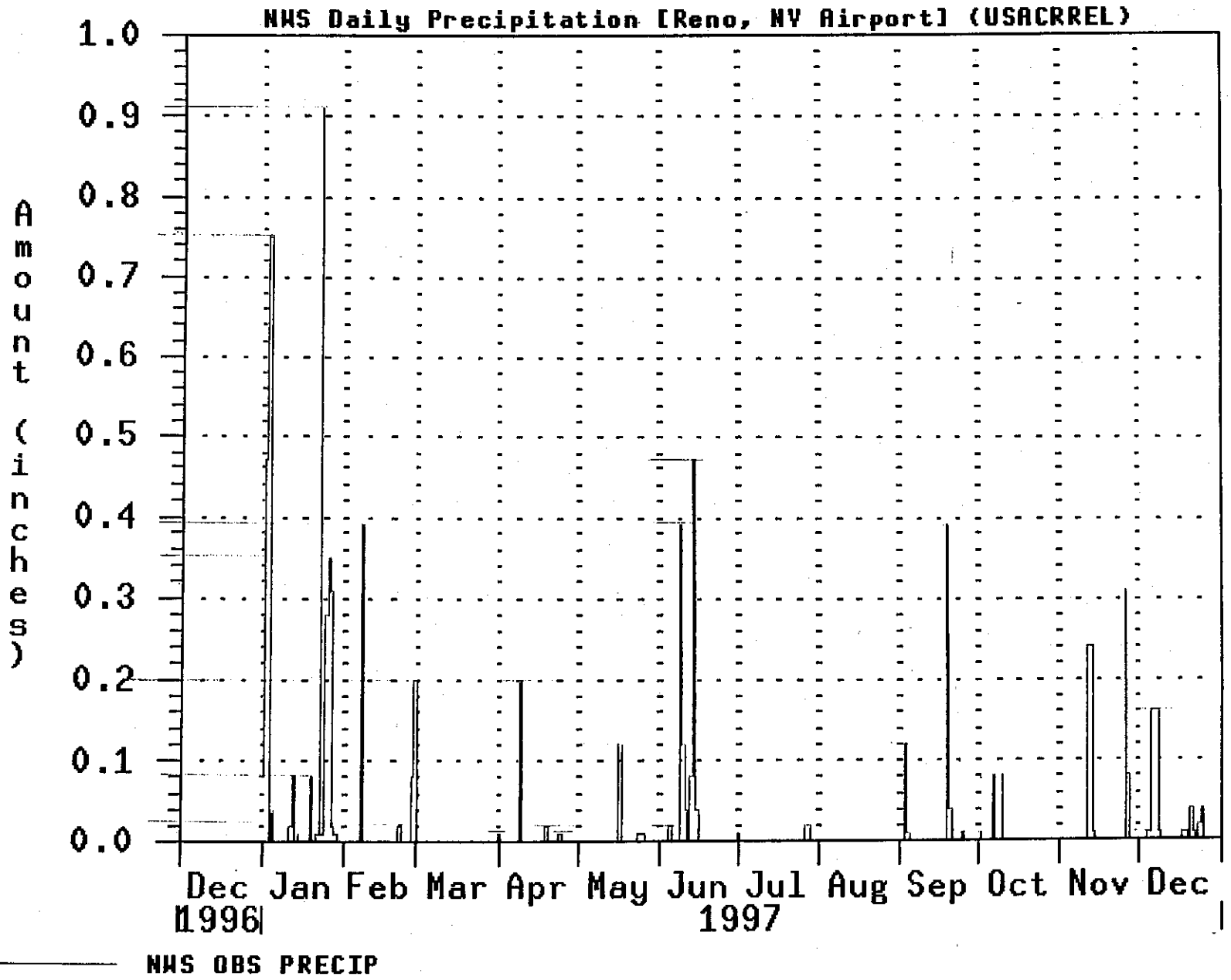


Figure B-1: May 1996 – December 1997 Reno Airport Daily Precipitation


NWS Daily Precipitation [Reno, NV Airport] (USACRREL)
Amount (inches)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1996
1997
NWS OBS PRECIP

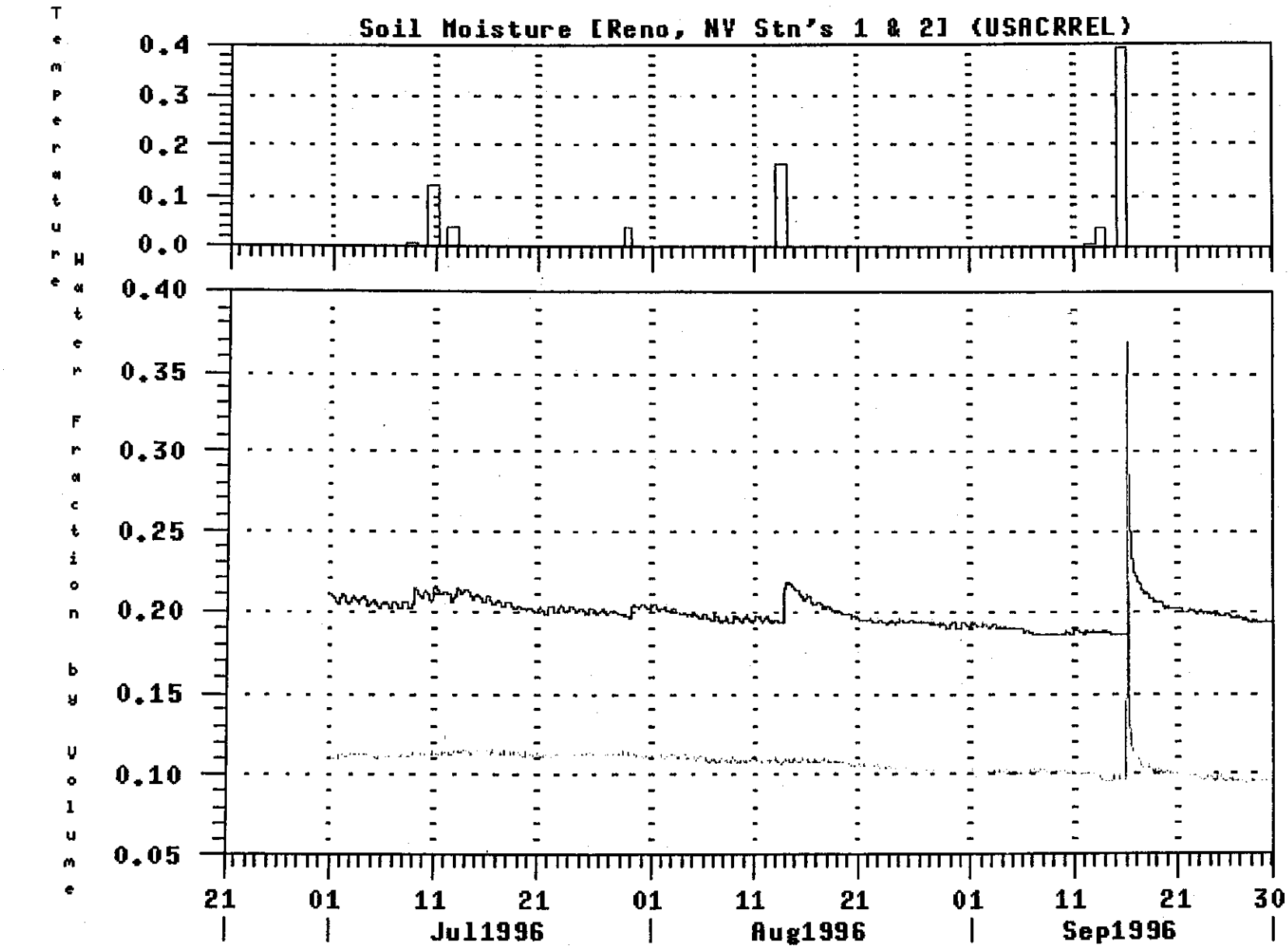
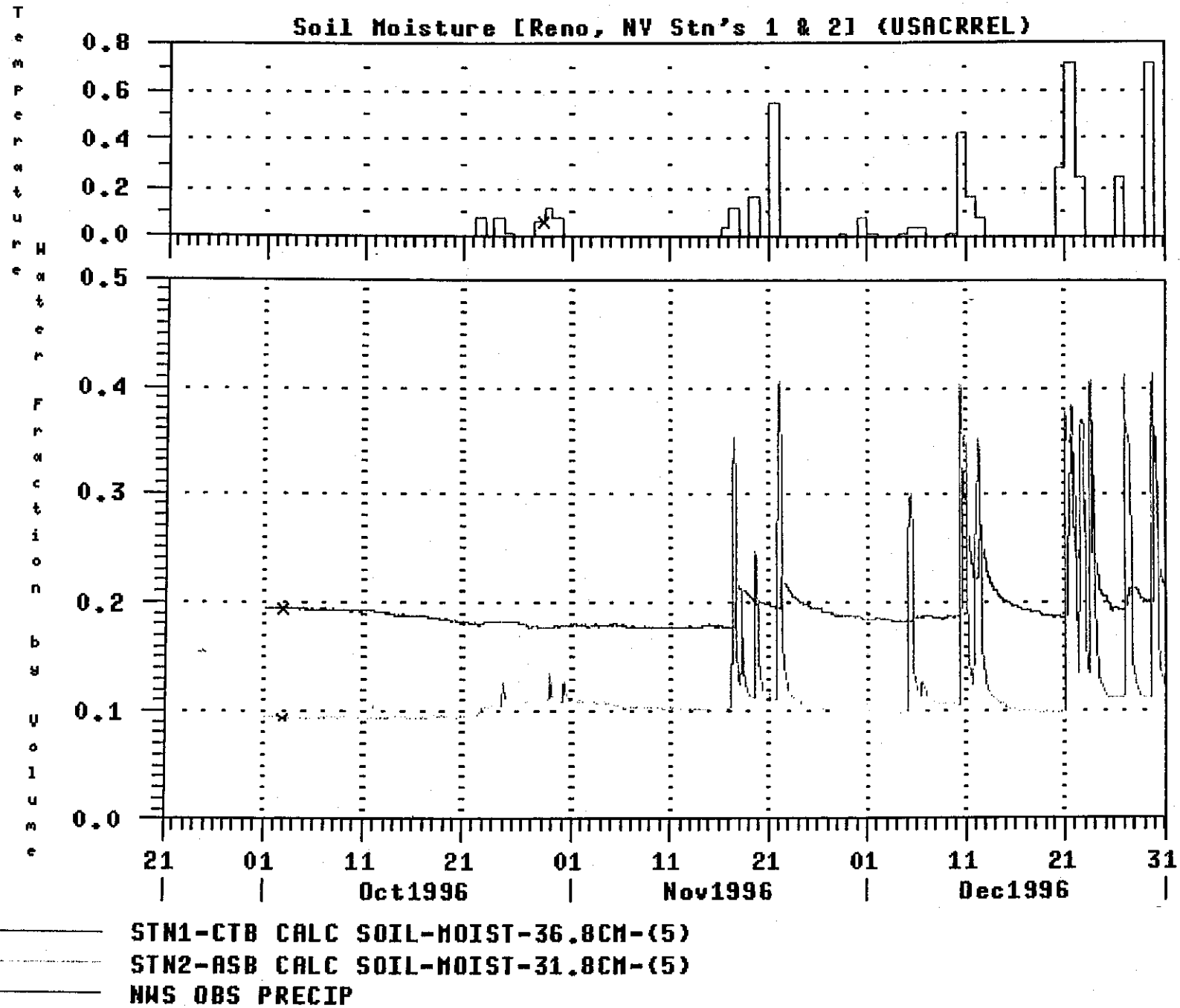
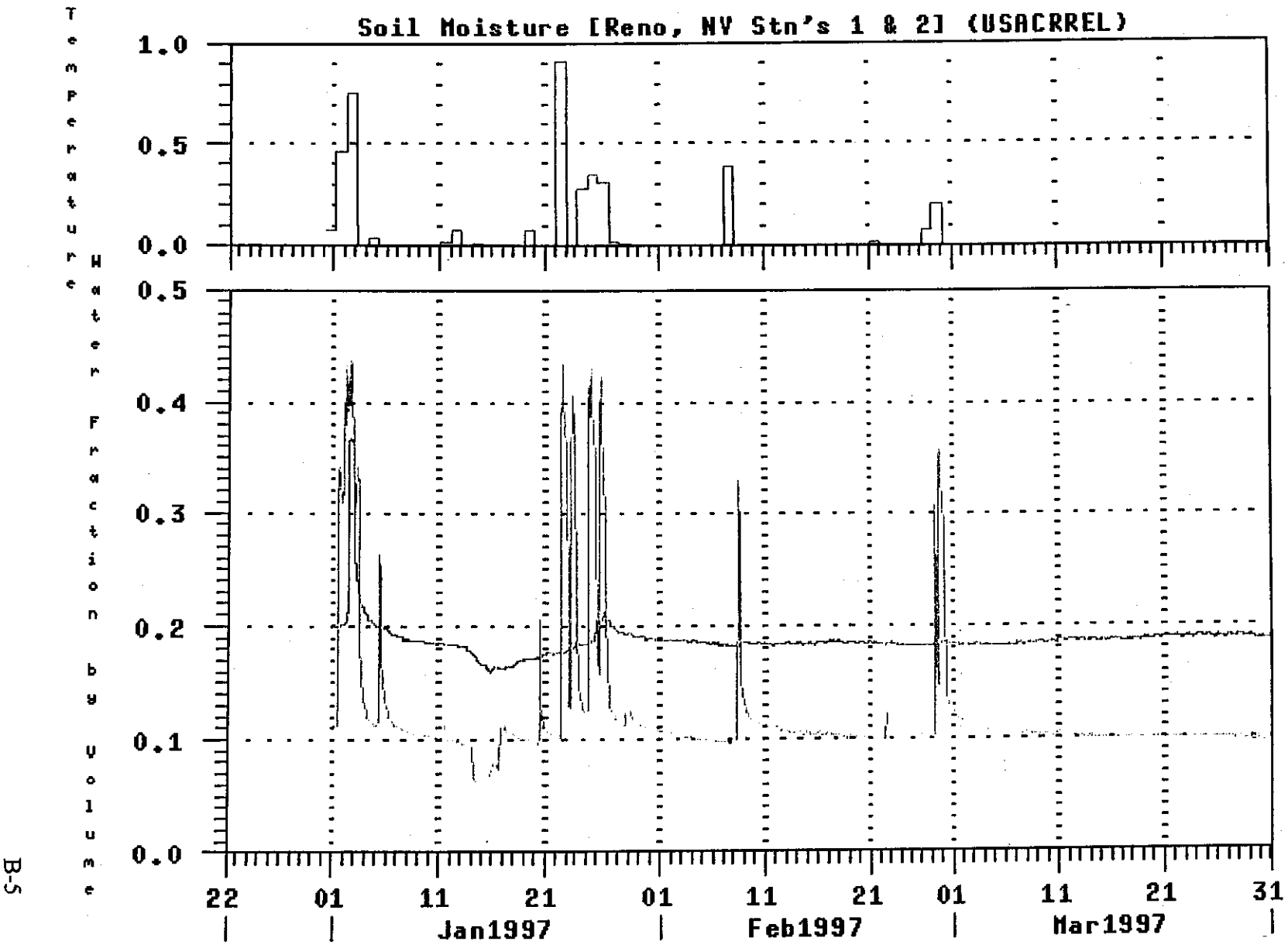
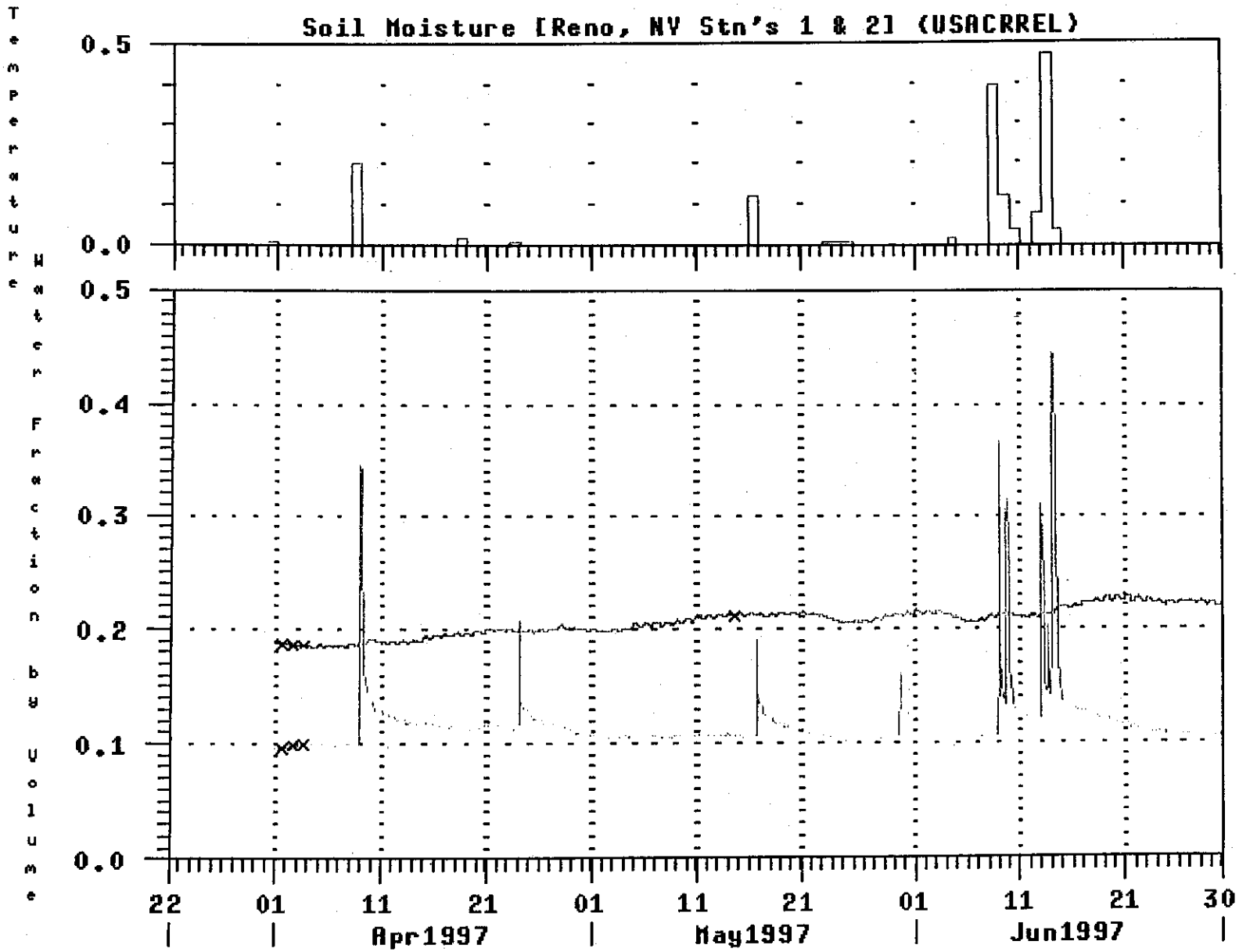


