FINAL REPORT

MONOSTATIC ACOUSTIC SOUNDER MEASUREMENTS TO ASSESS THE REPRESENTATIVENESS OF LILCO'S METEOROLOGICAL MONITORING

Prepared for

LONG ISLAND LIGHTING COMPANY

Hicksville, LI, New York 11801

BY

WALTER A. LYONS, Ph.D., CCM
R*SCAN Corporation
511 Eleventh Avenue South
Minneapolis, MN 55415

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R·SCAN CORPORATION

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1. INTRODUCTION

1.1 Background

Routine meteorological monitoring (USNRC, 1980) used for the preparation of Safety Analysis Reports and ongoing assessments of routine releases from operating nuclear power reactors needs to be both properly quality assured (USNRC, 1981) and truly representative of the site. In addition, these primary tower measurements of wind and thermal stability are to be used as input to emergency response planning (ERP) Class A models. Adequate backup wind data at the 10 meter level is also required (USNRC/FEMA, 1980).

A 400 ft instrumented tower has been operated by LILCO for almost a decade at a site about one mile west of the Shoreham One Nuclear Generating Station. While these data have been quality assured to be in conformance with 10CFR50, App. B, there has recently evolved some question as to the representativeness of the lower levels (33 ft and 150 ft) of the tower's data, with regards to the wind flow and turbulence in the immediate environs of the containment structure. The major reasons for the possible lack of representativeness of the tower's lower levels are (a) the vegetation surrounding the clearing in which the tower was constructed and (b) distortion of the wind which the tower was located. Data taken at the highest level are less likely to be affected by these interferences. Though these local site flow irregularities are expected often to be of second order, it is deemed prudent to analyze the boundary layer characteristics at the primary tower with respect to those occurring within the immediate vicinity of the plant, especially during periods of onshore flow.

1.2 Acoustic Sounding of the Planetary Boundary Layer

Acoustic sounding of the atmospheric PBL was first seriously explored in 1968, with commercial monostatic sounders becoming available by 1972. In the subsequent decade over 300 such systems have been brought into use worldwide (Gaynor, 1982). Sounders operating in the vertical monostatic mode produce a signal proportional to the vertical profile of the temperature structure function (C_T). This parameter is determined by several factors, including the temperature lapse rate of the atmosphere as well as the characteristics of small scale turbulence. Facsimile time/height displays, though producing a qualitative record requiring manual, subjective interpretation, have been found to be valuable for inferring the complex structures of the PBL, including such phenomena as the height of the mixed layer, thermal plumes associated with convective mixing, sea breeze fronts and inversions, elevated inversion surfaces and associated wave motions, etc. Sounders have a useful operating range from 500 to 1,000 meters and can provide valuable insights into the stability characteristics of the lower PBL, that part most actively involved in the dispersion of emissions from near-ground releases. Sea and lake breezes are especially well monitored by acoustic sounders (Bennett and List, 1977).

Monostatic vertically pointing sounders have been used to produce climatologies of mixing depths at coastal sites (Aggarwal et al., 1980; Rizzo and Lyons, 1977). Since the acoustic return as displayed on a facsimile chart essentially integrates a number of complex, interconnected atmospheric parameters, it is a reasonable assumption that if the traces from two sounders produce essentially identical results, that under most circumstances, the characteristics of the lower PBL at both locations are also quite similar with respect to the parameters important to nuclear plant diffusion evaluations.

Thus a sounder could therefore be used to validate the representativeness of the measurements being monitored by the primary Shoreham tower by comparison with sounder data located near the plant containment structure.

1.3 Overall Goals

It was proposed to use two monostatic acoustic sounders, one at the existing primary tower and the other at the plant site, to study the representativeness of the lower two levels of the primary tower. The sounders were installed (a) at the base of the existing 400 ft tower and (b) near the Reactor building at the plant site. They were run concurrently to ascertain, from the facsimile displays of boundary layer temperature structure function, if low level atmospheric characteristics are substantially the same at both locations. All types of mesoscale meteorological regimes were monitored, but primary analysis emphasis was placed on onshore flow conditions.

2. EXPERIMENTAL DESIGN

2.1 Statement of Tasks

R*SCAN Corporation (formerly Meteorological Applications, Incorporated) was contracted to design and conduct a field data gathering program at the Shoreham site from about 15 July to 22 September 1982. Data were to be analyzed to address the issues raised above. Included among the tasks were the following items:

2.1.1. Two AeroVironment Model 300 monostatic sounders were to be operated for about two months. The data were to be recorded on facsimile strip charts and forwarded to R*SCAN on a weekly basis. The two recorders were tested side-by-side at the beginning of the program to assure compatibility. Finanders were installed on both acoustic enclosures to eliminate as much environmental noise as possible by reducing side lobe interference.

2.1.2 The monostatic sounder traces were to be analyzed as to TIBL height, and qualitative turbulence characteristics for selected periods, using techniques employed on Lake Michigan (Rizzo and Lyons, 1977) and Chesapeake Bay (Rodney, Lyons, and Calby, 1980).

2.1.3 Complete supporting meteorological data were to be archived via real time climatology (RTC) to allow for comprehensive analysis of the sounder/tower data. These data included:

- GOES high-resolution satellite data.
- Hourly plotted radar summaries.
- NAFAX surface and upper charts.
- Plotted radiosondes form nearby NWS stations.

- Lists of hourly reports from nearby NWS, Coast Guard, and FAA stations.
- Ship buoy, and satellite water temperature for surrounding waters, etc.

2.1.4 To the extent practical, there was to be data exchanges with Brookhaven National Lab which conducted its own limited summer field program during this period (SethuRaman, personal communication). This included BNL 290 ft tower data, Tiana Beach tower data, Brookhaven Airport anemometer strip charts, and a monostatic sounder at BNL. Supporting information of this type can be valuable in case studies determining the true characteristics of mesoscale flows which are not always evident from single site measurements.

2.1.5 Limited case studies were to be performed for a variety of meso-synoptic conditions, concentrating on sound/land breezes. The data from the sounders, the existing primary 400 ft tower and the supporting supplemental data were to be carefully intercompared to ascertain the representativeness of the measurements made at the various levels.

2.1.6 The mixing heights and mesoscale PBL characterizations at the two locations were to be detailed and summarized.

Specifically, the following questions were to be addressed:

i. Are the measurements being made at the 150 ft level on the existing primary 400 ft tower representative of turbulence conditions at the same level near the containment structure, expecially during periods of onshore flow during sound breezes, TIBL and plume trapping situations?

ii. What are the frequences of the various Coastal Mesoscale Regimes occurring at this site during the duration of the field program?

iii. What are the general characteristics of the PBL, including such phenomena as TIBLs and Sound Breezes to the extent that the data assembled can reveal?

2.2 Acoustic Sounders

Two conventional AeroVironment monostatic vertically-pointing acoustic sounders (Model 300) were rented. The equipment was nominally scheduled for an operational period between 15 July and 13 September 1982. The first unit [Figure 2-1] was installed on plant property, approximately 800 ft (250 m) southwest of the con tainment. This location is about 2250 ft (700 m) inland and at an elevation of approximately 45 feet above mean water level. It was located next to a temporary building adjacent to a pipe fitting shop. Occassional noise bursts from that facility were anticipated, but not expected to interfere with the traces in other than a cosmetic way. This unit began operation on 16 July 1982, and continued through 24 September 1982. This site was selected from the several possible because: 1) nearby shelter was available for the recorder and electronics, 2) local vehicular traffic noise was comparatively low, 3) it was at an elevation and distance inland more comparable to the existing 400 ft primary tower than most construction area locations, and 4) it was representative of the region into which a plume would disperse during onshore flow.

The second sounder was installed on the Shoreham west meteorological tower grounds, in the east side of the clearing created for this facility (Figure 2-2). The site is acoustically quiet by comparison to the plant. Recorders and electronics were located in the electronics shed at the tower base. Data taking began on 15 July 1982 and continued through 24 September 1982.

Figure 2-1. Enclosure for the monostatic acoustic sounder located southwest of the containment structure at the Shoreham Nuclear Generating Station.

Figure 2.2. Enclosure for the monostatic acoustic sounder located adjacent to the Shoreham West meteorological tower.

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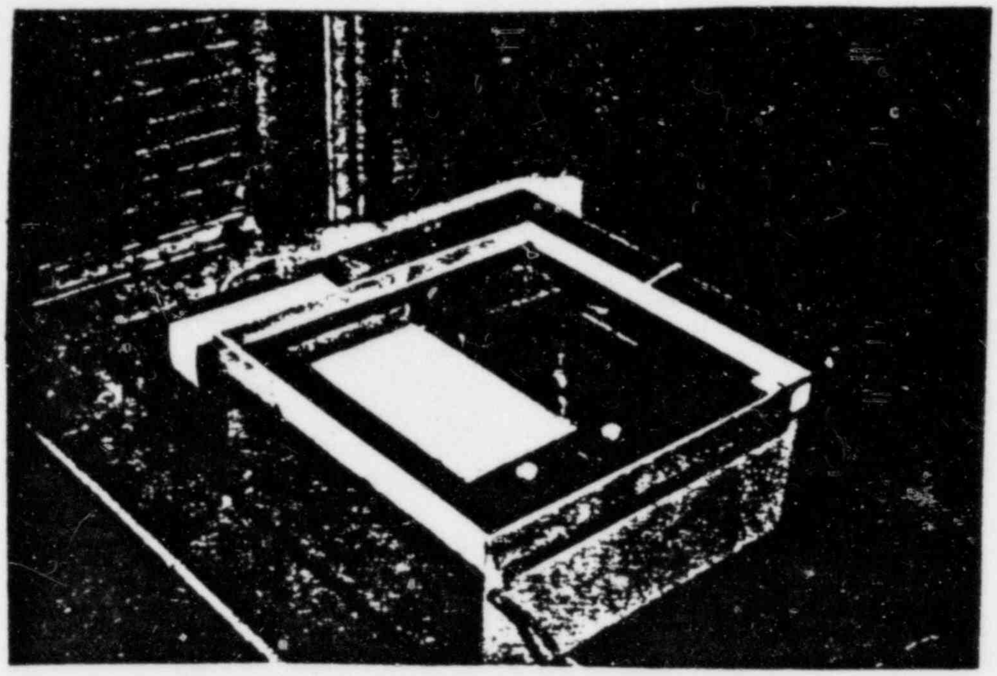


Figure 2-3. Facsimile recorder used for each of the two monostatic acoustic sounders.

Data from both sounders were recorded in conventional facsimile format (Figure 2-3). The chart speed of 1.20"/hr (nominal) produces a 24-hour trace approximately 28.8" in length. Frequent time hacks were made by LILCO personnel. No serious time errors were noted. Both systems were tested before installation by the manufacturer (AeroVironment) to assure that nearly identical traces were produced by both when operated under identical conditions. Using a common antenna and enclosure, both sets of electronics and recorders were operated at alternating 15 minute intervals under relatively constant atmospheric conditions. Both systems produced traces that were substantially similar. Thus, barring changes in system calibration or adjustments, differences in the appearance of the traces from the two sounders should imply differences in atmospheric structure. The maximum range for both systems was set at 500m. The characteristics of the systems, which were maintained throughout the observation program are listed in Table 2-1).

TABLE 2-1

ACOUSTIC SOUNDER OPERATING CHARACTERISTICS

Maximum Range	500 meters
Sensitivity	9.0
Pulse Width	200 msecs
Band Width	Wide

The traces for each system were collected every week to 10 days and sent by Express Mail to R*SCAN for initial inspection and Q/A, in order to detect any operating problems. The traces were then checked and cut into 24 hour segments [0000-2359Z]. These have since been photo-reduced for routine use to minimize smudging of the sensitive inprint on the original traces.

2.3 Supplemental Meteorological Data Acquisition

In order to properly interpret the sounder traces with respect to their meteorological content, considerable supplemental information was deemed highly useful. All data from the LILCO 400 ft tower, recently refurbished, were received as original strip chargs. This necessitated hand reduction of the charts by R*SCAN staff.

In order to answer the broader questions concerning the nature of the CMRs observed during the field program, other supplemental meteorological data were collected. At the R*SCAN Operations Center in Minneapolis, NAFAX and DIFAX charts were collected in order to provide an overview of general synoptic conditions affecting this site. When possible, GOES visible and infrared images showing Long Island were acquired. All routine surface, marine and upper air data transmitted over the NWS communications circuits was automatically archived on disk using the WSI Computerized Weather Data System in Bedford, MA. These data, arranged according to a predetermined format, were transferred daily to R*SCAN via a 1200 baud dial-up communications line, and accessed with a TI280 printer. Data transmission routinely took 25-35 minutes per day.

In addition to the real-time data acquisition activities, arrangements were made to receive data taken by Brookhaven National Lab at several sites in Long Island during the summer. These are described below.

The relationship of the various data gathering points in the general vicinity of the Shoreham plant are shown in Figure 2-4. This photograph is a Landsat RBV high resolution view of the area of eastern Long Island surrounding the plant. Brookhaven National Laboratory (BNL) is located approximately 6 miles (10 km)

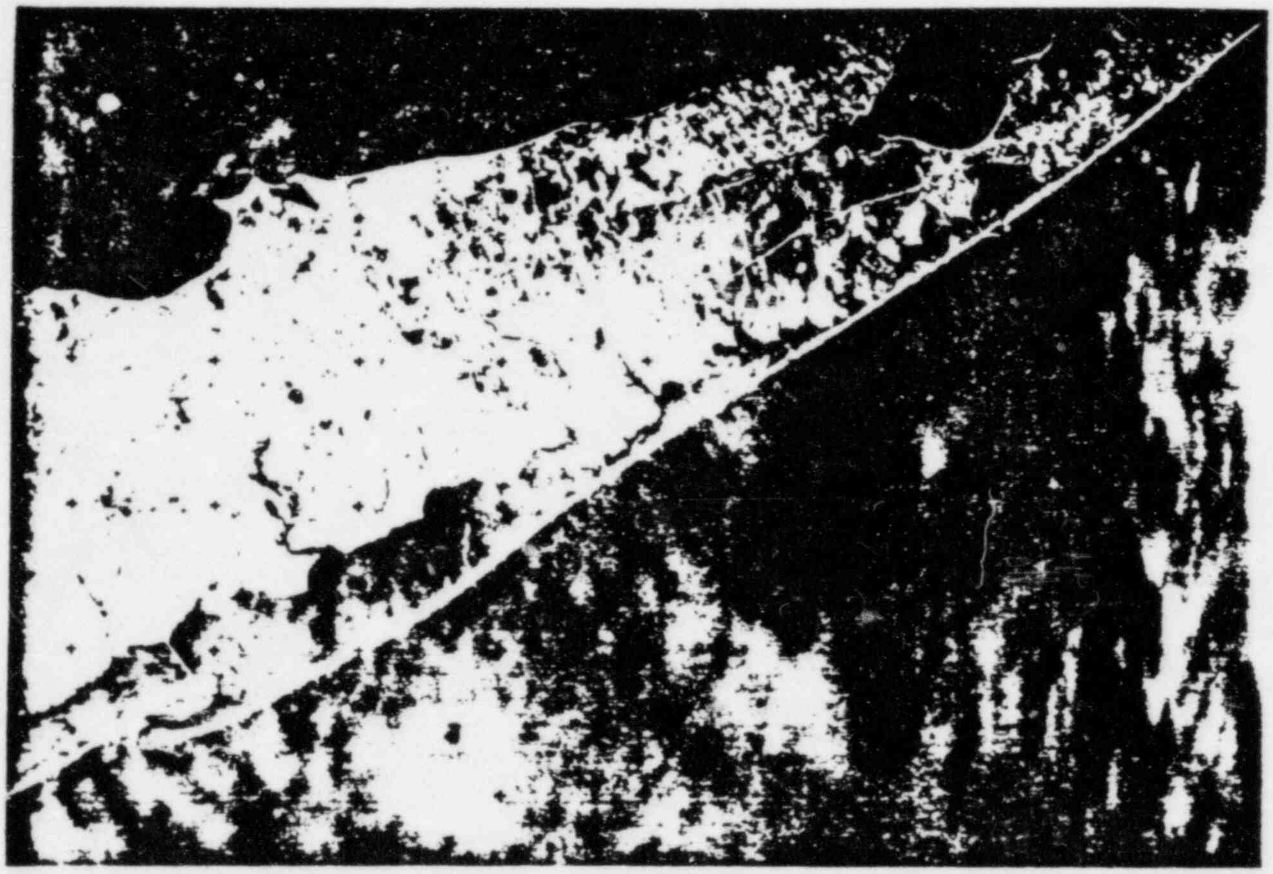


Figure 2-4. Landsat, RBV high resolution image of project area, 14 April 1982. Clearly visible on north shore is the plant construction site. To its south, the accelerator at BNL can be seen, as can the runways of the Brookhaven Airport, further to the south.

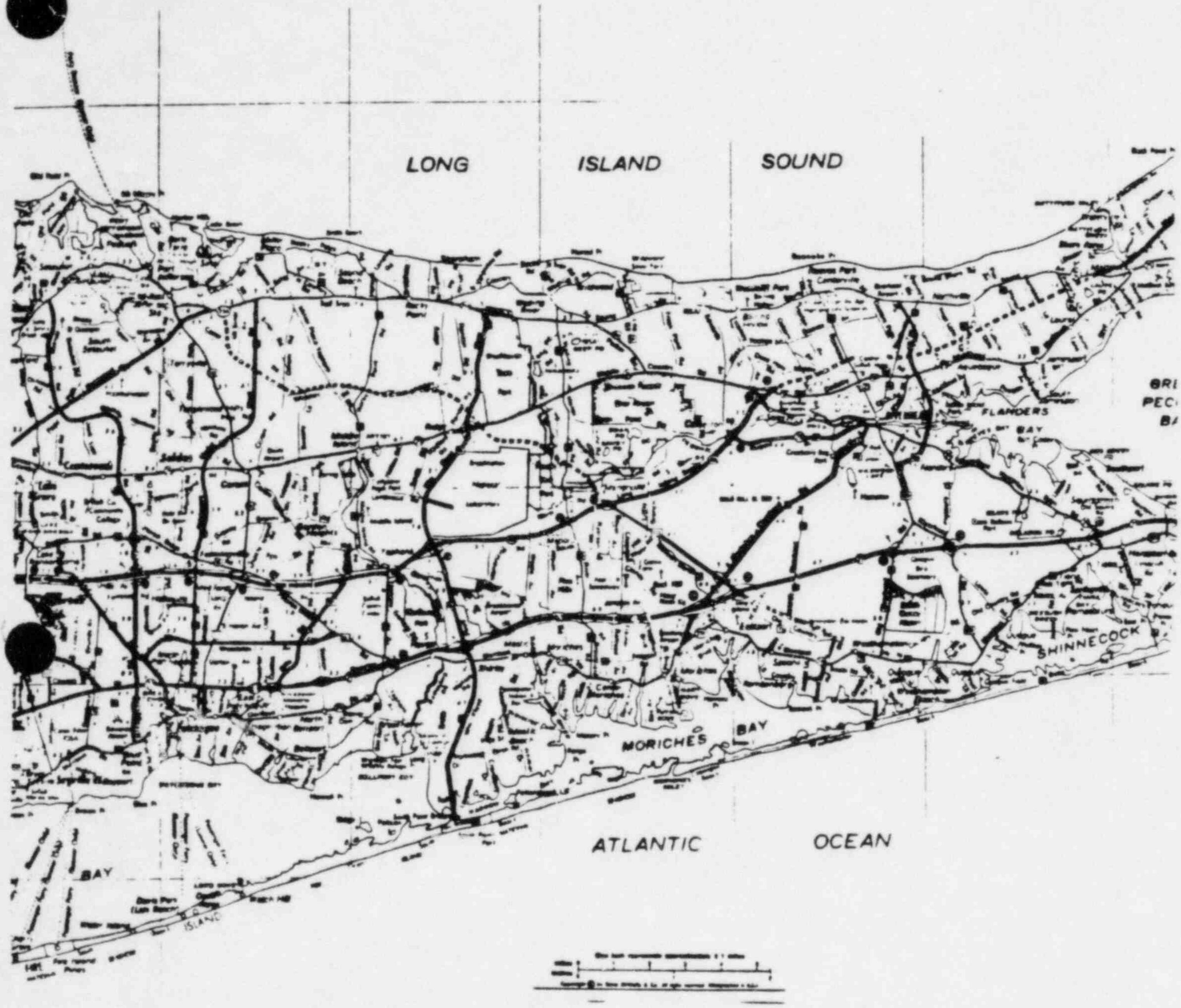


Figure 2-5. Standard highway map of the general project area.

due south of the plant. The Brookhaven Airport, where an anemometer was maintained by BNL, is located about 10 miles (16 km) due south of the plant, closer to the south shore. BNL also operated an instrumented tower at Tiana Beach, on the south shore itself, to the southeast of the study area. The FAA is charged with continuous monitoring of hourly and special weather conditions at Islip's MacArthur Airport (ISP), about 16 miles (26 km) southwest of Shoreham. These observations were acquired, along with numerous others, through the WSI data service. Long Island Sound is approximately 18 miles (29 km) wide at Shoreham. A section of a standard highway map is also shown (Figure 2-5) to assist in the geopolitical orientation of the reader.

3. SUPPLEMENTAL DATA ACQUISITION AND PREPARATION

3.1 Data Assembly

A substantial amount of meteorological information was acquired for this program for the period 15 July - 22 September, 1982. This encompassed a large sample of the summer and early fall mesoscale weather regimes to be expected at the site. The data are described below, along with a catalog of available information with qualitative estimates of the utility of these products in meeting project goals.

3.2 LILCO Tower Data

All data collected on the refurbished 400 ft LILCO tower at Shoreham West were collected and forwarded to R*SCAN. Included were strip charts with the following parameters:

* 33 ft temperature
* precipitation
* 33-150 ft temperature lapse rate
* 33-400 ft temperature lapse rate
* 33 ft wind speed, direction, sigma theta
* 150 ft wind speed, direction, sigma theta
* 400 wind speed, direction

The data were reduced at hourly intervals and (except for the precipitation) represent 15 minute averages ending on the hour. Thus, the data for 0500Z represents a quarter hour average from 0445Z to 0500Z. Greenwich time [Z-Time] is being utilized rather than Eastern Standard in order to more easily interface with standard offsite weather data sources. Each data "day" in fact is defined as extending from 0000Z to 2359Z. This [illegible] that the analysis day begins at 8:00 p.m., EST. This was chosen because local dayt[illegible] [illegible]scale circulations

have generally spent their course by this hour, and the nocturnal inversion is just beginning to become established. It is perhaps the best compromise in attempting to specify discrete occurrence intervals for CMR phenomena.

The data capture rate for the various parameters on a daily basis during the project (16 July - 20 September, 1982, inclusive) was tabulated. A total of eleven parameters were recorded and archived from the tower site. This resulted in a potential 17,688 total parameter-hours for which 16,783 were successfully acquired, for an overall data capture rate of 94.9%.

3.3 WSI Data Base

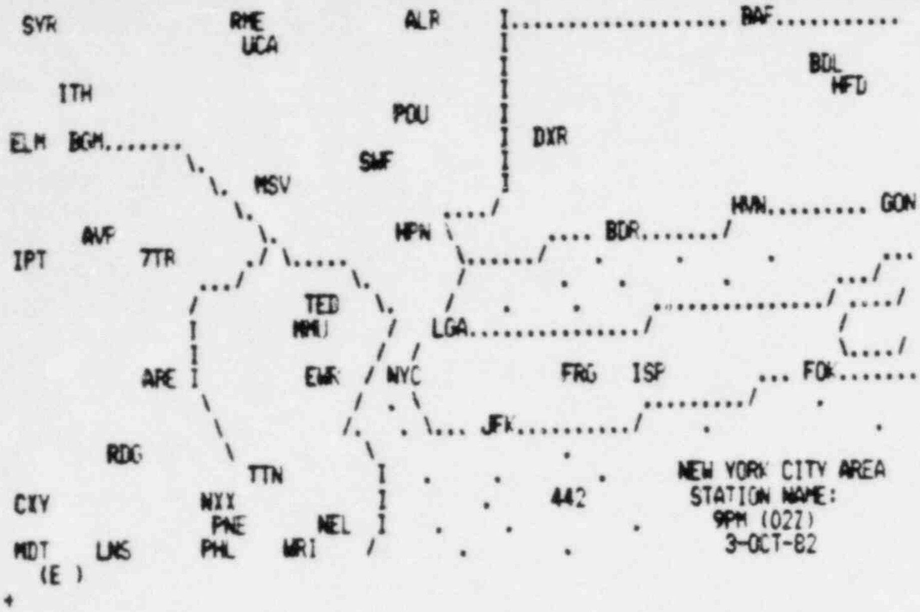
In order to properly interpret the sounder traces in the context of the prevailing CMR, it is necessary to have as much data as practicable from the surrounding 100 miles or so, as well as nearby upper air, buoy, ship and radar reports. To obtain these data after the fact through sources such as the National Climatic Center would be (1) extremely expensive, and (2) take months of time. Furthermore, the data would then be in raw form, on hard copy and require extensive sorting and handling before being ready for input into the analysis process. Alternately, the same data acquired on CCT would probably not be available for many months (if available at all) and would still require substantial post processing.

Thus, in order to acquire the needed regional weather information, which is transmitted over a variety of teletype circuits, it became obvious that the most effective approach was to employ a commercial interactive weather data base. All weather teletype circuits are read by a bank of DEC PDP-11/34 computers in Bedford, MA.

At the request of R*SCAN, all data of interest were accumulated offline via a command program and stored on a reserved portion of 30MBy hard disks. These were then accessed, in twelve hour blocks as described, generally on a daily basis, via a TI820 printer at 1200 baud at the R*SCAN Operations Center in Minneapolis. The data were also archived for up to a week's time. They could also have been transferred to CCT for later use, if requested. The data were formatted to be of maximum use to the project. A special map projection, showing Long Island and surrounding areas, was created. It is shown, along with the larger region, in Figure 3-1. The 3 letter codes are standard FAA weather station identifiers. The 3 digit numbers in the Atlantic Ocean are the new buoys established by the National Data Buoy Office of NOAA. These report measurements of conditions, including sea temperature, on an hourly basis.

Samples of the daily data collected through the data base are included in Appendix A. The data were obtained from 13 July to 20 September 1982. The data collected included:

* 24 hour chronological listings of raw aviation TTY reports for 21 regional stations.
* 24 hour chronological listings for the NDBO buoys near Long Island.
* all Coast Guard, Light Ship, and marine reports within the region bounded by 40°-46°N and 60°-74°W.
* upper air reports (raw data and plotted SKEWT diagrams) for Atlantic City, New Jersey and Chatham, Massachusetts.
* plots of 850 mb and 700 mb observations over the eastern United States.
* plots of hourly surface data (temperature, weather, and wind) around Long Island every three hours.
* plots of MDR (manually digitized radar) reports from the greater New York area, every three hours (see Figure 3-2 for a copy of the MDR grid from the WSR-57 radar in New York City.


SYR RME UCA ALR BAF
BDL HFD
ITH POU DXR
ELM BGM SWF MSV
HVN GON
AVP HPN BDR
IPT 7TR
TEB MMU LGA
ABE EWR NYC FRG ISP FOK
JFK
RDG TTN
NEW YORK CITY AREA
STATION NAME:
9PM (02Z)
3-OCT-82
CXY NXX 442
PNE NEL
MDT LNS PHL WRI

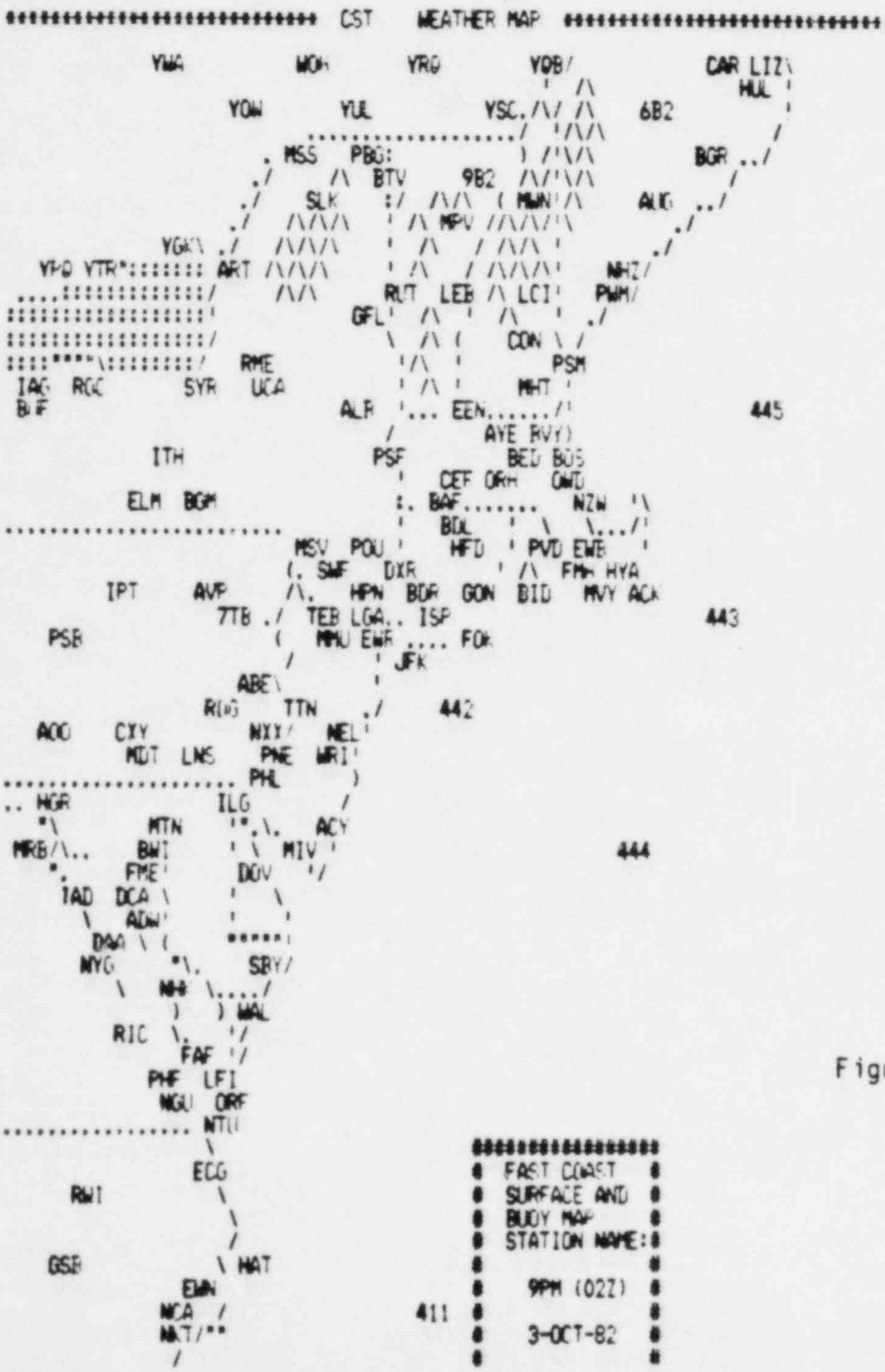

CST WEATHER MAP
YMA WOH YRG YQB CAR LIZ
HUL
YOW YUL YSC 6B2
MSS PBG BGR
BTV 9B2
SLK MWN AUG
MPV
YGK
YRD VTR ART NHZ
RUT LEB LCI PWM
GFL
CON
RME PSM
IAG ROC SYR UCA MHT
BUF ALR EEN 445
AYE BVY
ITH PSF BED BOS
CEF ORH OWD
ELM BGM BAF NZW
BDL
MSV POU HFD PVD EWB
SWF DXR FMH HYA
IPT AVP HPN BDR GON BID MVY ACK
7TB TEB LGA ISP 443
PSB MMU EWR FOK
JFK
ABE
RDG TTN 442
AOO CXY NXX NEL
MDT LNS PNE WRI
PHL
HGR ILG
MTN ACY
MRB BWI MIV 444
FME DOV
IAD DCA
ADW
DAA
NYG SBY
NHK
WAL
RIC
FAF
PHF LFI
NGU ORF
NTU
ECG
RWI
GSB HAT
EWN
NCA 411
NKT
EAST COAST
SURFACE AND
BUOY MAP
STATION NAME:
9PM (02Z)
3-OCT-82

Figure 3-1

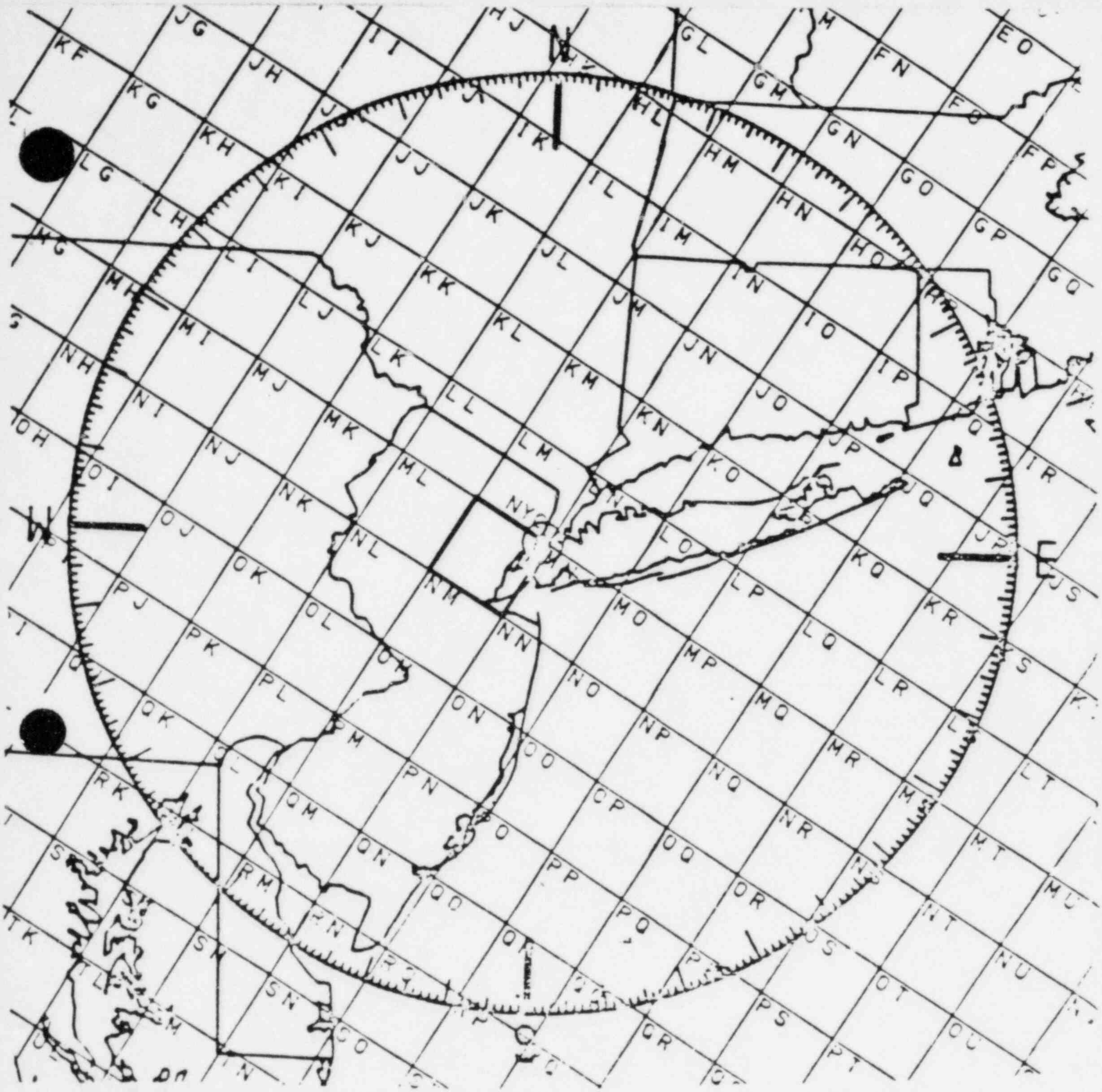


Figure 3-2. MDR (manually digitized radar) coverage of the area of interest, based in New York City WSR-57 Radar. Shoreham is contained in cell "KO". Similar coverage can be obtained from the Atlantic City, NJ and Chatham, MA radars. These are all combined into the WSI hourly digital radar summaries.

