EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

APPENDICES

VOLUME TWO

JUNE 2007

MARICOPA ASSOCIATION of GOVERNMENTS

EIGHT-HOUR OZONE PLAN
FOR THE MARICOPA NONATTAINMENT AREA

APPENDICES

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FOR

OZONE MODELING IN SUPPORT OF THE EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

APPENDICES

JUNE 2007

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APPENDIX I

MODELING PROTOCOL AND DATA FILE LIST

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MODELING PROTOCOL IN SUPPORT OF AN EIGHT-HOUR OZONE ATTAINMENT DEMONSTRATION FOR THE MARICOPA NONATTAINMENT AREA

Maricopa Association of Governments
January 31, 2006

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Abbreviations

ADEQ	Arizona Department of Environmental Quality
ADOT	Arizona Department of Transportation
AIRS	Aerometric Information Retrieval System
AZMET	Arizona Meteorological Network
BELD3	Biogenics Emissions Landuse Database, version 3
CAAA	Clean Air Act Amendments of 1990
CAMx	Comprehensive Air-quality Model with Extensions
CBP	County Business Patterns
CMAQ	Community Multi-scale Air Quality model
EPA	U. S. Environmental Protection Agency
EPS3	Emissions Preprocessor System, version 3
FDDA	Four Dimensional Data Assimilation
FSL	Forecast Systems Laboratory
GIS	Geographic Information Systems
I/M	Inspection and Maintenance
LCP	Lambert Conformal Projection
MAG	Maricopa Association of Governments
MAGBEIS3	MAG Modified Biogenic Emission Inventory System, version three
MCAQD	Maricopa County Air Quality Department
MM5	Penn State University/NCAR Mesoscale Model
MOBILE6	EPA-approved Onroad Mobile Source Emissions Model, version six
NAAQS	National Ambient Air Quality Standards
NO_x	Oxides of Nitrogen
NWS	National Weather Service
PRISMS	Phoenix Realtime Instrumentation for Surface Meteorological Studies
RVP	Reid Vapor Pressure
SIP	State Implementation Plan
TSD	Technical Support Document
UAM	Urban Airshed Model
UTM	Universal Transverse Mercator
VOC	Volatile Organic Compounds

1. OVERVIEW OF MODELING STUDY

1.1 Background

Under the 1990 Clean Air Act Amendments, the Maricopa County nonattainment area was initially classified as Moderate for the one-hour ozone National Ambient Air Quality Standards (NAAQS). The area did not achieve the NAAQS for one-hour ozone by the required deadline of November 19, 1996. The one-hour ozone nonattainment area was subsequently reclassified to Serious, effective February 13, 1998. The deadline for Serious areas to attain the one-hour ozone standard was November 19, 1999. There have been no exceedances of the one-hour ozone standard in the nonattainment area since 1996.

The Maricopa Association of Governments (MAG) prepared the One-hour Ozone Redesignation Request and Maintenance Plan which was submitted to EPA in 2004 [3]. EPA subsequently redesignated the Maricopa County one-hour ozone nonattainment area to attainment, effective June 14, 2005; EPA revoked the one-hour ozone standard on June 15, 2005.

On April 30, 2004, EPA published the final rule designating eight-hour ozone nonattainment areas, effective June 15, 2004. A 5,000 square mile area located mainly in Maricopa County and Apache Junction in Pinal County was designated as a nonattainment area for eight-hour ozone. The Maricopa eight-hour ozone nonattainment area is classified as "Basic" under Part D, Subpart I, of the Clean Air Act, with an attainment date of June 15, 2009.

As the designated Regional Air Quality Planning Agency, MAG conducts modeling of emissions and pollutant concentrations and prepares the air quality plans necessary for attainment and maintenance demonstrations in the Maricopa nonattainment area. This protocol is developed to detail and formalize procedures for conducting all phases of the modeling for the eight-hour ozone attainment demonstration.

The primary objective of the study is to determine whether the region will attain the eight-hour ozone standard by June 15, 2009. EPA requires that all control measures necessary to demonstrate attainment be implemented prior to the start of the ozone season preceding the attainment year [13]. To satisfy this requirement, MAG will model the impact of control measures on the attainment of the eight-hour ozone standard during the 2008 ozone season.

A secondary objective of the modeling study is to evaluate the complex chemical relationships between precursor emissions of volatile organic compounds and nitrogen oxides and the formation of ozone. This evaluation will determine if the region qualifies for a NO_x exemption under section 182(f) of the Clean Air Act [11].

Key objectives to be accomplished in this protocol document are to enhance technical credibility, encourage the participation of all interested parties, lay out responsibilities of all participants, provide for consensus-building concerning modeling issues, and provide documentation for technical decisions to be made in applying the models.

The protocol document describes procedures for conducting all phases of the modeling study. These include:

- identifying the background, objectives, tentative schedule, and organizational structure;
- developing the necessary input data bases;
- performing quality assurance and diagnostic model analyses;
- conducting model performance evaluations and interpreting results;
- describing procedures for using the model to demonstrate whether adopted control strategies are sufficient to demonstrate attainment of the eight-hour ozone standard; and
- evaluating the relationships between precursor emissions and ozone formation.

Procedures described in this protocol are intended to foster confidence in the modeling and technical analyses that support the attainment demonstration and request for a NOx exemption, if warranted.

1.2 Conceptual Model

MAG has conducted an analysis of eight-hour ozone data during the five-year period 2000 through 2004 in order to develop a conceptual model for the eight-hour ozone attainment demonstration. Major features of the conceptual model for the Maricopa nonttainment area are as follows. High ozone concentrations generally occur in May through September, when the weather is hot, covered by clouds, and with stagnant to light winds blowing from the east and southeast. More than 90 percent of high ozone events occur when the daily maximum temperatures are above 90° Fahrenheit (F). High ozone levels tend to occur when dew point temperatures are higher than the average. Most high ozone days occur when a low sea level pressure system resides over southwestern Arizona and a high sea level pressure system occurs over northeastern Arizona.

A detailed conceptual description for each episode is provided in Attachment II, Appendix G. A comparison of the conceptual model with eight-hour ozone modeling results will be included in the Technical Support Document.

1.3 Management Structure and Committees

MAG has responsibilities for regional involvement in a number of planning issues, and has established an extensive mechanism for ensuring coordinated policy direction from elected officials, coordinated management and technical input, advice from the appropriate agency staff, as well as direct citizen input. Figure 1-1 displays the MAG Policy Structure and Figure 1-2 presents the MAG Committee Structure. All policy committees and formal technical committees follow the Arizona open meeting law which requires, among other

requirements, the posting of meeting notices and agendas at least 24 hours prior to any meeting.

The MAG Regional Council is the governing body of MAG. It is comprised of elected officials from each member agency, two ex-officio members representing the Arizona State Transportation Board, and a representative from the Citizens Transportation Oversight Committee. This composition of elected officials is a reflection of citizen input at the local government level. The MAG Regional Council agenda includes a call to the audience, providing the opportunity for public comments at each monthly meeting.

MAG holds at least one formal public meeting prior to the adoption of any new or update to the nonattainment area plan. Formal public meetings are advertised locally at least 30 days prior to the meeting date and documentation is available for public review during this 30-day period. Draft documents are distributed to appropriate federal, state, and local agencies for review and comment during this period. Comments received are analyzed with a staff response for consideration by the MAG Air Quality Technical Advisory Committee and MAG Regional Council before taking approval action. Documentation of the comments and responses are incorporated into the plan document.

Due to the technical complexity of many MAG programs, committees consisting of professional experts are often needed to assist in program development. The Air Quality Technical Advisory Committee is composed of representatives from eight MAG member agencies, citizens, environmental interests, health interests, automobile industry, fuel industry, utilities, public transit, trucking industry, rock products industry, construction firms, housing industry, architecture, agriculture, industry, business, parties to the Air Quality Memorandum of Agreement, and various State and Federal agencies. The role of the Technical Advisory Committee is to review and comment on technical information generated during the planning process and make recommendations to the MAG Management Committee.

1.4 Participating Organizations

Technical oversight for this project will be provided by the Air Quality Planning Team. This team includes staff representatives from the Maricopa Association of Governments (MAG), the Arizona Department of Environmental Quality (ADEQ), the Arizona Department of Transportation (ADOT), and the Maricopa County Air Quality Department (MCAQD). The activities of this working group are directed by a Memorandum of Agreement among the agencies involved (see Attachment I). Representatives of other agencies, including EPA and the U.S. Department of Transportation, will be consulted on technical matters, as needed. The Air Quality Planning Team will meet as necessary during the ozone modeling effort. Periodic reports on the status and progress of various phases of the modeling work will be presented at these meetings, and technical issues will be discussed and resolved.