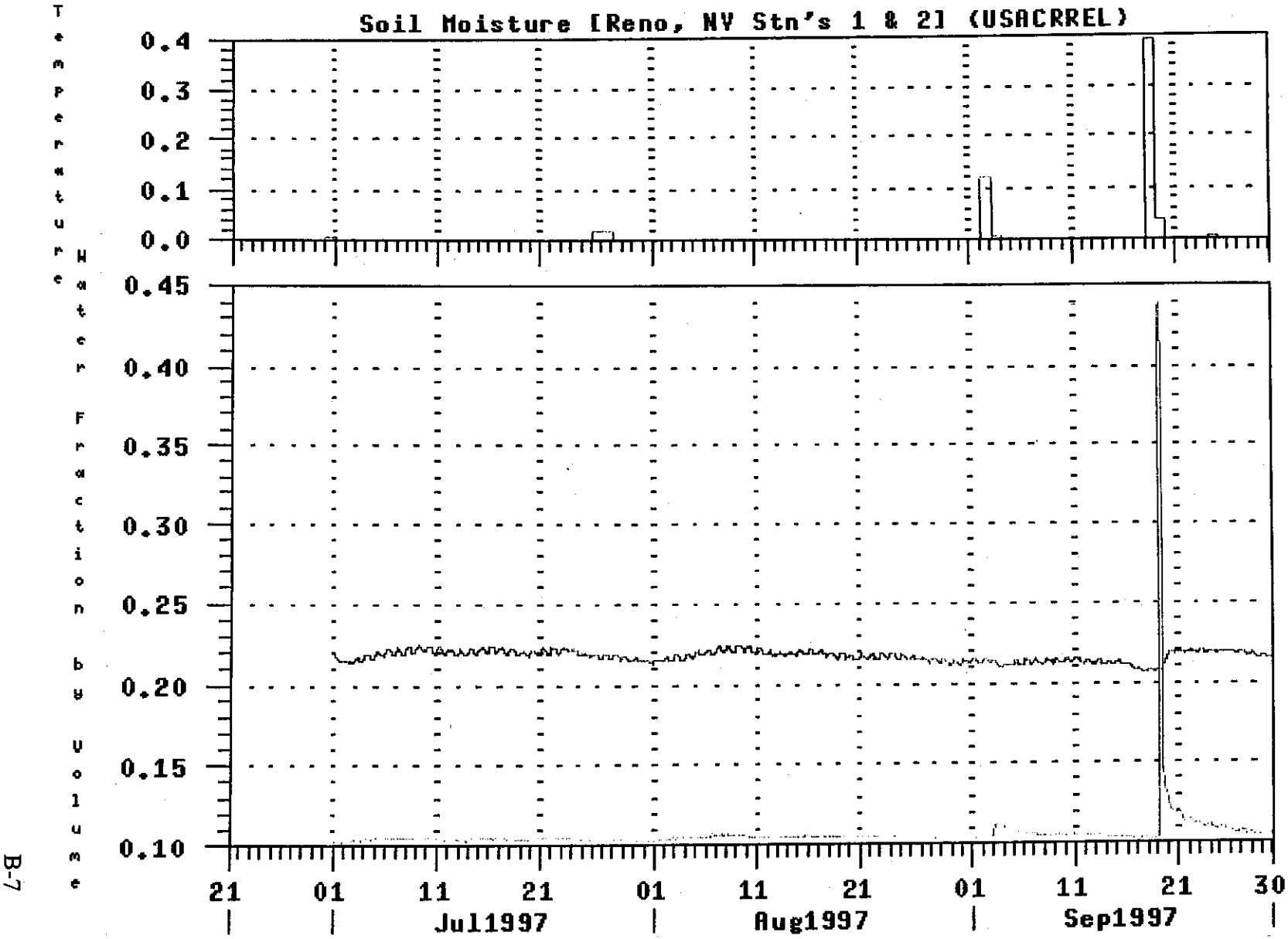
Figure B-2: Station 1 (CTB) Moisture Measurements at 36.8 cm vs. Station 2 (ASB) Moisture Measurements at 31.8 cm Pages B-3 through B-14

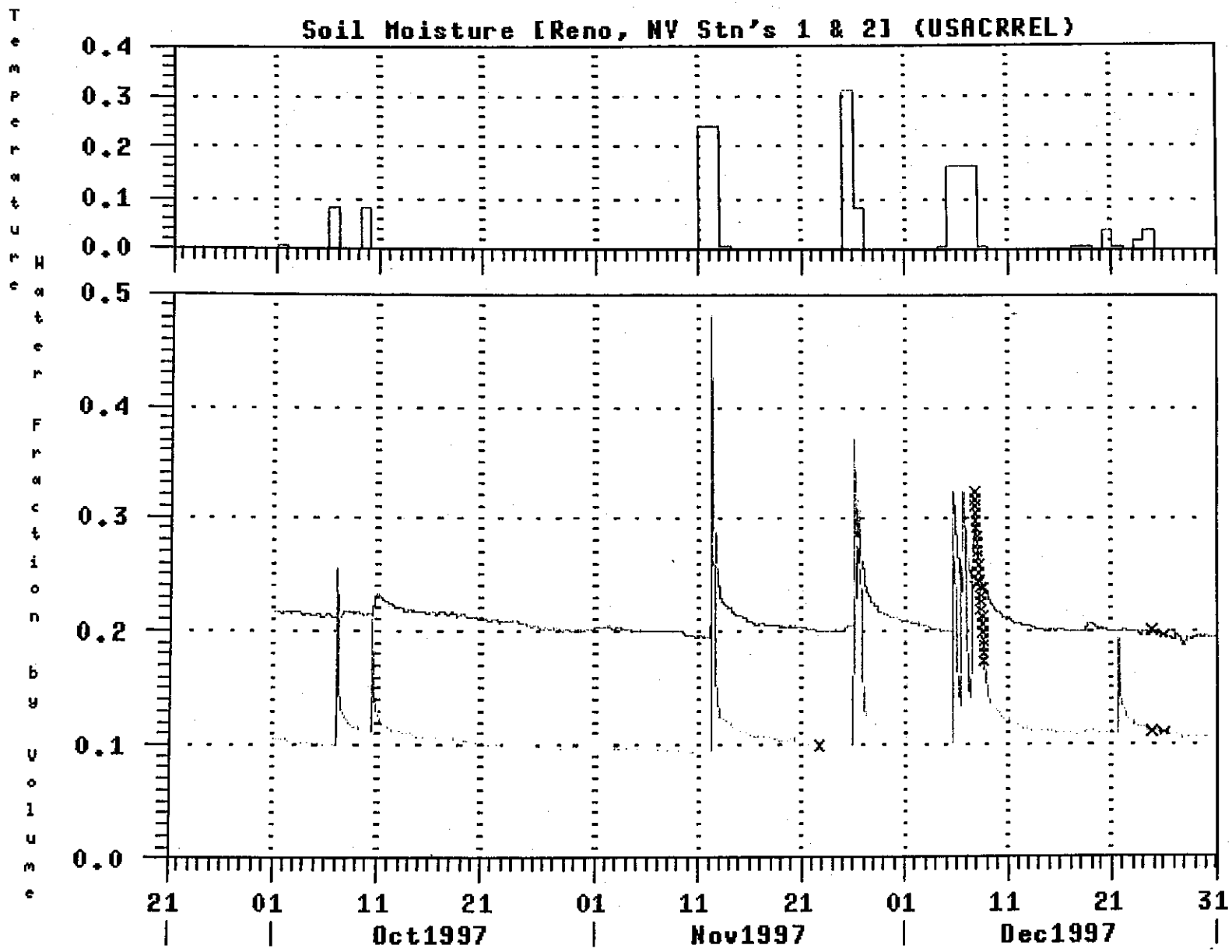

Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Temperature
Water Fraction by Volume
0.8
0.6
0.4
0.2
0.0
0.5
0.4
0.3
0.2
0.1
0.0
21
01
11
21
01
11
21
01
11
21
31
Oct1996
Nov1996
Dec1996
STN1-CTB CALC SOIL-MOIST-36.8CM-(5)
STN2-ASB CALC SOIL-MOIST-31.8CM-(5)
NWS OBS PRECIP

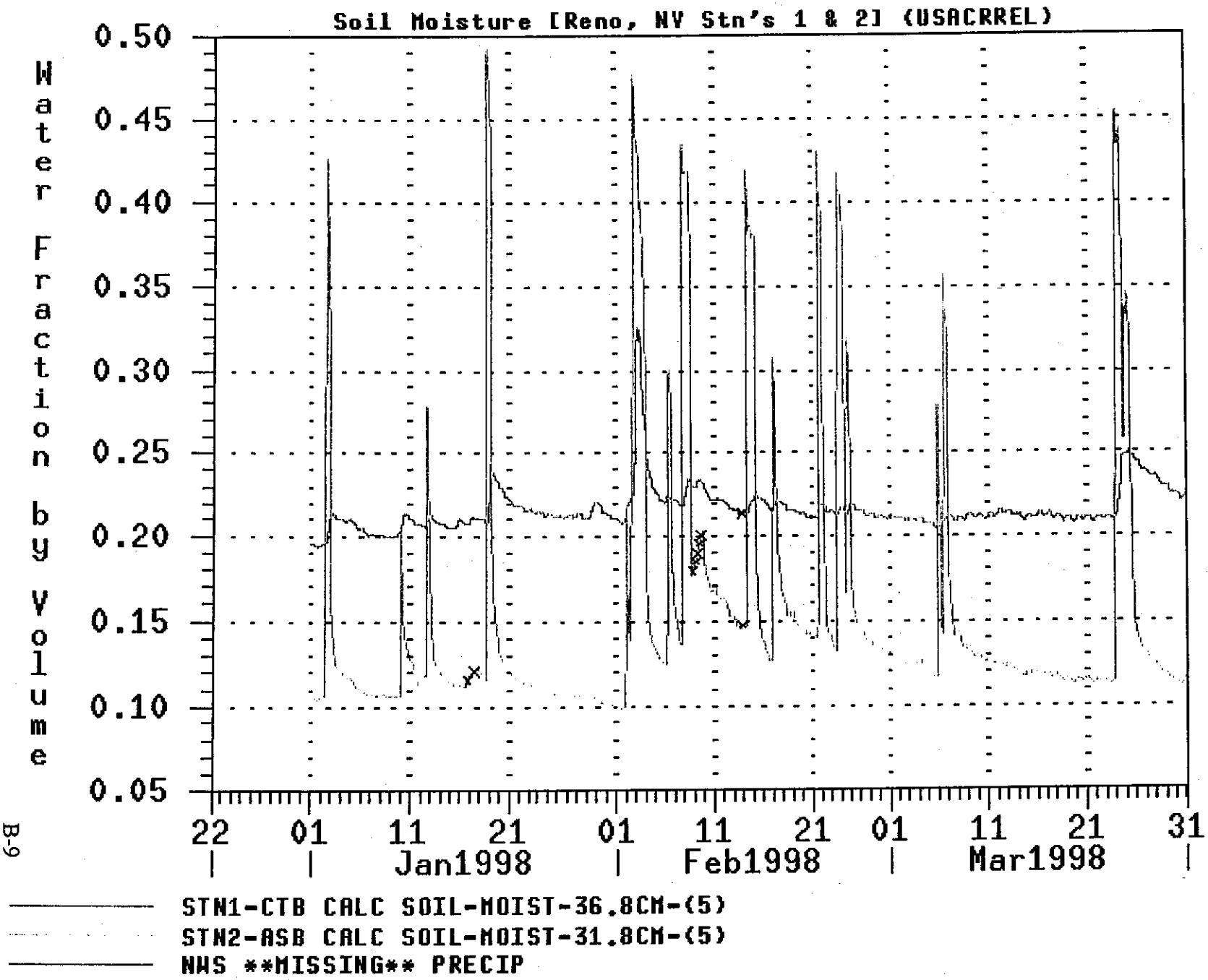
18MAY99 19:10:49

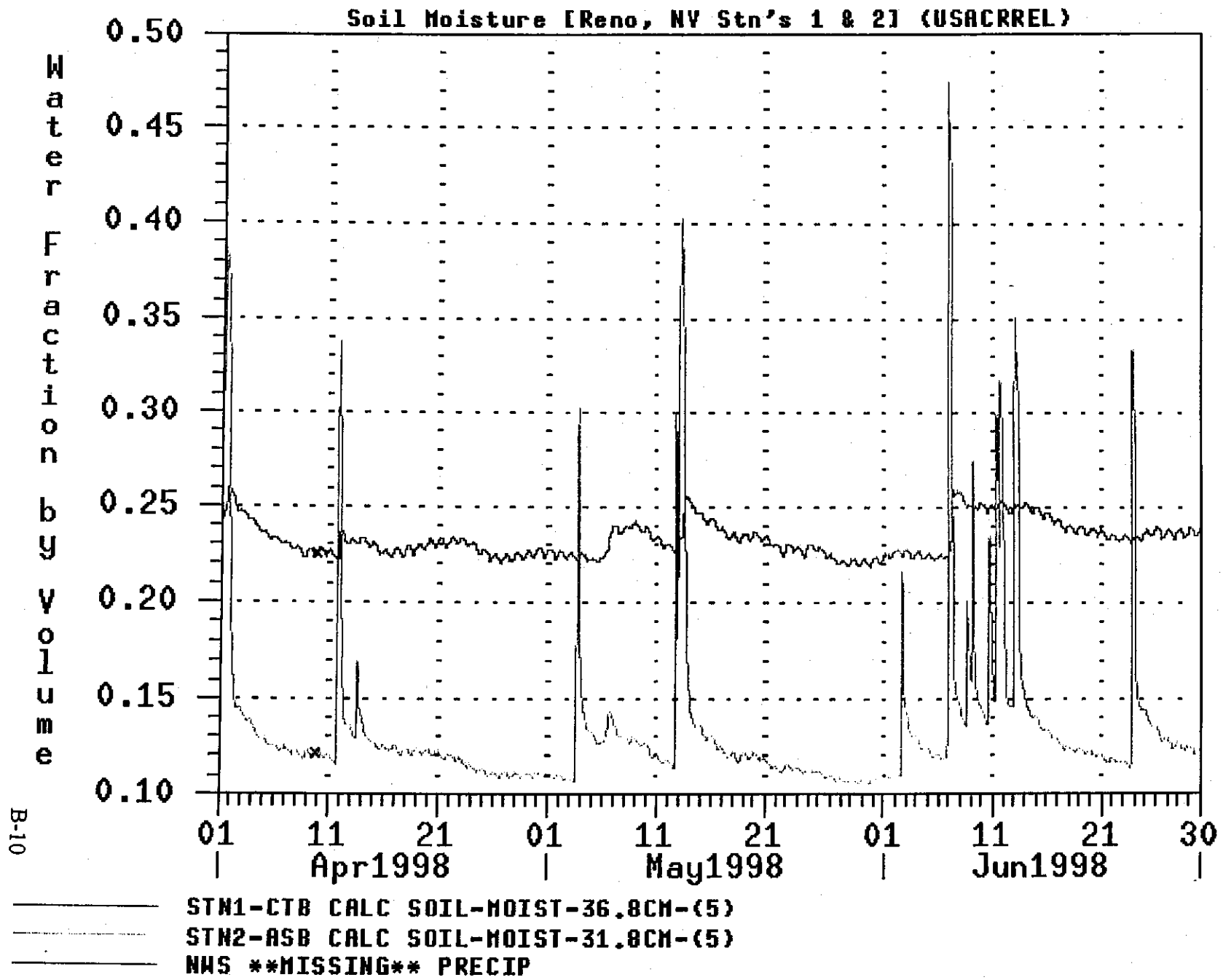


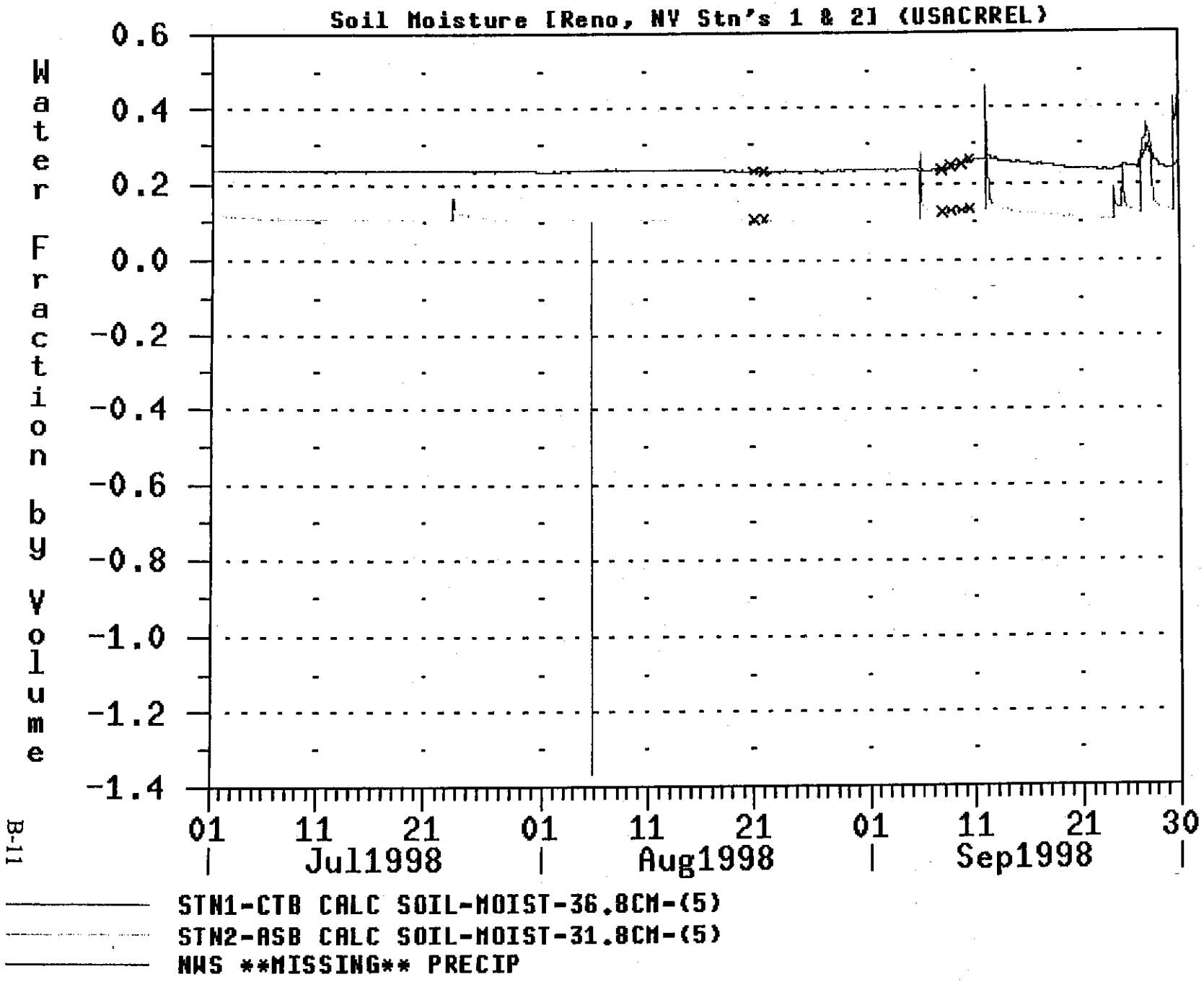

Soil Moisture [Reno, NV Stn's 1 & 21 (USACRREL)
Temperature
0.5
0.0
Water Fraction by Volume
0.5
0.4
0.3
0.2
0.1
0.0
22
01
11
21
01
11
21
01
11
21
30
Apr1997
May1997
Jun1997
STN1-CTB CALC SOIL-MOIST-36.8CM-(5)
STN2-ASB CALC SOIL-MOIST-31.8CM-(5)
NWS OBS PRECIP

