Exelon Generation LLC's Responses to the Board's Questions

ATTACHMENT 13

Hydrothermal Surveys of Dresden Station Units 2/3 Discharge to the Illinois River During Indirect Open Cycle Operation, June 15 - September 30, 1981

Introduction

During the time period June 15 to September 30, 1981, the Illinois Pollution Control Board (IPCB) allowed Dresden Station Units 2/3 to discharge condenser cooling water in an indirect open cycle mode to the Illinois River. During this mode of operation, condenser water was withdrawn from the Kankakee River, passed through the Units 2/3 condensers and to the cooling pond. After a retention time of approximately 2-5 days, the cooling water was then discharged directly through Units 2/3 discharge canal to the Illinois River. For the period of time that was approved for this type of operation, the following thermal limitation had to be met for discharge water entering the Illinois River in lieu of Rules 203(i)(3) and (4) of Chapter 3, The IPCB Water Quality Criteria: The temperature of Dresden Station Units 2/3 condenser discharge to the Illinois River shall not exceed 32.2°C (90°C) more than 10% of the time in the period and shall never exceed 33.9°C (93°F).

To provide a record of compliance with this alternative effluent standard during the period of applicability, hydrothermal surveys were conducted in the vicinity of Units 2/3 discharge to the Illinois River and continuous temperature records were obtained at the discharge point to the Illinois River and the Dresden Lock and Dam. The surveys and data aquisition were conducted in accordance with a study plan submitted to the IPCB on May 23, 1980, entitled "Proposed Hydrothermal Study Plan for Summer, 1980." The plan was approved on May 26, 1981, and was also found acceptable by the Illinois Environmental Protection Agency (IEPA).

The specific objectives of this survey and data acquisition for the time period were to:

1. Maintain a continuous temperature record at Dresden Station Units 2/3 discharge canal exit to the Illinois River;

2. Maintain a continuous temperature record at Dresden Island Lock and Dam;

3. Determine the surface dimension and strata characteristics of the thermal plume from the station discharge into the Illinois River;

4. Determine the surface area, in acres, of the excess $5^{\circ}F$ ($2.8^{\circ}C$) isotherm in the river; and

5. Determine compliance with the alternate effluent standard granted by the IPCB.

Methodology

Continuous temperature measurements were obtained at the station discharge point prior to entering the Illinois River and at Dresden Island Lock and Dam using a Foxboro (Model 40 RP-RPM 18) temperature sensor and recorder system installed at each location. The charts on which data was

recorded were changed and collected weekly. The location of the sensors is shown in Figure 1.

Thermal plume surveys were conducted on the following dates during 1981: June 15, 19 and 23; July 7 and 22; August 4 and 18; September 9, 22 and 29. Temperatures were obtained using a Montedoro Whitney temperature system (Model tC-5) that utilizes a sensor that can be lowered to any desired depth in the water column to obtain only specific temperature. During each plume survey, areal and strata temperature measurements were obtained by measuring the temperature strata in the Des Plaines River at the Joliet Yacht Club and in the Kankakee River upstream of Dresden Station intake. Temperatures were also obtained at Dresden Island Lock and Dam and at the station intake and discharge. The station heat input was subtracted from the mixed temperature obtained at the Lock and Dam to determine the ambient river temperature. The station discharge flow and flow of the Illinois River at the Dresden Lock and Dam were additionally used to flow weight the river ambient. This is expressed in the following mathematical expression that was applied to all areal and strata measurements that were conducted during the survey:

$$t_{amb} = tm - \frac{(Q2,3)(tD-tI)}{QIll}$$

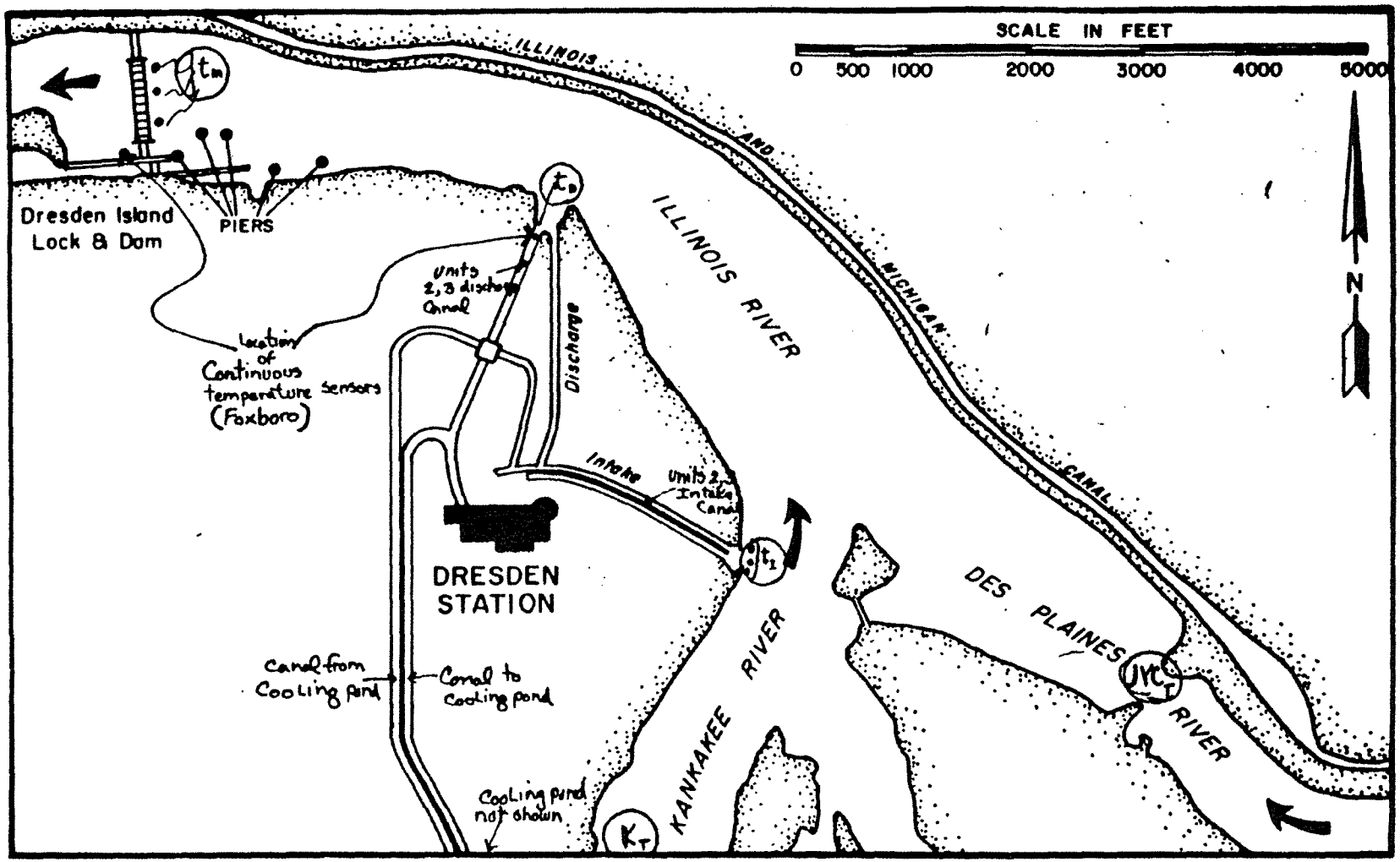


Figure 1 Location of continuous temperature sensors and of sampling points for determining t_m t_D t_I JYC_t and K_t temperatures.

Where: t_{amb} = ambient river temperature;

tm = average of temperature strata measurements obtained at locations across the Dresden Lock and Dam. Temperature represents the mixed temperature of the Des Plaines, Kanakakee Rivers including heat input from Dresden Station operation;

t_D = Average discharge temperature of Dresden Station Units 2/3;

t_I = Average temperature of measurements obtained at Dresden Station intake;

$Q_{2,3}$ = Dresden Station total circulating water flow; and

QIll = Illinois River flow obtained from the Dresden Island Lock and Dam during the study period.

After t_{amb} was obtained, a trolling survey was conducted at one foot below the surface to deliniate the acreage contained within the excess $5^{o}F$ ($2.8^{o}C$) isotherm. This temperature expression was determined by adding $5^{o}F$ ($2.8^{o}C$) to the t_{amb} temperature. This temperature value is expressed as the t_{allow}. The locations where temperature measurements were taken to obtain the t_{amb} and t_{allow} are shown in Figure 1.

Strata temperatures were obtained along survey gridlines shown in Figure 2. A minimum of strata temperature measurements were obtained along

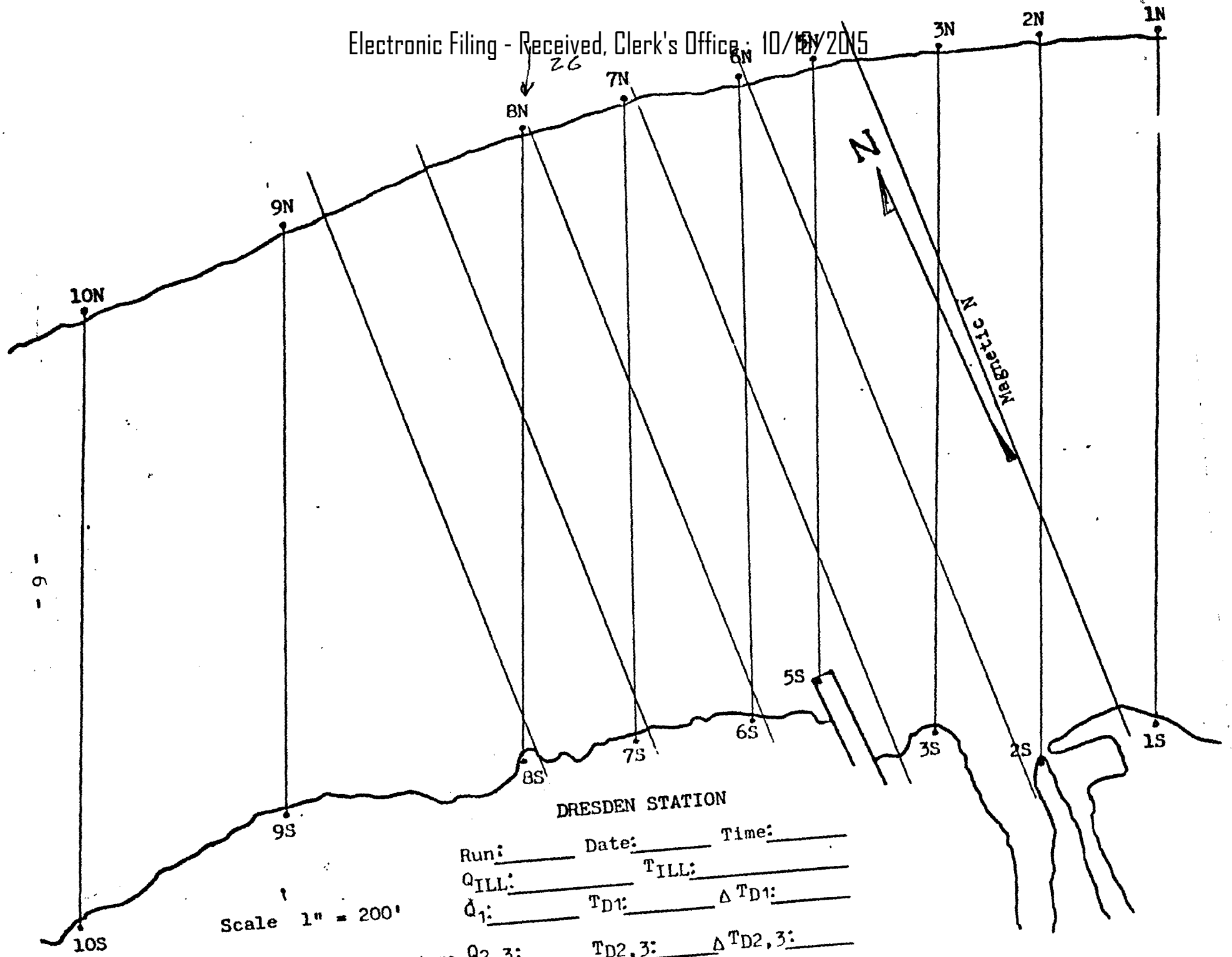


Figure 2 Gridlines - where temperature measurements were obtained.

each line to deliniate the transverse and longitudinal isotherms that exist at various depths within the area of the plume in the river. The values were obtained at the surface, -1 foot, -2 feet and thereafter every two feet of depth until the bottom of the river was reached.

Instrument calibration was conducted periodically when field trips were taken. The station discharge and Dresden Island Lock and Dam sensors and recorders were periodically checked against the Whitney instrument. The Whitney instrument was used to check the calibration of the Foxboro instruments because it was newly purchased at the beginning of the survey and was calibrated by the instrument manufacturer. It was guaranteed to be $\pm$ .1^{o}C accurate not to drift beyond $\pm$ .03^{o}C within the first year of ownership of the instrument. The whitney was checked with a laboratory thermometer periodically and found to be accurate.

The Dresden Island Lock and Dam temperature sensor and recorder was found to be accurate, when compared with the Whitney, throughout the study and required no adjustment. The temperature sensor and recorder system at Dresden Station discharge was compared with the Whitney and found to be recording temperatures +3^{o}F too high during the entire survey period. The recorder however, did not require adjustment since the temperature error that was recorded was consistant and linear throughout the survey. An adjustment for this +3^{o}F appears in the data presentation in Figures 3 to 5.

Results and Discussion

The maximum and minimum temperature recorded for the station discharge (t_D) was 91°F (32.0°C) and 69°F (20.6°C). These temperatures occurred on July 10-14 and September 19, 20, 22, 23, 24, 25, 29 and 30, respectively. The complete temperature record for the period is presented in Figures 3 to 8. (A continuous temperature is shown in the center column for the specific days. Temperature increases from left to right in the figures with each division representing a change of 1°F.)

The maximum and minimum temperature recorded at the Dresden Island Lock and Dam was 86°F (30.0°C) and 63°F (17.2°C). These temperatures occurred on July 10, 11 and September 29 and 30, respectively. The complete temperature record for the survey period is presented in Figures 9 to 11.

Temperatures at the station discharge to the Illinois did not exceed the IPCB alternate effluent standard of 32.2°C (90°F) or the upper limit of 33.9°C (93°F).

A summary of the station operation conditions, station hydrology, and other river and station temperature calculations used for input for determining areal plume size and strata readings is presented in Table 1. The areal plume and strata temperatures showing excess 5°F (2.8°C) isotherms at the -1 and -2 foot intervals to river bottom in addition to field data sheets are presented together for the specific date that the survey was conducted. These data are shown in Exhibits 1 to 10.

As can be seen from the figures of areal plumes, for the periods of the surveys, the overall size of all plumes were relatively small. This was due in part to the above normal river flows encountered during the survey period. The largest areal plume that was measured for the excess 5°F (2.8°C) isotherm occurred on August 4th. The size was approximately 12 acres. In contrast, on September 22 and 29, no plume could be detected because the allowable temperature, t_{allow}, was approximately the same temperature of the discharge temperature, t_D. There was not enough heat input into the Illinois River for a detectable plume to form.

Strata measurements conducted throughout the survey indicate that the various strata of temperature mix rapidly with the surrounding cooler river water temperature thereby reducing the overall volume of plume size in the river or for a specific isotherm. This is shown in Exhibits 1 to 10

Strata analysis also indicates that the Des Plaines River was warmer than the Kankakee River for all periods during the survey. Mixing of the two rivers did not occur until near the Dresden Island Lock and Dam.

Summary and Conclusion

1. Continuous temperatures recorded at the Dresden Station discharge canal for Units 2/3 for the period of the survey ranged from 91°F (32°C) to 69°F (20.6°C).

2. Continuous temperature recorded at the Dresden Island Lock and Dam for the period of the survey ranged from 86°F (30.0°C) to 63°F (17.2°C).

3. Areal surveys were all relatively small during the survey period. The largest area of excess 5°F (2.8°C) temperature was approximately 12 acres in size (August 4, 1981). There were two surveys when no plume was detected (August 23 and 29, 1981).

4. Thermal plumes were relatively small and dissipated rapidly. Plumes never reached the north shore opposite the Dresden Station discharge. The plume never formed a significant barrier across the river.

5. During the period June 15 to September 30, 1981 the station was in compliance with the alternative effluent standard granted by the IPCB for indirect open cycle operation.

Date	Unit 2 (MWe)	Unit 3 (MWe)	Circulating Water Pumps	House Service Pumps	$Q_{2,3}+Q_{HS}$ cfs	Q_{ILL} cfs	Unit 2,3 Discharge T_D	Unit 2,3 Intake T_I	Dresden Island L&D Mix T_M	JYC_T	KKR_T	T_{allow}	Acres within 5°F (2.8°C) Isotherm
6/15/81	280	874	6	3	2198	52,502	30.1°C	23°C	23.2°C	22.8°C	22.8°C	25.7°C	8
6/19/81	749	753	6	3	2198	20,823	27.9	21.9	23.3	23.6	21.8	25.4	9.6
6/23/81	776	796	5	2	1815	18,162	27.3	21.7	23	23.0	20.9	25.3	8
7/7/81	728	759	6	3	2198	11,150	31.1	25.5	27.8	26.6	25.5	29.4	4
7/22/81	805	671	6	3	2198	13,450	30.1	23.0	25.6	26.2	23.0	27.2	15
8/4/81	800	687	6	3	2198	16,450	29.7	22.8	25.7	26.34	22.7	27.6	12
8/18/81	633	648	6	3	2198	7,250	25.3	21.2	23.3	23.6	20.9	24.8	5.5
9/9/81	784	607	6	3	2198	11,350	26.7	19.74	22.97	23	19.6	24.4	8
9/23/81	0	595	6	3	2198	7,300	20.9	18.2	20.2	20.7	17.6	22.1	0
9/29/81	819	566	6	3	2198	9,800	20.8	16.6	18.7	19.5	15.9	20.4	0

Table 1 Summary of Thermal Plume Studies - 6/15 - 9/29/81

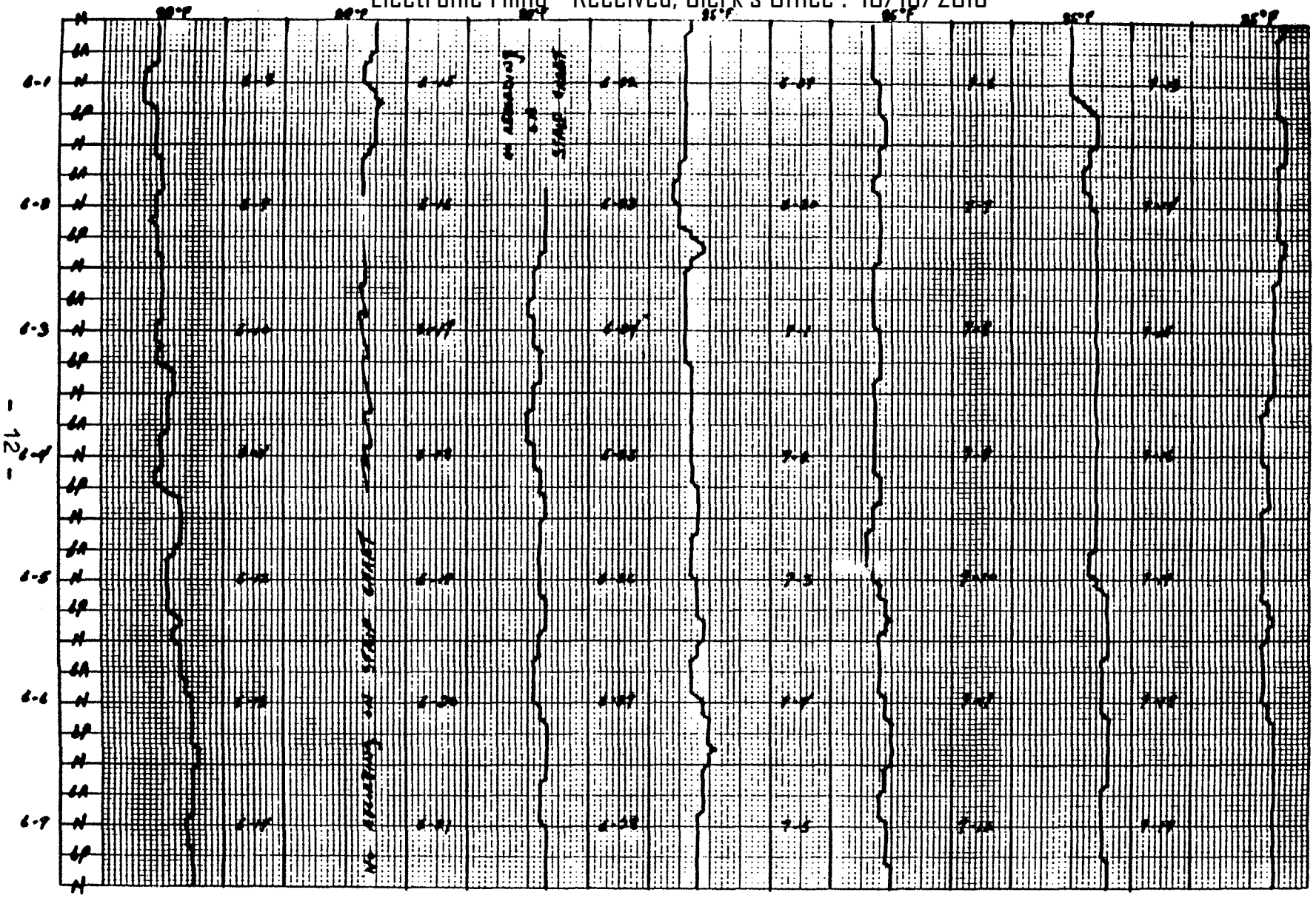


Figure 3 - Dresden Station Discharge Temperature Record 6/1-9/30, 1981. (temperatures adjusted to compensate for instrument calibration)

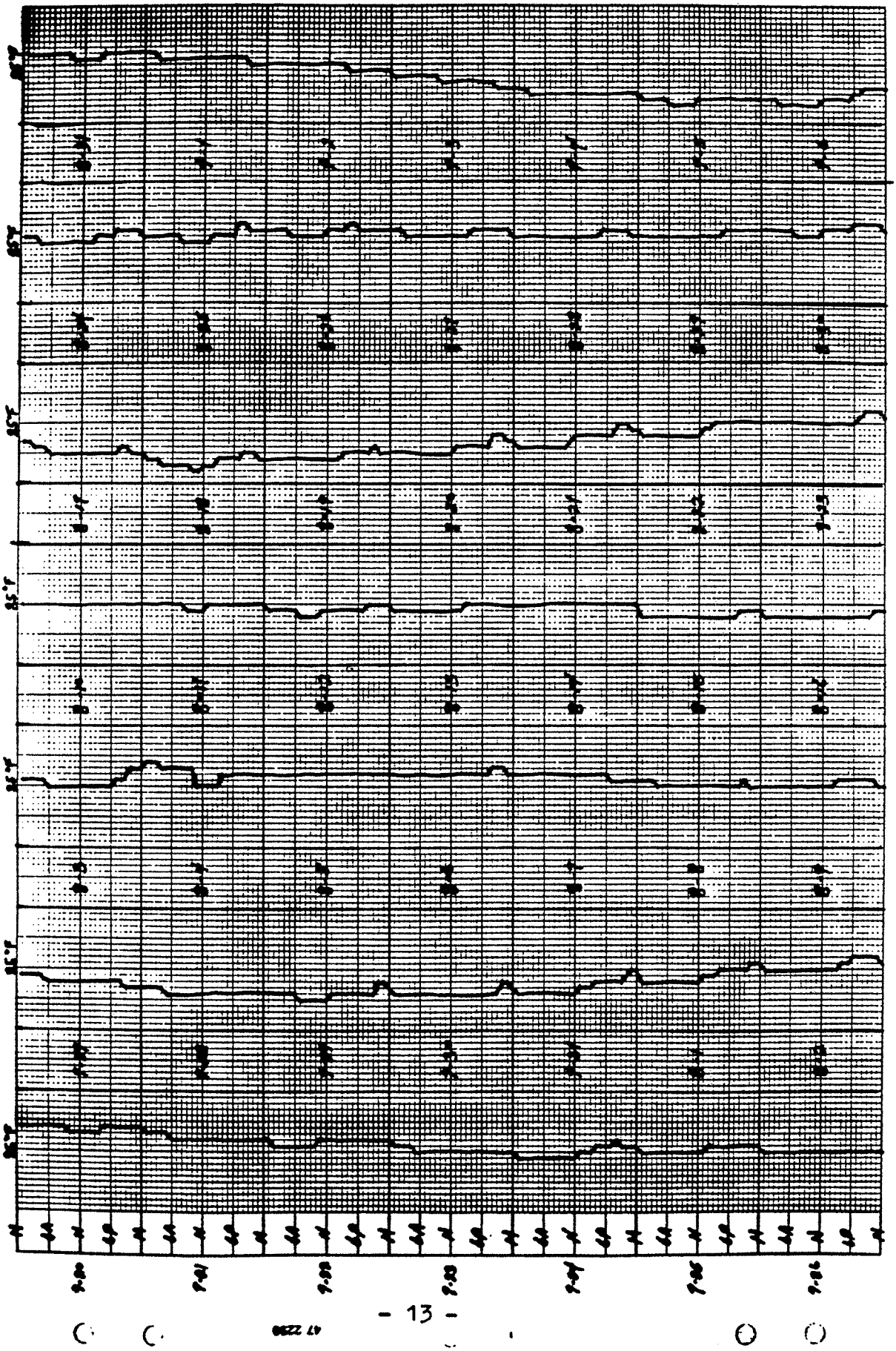


Figure 4 - Continuation of figure 3

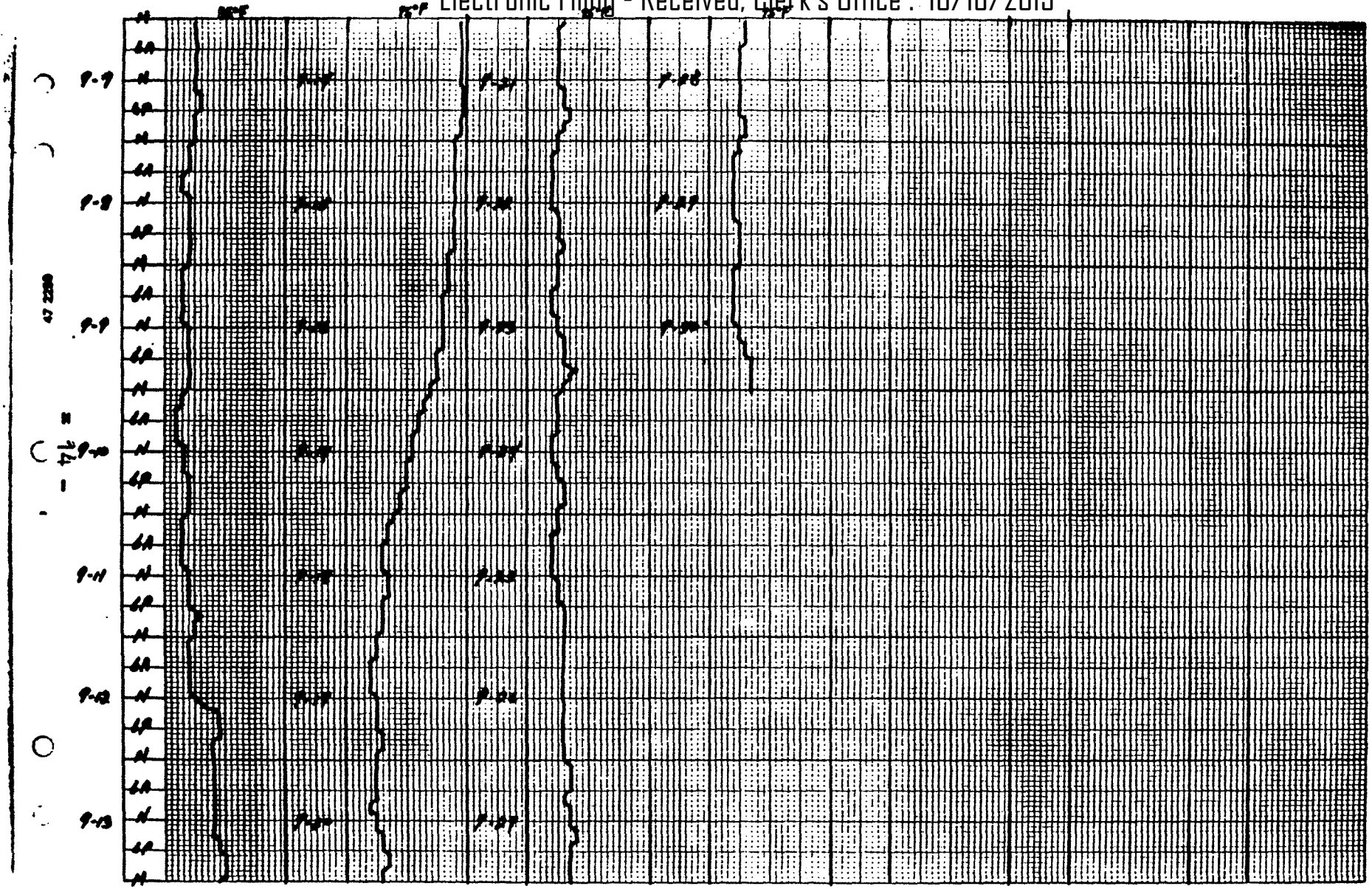


Figure 5 - Continuation of figures 3 and 4

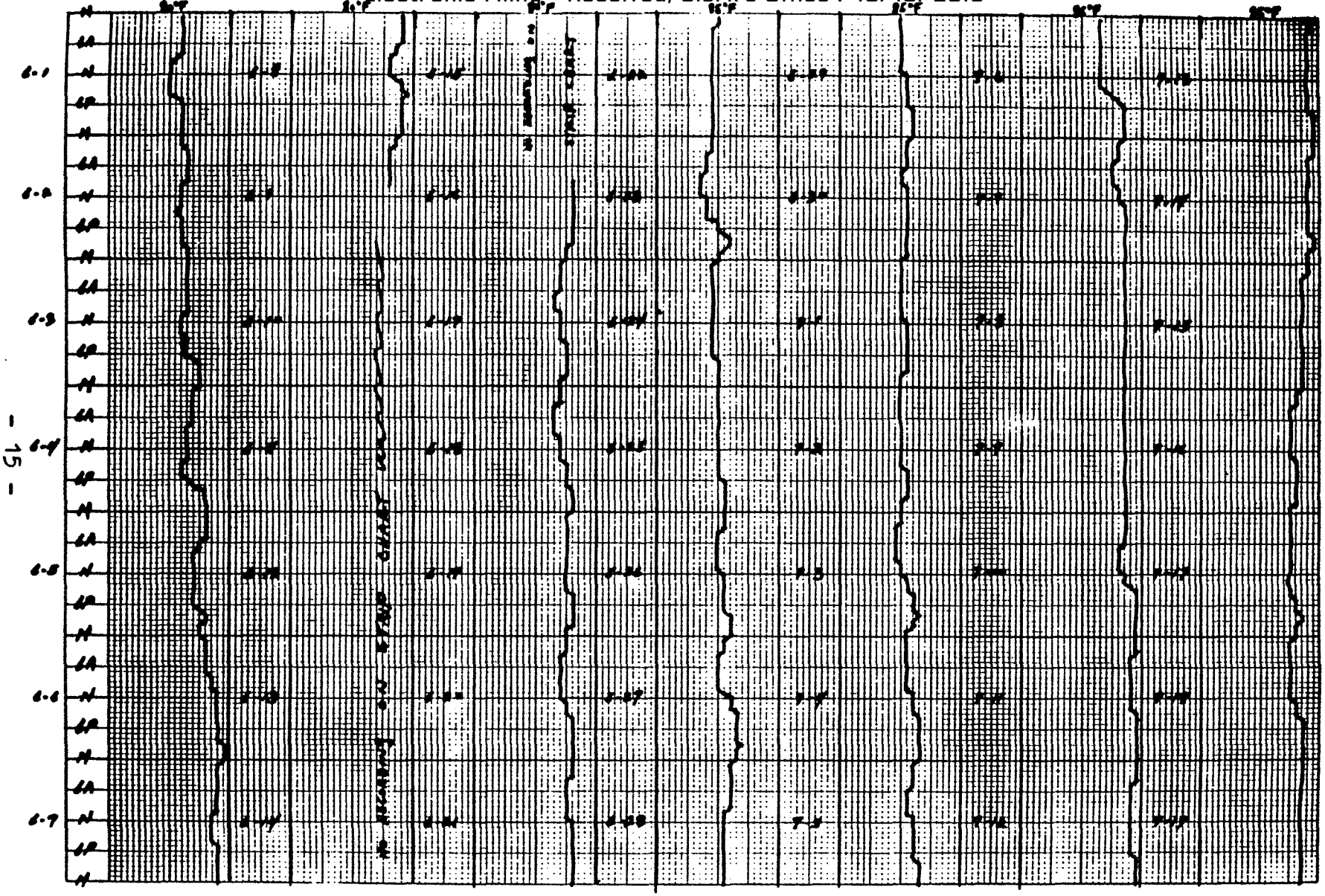


Figure 6 - Dresden Station Discharge Temperature Record 6/1-9/30, 1981. (temperatures prior to calibration adjustment)