MAG POLICY STRUCTURE

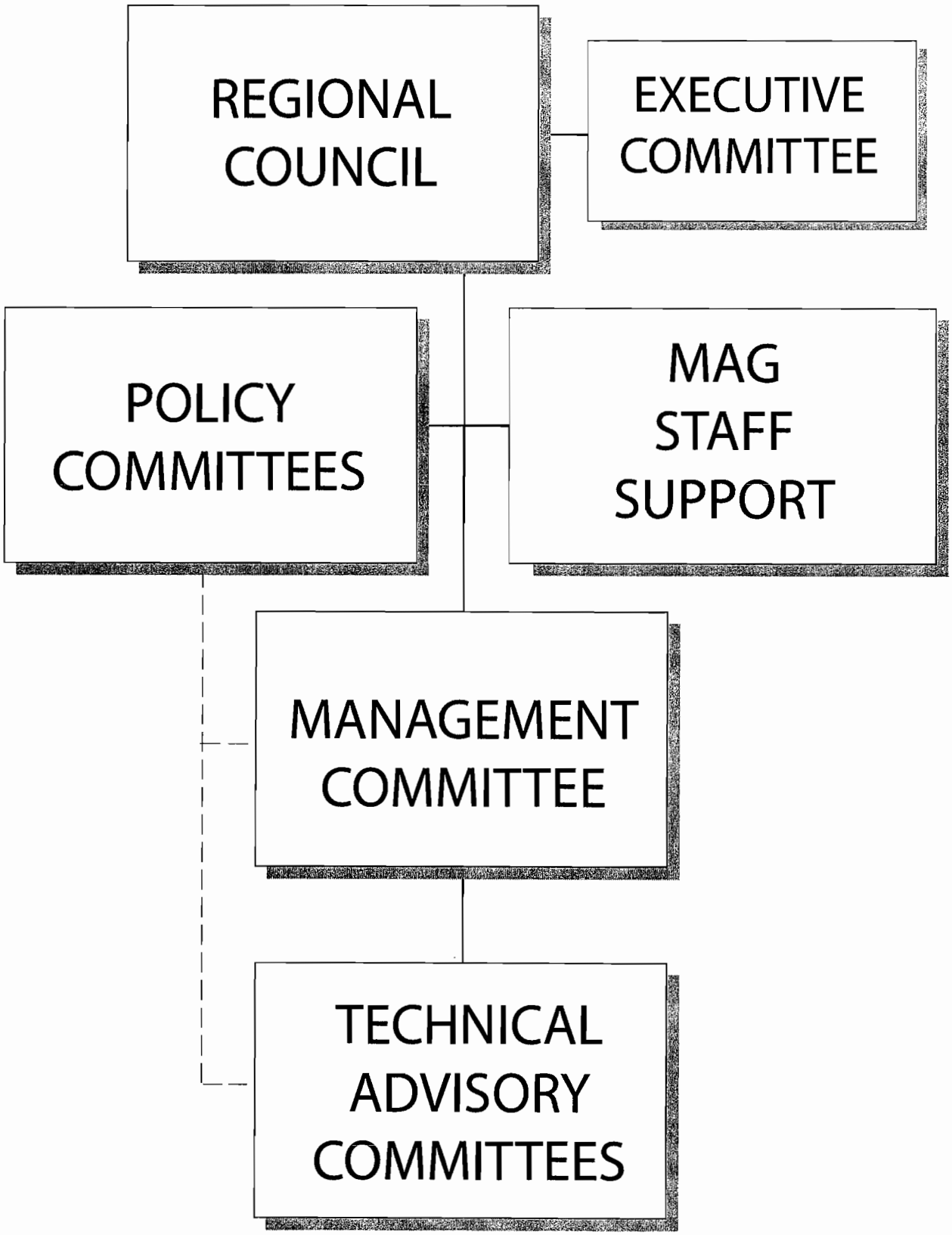


Figure 1-1: MAG Policy Structure

MAG COMMITTEE STRUCTURE

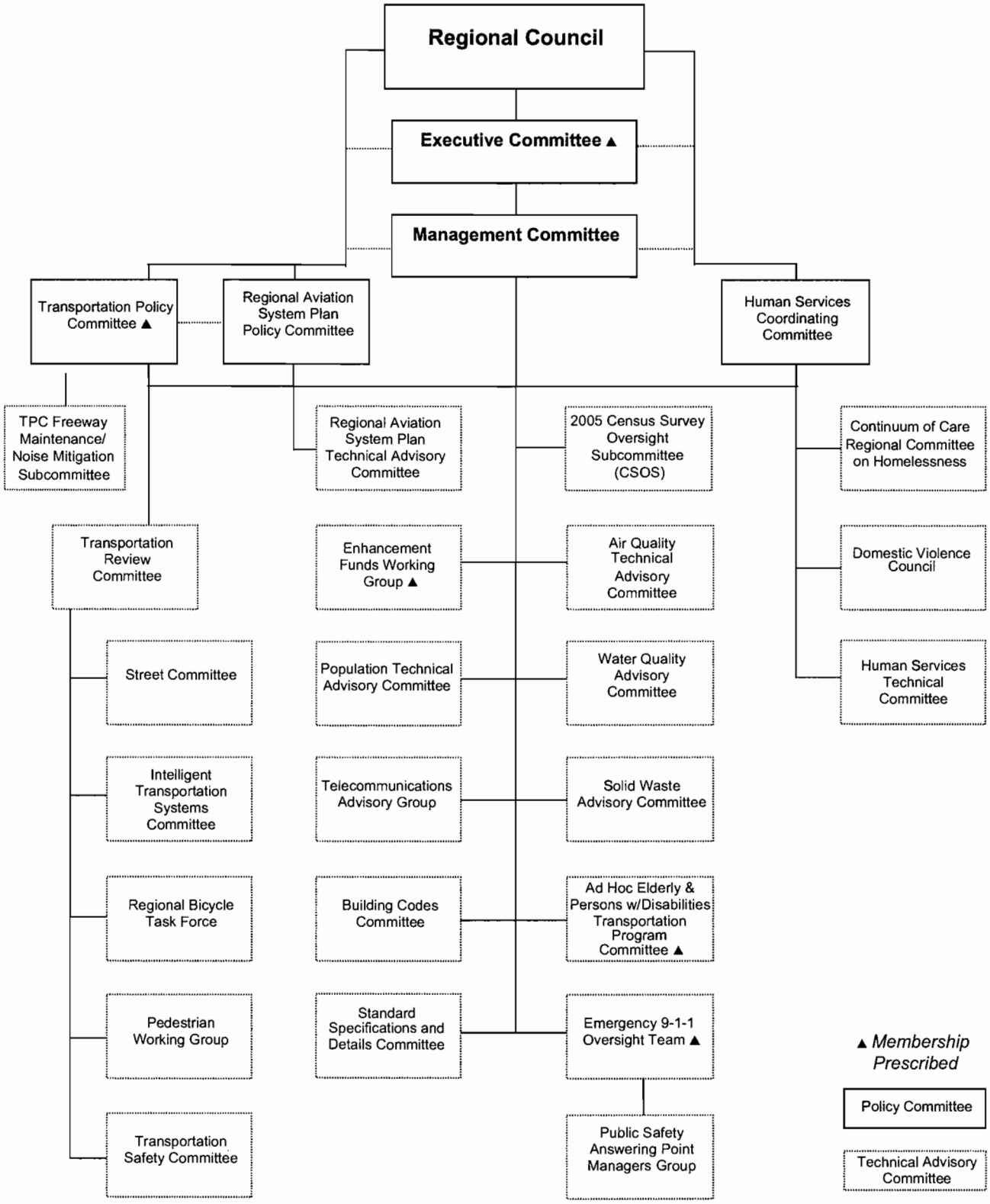


Figure 1-2: MAG Committee Structure

1.5 Schedule

The eight-hour ozone analysis for the Maricopa Nonattainment Area will include the following tasks. The schedule for these tasks is presented graphically in Figure 1-3.

1. Prepare a protocol document (this document) describing the purpose, background, and the procedures to be followed in the remainder of the analysis. This document also specifies the modeling domain and identifies three modeling episodes. (Completion Date: January 31, 2006)

2. The ozone precursor emissions inventory reported in *"2002 Periodic Emissions Inventory for Ozone Precursors"* [6] will be input to the Emission Preprocessor System 3, which will reformat the data into the appropriate CAMx input files for the 2001 and 2002 episodes. (Completion Date: February 28, 2006)

3. Prepare onroad mobile source emissions using MOBILE6 and M6Link for the 2001 and 2002 episode periods. (Completion Date: February 28, 2006)

4. Develop land use, meteorological and air quality inputs for the 2001 and 2002 episode periods. (Completion Date: February 28, 2006)

5. Develop biogenic emissions inventories for 2001 and 2002 using the model recommended by ENVIRON. (Completion Date: June 30, 2006)

6. Run CAMx and evaluate model performance for the 2001 and 2002 episode periods. Select the period with the overall best model performance for modeling the future year. (Completion Date: October 31, 2006).

7. Develop the emissions inventory for 2008. (Completion Date: November 30, 2006)

8. Perform CAMx simulations for 2008. (Completion Date: January 31, 2007)

9. Complete technical analyses and write a technical support document (TSD). (Completion Date: February 28, 2007)

10. Release the Plan and TSD for public review. (Completion Date: March 15, 2007)

11. Make final revisions to the plan and TSD. (Completion Date: April 30, 2007)

12. Submit the plan and TSD to ADEQ/EPA. (Completion Date: May 31, 2007)

					2006												2007				
Ozone Modeling Task List	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Prepare protocol document					☆																
Base Year (2001, 2002) Emissions Inventory (EI) preparation						☆															
MOBILE6 modeling of 2001 and 2002 onroad mobile emissions						☆															
Land use, meteorological and air quality input preparation for episode periods						☆															
Biogenic emissions inventory										☆											
CAMx modeling and episode performance evaluation														☆							
Develop EI for 2008															☆						
CAMx simulations for 2008																	☆				
Complete analyses and write TSD																		☆			
Documents available for public review																			☆		
Final revisions																				☆	
Submit to ADEQ/EPA																					☆

Figure 1-3 Schedule for the Eight-Hour Ozone Attainment Demonstration for the Maricopa Nonattainment Area

2. MODELS AND INPUTS

This Chapter discusses the data and models to be used in simulating meteorology and ozone concentrations. It concludes with a discussion of the quality assurance tests that will be performed to ensure that the air quality, meteorological and emissions inputs to the models are reasonable.

2.1 Rationale for Model Selection

To perform the modeling for the eight-hour ozone attainment demonstration, MAG considered three photochemical dispersion models: the Comprehensive Air-quality Model with Extensions (CAMx), the Community Multi-scale Air Quality (CMAQ) model, and the Variable-grid Urban Airshed Model (UAM-V). EPA has indicated that any of these three models would be appropriate to simulate eight-hour ozone concentrations in urban areas [12]. These models were evaluated according to the selection criteria shown in Table 1-1. A simple scoring system was used for the evaluation; the scores range from 0 to 3, with 0, the lowest score, and 3, the highest.

All three models have been peer-reviewed and are adequately documented[12]. In recent years CAMx and CMAQ have been used more frequently in regulatory applications. EPA used CAMx to model eight-hour ozone in the eastern United states for the Clean Air Interstate Rule (CAIR). CMAQ has been applied by the Western Regional Air Partnership to model visibility in the western United States. EPA has also used CMAQ to model PM-2.5 and visibility for the CAIR.

UAM-V has been applied less frequently than previous versions of UAM. MAG staff had used older versions of UAM to model carbon monoxide, one-hour ozone, and PM-10, but do not have hands-on experience running UAM-V. One MAG staff member has experience using CAMx, and all have either received training or have experience in the application of CMAQ. The UAM-V is the most computationally efficient model, whereas the CMAQ model is the most computationally-intensive. UAM-V is a proprietary model, unlike CAMx and CMAQ.

CAMx accepts emissions in the Universal Transverse Mercator (UTM) coordinate system that the MAG emissions processor (EPS3) utilizes, while CMAQ requires Lambert Conformal Projections (LCP). While conversion from UTM to LCP coordinates can be performed, it reduces spatial accuracy in the modeling process.

The evaluation above suggests that CAMx is the most appropriate photochemical dispersion model for use in the present study. Although CAMx will be the core eight-hour ozone model, MAG also intends to run CMAQ in order to corroborate the air quality modeling results obtained with CAMx.