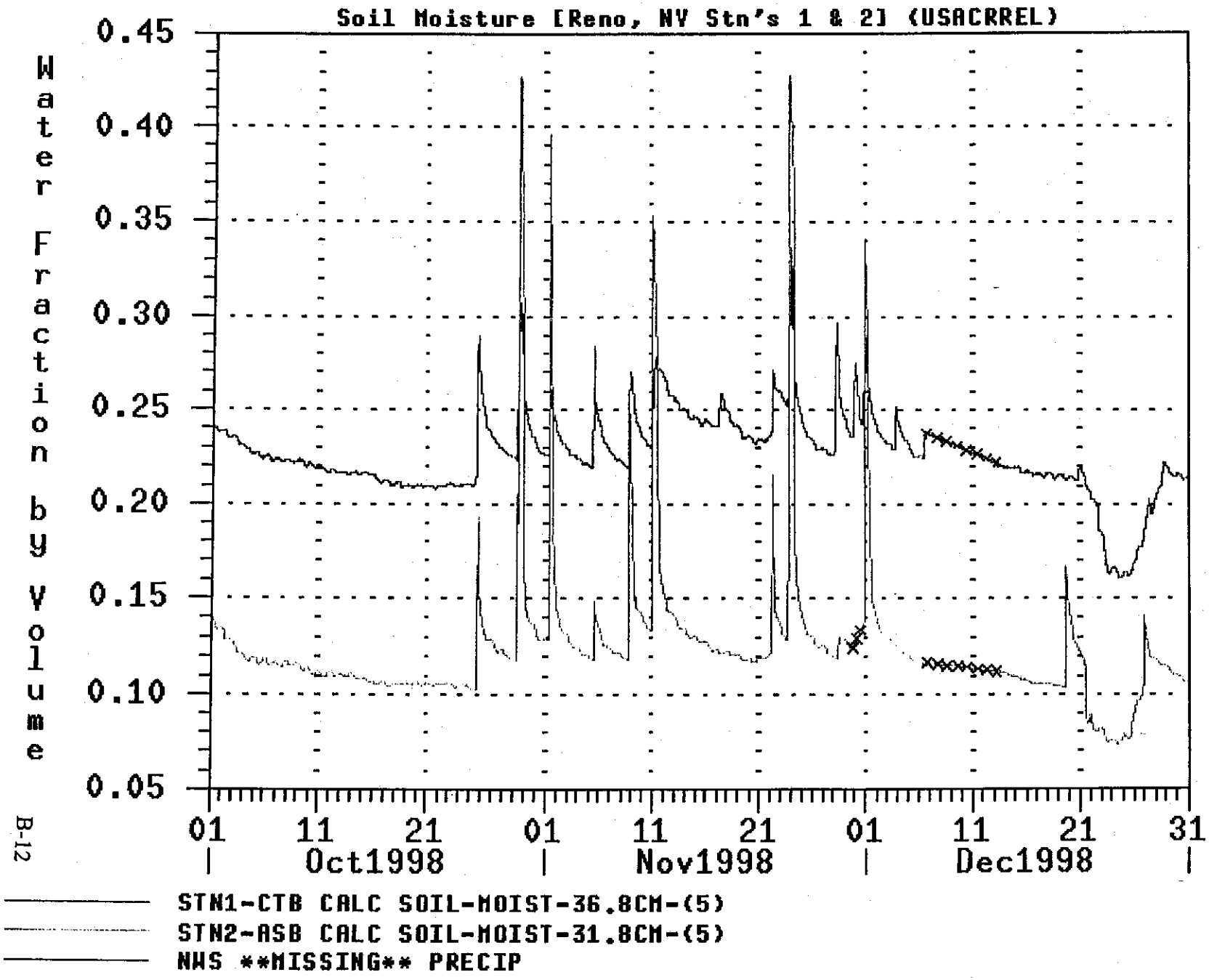

Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Temperature
Water Fraction by Volume
0.4
0.3
0.2
0.1
0.0
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
21
01
11
21
01
11
21
01
11
21
30
Jul1997
Aug1997
Sep1997
STN1-CTB CALC SOIL-MOIST-36.8CM-(5)
STN2-ASB CALC SOIL-MOIST-31.8CM-(5)
NWS OBS PRECIP


Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Temperature
Water Fraction by Volume
0.4
0.3
0.2
0.1
0.0
0.5
0.4
0.3
0.2
0.1
0.0
21
01
11
21
01
11
21
01
11
21
31
Oct1997
Nov1997
Dec1997
STN1-CTB CALC SOIL-MOIST-36.8CM-(5)
STN2-RSB CALC SOIL-MOIST-31.8CM-(5)
NWS OBS PRECIP

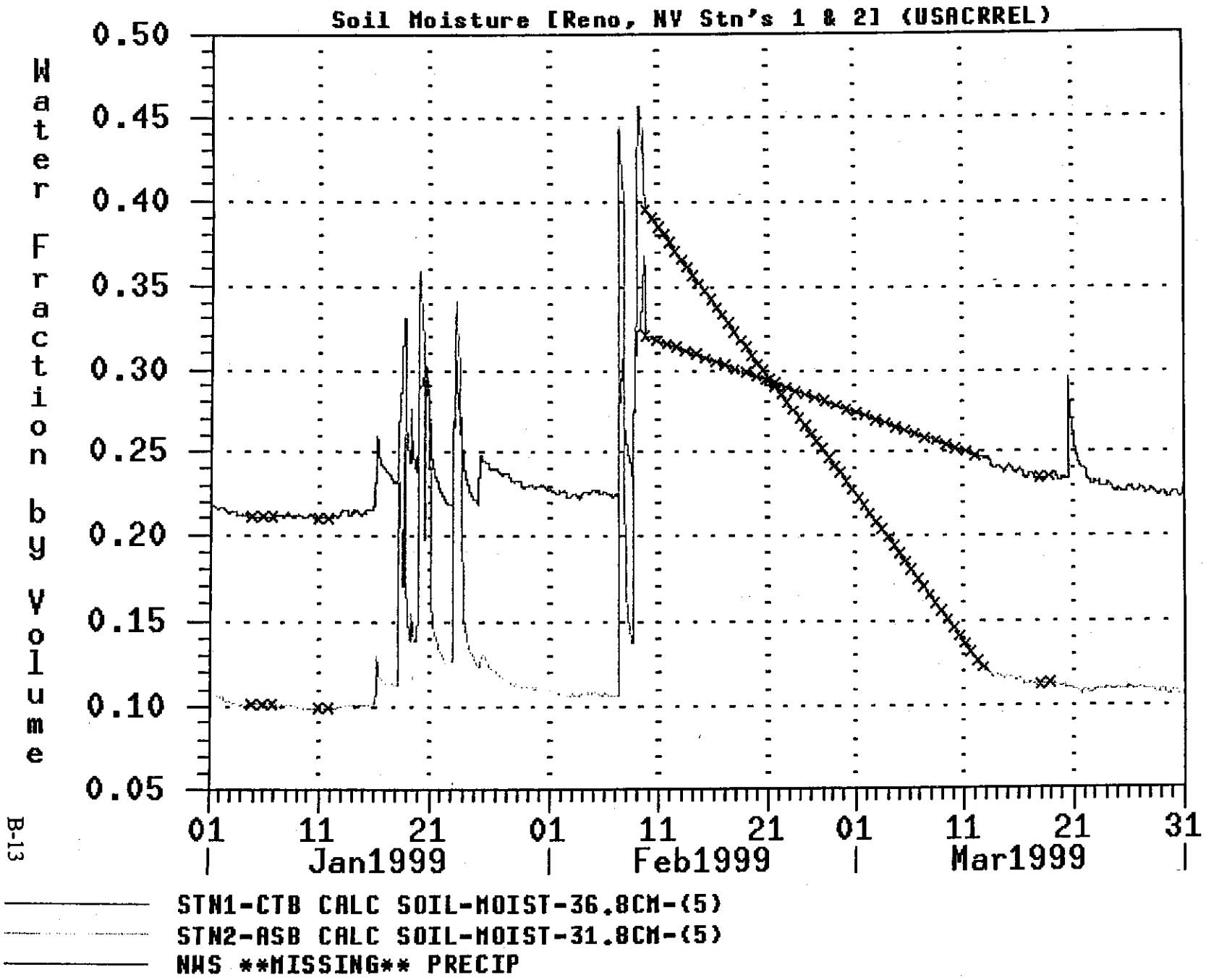

Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Water Fraction by Volume
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
22
01
11
21
01
11
21
01
11
21
31
Jan1998
Feb1998
Mar1998
STN1-CTB CALC SOIL-MOIST-36.8CM-(5)
STN2-ASB CALC SOIL-MOIST-31.8CM-(5)
NWS **MISSING** PRECIP

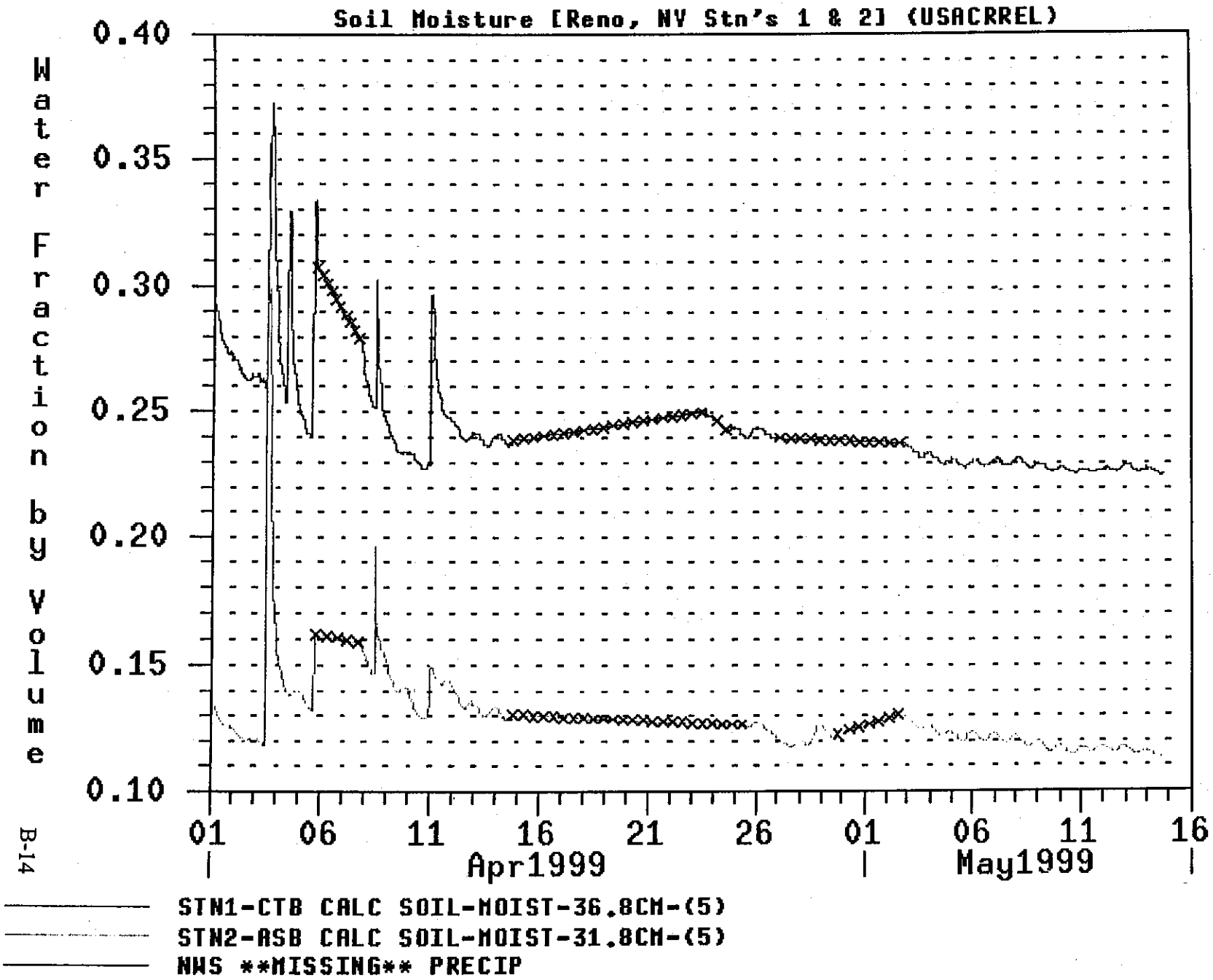

Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Water Fraction by Volume
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
01
11
21
01
11
21
01
11
21
30
Apr1998
May1998
Jun1998
STN1-CTB CALC SOIL-MOIST-36.8CM-(5)
STN2-ASB CALC SOIL-MOIST-31.8CM-(5)
NWS **MISSING** PRECIP


Soil Moisture [Reno, NV Stn's 1 & 21 (USACRREL)
Water Fraction by Volume
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2
-1.4
01
11
21
01
11
21
01
11
21
30
Jul1998
Aug1998
Sep1998
STN1-CTB CALC SOIL-MOIST-36.8CM-(5)
STN2-ASB CALC SOIL-MOIST-31.8CM-(5)
NWS **MISSING** PRECIP


Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Water Fraction by Volume
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
01
11
21
01
11
21
01
11
21
31
Oct1998
Nov1998
Dec1998
STN1-CTB CALC SOIL-MOIST-36.8CM-(5)
STN2-ASB CALC SOIL-MOIST-31.8CM-(5)
NWS **MISSING** PRECIP

18MAY99 19:18:44




Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Water Fraction by Volume
0.40
0.35
0.30
0.25
0.20
0.15
0.10
01
06
11
16
21
26
01
06
11
16
Apr1999
May1999
STN1-CTB CALC SOIL-MOIST-36.8CM-(5)
STN2-RSB CALC SOIL-MOIST-31.8CM-(5)
NWS **MISSING** PRECIP