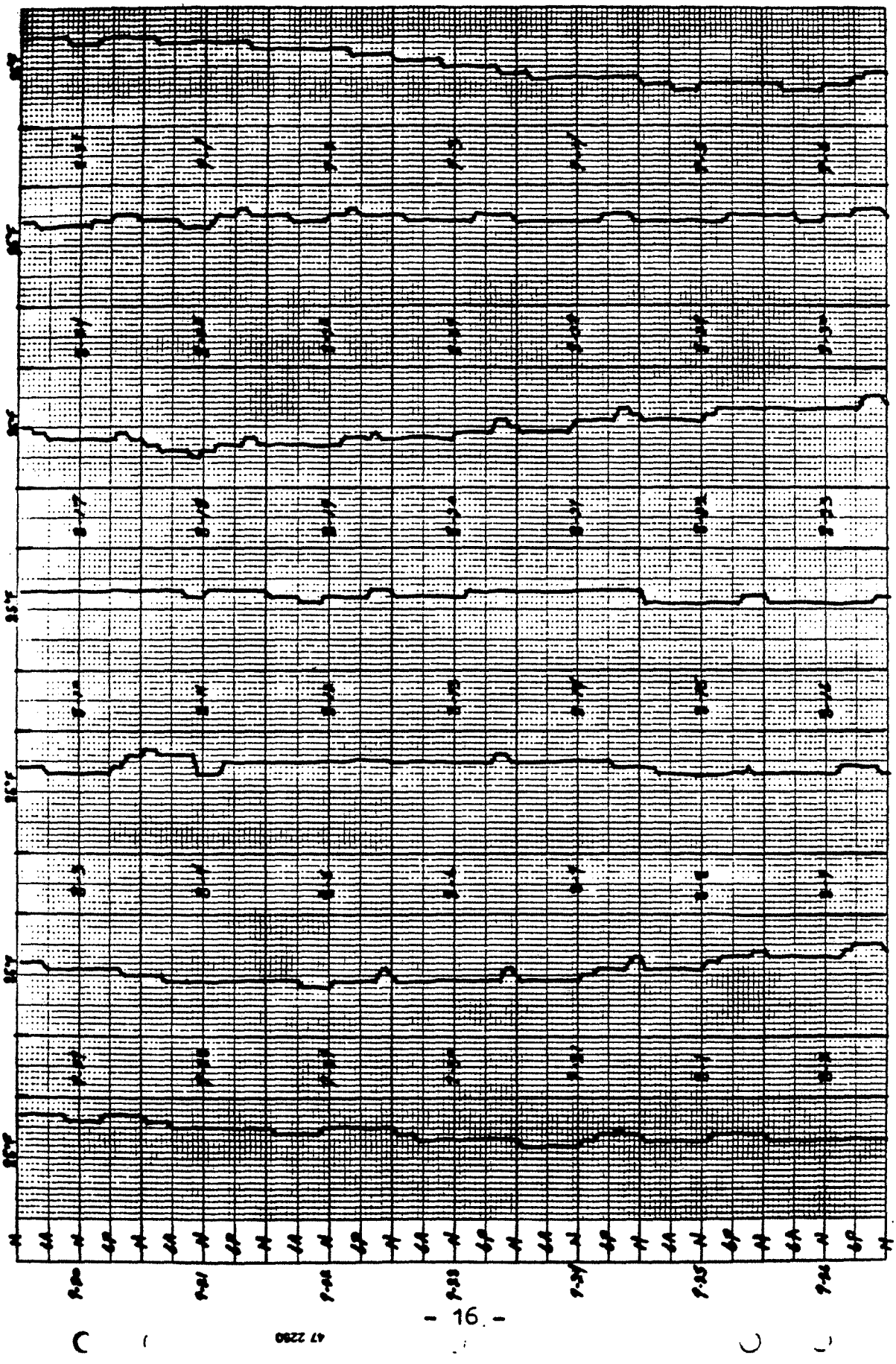


Figure 7 - Continuation of figure 6

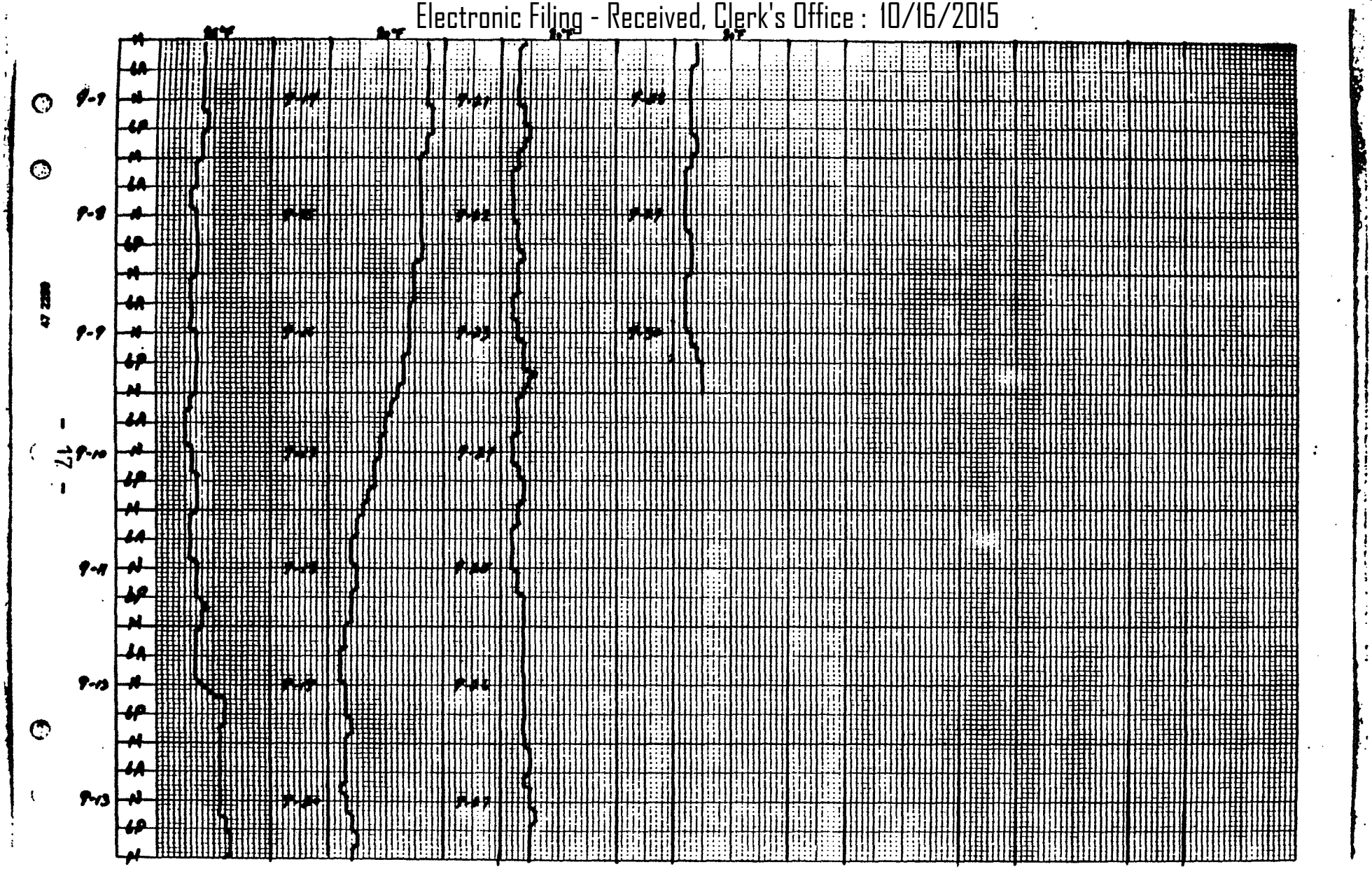


Figure 8 - Continuation of figures 6 and 7

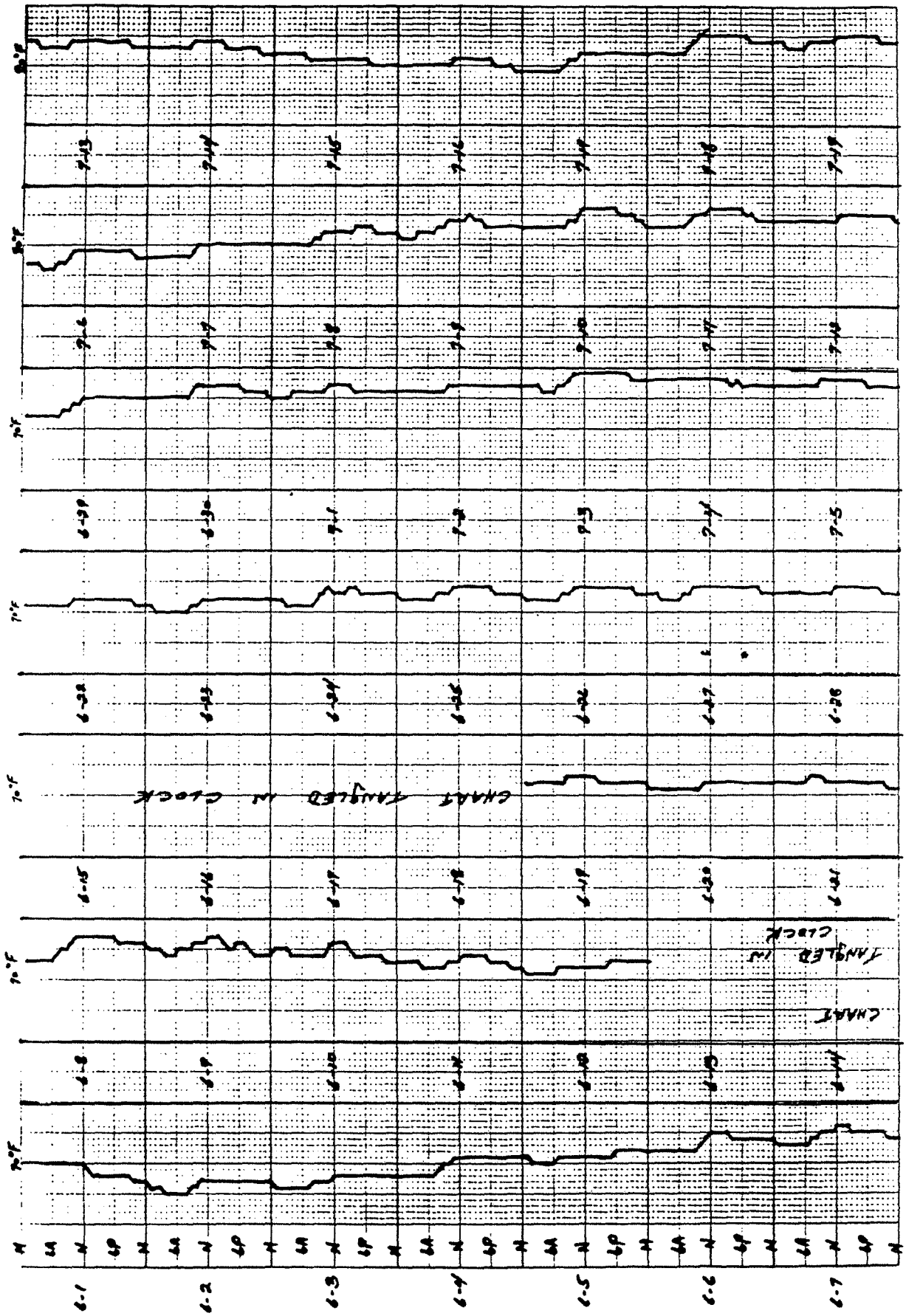


Figure 9 - Dresden Island Lock and Dam Temperature Record 6/1-9/30,1981

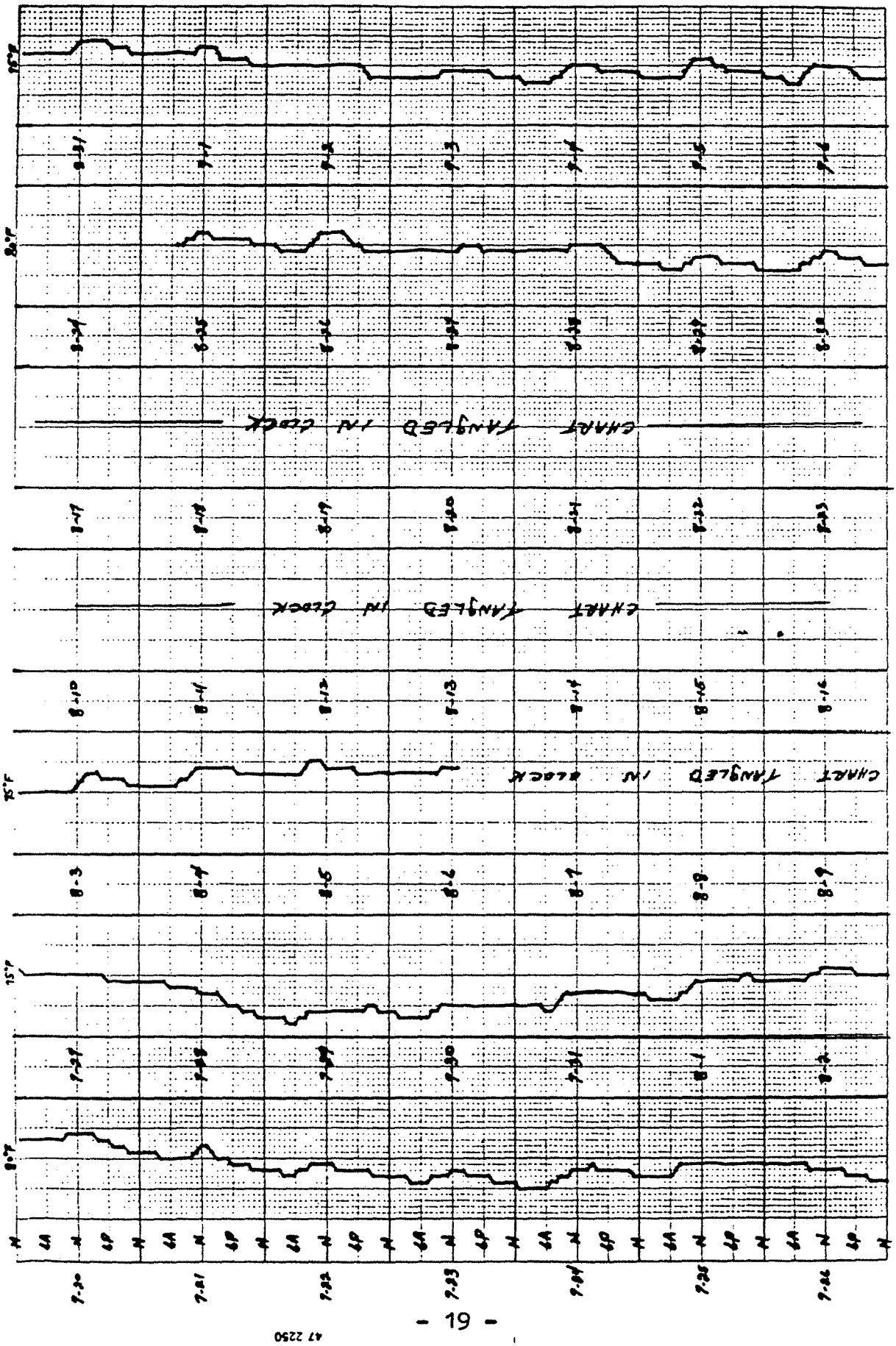


Figure 10 - Continuation of figure 9

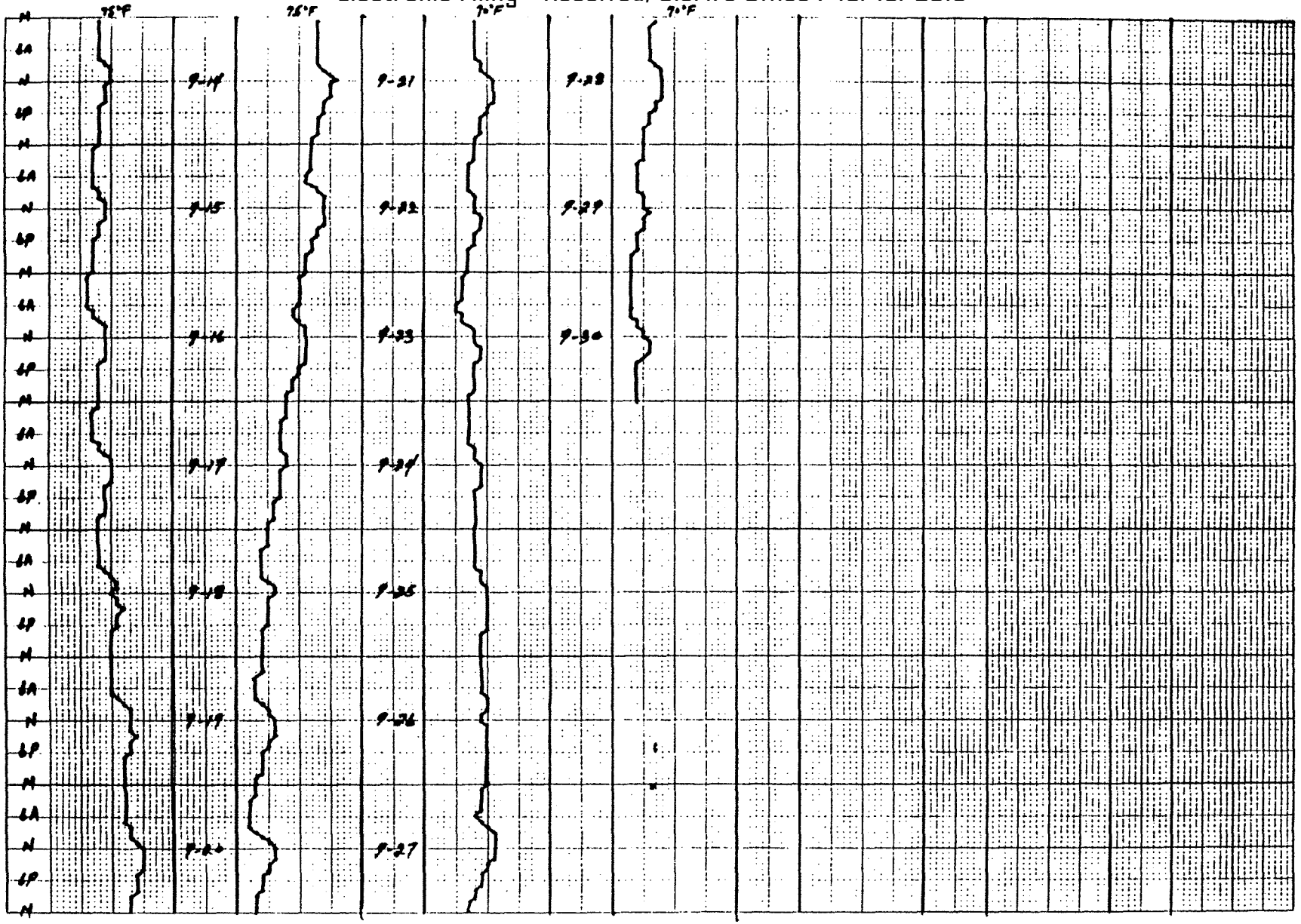
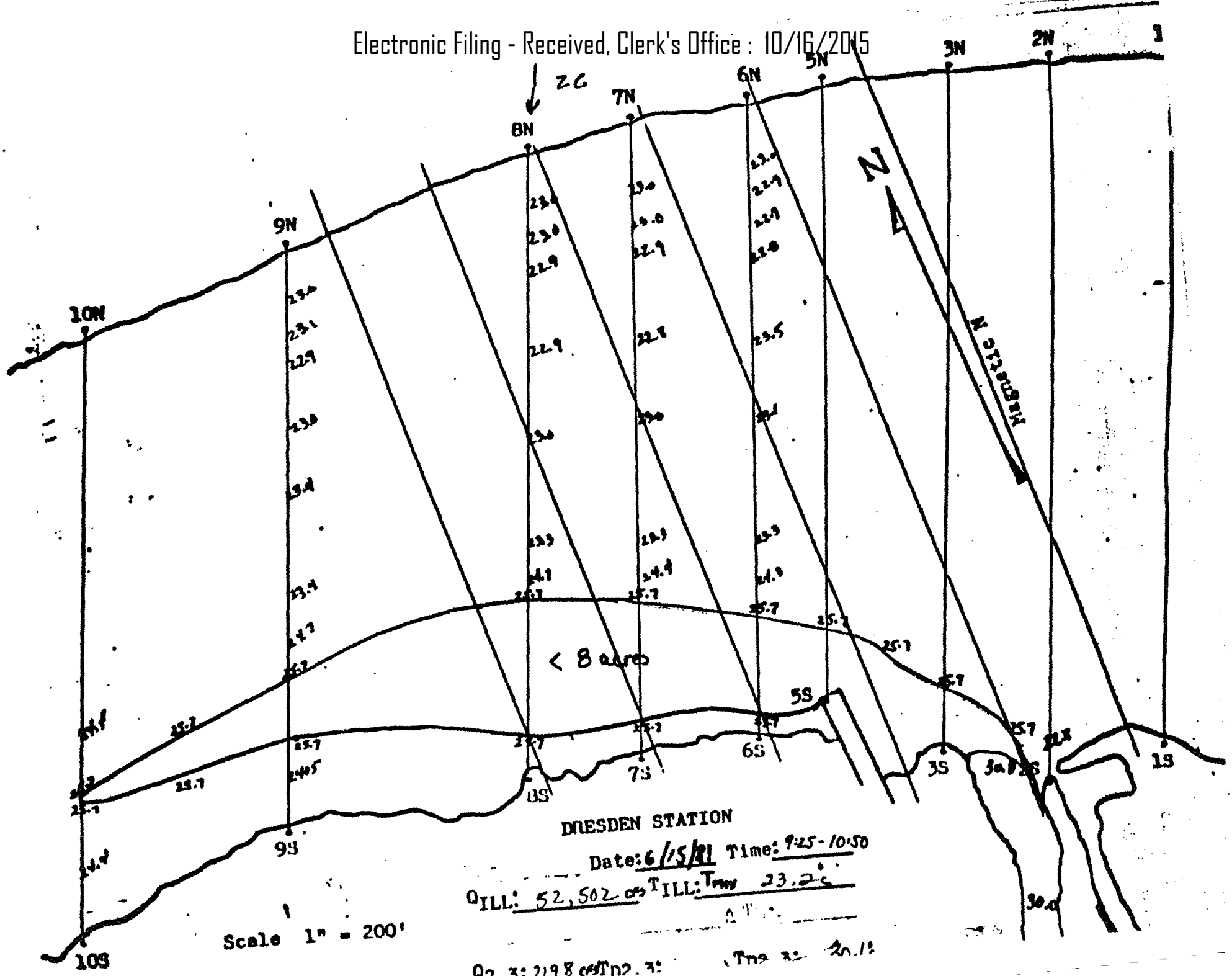
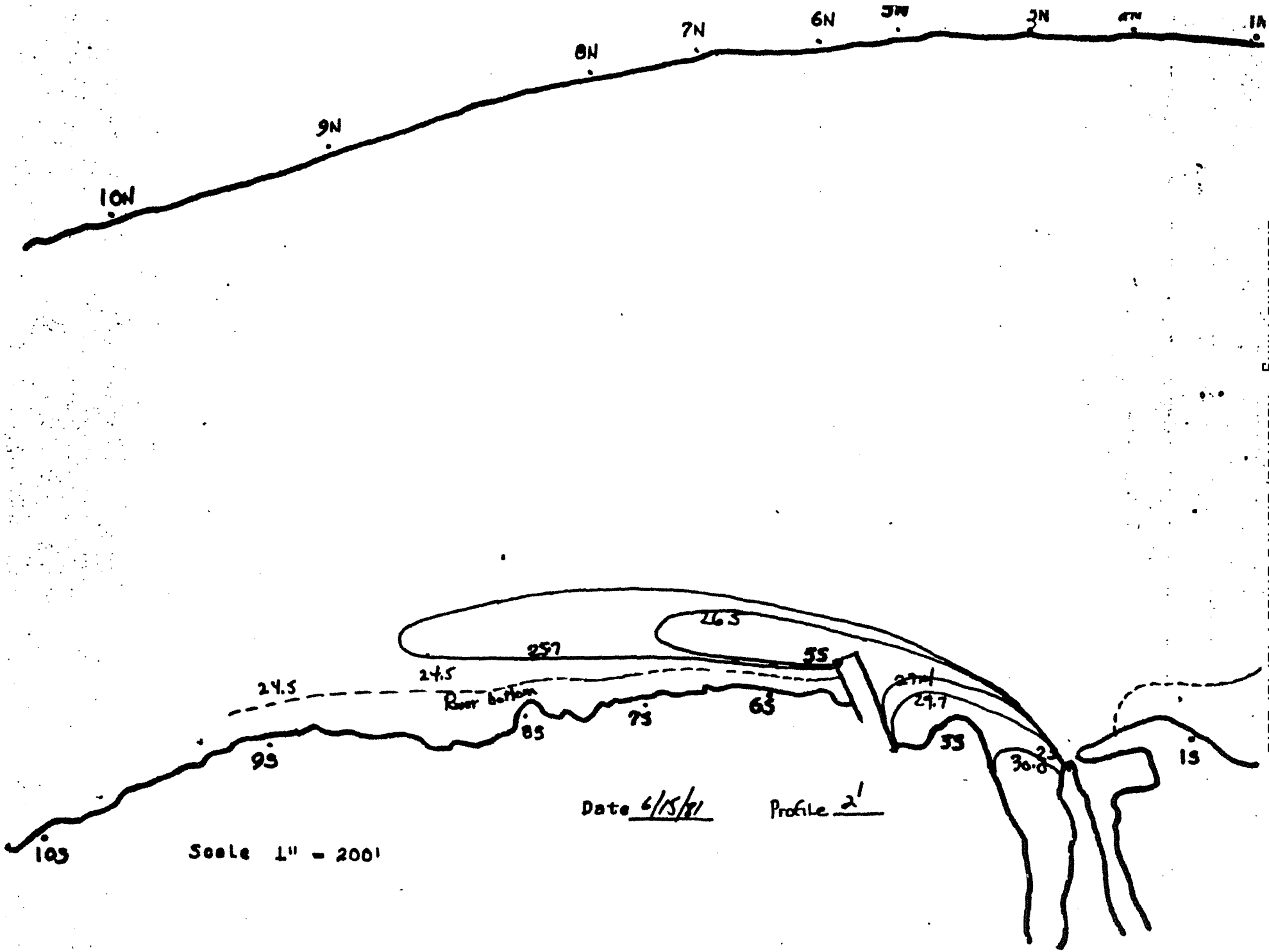
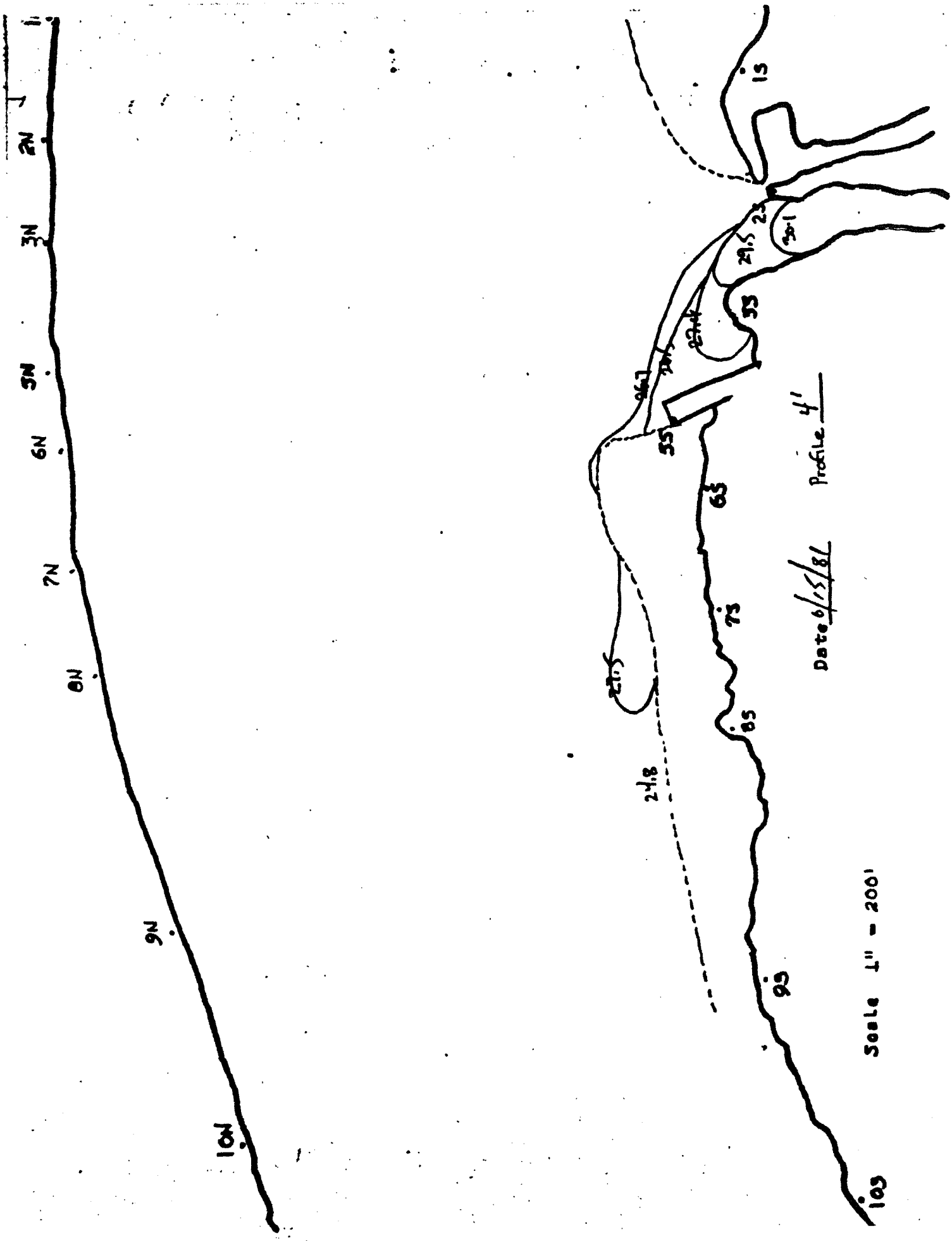


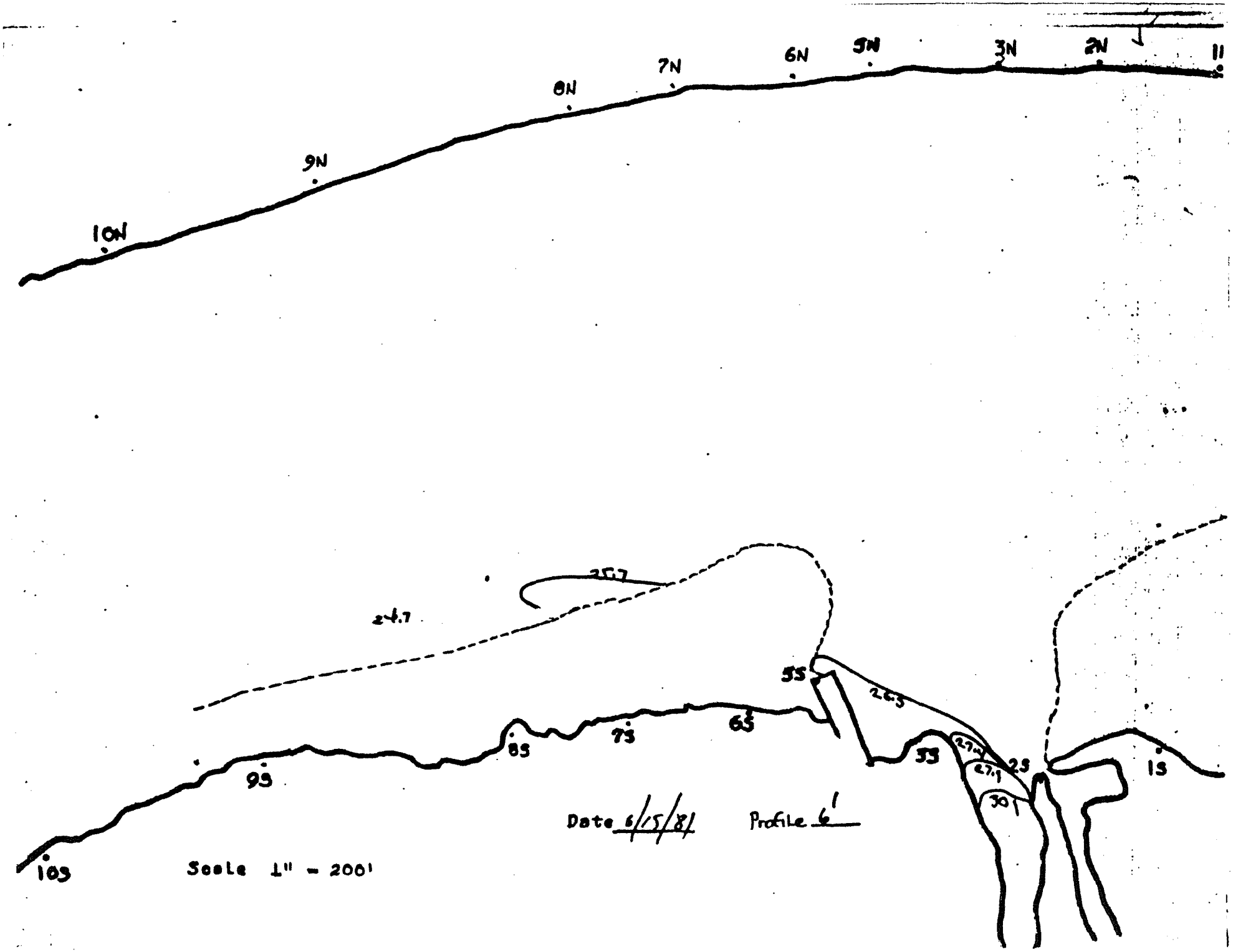
Figure 11 - Continuation of figures 9 and 10

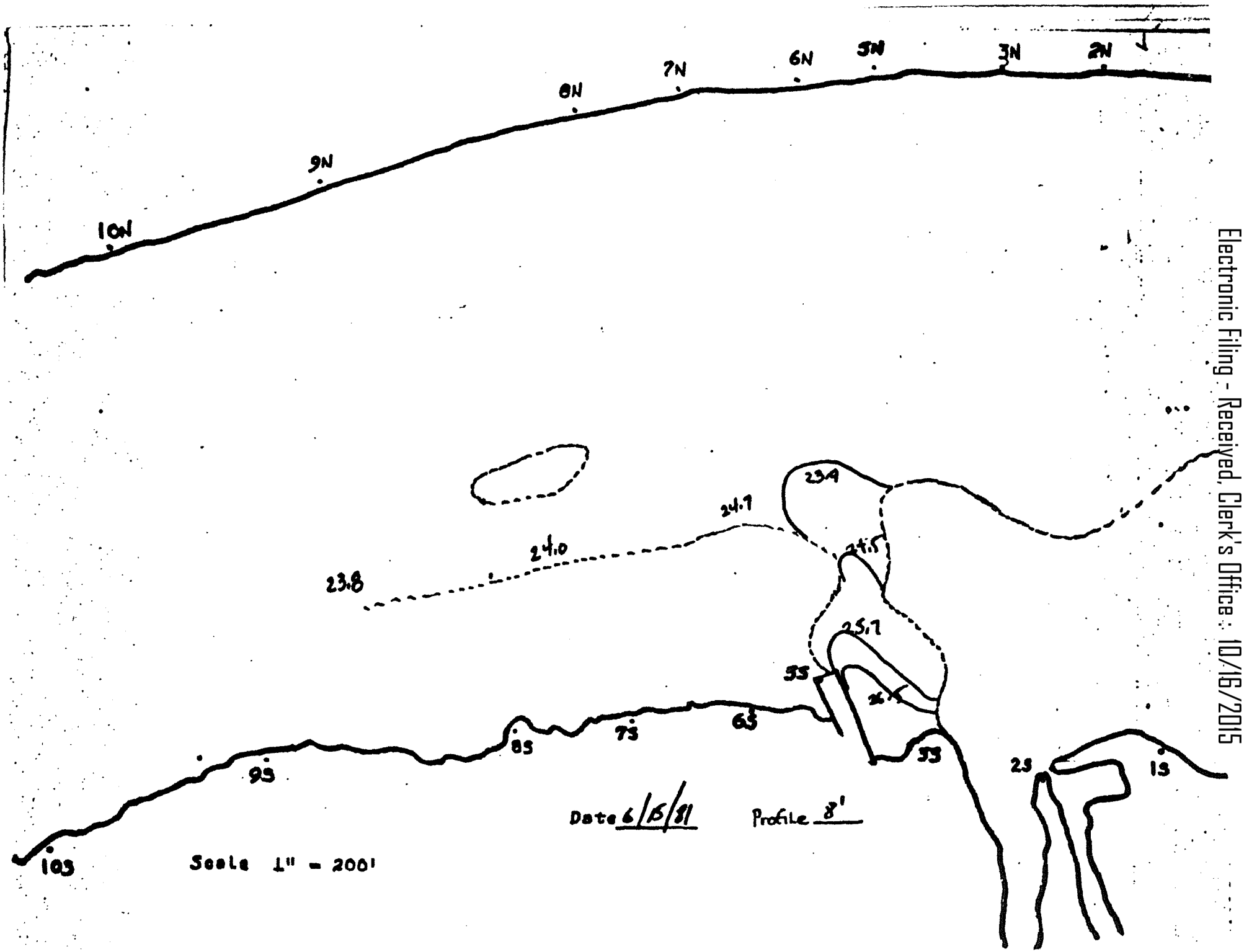
Exhibit 1 — Dresden Station Plume Survey for 6/15/81. Areal Plume and Strata Temperatures Showing Excess 5°F (2.8°F) Isotherm at the -1' to River Bottom and Field Data Sheet.