Table 1-1 Attributes of Candidate Air Quality Models

Selection Criteria	UAM-V	CAMx	CMAQ
Documentation and Track Record	3	3	3
Advanced Technical Features	3	3	3
Recent Applications	1	3	3
Experience of MAG Staff	2	3	3
Computational Efficiency	3	2	1
Flexibility (Proprietary vs. Open Source)	0	3	3
Total	**12**	**17**	**16**

Figure 2-1 depicts the MAG air quality modeling chain with CAMx as the core model. Most of the CAMx input files will be prepared using preprocessor programs. The input files containing information on air quality and meteorology will be based on measured data, where available. The meteorological inputs to CAMx will be prepared using the MM5 model. The Emissions Preprocessor System, EPS3, will be used to process the emissions inventory. The onroad mobile emissions will be generated by the EPA MOBILE6 model and M6Link, a MAG-developed software program that spatially and temporally allocates emissions. More detailed discussions on the preparation of the emissions inventory and meteorological inputs are provided later in this protocol.

2.2 Modeling Domain

Selection of the air quality modeling domains takes into account the eight-hour ozone nonattainment area boundaries, the distribution of major emissions sources, the location of the meteorological and air quality monitoring sites, and the prevailing winds associated with ozone episodes. The CAMx modeling domains are mapped in Figures 2-2 and 2-3. The first map illustrates the inner dispersion modeling domain comprised of 4 km grids. The second shows the spatial relationship between the inner (4 km) and outer (12 km) CAMx modeling domains.

An evaluation of 36-hour back-trajectory air flow patterns was conducted to determine if an even larger CAMx modeling domain, at the 36 km grid resolution, was justified. The evaluation concluded that the outer 12 km CAMx domain shown in Figure 2-3 is of sufficient size to capture transport characteristics for the ozone episodes to be modeled. See Attachment III for details [5]. However, meteorological modeling with MM5 will utilize three nested domains, at 4 km, 12 km, and 36 km grid resolutions, to simulate the selected episode periods. As shown in Figure 2-3, the boundaries of the 4 km and 12 km MM5 modeling domains are larger than the CAMx modeling domains.

The inner CAMx modeling domain encompasses the entire eight-hour ozone nonattainment area and consists of 50 (4 km) grid cells in the west-east direction and 29 (4 km) grid cells in the south-north direction. The origin, at the southwest corner of the inner domain, is located at 297 km easting and 3652 km northing in UTM zone 12. The inner domain has an area of approximately 9,000 square miles.

2.3 Air Quality and Meteorological Data

Air quality and meteorological data to be used in photochemical dispersion modeling will be collected from all valid monitoring sites in the nonattainment area.

2.3.1 Air Quality Data

The Arizona Department of Environmental Quality (ADEQ) and the Maricopa County Air Quality Department (MCAQD) maintain monitoring networks that collect air quality data.