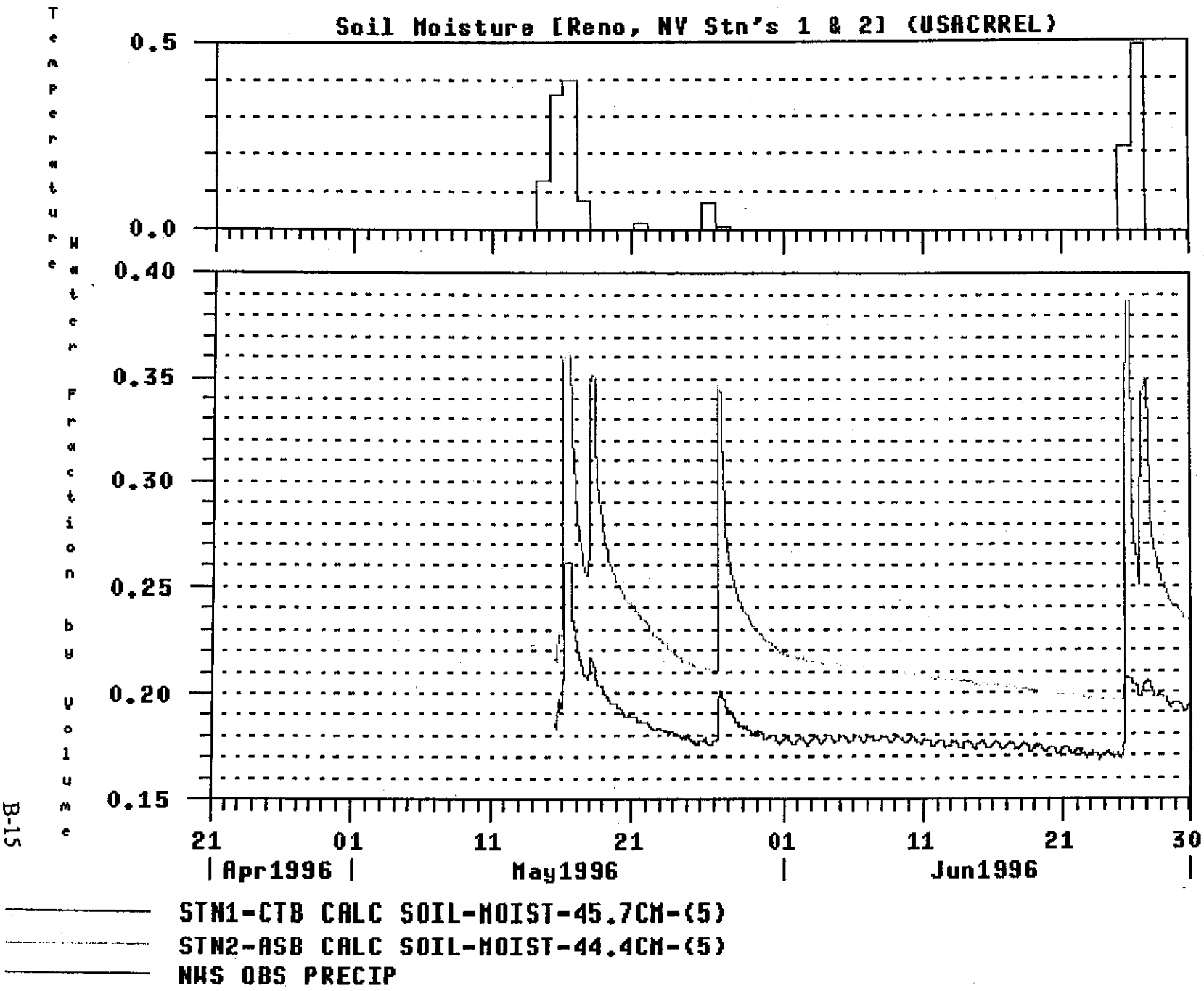
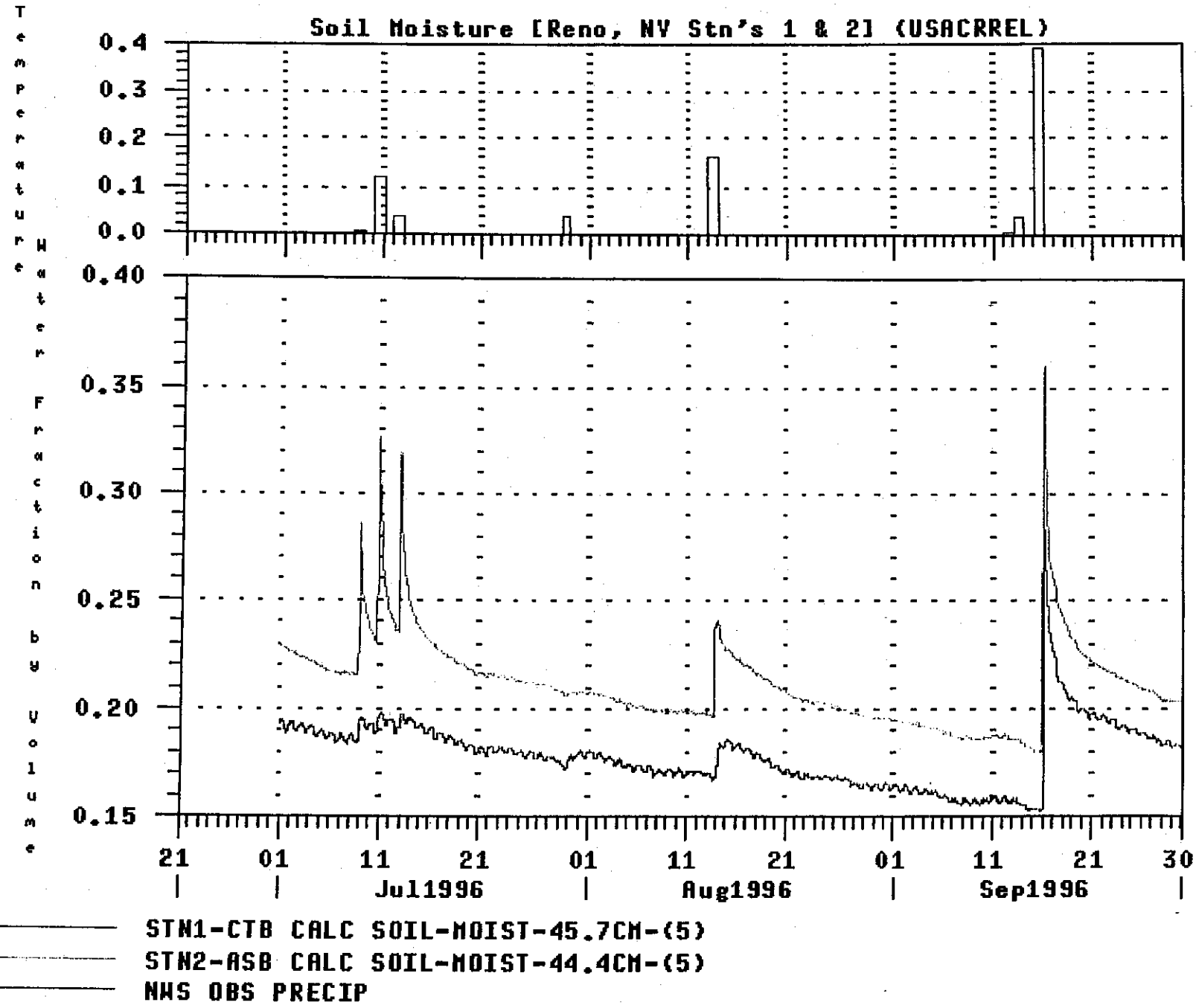
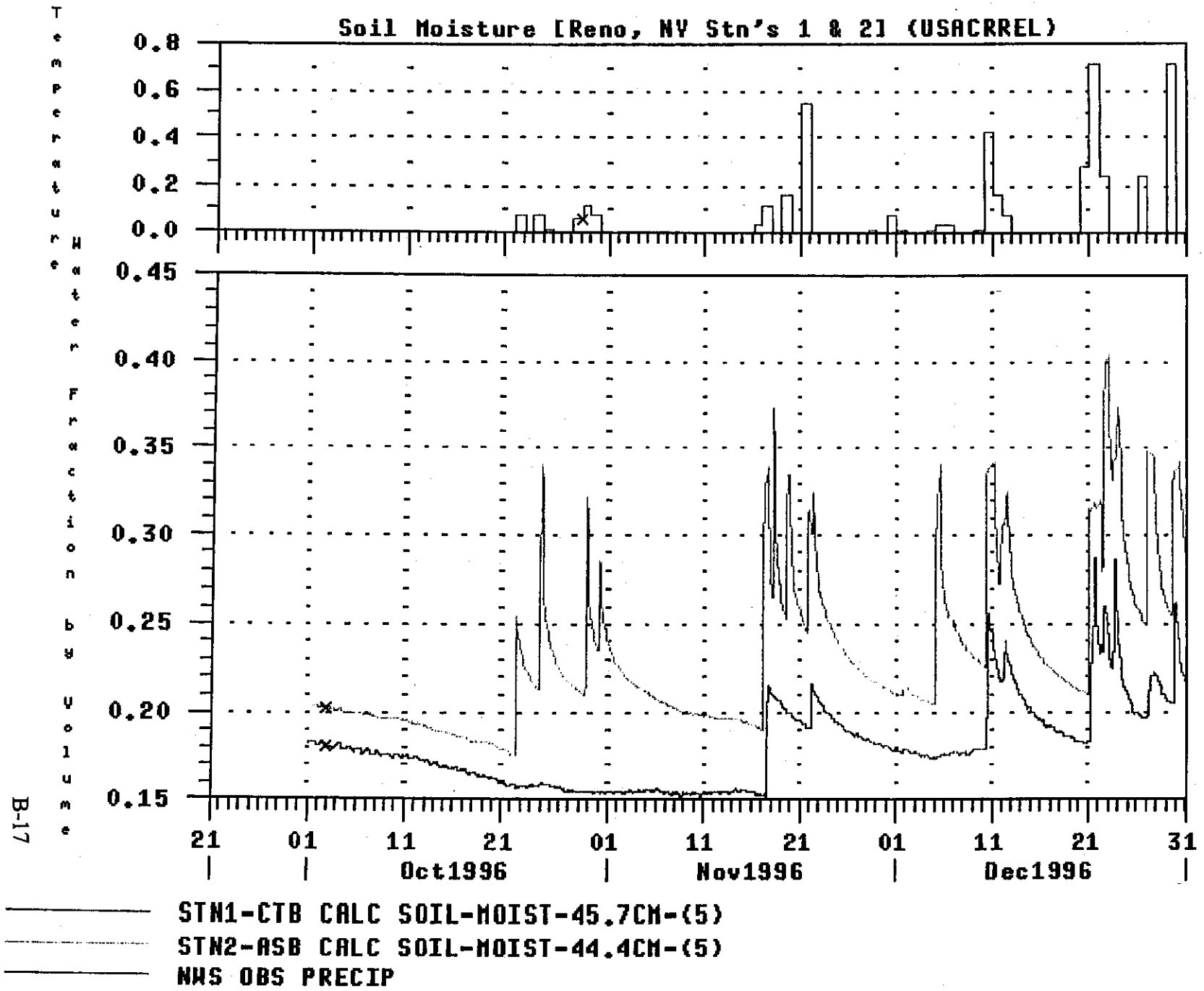
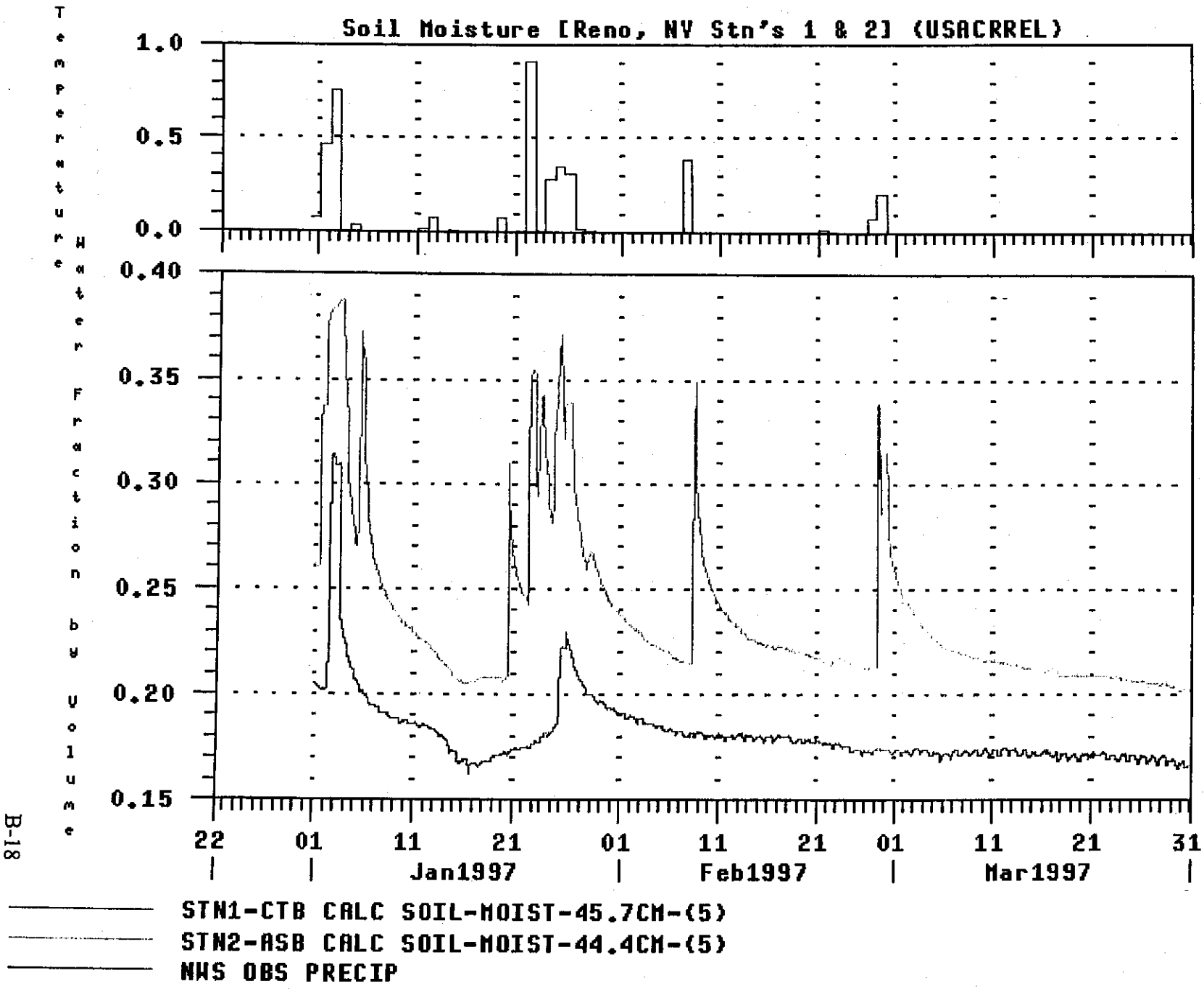


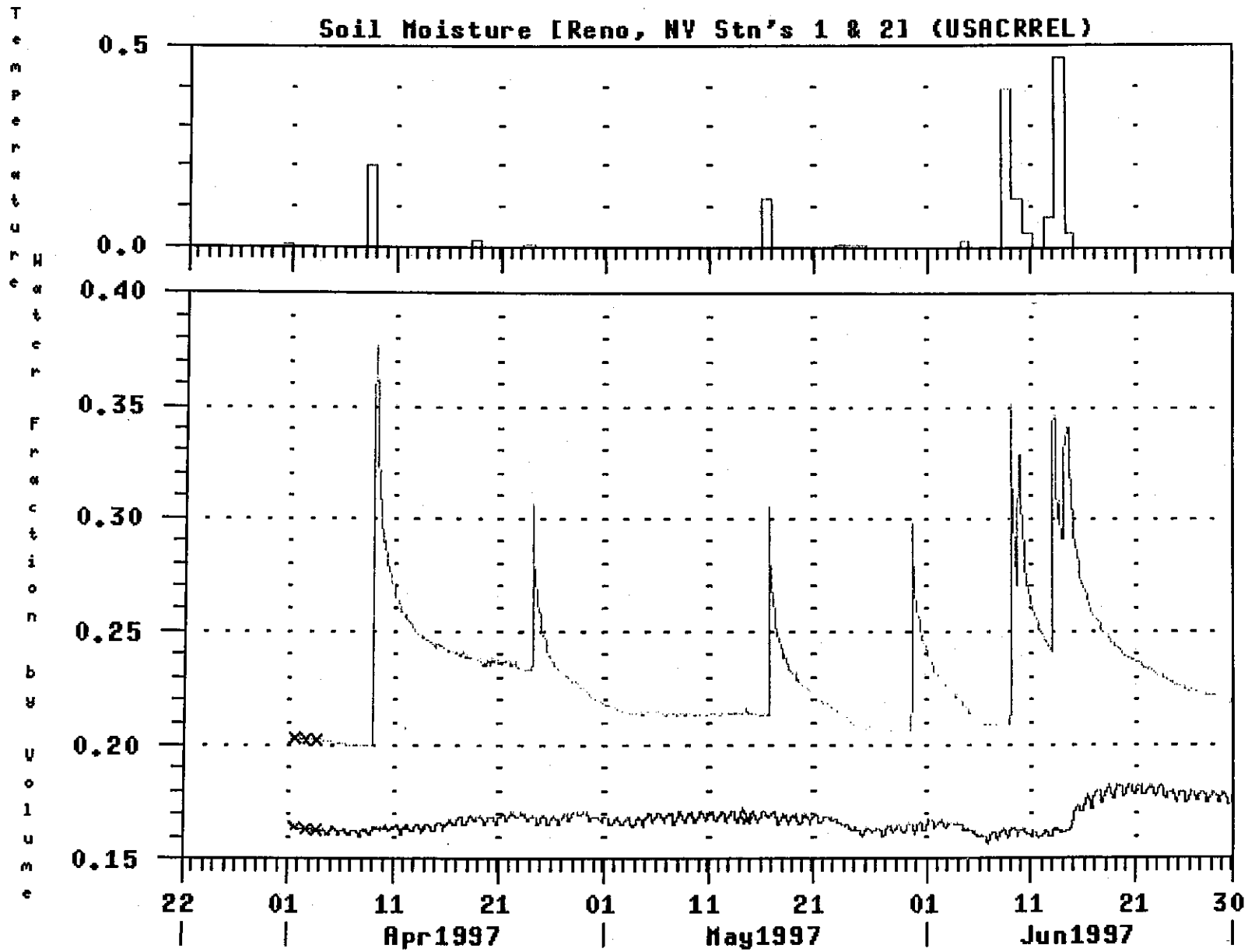
Figure B-3: Station 1 (CTB) Moisture Measurements at 45.7 cm vs. Station 2 (ASB) Moisture Measurements at 44.4 cm Pages B-15 through B-27

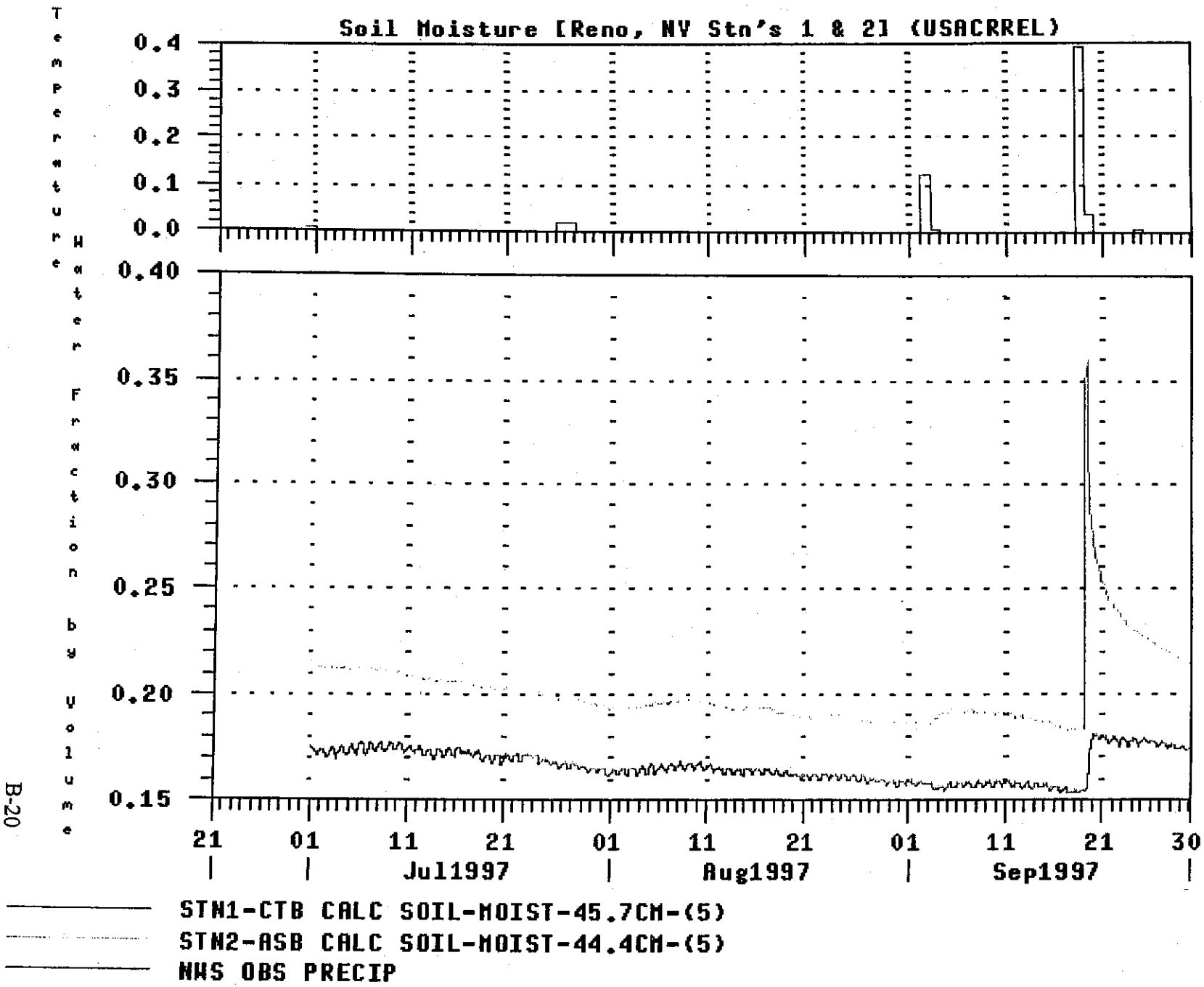

Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Precipitation
0.4
0.3
0.2
0.1
0.0
Water Fraction by Volume
0.40
0.35
0.30
0.25
0.20
0.15
21
01
11
21
01
11
21
01
11
21
30
Jul1996
Aug1996
Sep1996
STN1-CTB CALC SOIL-MOIST-45.7CM-(5)
STN2-ASB CALC SOIL-MOIST-44.4CM-(5)
NWS OBS PRECIP

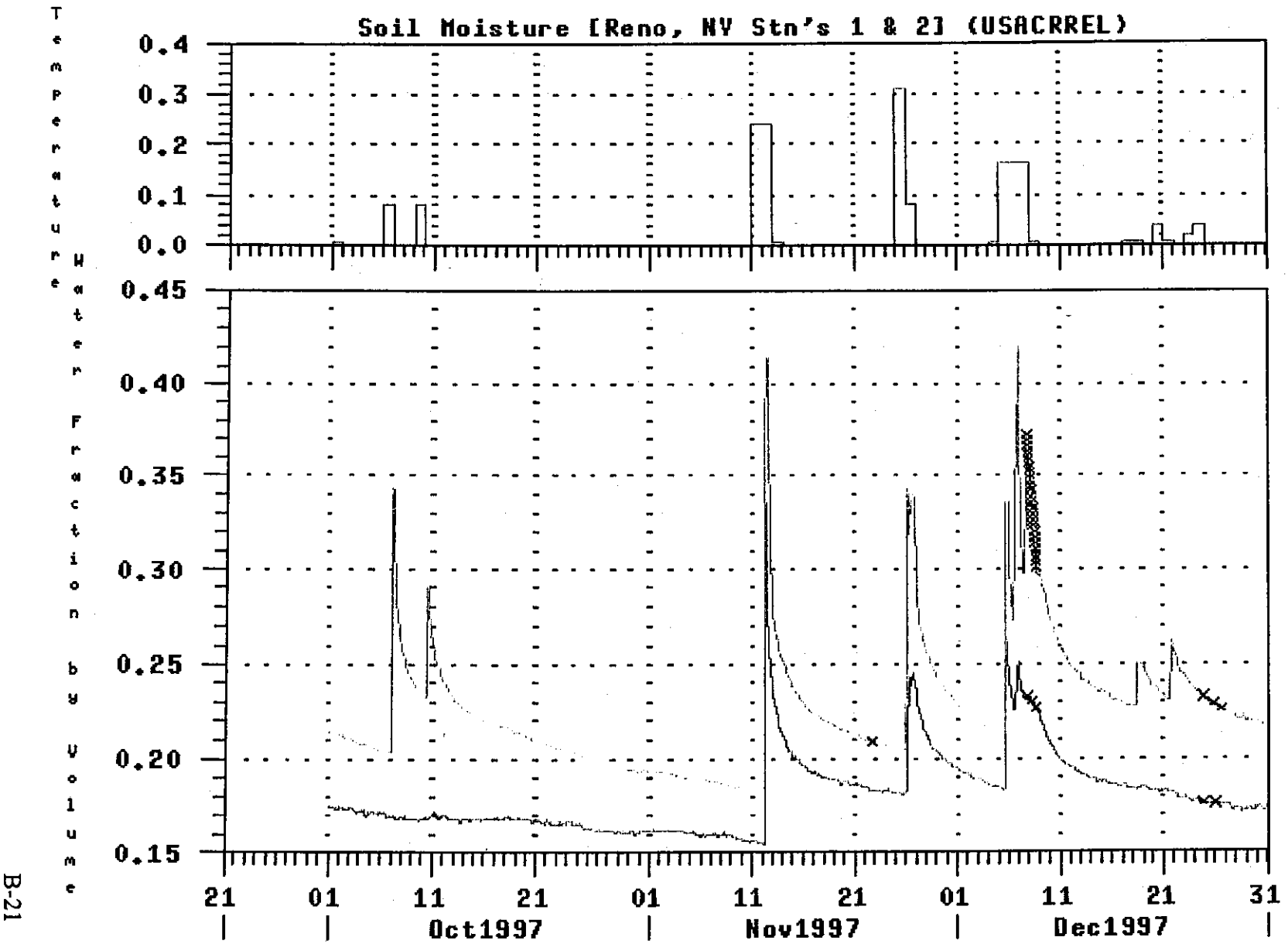

Soil Moisture [Reno, NV Stn's 1 & 21 (USACRREL)
Precipitation
0.8
0.6
0.4
0.2
0.0
Water Fraction by volume
0.45
0.40
0.35
0.30
0.25
0.20
0.15
21
01
11
21
01
11
21
01
11
21
31
Oct1996
Nov1996
Dec1996
STN1-CTB CALC SOIL-MOIST-45.7CM-(5)
STN2-ASB CALC SOIL-MOIST-44.4CM-(5)
NWS OBS PRECIP