2N
3N
5N
6N
7N
8N
9N
10N
15
30-1
23
21.5
33
55
63
73
83
93
103
24.8
Profile 4'
Date 6/15/81
Scale 1" = 200'





Project DRESDEN PLUME SURVEY Sheet 1

Subject E.H. DOBOLD, H.F. BERNHARD, J.V. BONKER, D.P. RUBNER Name H. BERNHARD

Date 6/15/81

READING#	1	2	3	4	5	6	7	8	9	10		
LOCATION	Jyc	KANR	INT S	INT C	INT N	LVD 69	LVD 65	LVD 61	DISCH U2,3	Jyc		
TIME	9:25	9:32	9:37	9:40	9:43	10:29	10:29	10:32	9:50	10:30		
S	23.0	23.0	23.2	23.1	23.0	23.3	23.8	23.7	30.0	23.2		
-1FT.	22.8	23.0	23.2	23.0	23.0	23.2	23.0	23.9	30.0	23.2		
-2	22.8	22.9	23.1	23.0	23.0	23.1	23.0	23.9	30.1	23.3		
-4	22.8	22.9	23.1	23.0	23.0	23.0	23.0	23.9	30.1	23.2		
-6	22.8	22.8	23.1	23.0	23.0	23.0	23.0	23.8	30.1			
-8	22.8	22.8	23.1	23.0	23.0	23.0	22.9	23.7	30.1			
-10	22.8	22.8	23.0	23.0	23.0	23.0	22.9	23.5				
-12	22.8	22.8				23.0	22.9	23.5				
-14	22.8	22.8				23.0	22.9					
-16	22.8											
-18												
-20												
-22												
-24												
	22.8											

t_m = { Lock & Dam # 69, "65, " 61.

T_J { Intake S, C, N.

$$T_{amb} = t_m - \frac{(Q_{1,2,3})(t_D - T_J)}{Q \text{ Ill River}}$$

$$23.2 - \frac{(2298)(30.1 - 23)}{52,502}$$

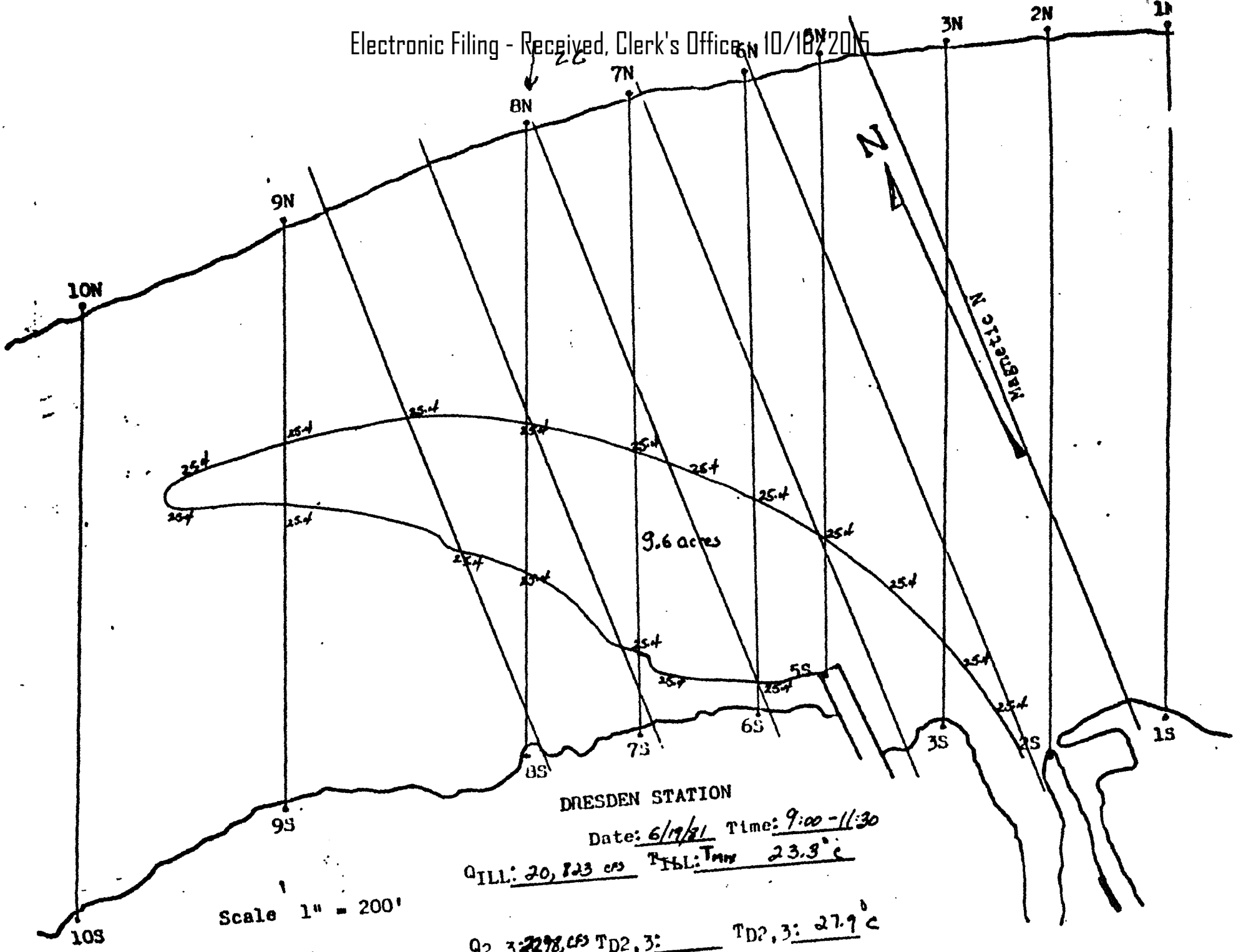
$$23.2 - \frac{15,605.8}{52,502}$$

t_{amb} = 29 − 23.2 = 22.9

$T_{allow} = t_{amb} + 5°F / (2.8°C)$

T_{allow} = 22.90 + 2.8 = 25.7

Exhibit 2	Dresden Station Plume Survey for 6/19/81. Areal Plume and Strata Temperatures Showing Excess 5°F (2.8°F) Isotherm at the -1' to River Bottom and Field Data Sheet.



DRESDEN STATION

Date: 6/19/81 Time: 9:00 - 11:30

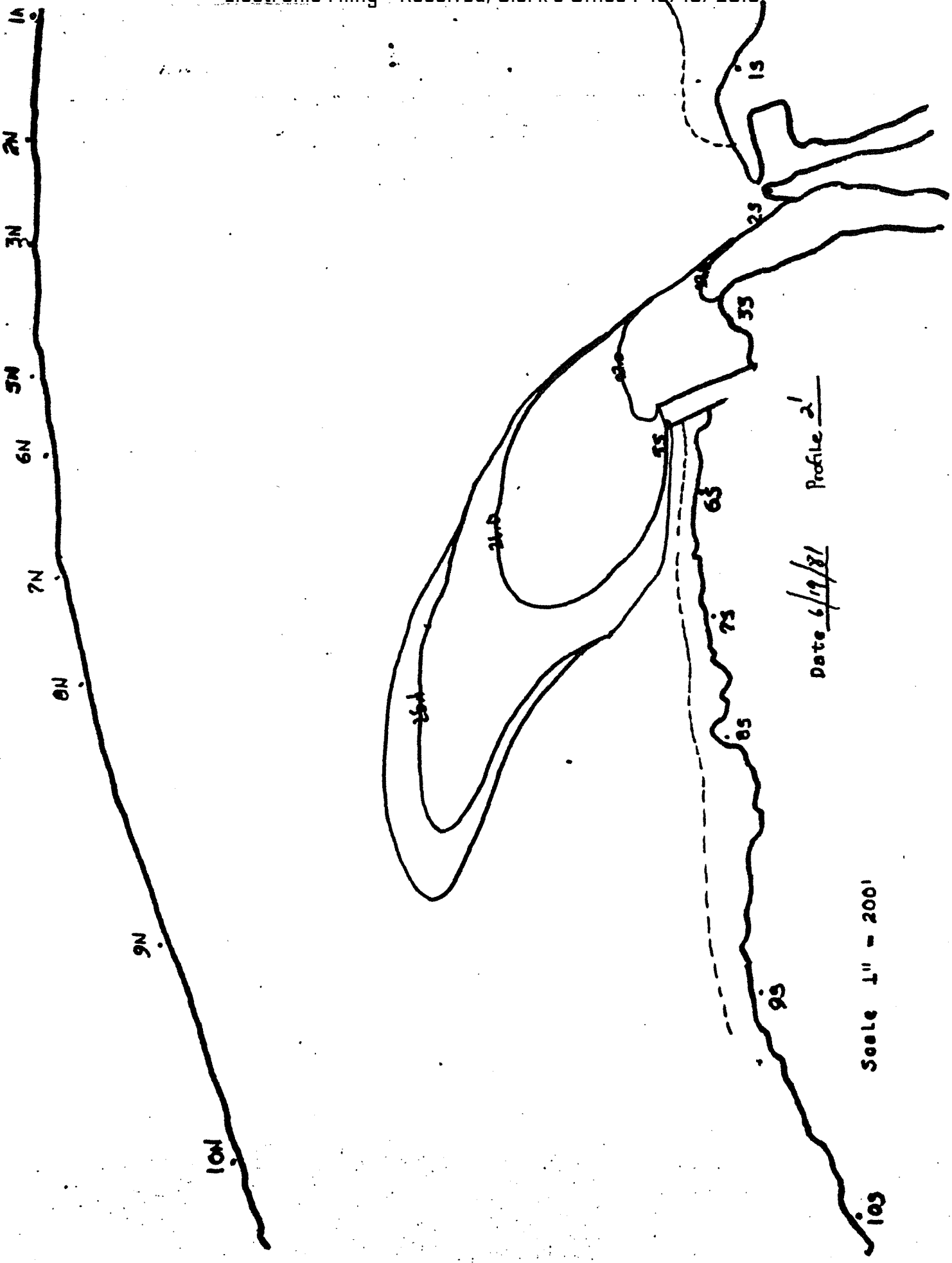
Q_{ILL}: 20,823 cfs T_{ILL}: T_{max} 23.3°c

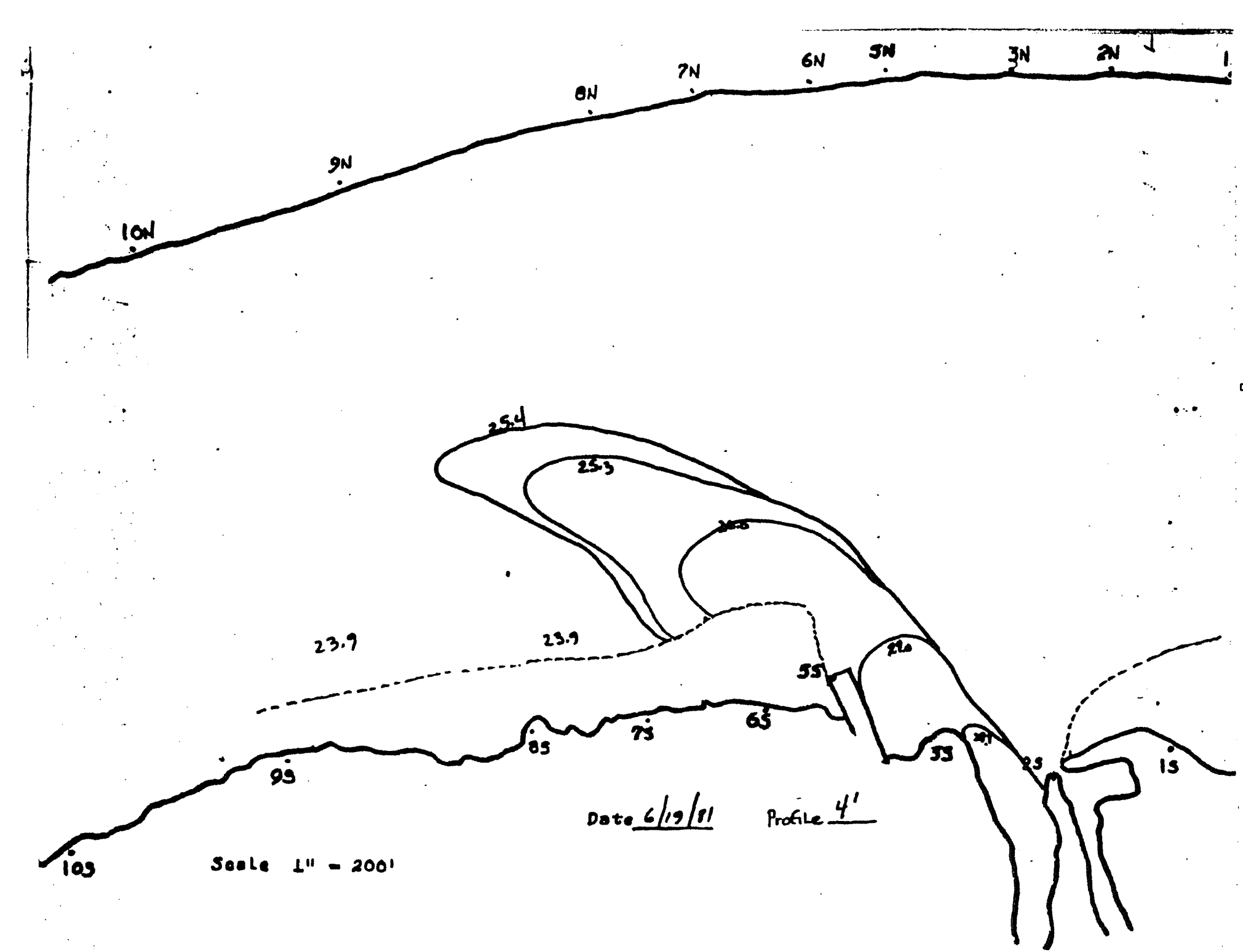
$Q_{2,3}$: ~~2278~~ cfs $T_{D2,3}$: _____ $T_{D2,3}$: 27.9°c

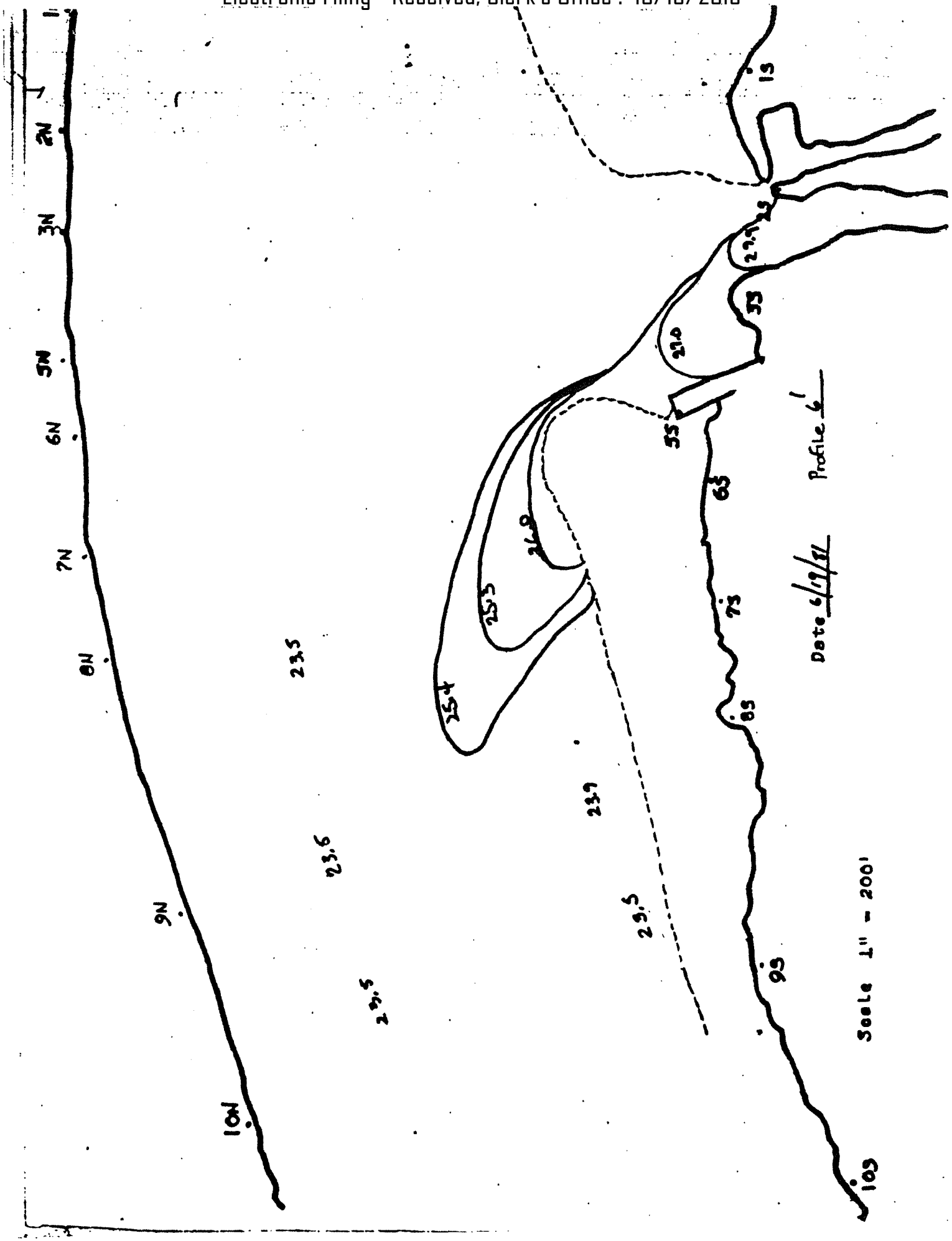
+ 25.4°c

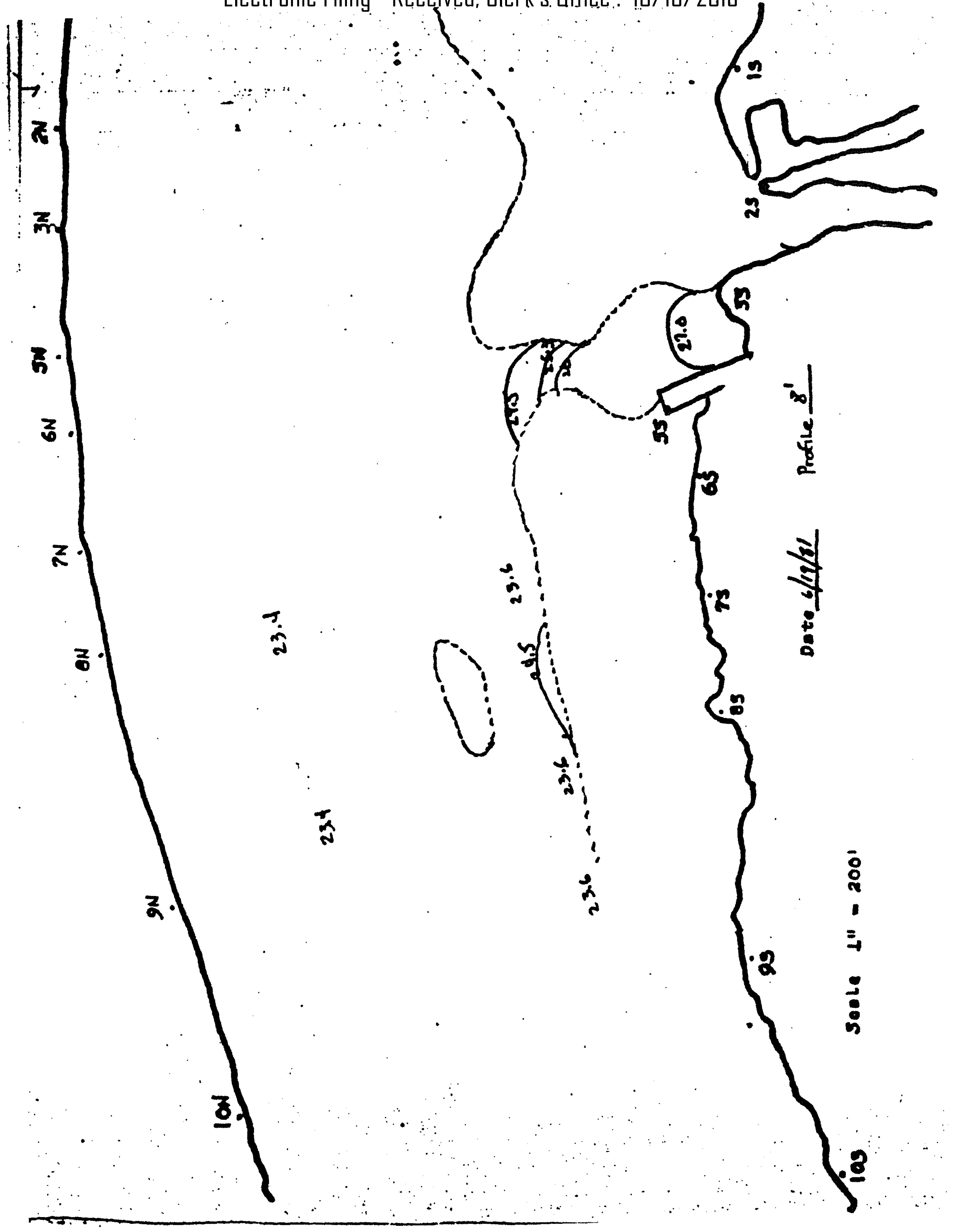
Scale 1" = 200'

All temperatures shown are of 1 ft. depths









Project Dresden Plume Survey Indirect open Cycle Sheet ____

Subject ____ Name H. Bernhard

Depth 1, 2, 3, 4, 5 - 0 ; #6, 7, 8 - 3' ; 9 - 8'. Date 6/19/81

READING#	1	2	3	4	5	6	7	8	9			
LOCATION	JYC	KAN R	INT S	INT C	INT N	LKD 69	LKD 65	LKD 61	DISCH U2,3		JYC	
TIME	9:00	9:10	9:15	9:17	9:20	9:27	9:30	9:34	9:41		11:30	
S	23.6	21.8	21.8	21.8	21.8	24.6	24.0	23.5	27.9		23.5	
-1FT.	23.6	21.8	21.9	21.8	21.8	23.9	23.6	23.5	27.9		23.5	
-2	23.6	21.8	21.9	21.9	21.9	24.1	23.4	23.4	27.9		23.6	
-4	23.6	21.8	21.9	21.9	21.9	24.0	23.2	23.0	27.9		23.6	
-6	23.6	21.8	21.9	21.9	21.9	23.9	23.1	22.8	27.9		23.6	
-8	23.6	21.8	21.9	21.9	21.9	23.8	23.0	22.7	27.9		23.6	
-10	23.6	21.8	21.9	21.9	21.9	23.7	23.0	22.6	27.9		23.6	
-12	23.6	21.8				23.7	23.0	22.5			23.6	
-14	23.6						23.0	22.5			23.6	
-16	23.6						23.0				23.6	
-18	23.6						23.0				23.6	
-20	23.6						23.0				23.6	
-22							22.8					
-24												
	23.6	21.8	21.9	21.9	21.9	24.0	23.2	22.9	27.9			

$t_I = 21.9°$ $t_m = 23.3°$ $t_D = 27.9°$

t_m = { Lock & Dam # 69, "65, "61.

T_I = { Intake S, C, N.

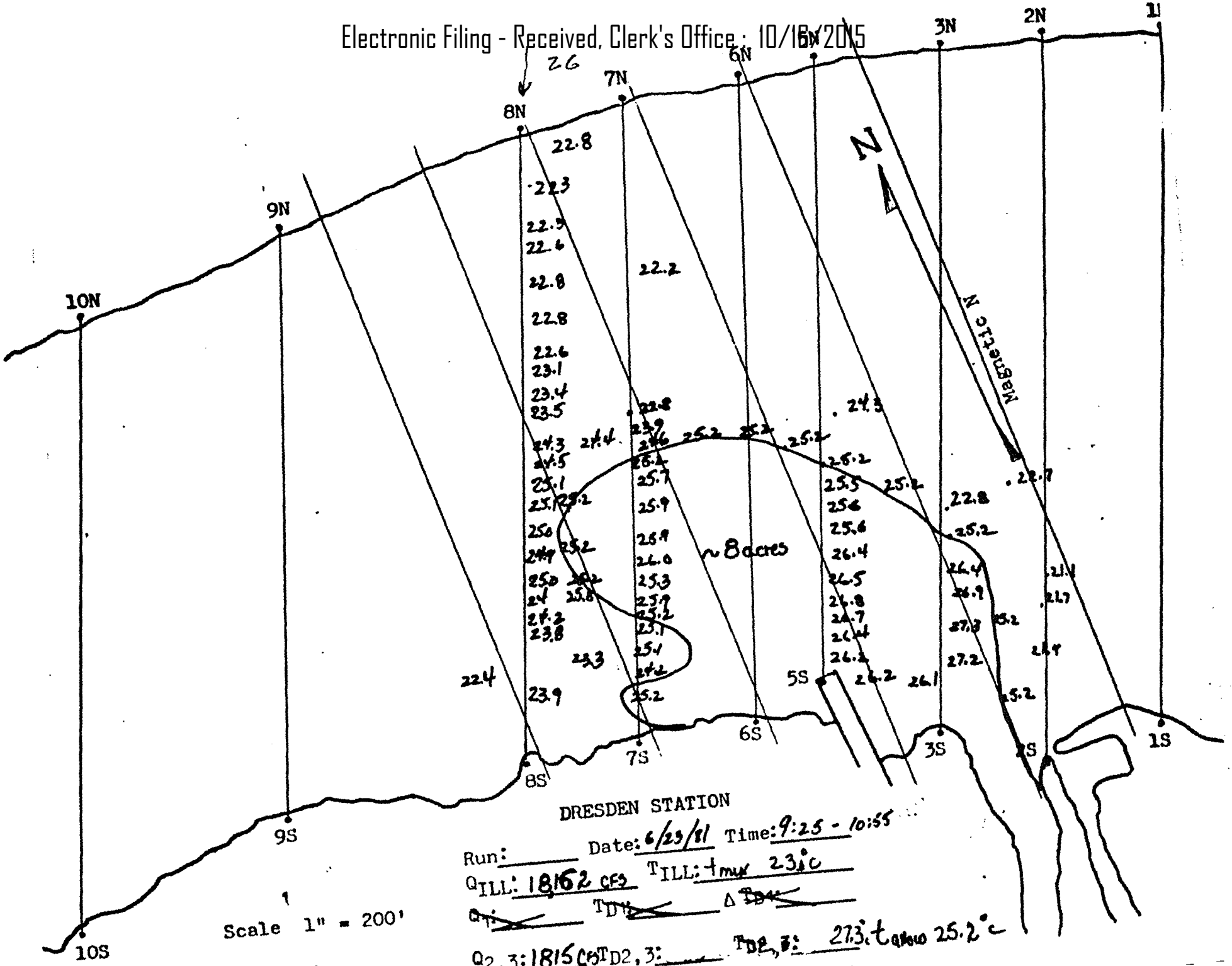
$$T_{amb} = t_m - \frac{(Q_{1,2,3})(t_D - T_I)}{Q \text{ Ill River}}$$

$$23.3°C - \frac{(2288.2)(27.9 - 21.9}{20,823}$$

$t_{amb} = 23.3 - 0.6 = 22.$

$T_{alow} = t_{amb} + 5°F / (2.8°C)$ $t_{all} = 22.6 + (2.8) = 25.4°$

Exhibit 3 Dresden Station Plume Survey for 6/23/81. Areal Plume and Strata Temperatures Showing Excess 5°F (2.8°F) Isotherm at the -1' to River Bottom and Field Data Sheet.