* copies of NWS computerized forecast products including regional trajectories, LFM model output and MOS statistics.

3.4 Facsimile and Satellite Data

In order to be able to quickly determine the overall synoptic environment in which the sounder traces were being taken, and also to better understand any superimposed mesoscale perturbations, it was necessary to obtain copies of the standard synoptic maps transmitted over NAFAX and DIFAX circuits. Since the charts are large (typically 30" x 48"), it was necessary to photo-reduce them to include them in the DDF folders. A daily acquisition and reduction schedule was maintained for all needed maps. Table 3-1 shows those maps which were routinely acquired. Figures 3-3 through 3-8 are sample maps.

Arrangements were made to acquire GOES satellite images over the area of interst. Since R*SCAN circuits were only receiving midwest sectors, and a special data line to NESS in Washington would have been costly, outside sources were requested to forwarded as many GOES images as possible. The result was at least a few pictures for most days of the project.

Table 3-2 is a compilation of the WSI, facsimile and GOES satellite images available in each DDF for the project. Satellite images covering the project area totaled 238. Facsimile charts acquired, reduced and incorporated into the DDFs averaged 42 per day, for a total of 2,948.

3.5 Other Data Resources

Several additional sources of data were investigated. BNL kindly consented to provide copies of their routinely acquired meteorological data taken during the

LILCO/SHOREHAM

Date 15 JULY, **1982**

Day __Exp.#______

NAFAX/DIFAX PRODUCTS LOG

#	N/D	PRODUCT	R	Q	X	#	N/D	PRODUCT	R	Q	X
1	N008/D013	00Z SFC ANAL •				35	/D149	1335Z RADAR			
2	N009/D018	01Z WX DEPICTION•				36	/D152	13Z WX DEPICTION •			
3	D027	0035Z RADAR •				37	N083/D164	1435Z RADAR•			
4	N011/D019	0135Z RADAR				38	~~N085~~	~~12Z LFM INITIAL~~			
5	N012/D	00Z 700MB ANAL•				39	/D172	1535Z RADAR			
6	N013/D	00Z 850MB ANAL•				40	N090/D179	15Z SFC ANAL•			
7	~~N014/D~~	~~00Z 500MB ANAL~~				41	~~N091/D188~~	~~16Z WX DEPICTION~~			
8	N015/D054	0235Z RADAR •				42	/D119	1635Z RADAR •			
9	~~N018/D~~	~~00Z 12Z INITIAL~~				43	~~N092~~	~~12Z THICKNESS~~			
10	N023/D043	03Z SFC ANAL				44	N096/D214	1735Z RADAR			
11	/D156	0335Z RADAR				45	~~N100~~	~~12Z 4-PANEL~~			
12	N025/D050	0435Z RADAR •				46	N105/D279	18Z SFC ANAL•			
13	~~/D046~~	~~04Z WX DEPICTION~~				47	N106	12Z WINDS ALOFT•			
14	N026	00Z WINDS ALOFT•				48	/D279	1835Z RADAR•			
15	~~N028~~	~~00Z THICKNESS~~				49	N107	19Z WX DEPICTION•			
16	N033/D051	0535Z RADAR				50	N108/D265	1935Z RADAR			
17	~~N036~~	~~00Z 4-PANEL~~				51	N114/D234	2035Z RADAR•			
18	N038/D059	0635Z RADAR•				52	N119/D282	2135Z RADAR			
19	N041/D0	06Z SFC ANAL•				53	N120/D259	21Z SFC ANAL•			
20	/D085	0735Z RADAR				54	~~N122/D260~~	~~21Z WX DEPICTION~~			
21	~~/D088~~	~~07Z WX DEPICTION~~				55	N124/D261	2235Z RADAR•			
22	N050/D099	0835Z RADAR•				56	N002/D009	2335Z RADAR			
23	N056/D110	0935Z RADAR				57	N007/D011	MAX TEMPS •			
24	N057/D118	09Z SFC ANAL						**MISC/NOTES**			
25	~~N060/D127~~	~~10Z WX DEPICTION~~									
26	N062/D130	1035Z RADAR •									
27	N068/D128	1135Z RADAR									
28	N074/D143	MINIMUM TEMPS•									
29	/D140	1235Z RADAR •									
30	N075/D146	12Z SFC ANAL•									
31	N079/D	700 MB ANAL•									
32	N080/D	850 MB ANAL•									
33	N081/D167	24 HR PRECIP•									
34	~~N082/D235~~	~~300 MB ANAL~~									

• PRIMARY CHART

511 Eleventh Ave South
MINNEAPOLIS, MN 55415
(612) 333-1424

CODE R-RECEIVED, YES(✓)NO(—) Q-QUALITY,GOOD(A)FAIR(B)POOR(C) R·SCAN

X-XEROXED,YES(X)

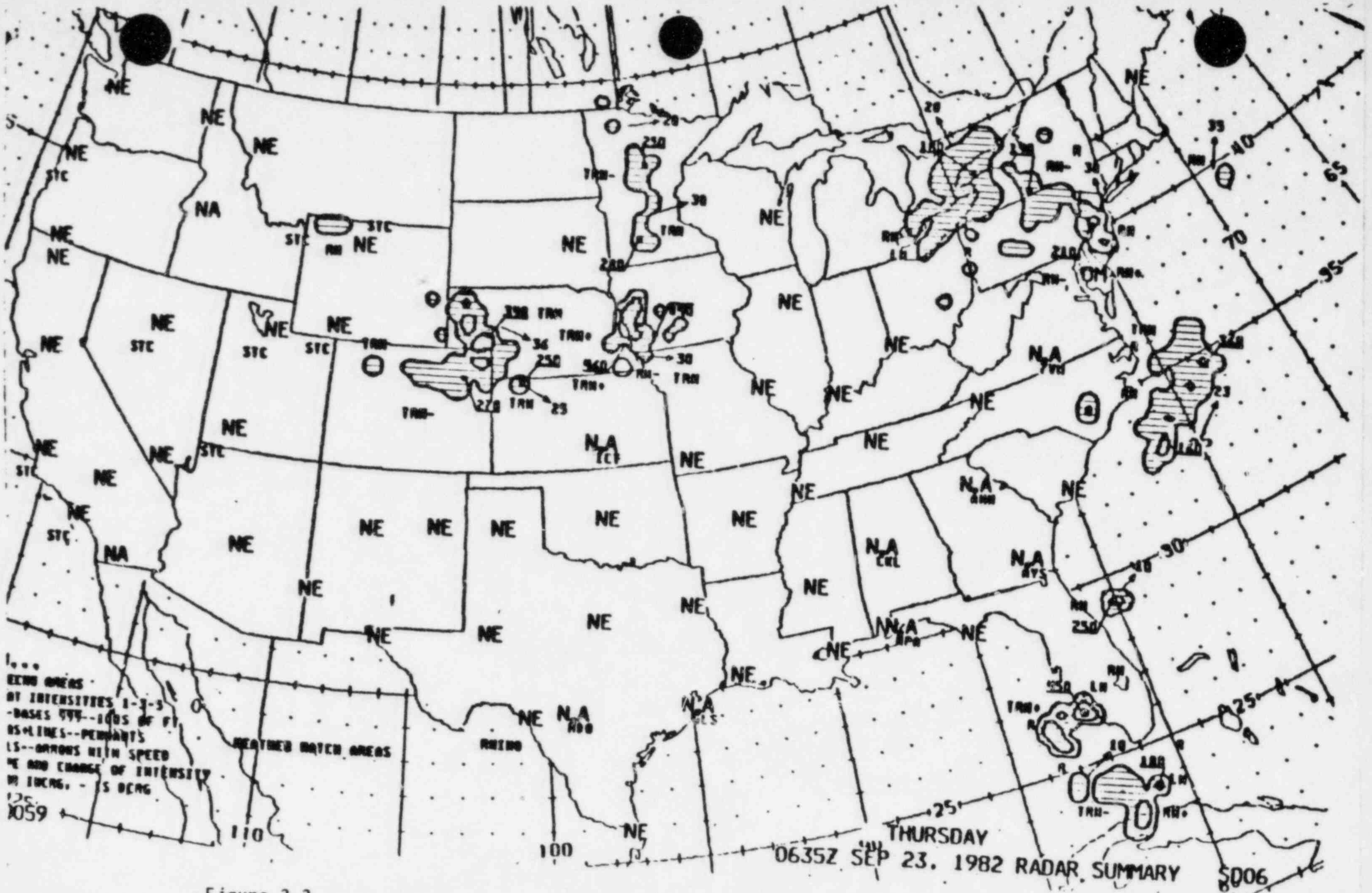

THURSDAY
0635Z SEP 23, 1982 RADAR SUMMARY
S006
WEATHER WATCH AREAS
NE
NA
STC
TRW
RW
110
100
25
30
40
65
70
95

Figure 3-3

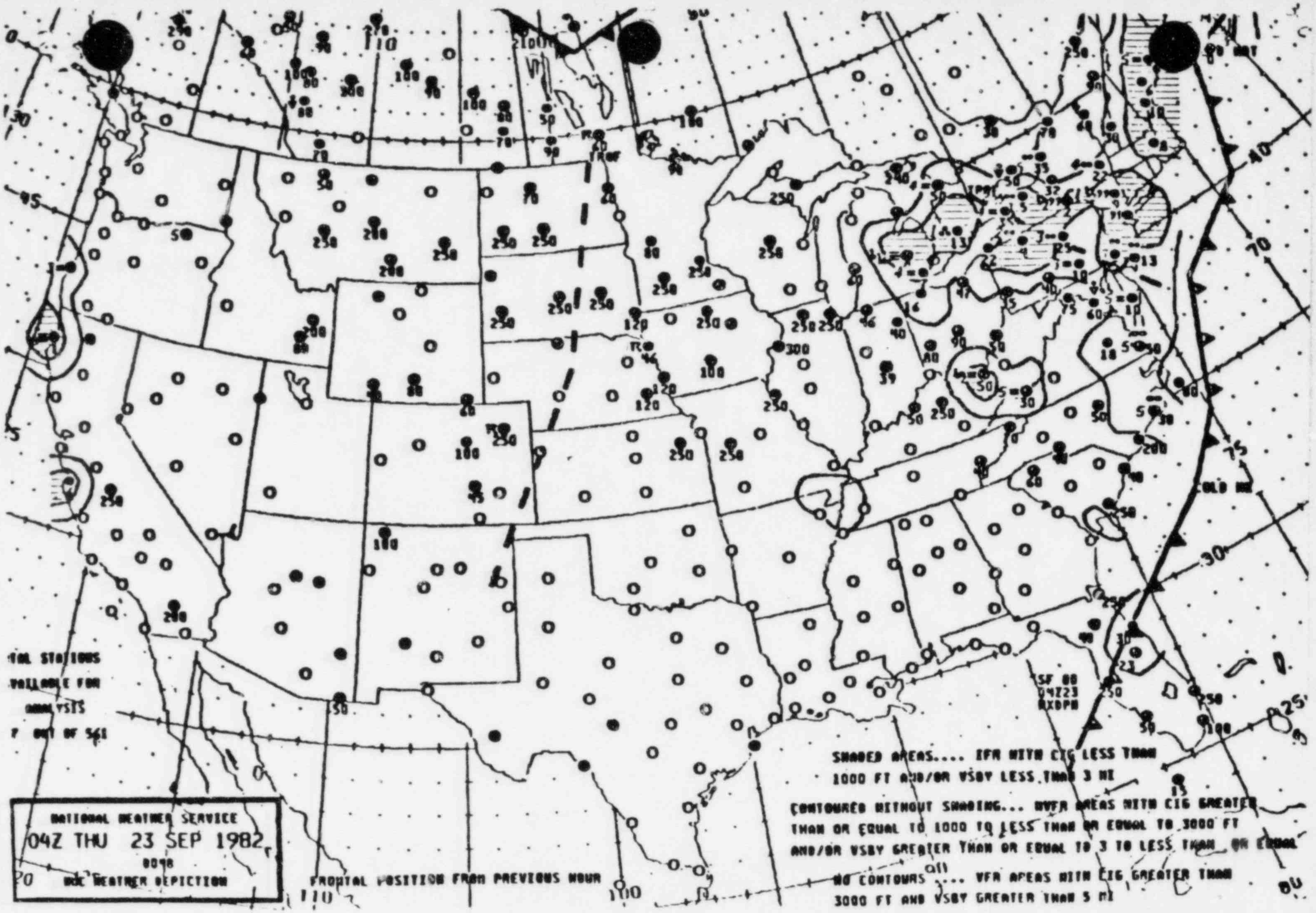

NATIONAL WEATHER SERVICE
04Z THU 23 SEP 1982
WEATHER DEPICTION
FRONTAL POSITION FROM PREVIOUS HOUR
SHADED AREAS.... IFR WITH CIG LESS THAN 1000 FT AND/OR VSBY LESS THAN 3 MI
CONTOURED WITHOUT SHADING... MVFR AREAS WITH CIG GREATER THAN OR EQUAL TO 1000 TO LESS THAN OR EQUAL TO 3000 FT AND/OR VSBY GREATER THAN OR EQUAL TO 3 TO LESS THAN OR EQUAL
NO CONTOURS .... VFR AREAS WITH CIG GREATER THAN 3000 FT AND VSBY GREATER THAN 5 MI
COLD AIR

Figure 3-4

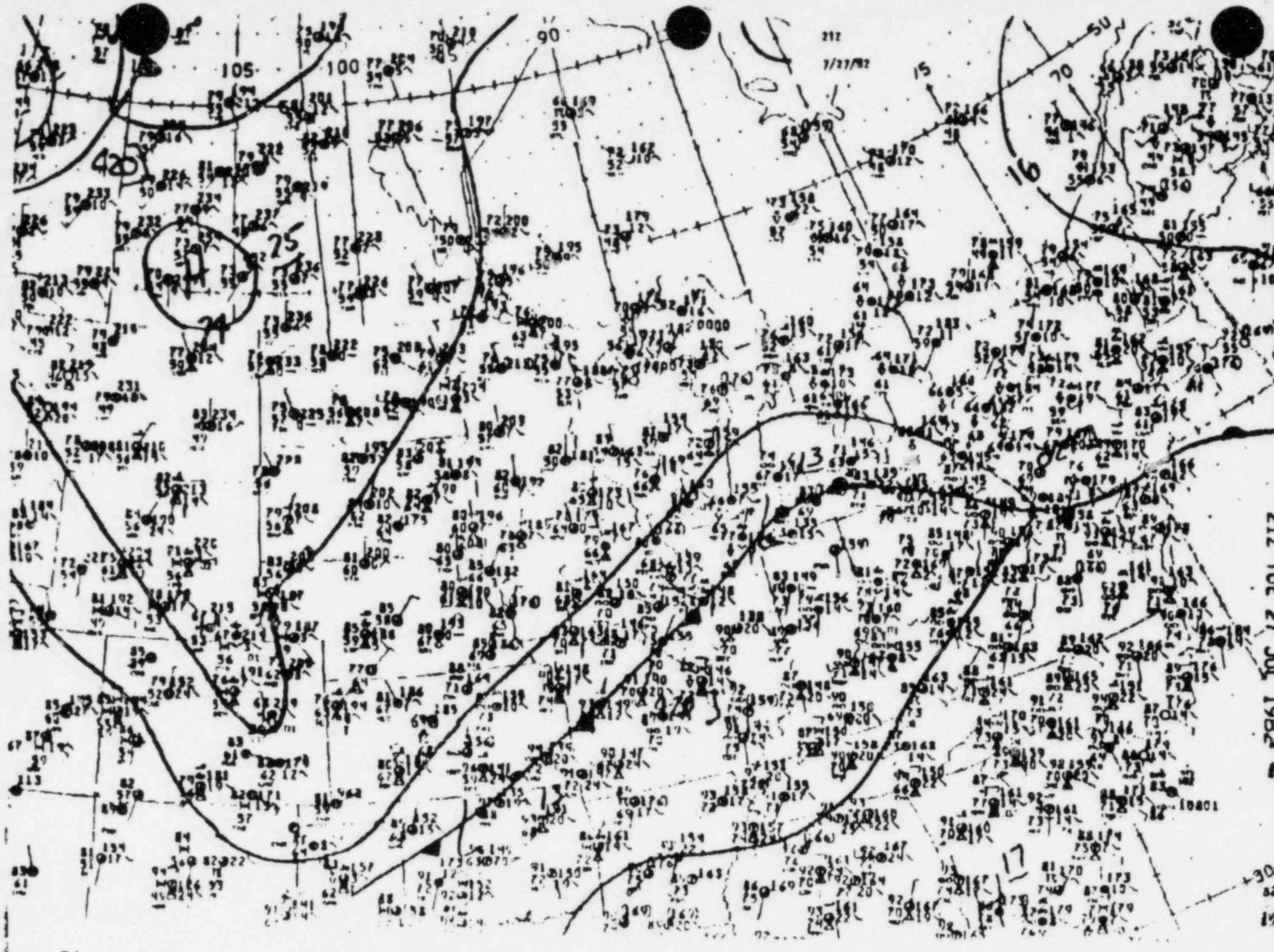


Figure 3-5

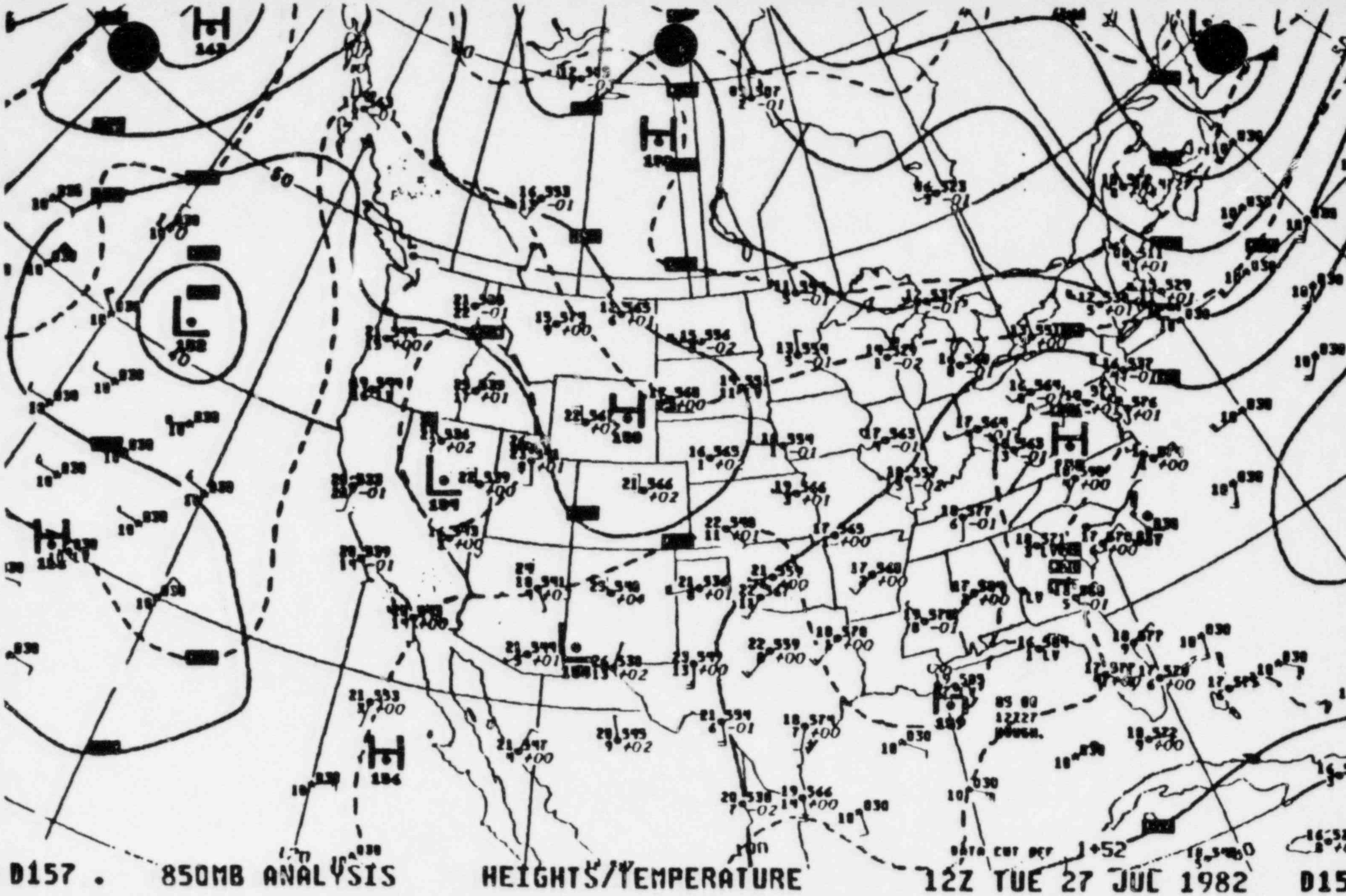

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Figure 3-6

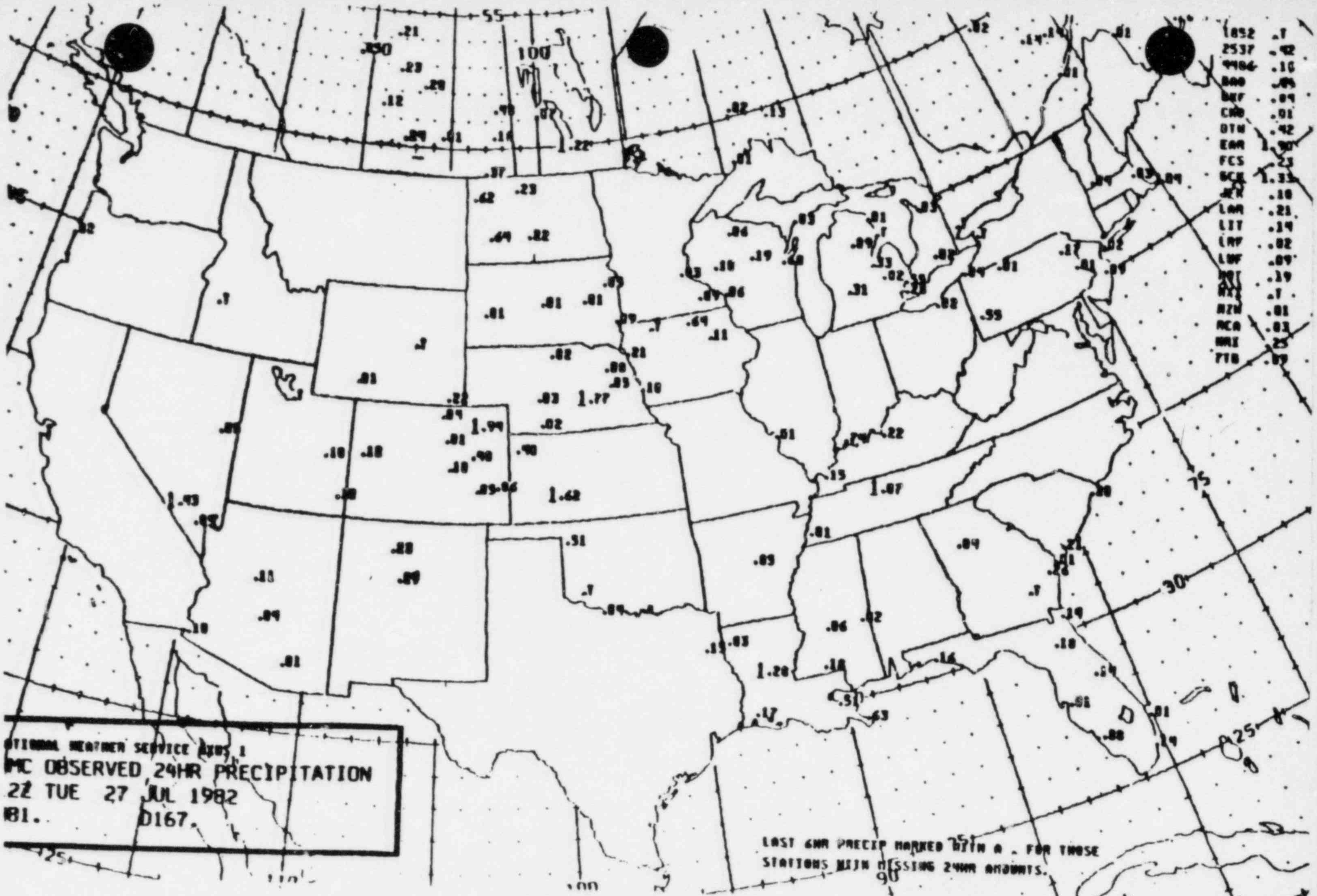
NATIONAL WEATHER SERVICE
MC OBSERVED 24HR PRECIPITATION
22 TUE 27 JUL 1982
D167.
LAST 6HR PRECIP MARKED WITH A . FOR THOSE
STATIONS WITH MISSING 24HR AMOUNTS.

Figure 3-7

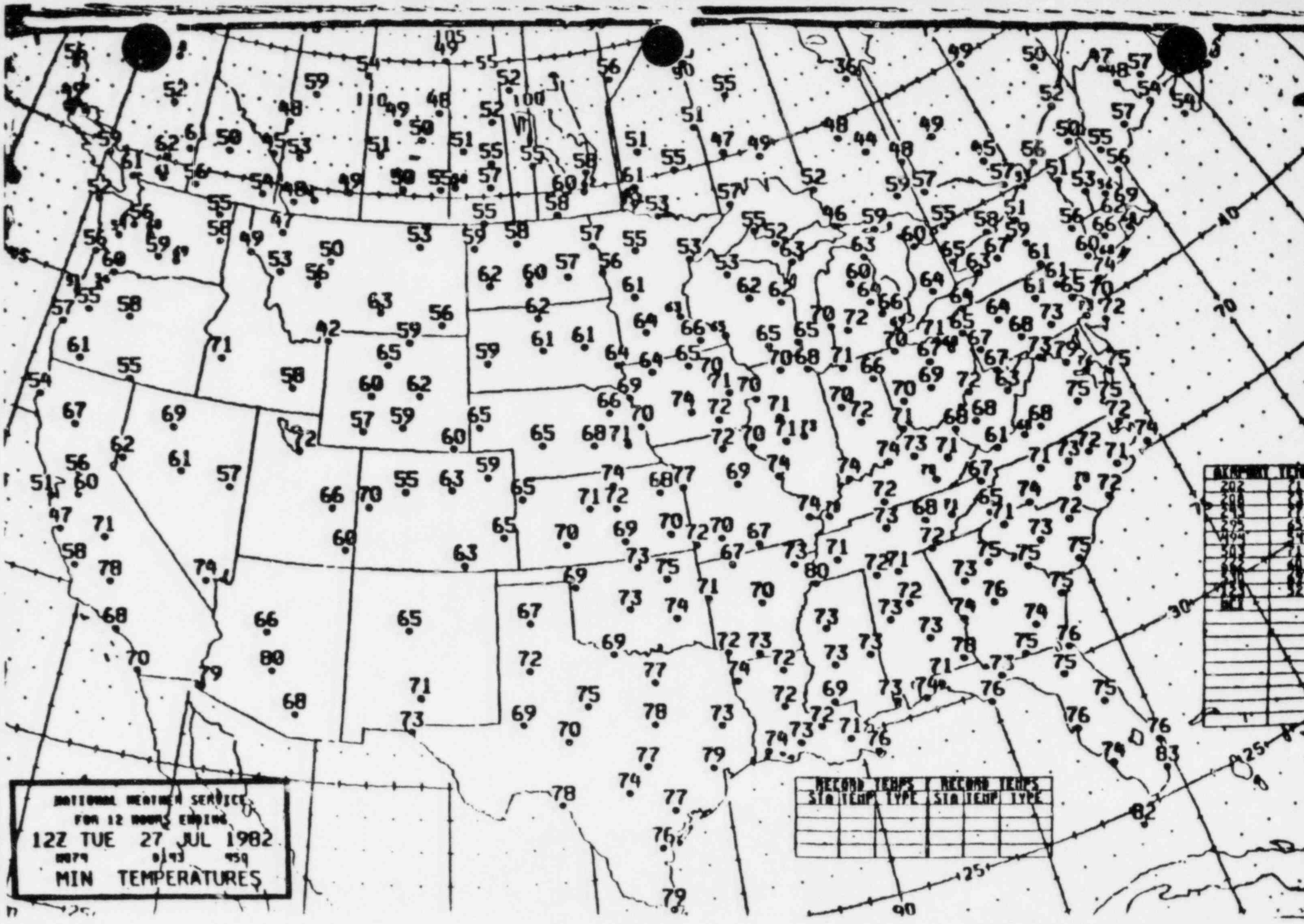
NATIONAL WEATHER SERVICE
FOR 12 HOURS ENDING
12Z TUE 27 JUL 1982
MIN TEMPERATURES
RECORD TEMPS
STA TEMP TYPE
RECORD TEMPS
STA TEMP TYPE

Figure 3-8

TABLE 3-2

DATA COLLECTION SCHEDULE, SUMMER 1982

DATE	FAX CHARTS	SAT PIX	WSI RUNS	DATE	FAX CHARTS	SAT PIX	WSI RUNS
JULY 15	39	5	XX	AUG 24	43	3	XX
JULY 16	37	9	XX	AUG 25	40	1	XX
JULY 17	43	5	XX	AUG 26	46	1	XX
JULY 18	47	2	XX	AUG 27	46	1	XX
JULY 19	44	4	XX	AUG 28	49	2	XX
JULY 20	32	8	XX	AUG 29	47	3	XX
JULY 21	34	9	XX	AUG 30	35	2	XX
JULY 22	40	5	XX	AUG 31	41	0	XX
JULY 23	44	5	XX				
JULY 24	42	7	XX	SEPT 01	47	0	XX
JULY 25	40	1	XX	SEPT 02	48	0	XX
JULY 26	44	4	XX	SEPT 03	41	0	XX
JULY 27	45	8	XX	SEPT 04	51	0	XX
JULY 28	39	5	XX	SEPT 05	50	1	XX
JULY 29	39	3	0X	SEPT 06	50	0	XX
JULY 30	34	6	XX	SEPT 07	48	2	XX
JULY 31	47	6	XX	SEPT 08	44	1	XX
				SEPT 09	49	1	XX
AUG 01	47	2	XX	SEPT 10	45	2	XX
AUG 02	44	6	XX	SEPT 11	48	5	XX
AUG 03	45	6	XX	SEPT 12	48	4	XX
AUG 04	38	3	XX	SEPT 13	38	5	XX
AUG 05	37	1	XX	SEPT 14	39	2	0X
AUG 06	43	4	XX	SEPT 15	44	6	0X
AUG 07	43	2	XX	SEPT 16	43	5	X0
AUG 08	45	6	XX	SEPT 17	38	11	XX
AUG 09	43	8	XX	SEPT 18	39	6	XX
AUG 10	43	7	XX	SEPT 19	46	5	XX
AUG 11	42	1	XX	SEPT 20	44	5	XX
AUG 12	42	4	XX	SEPT 21	44	0	00
AUG 13	41	1	XX	SEPT 22	41	0	00
AUG 14	44	1	XX				
AUG 15	48	3	XX				
AUG 16	4	3	XX				
AUG 17	40	2	XX				
AUG 18	35	2	XX				
AUG 19	42	4	XX				
AUG 20	35	0	XX				
AUG 21	43	2	XX				
AUG 22	45	2	XX				
AUG 23	37	2	XX				

project period. Delivered at the end of November, 1982, were the hourly averaged data taken on their 290 ft tower at BNL. These data included: shelter air temperature, wind speed and direction at 37 ft and 290 ft, BNL Gustiness Class (Singer and Smith, 1966), solar radiation, relative humidity, hourly precipitation, and station pressure. Values are generally averaged for a one-hour time span. Times are in Eastern Standard, indicating the end of the hour averaging period.