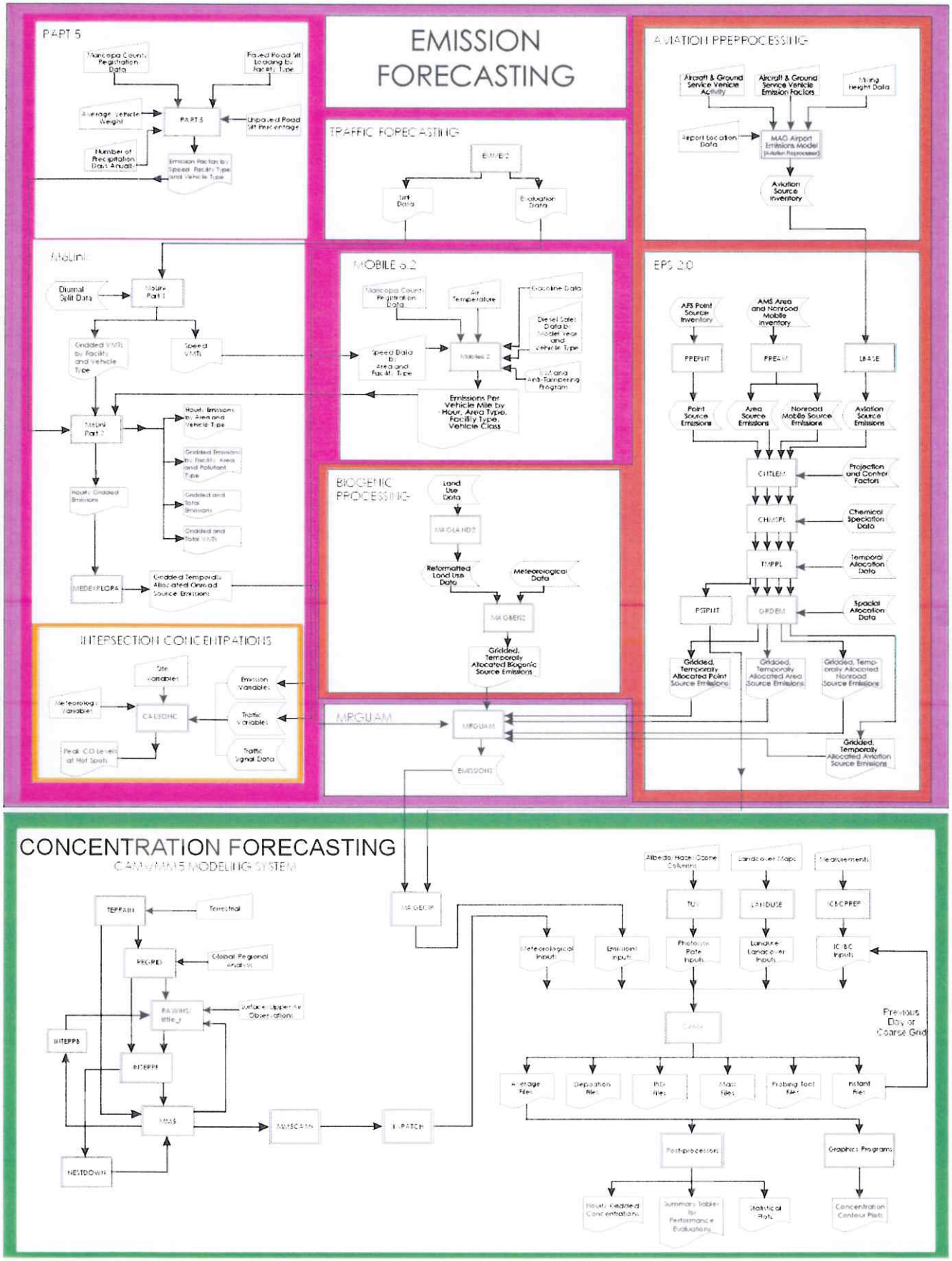


Figure 2-1 MAG Air Quality Modeling Chain

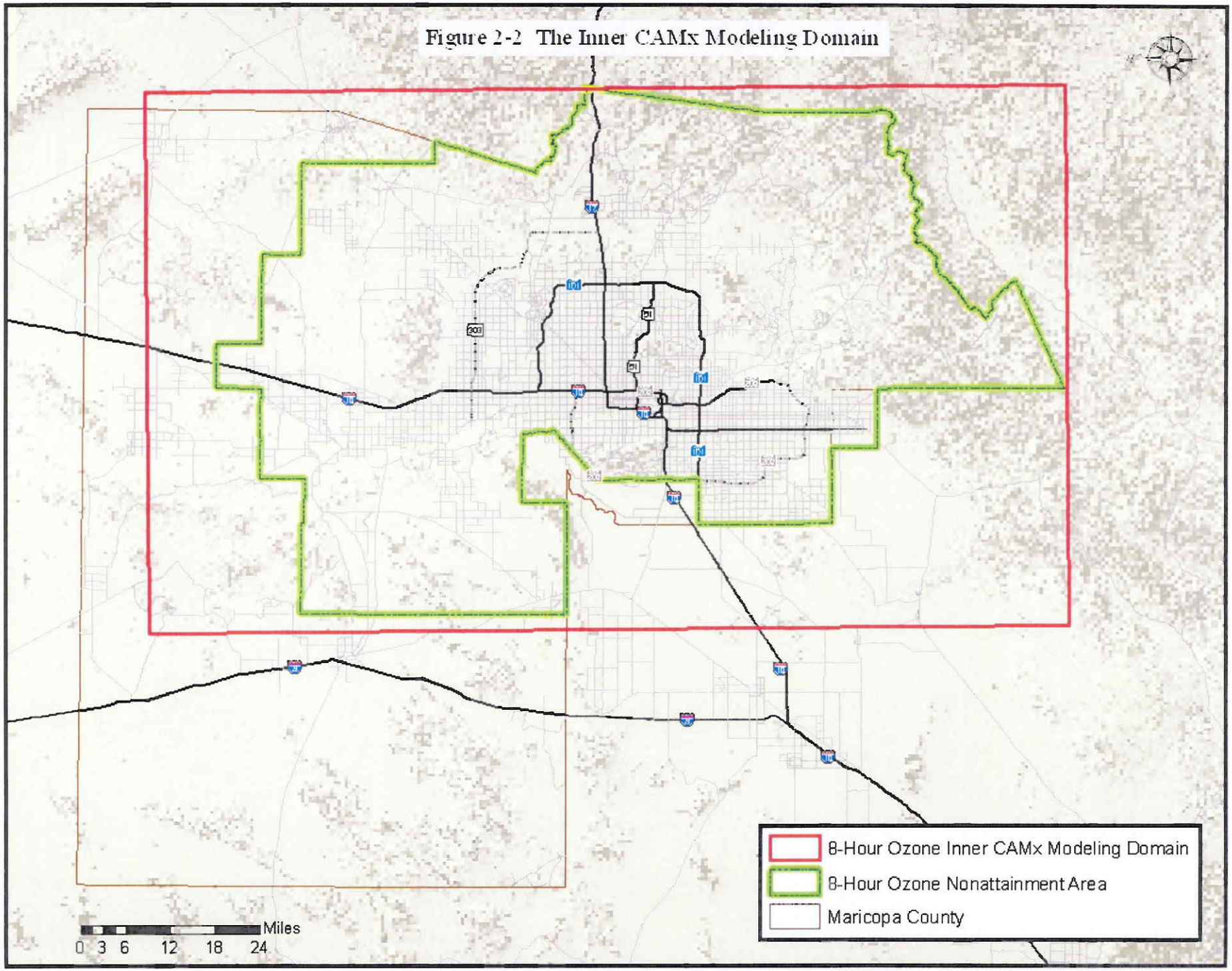
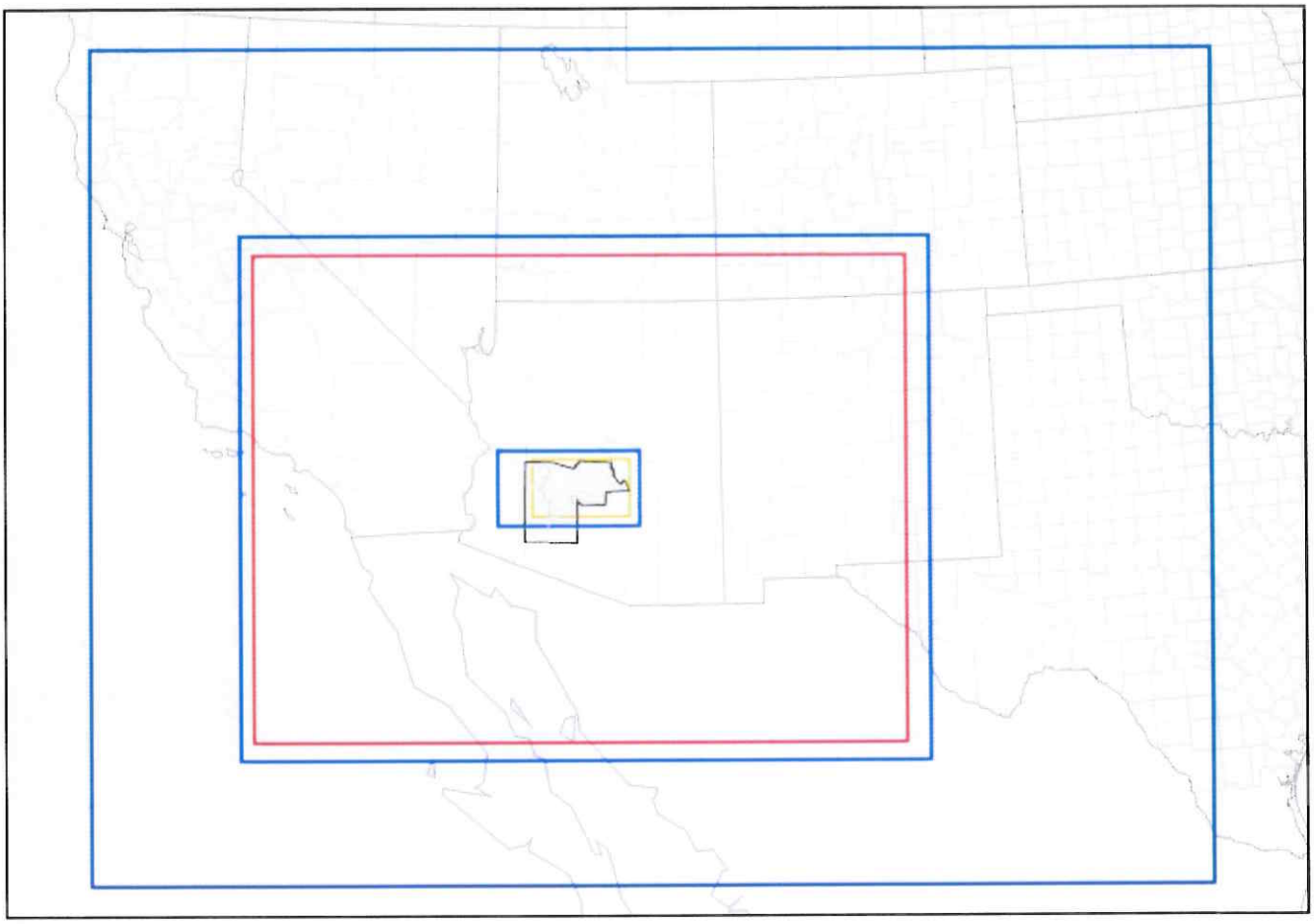


Figure 2-2 The Inner CAMx Modeling Domain

Figure 2-3 Nested CAMx and MM5 Modeling Domains



Two CAMx domains: 12-km grid domain (red) / 4-km grid domain (orange).
Three MM5 domains (blue): 36-km grid domain / 12-km grid domain / 4-km grid domain.
The map projection is UTM Zone 12.

Table 2-1 lists and Figure 2-4 illustrates the locations of the ozone monitoring sites located in the inner CAMx modeling domain. Data from monitoring sites with incomplete data and those sites lying outside the eight-hour ozone nonattainment area were not used in the episode evaluation [4].

Air quality data generally serves two purposes in photochemical dispersion modeling. First, the data are used to specify initial and boundary concentrations. Second, ambient measurements are used to assess the ability of the model to replicate a historical episode, that is, to evaluate model performance for the base case. These topics are addressed in the relevant sections of the modeling protocol below.

2.3.2 Meteorological Data

The air quality networks maintained by ADEQ and MCAQD collect meteorological, as well as air quality data. Additional surface meteorological data have been collected from other monitoring networks including the AriZona METeorological network (AZMET), the National Weather Service (NWS), and the Forecast Systems Laboratory (FSL). Two networks (AZMET and NWS) provide surface observations and the third (FSL) provides upper air data. Table 2-2 identifies the meteorological stations for these three networks. Meteorological data from the Phoenix Realtime Instrumentation for Surface Meteorological Studies (PRISMS) network and the Maricopa County Department of Transportation's ALERT station map will also be evaluated for potential use in meteorological modeling.

The upper air station data for meteorological modeling will be derived from the FSL stations shown in Table 2-2. The stations in Flagstaff, Tucson, and Yuma are located in the outer (12 km) air quality modeling domain. Figure 2-5 illustrates the location of the meteorological monitoring sites. Other valid meteorological data will be applied, as appropriate.

The MM5 meteorological model will be used to generate meteorological inputs, such as horizontal wind components, temperature, pressure, water vapor, vertical diffusivity, clouds and rainfall, in 3-dimensional gridded format. This model incorporates available observations and provides information on terrain-induced air flows in regions where observations are absent. To reduce divergence of the model predictions from actual observations at a particular point in time and space, four dimensional data assimilation (FDDA) will be used with the observational meteorological data.

The modeling domains for MM5 will be larger than the inner and outer dispersion modeling domains, as shown in Figure 2-3. The wind fields for the dispersion model applications will be a subset of the MM5 wind fields. This approach will further diminish the errors propagating from the boundaries to the area of interest.

The mixing depths contained in the MM5 model will be used. Other input variables required as input to CAMx include:

Table 2-1 Ozone Monitoring Sites

Abbr.	Name	AIRS Code	Operator	Location	Data Availability	O_3	CO	NO	NO_2	WS/WD
AJ*	Apache Junction	04-021-3001	PCAQD	305 E Superstition Blvd	2002-2004	✓				
BP†*	Blue Point	04-013-9702	MCAQD	Usery Pass & Bush Highway	2000-2004	✓				✓
BE	Buckeye	04-013-4011	MCAQD	26453 W MC85	Since 8/1/2004	✓	✓		✓	✓
CC*	Cave Creek	04-013-4008	MCAQD	37019 N Lavon Ln	Since 8/1/2001	✓				✓
CP†*	Central Phoenix	04-013-3002	MCAQD	1845 E Roosevelt	2000-2004	✓	✓		✓	✓
DY	Dysart	04-013-4010	MCAQD	16825 N Dysart	Since 7/21/2003	✓	✓			✓
EM	Emergency Management	04-013-3004	MCAQD	52nd St & McDowell Rd	Till 5/31/2001	✓				
FF†*	Falcon Field	04-013-1010	MCAQD	4530 E Mckellips	2000-2004	✓				✓
FH†*	Fountain Hills	04-013-9704	MCAQD	16426 E Palisades	2000-2004	✓				✓
GL†*	Glendale	04-013-2001	MCAQD	6000 W Olive	2000-2004	✓	✓			✓
HM†*	Humboldt Mountain	04-013-9508	ADEQ	7 Springs Rd	2000-2004	✓				
LP*	Lake Pleasant	04-013-9805	MCAQD	41402 N 87th Ave	Till 7/31/2001	✓				✓
MRCP**	Maricopa	04-021-3010	PCAQD	44625 W Garvey Rd	Since 7/1/2002	✓				
MV*	Maryvale	04-013-3006	MCAQD	6180 W Encanto	2000-2003	✓	✓			
ME*	Mesa	04-013-1003	MCAQD	370 S Brooks	2000-2002	✓	✓			✓
MORD*	Mount Ord	04-013-9701	ADEQ	Mountain Ord Summit	5/19/2000-2001	✓				✓
NP†*	North Phoenix	04-013-1004	MCAQD	610 E Butler	2000-2004	✓	✓			✓
PALV†*	Palo Verde	04-013-9993	ADEQ	36248 W Elliot Rd	2000-2004	✓		✓	✓	
PP†*	Pinnacle Peak	04-013-2005	MCAQD	25000 Windy Walk Way	2000-2004	✓	✓			✓
QC**	Queen Creek	04-021-3009	PCAQD	301 E Combs Rd	Since 7/1/2002	✓				
QV**	Queen Valley	04-021-8001	ADEQ	10 S Queen Ann	Since 5/23/2001	✓		✓	✓	
RV†*	Rio Verde	04-013-9706	MCAQD	N Forest Rd & Del Ray Ave	2000-2004	✓				
SAC**	Sacaton	04-021-7001	Tribal	35 Pima St	Since 7/1/2002	✓				
SP†*	South Phoenix	04-013-4003	MCAQD	33 W Tamarisk Ave	2000-2004	✓	✓			✓
SS†*	South Scottsdale	04-013-3003	MCAQD	2857 N Miller Road	2000-2004	✓	✓		✓	✓
SUPR†*	Super Site	04-013-9997	ADEQ	4530 N 17th Ave	2000-2004	✓	✓	✓	✓	✓
SU	Surprise	04-013-4007	MCAQD	18600 N Reems Rd	2001-7/14/2003	✓	✓			
TEMP*	Tempe	04-013-4005	MCAQD	1525 S College Ave	Since 7/1/2000	✓	✓		✓	✓
TNM**	Tonto National Monument	04-007-0010	ADEQ	South of SR88	Since 5/24/2002	✓		✓	✓	
WC	West Chandler (old)	04-013-3009	MCAQD	163 S Price Rd	Till 5/31/2000	✓	✓			✓
WC*	West Chandler	04-013-4004	MCAQD	Ellis St & Frye Rd	Since 8/1/2000	✓	✓			✓
WP†*	West Phoenix	04-013-0019	MCAQD	3847 W Earll Rd	2000-2004	✓	✓		✓	✓

† Monitoring sites having a complete data record.