DRESDEN STATION

Run: _____ Date: 6/23/81 Time: 9:25 - 10:55

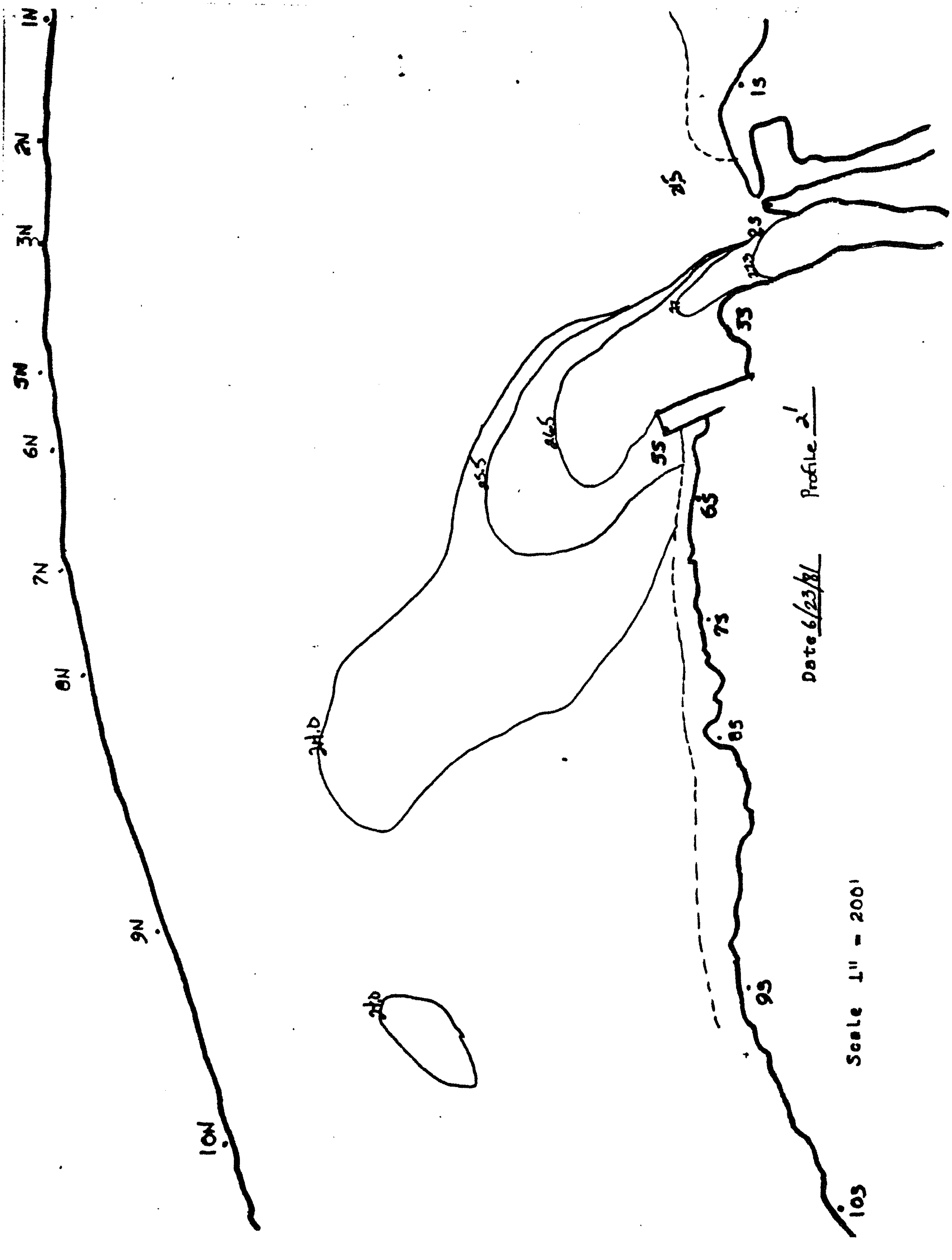
Q_{ILL}: 18162 CFS T_{ILL}: T_{max} 23.1°C

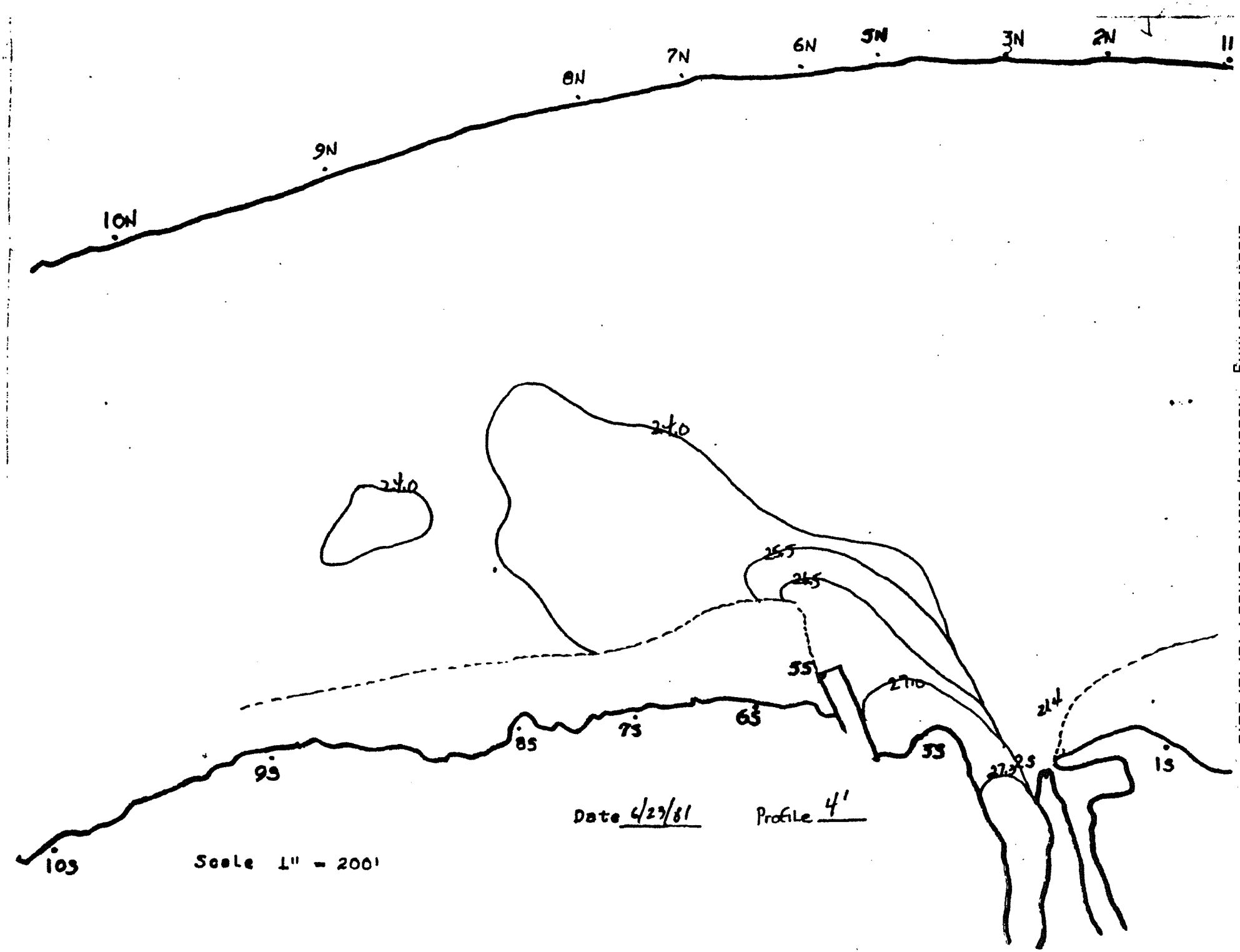
~~Q_{T1}~~: _____ ~~T_{D1}~~ _____ ~~ΔT_{D1}~~ _____

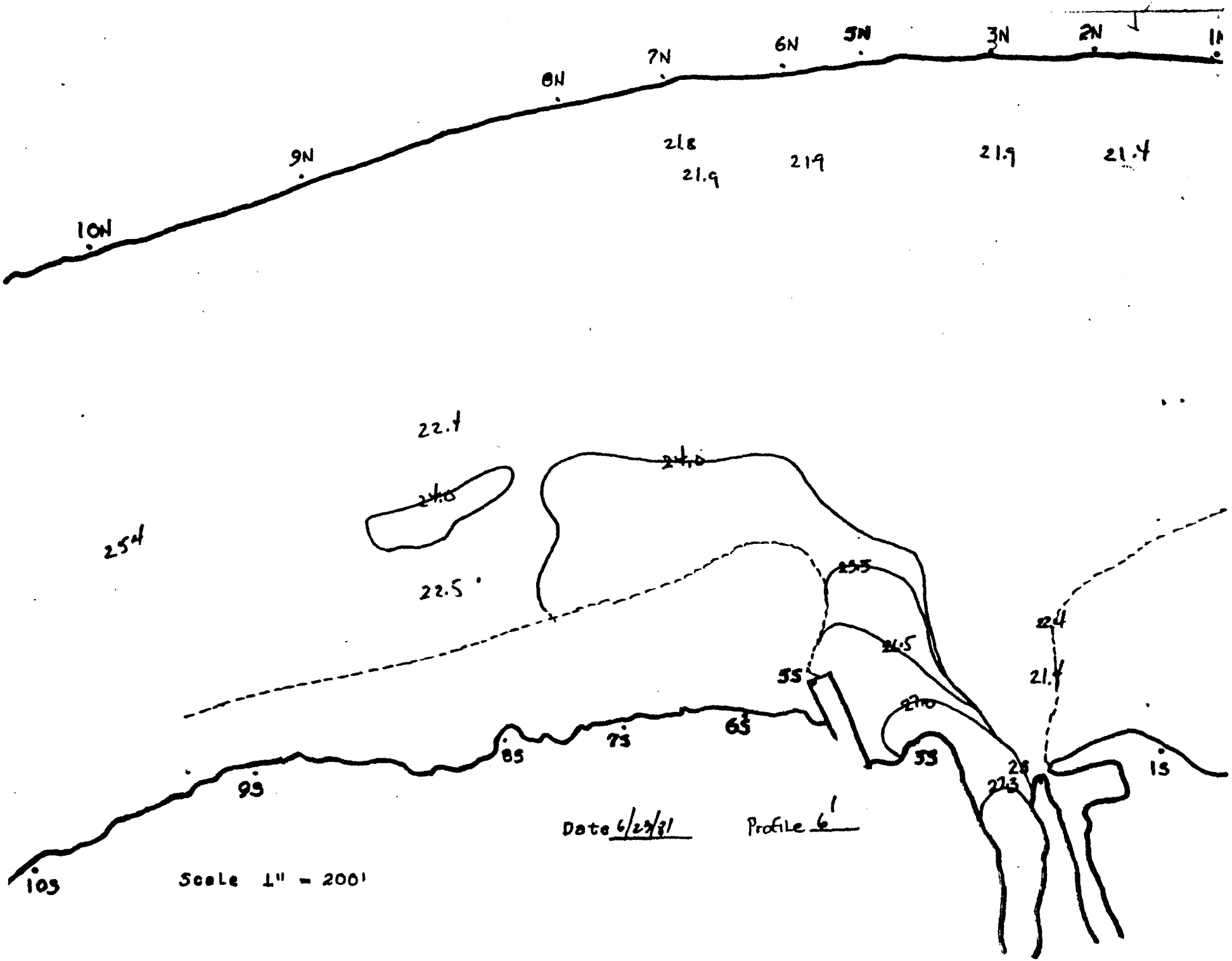
$Q_{2,3}$: 18156 CFS $T_{D2,3}$: _____ $T_{D2,3}$: 27.3, $t_{@Q=18K}$ 25.2°C

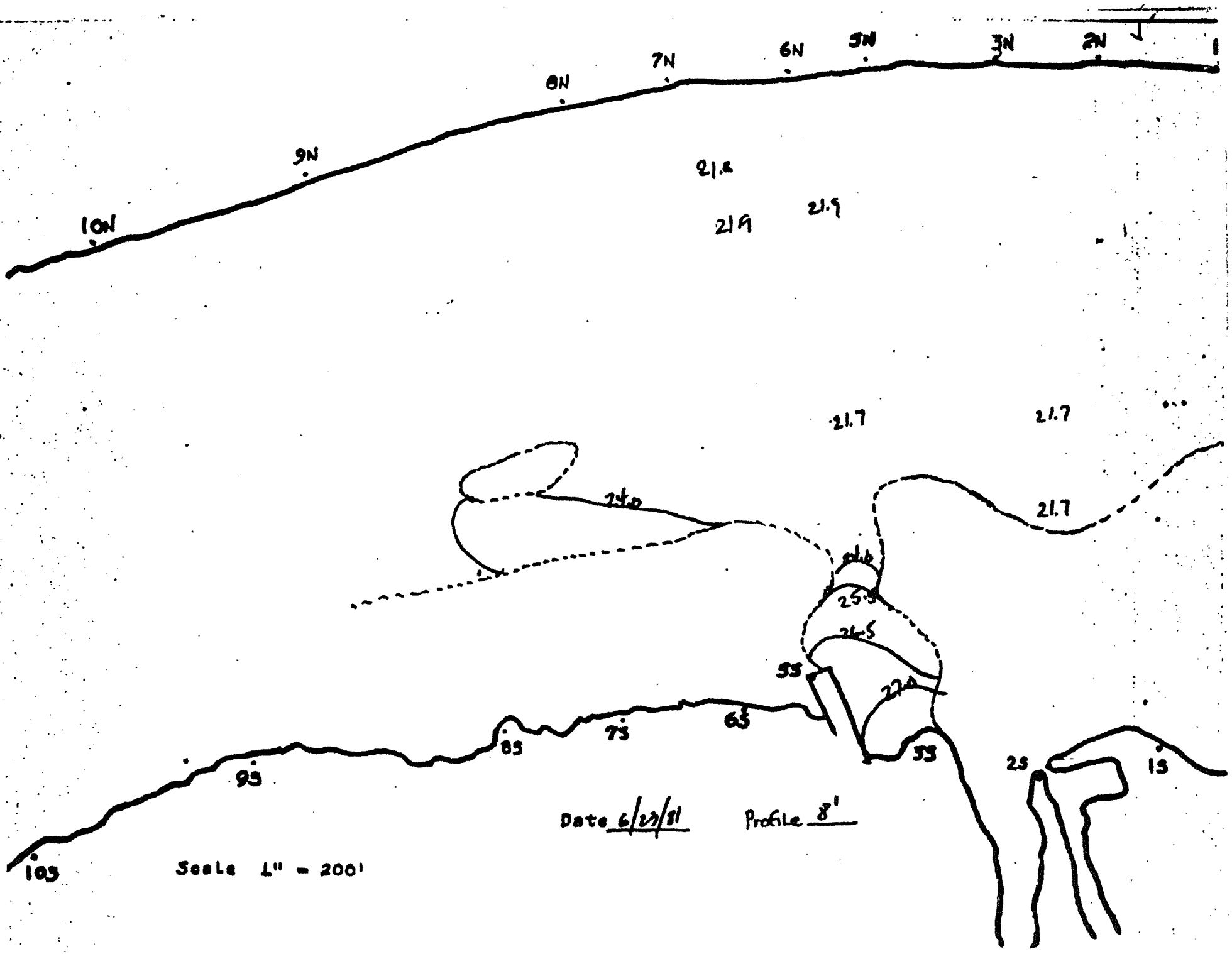
Scale 1" = 200'

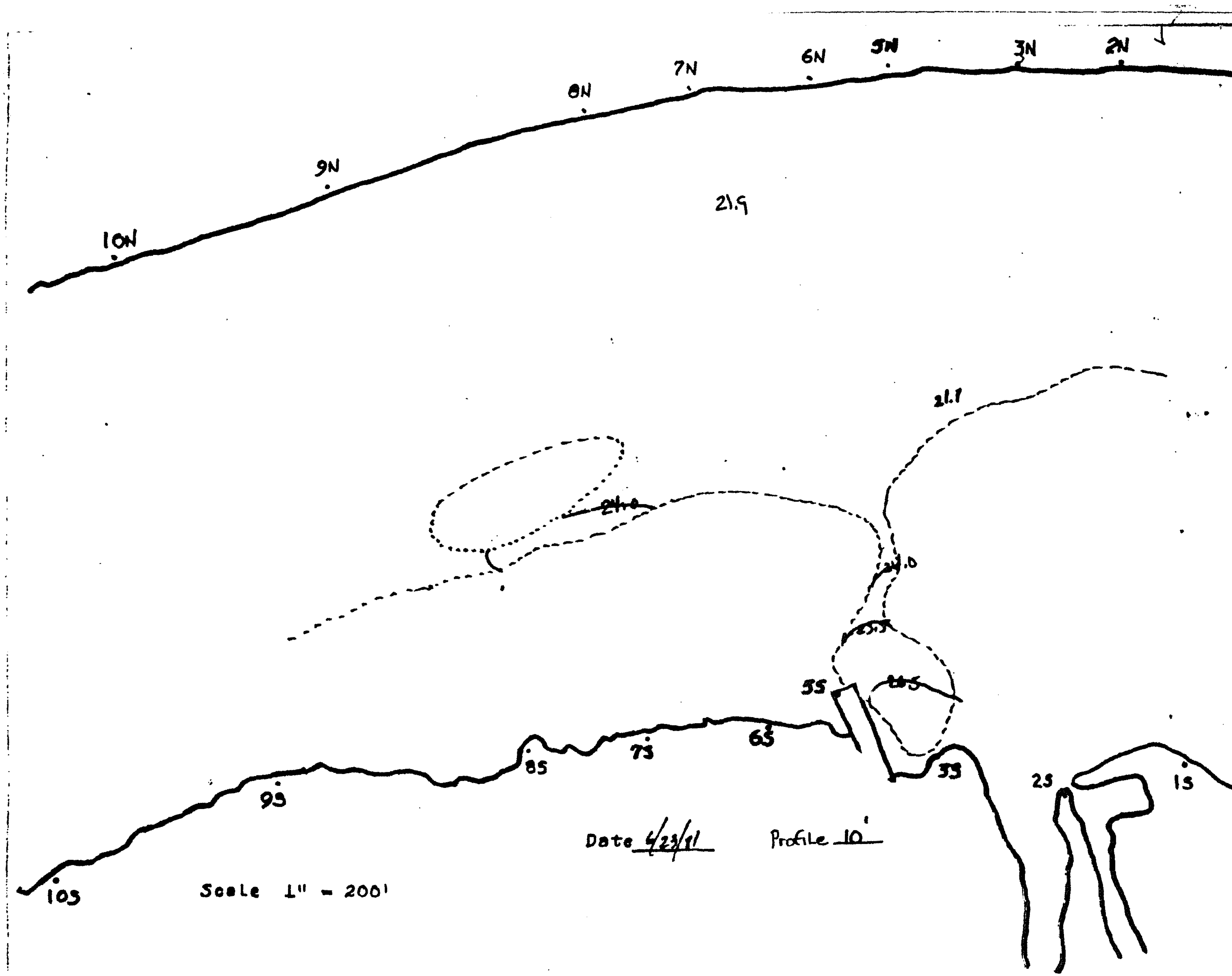
All temperatures shown are of 1 ft. depths











Project Dresden Plume Survey — Sheet

Subject DuSold, Masek, Walker, Bernhard — Name E.K. DuSold

Date 6/23/81

			t_I			t_D	t_m					
READING#	1	2	3	4	5	6	7	8	9			
LOCATION	JVC	KAN. R	INT S	INT C	INT N	DISCH U2-3	L&D G9	L&D G5	L&D G1	JVC Retake I	JVC Retake II	
TIME	9:25	9:57	10:00	10:05	10:10	10:55	10:35	10:40	10:45	9:31	9:35	12:[illegible]
S	24.6	20.9	21.2	21.0	22.8	27.3	24.2	23.7	23.3	25.0	23.3	24.6
-1FT.	[illegible]	[illegible]	21.2	21.0	22.8	[illegible]	[illegible]	[illegible]	23.3	25.1	23.3	24.3
-2	24.8	20.9	21.2	21.0	22.9	27.3	24.2	23.7	23.4	25.0	23.2	23.5
-4	24.9	20.9	21.1	21.0	23.0	27.3	23.9	23.0	23.3	25.2	23.1	23.2
-6	25.0	20.9	21.1	21.0	23.1	27.3	23.9	22.6	22.3	24.7	23.1	23.2
-8	25.0	20.9	21.1	21.0	23.0	27.3	23.3	22.5	22.3	24.8	23.0	23.2
-10	25.1	20.4	21.1	21.0	23.2		23.2	22.4	22.1	25.1	23.0	23.2
-12	25.1	20.9					23.2	22.4	22.3	24.0	23.0	23.1
-14	25.1						23.0	22.4		24.3	23.0	23.1
-16	24.9							22.4		24.2	23.0	23.0
-18	25.1							22.8		22.8	23.0	23.0
-20								22.9		25.3	23.0	23.0
-22												23.0
-24												
		20.9	21.1	21.0	23.0	27.3						

$t_I = 21.7°$ $t_D = 27.3°$ $t_m = 23.0°$

t_m { Lock & Dam = 69, 65, 61.

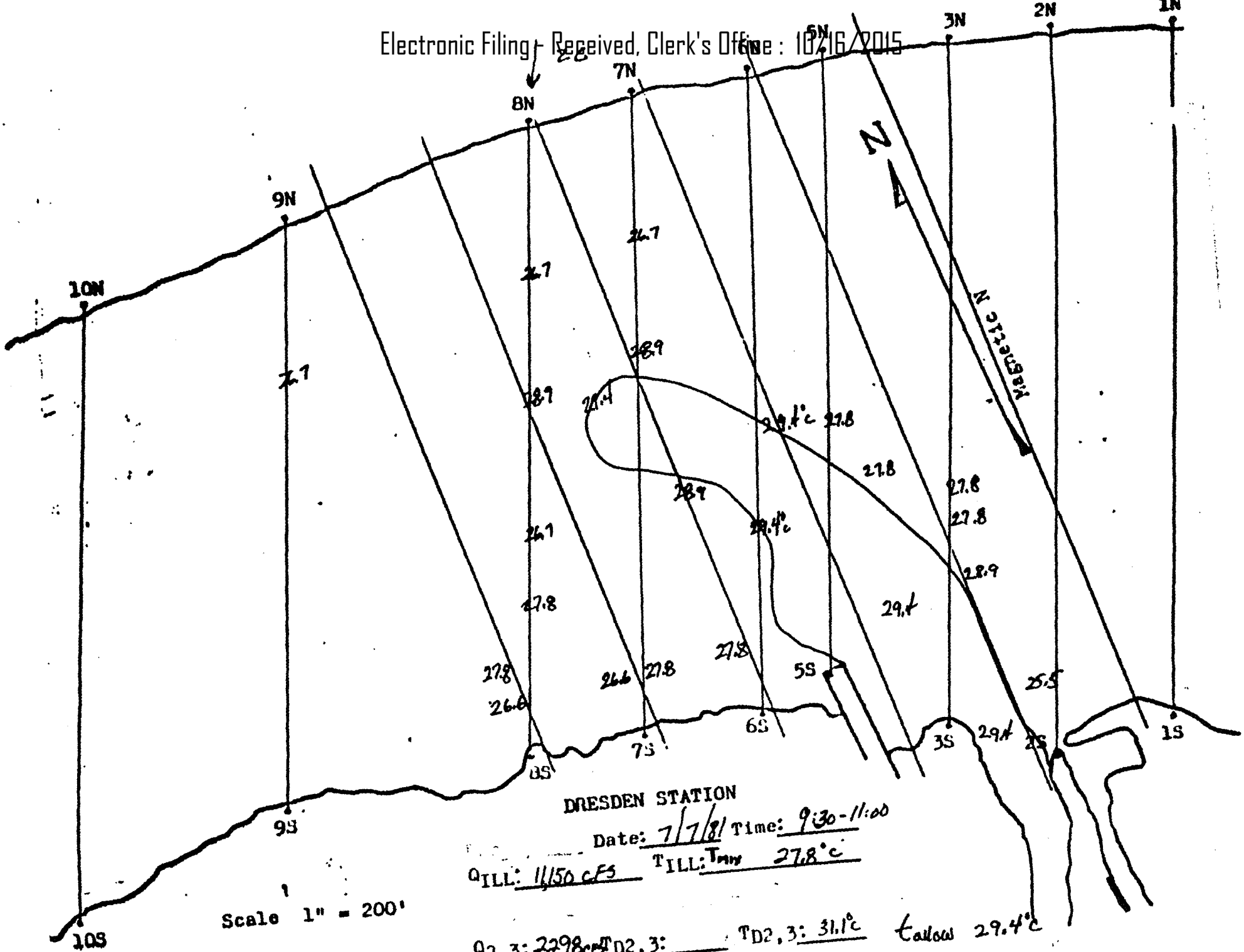
T_I { Intake S, C, N.

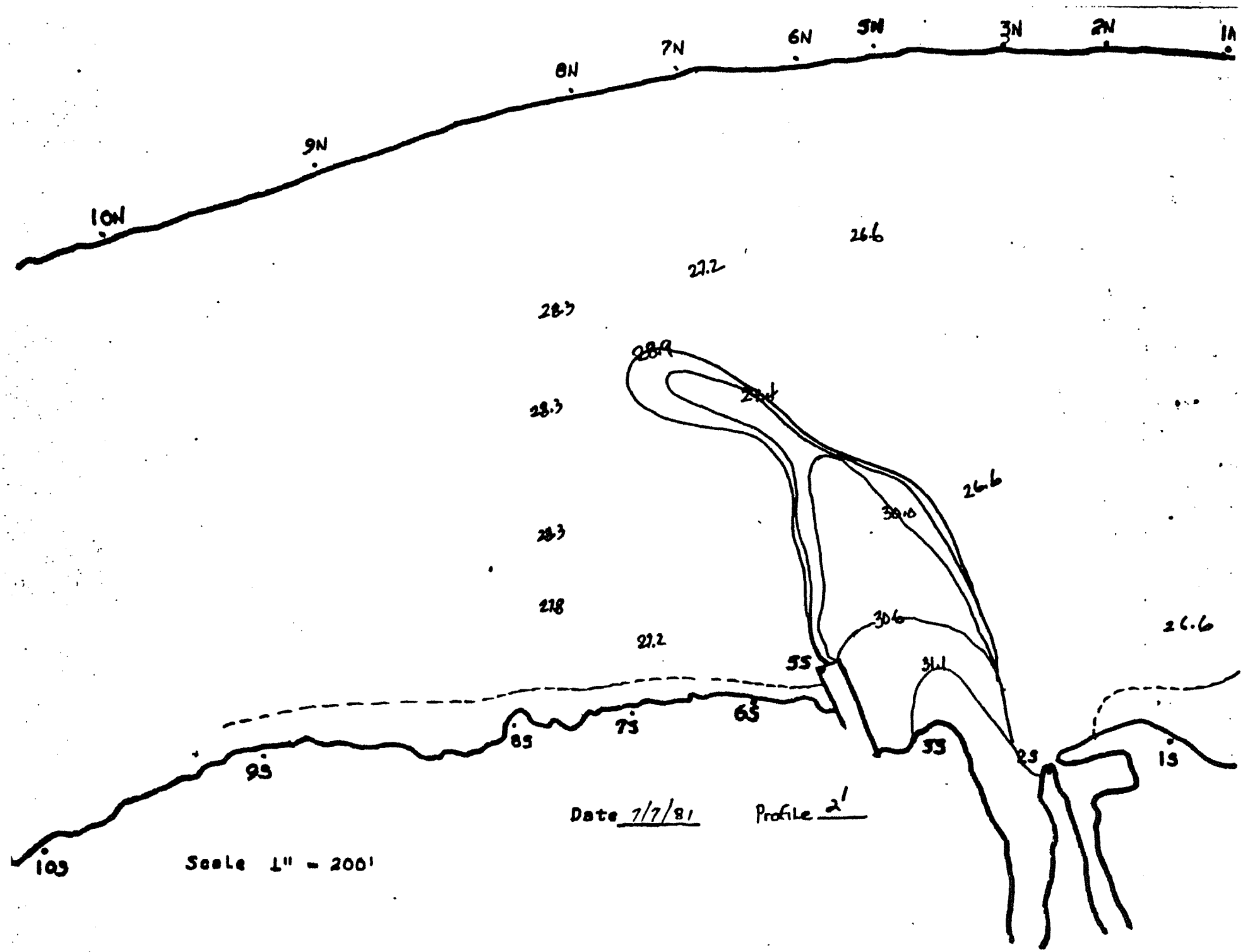
$$T_{amb} = t_m - \frac{(9,2,3)(t_D - T_I)}{Q\ \text{Ill River}} 23.0 - \frac{(1815\ \text{cfs})(27.3 - 21.7)}{(18{,}162\ \text{cfs})}$$

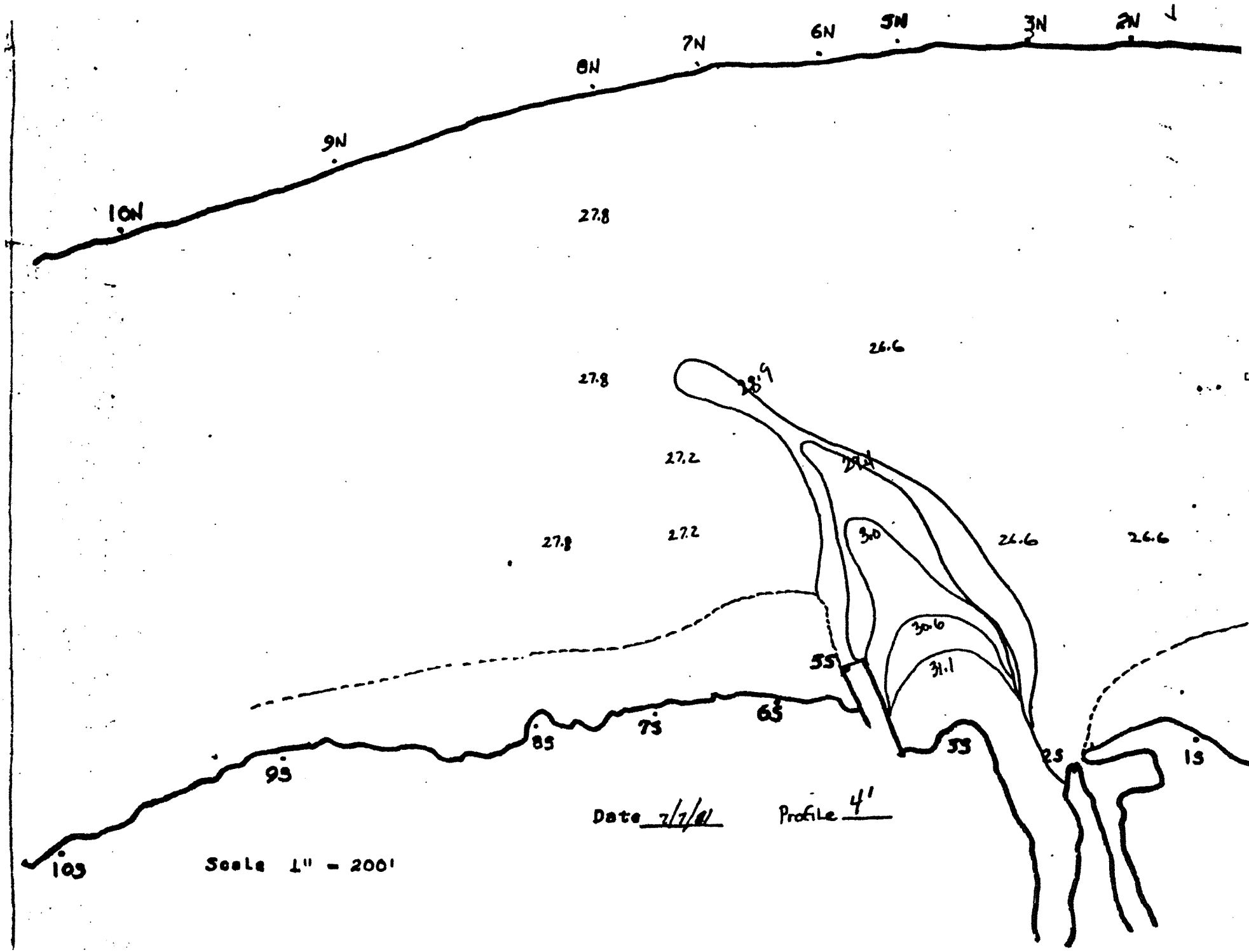
$T_{alow} = t_{amb} + 5°F / (2.8°C)$ $t_{amb} = 22.4$

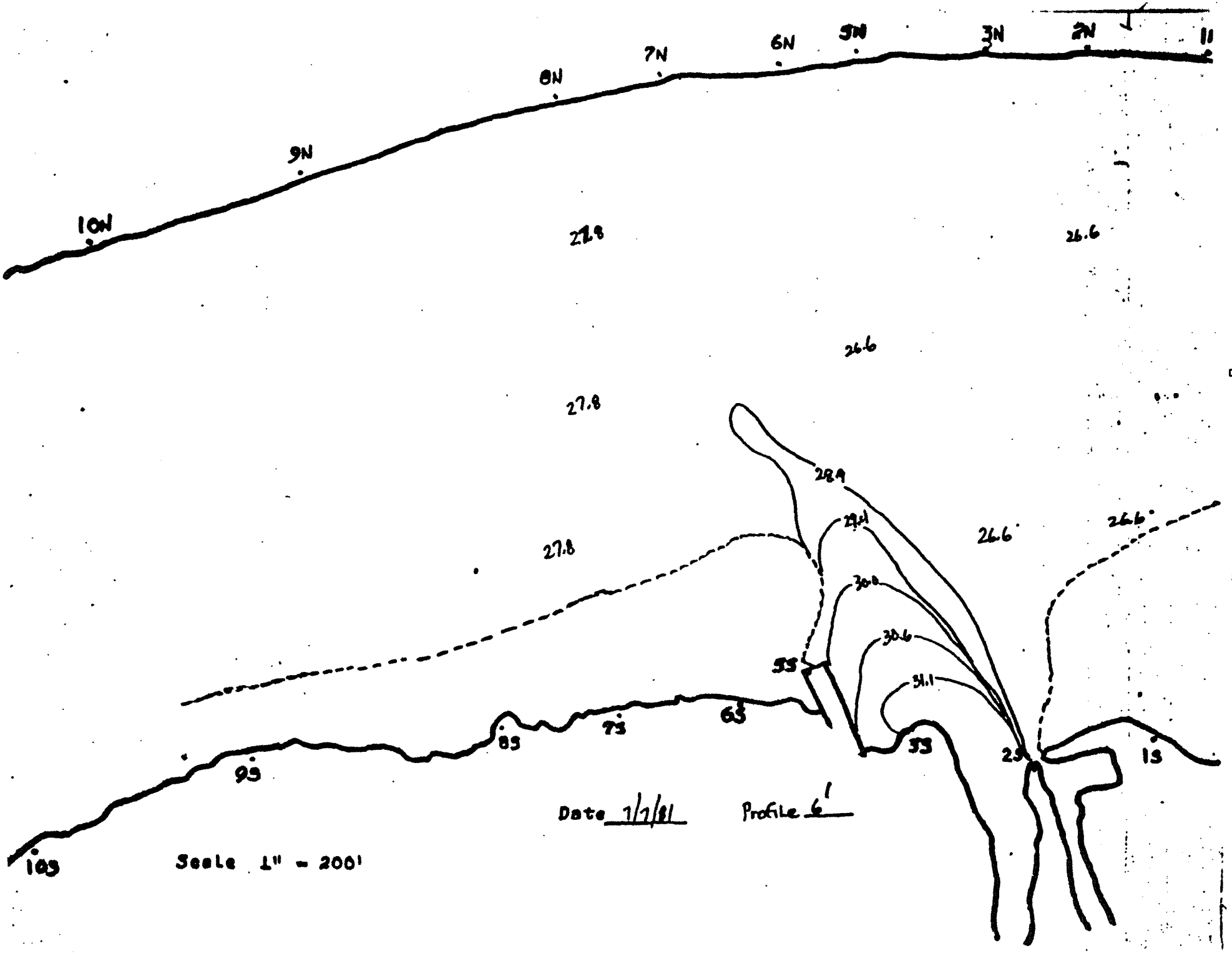
$t_{alow} = 22.4 + 2.8 = 25.2°$

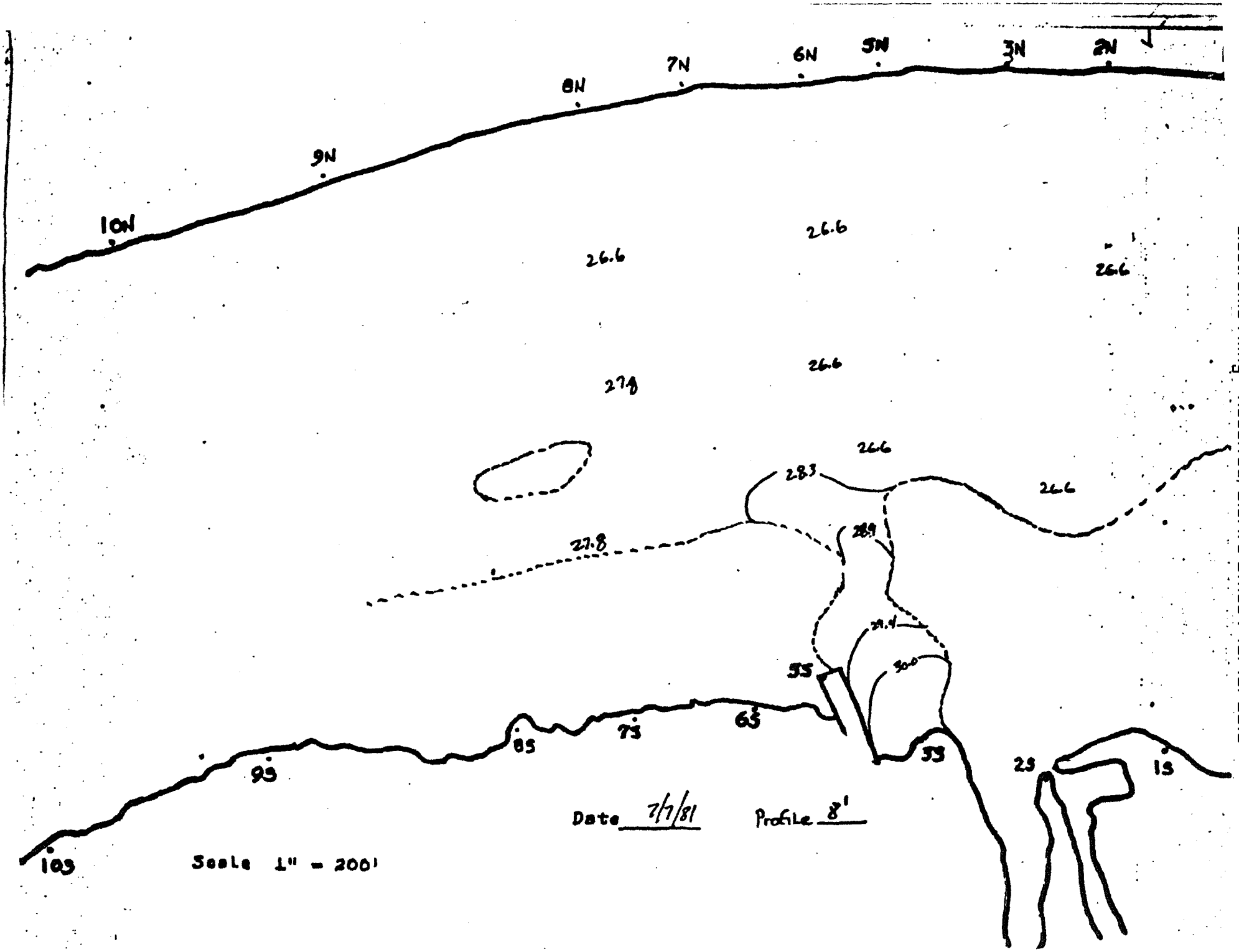
Exhibit 4 Dresden Station Plume Survey for 7/7/81. Areal Plume and Strata Temperatures Showing Excess 5°F (2.8°F) Isotherm at the -1' to River Bottom and Field Data Sheet.