Strip charts of 10 m wind speed and direction, using a standard Aerovane anemometer, from the site at the Brookhaven Airport were provided MAI by BNL staff during our September site visit. These data have been manually reduced, at hourly intervals, with 15 minute averages ending on the hour. A calibration check by BNL staff after the data were reduced revealed a 6° directional misalignment, and an 0.8 m/sec positive zero offset in the wind speed. Both were corrected for in the final data summary, along with an intentional 90° rotation of the anemometer to make the reading of predominantly southerly (180°) winds easier on the strip charts used.

Water surface temperature is an important parameter in assessing the development and characteristics of summertime CMRs. A routine source of this information, frequently overlooked, is the approximately weekly maps of East and Gulf Coast water temperatures produced by infrared meteorological satellite sensors. Figure 3-9 is a sample of such a map. It is generally felt that under optimum conditions the water surface temperatures are accurate to within ± 1.0°C. Some smearing of the data near shore or in other areas of strong radiative surface

temperature gradients might be expected to make these data less useful, as in Long Island Sound. These charts (NAFA N98; DIFAX D127) are transmitted as special products about once per week. Those collected were assembled into Appendix B. Ship weather reports also include water temperatures (generally at intake level). These were archived through WSI, as were the more continuous reports from the Ambrose Light Tower near the mouth of New York Harbor and Buoy 443, southeast of Cape Cod (Figure 3-1).

3.6 Data Logging

The quantity of data assembled is considerable. For 70 days, 24 hours a day, and at least 35 parameters of interest, on the order of 60,000 individual data elements can therefore be identified.

A coding sheet (Table 3-10) has been designed to accommodate the variables of primary interest. The inputs, some of which are self-explanatory, will be described below in greater detail. The hourly data were entered onto this chart to be used both for a quick reference data sheet in each DDF, as well as a form for future key-to-disk data input. This would allow the data to be reprinted in several different formats, as well as be extensively sorted and stratified using microcomputer-based disk sorting software. Putting all relevant data onto a common form allows for relatively rapid visual scanning of the data, not only for Q/A purposes (data inconsistencies often become patently obvious) but for making mental time-section analyses, which is central to classic mesoanalysis theory.

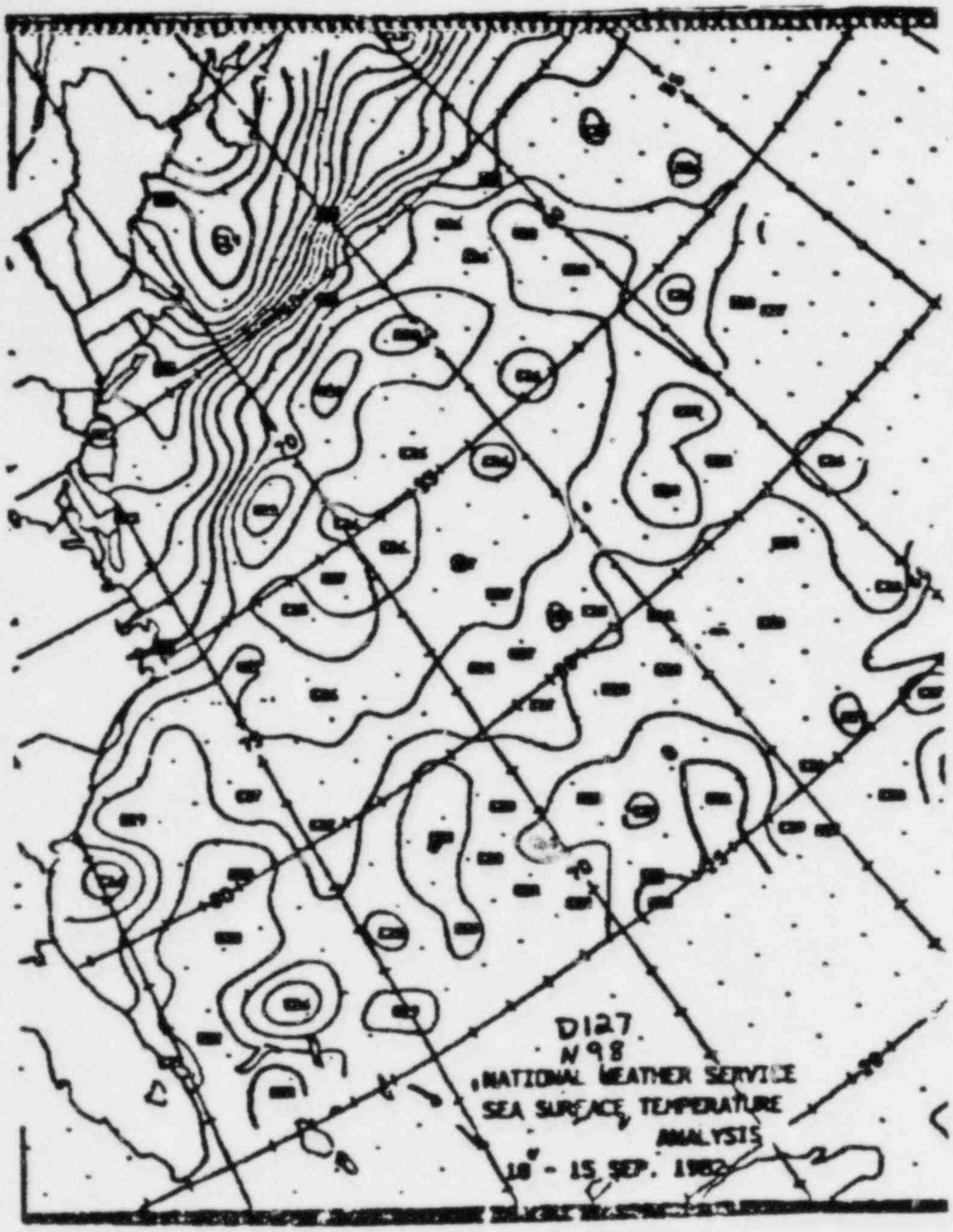

Figure 3-9. Sample sea water temperature maps derived by satellite IR measurements.

Month	Date	Hour-Z	INDICATORS					WINDS				TEMPERATURES					SIGMA	ACOUSTIC SOUNDERS							SHOREHAM WEST TOWER DATA														
								GEOSTR.		850 MB								TOWER		PLANT			BNL		33 FT					150 FT					400 FT				
			Synoptic	Meso Regimes	Precip	TIBL	CZ Pen	DDD	VVV	DDD	VVV	Tocean	Tsound	Tinland	T850	ΔT		Code	Depth	Code	Depth	DeltaZ	Code	Depth	DDD	VVV	σ_θ	I	P-G	DDD	VVV	σ_θ	DelT	P-G	DDD	VVV	σ_θ	DelT	P-G
		01																																					
		02																																					
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Figure 3-10

4. METEOROLOGICAL CHARACTERIZATIONS DURING THE FIELD PROGRAM

4.1 General Synoptic and Climatographic Considerations

The field program was operated for a 70 day period during the later part of the "warm season" of 1982 (15 July - 22 September). In general, conditions appeared quite favorable for the development of coastal mesoscale regimes (CMRs) due to typically light winds, the absence of frequent extratropical or tropical cyclonic disturbances, and generally dry weather. According to tower rain gauge data, measurable precipitation totaled 7.14", close to the regional average precipitation for that period. Rain fell on part of 17 of the 70 days. When one notes that much of the rain fell during three intense episodes (5.58" in three days), then 1.56" was distributed over the remaining 67 days. Only 66 hours of rainfall (4% of the total) were actually observed, thus characterizing the period as basically rather dry. No notable major mesoscale convection systems appeared to directly impact the site, although thunderstorm systems of at least medium intensity were within 80 km of the site on about a dozen days during the project. Rain free periods of seven (twice), ten, and thirteen days were noted (Table 4-1). Solar insolation was subjectively categorized for each day as weak, moderate, or strong, using the on-site measurements, ISP sky cover reports, and satellite imagery. Moderate to strong insolation was noted on 58 of 70 days (83%).

One form of mesoscale perturbation or another, either from coastal effects or thunderstorm mesosystems, was found to exist for at least a portion of the hours on 60 of the 70 days. On the whole, meteorological conditions were quite propitious for the experiment undertaken. A synopsis of the major events, rainfall, and solar radiation for each day is presented in Table 4-1.

Table 4-1

BRIEF SYMMARY OF MESOSYNOPTIC CONDITIONS
DURING FIELD PROGRAM, 15 JULY - 22 SEPT 1982

NB: # indicates detailed case study not performed
SUM: W - Weak; M - Moderate; S - Strong

			RAIN		
			HRS	TOT.	SUM
#	July 15	Sound Breeze/Atlantic Sea Breeze	0	0	S
	July 16	S Flow/Sound Breeze/Atl. Sea Breeze	0	0	S
	July 17	SW Flow/Sound Breeze/Atl. Sea Breeze	0	0	S
	July 18	SW Flow/Sound Breeze/Atl. Sea Breeze	0	0	S
	July 19	SW Flow/Sound Breeze/Thunderstorms Near	0	0	M
	July 20	SW Flow/Cold Front/Thunderstorms	4	.39	W
	July 21	NW Flow/Plume Trap/Fumigation/Atl. Sea Breeze	0	0	S
#	July 22	W Flow/Fumigation/Westerly Confluent Flow	0	0	S
#	July 23	W Flow/Westerly Confluent Flow/Atl. Sea Breeze	0	0	M
#	July 24	NE Flow/Fumigation/Atl. Sea Breeze	0	0	S
	July 25	Land Breeze?/Sound Breeze/Atl. Sea Breeze	0	0	S
#	July 26	Land Breeze/Sound Breeze/SW Flow	0	0	S
#	July 27	NW Flow/SW Flow/Possible Sound Breeze	0	0	S
#	July 28	SW Flow/Thunderstorms	7	1.21	M
#	July 29	Cold Front/WNW Flow/Fumigation	0	0	S
#	July 30	W/S Flow/Sound Breeze?/Showers Late	2	.06	M
#	July 31	S Flow/Mostly Cloudy	0	0	W
	Aug 1	Plume Trap/Fumigation	0	0	W
#	Aug 2	Fumigation/Atl. Sea Breeze	0	0	S
#	Aug 3	Land Breeze/Fumigation/Atl. Sea Breeze	0	0	M
	Aug 4	Sound Breeze/Atl. Sea Breeze	0	0	S
	Aug 5	Sound Breeze/Atl. Sea Breeze/ Tstm. Near	0	0	M
#	Aug 6	Fumigation/Atl. Sea Breeze	0	0	M
#	Aug 7	Land Breeze/Sound Breeze/Atl. Sea Breeze	0	0	S
	Aug 8	S Flow	0	0	S
	Aug 9	S Flow/Thunderstorms Near	0	0	M
	Aug 10	Thunderstorms/Sound Breeze/Atl. Sea Breeze	3	.09	M
#	Aug 11	W/NW Flow/Cloudy/Showers	3	.11	W
#	Aug 12	Fumigation/Atl. Sea Breeze?	5	.10	S
	Aug 13	Land Breeze/Westerly Confluent Flow?	0	0	S
#	Aug 14	NW Flow/Sound Breeze/Atl. Sea Breeze	0	0	S
#	Aug 15	NW Flow/Fumigation	0	0	S
#	Aug 16	Land Breeze?/NW Flow/Sound Br./Atl. Sea Breeze	0	0	S
#	Aug 17	SW Flow/Thunderstorms	3	.18	M
	Aug 18	Fumigation/Atl. Sea Breeze	1	.01	S
#	Aug 19	S Flow/ Sound Breeze/Atl. Sea Breeze	0	0	S
#	Aug 20	WSW Flow/Variably Cloudy	0	0	M
#	Aug 21	NW Flow/Fumigation	0	0	M
#	Aug 22	NW Flow/Fumigation/Atl. Sea Breeze	0	0	S
#	Aug 23	SW Flow/Thunderstorms	9	2.06	W
#	Aug 24	NW Flow/Fumigation/Atl. Sea Breeze?	1	.01	S
#	Aug 25	Cold Front/Thunderstorms/Fumigation?	5	.28	W
#	Aug 26	NW Flow/Fumigation/Atl. Sea Breeze	0	0	S
#	Aug 27	SW Flow/Cloudy	0	0	W
#	Aug 28	Cold Front/Fumigation/Atl. Sea Breeze	0	0	S
#	Aug 29	NW Flow/Fumigation/Atl. Sea Breeze	0	0	S
#	Aug 30	SW Flow/Sunny	0	0	S
#	Aug 31	SW Flow/Sunny	0	0	S
#	Sep 1	S Flow/Cloudy	0	0	W
#	Sep 2	Thunderstorms/S Flow	8	2.31	W
#	Sep 3	SW Flow/Westerly Confluence	4	.05	M
	Sep 4	NW Flow/Fumigation	0	0	S
	Sep 5	Sound Br/Atl. Sea Breeze	0	0	S
	Sep 6	Land Breeze/Sound Breeze/Atl. Sea Breeze	0	0	S
#	Sep 7	NE Flow/Fumigation?	0	0	M
	Sep 8	Easterly Confluence/Atl. Sea Breeze	0	0	M
	Sep 9	Land Breeze/Westerly Confluence/Atl. Sea Breeze	0	0	M
	Sep 10	Sound Breeze/Atl. Sea Breeze	0	0	S
	Sep 11	Sound Breeze/Atl. Sea Breeze	0	0	S
	Sep 12	Sound Breeze/Atl. Sea Breeze	0	0	M
	Sep 13	Sound Breeze/Atl. Sea Breeze	0	0	M
	Sep 14	Sound Breeze/Atl. Sea Breeze	0	0	M
	Sep 15	Sound Breeze/Atl. Sea Breeze	0	0	M
	Sep 16	Cold Front/Sound Breeze/Alt. Sea Breeze	0	0	W
#	Sep 17	N Flow/Fumigation	2	.05	S
#	Sep 18	SLY Flow/Sunny	0	0	S
#	Sep 19	Fumigation/Atl. Sea Breeze	0	0	S
	Sep 20	Land Breeze/Showers	5	.15	M
	Sep 21	NE Flow/Plume Trapping	1	.01	W
	Sep 22	NE Flow/Cloudy	3	.07	W

[F: LILCO4-2.1]

In total, 30 days were selected for more detailed analysis (see below). For each hour, a synoptic meteorological characterization code was assigned (Table 4-2). In general it would be expected that overall conditions favoring the development of CMRs would be associated with codes 2, 13, 14, 15, 17, and 20 (although they certainly can occur at virtually any other time with the probable exception of code 19). Of the hours elected for detailed case study analysis, 55% were categorized by one of the 6 codes mentioned above.

4.2 Site Climatography

In order to facilitate the task of collecting, interpreting and incorporating field data in a cost-effective manner for the planning, formulation and execution of an emergency response dose assessment code (ERDAC), knowledge of a site's climatography is most useful. Climatography is defined (Lyons, 1983) as the identification and determination of the frequency of occurrence of the several distinct mesoscale regimes impacting a given site. Most coastal zones in mid-latitudes not influenced by complex terrain have similar coastal mesoscale regimes (CMRs) contributing to their climatography. Thunderstorm mesosystems, though not coastal in nature, are generally frequent enough that their impact need be considered in any climatographic study. Table 4-3 lists 16 regimes of potential importance. Synoptic discontinuities, such as cold frontal passages, are included since a well defined frontal wind shift has mesoscale aspects within the context of defining the wind flow within 10 to 50 miles of a given point. CMRs have been defined in great detail in other papers (Lyons, 1975; Lyons, et al., 1981; Keen and Lyons, 1978). A brief, noncomprehensive description of each, in the context of the Shoreham site, is given as follows on the next page.

Land Breeze - nocturnal flow from stable land over warmer water during light synoptic winds and clear skies, often very shallow and highly sheared, rarely exceeding 5 m/sec. Near calm (pooling) conditions are likely to be a sub-set of this CMR.

Classic Sound Breeze - typical of those described within the literature of lake breezes (Lyons, 1972), but quite a bit shallower and weaker. A distinct wind shift to onshore occurs after sunrise, and a convergenze zone, with updrafts and a return flow layer aloft are maintained until either nightfall, clouds, thunderstorms, or the Atlantic sea breeze intervenes.

Ridge/Trough Passage Sound Breeze - often onshore winds from the prior night are maintained on a sunny day while changing synoptic pressure gradients develop flow towards the coast further inland. A convergence zone develops, and in all other regards a sound breeze ensues.

Confluence Zones - often when the gradient flow is rather strong, and nearly parallel to the shoreline, combined frictional and differential heating effects maintain zones of confluence at some distance inland. These "almost sound breezes" will channel effluents parallel to the coast for considerable distances.

Fumigation - onshore flow of neutral to stable air on sunny days results in the development of the thermal internal boundary layer (TIBL). Diffusion under these conditions has been described by Lyons and Cole (1973). Fumigation occurs in the sound breeze variations described above as well as during gradient onshore flow.

Plume Trapping - potentially the most restrictive regime as far as diffusion from a near ground release in coastal zones is concerned. Often, during the spring, the adjacent cold body of water is rimmed by a narrow band of warmer near shore water. The intense low-level conduction inversion formed during overwater passage is partially eroded in the last few miles of before landfall, resulting in a shallow mixed layer capped by intense inversion (Figure 4-1). Highly restrictive vertical mixing can be maintained for many miles inland at night or on cloudy days. This effect is possibly important at Shoreham during the March-June period.

Atlantic Sea Breeze - frequently the Atlantic Sea Breeze (ASB) reaches the north shore of Long Island by the middle to late afternoon. Its primary impact is a rapid reversal of low level winds to offshore. Mixing depths generally would be expected to increase, but not to the depth present over far inland areas. For Shoreham the ASB is not a restrictive regime.

Gradient Onshore Flow (Atlantic TIBL) - when southerly winds are sufficiently strong, daytime onshore flow from the south develops a TIBL, which is reasonably deep by the time the Shoreham area is crossed. As in the ASB, this is not a particularly restrictive regime for Shoreham, though fully developed inland mixing depths are certainly not achieved.

TABLE 4-2

SYNOPTIC METEOROLOGICAL CHARACTERIZATION INDICATOR CODES

1	Near Center of Low (2° Latitude)
2	Cyclonic Flow - Weak
3	Cyclonic Flow - Moderate to Strong
4	Cold Front Approaching (Also Occluded Fronts)
5	Cold FROPA This Hour
6	Behind Cold Front
7	Warm Front Approaching
8	Warm FROPA This Hour
9	In Warm Sector
10	Stationary Front to North
11	Stationary Front to South
12	Low Pressure Trough
13	High Pressure Ridge
14	Near Center of High (2° Latitude)
15	Anticyclonic Flow - Weak
16	Anticyclonic Flow - Moderate to Strong
17	Straight Line Flow - Weak
18	Straight Line Flow - Moderate to Strong
19	Hurricane/T.S. Circulation
20	Poorly Defined Synoptic Features

TABLE 4-3

MESOSYNOPTIC CHARACTERIZATION INDICATOR CODES

		Total Observed
0	Steady Synoptic Influences Predominate	316
1	Synoptic Discontinuity, $\geq$ 50° Change/2 Hours	4
2	Gradient Onshore Flow (Cloudy/Night) with Plume Trapping	19
3	Gradient Onshore Flow (Sunny) with Fumigation	41
4	Gradient Offshore Flow - Stable Air Over Colder Water	0
5	Near Calm (Pooling)	11
6	Land Breeze	42
7	Classic Sound Breeze - Onset Past Hour	11
8	Classic Sound Breeze in Progress	54
9	Parallel Shore Confluence - From West	22
10	Parallel Shore Confluence - From East	6
11	Ridge Trough Passage Sound Breeze	44
12	Atlantic Sea Breeze - FROPA Past Hour	20
13	Atlantic Sea Breeze in Progress	54
14	Gradient Onshore Flow - Atlantic TIBL	22
15	Thunderstorm Mesosystem in Area	25
16	Poorly Defined Mesosynoptic Regimes/Inertial Flows	29
		720 Hours

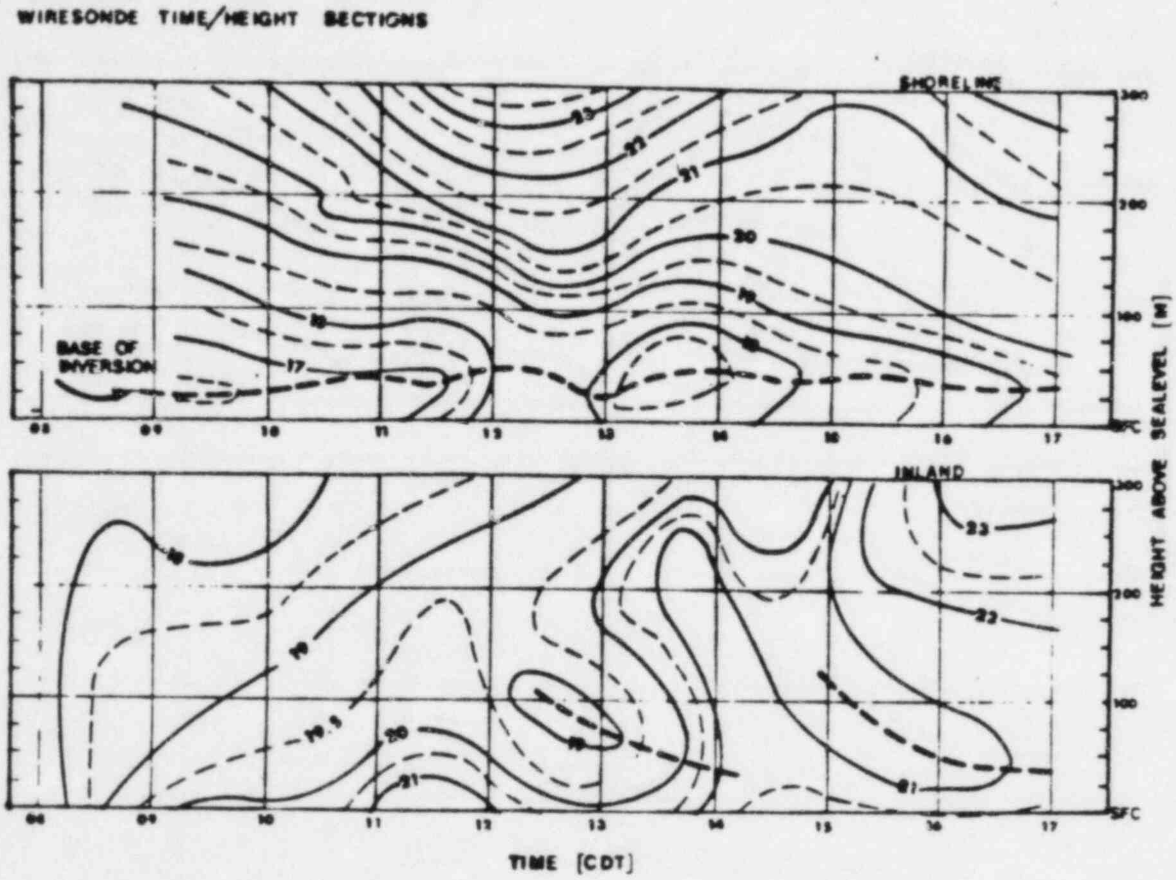

Figure 4-1. Temperature time sections, surface to 300 m (0.5°C isotherms), 28 June 1974, taken at the shoreline of Lake Michigan near Waukegan, Ill. (top) and 3 km inland (bottom). Note the intense caping inversion above 50 m that continued throughout the day. This was the result of air flow over a still cold lake, but with a brief period of remodification by a band of warm water near shore. Almost neutral conditions were found at 3 km inland, as the TIBL had generally developed above 300 m by that point. Similar PBL temperature structures are possible at the Shoreham site from March through June during the warm-up of Long Island Sound.

As shown in Table 4-1, and summarized in Table 4-4, various CMRs and thunderstorm mesosystems were frequently present during the field program data gathering phase. Table 4-4 does not account for the somewhat restricted mixing depths experienced during southerly gradient flows (Atlantic TIBL).

For the thirty detailed case study days, a more rigorous inspection of all available data sources was employed in order to develop an hour by hour categorization of the mesosynoptic conditions at the site. These are shown in Table 4-5a,b. Note in this graphical format, the ° sign is used to indicate periods of onshore flow (270° - 070° inclusive) as measured on the 33 ft level on the Shoreham West tower.

During the 30 days (720 hours) studied in detail, 11 "classic" sound breeze passages were noted. A total of 137 hours of sound breeze-like wind flows were experienced. These would be associated with TIBL phenomena. As will be discussed below, since virtually no daytime surface-based inversions were found, the diffusion mechanism for a low-level release would de facto be plume trapping (under an increasing lid height) rather than fumigation. Similarly, for the additional 41 hours during which "fumigation" potential existed due to gradient onshore flow, releases with heights under about 100 m would not undergo classic fumigation [Lyons and Cole, 1973], but rather would be constrained in vertical mixing due to the gradually increasing TIBL depth while moving inland. During the later part of the "warm season", after about 1 July, it is considered unlikely that daytime onshore flows during daytime with strong surface based inversions will occur with any significant frequency.

Table 4-3 contains totals of the various regimes encountered during the 720 study hours. More than half (392 hours) had regimes (Numbers 0,13,14) in which

conventional straight-line Gaussian modeling approaches would appear perfectly adequate for ERDAC purposes. During other periods not selected for their high probability of CMRs, this percentage would even be significantly higher.

Precipitation is highly spatially variable. The on-site raingauge, while certainly useful, does not give indications of significant rainfall events occurring within 10 or 50 miles of the sites. These can cause local wind and stability perturbations that can be misinterpreted as marine weather effects if their presence is not recognized. Therefore, using the radar data available both from the hourly national radar summary maps and the WSI MDR composites, plus the hourly surface reports from area stations, a code to alert the analyst to possible precipitation system interactions was devised and is shown in Table 4-6.

Of prime interest to this effort are the characteristics of the lower PBL at each site during periods of onshore flow, TIBL and plume trapping conditions in particular. Table 4-7 lists the indicator codes covering these events and which can be used to sort and retrieve the appropriate hourly observations.

4.3 Onshore Flow Periods

Since periods of onshore flow were the primary interest of this study, their occurrence was catalogued. For the purposes of this report, onshore flow is defined as a 33 ft Shoreham West tower wind direction between 270° and 070° inclusive. Table 4-8 highlights all hours during the project in which onshore flow was noted (direction in tens of degrees). Dashes are used to indicate

TABLE 4-4

NUMBER OF DAYS WITH COASTAL
MESOSCALE REGIMES AT
SHOREHAM WEST TOWER

Land Breeze	9
Sound Breeze	25
Confluence Zone	6
Atlantic Sea Breeze	36
Onshore Flow & Fumigation	22
Onshore Flow & Plume Trapping	3
Thunderstorms Nearby	11

TABLE 4-5

ON-SITE MESOSYNOPTIC CHARACTERIZATION [FROM DETAILED ANALYSES]
HOUR ENDING

[Z-TIME]

JUL 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
15																								
16	0	0	0	0	0	0	0	0	0	0	0	0*	7*	8*	8*	8*	12	13	13	13	13	13	13	13
17	0	0	0	0	0	0	0	0	0	0	0	0	7*	8*	8*	8*	8*	12	13	13	13	13	13	13
18	0	0	0	0	0	0	0	0	0	0	0	0	0	7*	8*	8	8*	8*	8*	12	13	13	13	13
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7*	8*	8*	8	15	15	15	15	15	15
20	0	0	0	0	0*	0	0	0	0	0	0	0	1*	0*	0*	0*	0*	0*	15*	15*	15*	0*	0*	0*
21	0*	2*	2*	2*	2*	2*	2*	2*	2*	2*	2*	2*	3*	3*	3*	3*	3*	3*	3*	3*	3*	3*	0*	12
22																								
23																								
24																								
25	13	13	16	16	16	16	16*	16	16	0	0	0	0	0	7*	8*	8*	8*	12	13	13	13	13	13
26																								
27																								
28																								
29																								
30																								
31																								
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

D-POF-2

[illegible]G 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	0	0	0	0	0	0*	0*	0	2*	2*	2*	3*	3*	3*	3*	3*	3*	3*	3*	3*	3*	3*	3	3
2																								
3																								
4	0	0	0	0	0	0	0	0	0	0	0	0	0	7	8*	8*	8*	8*	8*	12	13	13	13	13
5	0	0	0	0	0	0	0	0	0	0	0	0	0	14	14	7*	8*	8*	12	13	13	15	15	15
6																								
7																								
8	0	0	0	0	0	0	0	0	0	0	0	0	14	14	14	14	14	14	14	14	14	14	14	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	15	14	14	14	14	14	14	14	14	0	0
10	0	5	5	5	5	0	0	0	0	0	0	0	0	[illegible]	9*	9*	9*	9*	9*	9*	9*	12	13	0
11																								
12																								
13	6	6	6	6	6	6	6	6	6	2*	2	2*	0*	9*	9*	9*	9*	9*	9*	9*	9*	9*	9*	0
14																								
15																								
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

D-POF-4

TABEL 4-5(continued)

ON-SITE MESOSYNOPTIC CHARACTERIZATION [FROM DETAILED ANALYSES]
HOUR ENDING

[Z-TIME]

AUG 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
16																									
17																									
18	0	0	1	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3	12	13	
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20																									
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30																									
31																									
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	

D-POF-5

SEPT 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1																									
2																									
3																									
4	3	3	3	3	3	3	3	3	15	15	15	16	16	16	16	15	15	15	15	15	15	15	15	15	
5	0	0	0	0	0	0	0	0	0	0	0	0	0	11	11	11	11	11	11	11	12	13	13	0	
6	6	6	6	6	6	6	6	6	6	6	6	6	16	7	8	8	8	8	8	8	12	13	13	6	
7																									
8	0	0	0	0	0	0	0	0	0	0	0	0	10	10	10	10	10	10	8	8	8	12	13	16	
9	6	6	6	6	6	6	6	6	6	6	6	6	6	16	9	9	9	9	9	12	13	13	13	13	
10	0	0	0	0	0	0	0	0	0	0	0	16	7	8	8	8	8	8	8	8	12	13	13	13	
11	0	0	0	0	0	0	0	0	0	0	0	0	11	11	11	11	11	11	11	11	11	12	13	0	
12	0	0	0	0	0	0	0	0	0	0	0	11	11	11	11	11	11	11	11	11	11	12	13	0	
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	8	8	8	8	8	8	12	13	13	
14	0	0	0	0	0	0	16	16	16	16	16	16	11	11	11	11	11	11	11	11	11	11	12	13	
15	16	16	16	16	5	5	5	5	5	5	5	2	2	11	11	11	11	11	11	11	11	12	13	13	
16	14	16	16	16	16	1	0	0	0	0	0	0	7	8	8	8	8	8	8	8	12	13	13	13	
17																									
18																									
19																									
20	0	0	6	6	6	6	6	6	6	[illegible]	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
22																									
#	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
HOURS THIS HOUR																									

D-POF-3

TABLE 4-6

PRECIPITATION CHARACTERIZATION INDICATOR CODES

0	None at Site, nor within 80km
1	None at Site, but showers within 16-80km
2	None at Site, but Thunderstorms within 16-80km
3	None at Site, but Showers within 16km
4	None at Site, but Thunderstorms within 16km
5	Light rain, Drizzle at Site
6	Moderate Rain, Shower at Site
7	Probably Thunderstorm at Site
9	No Data Available

TABLE 4-7

TIBL/PBL CHARACTERIZATION INDICATOR CODES

0	No TIBL
1	TIBL - Onshore - Surface based
2	TIBL - Onshore - Elevated base
3	TIBL - Atlantic Sea Breeze/Gradient
4	Elevated Inversion/Plume Trapping
9	Information not available

where data were missing or possibly erroneous, but onshore flow could be reasonably assumed from other indicators. The number of hours of onshore flow per day, as well as per hour of the day for each time block, are indicated in Table 4-8. When plotted in graphical form (Figure 4-2) the impact of Long Island Sound on the wind direction at Shoreham during this period becomes highly evident. At 1700Z, 53 of the 70 project days (76%) had onshore flow. The minimum number of onshore flow hours (8, or 11%) occurred only 7 hours later (0000Z). This appears to be the impact of the Atlantic Sea Breeze (or its remnant southerly flow) reaching the site and terminating the sound breeze. A total of 728 hours of onshore flow were observed during the project. The number of occurrences at 1700Z was 562% higher than at 0000Z. This is perhaps one of the more striking examples of diurnally induced local wind regimes at mid-latitudes that the author has observed. Though the sound breeze is indeed weaker and shallower than its oceanic and Great Lakes counterparts, if the prevailing synoptic flows are sufficiently light, it can be a persistent and repeatable phenomenon.