*** Monitoring sites having 8-hour ozone exceedance at least once during the period (2000-2004) that affected selection of episodes to be modeled.**

**** Monitoring sites inside of the inner model domain but outside of the 8-hour ozone nonattainment area. Data from these sites will be used for model performance evaluation.**

Figure 2-4 Ozone Monitoring Sites

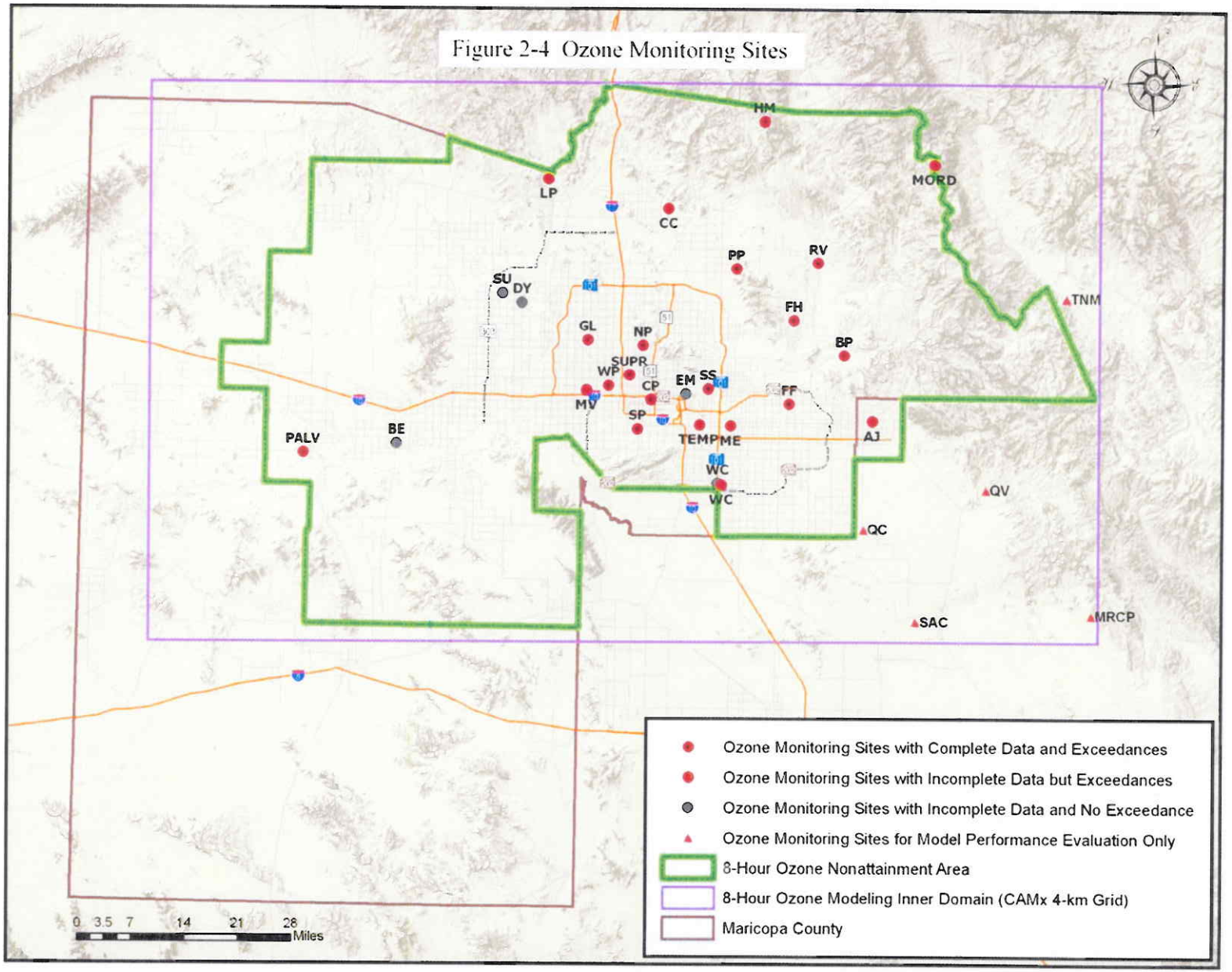


Table 2-2 Meteorological Monitoring Stations

NWS (33 sites)								
Site	Abbr.	Lat	Lon	UTM (Zone 12) Northing (m)	UTM (Zone 12) Easting (m)	Elev. (m)	Address	County
Casa Grande Municipal Airport	KCGZ	32.95000	-113.76389	3646004.74	428339.63	446	510 E. FLORENCE BLVD, Casa Grande	Pinal
Chandler Municipal Airport	KCHD	33.26917	-113.93306	3681421.13	424459.38	379	2380 S. STINSON WAY, Chandler	Maricopa
Davis-Monthan Air Force Base	KDMA	32.16667	-111.44806	3558916.01	511000.13	824	DAVIS-MONTHAN AFB, Tucson	Pima
Douglas Bisbee International Airport	KDUG	31.46917	-112.42222	3482443.65	632656.74	1266	1415 MELODY LANE, BLDG C, Douglas Bisbee	Cochise
Phoenix Deer Valley Municipal Airport	KDVT	33.69028	-110.72083	3728325.15	401239.94	450	702 W DEER VALLEY DR, Phoenix	Maricopa
Tucson NEXRAD	KEMX	31.88300	-110.00556	3527531.19	536222.38	1586	Tucson	Pima
Mesa/Falcon Field	KFFZ	33.46667	-109.37917	3703264.45	431857.54	424	4800 FALCON DR, Mesa	Maricopa
Flagstaff	KFGZ	36.21700	-111.67222	4008326.71	426567.23	2192	Flagstaff	Coconino
Libby AAF Fort Huachuca	KFHU	31.60000	-111.81700	3496292.91	563243.03	1438	401 GIULIO CESARE AVE, Sierra Vista	Cochise
Flagstaff Pulliam Airport	KFLG	35.14028	-112.15472	3888806.53	438763.21	2137	6200 S. PULLIAM DR, 204, Flagstaff	Coconino
Flagstaff NEXRAD	KFSX	34.56700	-114.55944	3825044.89	481654.04	2260	Flagstaff	Coconino
Gila Bend U.S. Army Airfield	KGBN	32.43333	-112.68333	3589715.73	341743.08	262	Gila Bend	Maricopa
Grand Canyon National Park Airport	KGCN	35.94611	-110.61700	3978587.39	395854.86	2014	Grand Canyon	Coconino
Glendale Municipal Airport	KGEU	33.52722	-112.38333	3710488.09	379721.07	325	6801 N. GLEN HARBOR BLVD 201, Glendale	Maricopa
Goodyear Municipal	KGYR	33.41667	-110.84583	3698335.76	371380.94	295	1658 SO LITCHFIELD RD, Goodyear	Maricopa
Laughlin/Bullhead International Airport	KIFP	35.15750	-110.33333	3893236.68	722300.40	212	2550 LAUGHLIN VIEW DR, Bullhead City	Mohave
Kingman Airport	KIGM	35.25778	-109.60361	3905575.22	233156.32	1050	7000 FLIGHTLINE DR, Kingman	Mohave
Winslow Municipal Airport	KINW	35.02806	-110.95528	3876190.43	525466.06	1505	21 WILLIAMSON AVE, Winslow	Navajo
Mesa Williams Gateway Airport	KIWA	33.31660	-109.63556	3686574.65	439496.98	421	6001 SOSSAMAN RD, Mesa	Maricopa
Williams AFB/Chandler	KIWA	33.31667	-111.76667	3686574.65	439496.98	421	6001 SOSSAMAN RD, Mesa	Maricopa
Luke Air Force Base/Phoenix	KLUF	33.53333	-111.81111	3711271.17	371553.24	332	LUKE AFB, Glendale	Maricopa
Yuma Marine Corps Air Station	KNYL	32.62361	-109.06667	3612935.22	240675.79	64	Yuma	Yuma
Nogales International Airport	KOLS	31.42083	-111.73333	3476252.27	514652.98	1198	Nogales	Santa Cruz
Page Municipal Airport	KPGA	36.92056	-112.06556	4086153.63	460091.83	1314	697 VISTA AVENUE, Page	Coconino
Phoenix Sky Harbor International Airport	KPHX	33.43417	-111.65000	3699914.60	402291.25	345	3400 SKY HARBOR BLVD, Phoenix	Maricopa
Prescott Love Field	KPRC	34.64917	-111.65000	3835058.29	369663.82	1537	6546 CRYSTAL LANE, Prescott	Yavapai
Wind Rock Airport	KRQE	35.65000	-112.29528	3946850.91	675023.86	2055	Window Rock	Apache
Safford Municipal Airport	KSAD	32.85722	-111.91056	3636283.38	627670.20	968	4550 E AVIATION WAY, Safford	Graham
Scottsdale Airport	KSDL	33.62278	-114.60000	3720703.49	415540.50	460	15000 N AIRPORT DR, Scottsdale	Maricopa
St. Johns Industrial Airpark	KSJN	34.51833	-111.20000	3820822.44	648772.04	1747	St. Johns	Apache
Show Low Regional Airport	KSOW	34.26528	-110.88333	3792017.67	591549.62	1955	3150 AIRPORT LOOP, Show Low	Navajo
Tucson International Airport	KTUS	32.13139	-112.05111	3555000.31	504218.01	805	Tucson	Pima
Yuma International Airport	KYUM	32.65000	-112.38333	3615031.47	725106.73	65	2191 E 32ND ST, Yuma	Yuma

Table 2-2 Meteorological Monitoring Stations (Continued)