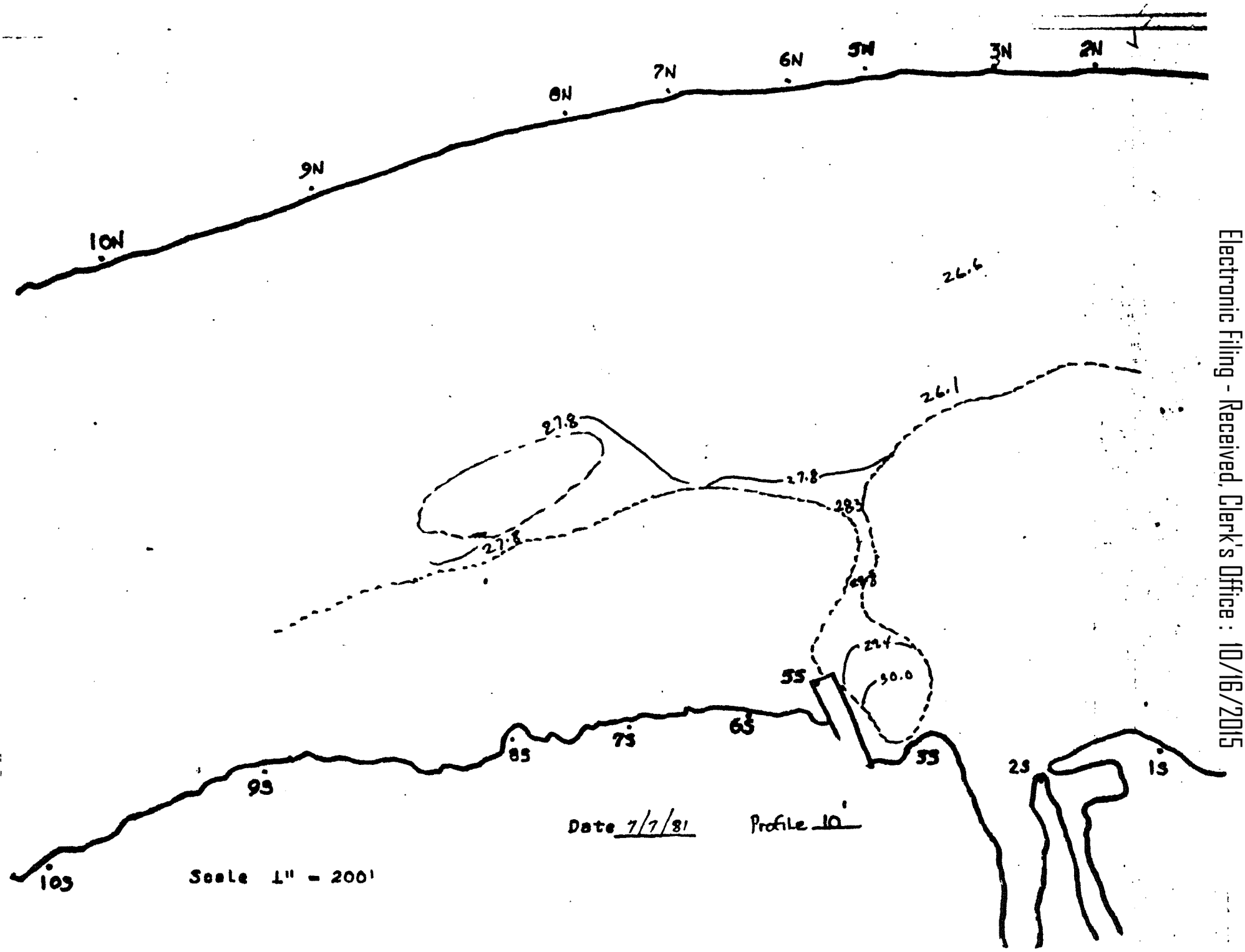












Project Dresden Plume Survey

Subject J. J. M. M.E.W. DRD, SVB

Sheet

Name Mike Walter

Date 7/7/81

			t_I			t_D	t_m		
READING#	1	2	3	4	5	6	7	8	9
LOCATION	Jyc	KAN R	INT S	INT C	INT N	DISCH 02-3	L&D G9	L&D G5	L&D G1
TIME	9:36	9:56	10:10			31.1			
S	26.6	25.6	25.56	25.56	25.5		27.8	27.8	27.8
-2		25.6							
-4									
-6									
-8									
-10									
-12									
-14									
-16	26.6								
-18									
-20									
-22									
-24									
	26.6	25.6	25.56	25.56	25.5		27.8	27.8	27.8

t_I = 25.56°C t_D = 31.1°C t_m = 27.8°C

t_m { Lock & Dam = 69, 65, 61.

T_I { Intake S, C, N.

$$T_{amb} = t_m - \frac{(Q_{1,2,3})(t_D - T_I)}{Q \text{ III River}} \quad 27.8 = \frac{(2298 \text{ cfs})(31.1 - 25.5)}{(11,150 \text{ cfs})}$$

$T_{allow} = t_{amb} + 5°F / (2.8°C)$

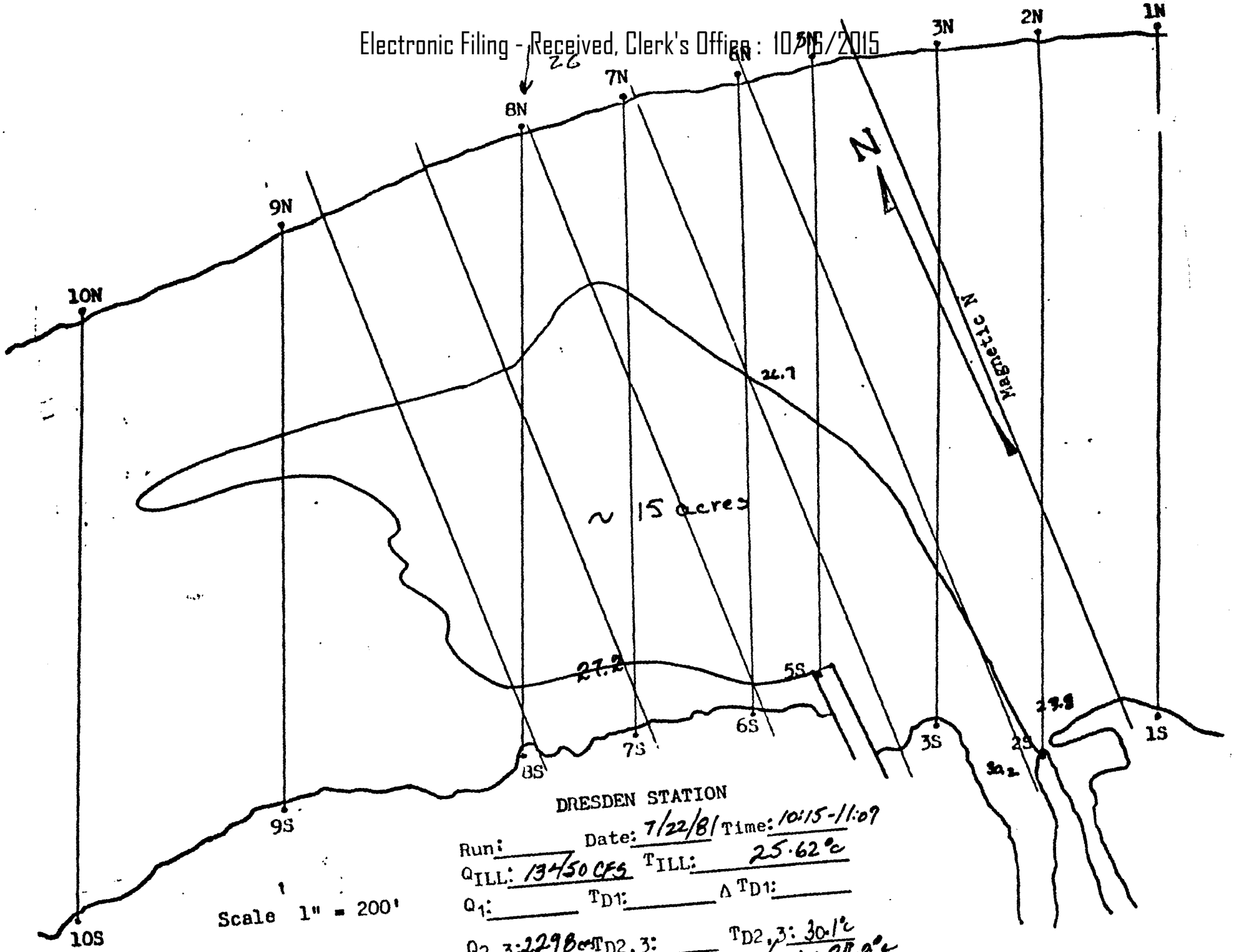
$t_{amb} = 27.8 - \frac{12,730.1 \times 5.54}{11,150 \text{ cfs}} =$

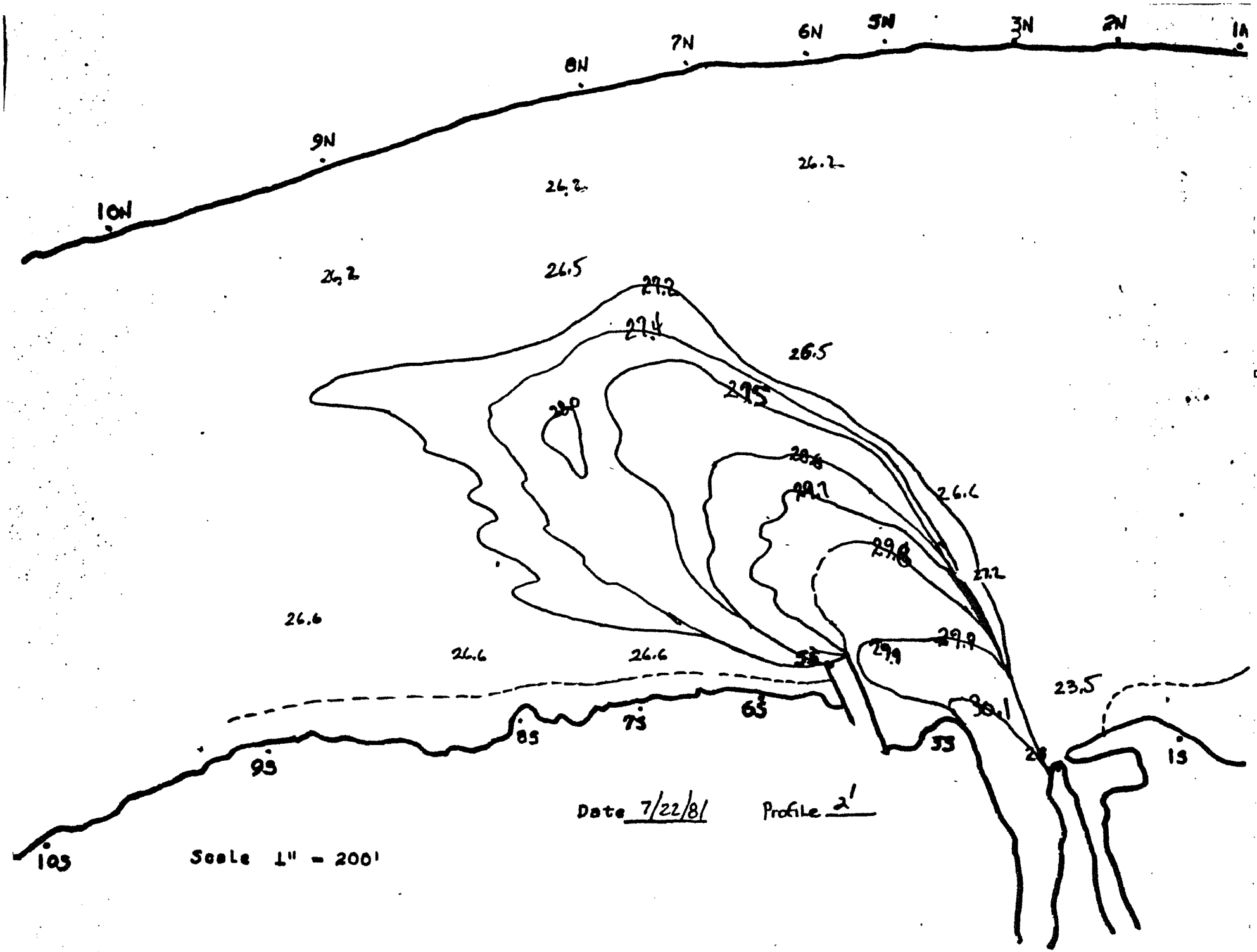
$t_{amb} = 27.8 \frac{12730.9}{11,150} = 1.14$

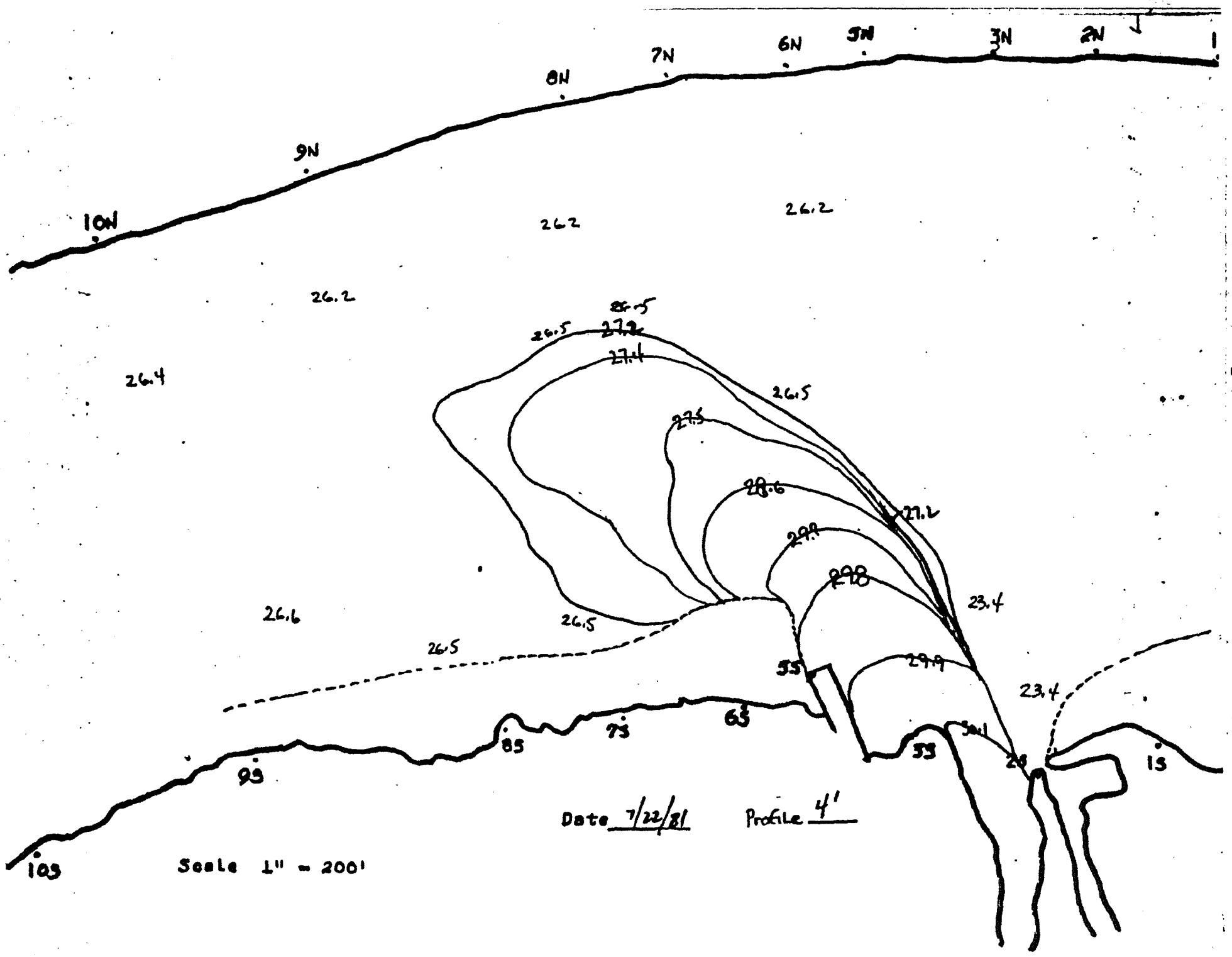
t_{amb} 1.14 − 27.8 = 26.6

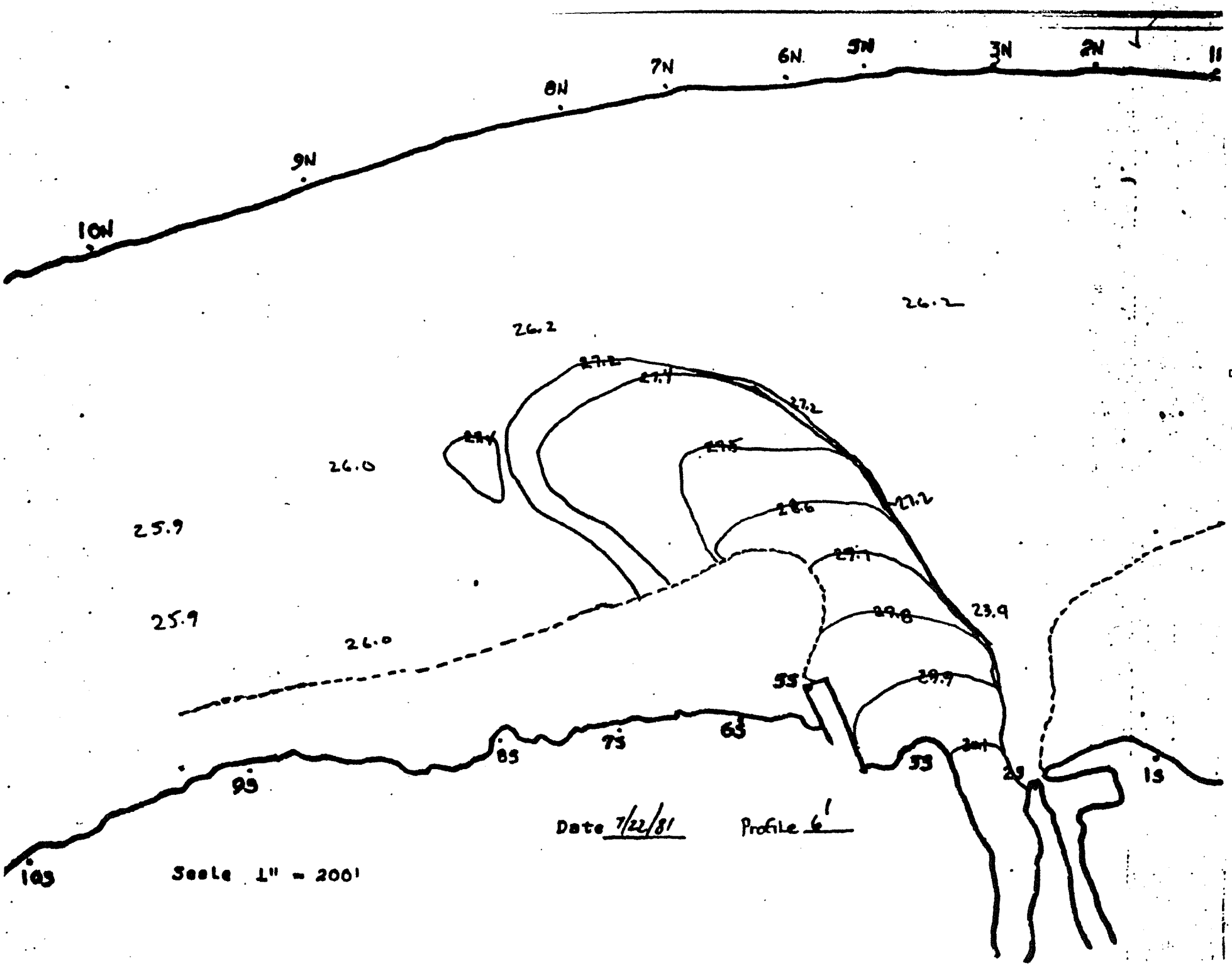
$t_{allow} = 2.8 + 26.6 = 29.4$

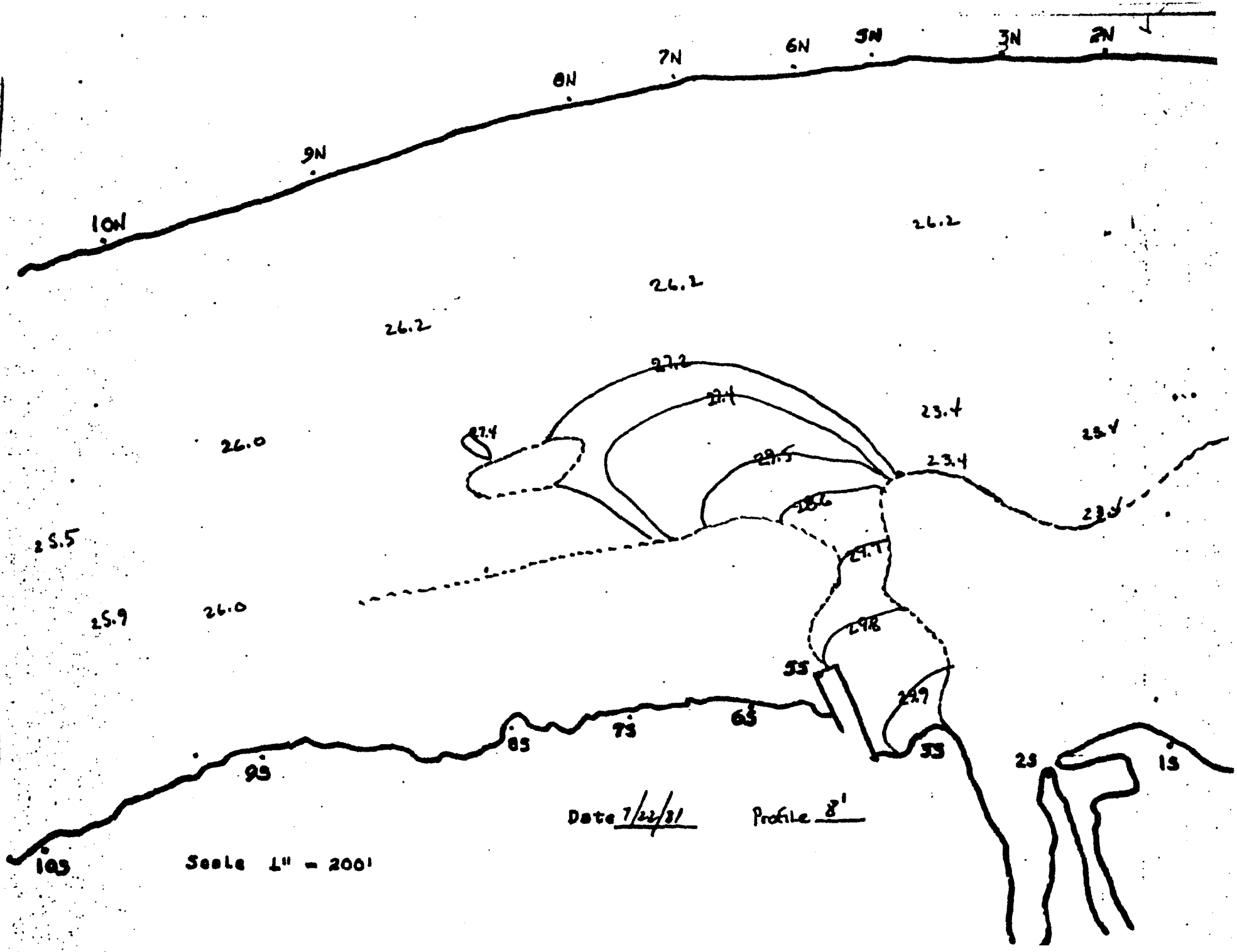
Exhibit 5 Dresden Station Plume Survey for 7/22/81. Areal Plume and Strata Temperatures Showing Excess 5°F (2.8°F) Isotherm at the -1' to River Bottom and Field Data Sheet.

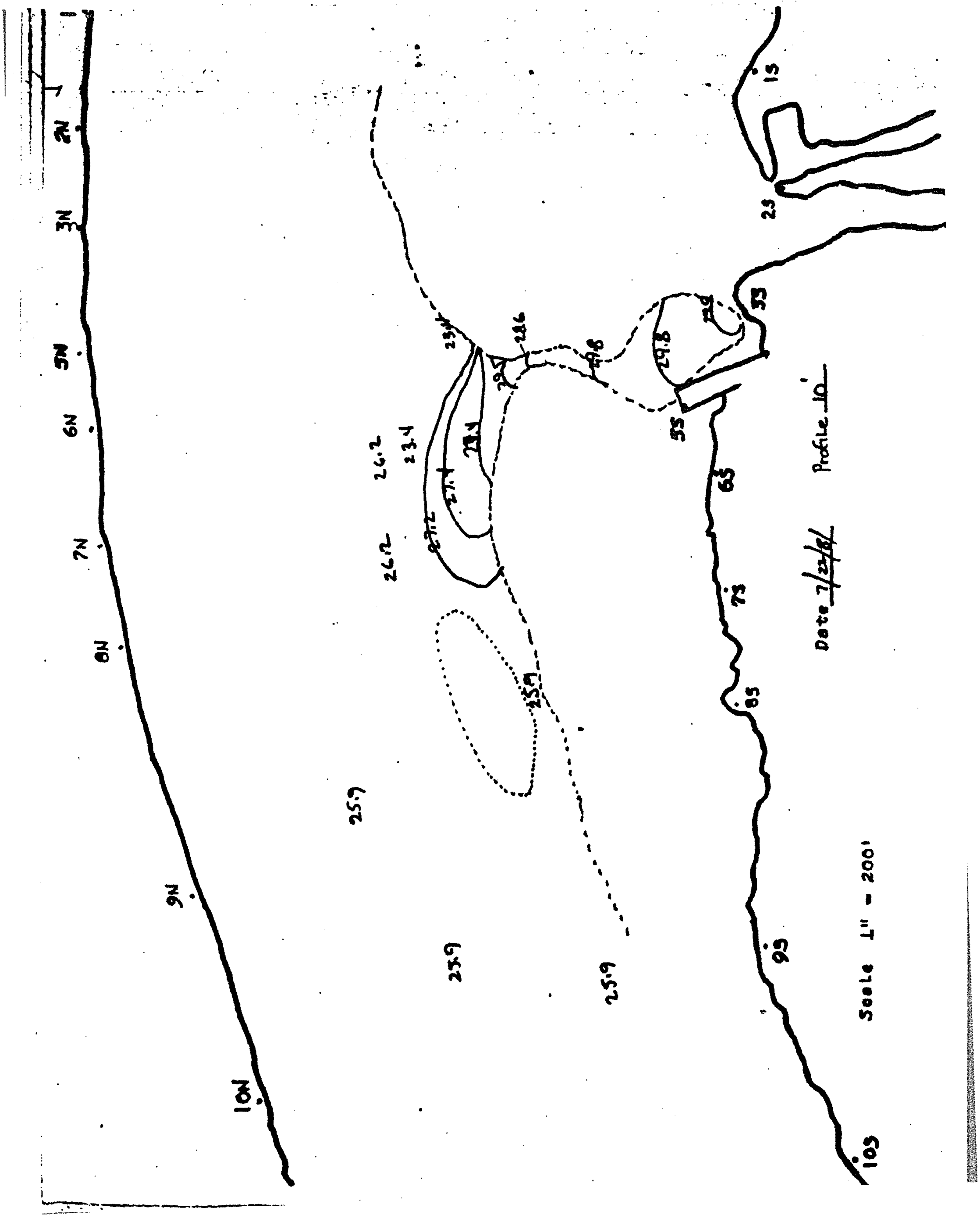












Project Dresden Plume Study — Sheet
Subject MSB, DPR, SNB, Joliet — Name W Bernhard
Date 7/22/81

READING#	1	2	3	4	5	6	7	8	9			
LOCATION	JYC	KANKAKEE R	INT S	INT C	INT N	LKD 6"9	LKD 6"5	LKD 6"1	DISCH U2,3			JYC
TIME	10:15	10:20	10:27	10:31	10:35	10:36	11:03	11:07	10:55			1230
S	26.2	23.2	23.0	23.0	23.1	26.0	26.4	26.2	30.0			26.8
-1FT.	[illegible]											26.7
-2	26.2	23.2	23.1	23.0	23.1	26.0	26.3	26.1	30.1			26.5
-4	26.2	23.0	23.1	23.0	23.1	26.0	26.3	26.1	30.1			26.4
-6	26.2	23.0	23.0	23.0	23.1	26.0	25.3	25.3	30.1			26.4
-8	26.2	23.0	23.0	23.0	23.0	26.0	25.2	25.1	30.1			26.3
-10	26.2	23.0	23.0	23.0	23.0	26.0	25.2	25.0	30.1			26.3
-12	26.2	22.9	23.0	23.0	23.0	26.0	25.2	25.0				26.2
-14	26.2	22.9			23.0	25.9	25.0	25.0				26.1
-16	26.2						25.0					26.0
-18	26.2						25.0					25.9
-20	26.2						25.0					25.9
-22	26.2						25.0					25.9
-24							25.0					
	26.2	23.0	23.0	23.0	23.05	25.96	25.4	25.5	30.1			

T_s = 23.05 — T_D = 25.62 — T_D = 30.1

1.20

t_m { Lock & Dam 69, 65, 61.

T_s { Intake S, C, N.