Figure 4-3 is another representation of Long Island Sound induced or augmented onshore flow regimes at Shoreham. The initiation of the onshore flow is given by a "O", and its termination by an "X". Some of these episodes were as short lived as four hours. Note also the large number of events in which the onshore flow was pre-existent at 1200Z. These represent either ridge/trough line passage sound breezes, or gradient northerly flows which are countervened by the advancing Atlantic Sea Breeze.

Table 4-9 suggests that on most days, if an onshore flow is not established by 1700Z, it is unlikely that an onshore wind shift will occur during the afternoon.

TABLE 4-8

PERIODS OF ONSHORE FLOW (270° - 070° AT 33 FEET)
HOUR ENDING

[Z-TIME]

JUL 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	# HOURS THIS DAY
15															34	36	04	02	04						5
16												-	31	33	31	21									5
17													-	30	30	29	27								5
18														28	26		28	27	30						5
19															28	29	29								3
20					32								33	30	05	04	02	34	35	36	36	36	31	29	13
21	33	36	36	36	36	36	35	34	36	34	35	34	31	35	33	33	32	30	33	34	01	27	27		23
22	27	28	27	27	27	27	27	27	27		27	28	29	28	27	28	27	27	27	27	27				20
23					27	27	27	27		27	28	27	28	28			28	28							11
24			29	04	03	03	36	02	01	36	04	03	34	32	34	32	32	32	02	06	04	-			20
25							28								30	28	28	28							5
26												27	28		29	29	29	28	28	29					8
27			27	30	30	28	29	29	36	36	04	06	-	-	-	-	-	-	-	-					16
28														03											1
29					28	27	28	28	27		27	27	27	27	28	28	27	28	28	27	27	28			17
30					27	27	28	29	33		36		36		36	05	03	04							11
31																									0
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	170
# HRS. THIS HOUR	2	2	4	4	8	7	8	7	6	4	7	8	11	11	14	13	14	12	9	7	5	4	2	1	170

AUG 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	# HOURS THIS DAY
1						27	28		29	30	29	31	30	29	28	29	30	29	28	28	28	28			16
2						29		27	28	27	28	28	28	-	-	30	32	31	31	30	31	27			16
3								33	33	35	01	04	06	04				04	05	36	04	36			12
4															01	35	33	05	05						5
5																30	30	28							3
6		29	31	05	06	07	07					07	07	07	-	06	06		07	06					14
7														33	35	34	01								4
8																									0
9																									0
10															28	28	29	29	30	28	27				7
11			27			27	28	35	36	36	01	33	-	27	32	35	34	27	27		27		27		17
12					34	01	01	03	04	06	02	07	06	06	06	07	-	-	06	36	35	35	-		19
13										05		07	06	-	31	32	30	30	29	28	28	27	27		13
14	27	27	27	28	27	28	27	27		28	30	29	31	30	30	29	30	30	29	28					19
15							27	28	30	30	30	28	29	28	29	30	29	29	27	28	28	27			16
	01	02	03	02	03	06	06	06	06	08	07	09	09	10	11	12	12	11	11	09	08	06	03	00	161 161

R·SCAN

TABLE 4-8(continued)

PERIODS OF ONSHORE FLOW (270° - 070° AT 33 FEET)
HOUR ENDING

[Z-TIME]

AUG 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	# HOURS THIS DAY
16							28	30	29	29	29	30	-	28	29	29	29	28	29	28	29				15
17																									0
18					27	29	30	30	03	05	02	03	03	03	-	05	04	36	30	30	29	28			18
19															35	34	30	29	29	27					6
20																									0
21	27				27	28	29	28	30	31	03	04	06	03	36	01	34	29	31	30	32	31	33	32	21
22	32	32	32	32	33	03	34	03	32	32	32	31	33	34	33	29	29	33	32	31					20
23																									0
24								27	28	27	28	28	30	28	28	29	28	28	29	28	27				14
25																					28	28	27	28	4
26	27	28	27	28	28	28	28	28	29	29	28	28	28	28	28	27	29	28	29	30					20
27																									0
28							27	30	33	33	35	02	04	06	07	03	36	36	34						13
29	29	29	30	31	32	30	32	32	33	33	33	32	33	32	32	30	30	34	28	28	28				21
30																									0
31																									0
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	152
# HOURS THIS HOUR	4	3	3	3	5	5	7	8	8	8	8	8	8	8	9	9	9	9	9	8	6	3	2	2	152

POF-4 (A)

SEPT 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	# HOURS THIS DAY
1																									0
2																									0
3																	26	28	29	28	27	27			6
4				27	27	27	27	27					27	29	28	28	27	28	27	28	27	29	26	26	17
5	29	29	29	30	32	32	31	31	31	32	31	32	34	33	36	36	36	36	36	36					20
6							27							31	31	34	34	34	36	32					8
7						29	27	33	36	04	04	03	03	04	03	03	36	36	04	05					15
8													07			05	04	05	05	07					6
9															27	29	29	28							4
10												27	-	29	30	30	30	30	29	29					9
11							28	28	29	29	30	29	29	30	30	31	32	32	30	29	30				15
12					30	30	30	30		30	31	36	34	01	01	02	03	02	06	04	06				16
13															-	04	03	04	06	05	06				7
14							05		31		07		06	02	04	06	04	35	01	01	05	05			13
15												01	36	-	36	35	33	03	36	06	07				10
16													07	06	06	06	06	02	06						7
17			33	36	34	33	36	35	33	32	33	32	33	31	32	-	31	31	30	30	31	29	28	30	22
18	32	33	02																				28	28	5
19	28	28	28	36	33	33	33	33	33	33	35	34	36	36	35	01	36	36	30	32	33				21
20															07								04	05	3
21	06	06	05	05	04	03	04	05	01	02	03	02	05	04	06	07	06	07	06	06	06	07			22
22						07	07	06	06	06	05	06	07	06	06	06	06	06	05	35	04	04	36	05	19
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	245
# HOURS THIS HOUR	4	4	5	5	6	8	11	9	8	8	9	10	14	14	17	17	18	18	17	16	11	6	5	5	245
GRAND SUM	11	11	15	14	22	26	32	30	28	28	31	35	42	43	51	51	53	50	46	40	30	19	12	8	728 728

NUMBER OF HOURS OF ONSHORE FLOW
AT THE SHOREHAM WEST TOWER

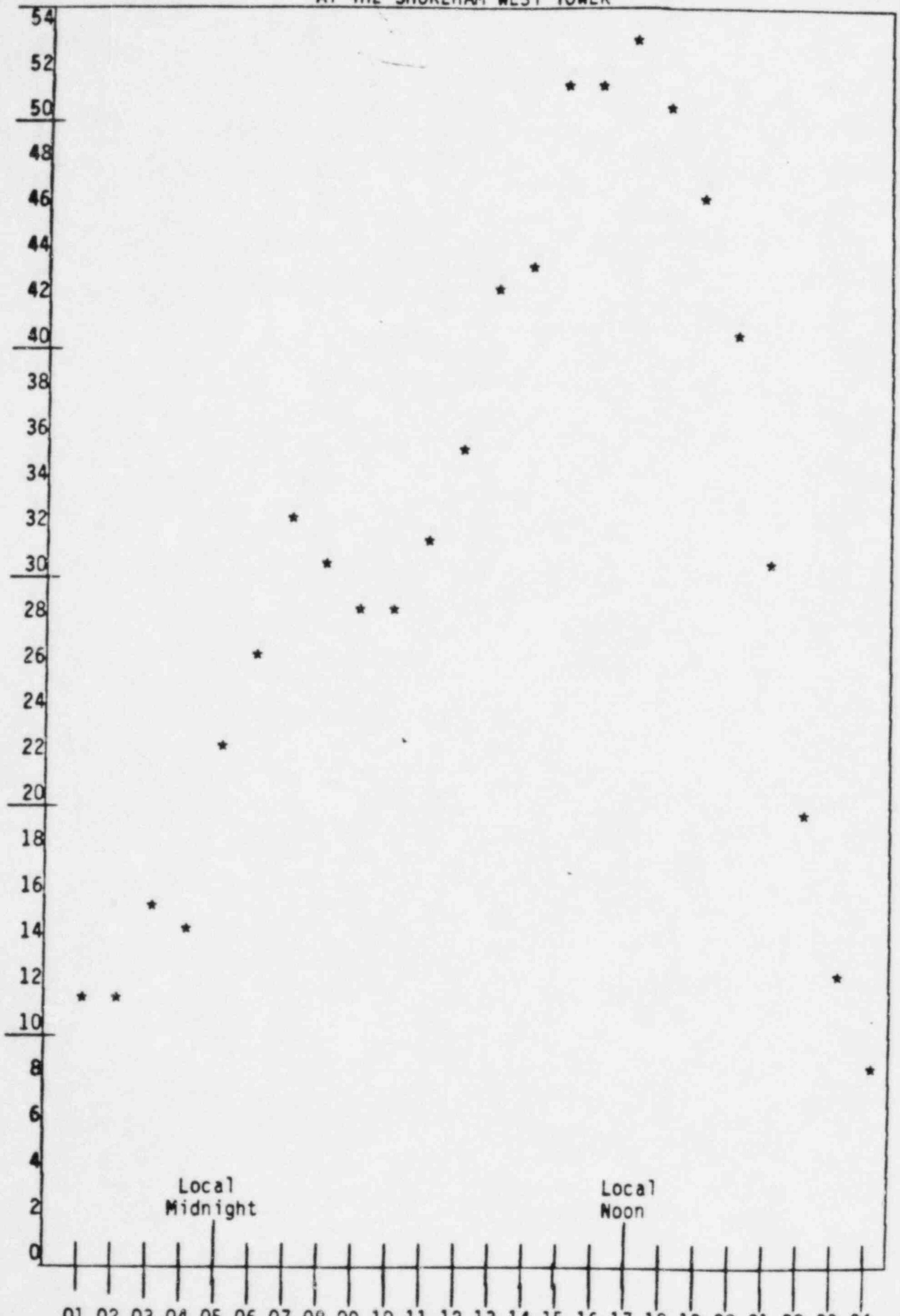


Figure 4-2

FIGURE 4-3

TIMES OF ONSET [O] OF ONSHORE FLOW REGIMES AND TIMES OF BREAK DOWN [X] AT SHOREHAM WEST TOWER

HOUR ENDING [Z-TIME]

	<12	12	13	14	15	16	17	18	19	20	21	22	23	24
7/15					0?	.	.	.	.	X				
7/16			0	.	.	.	X							
7/17			0	.	.	.	.	X						
7/18				0	.	.	.	.	.	X				
7/19					0	.	.	.	X					
7/21	0	.	.	.	.	.	.	.	.	.	.	.	.	X
7/22	0?	.	.	.	.	.	.	.	.	.	.	X		
7/23	0	.	.	.	.	.	.	.	X					
7/24	0	.	.	.	.	.	.	.	.	.	.	.	X	
7/25					0	.	.	.	X					
7/26		0?	.	.	.	.	.	.	.	.	X			
7/27	0	.	.	.	.	.	.	.	.	.	X			
7/30			0	.	.	.	.	.	X					
8/2	0	.	.	.	.	.	.	.	.	.	.	.	X	
8/3	0	.	.	.	.	.	.	.	.	.	.	.	X	
8/4					0	.	.	.	.	X				
8/5						0	.	.	X					
8/6	0	.	.	.	.	.	.	.	.	X				
8/7				0	.	.	.	.	X					
8/10					0	.	.	.	.	.	.	X		
8/12	0	.	.	.	.	.	.	.	.	.	.	.	.	X
8/13	0	.	.	.	.	.	.	.	.	.	.	.	X	
8/14	0	.	.	.	.	.	.	.	.	.	X			
8/16	0	.	.	.	.	.	.	.	.	.	.	X		
8/18	0	.	.	.	.	.	.	.	.	.	.	.	.	X
8/19					0	.	.	.	.	.	X			
8/22	0	.	.	.	.	.	.	.	.	.	X			
8/24	0	.	.	.	.	.	.	.	.	.	.	X?		
8/26	0	.	.	.	.	.	.	.	.	.	X			
8/28	0	.	.	.	.	.	.	.	.	X				
8/29	0	.	.	.	.	.	.	.	.	.	.	X		
9/3							0	.	.	.	.	.	X	
9/5	0	.	.	.	.	.	.	.	.	.	.	X		
9/6				0	.	.	.	.	.	.	X			
9/8			0	.	.	.	.	.	.	.	X			
9/9					0	.	.	.	.	X				
9/10		0	.	.	.	.	.	.	.	.	.	X		
9/11	0	.	.	.	.	.	.	.	.	.	.	X		
9/12	0	.	.	.	.	.	.	.	.	.	.	X		
9/13						0	.	.	.	.	.	X		
9/14	0	.	.	.	.	.	.	.	.	.	.	.	X	
9/15	0	.	.	.	.	.	.	.	.	.	.	X		
9/16			0	.	.	.	.	.	.	.	X			
9/19	0	.	.	.	.	.	.	.	.	.	.	X		

TABLE 4-9

TIMES OF ONSETS OF SOUND BREEZES,

CONFLUENCE ZONES, AND ONSHORE GRADIENT

FLOWS REVERSED BY ATLANTIC SEA BREEZES

HOUR ENDING [Z-TIME]

<12	12	13	14	15	16	17	18	19	20	21	22	23	00
24	2	5	3	7	2	1	0	0	0	0	0	0	0

TABLE 4-10

TIMES OF BREAKDOWN OF ONSHORE

FLOW REGIMES

<12	12	13	14	15	16	17	18	19	20	21	22	23	00
0	0	0	0	0	0	1	1	6	6	9	12	6	3

Thunderstorm mesosystems can obviously countermand this "rule of thumb". Also, onshore flow breakdown does not generally occur before 1900Z, but becomes rapidly and increasingly likely thereafter, with a peak in reversals to offshore being noted at 2200Z [Table 4-10]. In many of the later afternoon cases, it could be questioned whether or not an active ASB front had actually impacted Shoreham. This is said because by this late in the day, sun angles were often very low. In fact, tower stabilities frequently indicated neutral to stable conditions on both sides of the ASB "front". However a clear wind shift was in evidence. This could however be resulting from an "inertial" remnant of the ASB. This low-speed southerly flow across Long Island was often noted to persist well into the night, often against weak northerly gradient flows. This may in fact be a distinct and previously unrecognized CMR. It tends to mimic, and perhaps become absorbed into, a true land breeze as the night wears on.

4.4 Water Temperature

Water temperatures over the Atlantic Ocean and especially LI Sound are of importance to interpreting local diurnal wind flows and low level PBL structure during onshore flow. Unfortunately, such data are not always routinely acquired. For this program, several sources were utilized, including satellite IR surveys (see Figure 3-5 and Appendix D), light tower and buoy data, and some data taken about 1 mile offshore from the Shoreham plant as part of the preoperational aquatic ecology study. Table 4-11 summarizes these data. The satellite-derived Sea Surface Temperature (SST) for LI Sound agree quite well with the in-situ measurements. As appears to be climatologically normal, the Sound water temperature had reached its maximum by the start of the program, and

TABLE 4-11

LI SOUND AND OCEAN WATER SURFACE TEMPERATURES

	SATELLITE			IN-SITU	
DATE	LI SOUND	40°N/72°W	BUOY 44003	SHOREHAM[1]	BUOY 44003[2]
Apr 28	8.0°	10.5°	5.0	8.7° (1981)	N/A
May 26	12.5°	13.0°	8.5	14.8° (1981)	N/A
Jun 09	12.0°	11.8°	9.6	18.0° (1981)	N/A
Jul 01	17.7°	18.1°	8.0	20.5° (1981)	N/A
				- - - -	
Jul 07	18.8°	19.3°	13.0°	19.9° (7/6)	N/A
Jul 28	22.0°	24.0°	17.5°	22.5° (7/28)	16.1°/11.7°
Aug 04	21.5°	23.0°	18.5°	N/A	18.9°/12.2°
Aug 19	21.0°	22.3°	16.0	22.0° (8/18)	18.9°/13.3°
Aug 31	19.8°	21.0°	15.0	20.6° (9/2)	15.6°/14.4°
Sep 08	19.5°	20.5°	15.5	20.7° (9/9)	15.6°/13.9°
Sep 15	20.5°	21.0°	15.0	21.7° (9/15)	17.2°/14.4°
Sep 22	18.5°	19.9°	15.5	20.2° (9/20)	16.1°/15.0°[3]

(1) Source: Geomet Technologies, Inc., Preoperational Aquatic Ecology Study, Shoreham Nuclear Power Station. Data taken about 1 mile offshore.

(2) Maximum and minimum temperatures reported are shown.

(3) Sept. 20 data.

TABLE 4-12

MEASURED WATER AND AIR TEMPERATURES (C°)

	BOUY 44003				AMBROSE TOWER							
	T WATER (°C)		T (Ta-Tw)		00Z		06Z		12Z		18Z	
DATE	MAX	MIN	MAX	MIN	Ta	Tw	Ta	Tw	Ta	Tw	Ta	Tw
JULY 15	13.3	11.7	+4.4	+1.1	21.7	21.7			20.6	21.7	25.0	21.7
16	17.2	11.7	+3.9	-0.6			22.2	21.7	21.7	21.7	22.8	21.7
17	16.1	11.7	+5.0	+2.8			23.3	21.7	22.2	21.7		
18	13.9	11.7	+6.6	+2.8			23.9	21.7	23.3	21.7		
19	14.4	11.7	+6.6	+3.9			26.7	21.7	23.9	21.7	30.6	22.8
20	16.1	11.1	+6.1	+2.8	26.7	22.8	25.6	22.8				
21	15.0	11.1	+6.6	-0.6								
22	16.7	11.1	+3.3	-2.2			21.7	22.8				
23	13.3	10.6	+5.5	+1.7			25.6	22.8			23.3	22.8
24	13.3	11.1	+5.5	+1.1	25.6	22.8	23.3	22.8				
25	17.2	11.1	+6.1	+0.6			21.1	22.8	22.8	23.9	23.9	23.9
26	11.7	11.1	+5.0	+2.8	23.3	23.9	22.8	23.9	23.9	23.9	26.7	23.9
27	16.7	11.1	+3.3	-1.1					22.3	23.9		
28	16.1	11.7	+4.4	+1.1	23.3	23.9					23.3	23.9
29					22.8	23.9	21.1	23.9				
30	13.3	11.7	+5.0	+1.7			22.8	23.9	23.3	23.9		
31	16.7	11.7	+5.5	+0.6	21.7	23.9	20.6	23.9	20.0	23.9	22.8	23.9
AUG 1	18.9	14.4	+5.0	-1.1			22.8	23.9	22.8	23.9		
2	18.9	12.2	+6.1	-1.7	26.7	23.9						
3	16.7	12.2	+3.3	-1.1	24.4	23.9	22.8	23.9				
4	18.9	12.2	+2.8	-2.8					22.2	23.9		
5	20.0	14.4	+2.8	-2.8	22.8	23.9			21.7	23.9		
6	19.4	13.3	+2.8	-1.7			25.0	25.0				
7	18.3	16.4	-0.6	-2.2	22.8	23.9	21.7	23.9				

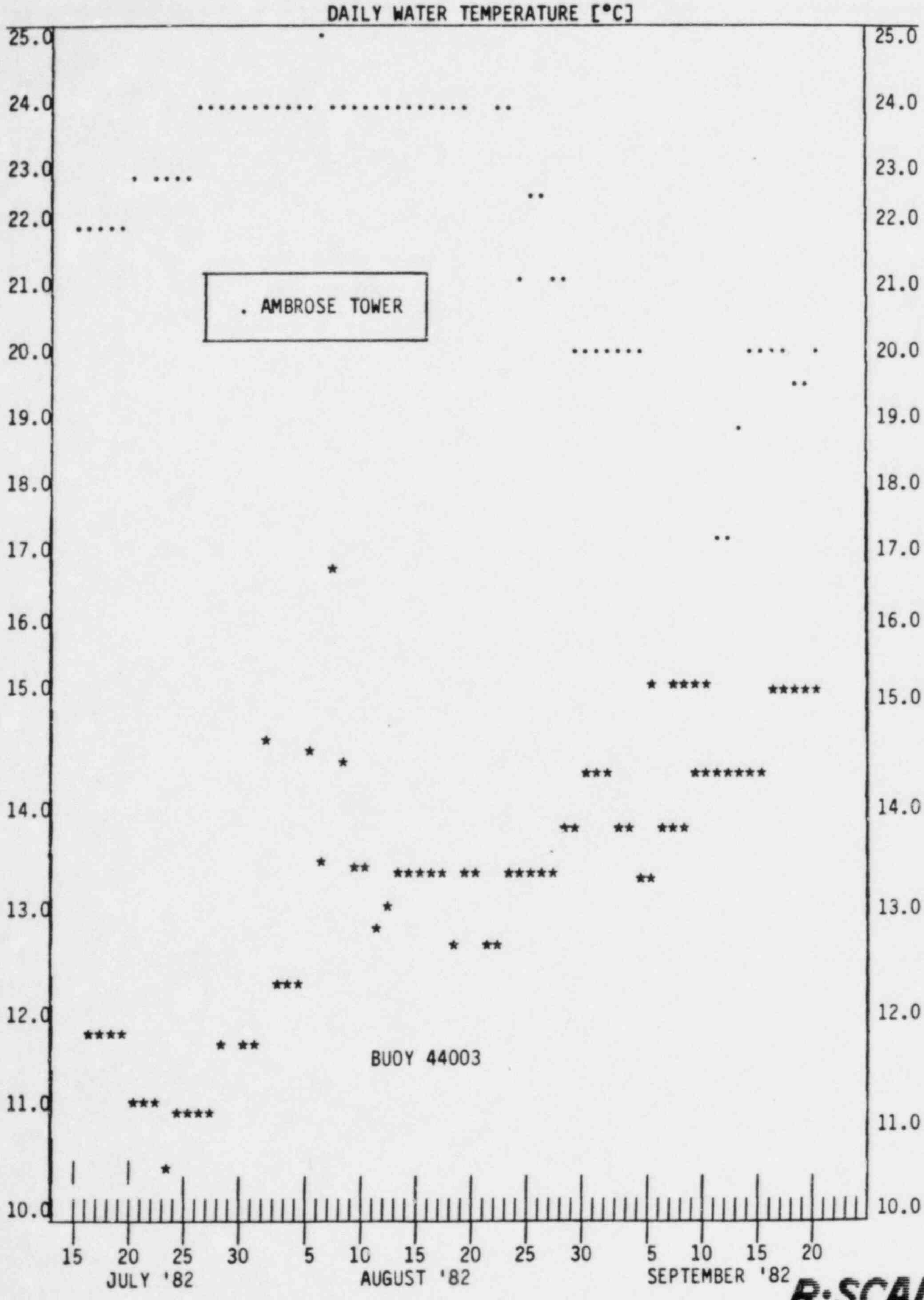
MEASURED WATER AND AIR TEMPERATURES (C°)

	BOUY 44003				AMBROSE TOWER							
	T WATER (°C)		T (Ta-Tw)		00Z		06Z		12Z		18Z	
DATE	MAX	MIN	MAX	MIN	Ta	Tw	Ta	Tw	Ta	Tw	Ta	Tw
AUG 8	18.3	14.4	+3.9	-1.7			23.9	21.1	23.9	20.0	23.9	23.3
9	17.2	13.3	+5.5	+2.2	23.9	22.8	23.9	22.2	23.9	22.8		
10	15.0	13.3	+6.1	+3.9			23.9	22.8	23.9	22.2		
11	16.1	12.8	+5.0	+0.6	23.9	23.9					23.9	22.8
12	17.8	12.9	+2.8	-3.3	23.9	17.8	23.9	19.4				
13	17.8	13.3	+1.7	-1.1	23.9	23.3	23.9	20.0	23.9	20.0		
14	16.1	13.3	+3.3	-0.6			23.9	20.0	23.9	20.6	23.9	22.2
15	16.1	13.3	+3.9	0							23.9	23.3
16	16.7	13.3	+3.9	-0.6					23.9	21.1	23.9	25.0
17	17.2	13.3	+5.0	+1.1	23.9	23.9			23.9	21.1		
18	17.2	12.8	+5.5	0			23.9	21.1	23.9	21.1		
19	18.9	13.3	+3.3	-2.2					23.9	21.1		
20	17.8	13.3	+6.6	+1.1								
21	13.9	12.8	+5.0	+2.2								
22	18.3	12.8	+1.1	-3.9					23.9	14.4	23.9	18.9
23	18.3	13.3	+5.0	0			23.9	18.9				
24	16.7	13.3	+4.4	+0.6			21.1	21.1			21.1	22.8
25	15.0	13.3	+6.1	+1.1			22.2	22.2	22.2	21.1	22.2	25.6
26	14.4	13.3	+5.5	+1.1					22.2	18.3		
27	14.4	13.3	+2.8	+0.6	21.1	22.2						
28	15.0	13.9	+3.3	-0.6	21.1	20.6						
29	15.0	13.9	0	-1.1	21.1	20.6	21.1	16.1	21.1	12.9	20.0	16.1
30	15.0	14.4	+1.1	-1.1	20.0	16.1	20.0	15.0			20.0	18.3
31	15.6	14.4	+2.8	-0.6	20.0	18.9						

MEASURED WATER AND AIR TEMPERATURES (C°)

	BOUY 44003				AMBROSE TOWER							
	T WATER (°C)		T (Ta-Tw)		00Z		06Z		12Z		18Z	
DATE	MAX	MIN	MAX	MIN	Ta	Tw	Ta	Tw	Ta	Tw	Ta	Tw
SEPT 1	15.6	14.4	+3.3	+2.2			20.0	19.4	99.9	18.3	20.0	20.0
2	15.6	13.9	+4.4	+2.2			20.0	18.3	20.0	18.3		
3	16.1	13.9	+5.5	+2.8	20.0	18.9						
4	16.1	13.3	+3.3	+0.6	20.0	22.2			20.0	15.0	20.0	20.0
5	16.7	13.3	+3.3	0	20.0	21.1			15.0	15.6	15.0	20.6
6	16.1	13.9	+1.7	+0.6								
7	16.1	13.9	+1.7	-0.6			15.0	18.3				
8	15.6	13.9	+1.1	-0.6	15.0	18.3					15.0	21.7
9	15.6	14.4	+0.6	-1.7			15.0	16.7				
10	15.6	14.4	+1.7	+0.6			15.0	17.8				
11	15.6	14.4	+2.2	+1.1	17.2	19.4	17.2	21.7				
12	16.7	14.4	+1.7	0			17.2	21.1	17.2	20.6		
13	17.2	14.4	+2.2	0			18.9	20.0				
14	17.2	14.4	+2.8	0							20.0	20.6
15	17.2	14.4	+3.3	0					20.0	17.8	20.0	19.4
16	17.2	15.0	+1.1	-1.1	20.0	20.6	20.0	22.2				
17	16.7	15.0	+0.6	-1.7			20.0	20.0			20.0	18.3
18	16.7	15.0	+1.1	-1.1			20.0	18.3	20.0	15.6	19.4	18.3
19	16.1	15.0	+2.2	0					19.4	15.0	20.0	21.1
20	16.1	15.0	+1.7	-0.6					20.0	17.8		
21												
22												

Figure 4-4



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remained in an essentially steady state throughout. Satellite SST estimates from due south of the site (40°N, 72°W) likewise suggest a nearly steady state ocean temperature, in the 20-24°C range. The Ambrose light tower, (Table 4-12) tended to confirm this value, except for a brief dip to 15°C during early September. The nearest operational NDBO buoy (443), to the southeast of Cape Cod, was located in a region of strong SST gradients. It also exhibited rather marked variability in its hour to hour water temperature readings possibly indicative of instrumentation problems. The minimum daily values suggested a slowly changing base reference value, which perhaps represented the true temperature. These data are plotted in Figure 4-4, and show a steady rise into mid-September. In Table 4-12, maximum and minimum air-water temperature differences were noted for each day at buoy 443. They showed a definite preference for significant over water stability in that area. Around the immediate envirions of Long Island, however, water temperatures were warmer (20°-24°C) throughout most of the field project.

5. ACOUSTIC SOUNDER ANALYSES

5.1 General Characteristics

As indicated above, the acoustic sounder data acquisition effort was successfully completed as designed. Systems began operating within one day of schedule, and continued for an additional week beyond the initially planned period. Overall data capture was well in excess of 95%. A problem with drifting marking power intensities did make some of the traces more difficult to copy and interpret than would normally be the case, but rarely prevented an intercomparison of lower PBL structure between the two sites. All sounder traces acquired were labeled, photoreduced and duplicated, and compiled into a Data Volume, submitted to LILCO on 31 January 1983.

Upon receipt of the first traces, it immediately became apparent that in a significant fraction of all hours the traces from both sites were very similar, and in many cases, indistinguishable. In fact, care had to be taken to mark each day's traces as to location as well as date in order to avoid possible intermixing during handling. The obvious similarity of typical traces can be seen by inspecting the representative samples shown in Figures 5-1 to 5-5.

Figure 5-1 shows an intense elevated inversion with minor wave activity, slowly growing in depth during the night. What appears to be a nearly neutral layer, with possible weak thermal plumes, is located closer to the surface. These plumes do appear slightly more pronounced at the plant site, but this does not represent a significant qualitative difference in PBL structure. On these traces, horizontal lines are 10 m apart, and the vertical markers represent one hour intervals.