AZMET (23 sites)								
Site	Abbr.	Lat	Lon	UTM (Zone 12) Northing (m)	UTM (Zone 12) Easting (m)	Elev. (m)	Address	County
Aguila	AGUI	33.946667	-113.188889	3758401	297716	655	0.6 Miles NW of Aguila City Limits	Maricopa
Bonita	BONI	32.463611	-109.929444	3592330	600610	1346	18 Miles N on Rex Allen Dr from Willcox at I-10	Graham
Buckeye	BCK1	33.400000	-112.683333	3696899	343454	304	3.5 km S of Exit 109 from I-10	Maricopa
Coolidge	COOL	32.980000	-111.604722	3649232	443496	422	0.8 km SW of the Curry Rd & Bechtel	Pinal
Eloy	ELOY	32.773889	-111.556944	3626358	447840	461	0.8 km E of 11 Miles Corner Rd on Arica Rd	Pinal
Harquahala	HARQ	33.483333	-113.116667	3706876	303337	350	1.8 km N of the Intersection of Courthouse Rd & 491st Ave	Maricopa
Laveen	LAVE	33.376389	-112.150000	3693605	393027	315	3921 W Baseline Rd	Maricopa
Litchfield	LITC	33.467222	-112.398056	3703959	370087	309	1 Mile N of McDowell Rd on Cotton Ln	Maricopa
Marana	MARA	32.461111	-111.233333	3591572	478071	601	1 Mile W of I-10 on Trico-Marana Rd	Pima
Maricopa	MARI	33.068611	-111.971667	3659313	409299	361	NW corner of field #5 S of Irrigation Lab Building	Pinal
Mohave	MOHA	34.967222	-114.605833	3872026	718581	146	14.2 Miles S of Bullhead City on AZ Route 95	Mohave
Paloma	PALO	32.926667	-112.895556	3644751	322765	219	9 Miles W of Gila Bend on I-8 to Paloma Exit	Maricopa
Parker	PARK	33.882778	-114.447778	3752091	736045	94	8 Miles S of Poston & 0.4 Miles E on Nez Rd	La Paz
Phx. Encanto	ENCA	33.479167	-112.096389	3704947	398135	335	SE of Thomas Rd & 19th Ave (Encanto Golf Course)	Maricopa
Phx. Greenway	PGRN	33.621389	-112.108333	3720728	397193	401	SE of Greenway & 23rd Ave (Cave Creek Golf Course)	Maricopa
Queen Creek	QUEE	33.258333	-111.641667	3680110	440233	430	0.1 km E of Queen Creek Rd & Ellsworth Rd	Maricopa
Roll	ROLL	32.744444	-113.961111	3626837	222539	91	County 4th St & Ave 39 E	Yuma
Safford	SAFF	32.813333	-109.678333	3631367	623729	901	0.8 km SE of Lone Star Rd & Mountain Rd	Graham
Tucson	TUCS	32.280278	-110.945833	3571504	505101	713	1 km NW of Campbell Ave & Roger Rd	Pima
Waddell	WADD	33.618056	-112.459722	3720763	364592	407	2 Miles W of Cotton Ln & 0.4 Miles S of Greenway Rd	Maricopa
Yuma Mesa	YMES	32.611944	-114.633889	3610740	722021	58	0.32 km W of Ave A on 15th St	Yuma
Yuma North Gila	YUMA	32.735278	-114.529444	3624641	731506	44	2.1 km W on 7th Ave from Gila Center	Yuma
Yuma Valley	YVAL	32.712500	-114.705000	3621744	715106	32	5 Miles W of Yuma on 8th St	Yuma
FSL (4 sites)								
Site	Abbr.	Lat	Lon	UTM (Zone 12) Northing (m)	UTM (Zone 12) Easting (m)	Elev. (m)	Address	County
Flagstaff/Bellemt	FGZ	35.23	-111.82	3898858	425383	2179	123 miles North from Central Phoenix	Coconino
Tucson	TUS	32.12	-110.93	3553739	506603	788	113 miles South from Central Phoenix	Pima
Yuma/US Army	YUM	32.87	-114.33	3640036	749823	131	138 miles West from Central Phoenix	Yuma
Yuma/US Army	1Y7	32.87	-114.40	3639872	743271	98	142 miles West from Central Phoenix	Yuma

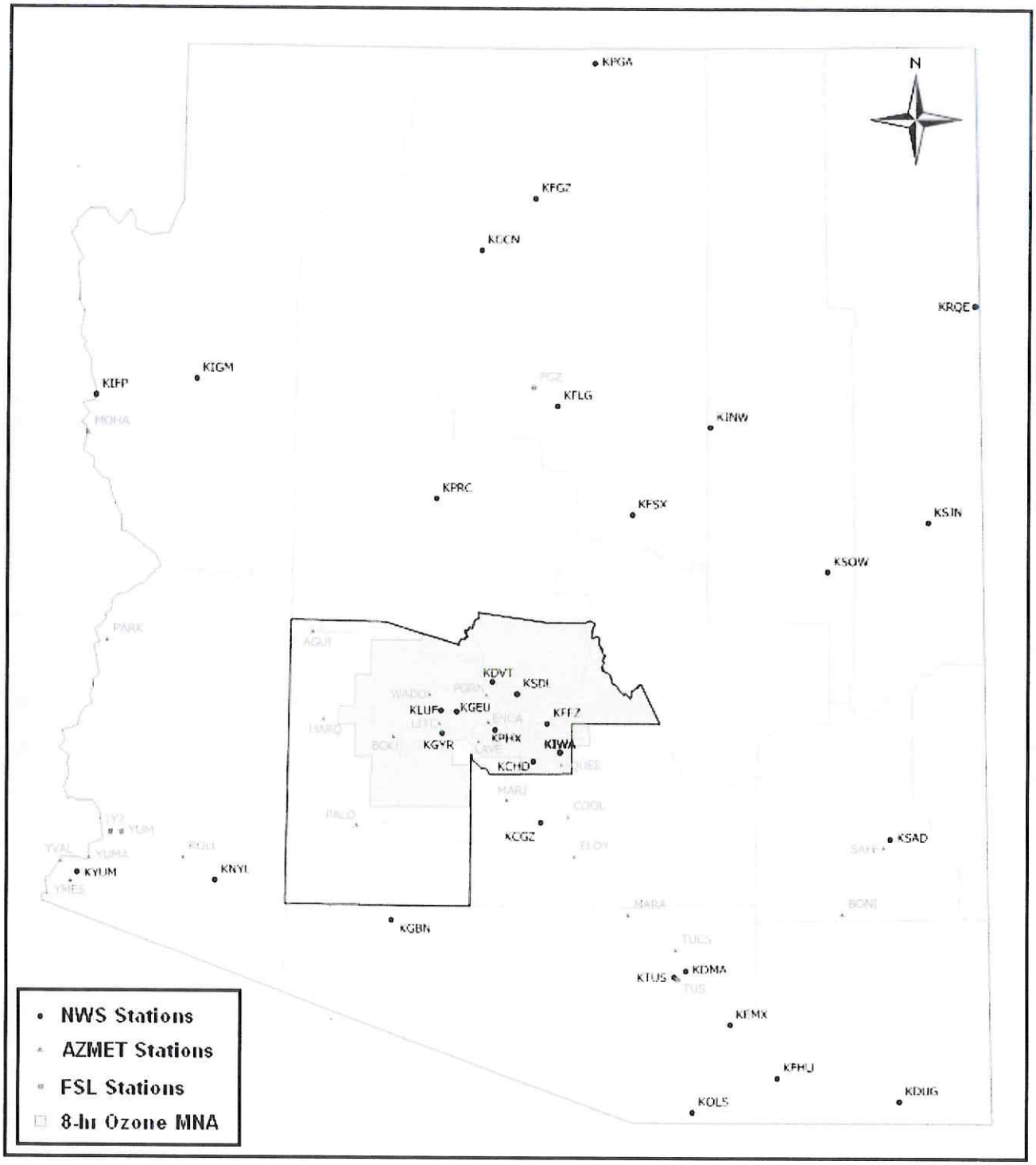


Figure 2-5. Meteorological monitoring stations

- cloud cover,
- water vapor,
- UV radiation,
- surface temperature, terrain, and land use and surface characteristics.

These inputs will be prepared according to locally measured data available for the modeling episodes. Otherwise, the values recommended by EPA will be used in the simulations of eight-hour ozone concentrations.

MAG has contracted with ENVIRON to perform the MM5 meteorological modeling for the three episode periods in 2001 and 2002. ENVIRON will supplement the MM5 meteorological data provided by MAG with data from other sources such as the Western Regional Air Partnership. Using the three nested domains (4/12/36 km grids), ENVIRON will conduct an extensive MM5 performance evaluation using all available measurement data for each episode. Sensitivity and diagnostic runs will be developed to improve model performance in replicating surface and aloft winds, temperature, humidity, boundary layer characterization, and rainfall rates. ENVIRON will recommend to MAG the single best meteorological representation to be used in modeling ozone concentrations for each episode. The MM5 tests and performance evaluation for the three episode periods will be described in the Technical Support Document.

2.4 Vertical Resolution

The number of layers in the vertical direction to be used in the CAMx simulations will be nineteen, fifteen layers within the boundary layer (below 2,500 meters) and four layers above the maximum planetary boundary layer (PBL). The top of the modeling domain will be set at 14,662 meters. The lowest layer in the eight-hour ozone simulation will be 36 meters. This vertical structure is consistent with the MM5 meteorological modeling being performed by ENVIRON for the Western Regional Air Partnership (WRAP) and exceeds the minimum standards recommended by EPA guidance[12].

2.5 Specification of Initial and Boundary Conditions

Air quality data within the 4 km grid modeling domain will be used to derive the initial eight-hour ozone concentrations. A distance-weighted interpolation will be used to generate horizontal gridded initial concentrations for the surface layer. Some pseudo sites at or near the lateral boundaries will be set up in the domain. Background values will be assigned to the 4 km grids based on input from the 12 km grid simulations. Boundary conditions for the 12 km modeling domain will be provided by ENVIRON based on WRAP and CAIR modeling. A constant vertical concentration profile will be specified for each grid column assuming that concentrations were well mixed below the region top of the modeling domain during the first simulation hour.

2.6 Episode Selection

Elevated ozone episodes that occurred during the ozone seasons of the five years, 2000 through 2004, were considered in the selection of episodes for this modeling study. The historical patterns of ozone episodes and the fundamental meteorological regimes conducive to ozone formation in the area were taken into account in evaluating and justifying the selection of episodes. The selected episodes represent three different meteorological regimes that correspond to ozone concentrations of at least 80 ppb. Wind flow patterns (e.g., well defined transport winds vs. light and variable winds) were the primary consideration for distinguishing among regimes. Region-wide temperature observations (e.g., high temperatures vs. less extreme temperatures) were also considered as a factor in selecting the modeling episodes. High ozone days were partitioned into the three major regimes recommended in EPA guidance [12]. The detailed evaluation resulting in episode selection is provided in Attachment II [4].

The primary criteria influencing the selection of the episode periods were:

- The episodes represent a variety of meteorological conditions that frequently correspond with eight-hour ozone exceedances at multiple monitoring sites;
- The episode days have eight-hour ozone concentrations that are close to the design value for each monitor;
- There are adequate emissions, air quality, and meteorological data available for the attainment test for these periods; and
- The selected episodes have a sufficient number of days to base the modeled attainment test on more than one day at each violating monitor.