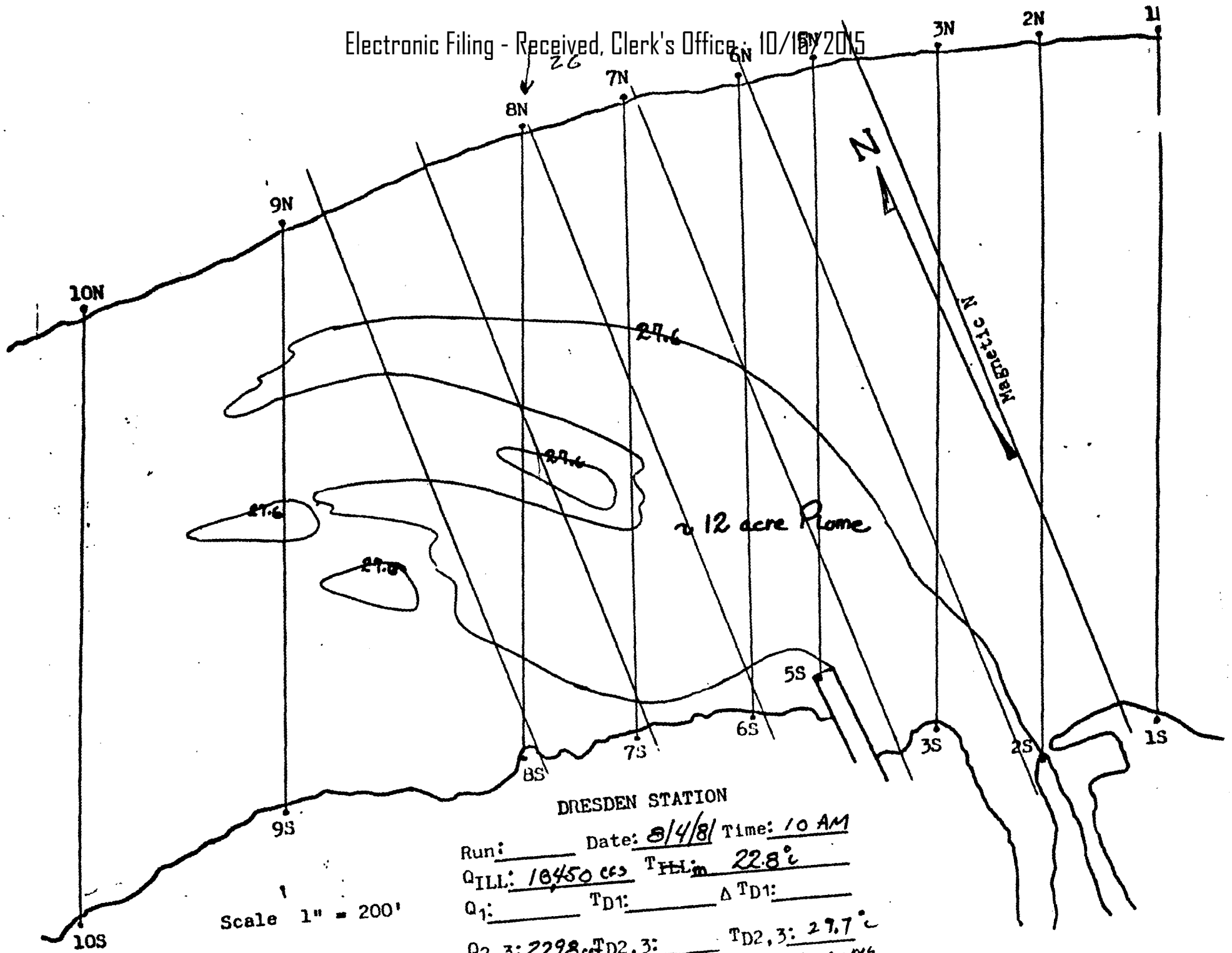
$(2288)(7.1) = 16104$

$$T_{amb} = t_m - \frac{(Q_{1,2,3})(t_D - T_s)}{Q \text{ Ill River}} \qquad 25.62 - \frac{(2288)(30.1 - 23.0)}{13,450}$$

$T_{allow} = t_{amb} + 5°F / (2.8°C)$

$t_{allow} = 27.2°C$

Exhibit 6	Dresden Station Plume Survey for 8/4/81. Areal Plume and Strata Temperatures Showing Excess 5°F (2.8°F) Isotherm at the -1' to River Bottom and Field Data Sheet.



DRESDEN STATION

Run: _____ Date: 8/4/81 Time: 10 AM

Q_{ILL}: 10450 cfs T_{ILL}: 22.8°C

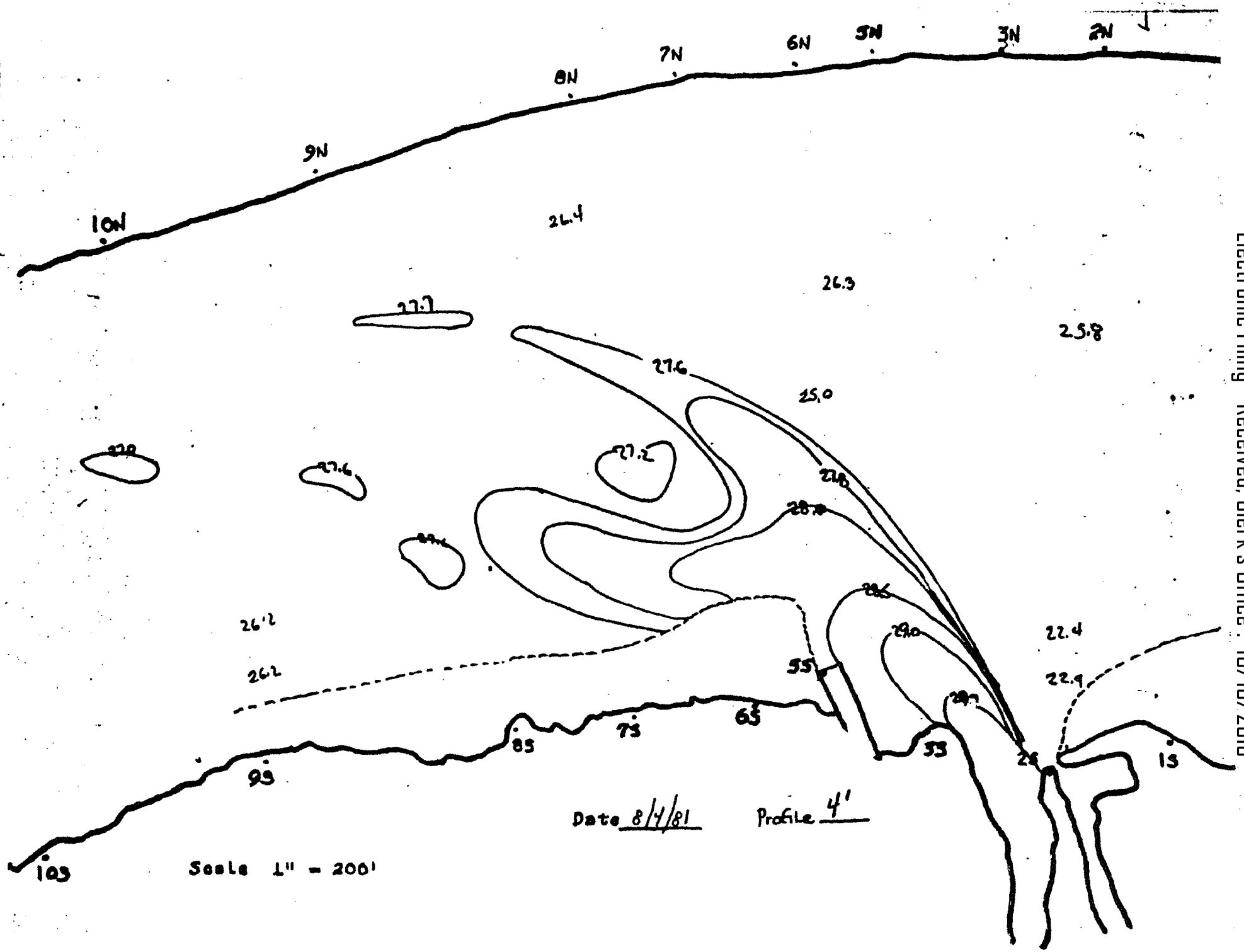
Q_1: _____ T_{D1}: _____ ΔT_{D1}: _____

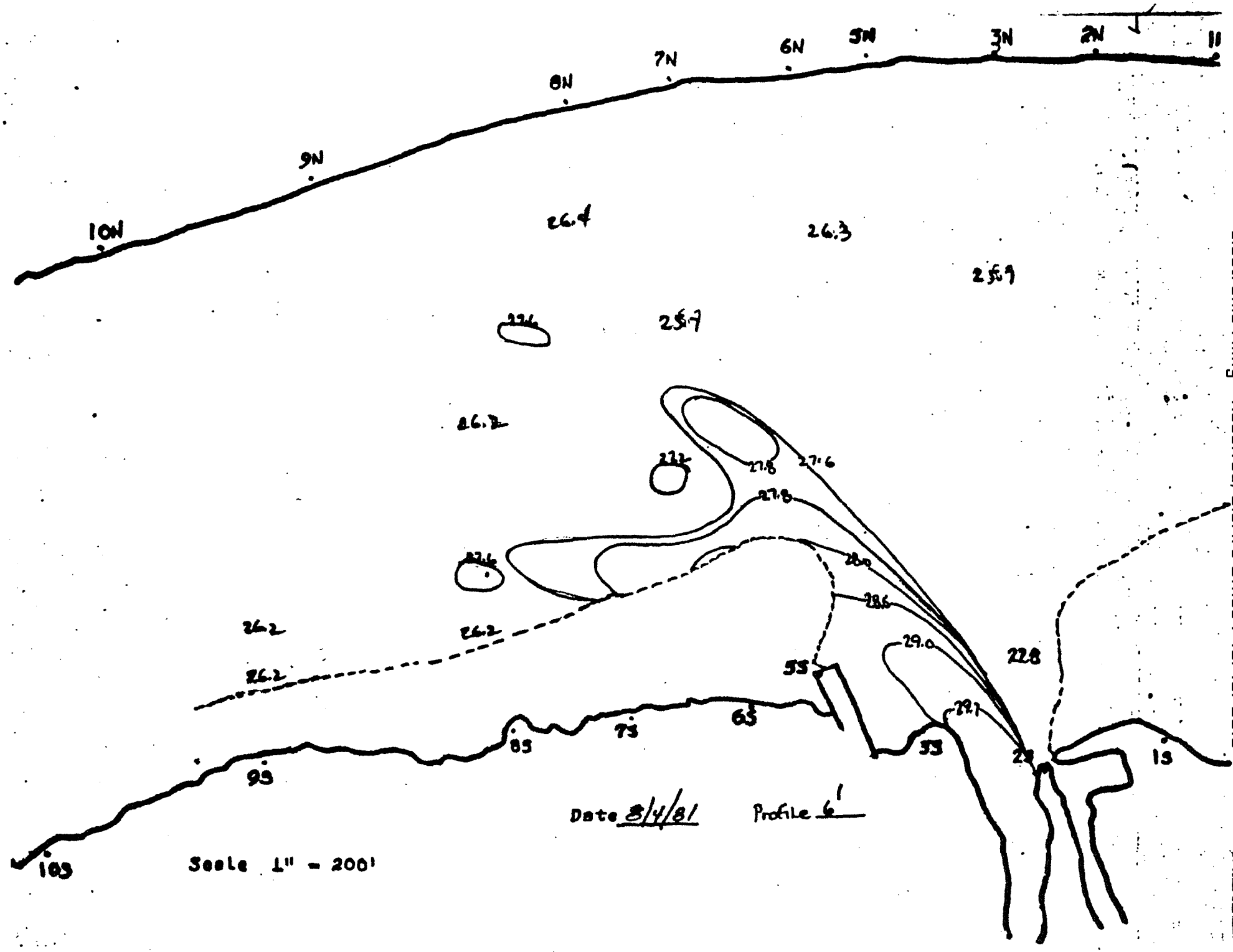
$Q_{2,3}$: 2298 cfs $T_{D2,3}$: _____ $T_{D2,3}$: 29.7°C

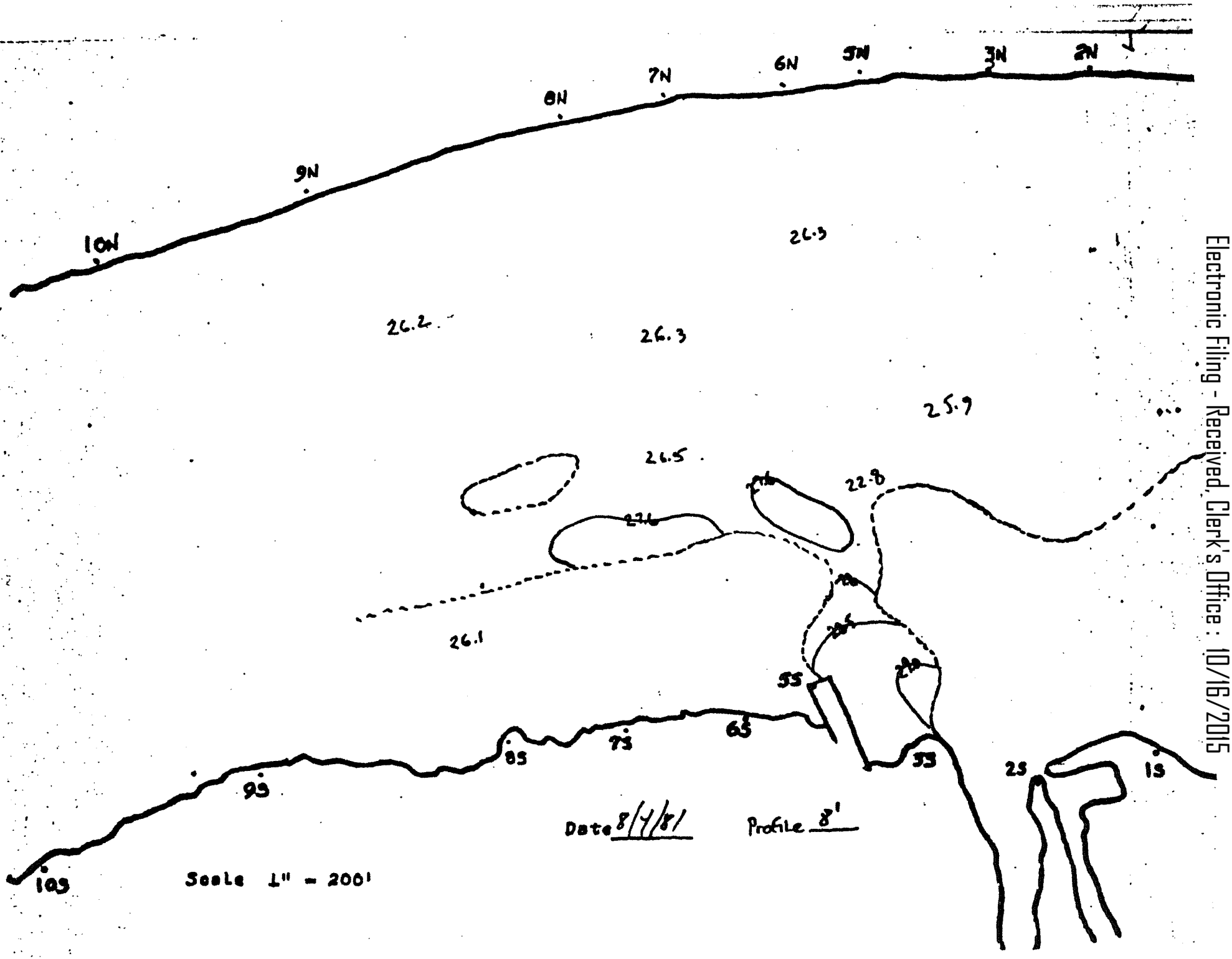
Scale 1" = 200'

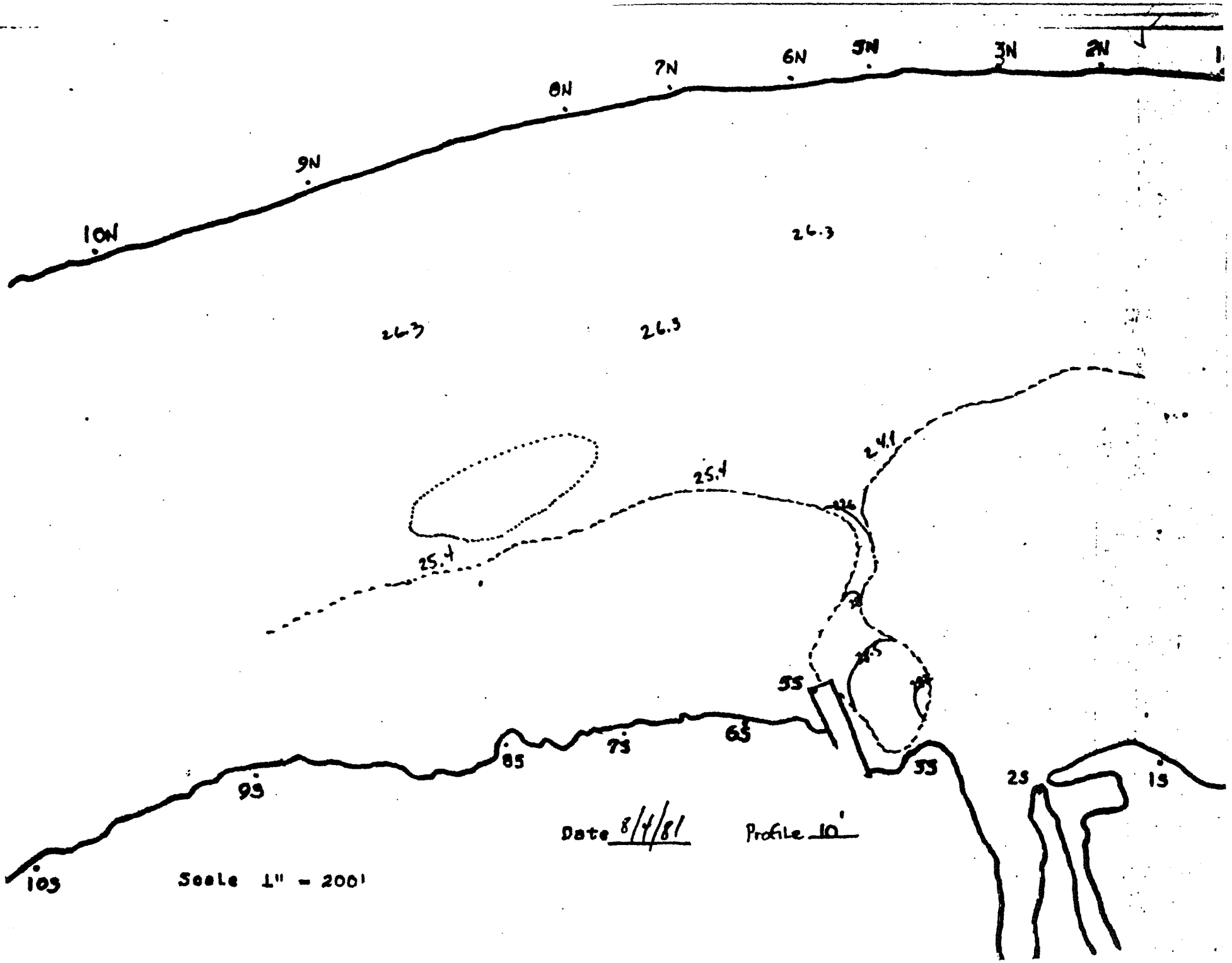
All temperatures shown are of 1 ft. depths

Collapsed 29.7°C. Plume size ≈ 12 acres









Project Mercer Thermal Plume Study – H.F.B, SVB, AEL, Jake — Sheet

Subject — Name H. Bernhard

Date 8/4/01

			t_I			t_D	t_m				
READING#	1	2	3	4	5	6	7	8	9		ID
LOCATION	Jyc	KAN R	INT S	INT C	INT N	DISCH 2-3	L&D G9	L&D G5	L&D G1		JYC
TIME	9:00am	9:10am	9:16am	9:20am	9:25am	9:35am	9:45am	9:48am	9:50am		11:20
S	26.5	22.9	22.9	22.9	22.8	29.6	26.2	26.4	26.4		26.7
-1FT.	26.4	22.8	22.9	22.8	22.9	29.7	26.2	26.5	26.4		26.4
-2.	26.3	22.7	22.8	22.8	22.9	29.7	26.1	26.3	26.1		26.5
-4		22.6	22.8	22.8	22.7	29.7	26.0	26.2	26.0		26.3
-6		22.6	22.8	22.7	22.7	29.7	25.8	26.0	25.4		26.2
-8		22.6	22.7	22.7	22.7	29.7	25.8	25.7	25.4		26.2
-10	SEE LOG #10	22.6			22.7	29.7		25.5	25.3		26.3
-12		22.6						25.4	25.2		26.3
-14								25.1			26.2
-16	DISTURBED BY BARGE							24.9			26.3
-18								24.8			26.3
-20								24.7			
-22											
-24											
		22.7	22.8	22.8	22.8	29.7	26.0	25.5	25.7		26.34

$t_I = 22.8$ $t_D = 29.7$ $t_m = 25.73$

t_m { Lock & Dam 69, 65, 61.

T_I { Intake S, C, N.

$$T_{amb} = t_m - \frac{(Q_{1,2,3})(t_D - T_I)}{Q_{III\ River}} = 25.73 - \frac{(22.8\ cfs)(29.7-22.8)}{(16,450\ cfs)}$$

$T_{alow} = t_{amb} + 5°F / (2.8°C)$

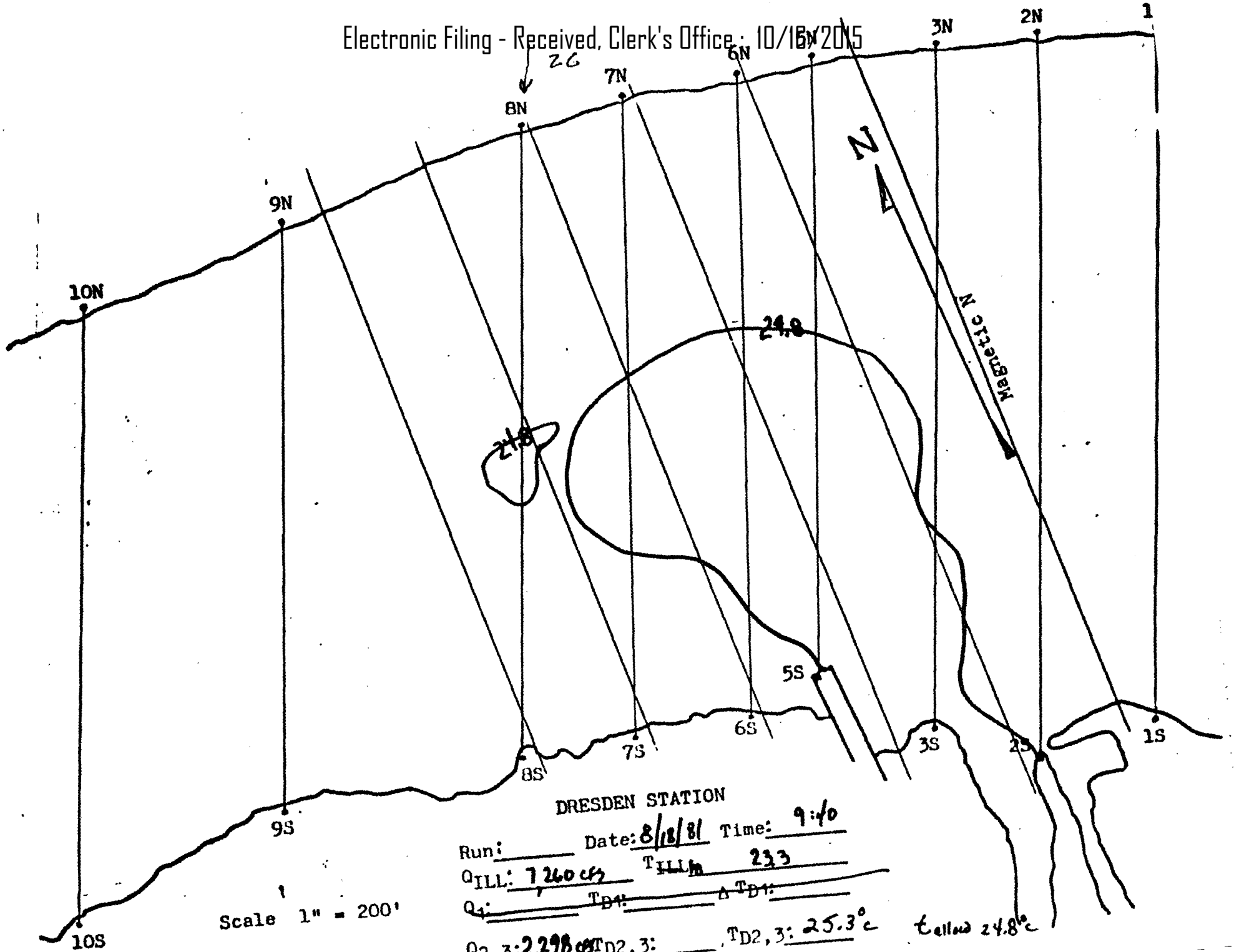
$t_{amb} = 24.76$

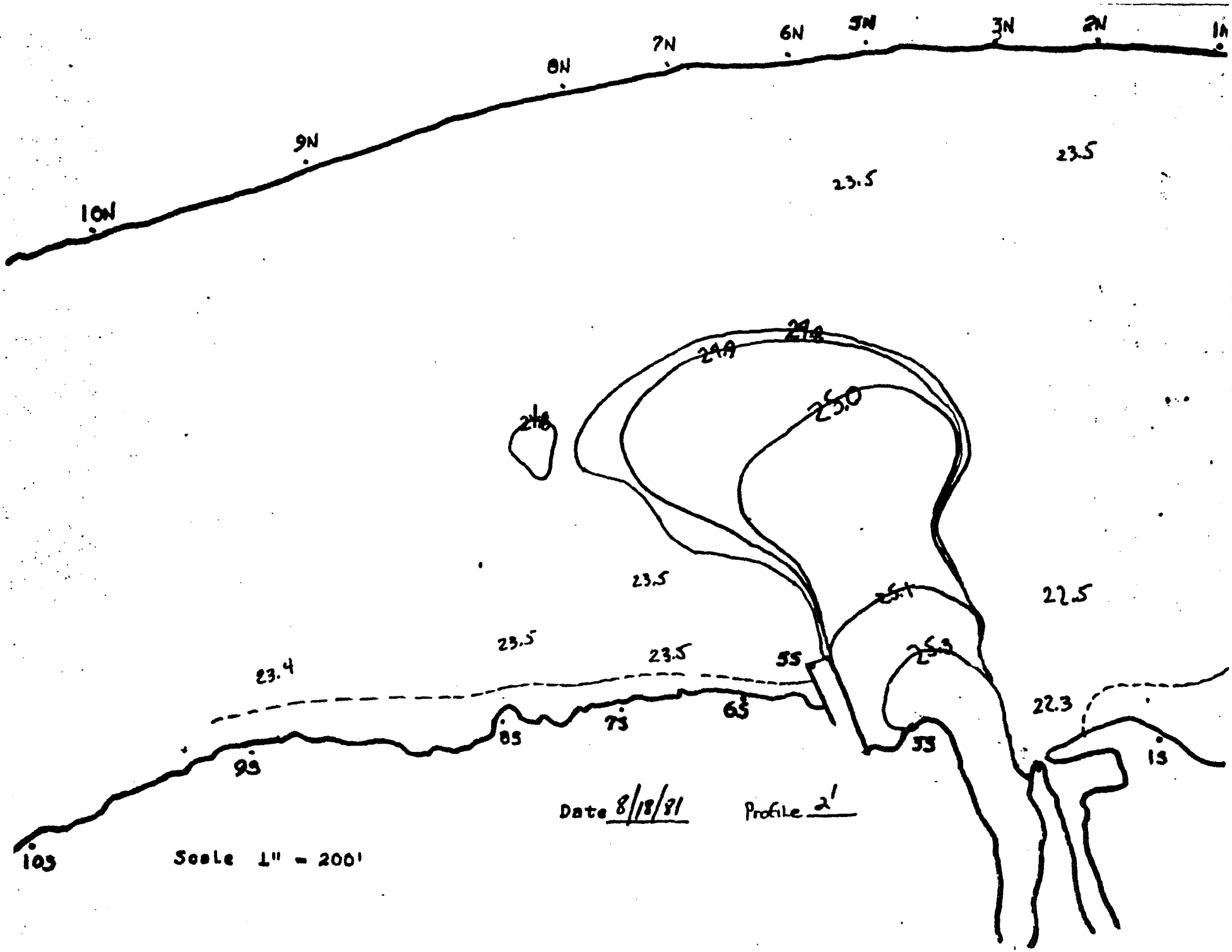
$t_{allow} = 24.76 + 2.8$

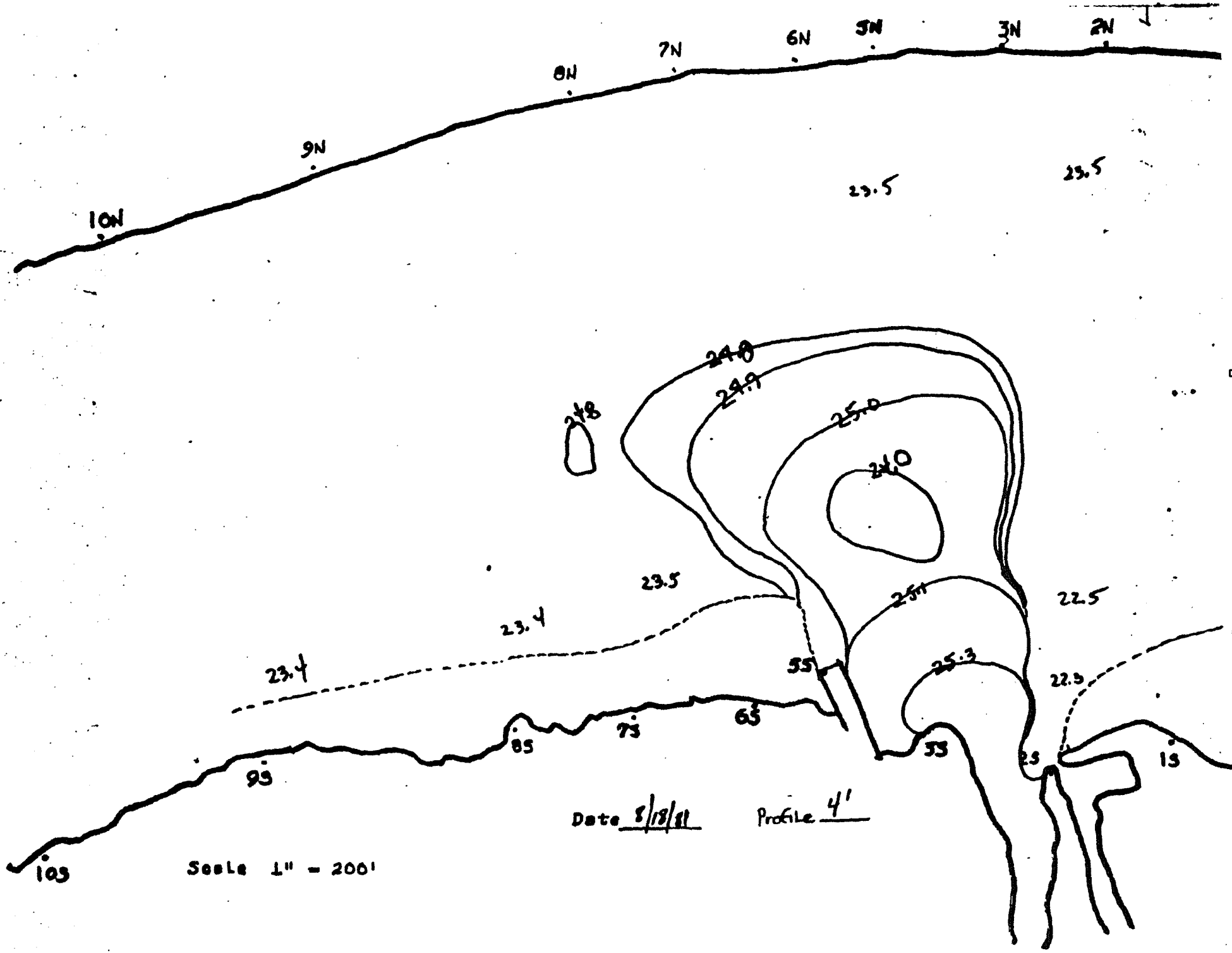
$$T_{amb} = 25.73 - \frac{(22.8)(29.7-22.8)}{(16,450)} = \boxed{24.76} = T_{amb}$$