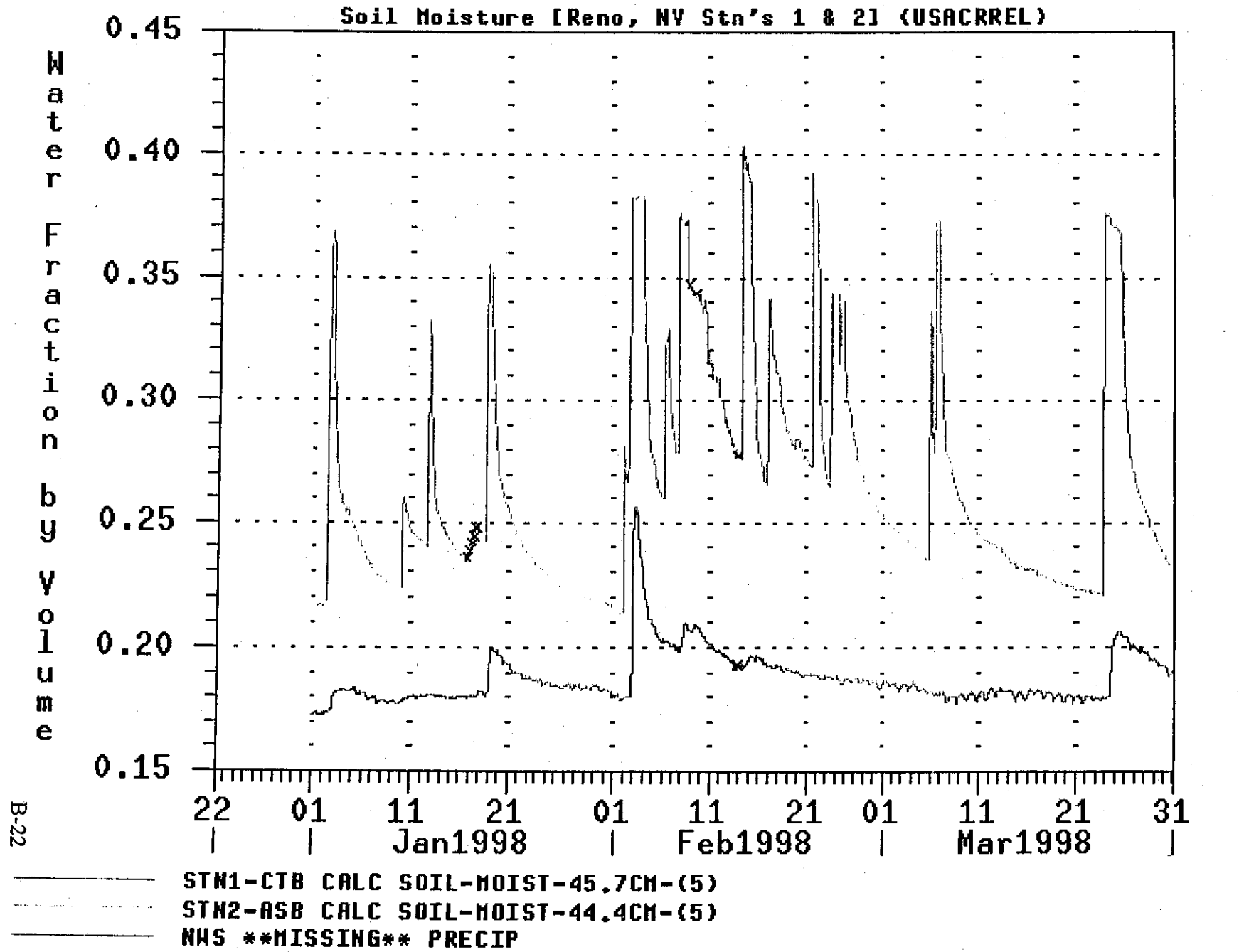

Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Temperature
Water Fraction by Volume
1.0
0.5
0.0
0.40
0.35
0.30
0.25
0.20
0.15
22
01
11
21
01
11
21
01
11
21
31
Jan1997
Feb1997
Mar1997
STN1-CTB CALC SOIL-MOIST-45.7CM-(5)
STN2-ASB CALC SOIL-MOIST-44.4CM-(5)
NWS OBS PRECIP

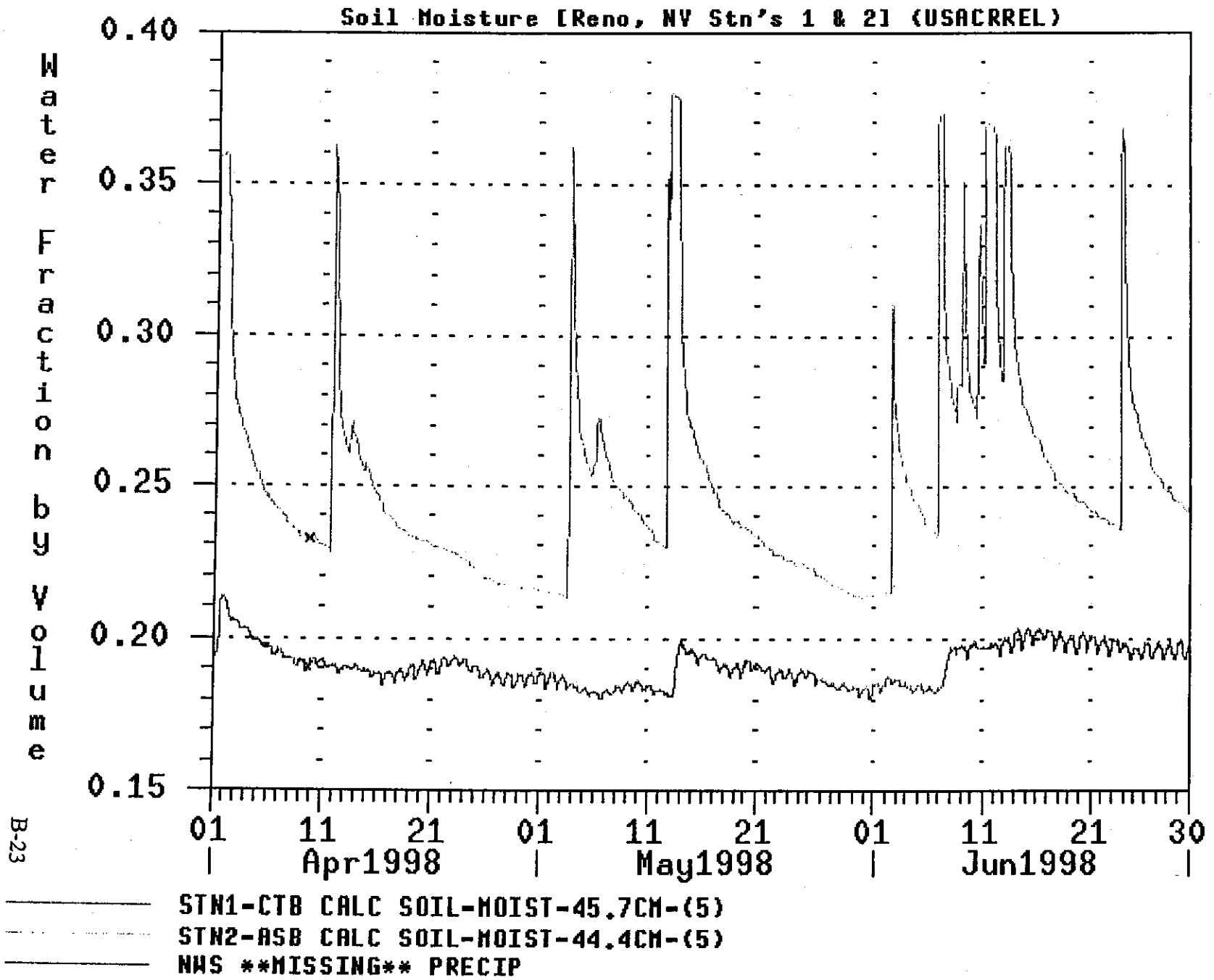
18MAY99 19:22:55

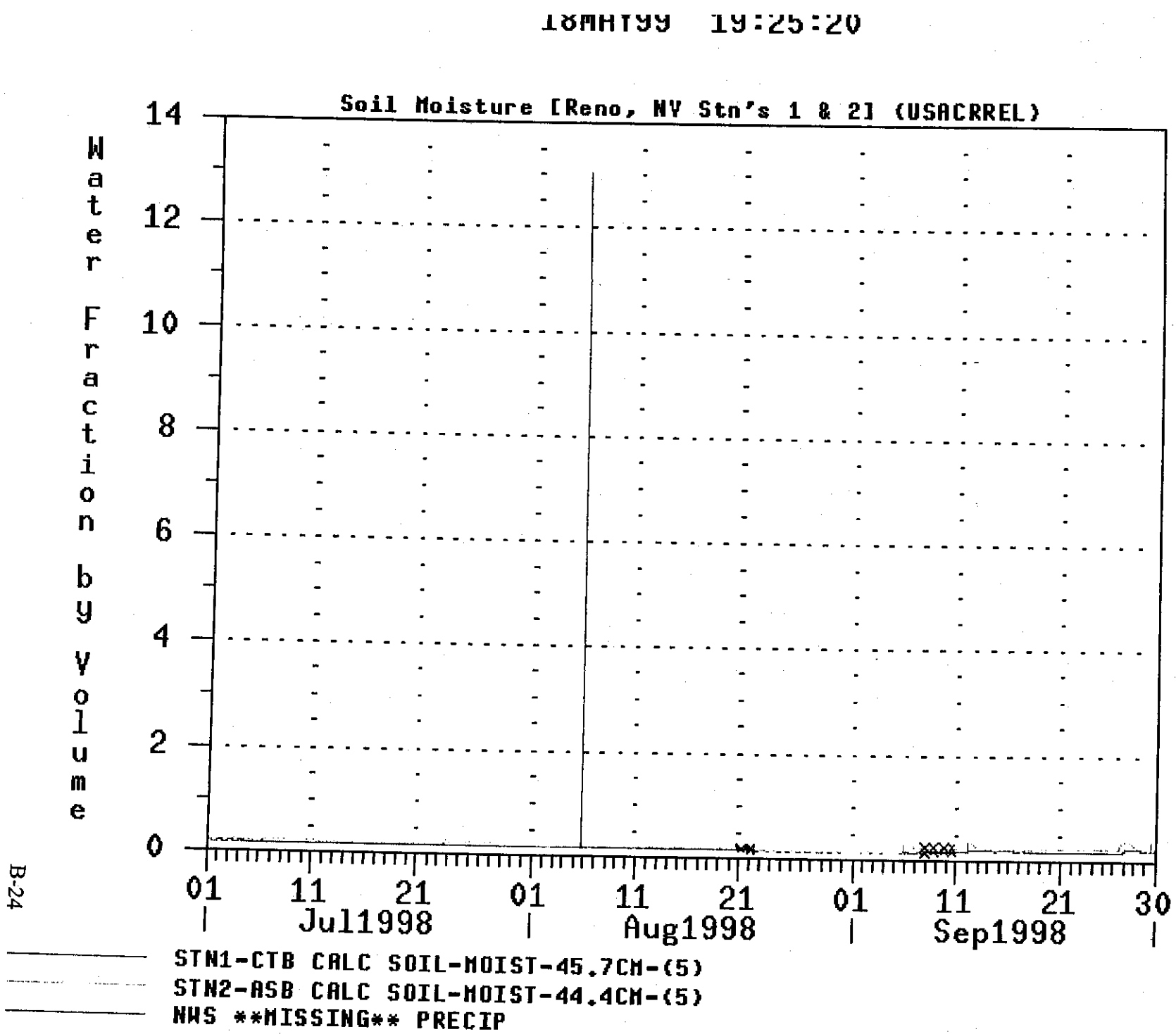


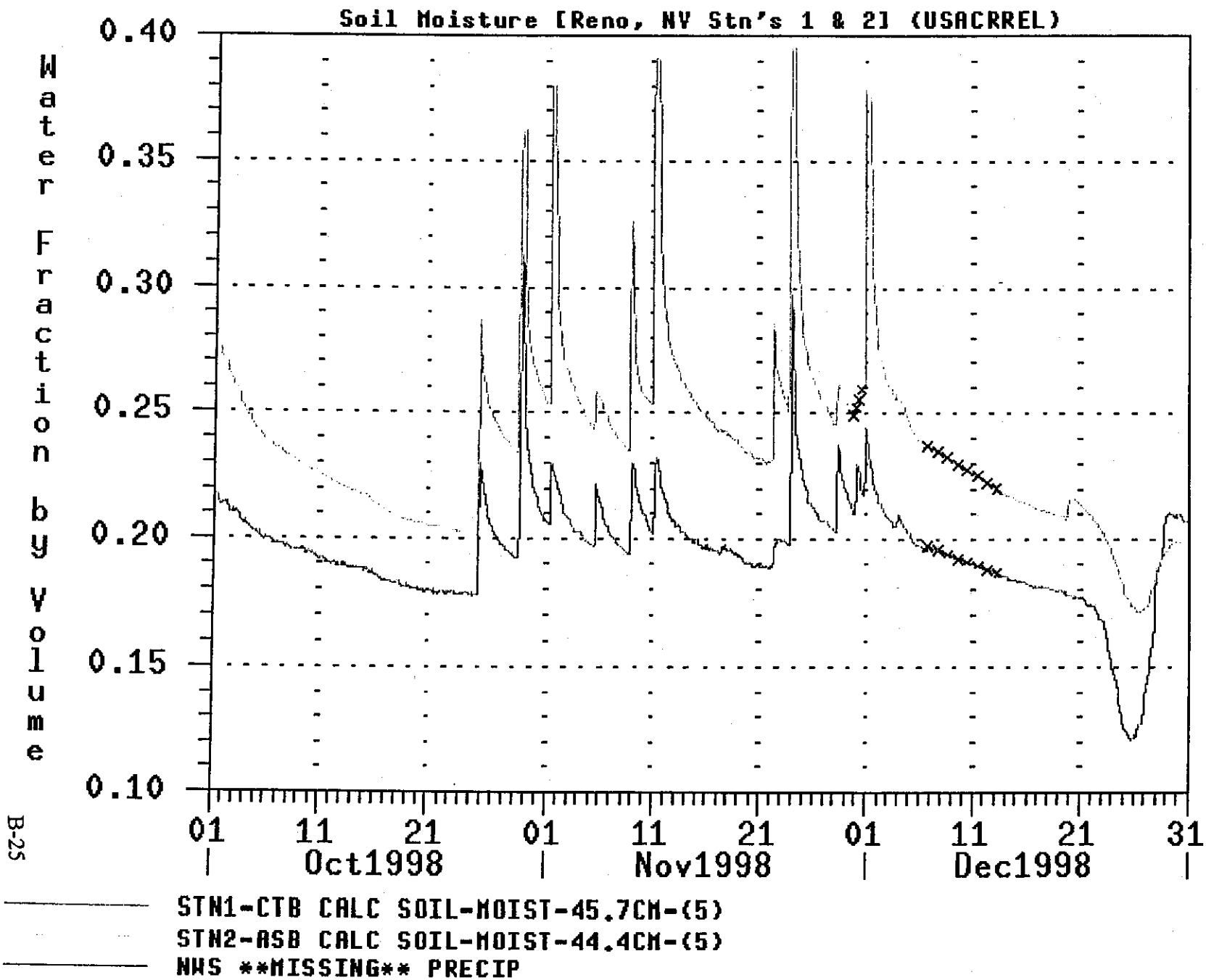

Soil Moisture [Reno, NV Stn's 1 & 21 (USACRREL)
Precipitation
0.4
0.3
0.2
0.1
0.0
Water Fraction by volume
0.40
0.35
0.30
0.25
0.20
0.15
21
01
11
21
01
11
21
01
11
21
30
Jul1997
Aug1997
Sep1997
STN1-CTB CALC SOIL-MOIST-45.7CM-(5)
STN2-ASB CALC SOIL-MOIST-44.4CM-(5)
NWS OBS PRECIP

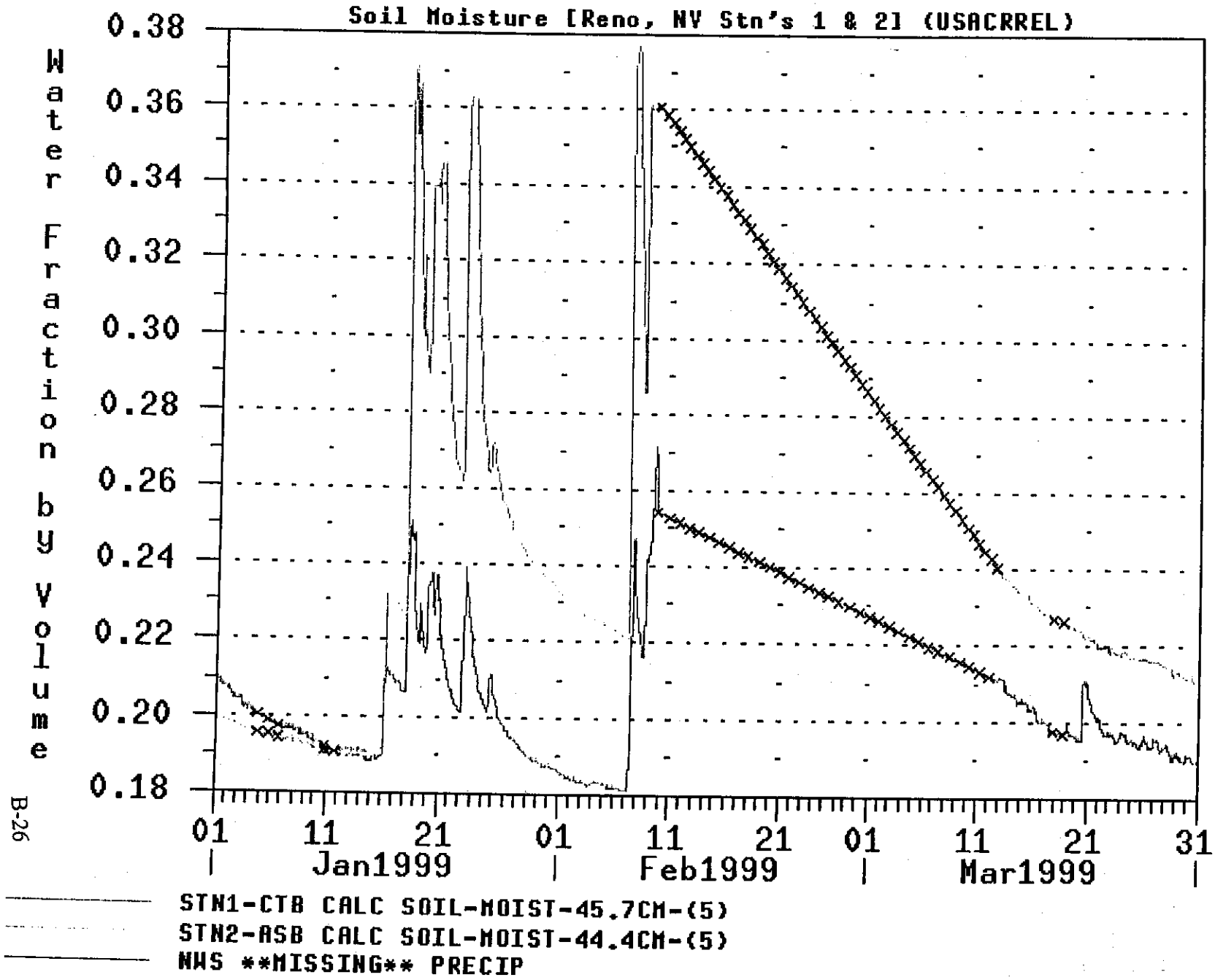

Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Temperature
Water Fraction by Volume
0.4
0.3
0.2
0.1
0.0
0.45
0.40
0.35
0.30
0.25
0.20
0.15
21
01
11
21
01
11
21
01
11
21
31
Oct1997
Nov1997
Dec1997
STN1-CTB CALC SOIL-MOIST-45.7CM-(5)
STN2-ASB CALC SOIL-MOIST-44.4CM-(5)
NWS OBS PRECIP


Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Water Fraction by Volume
0.45
0.40
0.35
0.30
0.25
0.20
0.15
22
01
11
21
01
11
21
01
11
21
31
Jan1998
Feb1998
Mar1998
STN1-CTB CALC SOIL-MOIST-45.7CM-(5)
STN2-ASB CALC SOIL-MOIST-44.4CM-(5)
NWS **MISSING** PRECIP

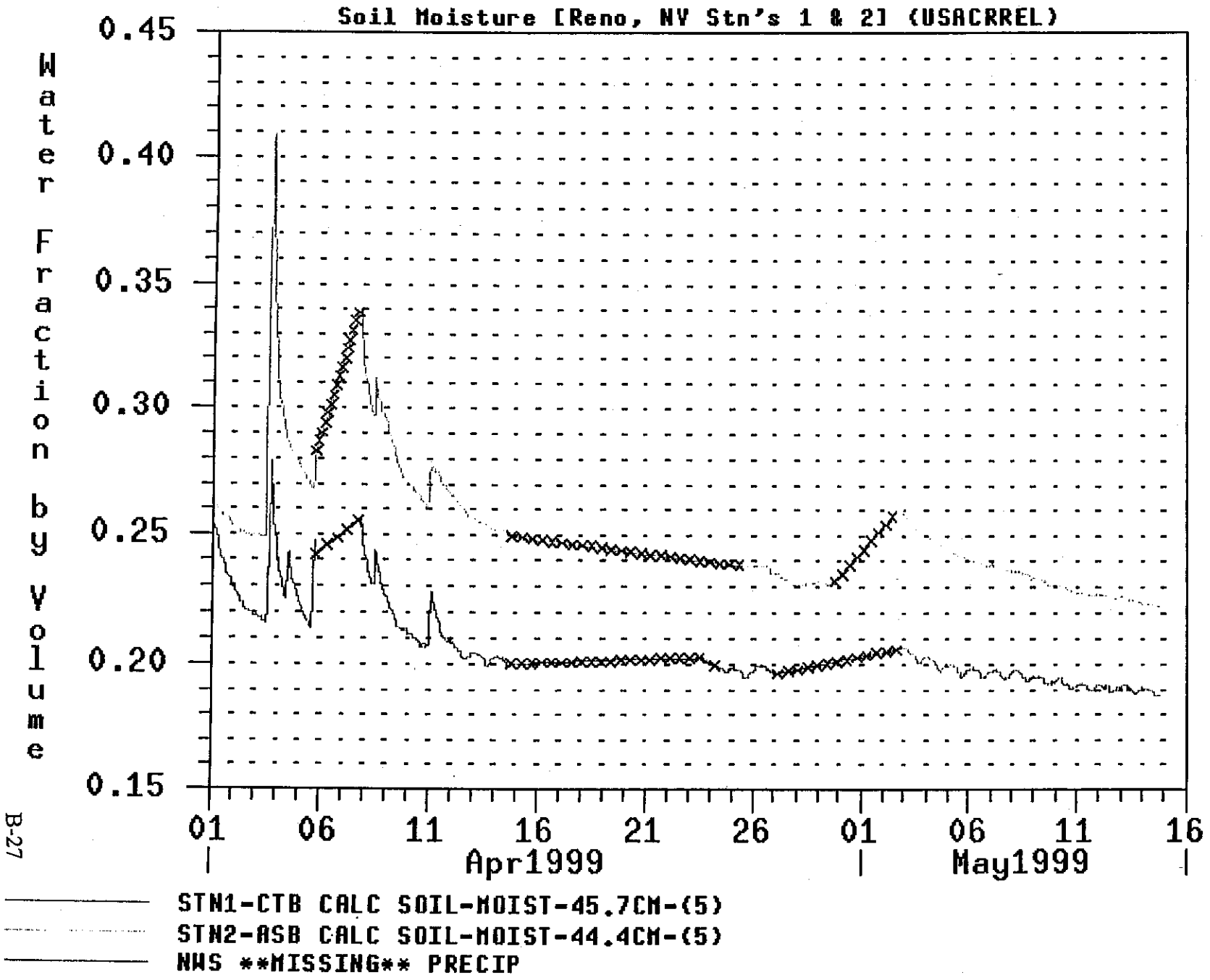

Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Water Fraction by Volume
0.40
0.35
0.30
0.25
0.20
0.15
01
11
21
01
11
21
01
11
21
30
Apr1998
May1998
Jun1998
STN1-CTB CALC SOIL-MOIST-45.7CM-(5)
STN2-ASB CALC SOIL-MOIST-44.4CM-(5)
NWS **MISSING** PRECIP


Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Water Fraction by Volume
14
12
10
8
6
4
2
0
01
11
21
01
11
21
01
11
21
30
Jul1998
Aug1998
Sep1998
STN1-CTB CALC SOIL-MOIST-45.7CM-(5)
STN2-ASB CALC SOIL-MOIST-44.4CM-(5)
NWS **MISSING** PRECIP


Soil Moisture [Reno, NV Stn's 1 & 21 (USACRREL)
Water Fraction by Volume
0.40
0.35
0.30
0.25
0.20
0.15
0.10
01
11
21
01
11
21
01
11
21
31
Oct1998
Nov1998
Dec1998
STN1-CTB CALC SOIL-MOIST-45.7CM-(5)
STN2-ASB CALC SOIL-MOIST-44.4CM-(5)
NWS **MISSING** PRECIP


Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Water Fraction by Volume
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
01
11
21
01
11
21
01
11
21
31
Jan1999
Feb1999
Mar1999
STN1-CTB CALC SOIL-MOIST-45.7CM-(5)
STN2-ASB CALC SOIL-MOIST-44.4CM-(5)
NWS **MISSING** PRECIP

18MAY99 19:26:34



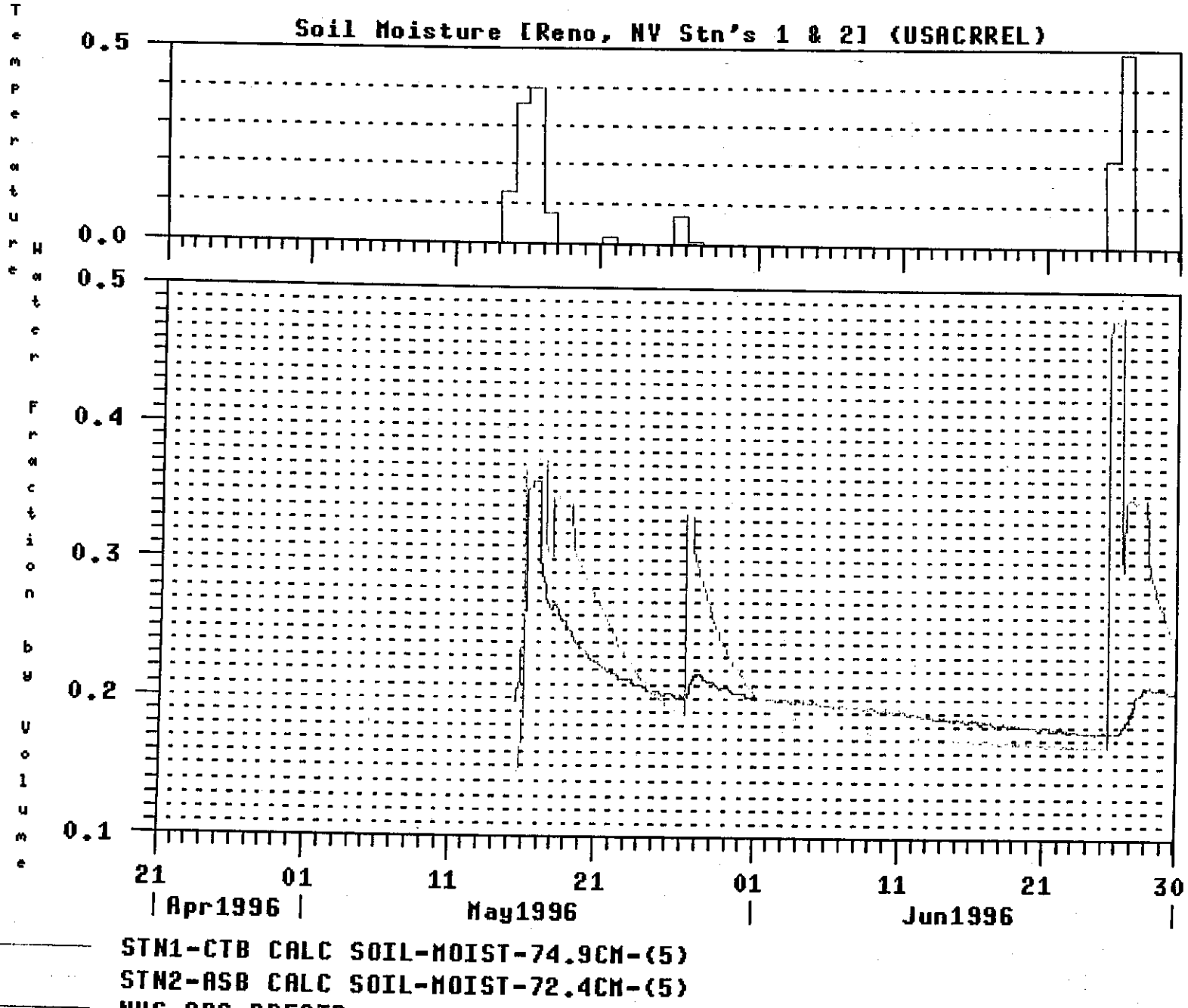
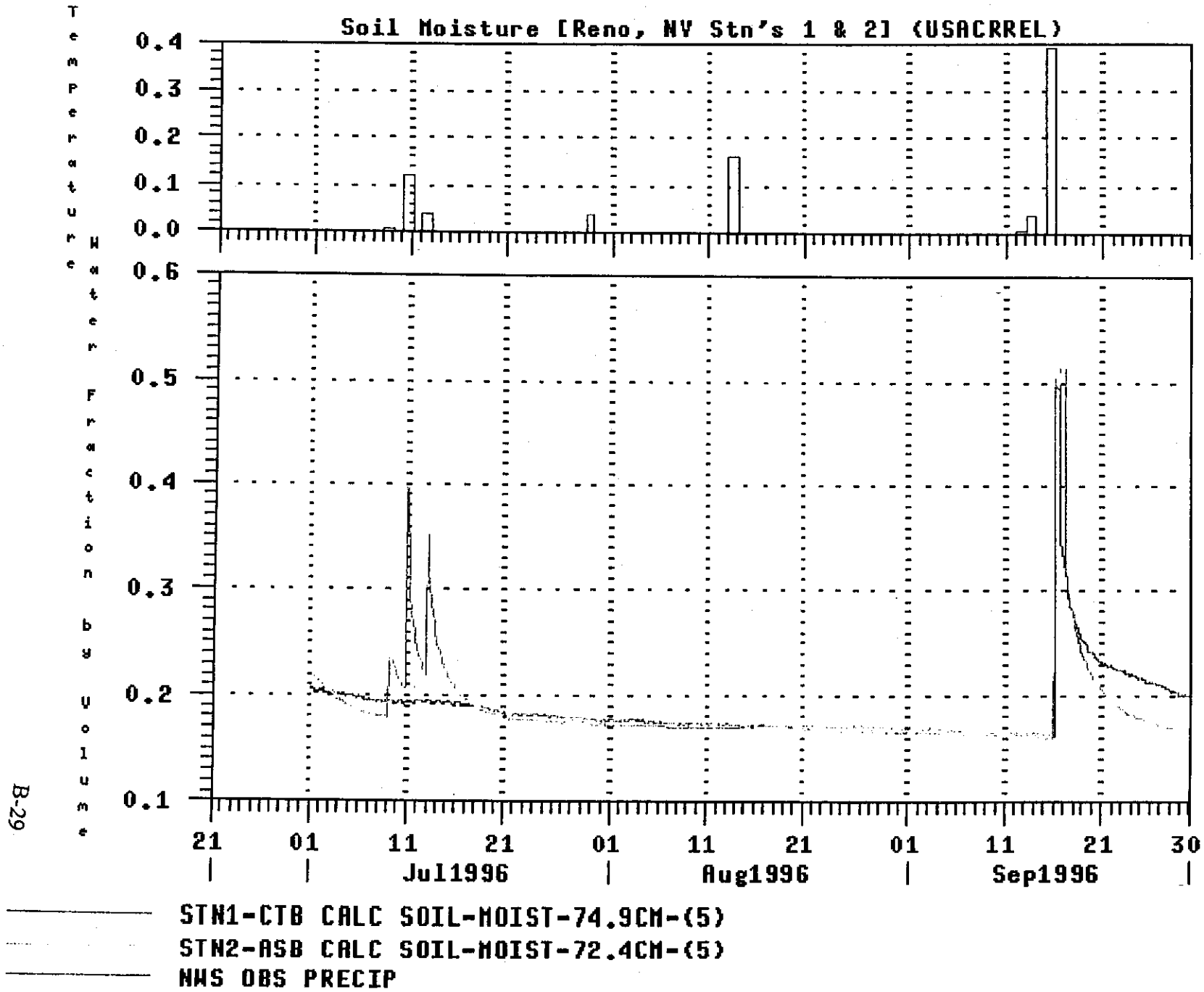
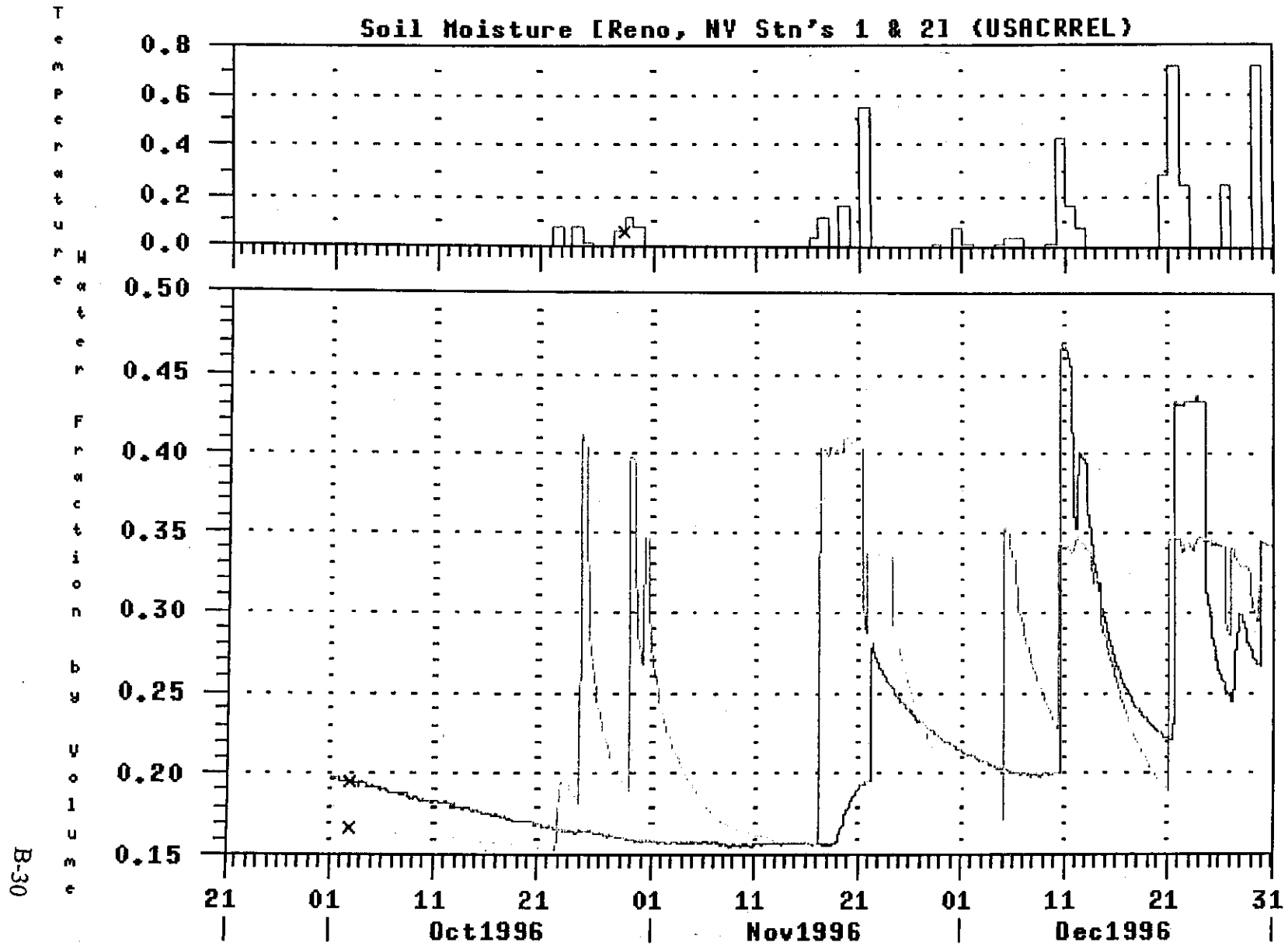
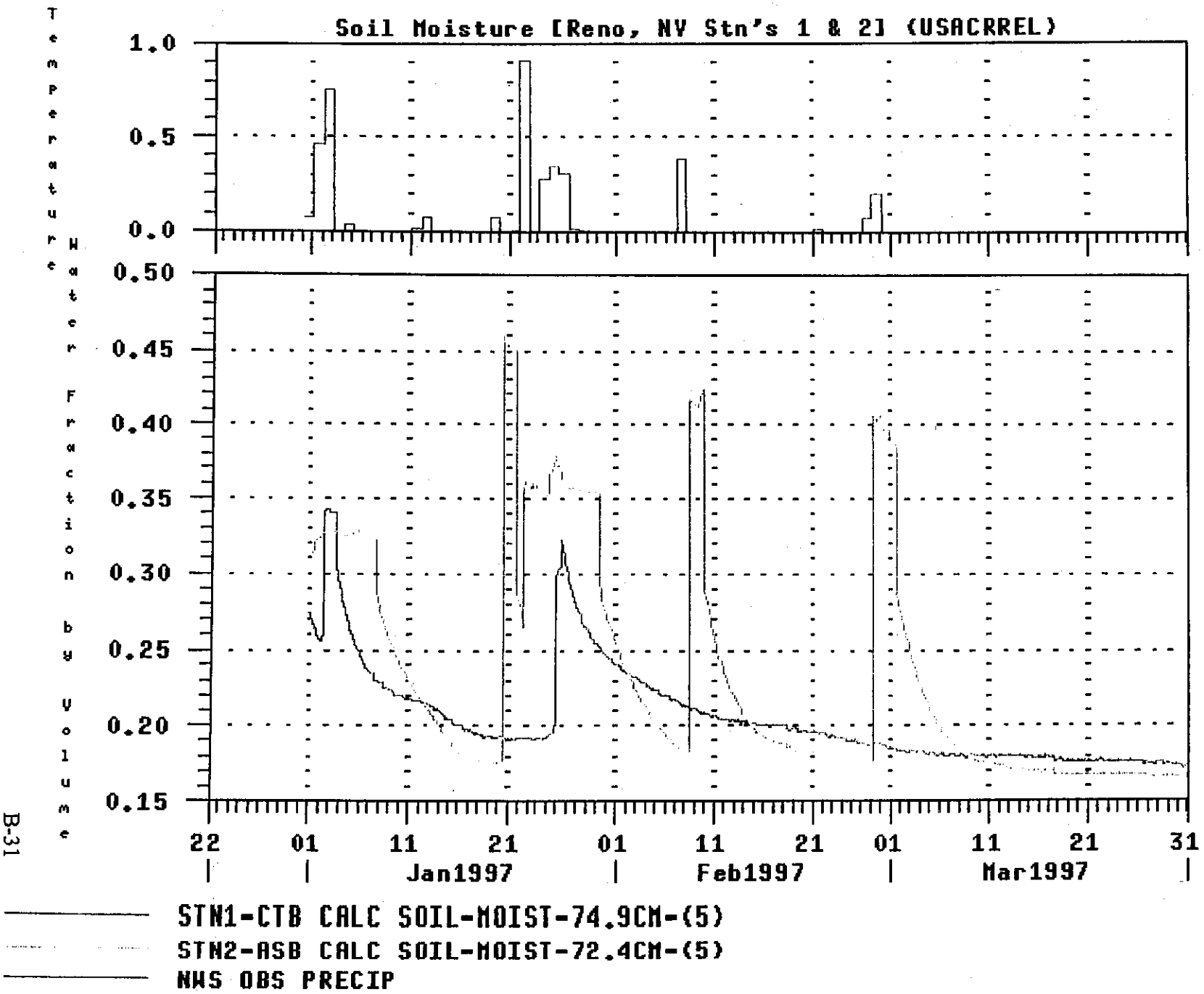