Three high eight-hour ozone episode periods have been selected based on the detailed analysis described in Attachment II. The three episodes are:

1. July 8-14, 2002 (Regime 1)
2. June 3-7, 2002 (Regime 2)
3. August 5-11, 2001 (Regimes 2 and 3).

The first episode (Regime 1) is characterized by stagnation and locally-generated ozone. It contains the highest 8-hour ozone measured in the Maricopa nonattainment area (MNA) between 2001 and 2004 and includes weekend exceedances. During this period, there were 17 sites with peak ozone concentrations greater than 85 ppb and 8 sites measured their fourth-highest concentrations of the year. This episode ranked the highest of the six candidate episodes that were evaluated.

The second episode (Regime 2) is characterized by higher surface winds, with potential transport mainly from the south and southwest. This episode does not include weekend exceedances. During this period, there were 8 sites with ozone

concentrations above 85 ppb and 9 sites measured their fourth-highest concentrations of the year. This episode ranked third among the six candidates evaluated.

The third episode (Regimes 2 and 3) is characterized by higher surface winds, with both locally generated and transported ozone. It includes weekend ozone exceedances and has 11 sites with concentrations above 85 ppb. This episode was fourth highest among the candidates evaluated.

These three episodes will be modeled in order to reflect the full range of meteorological, transport, and emissions-generation conditions that are characteristic of high ozone days in the MNA. Three spin-up days will be added to each episode, resulting in a total of 28 days to be modeled. Since the episodes occur in 2001 and 2002, emissions inventories will need to be developed for both of these base years.

2.7 Emissions Inventories

The Emissions Preprocessor System (EPS3) will be used to process the emissions inventories. The inventories will consist of emissions from point, area, onroad mobile, nonroad mobile, and biogenic sources. The emissions will be temporally adjusted and spatially allocated in the grid cells using EPS3. EPS3 consists of a set of FORTRAN programs (modules) that are executed sequentially in order to prepare the gridded emissions inventory for use in photochemical dispersion modeling.

The 2001 and 2002 emissions will be adjusted to be consistent with the meteorological conditions during the selected episode periods. The resulting episode period emissions will also be adjusted to reflect control programs and activity levels prevailing during the days and years modeled. These adjustments will result in different modeling inventories for each of the 2001 and 2002 base case ozone episodes.

The base case modeling inventory for 2002 will be adjusted to reflect emissions expected to occur in 2008. The general methodology for creating the 2008 base case emissions will be based on EPA guidance on the preparation of emissions projections [9]. This adjustment will entail the use of growth factors, ongoing control programs, and retirement rates for obsolete sources of emissions.

The growth factors used to create the 2008 inventory for area and onroad mobile sources will reflect the latest socioeconomic projections based on the 2000 Census. It is anticipated that new socioeconomic projections will be approved by the MAG Regional Council in mid-2006.

The modeling inventories for the 2001 and 2002 base cases and the 2008 future year will reflect the impact of the committed control measures, where appropriate. The 2008 emissions inventory, reflecting the worst case episode period selected from among the three base cases, will be used to demonstrate the modeled attainment status.

Table 2-3 summarizes the daily ozone precursor emissions for the five major source categories during the 2002 ozone season in Maricopa County. The assumptions to be used in estimating emissions for each of these source categories are discussed in more detail below.

2.7.1 Consistency With Periodic Emissions Inventories

The CAAA of 1990 requires that periodic inventories of ozone precursor emissions be prepared at three-year intervals for ozone nonattainment areas. The 2002 periodic inventory was prepared by MCAQD in June 2004 [6].

The Technical Support Document (TSD) for the eight-hour ozone attainment demonstration will describe how the point and area source emissions used in the modeling were derived from the 2002 periodic emissions inventory. The TSD will also explain and justify the differences between the 2002 base case onroad, nonroad, and biogenics emissions and the 2002 periodic emissions inventory. If Maricopa County and Pinal County have completed the 2005 periodic inventory of ozone precursor emissions by January 2007, a comparison of the 2002 base case and 2005 periodic emissions inventories will also be documented in the TSD.

2.7.2 Treatment of Point and Area Source Emissions

The 2002 point and area source emissions will be derived from the 2002 periodic inventories of ozone precursor emissions developed by the Maricopa County Air Quality Department (MCAQD) and the Pinal County Air Quality Control District (PCAQCD). MAG will work with MCAQD and PCAQCD to develop the factors needed to derive 2001 and 2008 point and area source emissions from the 2002 periodic inventories.

2.7.3 Treatment of Mobile Source Emissions

On January 29, 2002, EPA announced the official release of the MOBILE6 model for regulatory use outside of California. MOBILE6.2 is the latest update of the onroad mobile source model developed by EPA to estimate vehicle emission factors. The onroad mobile source emissions for the eight-hour ozone attainment demonstration will be developed using the MOBILE6.2 model. It should be noted that the onroad mobile source portion of the 2002 periodic inventory for ozone precursors [6] was also developed using the MOBILE6.2 model. However, onroad mobile source emissions will be re-estimated for this analysis using the latest socioeconomic data and transportation system assumptions available in mid-2006.

MOBILE6.2 uses a variety of inputs. Each modeled scenario will require at least ten runs: a minimum of one Inspection and Maintenance (I/M) run and a non-I/M run for each of the five area types included in the transportation modeling area: central business district, urban, urban fringe, suburban, and rural. The results from these runs will be weighted appropriately to reflect the actual proportions of I/M and non I/M

Table 2-3 2002 Daily Ozone Season Emissions in Maricopa County [6]

	VOC		NOx		CO	
	lbs/day	%	lbs/day	%	lbs/day	%
Area	315976	33.16	61570	8.08	1706230	31.36
Nonroad Mobile	116432	12.22	165466	21.70	1698871	31.23
Onroad Mobile	180380	18.93	437741	57.42	2023444	37.19
Biogenic	309511	32.48	71648	9.40	NA	NA
Point	30728	3.22	25938	3.40	12130	0.22
Total	953027	100.00	762363	100.00	5440675	100.00

vehicles within the nonattainment area. In addition, the inputs for each run will include Reid Vapor Pressure (RVP), oxygen, and sulfur gasoline content values appropriate for the summer ozone season. The temperature range will reflect episode day conditions in the nonattainment area for the episode chosen. Note that these values will vary depending upon the episode period being modeled. The 2008 committed measure package runs will reflect control measure assumptions for the pertinent commitments contained in the MAG Serious Area Plans for PM-10 and CO [1,2], and the One-Hour Ozone Maintenance Plan [3], where appropriate.

MOBILE6.2 generates emission factors which incorporate local vehicle speeds, episodic temperatures, and hot/cold operating modes. These emission factors will be utilized by the M6Link system to estimate onroad mobile source vehicle emissions for the inner modeling domain.

The M6Link system is a FORTRAN-based set of programs (M6Link1 and M6Link2) that are applied at the regional level to examine transportation and related air quality issues. The system is designed to read in files created by the MAG EMME/2 transportation models, and extract the relevant data needed for an air quality analysis, including data needed to run the MOBILE6.2 model. The M6Link1 extracts data such as roadway link speeds, locations, and vehicle miles of travel (VMT) and assigns link VMT to the correct hour and air quality grid cell accordingly. M6Link1 also factors link VMT to be consistent with Highway Performance Monitoring System VMT by functional system.

The MOBILE6.2 program is run using the output from M6Link1 as part of its input data. The output from MOBILE6.2 is then used as one of the inputs to M6Link2, the second program of the M6Link system. M6Link2 combines the output from M6Link1 and the output of MOBILE6.2 to produce hourly gridded emissions, suitable for input to the photochemical dispersion model. These results incorporate locally-derived hourly VMT splits, vehicle speed data, VMT by four vehicle classes by area and roadway type, fuel characteristics, and temperatures, to ensure results appropriate to episode conditions.

In addition to CAMx-ready files, M6Link2 produces tables summarizing VMT and vehicle hours traveled (VHT) by facility type and area type. Also, tables summarizing emissions totals by hour, facility type, or emissions source (i.e. exhaust vs. evaporative) are produced. EPS3 will be used to combine the M6Link output with the emissions of other source categories (e.g., point, area, and biogenic emissions) to create the emissions file used by the photochemical dispersion model.

2.7.4 Treatment of Nonroad Mobile Emissions

MAG will use the Draft 2004 EPA NONROAD model to estimate ozone precursor emissions for all nonroad mobile sources, except aircraft and ground support equipment. Maricopa and Pinal County Business Patterns (CBP) data will be used to estimate 2001 and 2002 activity data that is input to the NONROAD model. Growth factors to forecast 2008 nonroad emissions for all sources except aviation will be based

on EPA default assumptions in the NONROAD model, unless other data (i.e., MAG socioeoconomic projections, WRAP growth factors) prove to be more representative of local conditions.

Locomotive emissions will be estimated using activity data provided by the Union Pacific and the Burlington Northern Santa Fe Railroads. Base case and forecast year activity data for aircraft and ground support equipment will be derived from recent airport surveys. Aircraft emission factors used in the MAG Aviation Preprocessor will be obtained from the International Civil Aviation Organization Engine Exhaust Emissions Data Bank.

2.7.5 Location of Anthropogenic Emissions

The locations of power plants in Maricopa County are provided in Table 2-4. The locations of emissions from other human activities are shown in the one-hour ozone emission density plots contained in Attachment IV [3]. The density plots show the distribution of onroad mobile source and background emissions of NOx and VOC for the one-hour ozone modeling domain during the episode period in August 1999. Background emissions include point, area and nonroad sources, but exclude onroad and biogenic sources.

2.7.6 Treatment of Biogenic Emissions

The biogenic emissions model allows hydrocarbons emitted by vegetation and NO_x emitted by soil to be included in the emissions inventory. MAG has contracted with ENVIRON to recommend a biogenic emissions model and biogenic emission rates appropriate for vegetation and soils in the Maricopa nonattainment area. These recommendations will be used to prepare the biogenic emissions inventory for the eight-hour ozone attainment demonstration.

The recommended biogenics emissions model will use local land use data and gridded hourly temperature data to calculate emissions of VOCs and NO_x in each grid cell of the modeling domain for each hour of the modeling period. The most recent land use data compiled by MAG for transportation and planning purposes will be used in spatially allocated the biogenic emissions. Procedures for development of the biogenic emissions will be documented in the TSD. The biogenic emissions will be generated in CAMx-ready format and will be merged with the other emissions input files.