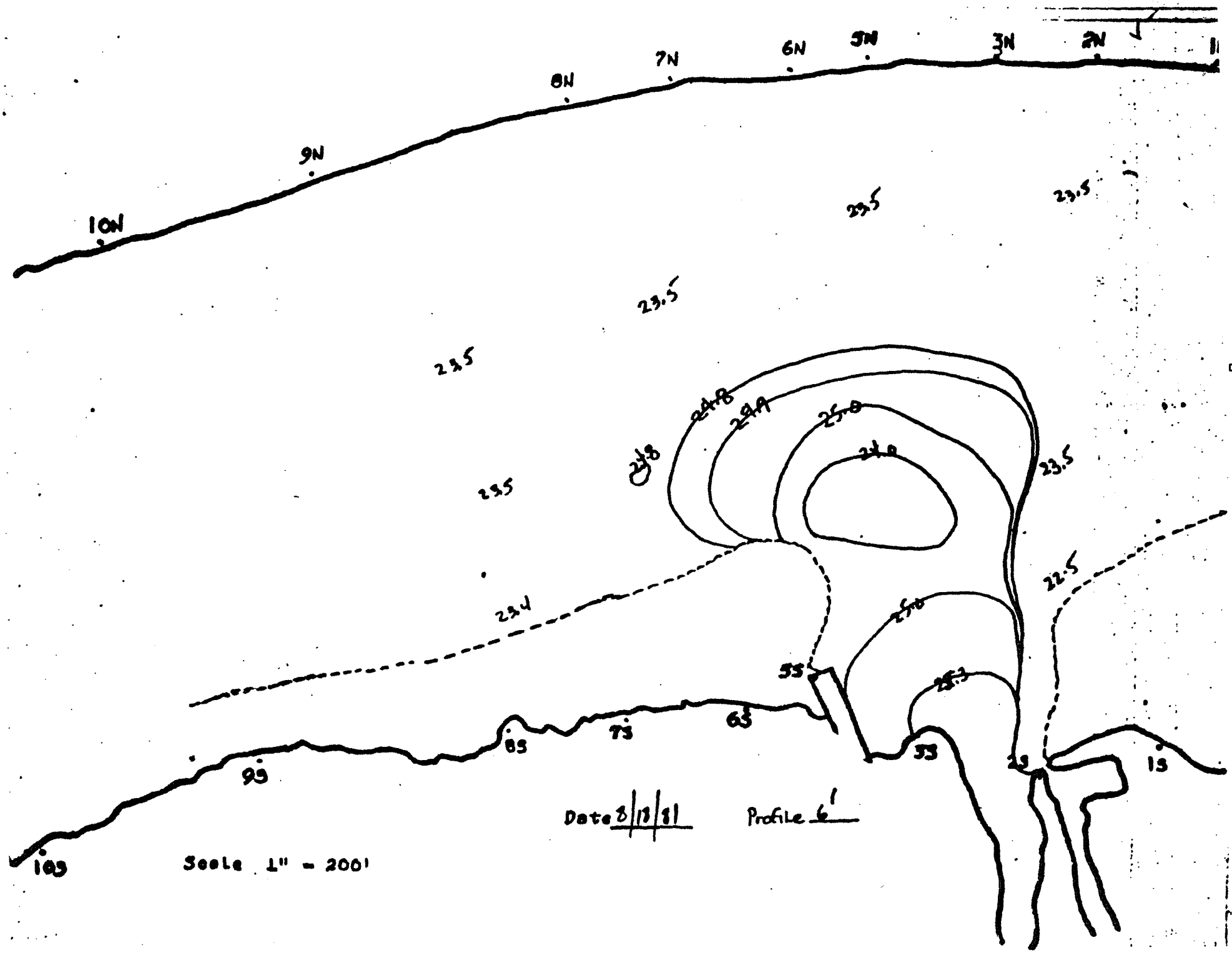
$T_{allow} = T_{amb} + 2.8°C = 27.56 \approx \boxed{27.6°C}$

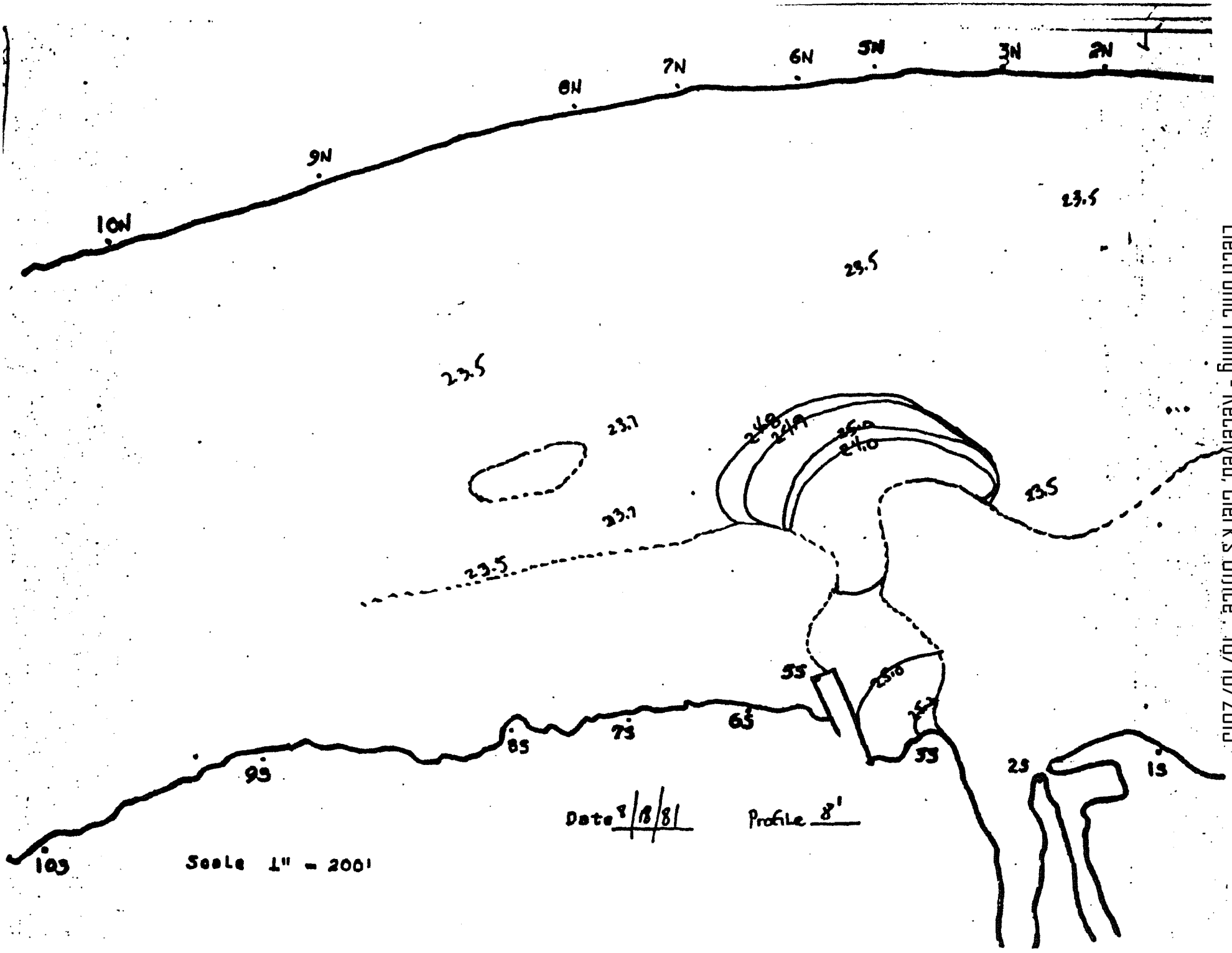
Exhibit 7	Dresden Station Plume Survey for 8/18/81. Areal Plume and Strata Temperatures Showing Excess 5°F (2.8°F) Isotherm at the -1' to River Bottom and Field Data Sheet.

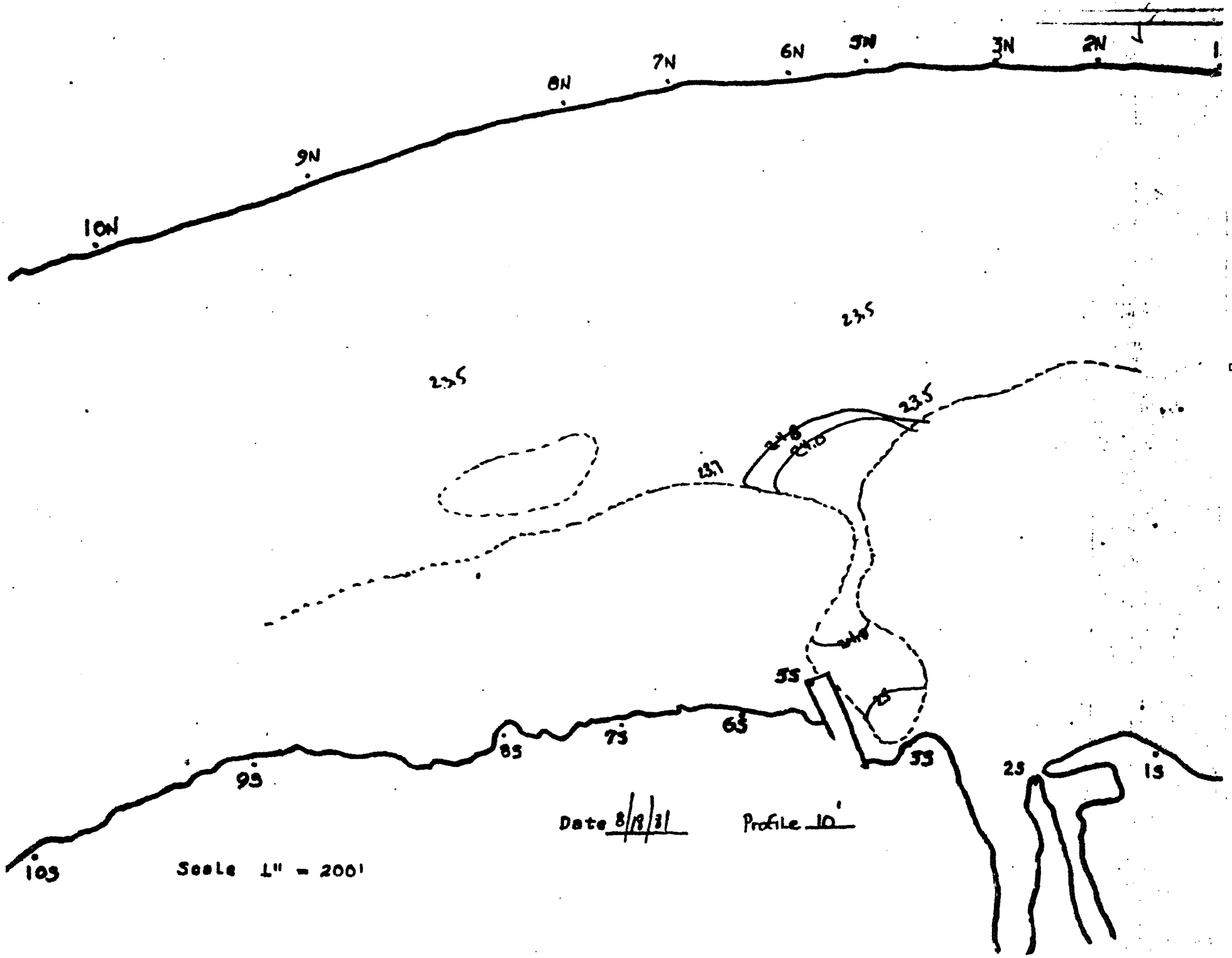












Project Dresden Thermal Plume Survey — Sheet 2 of 2

Subject H.F.B., SVB, AEL, DAV. — Name H.F.B., SVB, AEL, DAV

Date 8/18/81

READING#	1	2	3	4	5	6	7	8	9			
LOCATION	Jyc	KAN. R	INT 5	INT 2	INT N	LVD 69	LVD 65	LVD 61	DISCH U2,3	Retake Jyc		
TIME	8:35	8:50	8:62	9:00	9:04	9:10	9:13	9:15	9:27	10:05		
S	23.5	21.1	21.2	21.3	21.3	23.2	23.5	23.4	25.2	23.5		
-1FT.	23.5	21.1	21.2	21.3	21.3	23.2	23.5	23.4	25.3	23.5		
-2	23.6	21.1	21.2	21.3	21.3	23.2	23.5	23.4	25.3	23.6		
-4	23.6	21.0	21.2	21.2	21.3	23.2	23.5	23.4	25.3	23.6		
-6	23.6	20.9	21.1	21.2	21.2	23.2	23.4	23.4	25.3	23.6		
-8	23.6	20.9	21.1	21.1	21.1	23.1	23.3	23.4	25.3	23.6		
-10	23.6	20.9			21.1	23.0	23.3	23.4	25.3	23.6		
-12	23.6	20.8				23.0	23.3			23.6		
-14	23.6	20.8					25.2			23.6		
-16	25.5						23.2			23.6		
-18	23.5						23.2			23.5		
-20	23.6											
-22												
-24												
	23.6	20.9	21.2	21.2	21.2	23.1	23.4	23.4	25.3			

$t_I = 21.2$ $t_m = 23.3$ $t_D = 25.3$

t_m = { Lock & Dam # 69, 65, 61.

T_I { Intake S, C, N.

$Q_{2,3} = 2400$

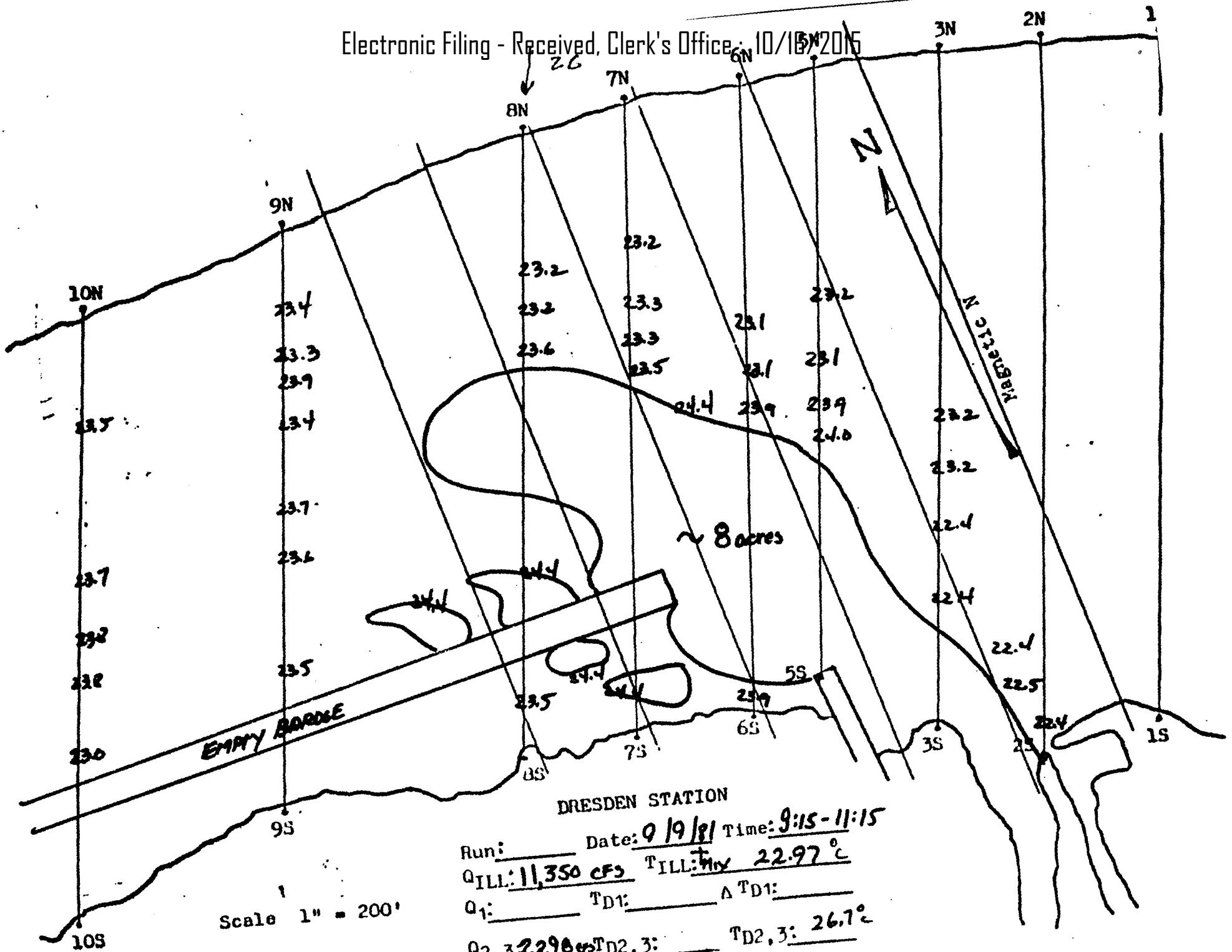
$Q_{III.} = 7250$

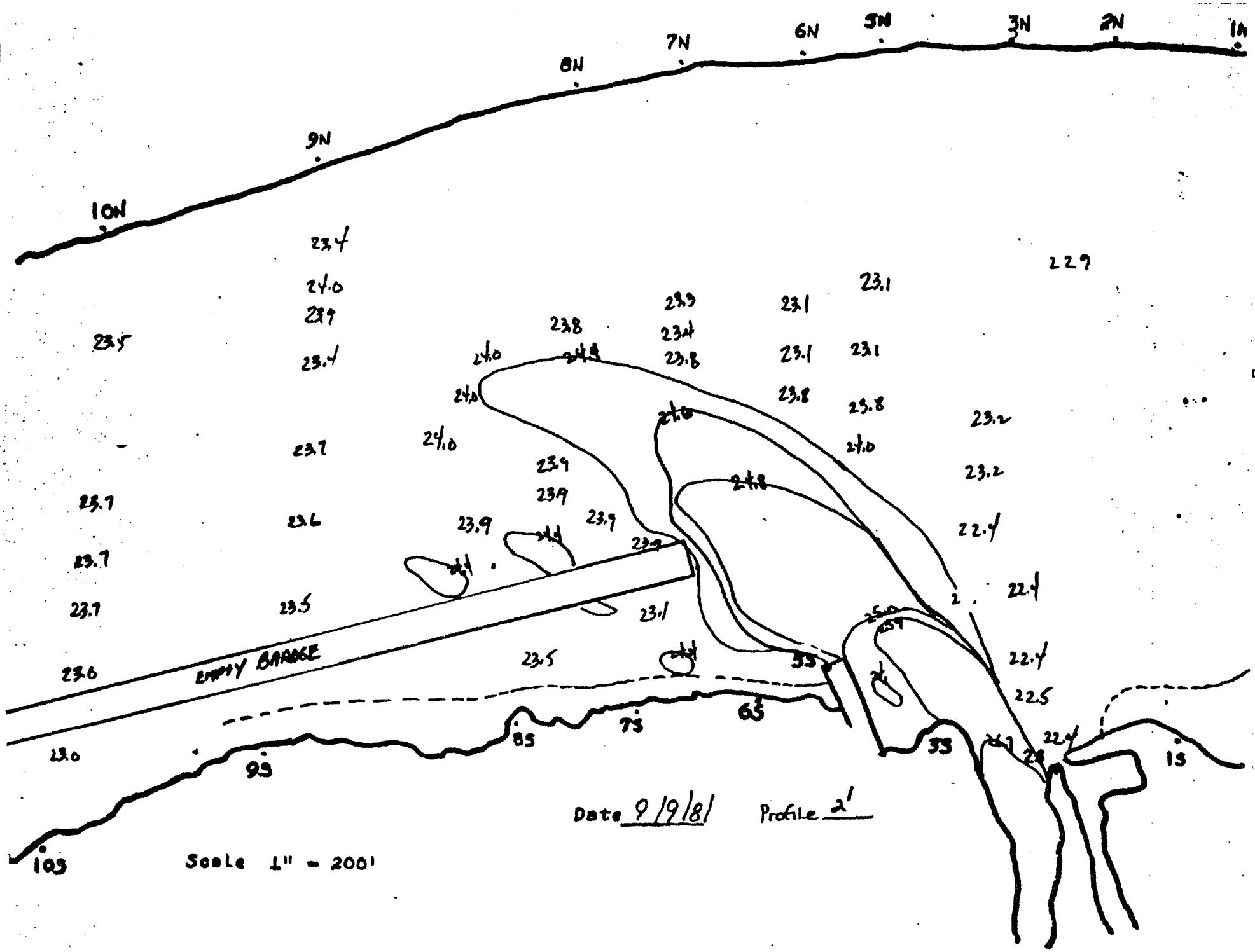
$$T_{amb} = t_m - \frac{(Q_{2,3})(t_D - T_I)}{Q_{III\ River}} \qquad 23.3 - \frac{2400\,(25.2 - 21.2)}{7250} = 22.0$$

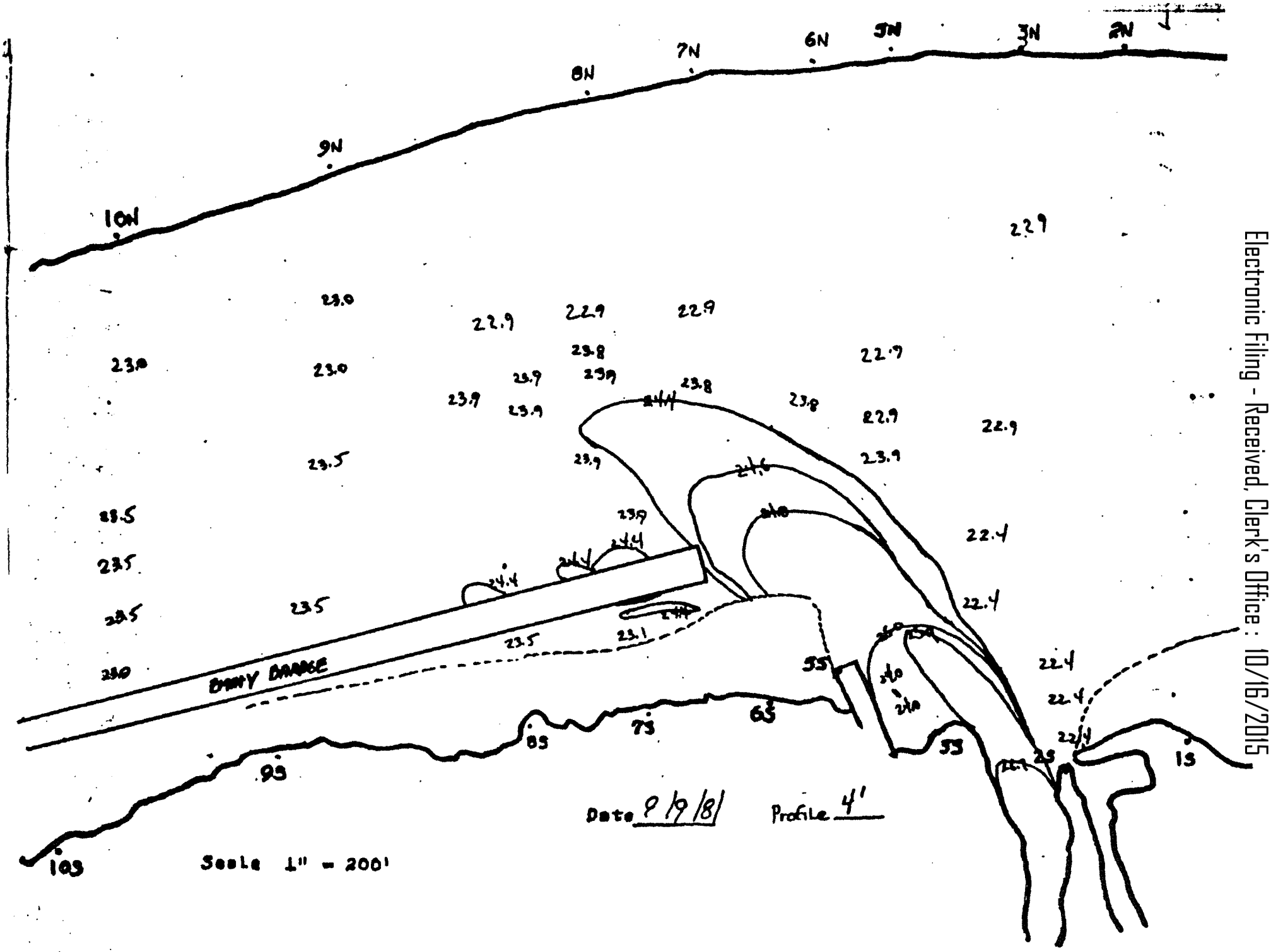
$T_{allow} = t_{amb} + 5°F / (2.8°C)$ $\quad 22.0 + 2.8 = \boxed{24.8°C}$

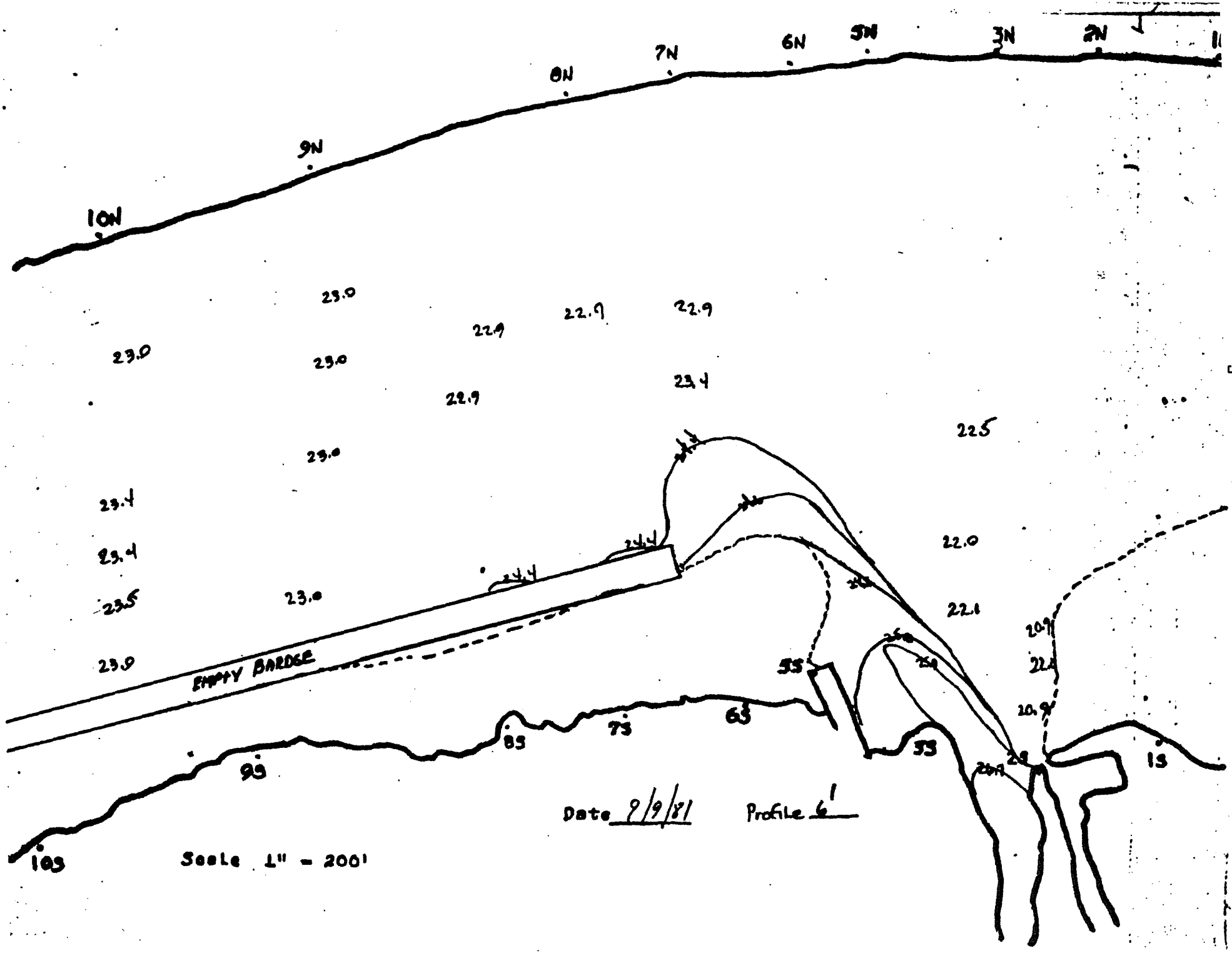
$t_{allow} = \boxed{24.8}$

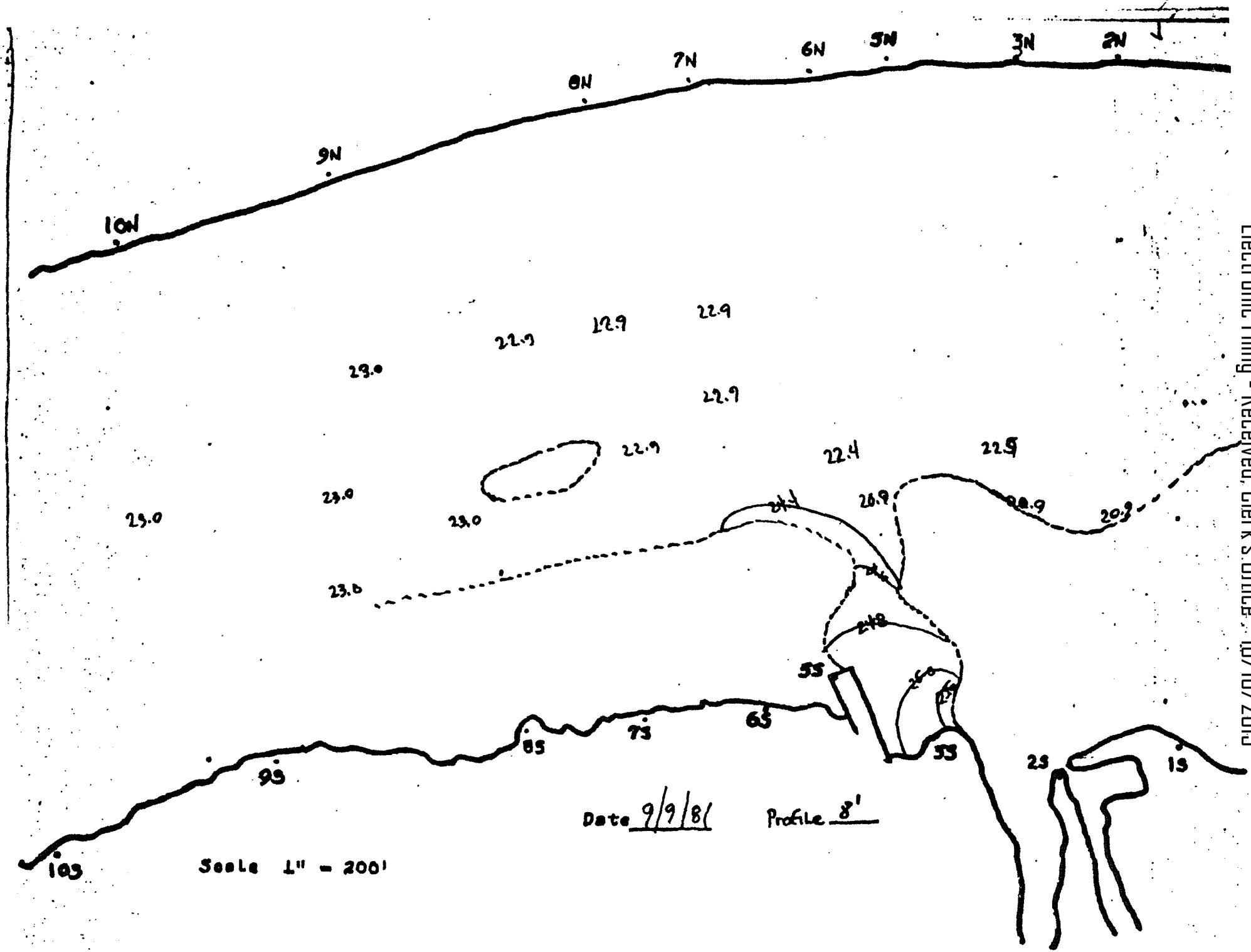
Exhibit 8 Dresden Station Plume Survey for 9/9/81. Areal Plume and Strata Temperatures Showing Excess 5°F (2.8°F) Isotherm at the -1' to River Bottom and Field Data Sheet.