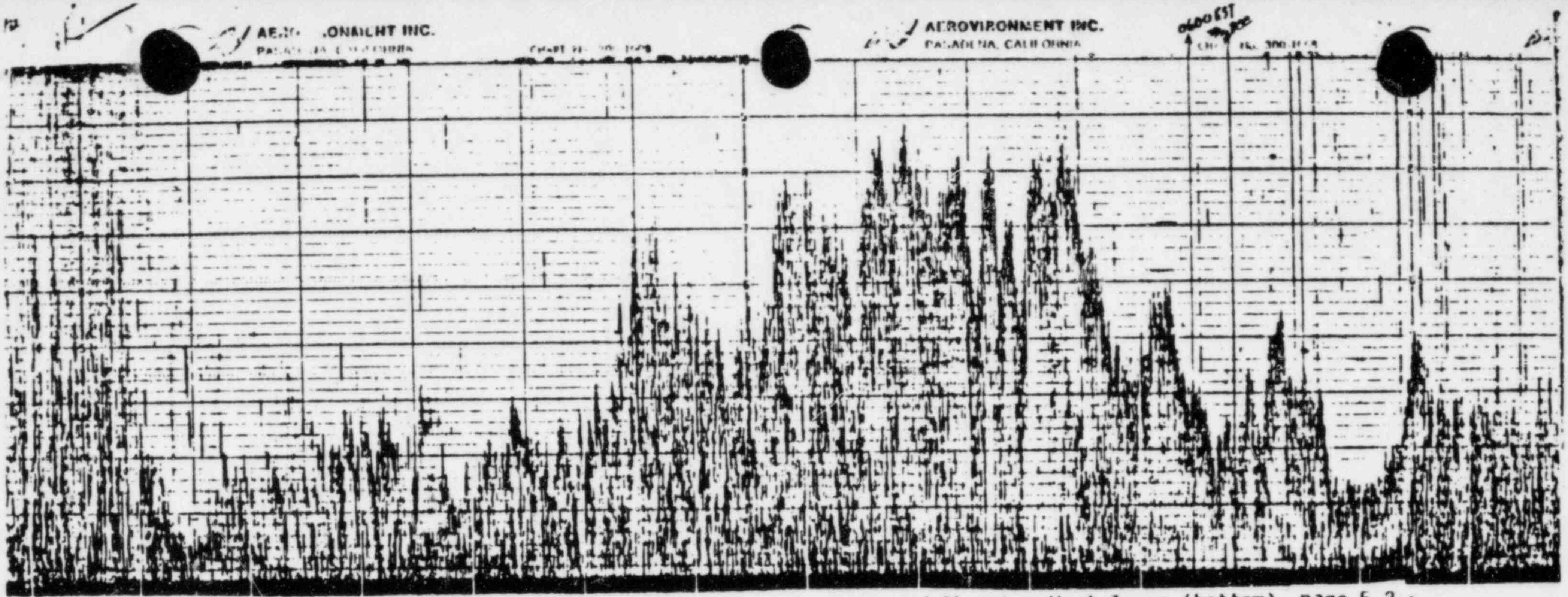
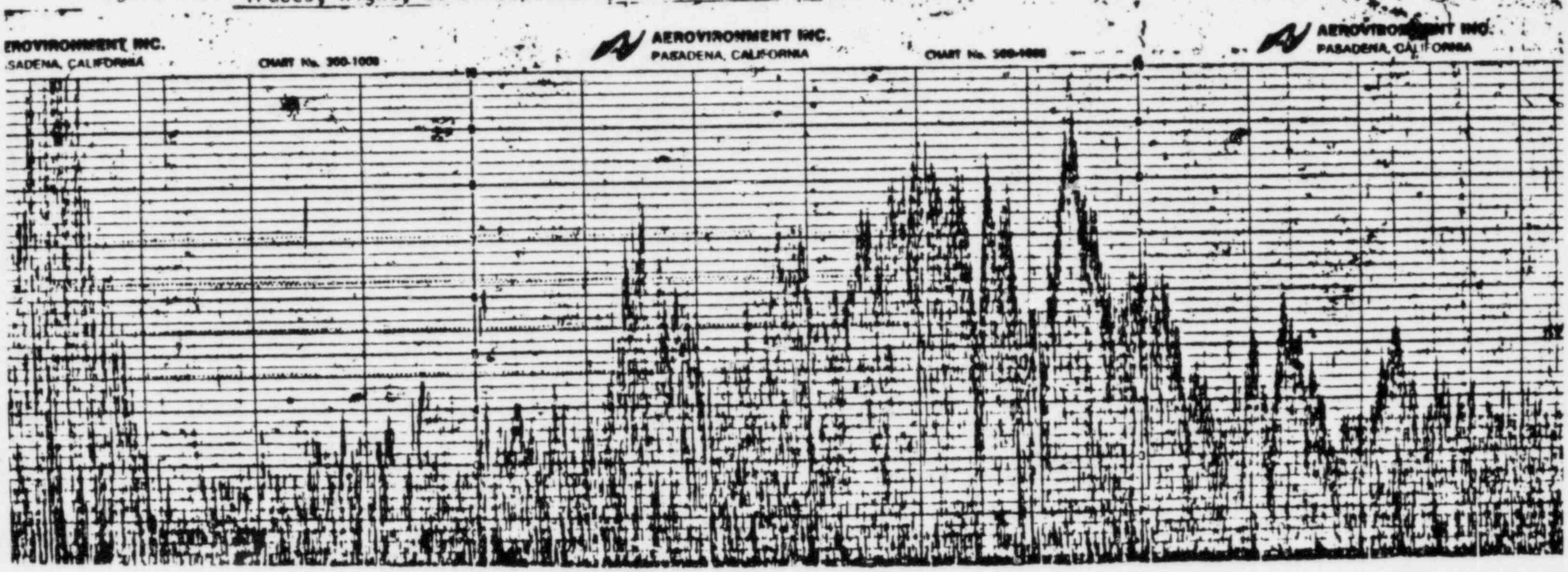


Figure 5-1. Traces, night, 13-14 September, 1982, for Plant (top) and Shoreham West Tower (bottom), page 5-2



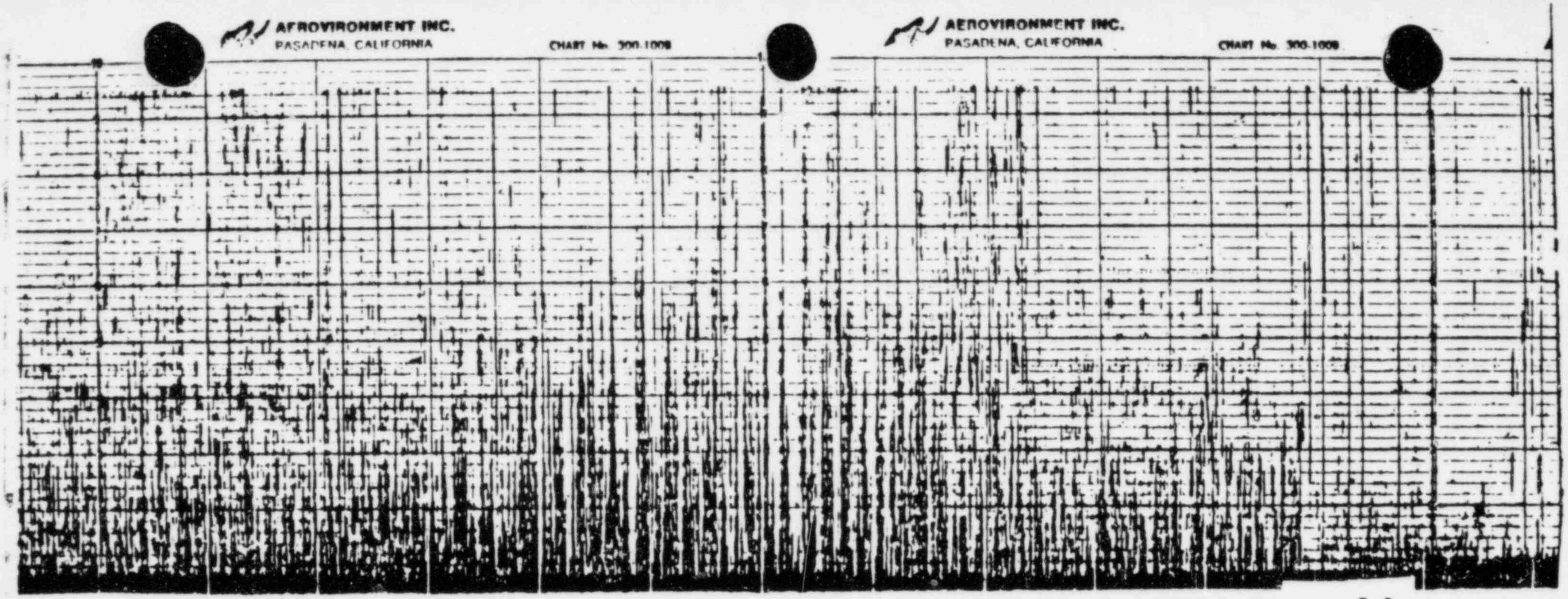
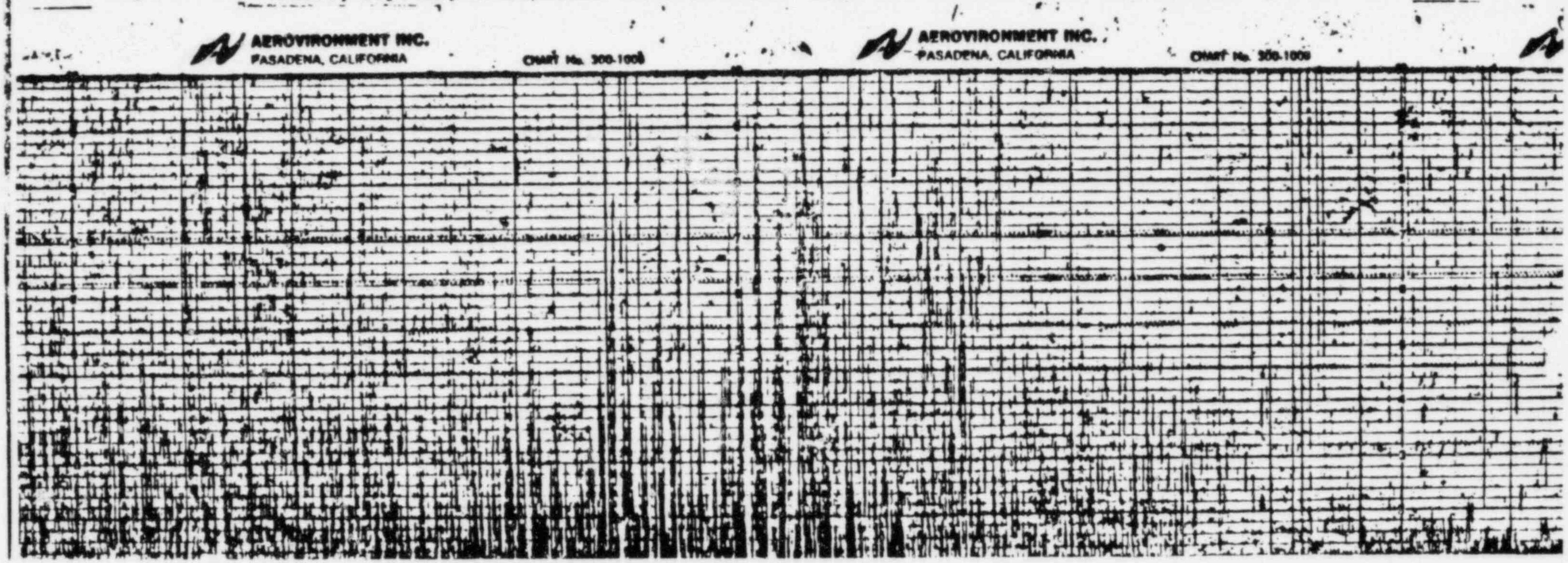


Figure 5-2. Traces, daytime, 19 September 1982 for Plant (top) and Shoreham West Tower (bottom), page 5-3



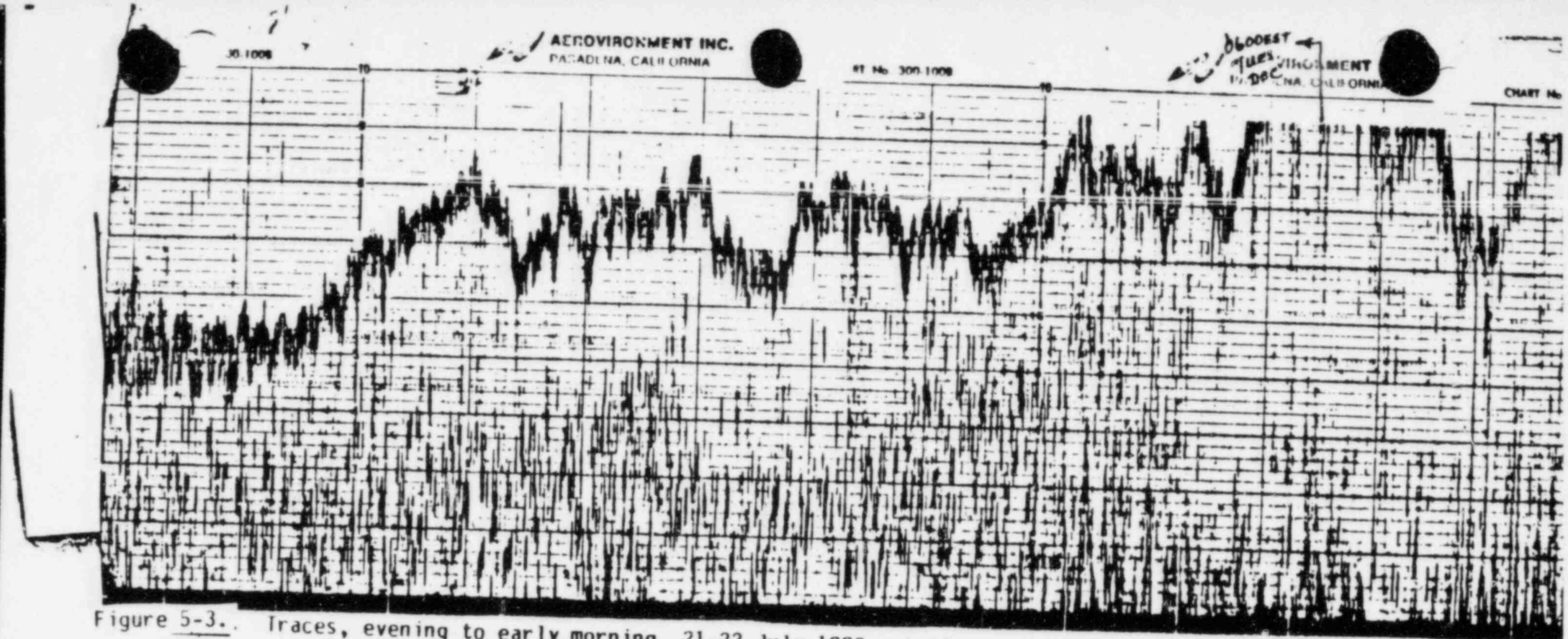
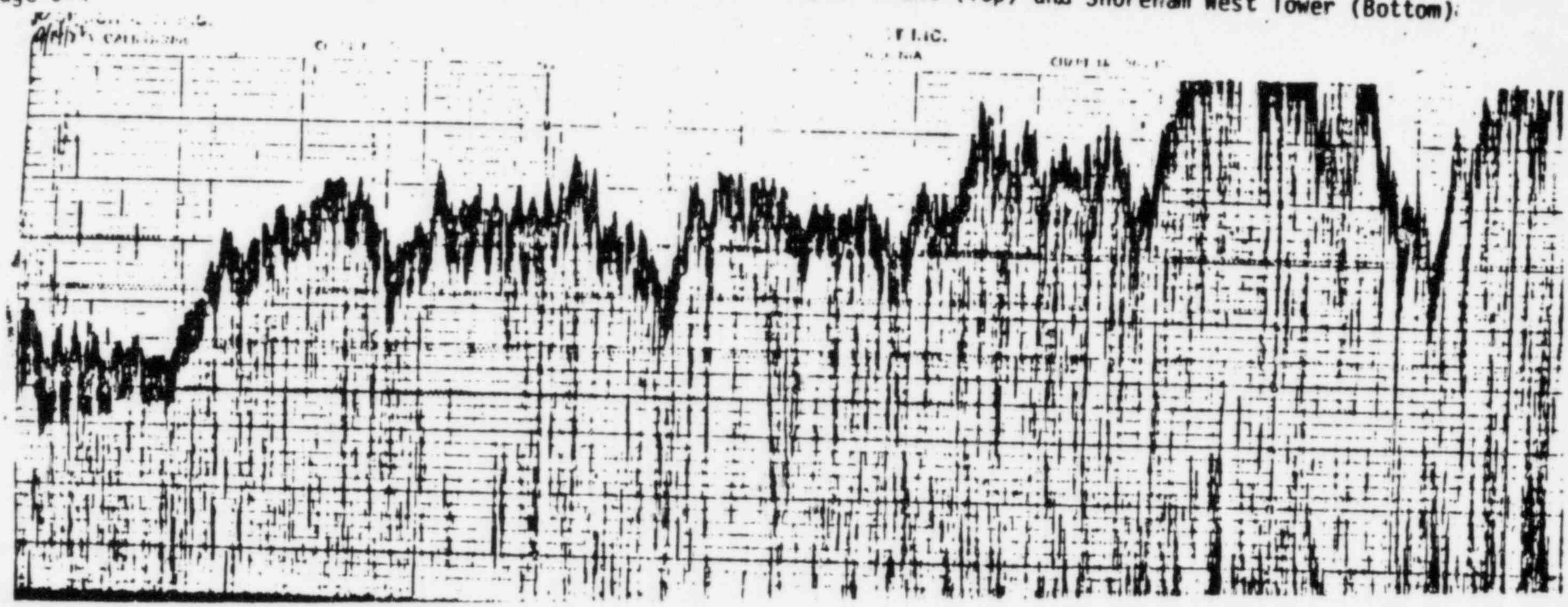


Figure 5-3. Traces, evening to early morning, 21-22 July 1982, at Plant (Top) and Shoreham West Tower (Bottom).

page 5-4



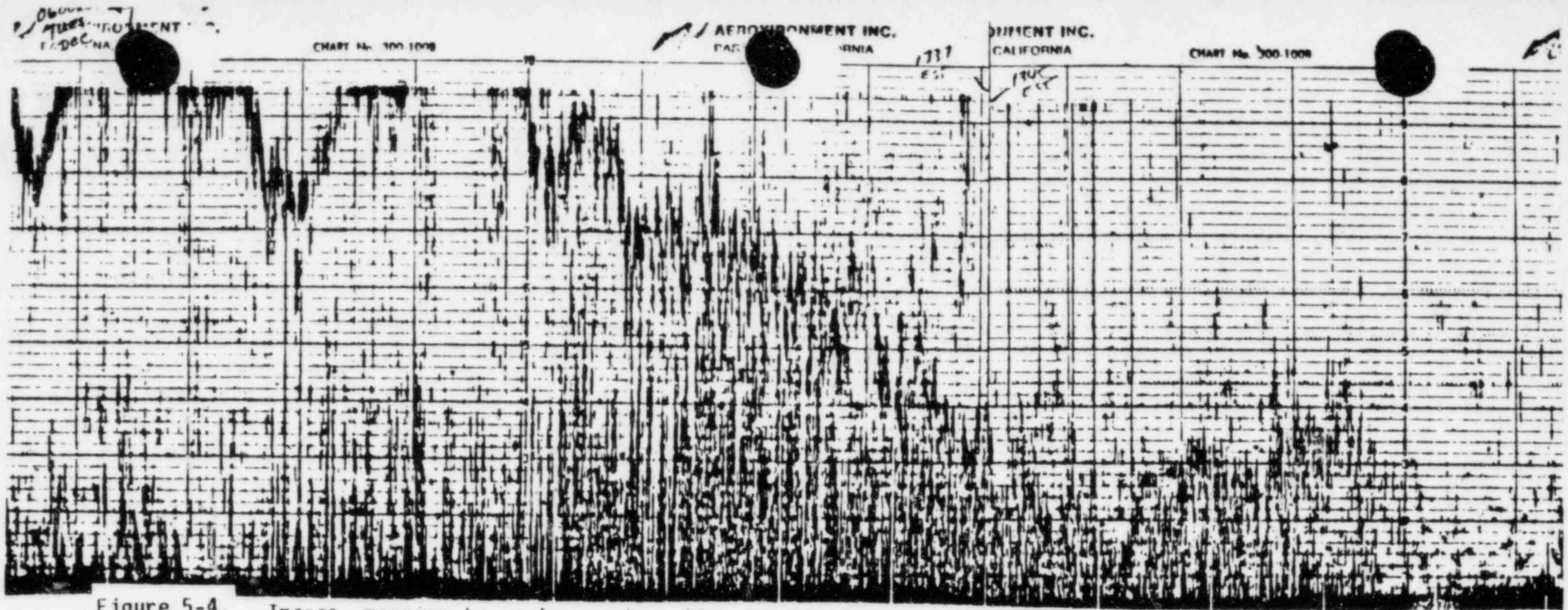


Figure 5-4. Traces, morning to early evening, 14 September 1982, at Plant (top) and Shoreham West Tower (Below) page 5-5.

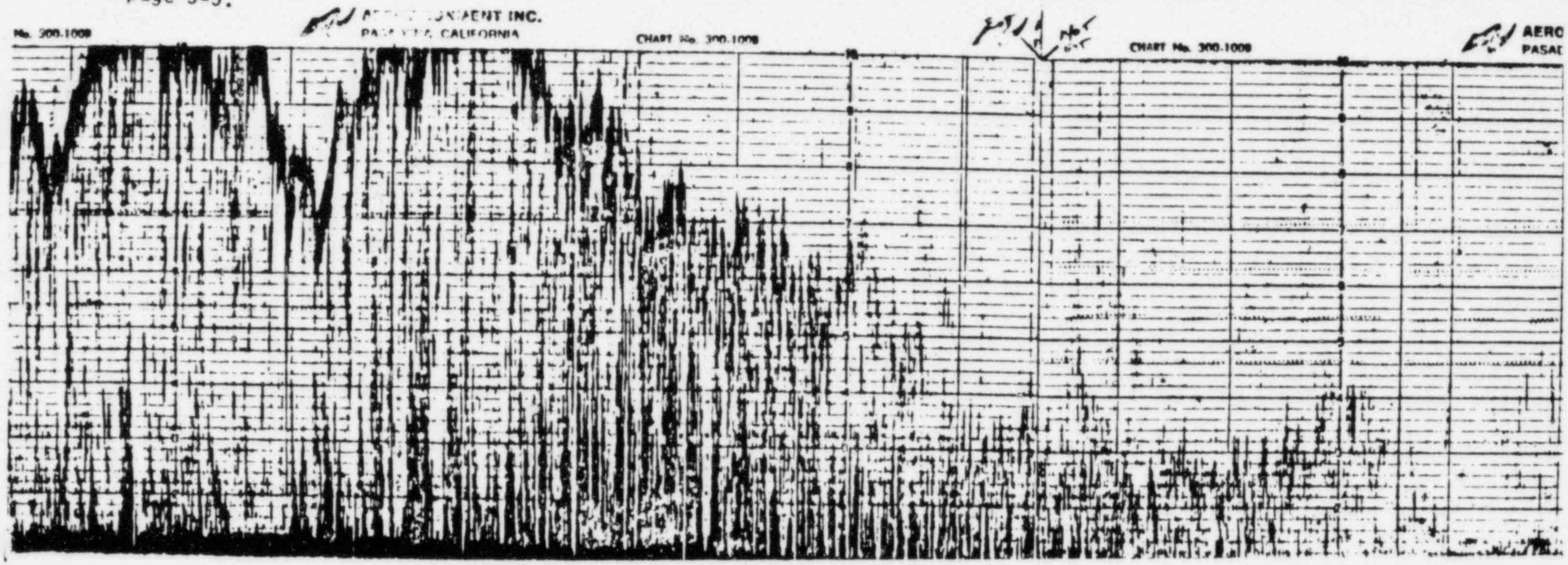


Figure 5-2 represents a period when a deep neutral layer extended above 500 m with marked thermal plume development throughout the layer. Again the thermals appear just slightly stronger at the plant site, plausibly due to the larger area of heated ground near the sounder. However, ambient noise spikes also can on occasion appear much as thermal plumes, and when intermixed, could possibly add to the impression of enhanced thermal plumes. As before, however, no substantial differences between the two sites are noted.

Figure 5-3 shows a complex surface-based inversion with pronounced waves. The patterns at each site are very similar even though separated by nearly a mile. At times, differences in the height of the inversion surface do appear to vary by perhaps 50 m, but these differences (likely the effect of propagating wave trains) were generally confined to altitudes substantially above the 150 ft anemometer.

Figure 5-4 shows what appears to be a distinct difference between the traces, namely the appearance of a series of sharp vertical bands at the plant site. In fact, these are the signature for bursts of environmental noise, easily recognized, and often annotated as such by LILCO staff. The noisier plant location was in fact expected to exhibit these trace characteristics. The impact of the ambient noise, however, was found to be sporadic and generally of little consequence to the meteorological interpretation of the traces.

After all traces were photoreduced and copied, they were included in the daily data files. Visual intercomparisons were then made between the traces on a day by day basis. Except for the expected differences due to ambient noise,

marking power intensity drift, and occasional time shifts due to either variations in chart speed or the propagation of wave-like disturbances, few, if any, significant differences in diagnosed lower PBL structure were noted.

The principal question to be answered in this report is whether or not the turbulence pattern 150 ft level data on the Shoreham West tower are in fact representative of conditions at the same level above terrain near the plant. If simultaneously acquired acoustic sounder traces from these sites prove nearly identical, a high degree of confidence can be had that the turbulence and transport processes within the lower PBL are generally similar at each site. First impressions certainly indicate that little significant variability is to be found between the tower and the plant sites, at least above the very lowest layers (above 50 m) of the PBL. We will now engage in a more detailed study of the selected case study days.

TABLE 5-1

ACOUSTIC SOUNDER PBL CHARACTERIZATION CODES

				Total Observed
1	Stable Layer, Single, Aloft, No Waves	-	Steady........	14
2	" " " " " "	-	Ascending.....	9
3	" " " " " "	-	Descending....	2
4	Stable Layer, Single, Aloft, Waves	-	Steady........	15
5	" " " " "	-	Ascending.....	9
6	" " " " "	-	Descending....	6
7	Stable Layer, Multiple, Aloft, No Waves	-	Steady........	2
8	" " " " " "	-	Ascending.....	0
9	" " " " " "	-	Descending....	0
10	Stable Layer, Multiple, Aloft, Waves	-	Steady........	8
11	" " " " "	-	Ascending.....	1
12	" " " " "	-	Descending....	1
13	Stable Layer, Single, Surface Based, No Waves	-	Steady........	78
14	" " " " " " "	-	Ascending.....	3
15	" " " " " " "	-	Descending....	2
16	Stable Layer, Single, Surface Based, Waves	-	Steady........	12
17	" " " " " "	-	Ascending.....	3
18	" " " " " "	-	Descending....	1
19	Stable Layer, Multiple, Surface Based, No Waves	-	Steady........	26
20	" " " " " " "	-	Ascending.....	3
21	" " " " " " "	-	Descending....	5
22	Stable Layer, Multiple, Surface Based, Waves	-	Steady........	139
23	" " " " " "	-	Ascending.....	5
24	" " " " " "	-	Descending....	3
25	Thermal Plumes, Tops Above 500m	-	....	42
26	Thermal Plumes, Tops Below 500m	-	....	73
27	Thermal Plumes, Stable Above, No Waves	-	Steady........	58
28	" " " " " "	-	Ascending.....	18
29	" " " " " "	-	Descending....	11
30	Thermal Plumes, Stable Above, Waves	-	Steady........	66
31	" " " " "	-	Ascending.....	20
32	" " " " "	-	Descending....	21
40	Weak Patterns, Unclassifiable		....	7
41	Complex Strong Patterns, Unclassifiable		....	0
42	Atlantic Sea Breeze FROPA		....	15
43	Thunderstorm Gust Front FROPA		....	3
44	Sound Breeze FROPA		....	11
45	Environmental Noise Predominates		....	2
46	Wind Noise		....	0
47	Rain Noise		....	13
48	Synoptic Front		....	1
	Add 50 to above to indicate trace very light, making difficult interpretation		....	3
99	Inoperative		....	9

NOTES:

1) Ascending/Descending assumes $\pm$ 50m change in prior hour
2) "Waves" require 50m amplitude during prior 2 hours

TABLE 5-2

ACOUSTIC SOUNDER PBL CHARACTERIZATION CODES
TOWER SITE

HOUR ENDING [Z-TIME]

JUL 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
15															*	*	*	*	*						
16	19	22	22	22	22	22	22	22	22	22	22	28*	44*	28*	28*	27*	42	31	30	30	32	32	32	32	
17	13	13	13	13	13	13	13	13	13	13	28	28	44*	26*	26*	26*	26*	26	25	25	25	29	29	29	
18	13	13	13	13	13	13	13	13	13	13	27	27	28	44*	26*	26	26*	26*	26*	26	26	29	29	29	
19	15	13	13	13	13	13	13	13	13	13	13	28	28	26	44*	27*	27*	27	43	4	4	5	4	4	
20	7	7	10	4	4*	6	4	5	6	19	19	31	31*	27*	27*	28*	27*	47*	47*	47*	47*	16*	16*	16*	
21	16*	2*	2*	1*	2*	1*	1*	1*	4*	4*	6*	5*	5*	30*	30*	31*	25*	25*	25*	25*	25*	25*	25*	42	
22	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*				
23					*	*	*	*		*	*	*	*	*			*	*							
24			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
25	22	22	22	22	22	22	22*	22	22	22	22	22	28	28	26*	26*	26*	26*	26	26	26	29	29	29	
26												*	*		*	*	*	*	*	*					
27			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*					
28														*											
29					*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*			
30					*	*	*	*	*		*		*		*	*	*	*							
31																									
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	

AUG 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	22	24	22	22	22	22*	22*	22	22*	22*	22*	27*	28*	28*	27*	27*	27*	27*	27*	27*	27*	29*	29	27	
2						*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
3								*	*	*	*	*	*	*				*	*	*	*	*			
4	22	22	22	22	22	22	22	22	22	22	22	31	31	44	30*	30*	30*	32*	31*	42	27	27	27	27	
5	22	22	22	22	22	22	22	16	17	16	16	17	16	30	30	44*	27*	27*	42	25	25	43	21	20	
6		*	*	*	*	*	*					*	*	*	*	*	*		*	*					
7														*	*	*	*								
8	13	13	19	22	22	22	22	22	22	22	30	31	26	26	25	25	25	25	25	25	25	26	26	26	
9	13	13	13	13	13	13	13	13	13	13	13	13	14	99	99	99	99	99	99	99	99	76	76	65	
10	5	47	6	47	47	16	17	18	21	19	19	31	26	26	44*	30*	30*	30*	26*	26*	26*	42	1	13	
11			*			*	*	*	*	*	*	*	*	*	*	*	*	*	*		*		*		
12					*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
13	22	22	22	22	22	22	22	22	22	30*	30	30*	31*	31*	26*	26*	26*	26*	26*	26*	26*	26*	26*	13	
14	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*					
15							*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	

Note: * indicates onshore flow

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TABLE 5-2(continued)

ACOUSTIC SOUNDER PBL CHARACTERIZATION CODES
TOWER SITE

HOUR ENDING [Z-TIME]

AUG 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
16																								
17																								
18	40	40	48	16	16*	16*	19*	20*	20*	19*	24*	23*	27*	27*	27*	25*	25*	25*	25*	45*	45*	26*	42	27
19																								
20																								
21																								
22																								
23																								
24																								
25																								
26																								
27																								
28																								
29																								
30																								
31																								
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

SEPT 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1																								
2																								
3																								
4	19	19	19	19*	19*	22*	22*	22*	22	22	22	23	26*	25*	25*	25*	25*	25*	25*	25*	25*	25*	2*	2*
5	2*	1*	1*	1*	1*	2*	2*	1*	1*	3*	1*	10*	30*	30*	32*	32*	26*	26*	26*	26*	42	1	1	19
6	22	22	22	22	22	22	22*	22	22	22	22	22	26	44*	27*	27*	27*	27*	28*	28*	42	30	30	22
7																								
8	27	27	27	27	27	27	27	27	27	27	27	27	25*	25	25	30*	30*	30*	30*	32*	32	42	2	4
9	22	22	22	27	22	22	22	22	22	22	22	22	23	28	25*	25*	25*	25*	25	25	25	32	32	22
10	21	21	21	19	19	22	22	22	22	22	22	22*	44*	31*	31*	31*	30*	26*	26*	26*	42	32	30	30
11	24	22	22	22	22	22	22*	22*	22*	22*	22*	23*	30*	30*	30*	31*	26*	26*	26*	26*	26*	42	30	19
12	19	22	22	24	22*	22*	22*	22*	22	22*	22*	23*	32*	30*	30*	30*	30*	32*	30*	30*	31*	42	27	19
13	22	22	22	22	22	10	10	11	10	10	10	10	31	30	44*	30*	30*	30*	30*	30*	30*	42	32	31
14	4	5	4	4	6	5	4*	5	4*	5	6*	32	31*	30*	32*	30*	30*	32*	30*	30*	30*	30*	42	40
15	19	19	19	19	19	22	22	22	22	22	[illegible]	22*	22*	30*	31*	30*	32*	32*	30*	30*	30*	42	12	10
16	3	13	13	13	19	22	22	19	13	[illegible]	40	40	[illegible]	30*	30*	32*	30*	30*	30*	30	42	30	30	30
17																								
18																								
19																								
20	13	13	13	13	13	13	13	13	14	13	13	47	47	14	28*	28	26	26	47	47	26	26	47*	26*
21	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	30*	30*	27*	27*	27*	26*	26*	26*	26*	26*	26	26
22	13	15	13	13	13	13*	13*	13*	47*	13*	47*	47*	13*	13*	26*	26*	40*	26*	26*	26*	26*	26*	26*	26*
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

Note: * indicates onshore flow

D-POF-13

5.2 Categorization and Analysis

The proper categorization of acoustic sounder traces, which is basically a subjective analysis, is greatly assisted by the ability to reference as much informa on about the local micrometeorology, regional mesometeorology, and synopti conditions as possible. Thus, for each of the 30 case studies selected for more intensive analysis, use was made of virtually all data assembled in the daily data files. Selection criteria for the case studies were skewed towards obtaining a larger sample of onshore flow regimes (sound breezes, TIBLs). A total of 720 hours of sounder traces were categorized.

Table 5-1 shows the system of categorization codes that was employed. It is derived partly from the approach used by Schubert (1978) and partly from the author's experience in sounder trace analysis. Table 5-2 provides a temporal history of the PBL characterization codes for each of the 30 days (note that ° indicates onshore flow at the Shoreham West tower). Not unexpectedly, the most commonly occurring classes represented stable inversion layers, single and multiple, elevated and surface-based (39% of all hours). Thermal plumes, with little indication of a stable layer above were found 16% of the time. For those cases were thermal plumes extended above the maximum range of the sounder (500 m), a height of the mixed layer of 750 m was assigned. Thermal plumes, but with indications of thermally stable layers above, were observed 20% of the time.