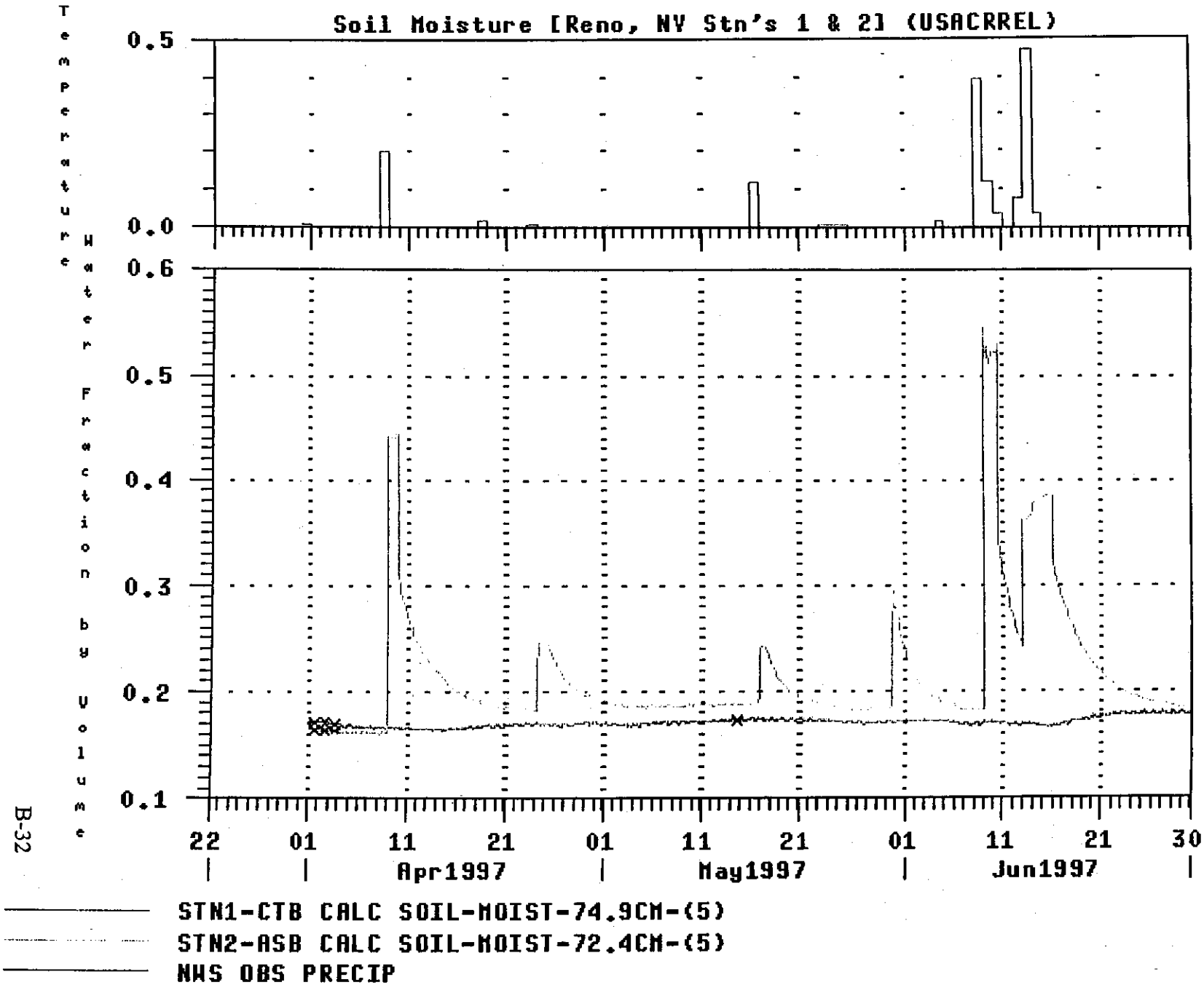
Figure B-4: Station 1 (CTB) Moisture Measurements at 74.9 cm vs. Station 2 (ASB) Moisture Measurements at 72.4 cm Pages B-28 through B-40


Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Temperature
Water Fraction by Volume
0.4
0.3
0.2
0.1
0.0
0.6
0.5
0.4
0.3
0.2
0.1
21
01
11
21
01
11
21
01
11
21
30
Jul1996
Aug1996
Sep1996
STN1-CTB CALC SOIL-MOIST-74.9CM-(5)
STN2-ASB CALC SOIL-MOIST-72.4CM-(5)
NWS OBS PRECIP

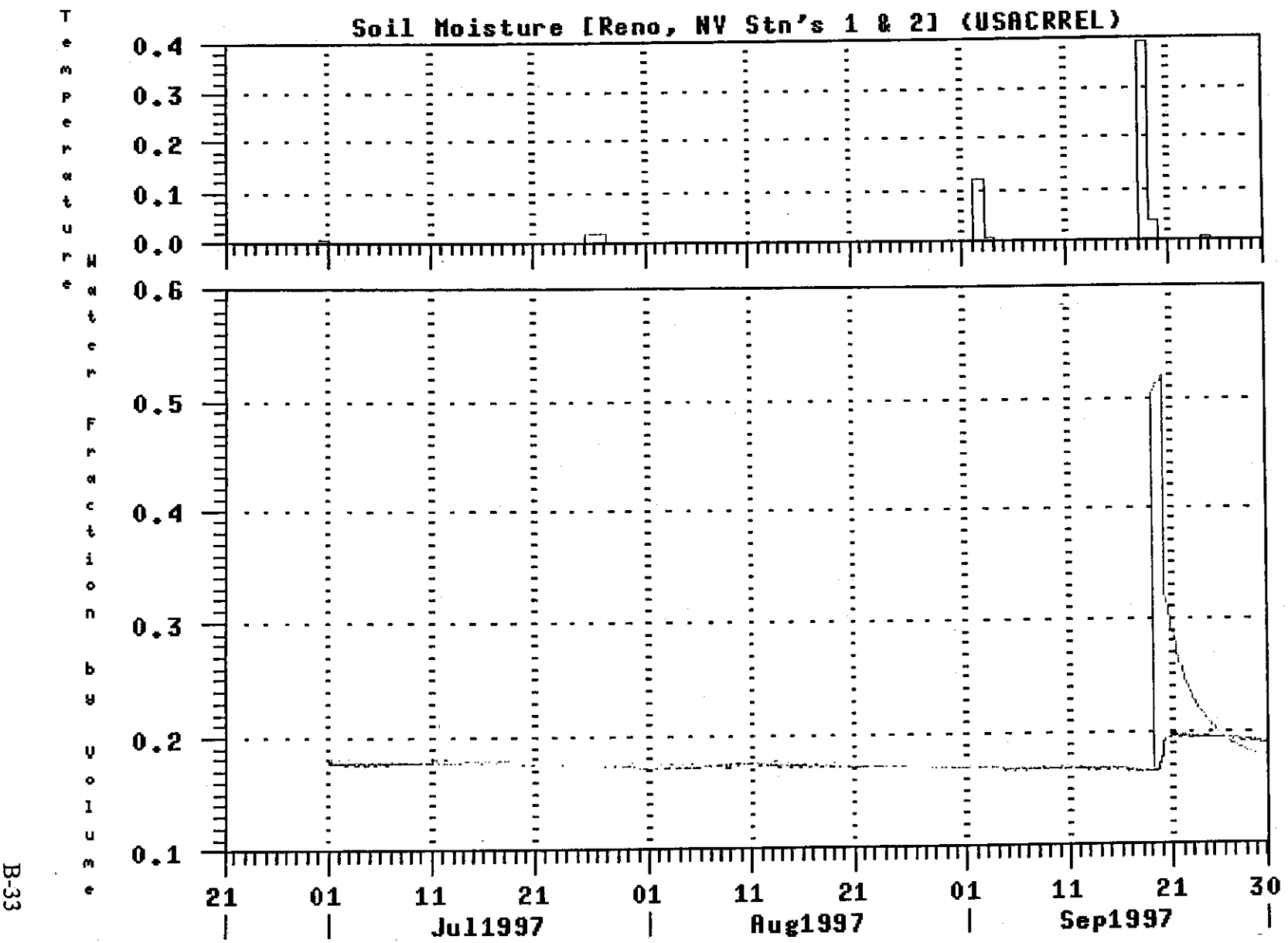
18MAY99 19:29:15

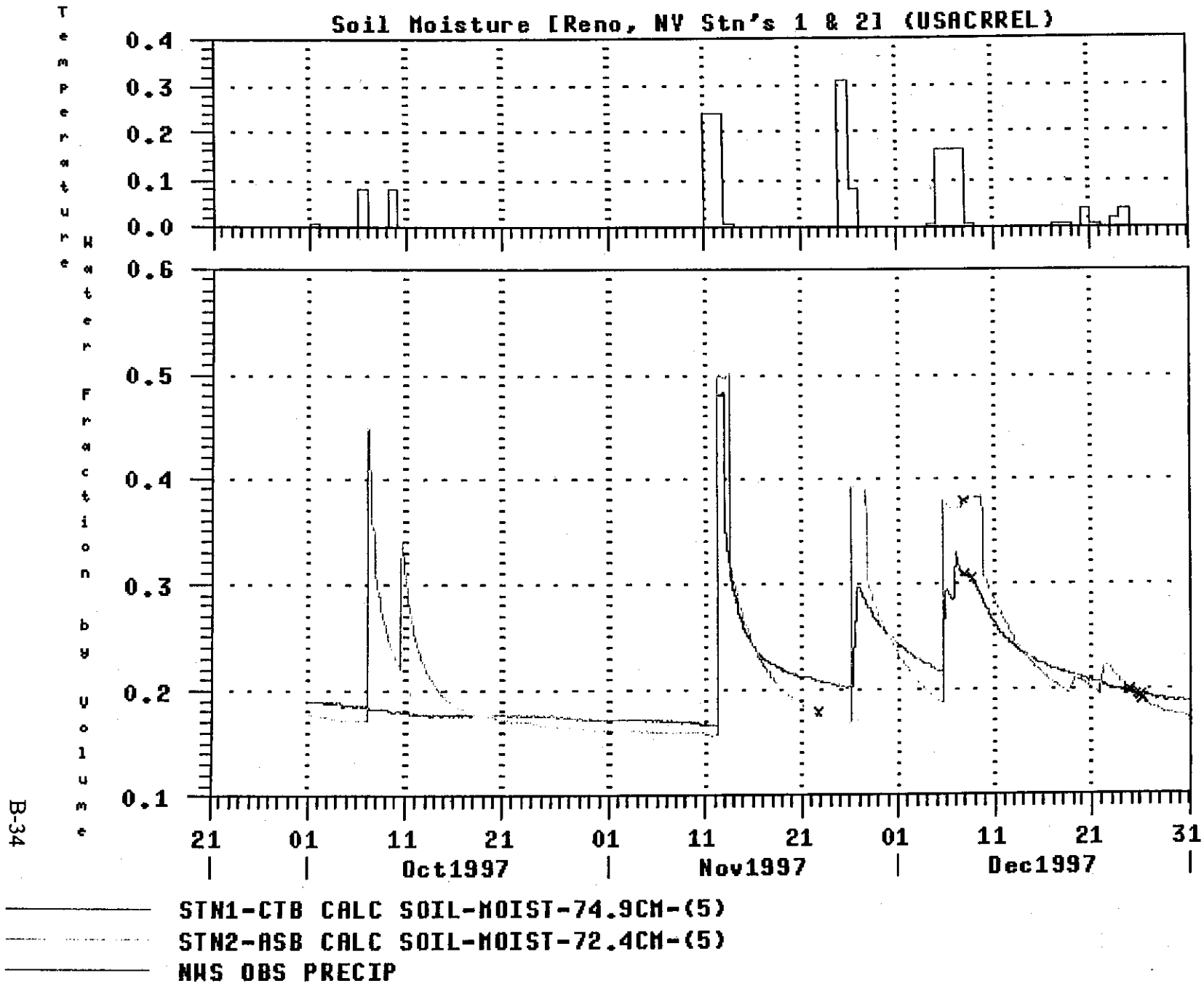



Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Temperature
1.0
0.5
0.0
Water Fraction by Volume
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
22
01
11
21
01
11
21
01
11
21
31
Jan1997
Feb1997
Mar1997
STN1-CTB CALC SOIL-MOIST-74.9CM-(5)
STN2-ASB CALC SOIL-MOIST-72.4CM-(5)
NWS OBS PRECIP

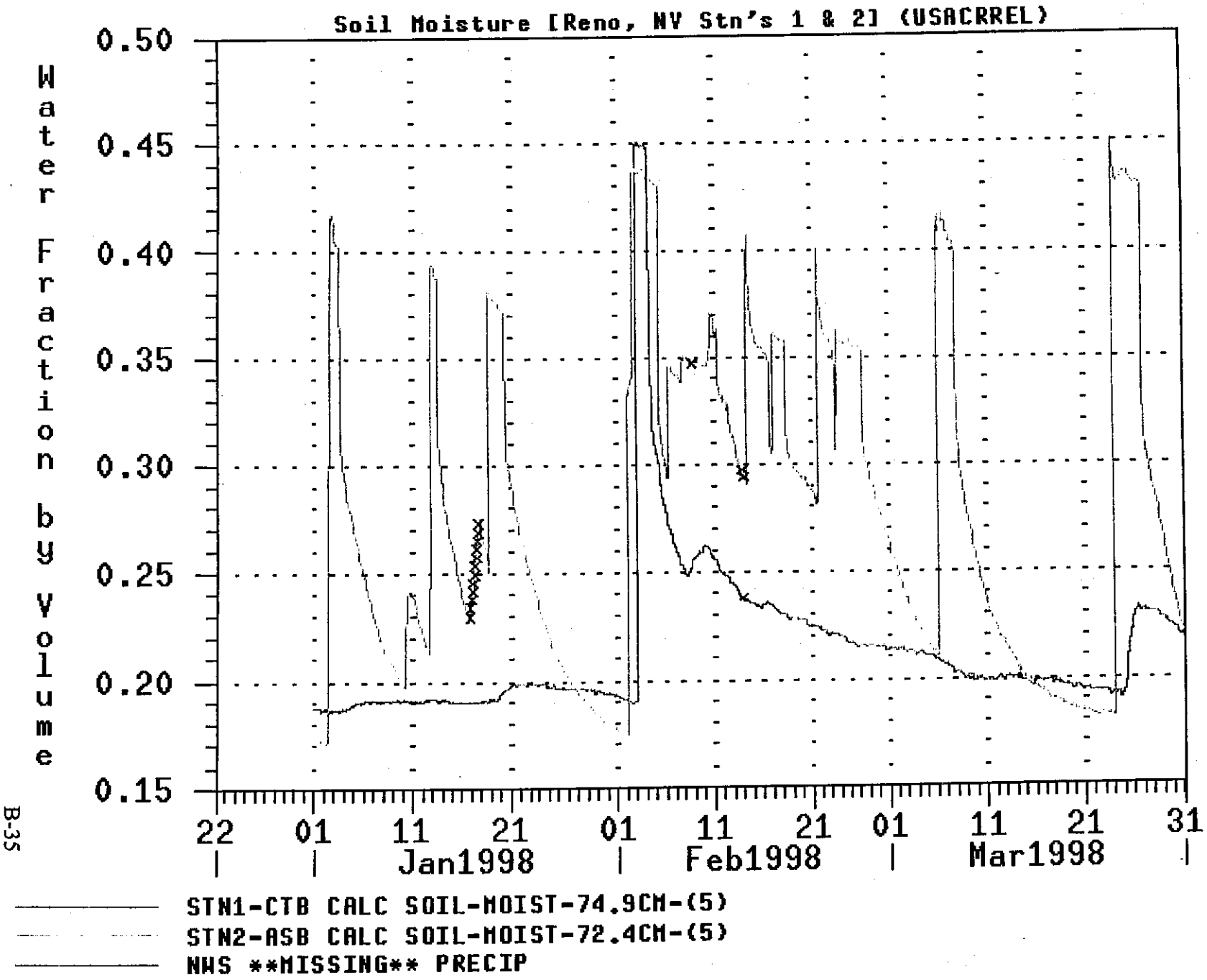

Soil Moisture [Reno, NV Stn's 1 & 21 (USACRREL)
Temperature
Water Fraction by Volume
0.5
0.0
0.6
0.5
0.4
0.3
0.2
0.1
22
01
11
21
01
11
21
01
11
21
30
Apr1997
May1997
Jun1997
STN1-CTB CALC SOIL-MOIST-74.9CM-(5)
STN2-ASB CALC SOIL-MOIST-72.4CM-(5)
NWS OBS PRECIP