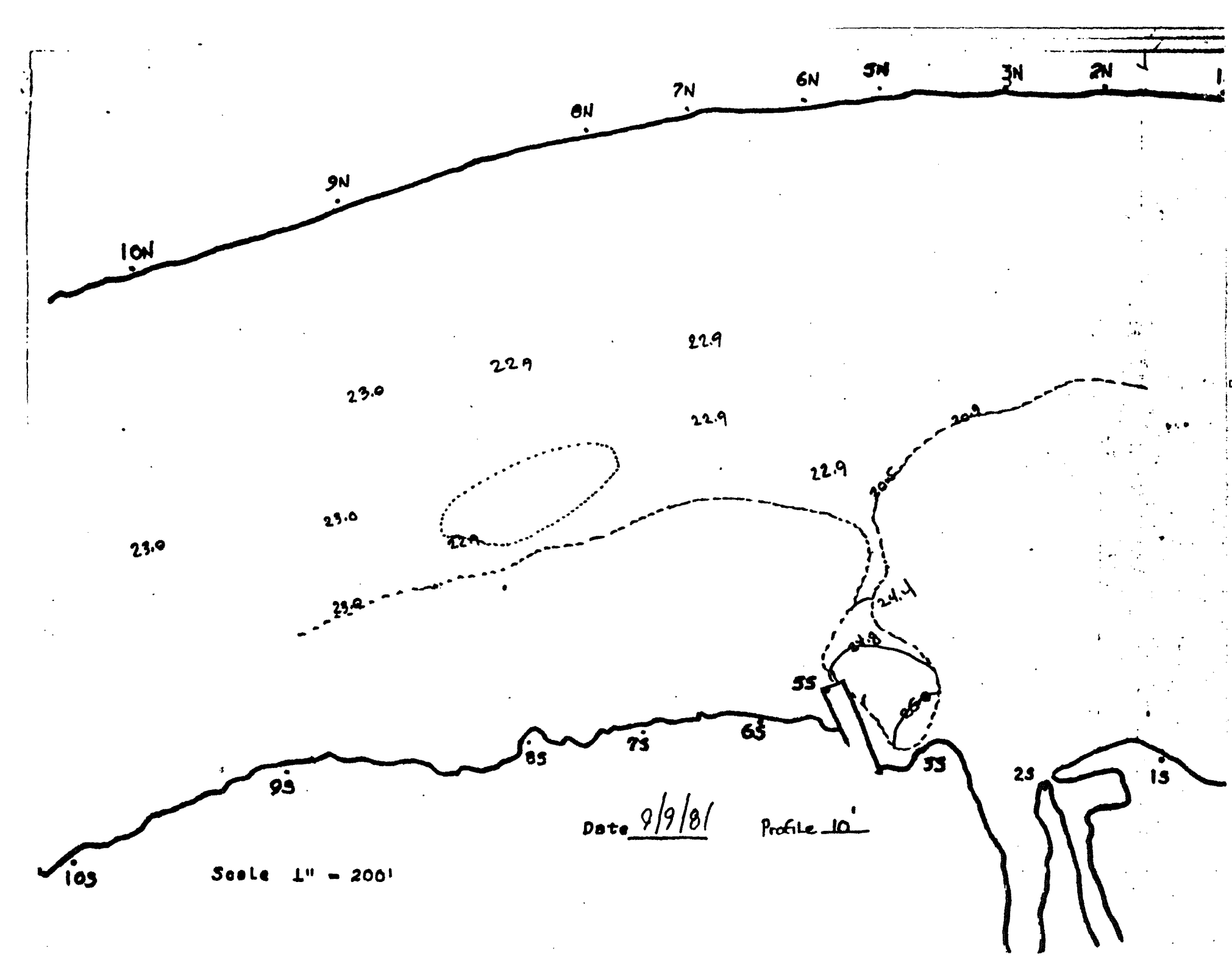












Project Dresden Plume Survey -9-9-81 Sheet 2

Subject H.F.B. W.H. V's. DPR Made

Date 9/9/81

			t_I			t_D	t_m					
READING#	1	2	3	4	5	6	7	8	9			JYC
LOCATION	JYC	KAW R	INT S	INT C	INT N	DISCH B2-8	LED G9	LED G5	LED G1			JYC
TIME	9:15a	9:22a	9:27a	9:31a	9:33a	9:53a	9:43a	9:45a	9:47a			11:16
S	22.8	19.8	19.8	19.8	20.0	26.7	22.9	23.3	23.2			22.9
												22.9
-2	22.9	19.7	19.8	19.7	19.8	26.7	22.9	23.3	23.2			22.9
-4	22.9	19.6	19.8	19.7	19.7	26.7	22.9	23.3	23.1			22.9
-6	22.9	19.6	19.8	19.7	19.7	26.7	22.9	23.1	23.0			22.9
-8	22.9	19.6	19.7	19.6	19.7	26.7	22.9	23.0	22.9			22.9
-10	22.9	19.5	—	—	19.7	—	—	23.0	22.9			22.9
-12	22.9	19.5			—			23.0	22.9			22.9
-14	22.9	19.5						22.9	22.9			—
-16	22.9	—						22.9	22.9			
-18	22.9							22.9	—			
-20	22.9							—				
-22	22.9											
-24	—											
	22.89	19.60	19.78	19.70	19.96	26.7	22.9	23.07	22.96			

$t_I = 19.74°$ $t_D = 26.7°$ $t_m = 22.97°$

t_m { Lock & Dam = 69, 65, 61.

T_I { Intake S, C, N.

$T_{amb} = 21.59$

$$t_m = \frac{(Q_{1,2,3})(t_D - T_I)}{Q \text{ Ill River}} = 22.97 - \frac{(2298\ cfs)(26.7 - 19.74)}{(11{,}350\ cfs)}$$

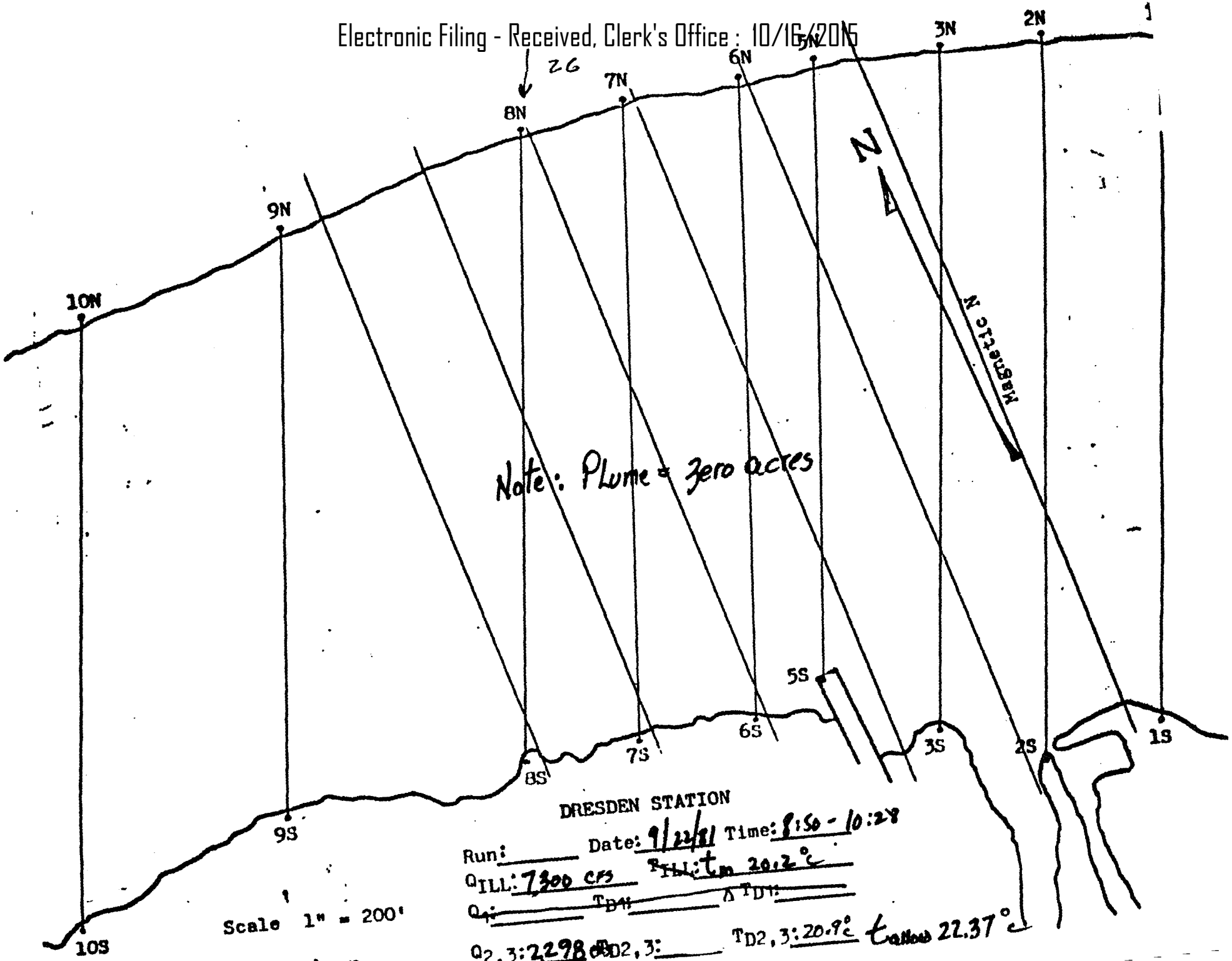
8.96

$t_{amb} = 1.409° - 22.97°$

$t_{amb} = 21.56°$

$t_{allow} = 24.36°$ [24.4]°

Exhibit 9	Dresden Station Plume Survey for 9/22/81. Areal Plume and Strata Temperatures Showing Excess 5°F (2.8°F) Isotherm at the -1' to River Bottom and Field Data Sheet.



Project Dresden Plume Survey
Subject CO, SVB, RP, H.F.B

Sheet
Name H. Bernhard
Date 9-22-81

			t_I			t_D	t_m				
READING#	1	2	3	4	5	6	7	8	9		Rebs
LOCATION	JYC	KAN R	INT S	INT C	INT N	DISCH 02-3	L&D G9	L&D G5	L&D G1		JYC
TIME	8:50	8:57	9:07	9:10	9:13	9:32	9:22	9:25	9:26		10:28
S	20.7	17.6	17.8	18.4	18.7	20.9	20.1	20.2	20.2		20.7
											20.7
-2	20.8	17.7	17.8	18.4	18.5	20.9	20.1	20.2	20.3		20.8
-4	20.8	17.7	17.8	18.5	18.4	20.9	20.1	20.2	20.3		20.8
-6	20.8	17.7	17.7	18.6	18.3	20.9	20.1	20.2	20.3		20.8
-8	20.8	17.6	17.7	17.8	18.2	20.9	20.1	20.2	20.3		20.8
-10	20.8	17.6			18.1		20.1	20.2	20.3		20.8
-12	20.8	17.5						20.2			20.8
-14	20.8	17.5						20.2			20.8
-16	20.8							20.2			20.8
-18	20.8							20.2			20.8
-20	20.8							20.3			20.8
-22											
-24											
	20.8	17.65									

$t_I = 18.2°$ $t_D = 20.9°$ $t_m = 20.2°$

t_m = { Lock & Dam = 69, 65, 61.

T_I = { Intake S, C, N.

$$T_{amb} = t_m - \frac{(Q_{1,2,3})(t_D - T_I)}{Q \text{ Ill River}} = 20.2 - \frac{\left(\frac{2298}{2983}\ cfs\right)(20.2 - 18.3)}{(7{,}300\ cfs)}$$

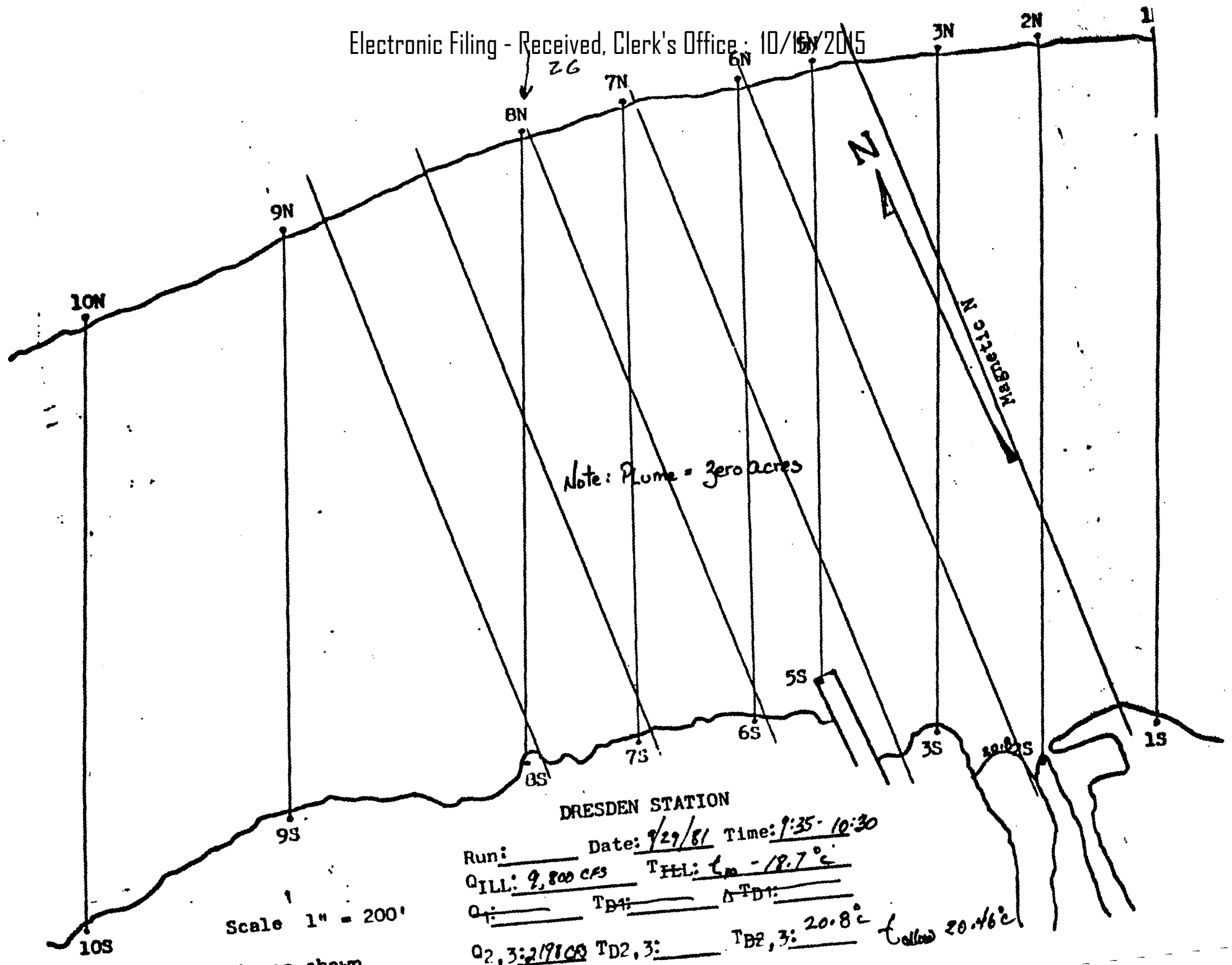
T_{allow} = t_{amb} + 5°F / (2.8°C)

$t_{amb} = 20.2 - 0.62 = 19.58$

$t_{allow} = 19.58 + 2.8$

$t_{allow} = 22.37°c$

Exhibit 10 Dresden Station Plume Survey for 9/29/81. Areal Plume and Strata Temperatures Showing Excess 5°F (2.8°F) Isotherm at the -1' to River Bottom and Field Data Sheet.



Project Dresden Reme Survey — Sheet
Subject R.P. - H.B. — Name L.Bernhard
Date 9/29/81

READING#	1	2	3	4	5	6	7	8	9			
LOCATION	Jyc	KAN R	INT S	INT C	INT N	L&D 6&9	L&D 6&5	L&D 6&1	DISCH U2,3			
TIME	9:35	9:44	9:47	9:50	9:52	9:55	10:00	10:03	10:13			
S	19.4	15.8	16.0	16.2	16.2	18.8	19.2	18.5	20.7			
-1FT.	19.4	15.8	16.0	11.2	16.2	18.9	19.2	18.5	20.8			
-2	19.5	15.9	16.1	16.2	16.2	18.9	19.2	18.5	20.8			
-4	19.5	15.9	16.1	16.2	16.2	18.9	19.0	18.5	20.8			
-6	19.5	15.9	16.1	16.2	16.2	18.9	18.7	18.5	20.8			
-8	19.5	15.8	16.1	16.2	16.2	18.9	18.5	18.5	208			
-10	19.5	15.9		16.2	16.2		18.5	18.5				
-12	19.5						18.4					
-14	19.5						18.3					
-16	19.5						18.3					
-18	19.5						18.3					
-20	19.5											
-22												
-24												
	19.5	15.9	16.1	16.2	16.2	18.9		18.5	208			

T_I = 16.2 (16.2) T_m = 18.7 T_D = 20.8

t_m { Lock & Dam # 69, "65, " 61.

T_I { Intake S, C, N.

$$T_{amb} = t_m - \frac{(Q_{1,2,3})(t_D - T_I)}{Q \text{ Ill River}}$$

$$18.7 - \frac{(3198)(20.8 - 16.2)}{9{,}800 \text{ CFS}}$$

T_{allow} = t_{amb} + 5°F / (2.8°C)

t_{amb} = 18.7 − 1.0317

t_{amb} = 17.66

t_{allow} 17.66 + 2.8 = 20.46°C

Exelon Generation LLC's Responses to the Board's Questions

ATTACHMENT 14

FINAL REPORT
DRESDEN STATION
AQUATIC MONITORING 1999
RM 266.0-274.4

Prepared for:

Commonwealth Edison Company
Dresden Generating Station
6500 North Dresden Road
Morris, Illinois 60450

Prepared by:

EA Engineering, Science, and Technology
444 Lake Cook Road, Suite 18
Deerfield, IL 60015

November, 2000

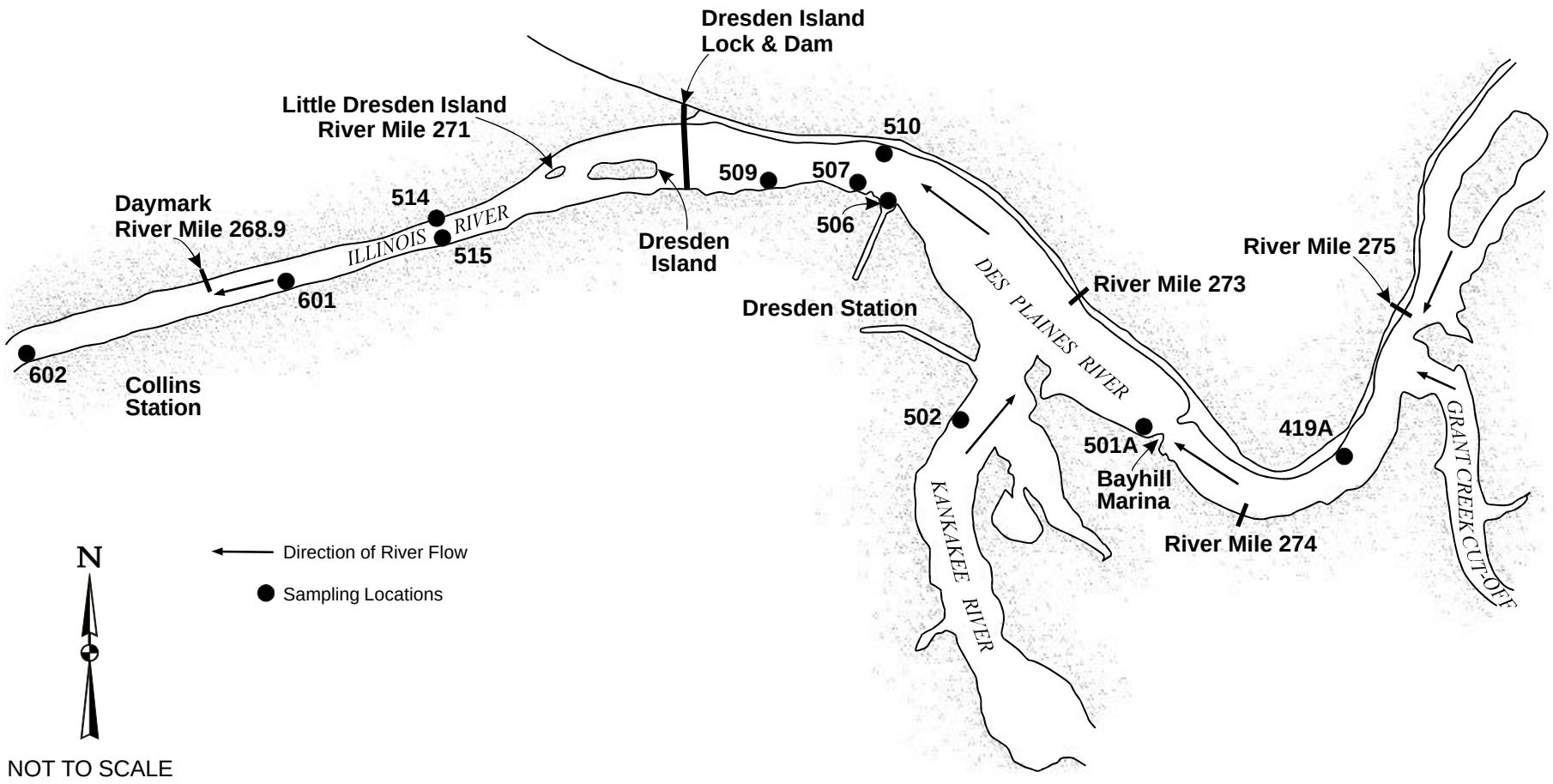


Figure 1. Sampling locations in the Kankakee, Des Plaines, and Illinois Rivers near Dresden Station.

6109001 ConEd Fish Map.cdr

Table 4. Summary of Water Temperature (C) and Dissolved Oxygen (ppm) Profile Measurements Near Dresden Station, 1999.

30 JULY 1999

	Upstream						Downstream											
	L.Des Plaines R. (midchannel)		Kankakee R. (midchannel)		(Intake)		Dresden Discharge		Downstream Dresden Discharge Transect: Near Shore (a)		1/4 point		1/2 point		3/4 point		Far Shore	
Depth (m)	T	DO	T	DO	T	DO	T	DO	T	DO	T	DO	T	DO	T	DO	T	DO
Surface	32.9	7.7	34.8	17.3	34.5	13.9	35.9	9.4			34.7	9.8	34.5	9.5	35.0	9.2		
Mid-depth									35.1	11.1							34.8	9.5
1.0	32.7	7.6	33.7	13.7	33.1	9.6	35.9	9.3			34.4	9.0	34.4	9.0	34.9	9.3		
2.0	32.6	7.5	32.9	9.8	32.4	8.9					34.4	8.9	34.4	8.9	34.9	9.2		
2.2							35.9	9.2										
3.0	32.5	7.2	32.1	10.7	32.3	8.6					34.3	8.7	34.3	8.6	34.7	9.0		
3.8					31.4	7.7												
4.0	32.4	6.9	31.3	8.5							34.3	8.6	34.3	8.6	34.6	8.9		
4.3	32.4	6.9																
5.0			30.5	5.2							34.2	8.5	34.3	8.6	34.6	8.9		
5.2			30.4	5.0														
6.0											34.2	8.3	34.3	8.6	34.6	8.9		
6.7															34.6	8.8		

14 SEPTEMBER 1999

	Downstream											
	Dresden Discharge		Downstream Dresden Discharge Transect: Near Shore (a)		1/4 point		1/2 point		3/4 point		Far Shore	
Depth (m)	T	DO	T	DO	T	DO	T	DO	T	DO	T	DO
Surface					27.4	7.2	27.3	7.1	27.4	7.1		
Mid-depth	28.4	7.1	--	--							27.2	6.4
1.0					27.5	7.1	27.4	7.2	27.5	7.1		
2.0					27.5	7.2	27.4	7.2	27.5	7.1		
3.0					27.5	7.2	27.4	7.0	27.4	7.1		
4.0					27.5	7.2	27.4	7.1	27.4	7.2		
5.0					27.5	7.2	27.4	7.1	27.4	7.2		
6.0							27.4	7.2	27.4	7.2		
6.5							27.4	7.1	27.4	7.1		

(a) Near shore=left bank facing downstream; Far shore=right bank facing downstream.

APPENDIX A

PHYSICOCHEMICAL MEASUREMENTS

APPENDIX A

DRESDEN STATION - COMMONWEALTH EDISON COMPANY
PHYSICAL MEASUREMENTS RECORDED AT EACH ELECTROFISHING LOCATION, 1999.

LOCATION	DATE	DEPTH(m)	TEMP (C)	D.O. (mg/l)	D.O. (% SAT)	COND (umhos/cm)	SECCHI (cm)
419A	12MAY	MID	22.8	8.9	100	1040	49.0
	10JUN	MID	29.6	7.7	103	895	64.0
	02JUL	MID	28.5	7.7	99	828	48.0
	23JUL	MID	32.3	7.2	90	822	48.0
	10AUG	MID	29.1	8.6	112	713	72.0
	31AUG	MID	27.3	7.1	92	747	51.0
	14SEP	MID	25.0	8.0	97	768	54.0
	07OCT	SUR	19.1	8.5	92	708	48.0
		1.0	19.0	8.2	88		
		1.5	18.8	7.8	84		
	19OCT	MID	19.4	7.5	81	867	66.0
502	11MAY	MID	19.5	9.3	102	629	39.0
	10JUN	MID	26.6	5.8	75	646	35.0
	02JUL	MID	26.3	7.6	96	597	42.0
	23JUL	MID	31.5	16.6	210	682	39.0
	10AUG	MID	28.5	11.0	142	709	48.0
	31AUG	MID	27.9	11.7	145	718	52.0
	14SEP	MID	25.7	8.8	111	765	54.0
	07OCT	MID	15.5	10.0	100	695	46.0
	19OCT	MID	18.5	8.7	93	798	40.0
506	11MAY	MID	24.2	8.7	103	680	54.0
	10JUN	SUR	33.9	6.4	90	675	79.0
		1.0	30.1	6.2	77		
		1.5	29.7	6.0	76		
	02JUL	SUR	32.6	7.9	109	637	75.0
		1.0	32.5	7.9	108		
		2.0	32.5	7.8	108		
	23JUL	SUR	35.0	7.5	111	759	70.0
		1.0	33.8	10.0	134	772	
		2.0	33.5	7.2	120	775	
	10AUG	MID	32.4	7.9	109	682	70.0
	31AUG	MID	31.3	7.7	100	754	57.0
	14SEP	MID	28.4	7.1	91	800	52.0
	07OCT	MID	33.2	8.7	121	713	55.0
	19OCT	SUR	25.2	9.0	109	804	66.0
		1.0	25.1	8.6	102		
		2.0	22.3	7.1	81		
510	11MAY	MID	20.4	9.0	99	1075	52.0
	10JUN	MID	29.7	6.4	82	879	50.0
	02JUL	MID	28.8	8.1	105	823	57.0
	23JUL	MID	33.7	9.4	130	786	66.0
	30JUL	MID	34.8	9.7	139		78.0
	10AUG	SUR	30.7	7.9	106	698	56.0
		1.0	30.6	7.9	105		
		1.5	30.6	7.9	105		
	31AUG	MID	29.8	8.8	116	734	58.0
	14SEP	MID	27.2	6.4	82	800	55.0
	07OCT	SUR	27.5	8.9	112	709	55.0
		1.0	27.5	8.7	110		
	19OCT	MID	24.7	8.8	106	813	55.0

APPENDIX A
DRESDEN STATION - COMMONWEALTH EDISON COMPANY
PHYSICAL MEASUREMENTS RECORDED AT EACH ELECTROFISHING LOCATION, 1999.

LOCATION	DATE	DEPTH(m)	TEMP (C)	D.O. (mg/l)	D.O. (% SAT)	COND (umhos/cm)	SECCHI (cm)
514	30JUL	MID	33.4	7.8	105		79.0
	11AUG	MID	30.2	8.3	111	703	62.0
	01SEP	MID	28.7	7.3	96	751	51.0
	15SEP	MID	25.9	7.9	97	769	45.0
	08OCT	MID	20.4	8.9	99	709	49.0
	18OCT	MID	20.4	8.7	97	801	55.0
515	30JUL	MID	32.9	7.8	108	679	78.0
	11AUG	MID	30.3	8.9	119	703	55.0
	01SEP	MID	28.2	7.8	101	747	55.0
	15SEP	MID	25.6	7.5	93	771	46.0
	08OCT	MID	20.4	9.1	100	709	54.0
	18OCT	MID	20.4	8.8	97	810	59.0
601	30JUL	MID	33.1	8.1	114		70.0
602	30JUL	MID	33.4	8.7	123		59.0

Exelon Generation LLC's Responses to the Board's Questions

ATTACHMENT 15

BEN B. EWING,

called as a witness herein on behalf of the Petitioner, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MS. PROCTOR:

Q. Please state your full name, for the record.

A. My name is Ben B. Ewing.

Q. Dr. Ewing, I'm handing you what has been marked as Commonwealth Edison Exhibit No. 5, the testimony by Dr. Ben B. Ewing and Dr. E. Downey Brill, which is entitled "The Effect of Dresden Station indirect open cycle operation on water quality in the Illinois River," and I will ask you if you prepared that testimony?

(WHEREUPON, the document was tendered to the witness.)

BY THE WITNESS:

A. I prepared it jointly with Dr. Brill.

BY MS. PROCTOR:

Q. Are there any corrections to be made in the testimony?

A. Yes, there are.

On Page 3, Paragraph 1, Line 9, should read:

"During the late summer, fall, and winter months, the intake flow exceeds the..."

Insert the word "flow" between "intake" and "exceeds."

On Page 5, Paragraph 2, Line 7, the line should read:

"...of ammonia nitrogen, coliform bacteria count, and trace metals."

On Page 13, Paragraph 1, the last line in the paragraph, that's Line 4, insert, after the word "streptococci," the words "under indirect open cycle operation."

MS. REHMANN: Where is that again, please?

THE WITNESS: On Page 13, the line just above the title "Effect on Ammonia."

That line should read, "streptococci under indirect open cycle operation is hardly significant...," and so forth.

BY THE WITNESS:

A. On Page 20, Paragraph 1, Line 4, change the word "will" to read "is expected to."

The line will then read with the changes:

"That monitoring program is expected to confirm these assessments."

Those are all of the corrections.

BY MS. PROCTOR:

Q. With those corrections, Dr. Ewing, is this testimony true and accurate, to the best of your knowledge?

A. Yes, it is.

MS. PROCTOR: At this time, we would move for the admission of Commonwealth Edison Exhibit No. 5, the testimony of Dr. Ewing, into evidence as if read.

THE HEARING OFFICER: Any objection?

MS. REHMANN: No objections.

THE HEARING OFFICER: All right. Commonwealth Edison Exhibit 5 is admitted.

(WHEREUPON, said document, previously marked Commonwealth Edison Exhibit No. 5, was received in evidence.)

BY MS. PROCTOR:

Q. Dr. Ewing, have you also prepared a summary of your testimony?

A. Yes, I have.

Q. Would you please read that?

A. "I am Ben B. Ewing, Professor of Environmental Engineering and Director of the Institute for Environmental Studies at the University of Illinois at Urbana-Champaign.

"I have studied and conducted research on water quality problems for the past thirty-two years. Dr. E. Downey Brill and I have served as consultants on water quality for Commonwealth Edison Company of Chicago since March, 1978.

"We have studied water quality monitoring data collected while the plant was operated in both variable blowdown closed cycle and indirect open cycle modes.

"These data have made possible some evaluation of the effect of each type of operation on the nearby river and within the cooling system for a variety of physical, chemical, and biological indicators of water quality.

"In general, the cooling pond-canal system provides some important improvements in water quality in addition to cooling.

"Basically, the 2.8 day average retention

time in the ponds provides that much additional recovery time for Des Plaines River and Kankakee River water at a location where those rivers are in a water quality recovery zone.

"The recovery time results in reduction of ammonia nitrogen, coliform bacteria count, and trace metals.

"Biochemical oxygen demand (BOD) (and other measures of organic matter such as chemical oxygen demand and total organic carbon) is generally decreased although occasionally it is increased, presumably due to primary production of algae through photosynthesis.

"Furthermore, the cooling pond surface aeration, the cascading of water over the spillway at the pond outlet, and the spray modules combine to nearly saturate the cooling water with dissolved oxygen before discharge to the Illinois River.

"I have estimated that in the case of indirect-open-cycle operation about 7,000 pounds of oxygen per day are added to the

Illinois River under typical August conditions.

"The effect on the dissolved oxygen in the Illinois River after mixing would typically be an increase of about 0.5 mg/l. In comparison, under closed-cycle operation the improvement would be 0.1 mg/l.

"On occasions, over 50,000 pounds may be added to the Illinois River and the overall improvement could be 1.5 mg/l.

"The degree of quality change differs somewhat between indirect open cycle and closed cycle operation due to the different amounts of river water withdrawn, the different residence time in the ponds and the difference in temperature in the ponds.

"The most important difference, however, is the much greater volume of pond discharge under the indirect open cycle operation mode.

"If the quality of the pond discharge is almost as high under indirect open cycle operation as under current operating conditions, but almost 20 times as much of the high quality water is discharged to the Illinois River, then the resulting improvement in the

Illinois River would be much greater during indirect open cycle operation, especially at periods of low flow in the streams.

"Under the indirect open cycle mode, the intake flow (2230 cfs) exceeds the flow in the Kankakee River during low flow periods, and most of the condenser cooling water comes from the Des Plaines River.

"In general, the quality of the Des Plaines River is much poorer than that of the Kankakee River.

"Thus, during critical, low-flow conditions the beneficial effects of the cooling system would be the greatest.

"In summary, we conclude that indirect open cycle operation of Dresden Station cooling pond-canal system during summer months would benefit the water quality in the Illinois River by (1) adding dissolved oxygen, (2) reducing BOD most of the time, (3) reducing ammonia levels, (4) reducing the coliform bacteria count, and (5) decreasing toxic heavy metals.

"All these effects would be much greater

for indirect open cycle operation than under closed cycle operation because the pond system's improved (higher quality) water would be discharged to the Illinois River at a much greater flow rate.

"Of these, the improvements in dissolved oxygen, ammonia, coliform bacteria count and copper would result in the greatest benefit to general water quality in the Illinois River.

"If indirect open cycle operation of the Dresden Station cooling system is resumed, Commonwealth Edison Co. plans to monitor water quality changes.

"That monitoring program is expected to confirm these assessments of water quality aspects of the system and provide information useful in assessing other generating stations which might contemplate indirect open cycle operation."

MS. PROCTOR: At this time, we would tender Dr. Ewing for cross-examination.

CROSS-EXAMINATION

BY MS. REHMANN:

Q. Dr. Ewing, if you are in a position to

answer this, could you describe what, if any, point source discharges there are on the Kankakee and Des Plaines Rivers, say, within like five miles upriver from the intake?

Are there numerous discharges?

A. No, there are none.

I'm not aware of any point source discharges on the Kankakee within that range, but I'm not really in a position to answer that with authority because I haven't addressed that question.

Q. Could I ask you, then, is it your impression that the water quality at the intake, then, is primarily influenced by natural conditions rather than other discharges upstream?

A. The water quality at the intake is primarily determined by the proportion of Kankakee and Des Plaines River water and the relative quality of those two.

The quality of water in the Kankakee River is of a higher quality than the Des Plaines River, but it is affected by other than natural conditions because there are sources of both point source and nonpoint source upstream in the Kankakee.

MS. REHMANN: No more questions.

THE HEARING OFFICER: All right. Anything further?

MS. PROCTOR: No.

THE HEARING OFFICER: All right. Thank you.

(Witness excused.)

THE HEARING OFFICER: You may call your next witness.

MS. PROCTOR: I call Dr. Verduin.

(WHEREUPON, the witness was duly sworn.)

MS. PROCTOR: Please mark this as Commonwealth Edison Exhibit No. 6, for identification.

(WHEREUPON, said document was marked Commonwealth Edison Exhibit No. 6, for identification.)