The onset of the sound breeze at times was marked by a frontal like pattern of echoes, but more typically was masked by other structures. In most cases

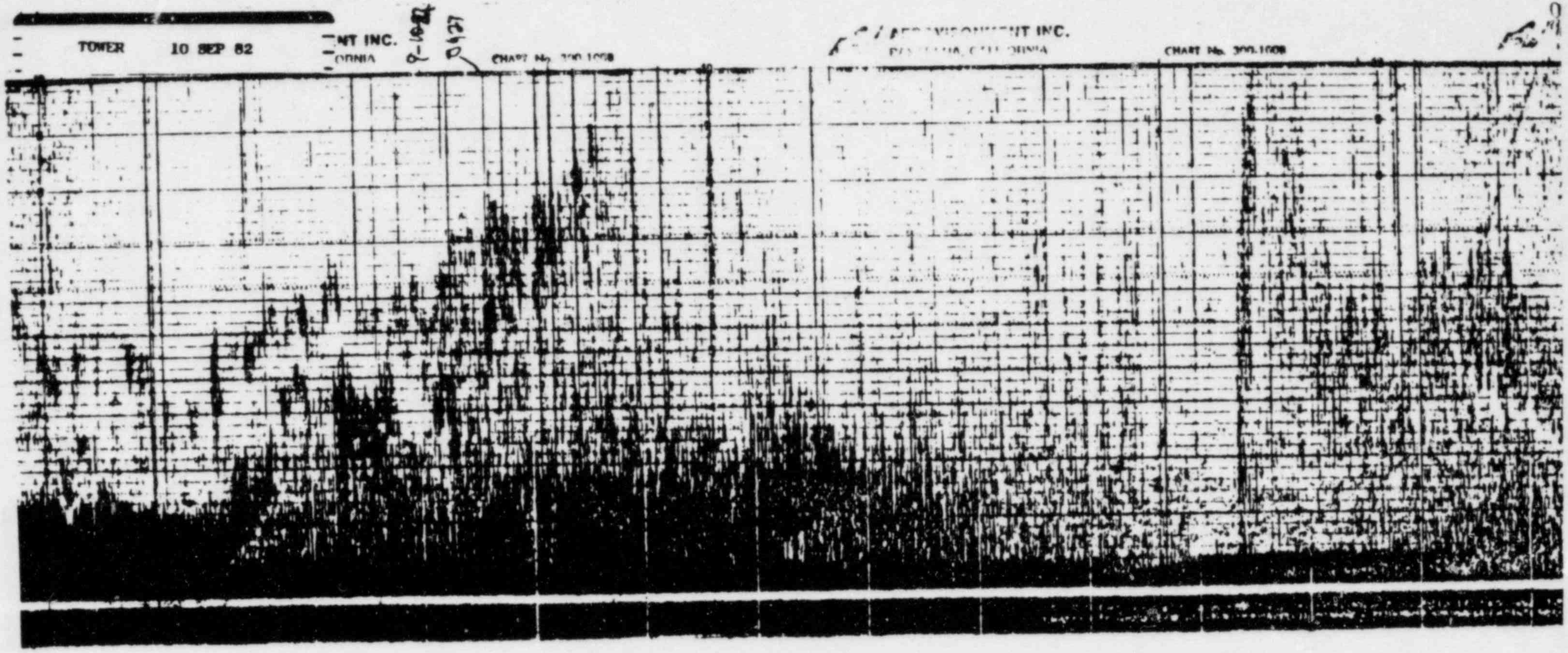

Figure 5-5

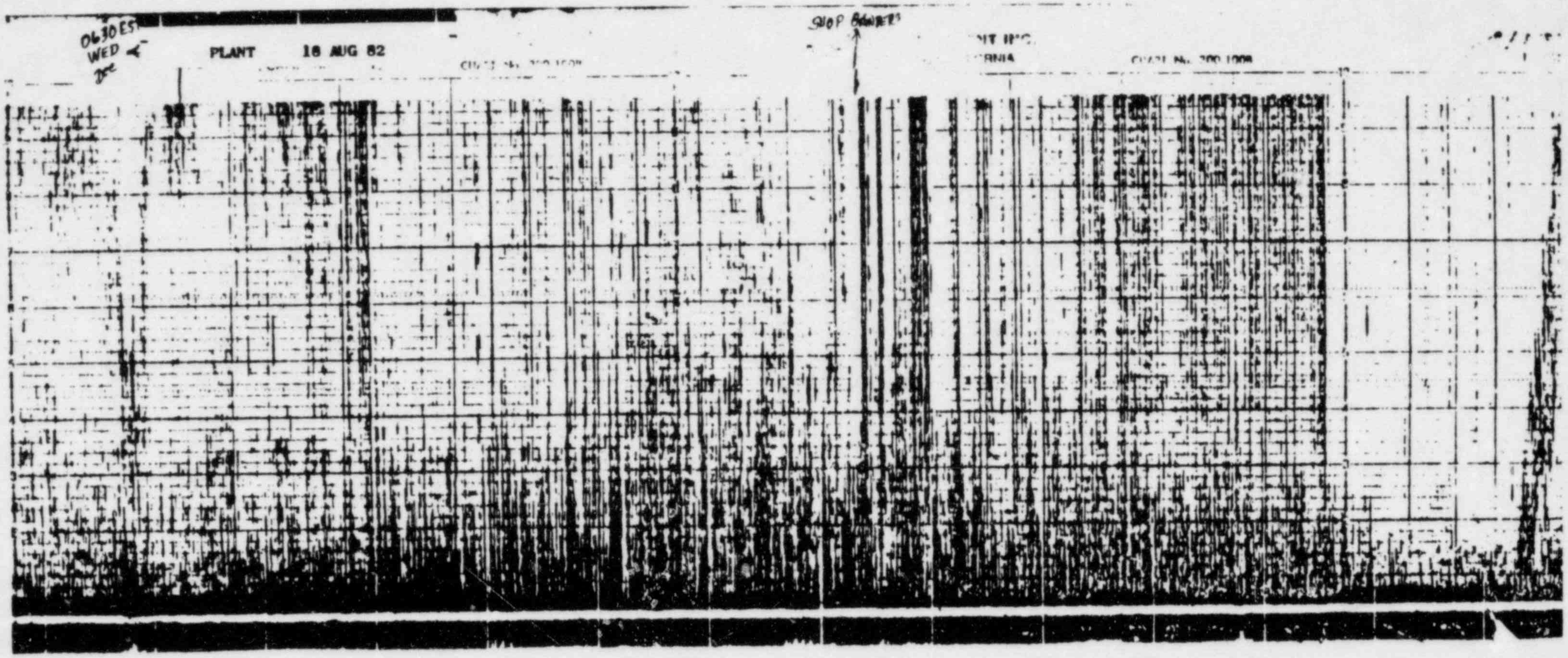

Figure 5-6

mixing had already begun and very weak thermal plume structures could be noted, often to the 500 m level. Upon sound breeze onset, more intense thermal plumes could appear, but capped by a definite stable layer. The ASB had two typical manifestations. It did sometimes appear as a classic frontal surface (Figures 5-5, 5-6). The front was gently sloped, and might extend to 500 m, or perhaps above. This apparently marked a zone of chimneylike updrafts known to be present with such features (Keen and Lyons, 1979). Immediately behind the frontal signature, a definite elevated inversion surface would be found, this marking the top of the Atlantic TIBL. Beneath it would be found weak thermal plumes. The more common ASB frontal passage, however, was accompanied by a complete lack of any strong echoes. In fact, the sounder trace tended to go blank or be replaced by a pattern of weak, mottled echoes. It would appear that the ASB frontal zone was a region of intense mixing, thermals and udrafts, with the consequent adiabatic lapse rate. This lack of strong temperature gradient within the sounder beam itself is consistent then with this observation. It could be the ASB frontal zone represents a region of larger scale upward motions, perhaps convective elements substantially larger than typical thermal plumes which yield the familiar spike-like signature. In either case, there is an abrupt transition in the local PBL structure during and after the passage of both sound breeze and ASB fronts.

5.3 Similarity

For each of the 720 hours, a subjective determination of the similarity of the structure of the lower PBL as indicated by the two sounder traces, was made. A simple code was devised:

A = no apparent differences in lower PBL structure

B = possible differences in lower PBL structure

C = differences likely in lower PBL structure

D = missing data; categorization not possible

The B category generally resulted from one of several causes: weak echo patterns making determination of structure somewhat difficult; chart timing errors putting discrete, recognizable features at both sites slightly out of phase; wave propagation effects causing similar features to occur at slightly different times; somewhat different patterns in overhead complex wave structures. For a C category to be noted, distinctly different atmospheric processes at each site would have to be in evidence - convective plumes at one versus a surface-based inversion at the other, etc. There were no C situations noted during the project. Twenty-six hours could not be simultaneously classified at both sides for one reason or another. Of the remaining hours, 635 had A similarity class, with only 59 showing possible structural differences between the sites, and therefore being rated a B. There were no apparent differences in the statistics between onshore and offshore flow (Table 5-4), although a slight tendency towards more B classes was noted duirng offshore flow. This usually was found during period of PBL growth in the early morning hours, when patterns are complex and often rather hard to discern. During onshore flow, when a determination could be made, 276 out of 297 (93%), off all trace comparisons suggested no reason whatever to suspect significant PBL differences between tne two sites.

The depth of the nocturnal stable layer, and the daytime mixing layer (herein both called the mixing depth) were similarly analysed and intercompared. This determination, again based upon subjective analysis and interpretation, was

TABLE 5-3

SOUNDER TRACE SIMILARITY

HOUR ENDING Z-TIME

JUL 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
15															•	•	•	•	•					
16	D	D	D	D	D	D	D	D	D	D	D	D•	A•	A•	A•	A•	A	A	A	A	A	A	A	A
17	A	A	A	A	A	A	A	A	A	A	A	A	A•	A•	A•	A•	A•	A	A	A	A	A	A	A
18	A	A	A	A	A	A	A	A	A	A	A	A	A	A•	A•	A	A•	A•	A•	A	A	A	A	A
19	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A•	A•	A•	A	A	A	A	A	A	A
20	A	A	A	A	A•	A	A	A	A	A	A	A	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•
21	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A•	A
22	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•			
23					•	•	•	•		•	•	•	•	•			•	•						
24			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
25	A	A	A	A	A	A	A•	A	A	A	A	A	A	A	B•	A•	A•	A•	A	A	A	A	A	A
26												•	•		•	•	•	•	•	•				
27			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•				
28														•										
29					•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•		
30					•	•	•	•	•		•		•		•	•	•	•						
31																								
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

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AUG 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
16							•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			
17																								
18	A	A	A	A	A•	A•	A•	A•	A•	B•	B•	A•	A•	A•	A•	A•	A•	A•	A•	D•	D•	B•	A	B
19															•	•	•	•	•	•				
20																								
21	•				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
22	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			
23																								
24								•	•	•	•	•	•	•	•	•	•	•	•	•	•			
25																						•	•	•
26	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•				
27																								
28							•	•	•	•	•	•	•	•	•	•	•	•	•					
29	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			
30																								
31																								
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

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TABLE 5-3(continued)

SOUNDER TRACE SIMILARITY

HOUR ENDING [Z-TIME]

AUG 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	A	A	B	B	B	A*	A*	A	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A	A	
2																									
3																									
4	A	A	B	A	A	A	A	A	A	A	A	A	B	A	A*	A*	A*	A*	A*	B	A	A	A	A	
5	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A*	A*	A*	D	A	D	D	B	B	
6																									
7																									
8	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
9	A	A	A	A	A	A	A	A	A	A	A	A	A	D	D	D	D	D	D	D	D	A	A	A	
10	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A*	A*	A*	A*	A*	A*	A*	B	B	B	
11																									
12																									
13	A	A	A	A	A	A	A	A	A	A*	A	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A	
14																									
15																									
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	

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SEPT 1982	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1																									
2																									
3																									
4	A	A	A	A*	A*	A*	A*	A*	A	A*	A	A	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	
5	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A	A	A	A	
6	A	A	A	A	B	A	A*	A	A	A	A	A	A	A*	A*	A*	A*	A*	A*	A*	A	A	A	A	
7																									
8	B	B	B	B	A	A	A	A	A	A	A	A	A*	A	A	A*	A*	A*	A*	A*	A	A	A	A	
9	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A*	A*	A*	A*	A	A	A	A	A	A	
10	A	A	A	A	A	A	A	A	A	A	A	A*	A*	A*	A*	A*	A*	A*	A*	A*	A	A	A	A	
11	A	A	A	A	A	A	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A	A	A	
12	A	A	A	A	A*	A*	A*	A*	A	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	B*	B*	B	A	A	
13	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A*	A*	A*	A*	A*	A*	A*	A	A	A	
14	A	B	B	B	B	B	B*	B	D*	A	A*	A	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	B	B	
15	B	B	B	B	B	B	B	B	B	B	B	B*	B	A*	A*	A*	A*	A*	A*	A*	A*	A	A	A	
16	A	A	A	A	A	A	A	A	A	A	A	A	A*	A*	A*	A*	A*	A*	A*	A	A	A	A	A	
17																									
18																									
19																									
20	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A*	A	A	A	A	A	A	A	A*	A*	
21	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A	A	
22	B	B	B	B	B	B*	B*	B*	B*	A*	B*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	A*	
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	

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TABLE 5-4

SUMMARY OF THE ANALYSES OF SIMILARITY OF
ATMOSPHERIC STRUCTURE IN THE LOWER PORTION OF THE PBL AT
THE TWO SOUNDER SITES [30 CASE STUDY DAYS]

CATEGORY	OFFSHORE FLOW	%	ONSHORE FLOW	%	ALL CASES	%
A Essentially Identical	359	85%	276	93%	635	88%
B Possibly Different	43	10%	16	5%	59	8%
C Likely Different	0	0%	0	0%	0	0%
D Data Not Available	21	5%	5	2%	26	4%
	423	100%	297	100%	720	100%

accomplished by penciling in the estimated mixing depth curve upon the reproduced sounder trace, and then reading off the values hourly to the nearest 10 meters. The traces from each site were analysed separately. Note that the entry 777 indicates that one or the other site had mixing depths greater than 500 m, 888 means one or the other trace was unable to yield a mixing depth, and 999 means one or the other sounder was inoperative. Differences could be ascertained for 560 hours (78% of the time). The average mixing depth difference between the two sites for all hours was 22.5 m. This further supports the homogeneity of conditions at both sites.

As one would expect, the number of hours with mixing depths above 500 m were overwhelmingly weighted towards the daylight hours (69, or 96% of the observations). About twice as many of the hours for which the mixing depth could not be ascertained (codes 888, 999) were during the day, the result of the large number of observations of weak thermal plumes without any obvious limiting stable layer above. During the night, an upper limit to the likely dispersion of a near-surface released plume could almost always be determined. As suggested by Table 5-5, there appears to be no apparent bias towards under- or over estimation of the mixing depth, either during the night or the day. In fact, for 111 hours, values within 10 m of each other were analysed (20% of the hours for which a discrete value was obtained).

The distibution of mixing depth differences as a function of time of day and direction of the low level wind was investigated. On the whole, differences tend to be smaller (less than 20 m) during the night. This is because the nocturnal stable layers produce much stronger and consistent returns, and are therefore somewhat easier to analyse. Also they are shallower and less subject

to large amplitude variations. No obvious trend in differences depending on whether the flow in onshore or offshore is noted.

During the night, the 150 ft sensors were generally found within the nocturnal inversion layers at both sites. During the day, since virtually no surface based inversions were detected, and since the mixing depth was almost always greater than 150 m, it is apparent that the middle level Shoreham West data are generally embedded within the same atmospheric layers. While site specific differences in turbulence and temperature lapse rate may exist, they would appear to sufficiently second order in nature to be largely unresolved by the sounders.

TABLE 5-5

DISTRIBUTION OF DIFFERENCES OF ACOUSTIC SOUNDER

DERIVED MIXING DEPTHS (TOWER MINUS PLANT)

[30 CASE STUDY DAYS]

	"NIGHT" [01-12Z]		"DAY" [13-00Z]	
TOTAL HOURS	360	(100%)	360	(100%)
MD > 500 Meters	3	(1%)	69	(19%)
MD Higher at Tower	135	(38%)	97	(27%)
MD Same Both Sites	77	(21%)	34	(9%)
MD Lower at Tower	112	(31%)	96	(27%)
MD Not Determinable	33	(9%)	64	(18%)

6. SUMMARY AND CONCLUSIONS

A field data collection program was conducted from 15 July to 22 September 1982 at the Shoreham West tower and at the Shoreham plant itself. The key component was the operation of two AeroVironment Model 300 standard monostatic acoustic sounders. In order to interpret their output and to categorize the structure of the lower planetary boundary layer (PBL) at both sites, a considerable amount of supplemental data were acquired. The strip charts from the newly refurbished 400 ft tower (wind at 33, 150 and 400 ft; delta T from 33-150 ft and 33-400 ft; sigma theta at 33 and 150 ft; precipitation; temperature; and solar radiation) were digitized hourly (15 minute averages). An overall data capture rate of 94.9% was noted. R*SCAN also received the processed tower data from Brookhaven National Laboratory (BNL), located 10 km to the south. Anemometer strip charts from the Brookhaven Airport (16 km south) were received, checked, and reduced. All available surface, upper air, marine, and buoy observations for the surrounding 200 miles were acquired via real-time climatological (RTC) data gathering with the assistance of WSI. Facsimile charts and GOES satellite images were included in the 70 daily data files (DDF) assembled to support the sounder chart reduction.

The project period was typified by light winds, sunny skies, and rather dry weather. Thus numerous examples of coastal mesoscale regimes (CMRs) were recorded. Between CMRs and thunderstorm mesosystems, 60 of the 70 project days had disturbances in the mesoscale atmospheric flow patterns in the general vicinity of the plant. Since the project began rather late in the warm season, both LI Sound and the Atlantic had reached to near their maximum water temperature (20°-22°C) by mid-July, with little change thereafter.

A climatographic analysis of the conditions during the project revealed that the several types of sound breezes occured on 31 days. Land breezes were noted on 9 days. Periods of onshore gradient flow resulting in fumigation or plume trapping conditions occured 25 days. The Atlantic Sea Breeze (ASB) reached the site 36 days. On 11 days, thunderstorm mesosystems potentially affected winds within about an 80 km radius of Shoreham.

Onshore winds were noted at the 33 ft level at Shoreham West 76% of the days at 1700Z. This was 562% higher than at the time of the minimum frequency (0000Z). In many sound breeze or onshore flow episodes, the winds were off the water prior to 1200Z (24 days). When a definite shift to onshore was noted, the most frequent time was 1500Z, and never later than 1700Z. The time of breakdown of the onshore flow most frequently was at 2200Z (12 days).

Analysis of the acoustic sounder traces showed little if any reason to suspect significant variability in the turbulence characteristics of the PBL around the 150 ft level between the tower and the plant site. Considering that towers at the same distance inland from Lake Michigan, but 42 miles apart, showed a high degree of correlation of wind patterns (Aron and Hodgson, 1982), this is not a surprising result. It should be noted that there are strong gradients of parameters normal to the shoreline, however. For the hours in which simultaneous sounder traces were analysed in detail (694), fully 92% appeared virtually indistinguishable. An additional 59 hours could possibly have been different, although no strong evidence was found to suggest this. No hours were found in which the lower PBL structure were clearly different at the two sites.

During daytime onshore flow within the period of study, the mixing depth almost invariably was greater than 150 m. Therefore the 150 ft wind and sigma theta measurements would appear to be within the TIBL layer for daytime onshore flow periods and representative of the dispersive environment for low plume rise releases from containment at the plant.

Mixing heights estimated at both sites averaged only 22.5 m difference. The values tended to be closer during the night when shallow inversions predominated. No impact of wind direction (onshore or offshore) could be found in terms of mixing depths differences between the two sites.

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Particular thanks are extended to Mr. David McGinnis of R*SCAN Corporation whose task it was to collect, catalog, and process the large amount of data assembled for this project, and without whose consistent efforts this report could not have been completed.

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APPENDIX A

Sample WSI Output

[This represents only a fraction of material archived daily]

R·SCAN
CORPORATION

-LILCO SEP20

SEP20.00 20-SEP-82

007-117 DATA FROM 20-SEP-82 -

ISP SA 1050 E80 BKN 120 OVC 10 166/60/52/0806/001
ISP SA 0950 M32 OVC 8 163/59/53/0806/000
ISP SA 0850 M32 BKN 10 163/56/52/0605/000/ 607
ISP SA 0750 M32 BKN 10 163/56/52/0000/000
ISP SA 0650 35 SCT 12 163/51/49/0000/000
ISP SA 0550 35 SCT 15 169/49/48/0000/002/ 807 71
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ISP SA 0250 CLR 15 176/50/48/0000/004
ISP SA 0150 CLR 15 176/51/47/0000/004
ISP SA 0050 CLR 15 176/56/48/0000/004
ISP SA 2350 CLR 15 166/60/48/0000/001/ 003 71
FOK SA 1045 E100 OVC 10 60/51/0000/0011
FOK SA FINO
FOK SA 0248 CLR 15 50/42/0000/002/LAST
FOK SA 0145 200 SCT 15 49/38/0000/002
FOK SA 0050 200 SCT 15 54/41/0000/001
FOK SA 2348 200 SCT 15 60/45/0000/000
FRG SP 1121 E25 BKN 50 OVC 7R- 1004/000/VSBY LWR S RB05
FRG SA 1045 40 SCT E80 OVC 10 0405/999
FRG SA FINO
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FRG SA 0145 CLR 15 0000/001
FRG SA 0055 CLR 15 0707/001
FRG SA 2345 200 SCT 15 1808/000
JFK SA 1050 M60 OVC 7RW- 166/62/55/0706/002/RB42
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JFK SA 0453 CLR 10 169/59/54/0807/003
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JFK SA 0250 CLR 10 169/60/53/1608/003/ 007
JFK SA 0150 CLR 10 173/62/53/1708/004
JFK SA 0050 CLR 15 169/63/52/1708/003
JFK SA 2350 CLR 12 163/62/52/1608/001/ 103 69
LGA SA 1052 M46 OVC 8R- 166/62/51/1509/002/RB45
LGA SA 0952 M44 OVC 10 163/62/51/1211/001
LGA SA 0852 M46 OVC 10 159/62/50/1209/000/ 603
LGA SA 0752 M49 BKN 10 159/60/51/1209/000 88///
LGA SA 0652 M50 BKN 250 BKN 10 159/61/51/1108/000
LGA SA 0552 E250 BKN 10 163/60/53/1107/001/710 1006 70
LGA SA 0452 E250 BKN 15 173/61/53/1905/004
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LGA SA 0252 200 SCT 15 173/61/52/2107/004/ 107 1002
LGA SA 0152 200 SCT 15 173/62/51/1809/004
LGA SA 0052 200 SCT 15 173/62/51/1905/004
LGA SA 2352 200 SCT 15 166/62/49/M/000/ 70
GON SA 1045 E80 BKN 250 OVC 15 50/M/0000/003
GON SA 0945 E250 BKN 15 50/M/0000/003
GON SA 0245 CLR 15 55/M/0000/004
GON SA 0145 CLR 15 55/M/0000/004
GON SA 0045 CLR 15 60/M/2205/002
GON SA 2345 CLR 15 62/M/2305/001
HVN SA 1047 E100 BKN 200 BKN 20 0506/002
HVN SA FINO
HVN SA 0145 CLR 20 M/M/0000/003/LAST
HVN SA 0045 CLR 20 M/M/0000/003
HVN SA 2345 CLR 20 M/M/0000/000
BDR SA 1053 M50 BKN 80 OVC 20 166/55/50/0308/002
BDR SA 1053 M50 BKN 80 OVC 20 163/55/50/0308/001
BDR RS 10[illegible] M50 BKN 80 OVC 20 [illegible]/LAST

BID AMOS 58/51/1006/M PK WND 09 000
BID SA 1055 AMOS 28 SCT E45 BKN 100 BKN 20 57/49/1004/M
PK WND 05 000 ALT 005
BID AMOS 57/48/1103/M PK WND 05 000
BID AMOS 56/47/0903/M PK WND 05 000
BID AMOS 55/46/0000/M PK WND 02 000
BID AMOS 56/46/1005/M PK WND 05 000
BID AMOS 55/45/1104/M PK WND 05 000
BID AMOS 55/44/1202/M PK WND 03 000
BID AMOS 55/44/1204/M PK WND 05 000
BID AMOS 56/45/1204/M PK WND 05 000
BID AMOS 53/43/1002/M PK WND 03 000
BID AMOS 57/46/1402/M PK WND 03 000
BID AMOS 57/46/1802/M PK WND 03 000
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BID AMOS 57/46/2004/M PK WND 04 000
BID AMOS 57/45/1903/M PK WND 04 000
BID AMOS 57/45/2103/M PK WND 04 000
BID AMOS 57/44/2203/M PK WND 05 000
BID SA 0159 AMOS CLR 20 58/45/2303/M PK WND 04 000 ALT
005 LAST
BID AMOS 56/44/1904/M PK WND 05 000
BID SA 0100 AMOS CLR 20 57/43/2004/M PK WND 05 000 ALT
005
BID AMOS 57/43/2104/M PK WND 05 000
BID SA 2355 AMOS CLR 20 57/43/2104/M PK WND 05 000 ALT
002
PVD SA 1054 75 -SCT E250 BKN 15 176/48/43/3003/005
PVD SA 0954 E250 BKN 15 172/47/42/3003/004/ AC SE-SW
PVD SA 0855 E250 BKN 15 172/49/43/2903/004/ 500 1002
PVD SA 0756 E250 OVC 15 169/48/43/E1302/003/ 98739
PVD SA 0654 E250 BKN 15 169/48/43/2903/003
PVD SA 0554 E250 BKN 15 172/47/42/2203/004/ 603 1002 46946
PVD SA 0454 250 -SCT 15 173/47/42/2205/004
PVD SA 0353 CLR 15 172/50/43/1603/004
PVD SA 0253 CLR 15 176/49/41/0000/005/ 307
PVD SA 0152 CLR 15 174/51/43/0000/004
PVD SA 0051 CLR 15 170/55/42/0000/003
PVD SA 2353 CLR 15 169/56/42/2106/003/ 214 46949
BDL SA 1050 E250 OVC 25 177/43/38/0000/005
BDL SA 0954 E250 OVC 25 174/43/38/0603/004
BDL SA 0852 E250 BKN 25 171/42/38/0203/003/603 1001
BDL SA 0650 E250 BKN 25 171/42/38/0000/003
BDL SA 0550 250-SCT 25 174/43/38/0000/004/ 103 1001 47043
BDL SA 0450 250-SCT 25 173/45/39/3104/004
BDL SA 0350 250 SCT 25 170/47/41/1703/003
BDL SA 0250 250 SCT 25 170/50/41/3104//003/ 110 1006
BDL SA 0150 250 SCT 25 170/52/42/E2802/003
BDL SA 0050 250 SCT 25 170/53/44/2803/003
BDL SA 2350 250 SCT 25 160/54/44/0000/000/ 307 47046
HFD SA 1056 60 SCT E110 BKN 20 3407/008
HFD SA FINO
HFD SA 0145 200 SCT 30 M/M/1704/006/LAST
HFD SA 0045 CLR 40 M/M/1904/005
HFD SA 2345 150 SCT 40 M/M/1808/003
HPN SA 1050 E55 OVC 15 166/54/50/0000/002
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HPN SA 0850 E150 BKN 20 166/55/50/0000/002
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EWR SA 1050 M55 OVC 12R- 163/63/56/1308/001 RB40
EWR SA 0950 M55 OVC 15 159 62/53/1204/000
EWR SA 0852 M50 OVC 15 152/59/54/3606/998 607 15//
EWR SA 0750 M60 OVC 15 152/59/55/0306/998
EWR SA 0652 M70 BKN 200 OVC 15 156/61/55/0803/999
EWR SA 0550 M70 BKN 200 OVC 15 145/62/55/1003/000/806 1057 70
EWR SA 0450 E200 BKN 20 169/61/55/2004/003
EWR SA COR E230 OVC 20 169/61/54/1603/003
EWR SA 0350 E1230 OVC 20 169/61/54/1603/003
EWR SA 0250 250 -OVC 20 169/60/54/1603/003/ 005 1001
EWR SA 0150 250-OVC 20 173/61/53/2304/004
EWR SA 0050 250-BKN 20 169/61/5[illegible]/2205/003
EWR SA 2350 250-SCT 20 163/63/5[illegible]/1808/001/ 205 1004 70
SWF SA 1055 40 SCT E80 BKN 12[illegible] OVC 12 49/36/2[illegible]/002

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BUOY DATA

STATION: 44003 TODAY'S DATE: 20-SEP-82

TIME	DATE	TMP	WTR	WIND	PRS	WAVE
8PM(00Z)	19	59	59	0904	170	0603
9PM(01Z)	19	59	59	1006	176	0603
10PM(02Z)	19	59	59	1206	176	0703
11PM(03Z)	19	58	59	1206	177	0603
12AM(04Z)	20	59	59	1306	174	0803
1AM(05Z)	20	60	61	1408	174	0603
2AM(06Z)	20	60	61	1306	173	0503
3AM(07Z)	20	60	60	1206	167	0903
4AM(08Z)	20	60	61	0806	166	0903
5AM(09Z)	20	59	59	0806	171	0901
6AM(10Z)	20	59	59	0708	173	0801
7AM(11Z)	20	59	59	0710	174	0801

STATION: 44005 TODAY'S DATE: 20-SEP-82

TIME	DATE	TMP	WTR	WIND	PRS	WAVE
8PM(00Z)	19	57		2504	175	0501
9PM(01Z)	19	57		2404	180	0501
10PM(02Z)	19	57		2606	181	0501
11PM(03Z)	19	57		2702	177	0701
12AM(04Z)	20	57		2704	177	0901
1AM(05Z)	20	57		2404	177	0801
2AM(06Z)	20	57		2104	177	0901
3AM(07Z)	20	57		2004	176	0901
4AM(08Z)	20	57		2004	178	0901
5AM(09Z)	20	56		0000	181	0901
6AM(10Z)	20	56		0000	182	0901
7AM(11Z)	20	57		1402	189	0801

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
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VGDT 20004 99449 70660 42998 02318 10128 2011/ 40144 52025 22284 00114 20302=
FPLH 20003 99449 70615 42/97 02504 1014/ 4014/=
CGMW 20004 99443 70643 42/95 13208 1014/ 4015/=
GUZJ 20004 99442 70666 42/98 12613 1013/ 4016/=
UKFY 20001 99434 70659 41998 03005 10100 40158 52015 22200 00110 20000=
VDND 20004 99442 70677 42998 02617 10125 2010/ 40146 52918 22274 00128=
KFCO 20003 99411 70655 42898 30409 10156 2012/ 40160 51015 70200 82101 22224
     00156 20601 30100 40801 50000=
UKFY 20001 99434 70659 41998 03005 10100 40158 52015 22200 00110 20000=
NRDD 20004 99412 70656 42598 10207 10150 2015/ 40178 52012 70100 81/// 22213
     00170 2//// 335// 40401 5////=
FPLH 20063 99447 70626 42/98 03209 1012/ 4017/=
CGMW 20064 99443 70643 42/98 01000 1010/ 4018/=
UKFY 20061 99434 70659 42/98 92203 10070 40174 52011 89/// 22200 00110 2////=
GYQT 20064 99424 70671 42/98 12305 1004/ 4017/=
NRDD 20064 99421 70654 42998 03305 10156 2016/ 54000 7//// 8//// 22262 00172
     2//// 300// 40401 5////=
VCWX 20064 99449 70662 42990 03304 10120 2008/ 40168 52012 22253 00130=
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```
SXUS8 KNYC 200700
ID  WXVSB/WIND /WAVE/SEA/AIR/PRES REMARKS STATION NAME
50N PCC09/S04  /CALM/    /64 /3002         ROCKAWAY
51N CC10 /SSE07/CALM/    /62 /3052         SHORT BEACH
45N CC10 /ESE04/CALM/    /58 /3000         FIRE ISLAND
N28 CYC10/S09  /0202/68  /64 /3003         AMBROSE TOWER
34N C10  /CALM /CALM/    /58 /3024         EATONS NECK NY
18N C10  /ESE05/CALM/    /56 /             NEW LONDON LEDGE
N11 C10  /NNE05/CALM/    /58 /             NEW HAVEN HARBOR
61N PC 10/ESE09/    /    /67 /2996         INDIAN RIVER
N91 CLR07/ESE06/    /    /68 /2997         CAPE MAY
55N CDY05/ESE07/    /    /62 /2999         ATLANTIC CITY
BT

3333
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SXUS8 KNYC 200200
ID  WXVIS WINDS/WAVE/SEA/AIR/PRES  REMARKS  STATION NAME
34N C10  /CALM /CALM/    /59 /3028          EATONS NECK NY
18N C10  /SSW10/0102/    /62 /              NEW LONDON LEDGE
N11 C10  /W10   /CALM/   /66 /2999          NEW HAVEN HARBOR
50N CC09  /S05  /CALM/   /64 /3003          ROCKAWAY
51N CC09  /S06  /CALM/   /66 /3051          SHORT BEACH
45N CC10  /S03  /CALM/   /60 /3000          FIRE ISLAND
N28 CC10  /SW09 /0202/68 /63 /3002          AMBROSE TOWER
61N PC 10  SE 09/    /   /68 /2998          INDIAN RIVER
N91 PC 05  ESE06/    /   /68 /3002          CAPE MAY
55N PC 06  ESE05/    /   /62 /3003          ATLANTIC CITY
BT
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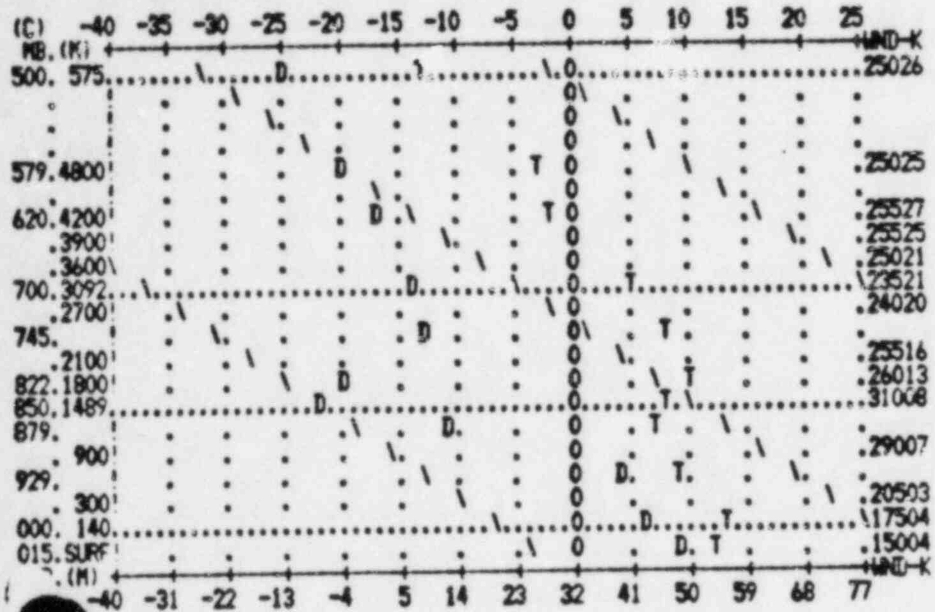
UPPER AIR PLOT FOR: CHH FOR 00Z, 20-SEP-82



LEVEL MB	THICKNESS (M)	AVG PRECIPITABLE WATER (IN)
500	5610	0.45
700	2952	0.33
850	1349	0.24

VERTICAL TOTAL	CROSS TOTAL	TOTAL TOTAL
22	-8	13

K INDEX = -19

FORECAST MAX TEMP = 24 (C)