18MAY99 19:30:26

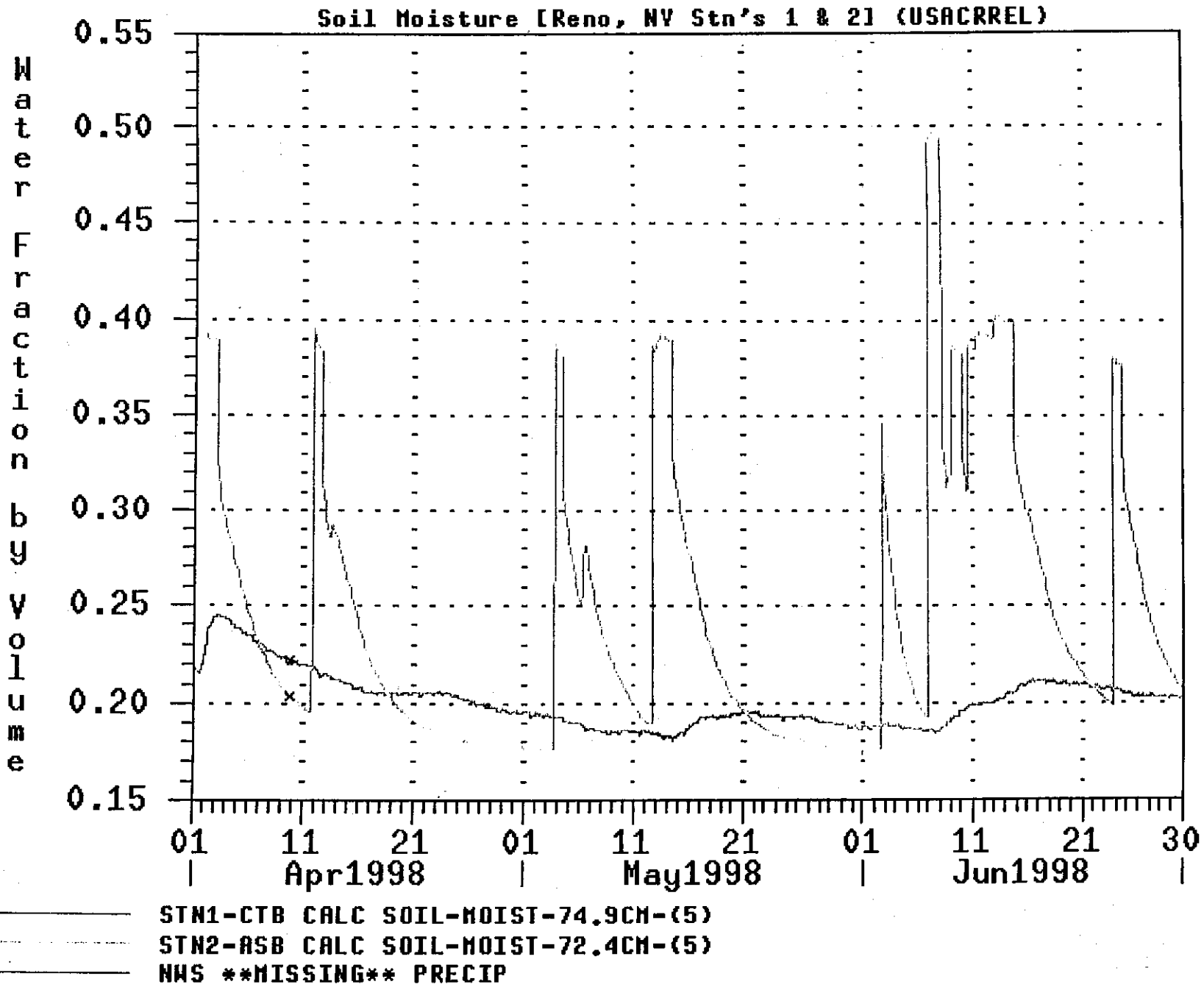


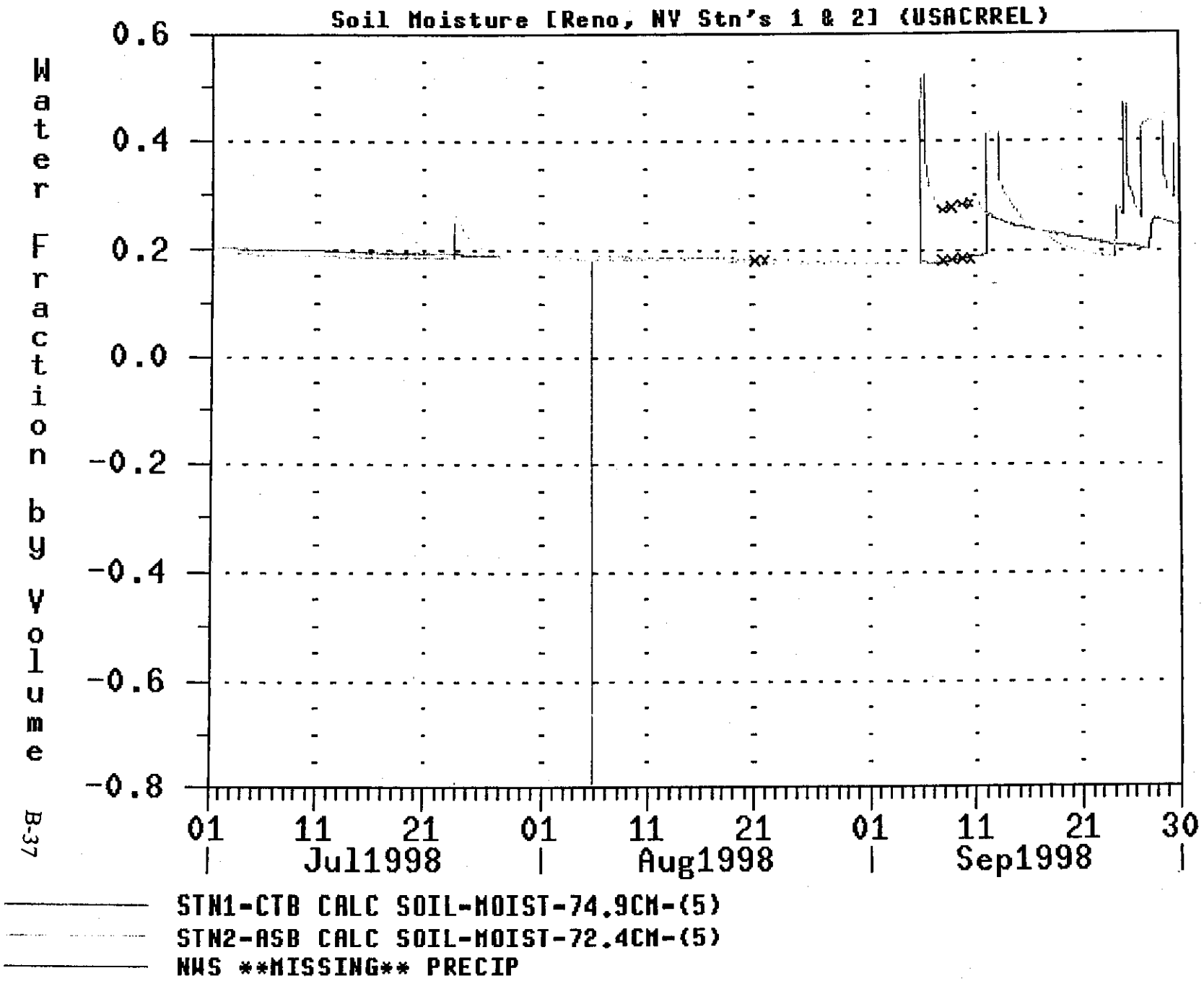

Soil Moisture [Reno, NV Stn's 1 & 21 (USACRREL)
Temperature
Water Fraction by Volume
0.4
0.3
0.2
0.1
0.0
0.6
0.5
0.4
0.3
0.2
0.1
21
01
11
21
01
11
21
01
11
21
31
Oct1997
Nov1997
Dec1997
STN1-CTB CALC SOIL-MOIST-74.9CM-(5)
STN2-ASB CALC SOIL-MOIST-72.4CM-(5)
NWS OBS PRECIP

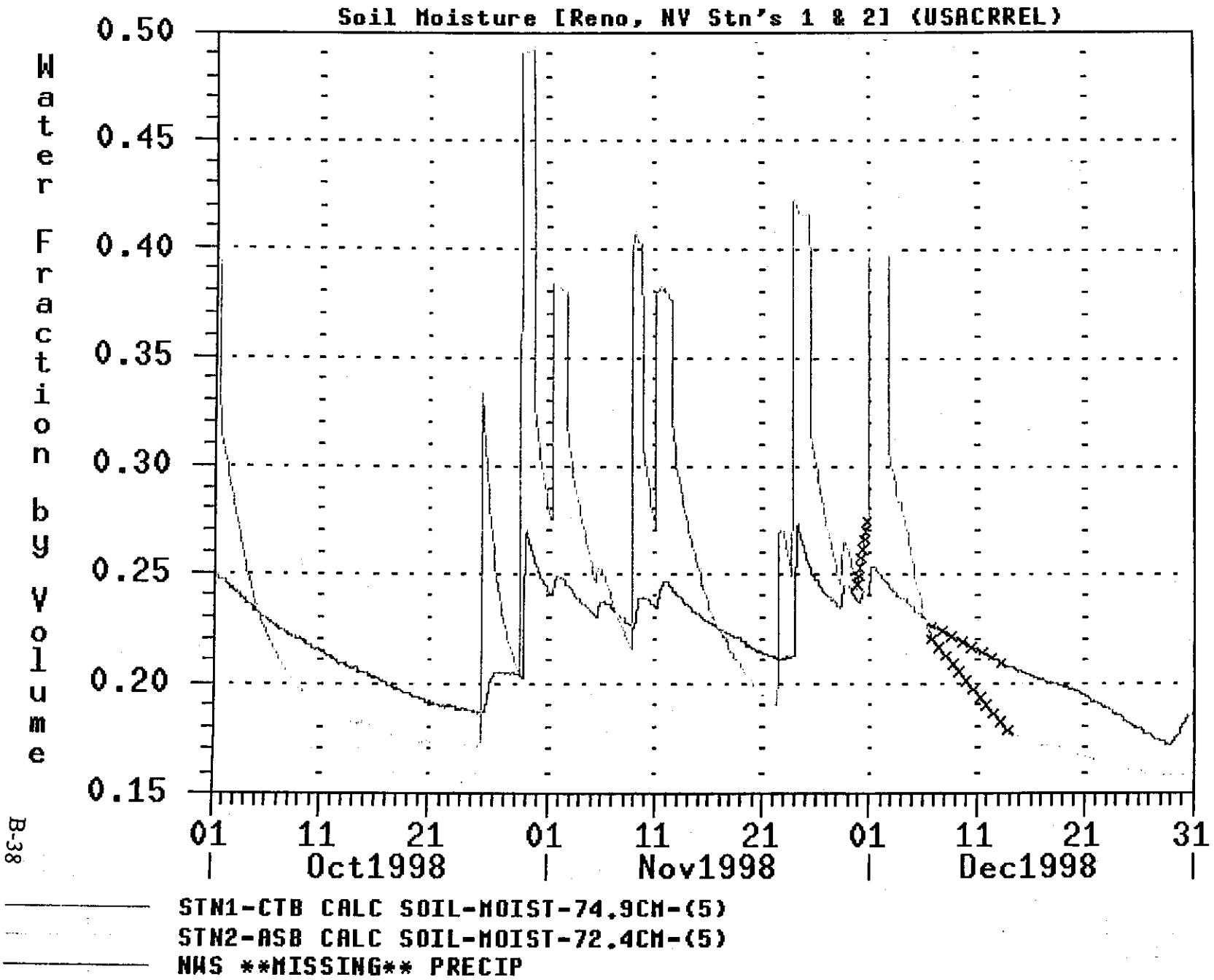
18MAY99 19:31:09



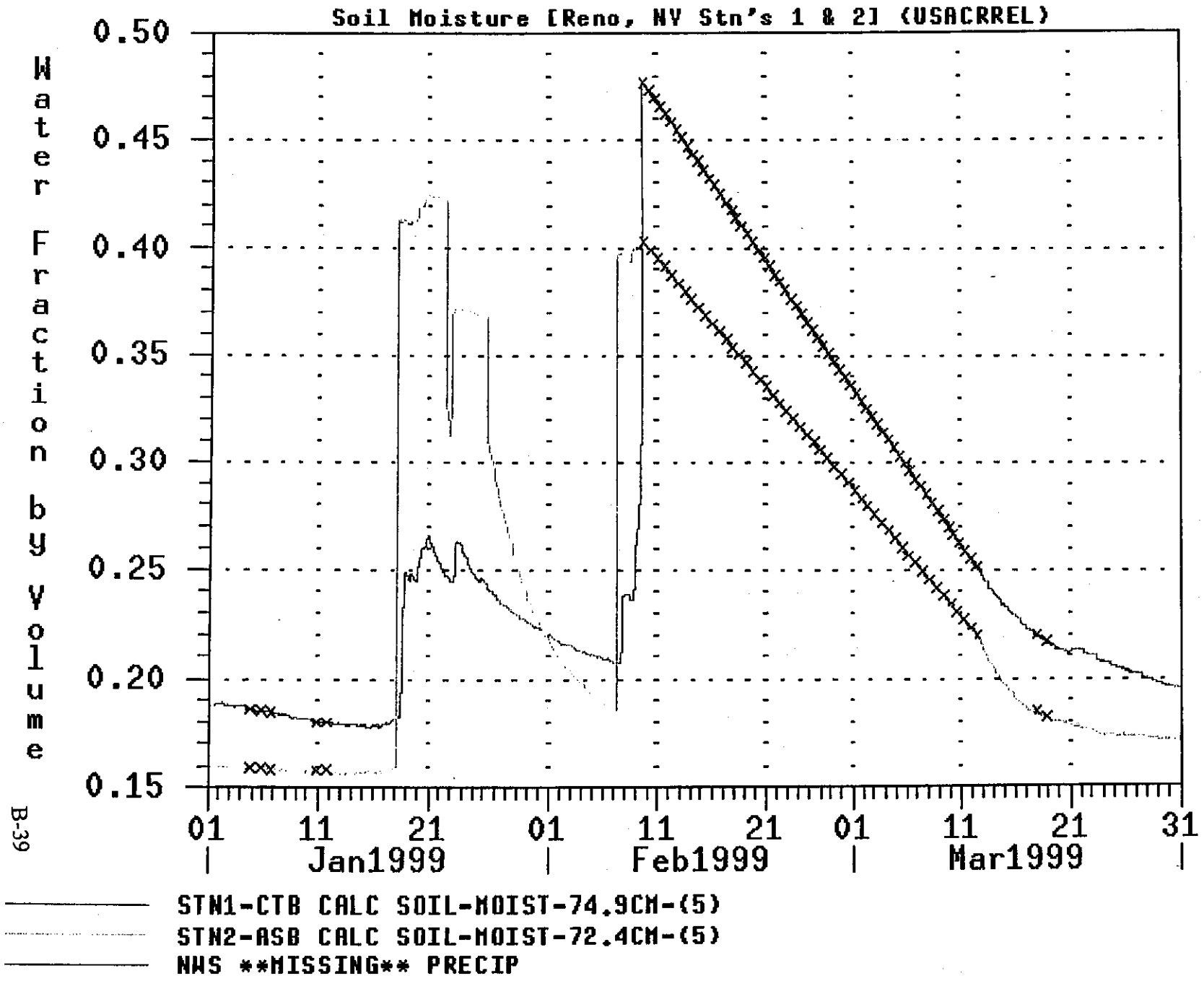
18MAY99 19:31:31

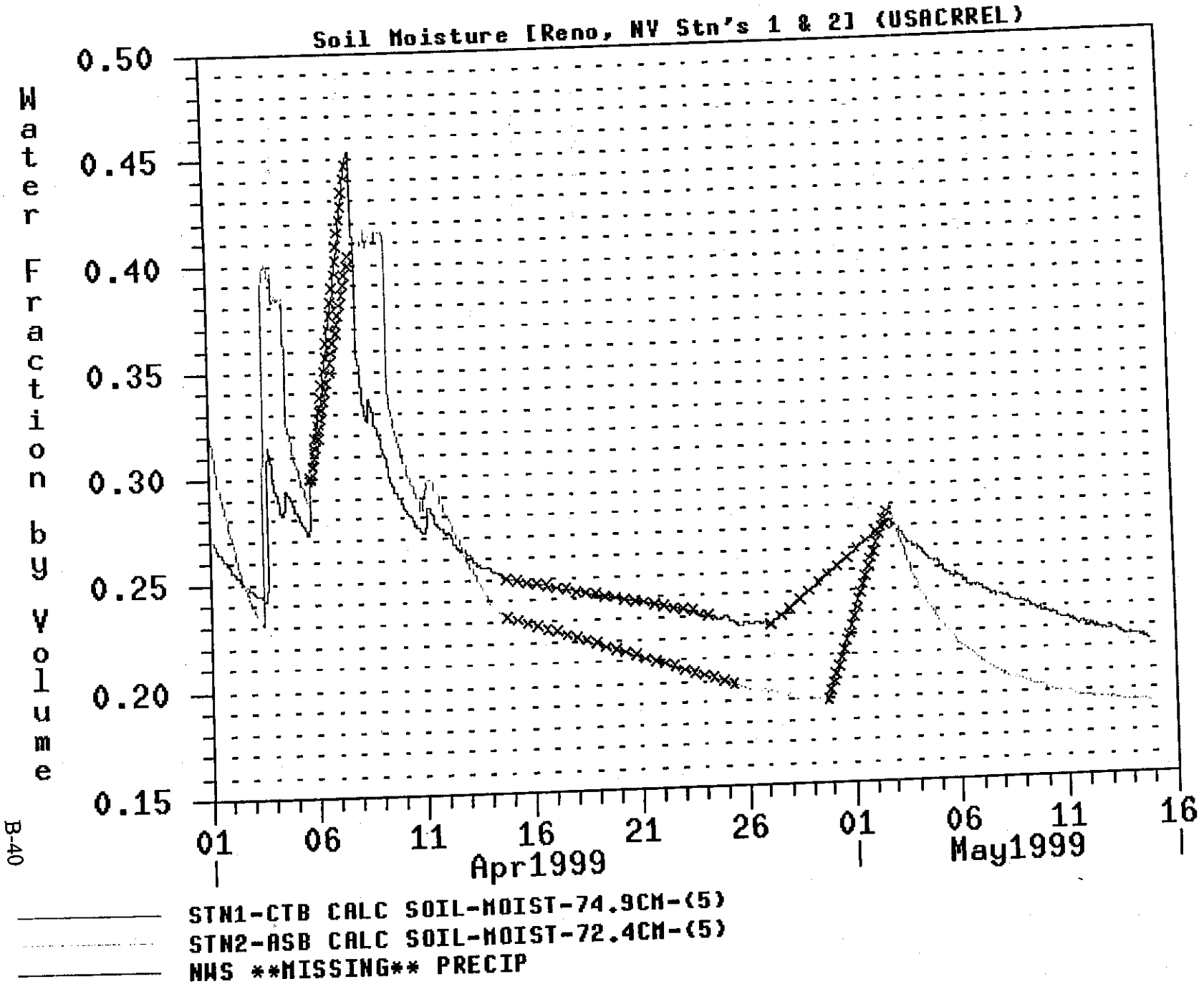



Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Water Fraction by Volume
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
01
11
21
01
11
21
01
11
21
30
Jul1998
Aug1998
Sep1998
STN1-CTB CALC SOIL-MOIST-74.9CM-(5)
STN2-ASB CALC SOIL-MOIST-72.4CM-(5)
NWS **MISSING** PRECIP


Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Water Fraction by Volume
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
01
11
21
01
11
21
01
11
21
31
Oct1998
Nov1998
Dec1998
STN1-CTB CALC SOIL-MOIST-74.9CM-(5)
STN2-ASB CALC SOIL-MOIST-72.4CM-(5)
NWS **MISSING** PRECIP

18MAY99 19:32:39




Soil Moisture [Reno, NV Stn's 1 & 2] (USACRREL)
Water Fraction by Volume
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
01
06
11
16
21
26
01
06
11
16
Apr1999
May1999
STN1-CTB CALC SOIL-MOIST-74.9CM-(5)
STN2-ASB CALC SOIL-MOIST-72.4CM-(5)
NWS **MISSING** PRECIP

Kenny C. Guinn, Governor

Nevada Department of Transportation
Tom Stephens, P.E. Director
Prepared by Research Division
Alan Hilton, Research Manager
(775) 888-7803
ahilton@dot.state.nv.us
1263 South Stewart Street
Carson City, Nevada 89712