LIFTED INDEX = 14

SHOWALTER INDEX = 17

CONVECTION CONTENSATION LEVEL = 634 MB

LIFTING CONDENSATION LEVEL = 968 MB

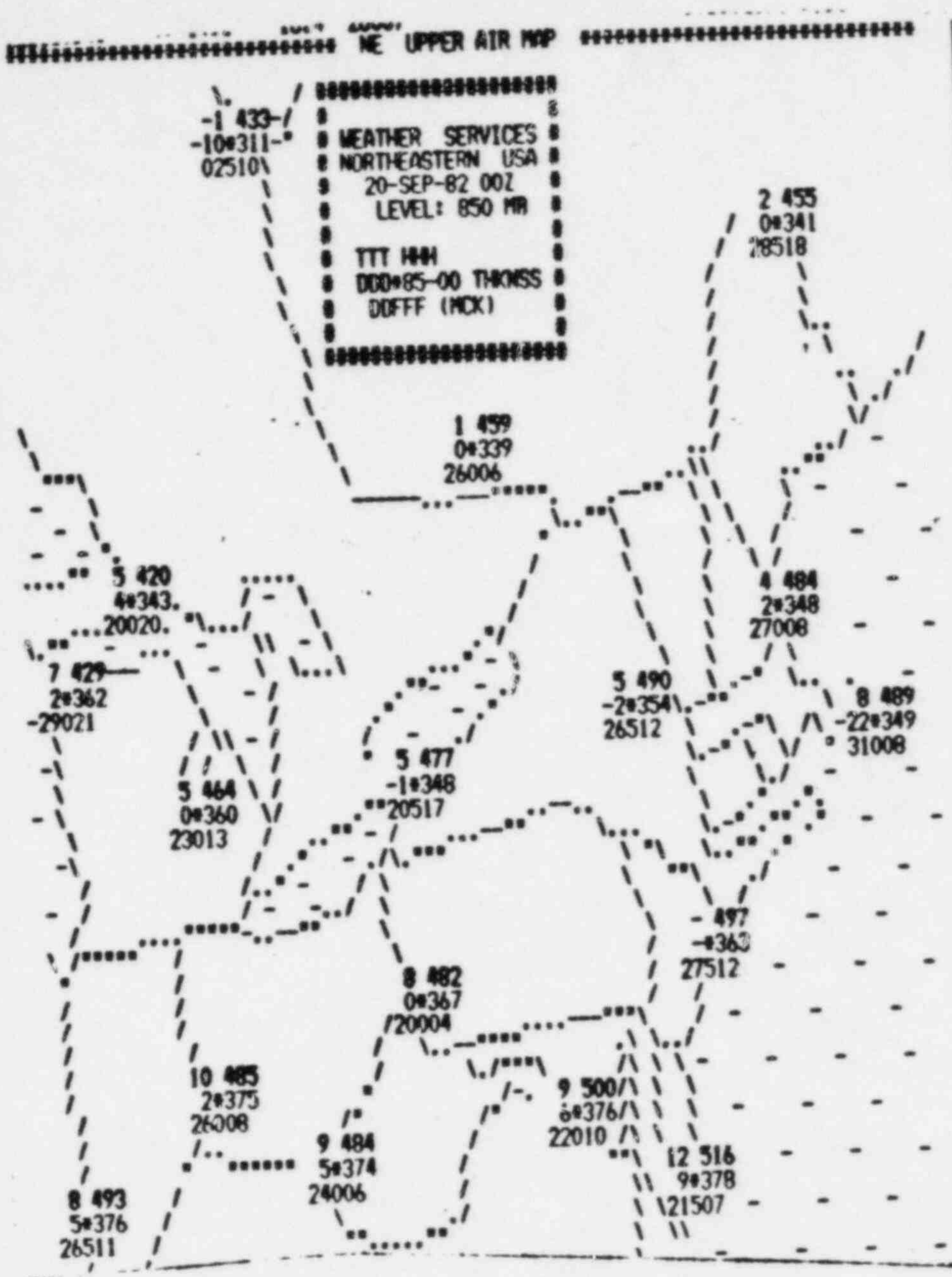
SEVERE WEATHER INDEX = -1012

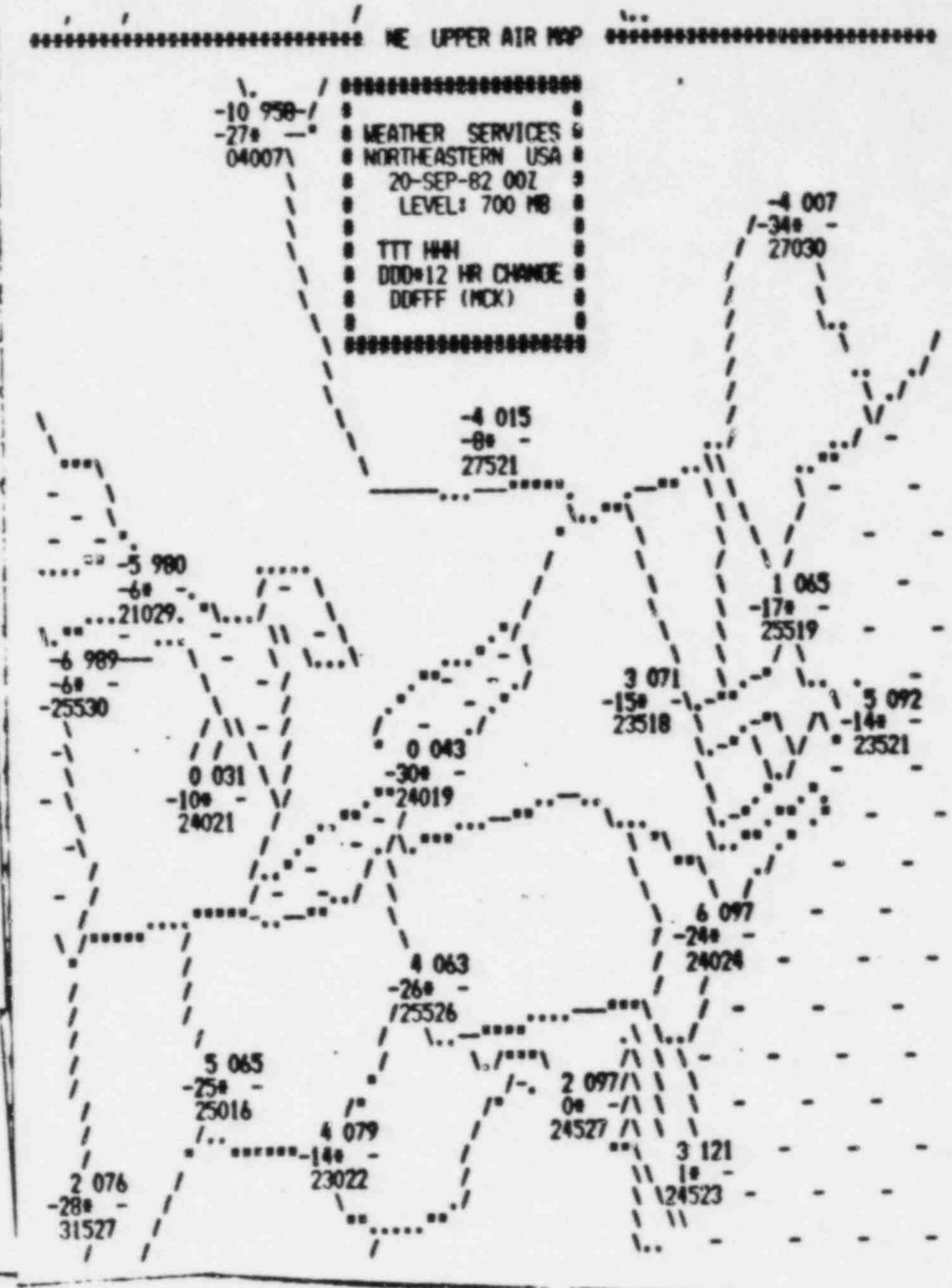
UPPER AIR DATA FOR: ACY FOR 00Z, 20-SEP-82

LEVEL (MB)	HEIGHT (M)	TMP (C)	DPT (C)	DDFFF (KTS)
100	16470	-61.7		26520
150	13950	-60.9		25547
161		-60.3		
200	12140	-54.9		26042
250	10700	-49.5		25042
300	9480	-39.7	-53.7	24536
348		-31.5	-61.5	
400	7440	-22.9	-52.9	24535
455		-15.3	-45.3	
500	5760	-12.1	-42.1	24528
669		4.2	-25.8	
700	3097	5.8	-24.2	24024
805		9.4	-20.6	
850	1497			27512
870		8.0	4.8	
1000	134	17.2	11.2	16008
1013	SURF	18.0	12.0	15007

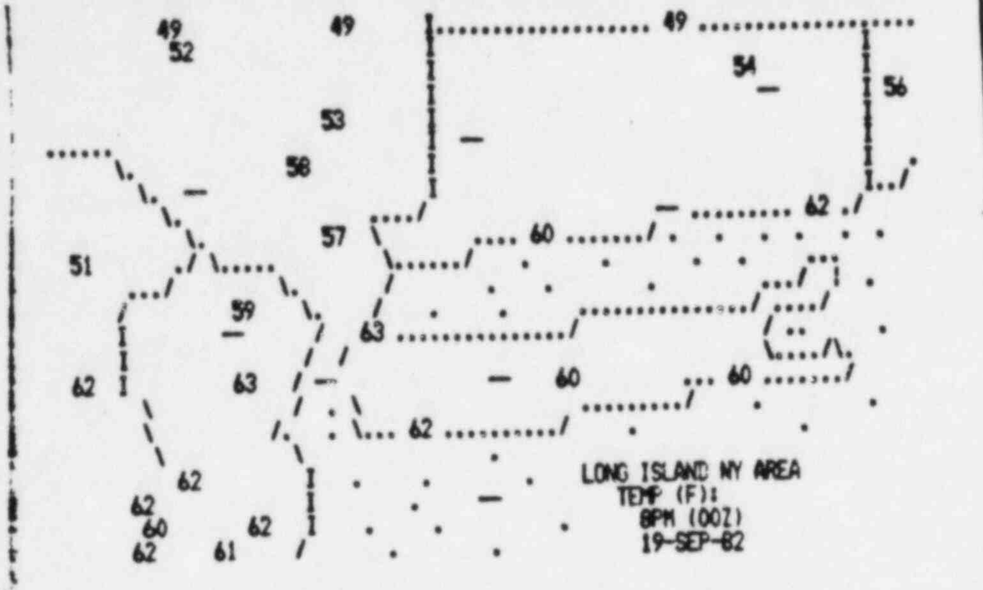
UPPER AIR DATA FOR: CHH FOR 00Z, 20-SEP-82

LEVEL (MB)	HEIGHT (M)	TMP (C)	DPT (C)	DDFFF (KTS)
100	16440	-60.3		25033
102		-61.3		
127		-58.1		
150	13900	-60.1		25539
172		-60.1		
200	12100	-54.7		24588
225		-55.3		
250	10660	-50.3		24542
300	9450	-41.3		24539
309		-39.1	-49.1	
400	7420	-24.3	-39.3	24040
500	5750	-13.3	-25.3	25026
579		-2.9	-19.9	
620		-1.5	-16.5	
700	3092	5.0	-14.0	23521
745		8.4	-12.6	
822		9.8	-20.2	
850	1489	8.4	-21.6	31008
879		7.4	-10.6	
929		8.6	3.6	
953		11.2	4.2	
1000	140	13.0	6.0	17504
1015	SURF	12.0	8.9	15004

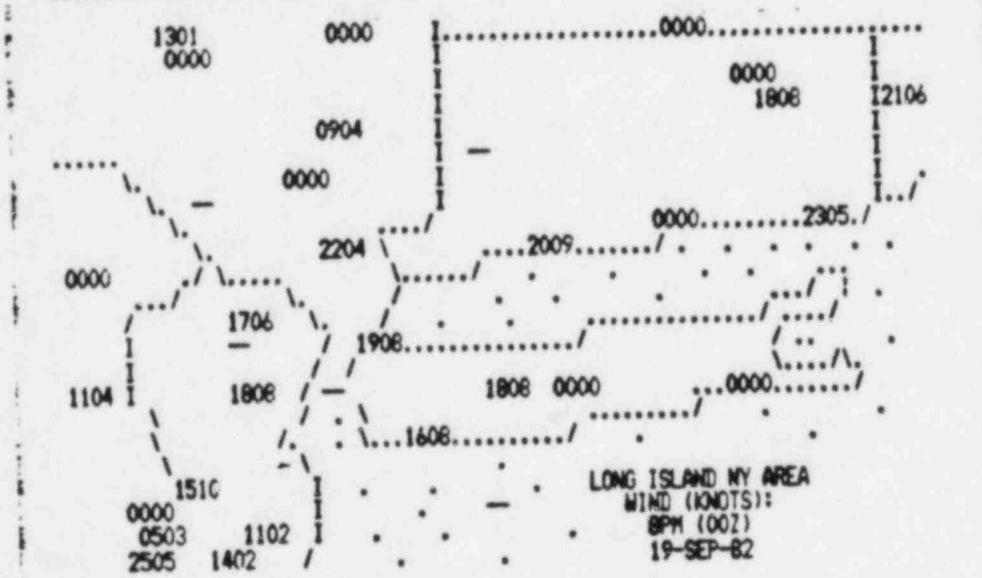

NE UPPER AIR MAP
WEATHER SERVICES
NORTHEASTERN USA
20-SEP-82 00Z
LEVEL: 850 MB
TTT HHH
DDD*85-00 THKNSS
DDFFF (MCX)
-1 433
-10*311
02510
2 455
0*341
28518
1 459
0*339
26006
5 420
4*343
20020
4 484
2*348
27008
7 429
2*362
-29021
5 490
-2*354
26512
8 489
-22*349
31008
5 477
-1*348
20517
5 464
0*360
23013
-497
-*363
27512
8 482
0*367
20004
10 485
2*375
26008
9 500
6*376
22010
9 484
5*374
24006
12 516
9*378
21507
8 493
5*376
26511


NE UPPER AIR MAP
WEATHER SERVICES
NORTHEASTERN USA
20-SEP-82 00Z
LEVEL: 700 MB
TTT HHH
DDD*12 HR CHANGE
DDFFF (MCX)
-10 958
-27*
04007
-4 007
-34*
27030
-4 015
-8*
27521
-5 980
-6*
21029
1 065
-17*
25519
-6 989
-6*
-25530
3 071
-15*
23518
5 092
-14*
23521
0 043
-30*
24019
0 031
-10*
24021
6 097
-24*
24024
4 063
-26*
25526
5 065
-25*
25016
2 097
0*
24527
4 079
-14*
23022
3 121
1*
24523
2 076
-28*
31527

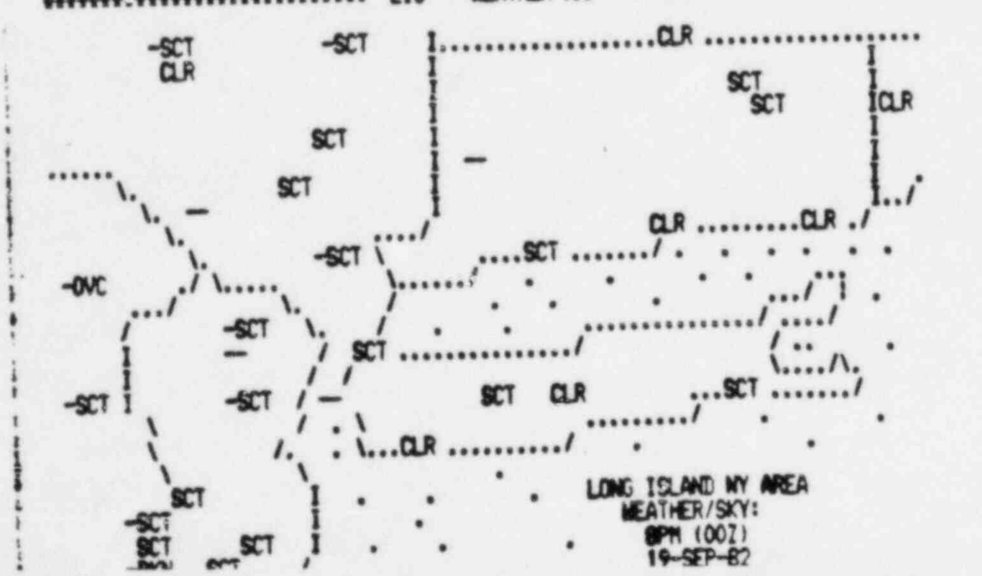
######################## LIS WEATHER MAP ########################



######################## LIS WEATHER MAP ########################



######################## LIS WEATHER MAP ########################



FOUS53 KWBC 200000

TRAJECTORY FCST

STA	LVL	200000Z LATLONPPP	200600Z LATLONPPP	201200Z LATLONPPP	201800Z LATLONPPP		210000Z TEMP	210000Z DEWPT	K
DCA	700	379886719	374860718	374832714	379801707		2.5	-12.3	16
	850	377827875	379815869	381800861	384786855		11.1	7.2	
	SFC	376787970	380784970	383782971	387777974	984	20.1	12.9	
IPT	700	399886729	395858726	396828719	402798709		-.1	-13.1	15
	850	392824882	395812875	399798865	406784857		8.9	4.5	
	SFC	392787961	397783961	401780959	408776965	970	17.1	7.3	
BUF	700	423900729	417870726	416839716	421811707		-2.7	-6.3	24
	850	410849882	413830874	418813865	424799856		7.1	2.1	
	SFC	405809972	411802973	417797978	426791982	985	15.7	5.9	
BTV	700	399823761	406801747	416777729	430754715		-1.2	-11.6	13
	850	414757883	418749876	424745868	435738860		6.2	.3	
	SFC	435713978	431712983	430719985	437726982	978	12.4	3.2	
ALB	700	390840751	393817742	401791728	413764714		.0	-10.6	16
	850	394771887	399763879	407757869	418748860		8.2	3.1	
	SFC	419723984	416723988	413730987	420736983	978	14.8	5.2	
LGA	700	376845740	377822735	383795724	393767712		1.8	-7.7	22
	850	375779886	381770878	388762867	398751859		10.7	8.2	
	SFC	399724010	396726011	395733011	401737006	003	18.4	10.7	
CAR	700	425766743	433746726	442726714	455703706		-2.3	-14.3	8
	850	454717836	453704846	455697850	461687851		4.1	-1.5	
	SFC	468690981	465679988	463675993	464674995	996	11.0	4.1	
PWM	700	384796760	393776747	404753730	419729716		-.1	-3.9	13
	850	411730878	411723873	415719867	426711860		7.3	-5.0	
	SFC	434676994	429678998	425686999	429695998	994	14.1	6.6	
BOS	700	372807756	381786745	391762730	406737716		.9	-1.6	20
	850	393742884	395734877	400729870	412720861		9.1	.6	
	SFC	420684009	415686010	412694011	416702008	005	16.3	8.8	
CON	700	382810758	390790746	400766731	415741716		.1	-5.3	15
	850	40374[illegible]883	405737877	410732869	421724861		7.8	-1.1	
	SFC	428689997	423690000	4206[illegible]001	424707998	995	14.6	6.4	

FOUS61 KWBC 200000

STA	RH	R1R2R3	VVLI	HHDDFF	TBPSPTT
BOS	39	613932	///15	592302	8716///
06	41	624327	01013	570209	8717000
12	46	674733	00011	571110	8815000
18	73	706787	01107	591306	9115000
24	94	869692	01305	591410	9114008
30	91	939773	00803	591405	9114014
36	84	908678	-0103	591104	9113006
42	78	877870	00402	610504	9215002
48	83	888183	00304	620809	9215002

FOUS61 KWBC 200000

STA	RH	R1R2R3	VVLI	HHDDFF	TBPSPTT
LGA	35	603318	///12	611703	8916/[illegible]
06	45	615222	00811	600306	9015000
12	69	687264	00509	591212	9015000
18	90	809489	01205	611707	9213000
24	86	889075	00703	611404	9213007
30	76	847866	00502	602403	9314004
36	70	796673	-0302	600104	9213001
42	72	796973	00503	610405	9315000
48	84	918184	00904	620508	9114014

FOUS78 KWBC 200000

STA	RH	R1R2R3	VVLI	HHDDFF	TBPSPTT
LGIN6					
00	44	694036	///10	641302	9016///
06	45	704630	00505	630206	9315000
12	53	705634	-0103	631008	9415000
18	76	707483	00900	661609	9613000
24	93	819595	01699	661610	9613011
30	87	789089	00798	672012	9713015
36	84	748395	00298	672305	9712005
42	80	737990	00498	681806	9813001
48	91	839197	01799	681203	9714016

DATE/GMT		20/06	20/12	20/18	21/00	21/06	21/12	21/18	22/00
LGA	POP06		10	60	60	30	20	40	50
	POP12				80		40		60
	QPF06		000/1	210/1	100/1	000/1	100/1	100/1	
	QPF12				3100/2		1100/1		2100/1
	TSTM				24		18		26
	POPT		0000/3	0000/3	0000/3	0000/3	0000/3	0000/3	0000/3
	POSH				99 99/0				
	MX/MN				68		56		68
	TEMP	60 59	60 64	66 66	63 61	60 59	61 65	66 65	63 62
	DEWPT	52 52	53 55	55 56	55 54	54 53	55 57	57 57	56 55
	WIND	1806	1006	1008	1106	3506	0206	0307	0207
	CLDS	2423/2	0226/4	0137/4	0127/4	0226/4	0126/4	0137/4	0028/4
	CIG	000118	001225	001332	001233	011224	011224	001332	012332
	VIS	000019	002214	001117	001116	001116	002214	001126	001216
	C/V	6/6	5/4	4/6	4/6	4/6	4/4	4/5	3/4
	OBVIS	90X1/1	42X4/4	71X2/1	61X3/1	60X4/1	41X5/4	62X2/2	61X3/2

DATE/GMT		20/06	20/12	20/18	21/00	21/06	21/12	21/18	22/00
BDL	POP06		5	50	60	50	30	30	40
	POP12				80		60		50
	QPF06		000/1	000/1	100/1	100/1	100/1	100/1	
	QPF12				2100/1		1100/1		1100/1
	TSTM				21		16		24
	POPT		0000/3	0000/3	0000/3	0000/3	0000/3	0000/3	0000/3
	POSH				99 99/0				
	MX/MN				65		50		6[illegible]
	TEMP	48 46	50 58	62 62	58 55	53 52	54 61	65 64	59 5[illegible]
	DEWPT	42 42	46 50	51 52	53 53	52 51	52 55	55 54	54 5[illegible]
	WIND	0000	3601	1406	0202	3604	3502	3604	010[illegible]
	CLDS	3412/2	0325/4	0127/4	0029/4	0227/4	0127/4	0137/4	0028/[illegible]
	CIG	000018	011126	001333	011332	011223	012223	011332	01233[illegible]
	VIS	000009	102114	001116	002215	002214	113113	001216	00121[illegible]
	C/V	6/6	6/4	4/6	4/3	3/3	3/1	4/4	3/[illegible]
	OBVIS	90X1/1	41X4/4	61X2/1	61X4/4	40X5/4	30X7/4	62X2/2	62X3/[illegible]

RADAR MAP (18, 81) - 19-SEP-82 11:35 PM (0335Z)

NYC 1030 AREA 5RW/NC 92/95 193/145 269/125 C2420 MT 230 AT 184/39
^KP1 LP2 MM1222 OK10112 PK111122 QL10021 RO1=

NYC 0930 AREA 5RW/+ 101/95 216/125 253/95 C2420 MT 180 AT 207/65
^MO22 NN121 OL1122 PL222 QM1=

NYC 0735 PPINE=

NYC 0635 PPINE=

NYC 0535 PPINE=

NYC 0435 PPINE=

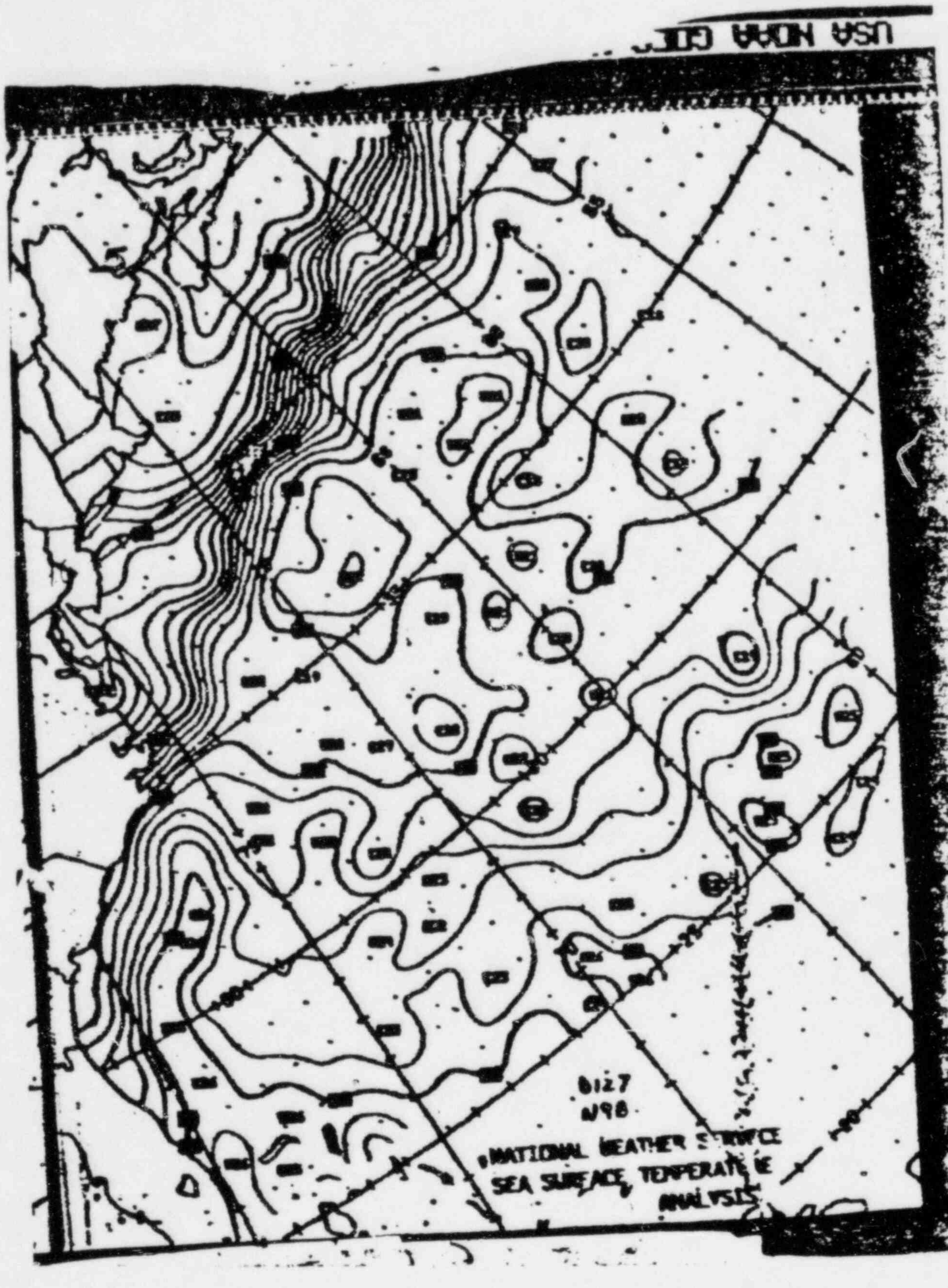
<<<< RADAR MAP (18, 81) - 20-SEP-82 2:35 AM (0635Z) >>>>

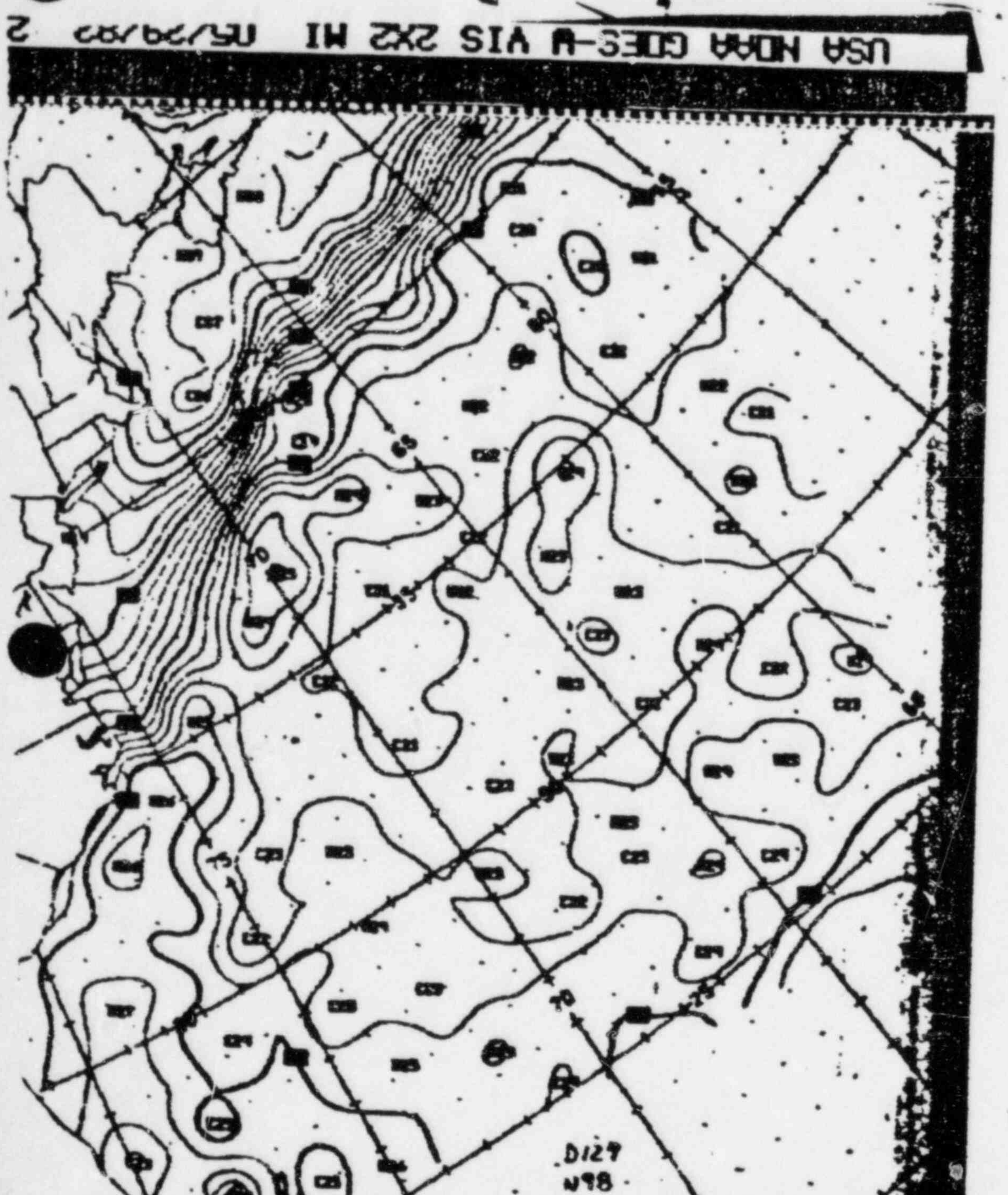
<<<< RADAR MAP (18, 81) - 20-SEP-82 5:35 AM (0935Z) >>>>

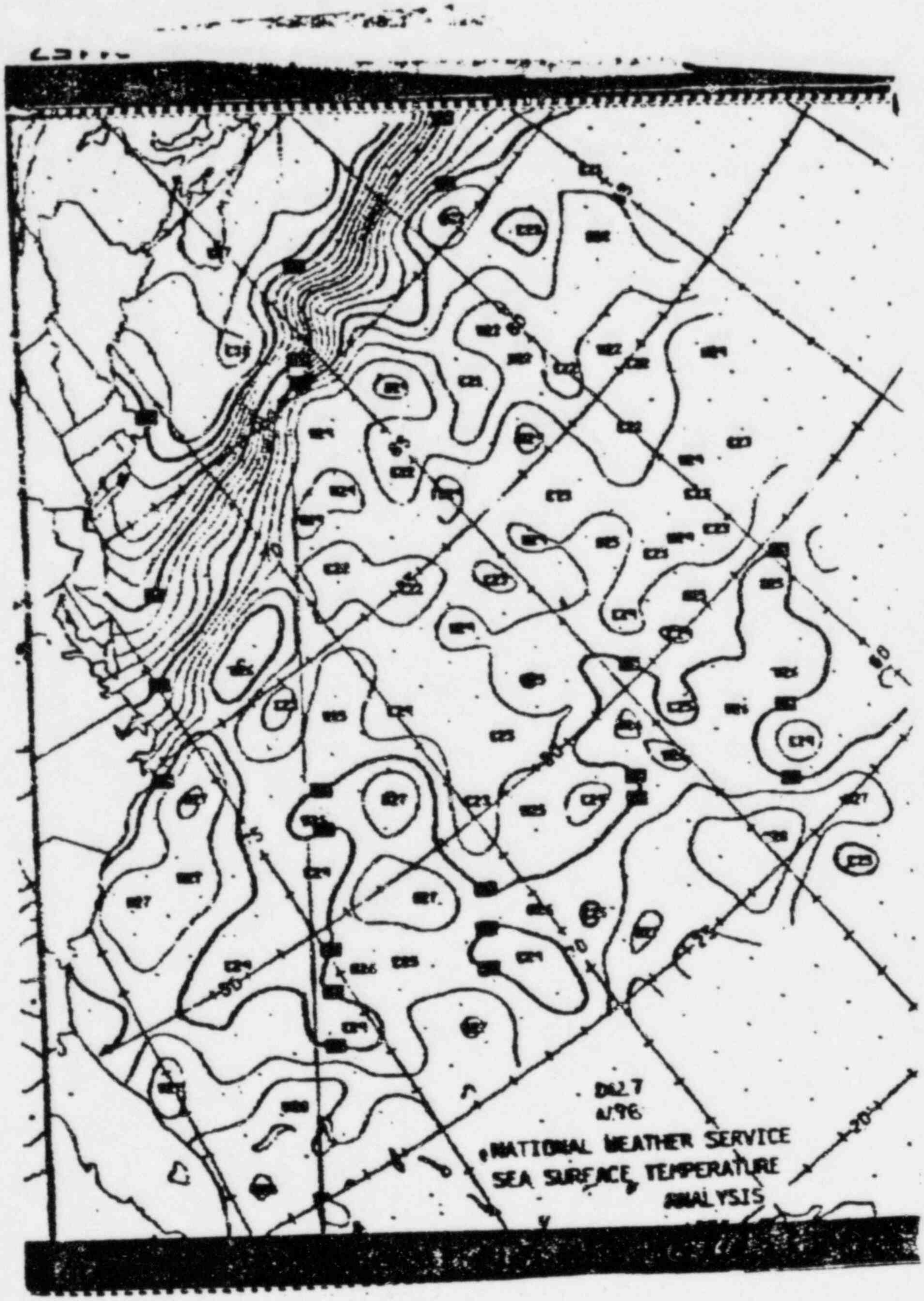
APPENDIX B

SATELLITE DERIVED SEA SURFACE TEMPERATURES

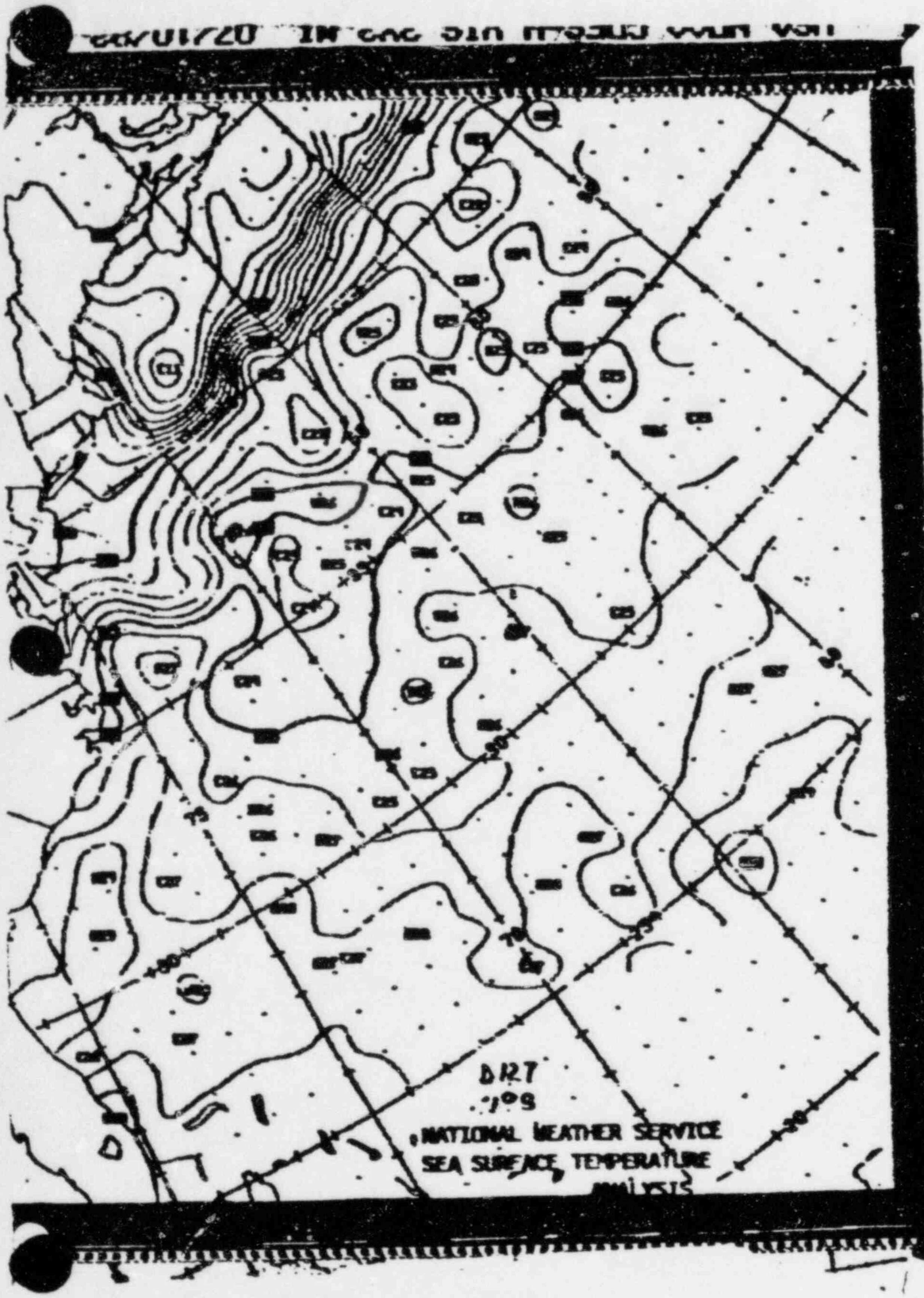
R·SCAN CORPORATION


6127
N98
NATIONAL WEATHER
SEA SURFACE
ANALYSIS

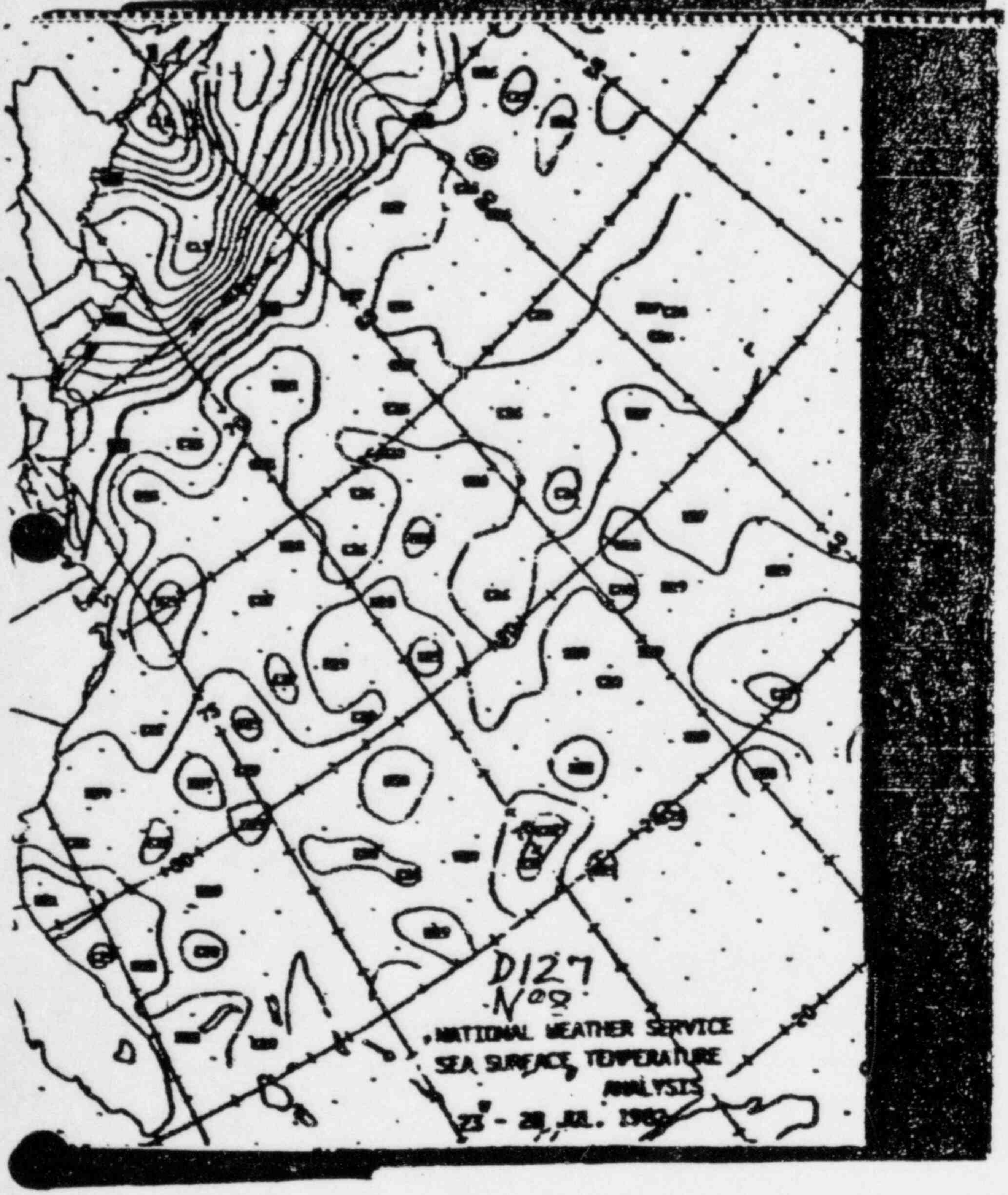

D127
N98
NATIONAL WEATHER SERVICE
SEA SURFACE TEMPERATURE
ANALYSIS
22 - 26 MAY. 1982

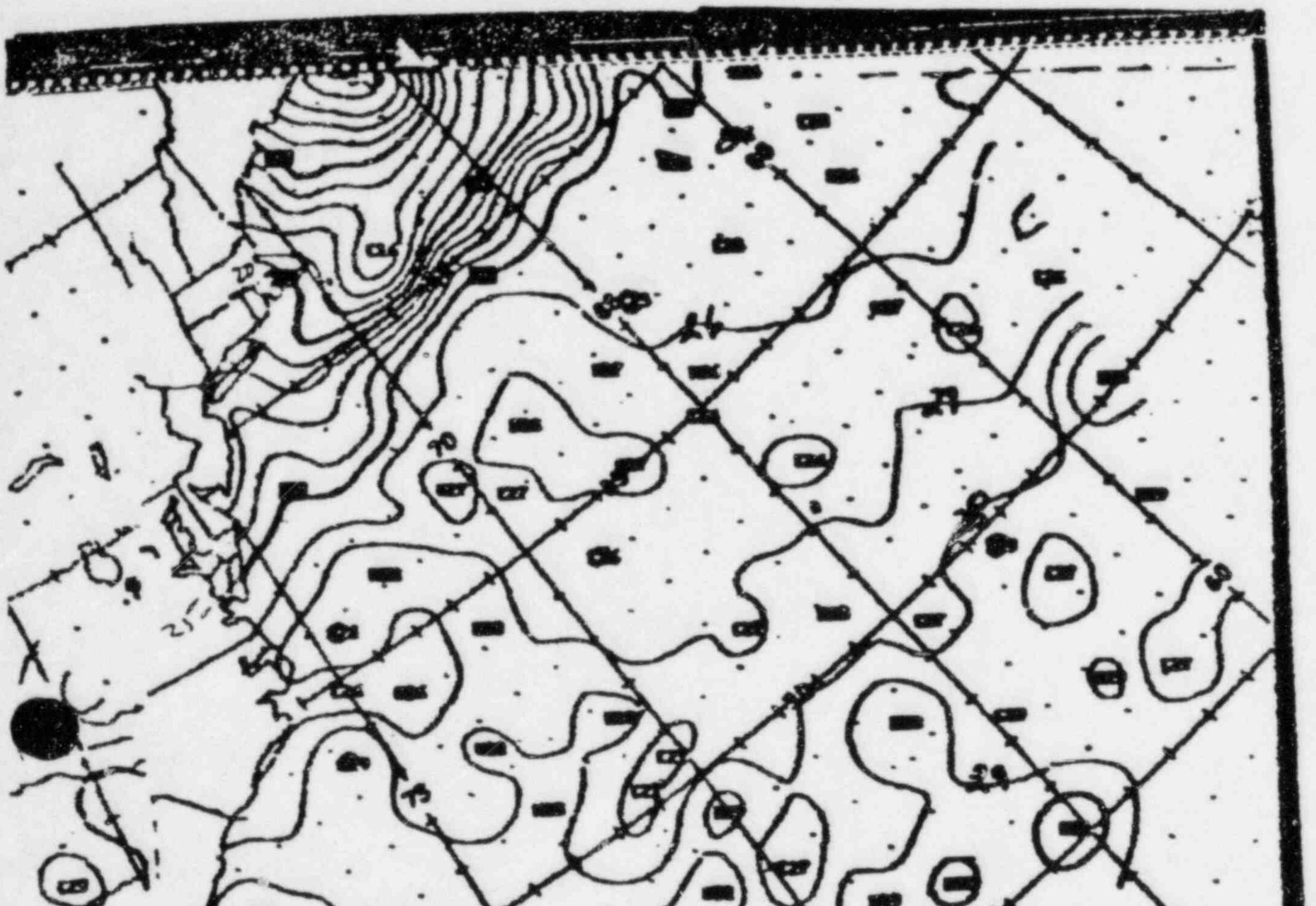

NATIONAL WEATHER SERVICE
SEA SURFACE TEMPERATURE
ANALYSIS

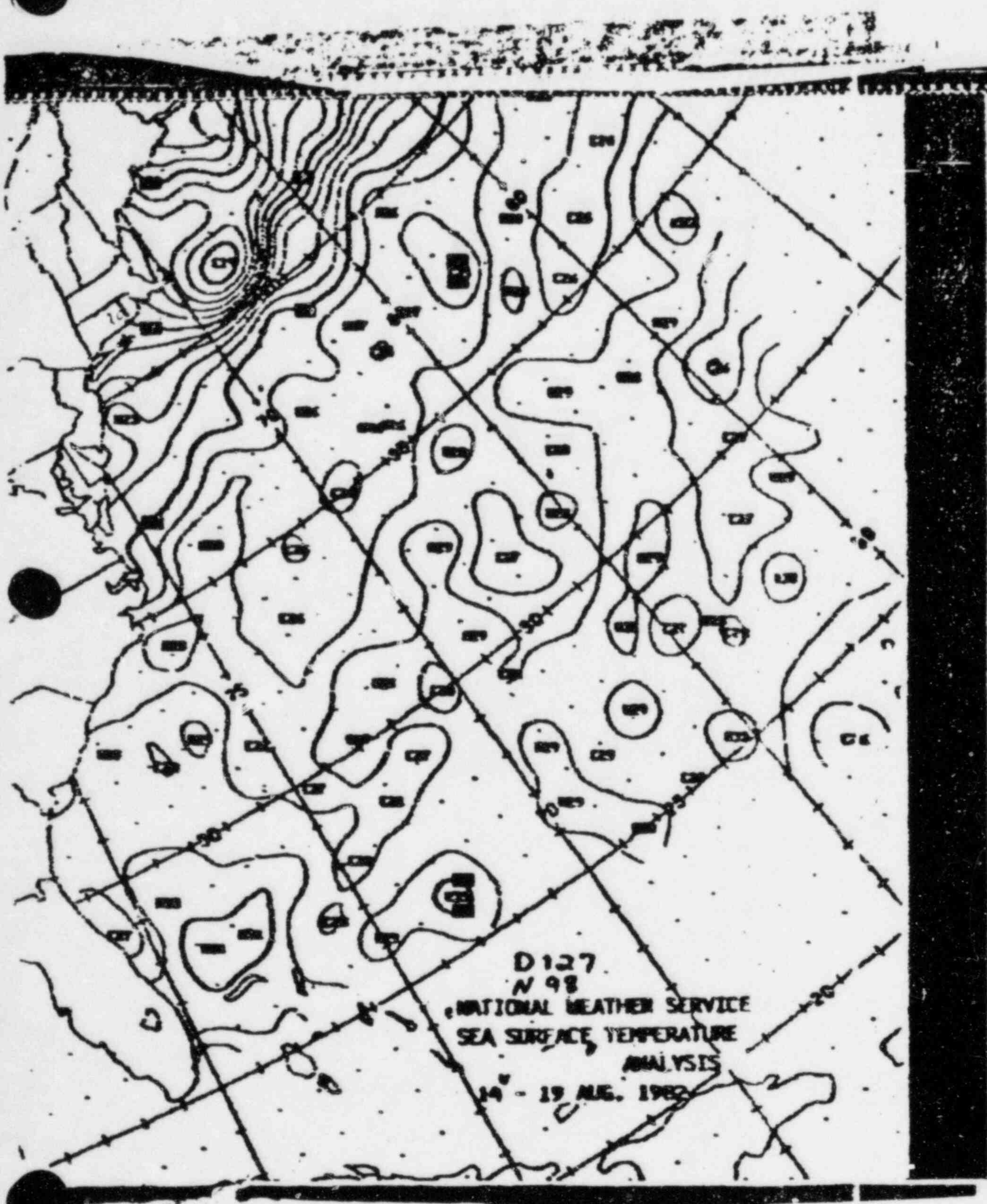

NATIONAL WEATHER SERVICE
SEA SURFACE TEMPERATURE
ANALYSIS
26 JUN - 1 JUL. 1982

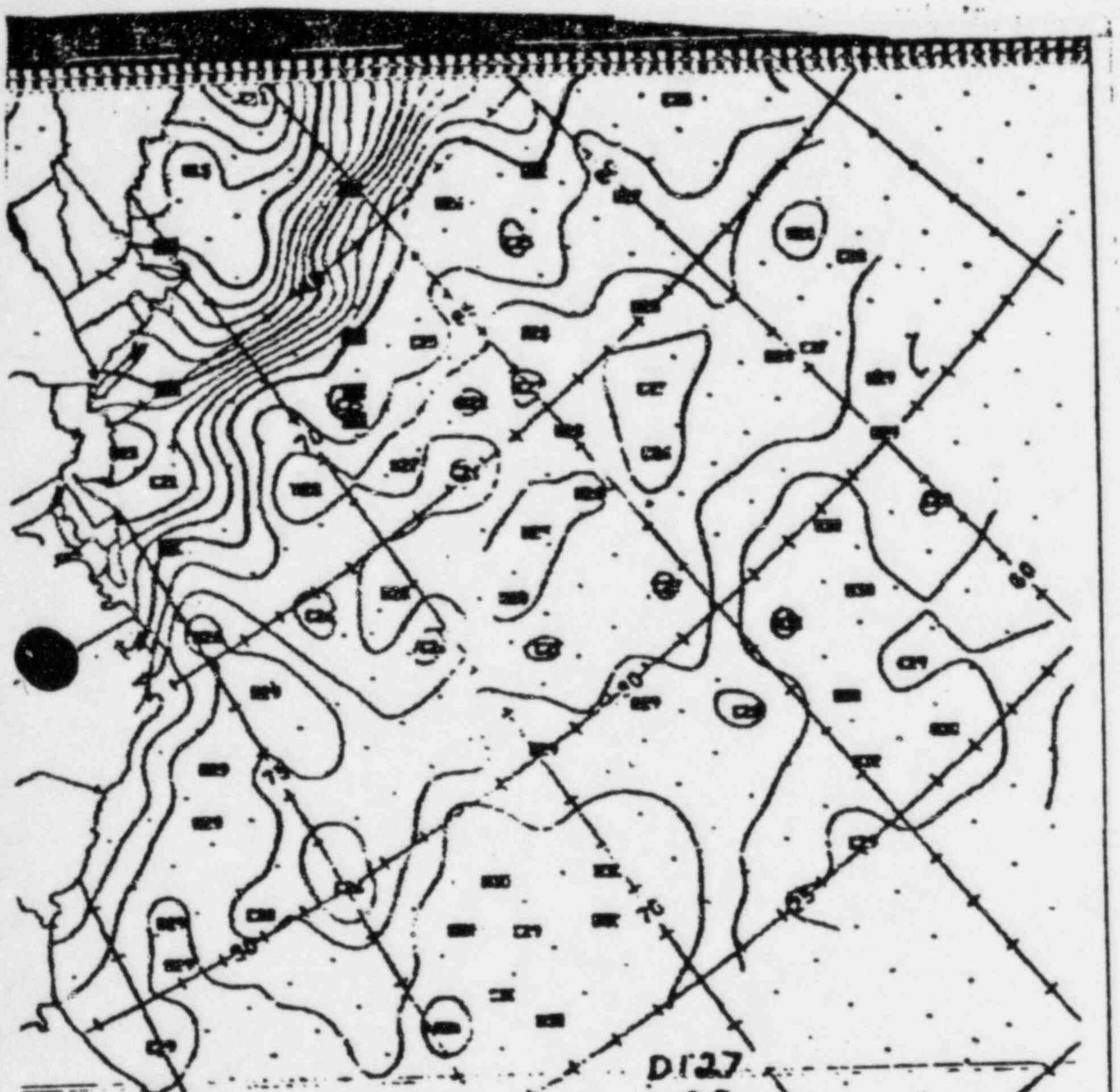

NATIONAL WEATHER SERVICE
SEA SURFACE TEMPERATURE
ANALYSIS

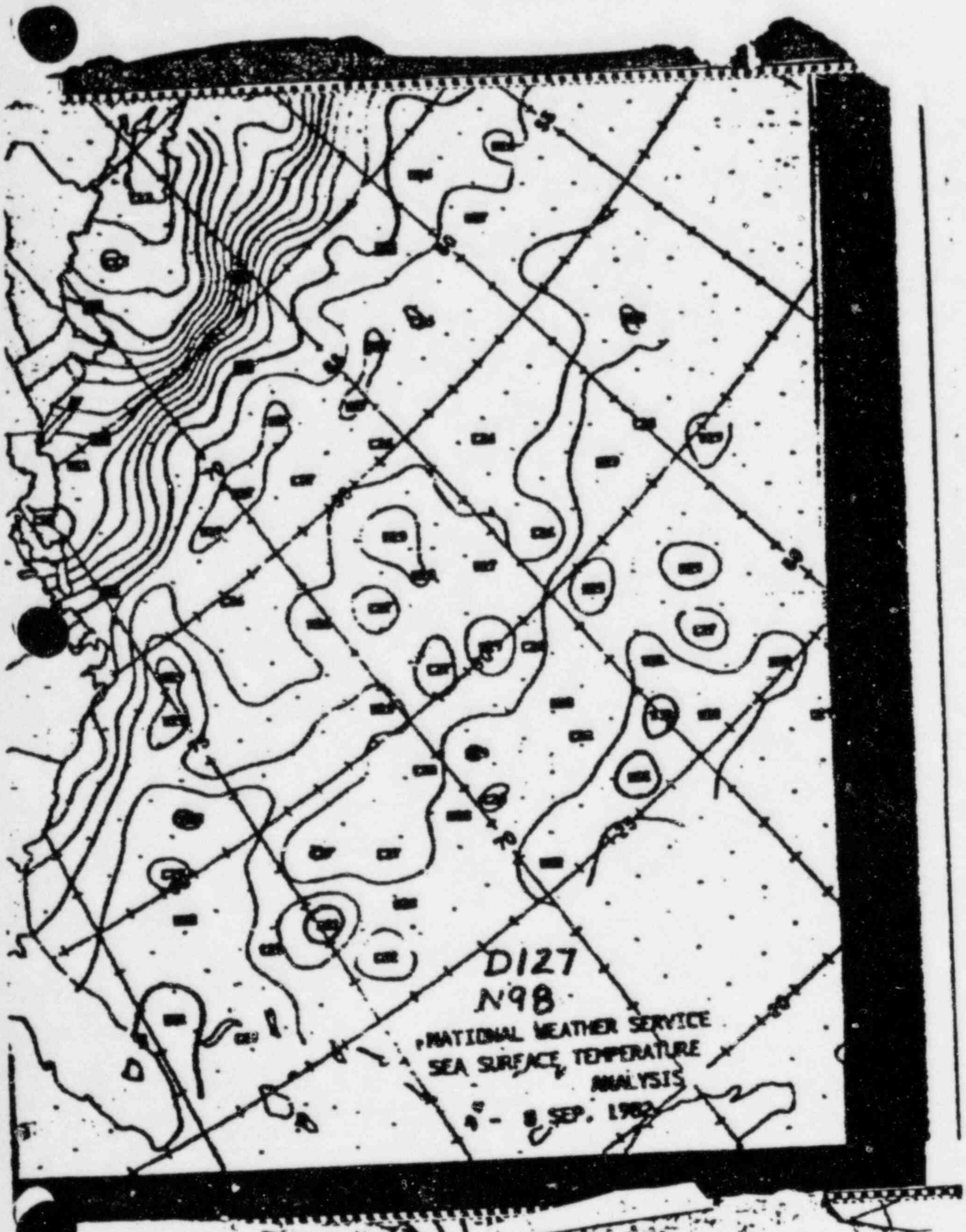

D127
N°8
NATIONAL WEATHER SERVICE
SEA SURFACE TEMPERATURE
ANALYSIS

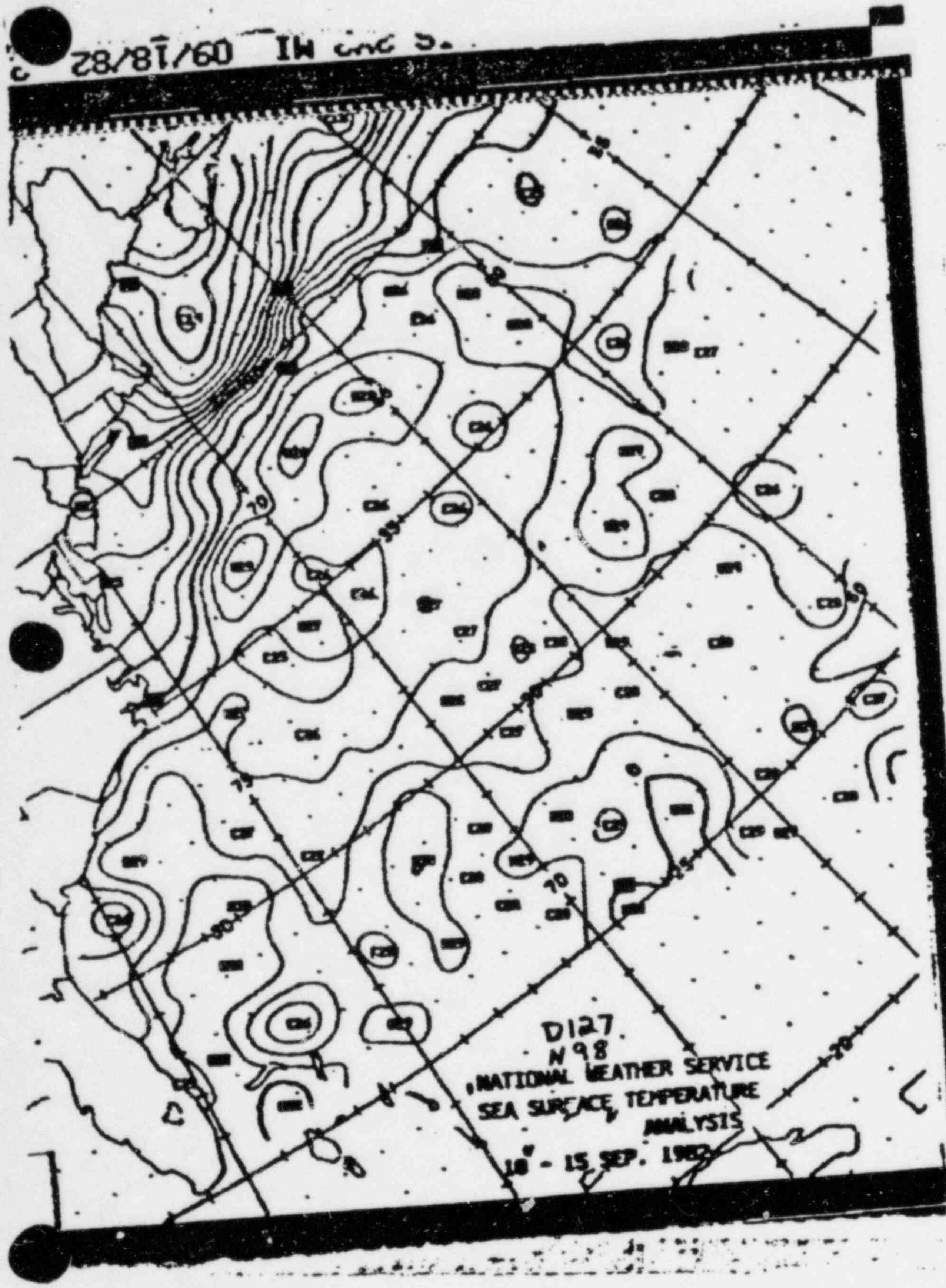

D127
N°8
NATIONAL WEATHER SERVICE
SEA SURFACE TEMPERATURE
ANALYSIS
23 - 28 JUL. 1982

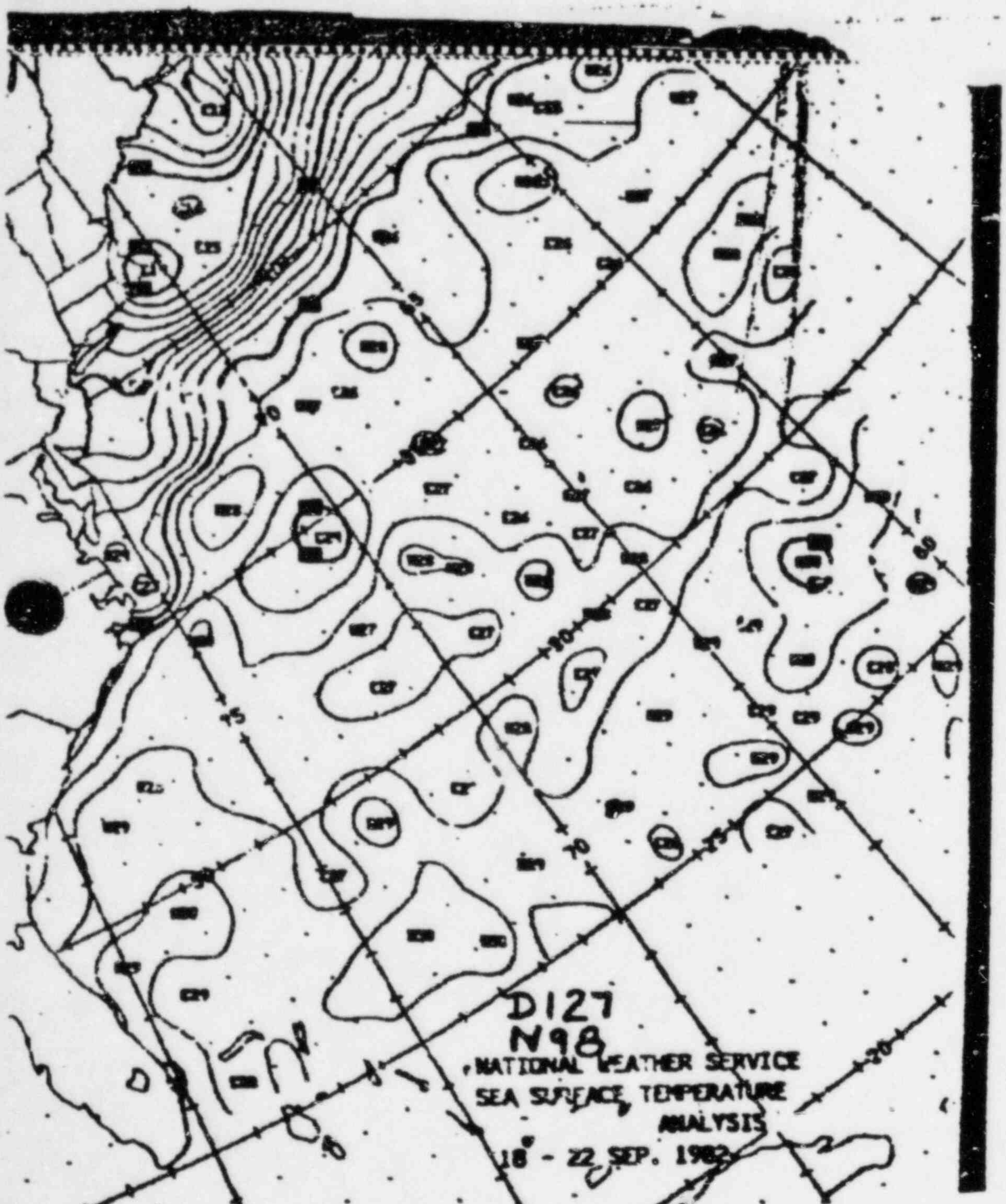

D127
#98
NATIONAL WEATHER SERVICE
SEA SURFACE TEMPERATURE
ANALYSIS


D127
N98
NATIONAL WEATHER SERVICE
SEA SURFACE TEMPERATURE
ANALYSIS
14 - 19 AUG. 1982


D127
N 98
NATIONAL WEATHER SERVICE
SEA SURFACE TEMPERATURE
ANALYSIS
27 - 31 AUG. 1982


D127
N98
NATIONAL WEATHER SERVICE
SEA SURFACE TEMPERATURE
ANALYSIS
8 SEP. 1982


D127
N98
NATIONAL WEATHER SERVICE
SEA SURFACE TEMPERATURE
ANALYSIS
10 - 15 SEP. 1982


D127
N98
NATIONAL WEATHER SERVICE
SEA SURFACE TEMPERATURE
ANALYSIS
18 - 22 SEP. 1982