2.7.7 Temporal Allocation of Emissions

Emissions in the 2002 periodic inventory for ozone precursors [6] are provided either as annual averages or as daily ozone season values, except for peaking power plants. Emissions from the peaking power plants for modeling purposes will be based on the actual operating schedule provided by MCAQD. Typical peak ozone season day

Table 2-4. Power Plants in Maricopa County

Power Plant	Location	City	UTM (Zone 12, m)	
			Easting	Northing
APS West Phoenix Power Plant	Hadley St.	Phoenix	392414	3701190
Duke Energy Arlington Valley	Elliot Rd.	Arlington	323858	3691307
New Harquahala Generating Co.	491st Ave.	Tonopah	303688	3705787
Mesquite Generating Station	Elliot Rd.	Arlington	326602	3691016
Ocotillo Power Plant	University Dr.	Tempe	415224	3698573
Palo Verde Nuclear Generating Station	Wintersburg Rd.	Tonopah	325615	3696527
Gila River Power Station	Watermelon Rd.	Gila Bend	341737	3649850
Redhawk Generating Station (Pinnacle)	363rd Ave.	Arlington	328940	3690200
Santan Generating Plant	Val Vista Dr.	Gilbert	430407	3688183
SRP Agua Fria Generating Station	Northern Ave.	Glendale	387108	3713387
SRP Kyrene Steam Plant	Kyrene Rd.	Tempe	412877	3691004

emissions correspond to an average weekday during the summer season, defined as July through September in the 2002 periodic inventory. To convert these values to average episode day values in 2001 or 2002, EPS3 will apply an adjustment factor representing the ratio of the episode day emissions to average summer emissions for each source type in the appropriate year.

All point sources, except peaking power plants, and area, nonroad mobile, and aviation sources, will be resolved temporally based on profiles for seasonal activity, activity provided by day of week, and diurnal patterns of activity. EPS3 will be used to convert to episode period values by applying monthly and day-of-week adjustment factors. For the 2008 forecast year, the point sources defined in the 2002 periodic inventory will be allocated according to projected operating schedule data, where available.

2.7.8 Spatial Allocation of Emissions

Point sources will be spatially allocated according to the coordinates (i.e., UTM) of each source. The latest projections based on the data from the 2000 U. S. Census, appropriate land use data, and general plan data will be used for the spatial allocation of area and nonroad mobile sources. The MAG transportation models will assign travel to 2001, 2002 and 2008 highway networks that will be used to spatially distribute onroad mobile source emissions. Biogenics emissions will be allocated spatially using the MAG 2004 land use cover for the urbanized portion of Maricopa County and the EPA Biogenic Emissions Landuse Database (BELD3) for the remainder of the modeling domain.

2.7.9 Treatment of SIP Control Measures

The base and future year emissions inventories will include the committed measures, where appropriate, from the Revised MAG 1999 Serious Area Carbon Monoxide Plan [2]; the Revised MAG 1999 Serious Area Particulate Plan for PM-10 [1]; and the MAG One-hour Ozone Redesignation Request and Maintenance Plan [3], to determine if the committed measures are sufficient to demonstrate attainment of the standard. If the modeling outlined in this protocol does not demonstrate attainment of the standard with the existing committed control measures, the technical support document will be revised to document any additional measures that will be necessary to attain the standard.

2.8 Quality Assurance

The purpose of quality assurance testing is to establish that apparently good model performance is the result of valid model inputs and assumptions, and not the result of compensating errors in input data. Prior to conducting a base case simulation, individual air quality, meteorological, and emissions data components will be reviewed for consistency and obvious omission errors. Both spatial and temporal characteristics of the data will be evaluated. Examples of component testing include:

- Air Quality: Check for correct order of magnitude; compare values with monitored data; assure reasonable speciation.

- Emissions: The emissions inventory will be tabulated, plotted, and examined. The quality assurance procedures will include documentation of major assumptions, careful accounting of emissions totals throughout the development process, verification of spatial distribution of emissions against known source locations and emission strengths, and identification of missing or unreasonable data values.

- Meteorology: If data are available, plot surface and elevated wind vectors and compare with monitoring stations and weather maps for consistent patterns; compare mixing height fields with sounding data; check temperature fields.

It is very important to perform the quality assurance tests prior to performing model simulations. Errors uncovered by the quality assurance testing of component input fields might be extremely difficult to diagnose later in the modeling process where errors could arise from any subset of the data inputs.

3. MODEL PERFORMANCE EVALUATION

This chapter discusses the procedures to be followed for diagnostic testing of the base case episode. The purpose of the diagnostic tests is to uncover potential data input gaps that, when corrected, lead to improved model results. The evaluation increases confidence in the ability of the model to capture key meteorological features in order to predict future ozone concentration levels.

3.1 Diagnostic Tests

After conducting the above quality assurance tests, CAMx will be run for the base case episode. Emphasis will be placed on correctly depicting the regional distribution and timing of observed ozone concentrations. Spatial and time series plots will be used to assess model behavior.

To aid the interpretation of simulation results, predicted and observed ozone concentration maps will be constructed for each base case episode. Concentration maps present spatial information on the structure of the ozone plume. Maps at eight hour intervals will be constructed over periods of the ozone plume and over periods of most interest. While a typical period might be defined as early morning to late afternoon for the day of the highest ozone concentration, it is useful to look at most time intervals under recirculation, stagnation, and transport conditions.

Consideration will also be given to constructing a map which depicts the highest predicted daily eight-hour ozone value for each grid cell. Examples of representative mapping techniques are described in Tesche, et. al. [13] The predicted concentration to be used in the time-series plots will be defined using the same method for deriving predicted concentrations for the model performance evaluation. This method consists

of a four-cell weighted average using bilinear interpolation of the predictions from the nearest four grid cells to the monitor location [13].

If feasible, time-series plots will be developed for NOx, as well as for VOC species at selected locations, particularly for cases in which ozone time-series or mapping results do not appear consistent with expectations. Comparisons of calculated ozone precursor concentrations with any available observations will be done for concentration levels above the detection limits of the monitoring equipment.

Additional diagnostic tests for the base case will be performed depending upon the availability of time and resources. A number of sensitivity tests will be conducted with CAMx to determine the response in ozone concentrations to changes in key inputs such as emissions and mixing depth. The sensitivity simulations could include one or more of the following:

Zero Boundary Conditions. Inflow concentrations at the lateral boundaries and top of the modeling domain will be reduced to zero. Sensitivity of the concentrations in the inner core and downwind portions of the modeling domain provide a measure of the influence of the boundary conditions. This simulation will provide assurance that the upwind extent of the domain is adequate.

Zero Initial Conditions. Initial concentrations for all grid cells will be reduced to zero. Sensitivity of concentrations within the modeling domain provide a measure of the influence of the initial conditions. Changes of less than a few percent indicate that the initial conditions are not dominating concentration estimates within the domain.

Diffusion Break Heights. Diffusion break heights will be doubled for one simulation and halved for another. Sensitivity of the concentrations within the modeling domain provide a measure of the influence of diffusion break heights. These simulations will provide assurance that the diffusion break heights are adequate.

More elaborate diagnostic tests involve sensitivity-uncertainty studies that examine model responses to a range of variation in input parameters (i.e., various changes in emission levels, emission speciation, etc.) All diagnostic steps will be documented to avoid misinterpretation of model performance results. Once confidence is gained that the simulation is based on reasonable interpretations of observed data, and model concentrations generally track, spatially and temporally, known urban plumes, a performance evaluation based on numerical measures will be conducted for each base case episode.

As part of the diagnostic tests, considerable effort will be expended to investigate the nature of the photochemical interaction between VOC and NOx and the formation/titration of ozone. The diagnostic tools available in CAMx will be applied to determine if all or a portion of the MNA is VOC-limited in 2008.

3.2 Test Results/Input Modifications

Following the diagnostic modeling analyses, the simulation results will be carefully examined for possible modification or refinement of the input components. On a case-by-case basis, the performance of CAMx for each base case simulation will be evaluated to determine whether or not it is acceptable, with or without input modifications. The model performance criteria listed in the EPA guidance [12], and supplemental analyses presented in the next chapter (Chapter 4), will be used in the evaluation.

3.3 Performance Evaluation Goals

Simulated and observed eight-hour average ozone concentrations at each monitoring station will be utilized in setting statistical performance goals. Some general model performance guidelines have been outlined in the EPA guidance [12]. Among the general guidelines are the following statistical performance goals:

Unpaired highest-prediction accuracy - percentage difference between domain wide simulated and observed peak unpaired in space or time. EPA recommended range: ±20%.

Normalized bias test - provides a measure of the ability of the model to replicate observed patterns during the times of day when available monitoring and modeled data are most likely to represent similar spatial scales. EPA recommended range: ±15%.

Gross error of all pairs above 80 ppb - in conjunction with bias, this metric provides and overall assessment of base case performance and may be used as a reference to other modeling applications. Gross error may be interpreted as precision. EPA recommended range: ±35%.

In general, performance measures that fall within or below these ranges would be considered acceptable. However, results from the above three statistical measures alone may not be sufficient to fully assess the capability of the model in reproducing the chemical and physical processes governing urban-scale ozone concentrations. Therefore, the model performance evaluation procedures will be expanded to include additional numerical and graphical measures recommended by Tesche, et. al. [13]

The additional seven numerical measures include temporally and spatially paired peak estimates, temporally or spatially paired peak estimates, average station peak estimates, bias and gross error, and variance. The additional graphical measures include time series plots and "spatial" time series plots, time series displaying highest and lowest estimates by sites, ground level isopleths, and scatter plots of estimates and observations.

If the statistical results do not meet the recommended performance criteria, and graphical analyses also indicate poor model performance, an alternative episode will be chosen or the EPA regional office will be contacted for review and approval of the base case episode before any future-year simulations are undertaken.

4. ATTAINMENT DEMONSTRATION

4.1 Identification of Attainment Year

The primary purpose of conducting regional modeling with CAMx is to demonstrate attainment of the NAAQS for eight-hour ozone by June 15, 2009. To ensure that all control measures necessary to show attainment are in place by the beginning of the ozone season in 2009, EPA requires that the ozone season in the previous year, 2008, be modeled.

4.2 Identification of Control Measures

The committed control measures already implemented in the Serious Area CO Plan, the Serious Area PM-10 Plan and the One-hour Ozone Maintenance Plan will be evaluated. If additional control measures are needed, they will be submitted to the MAG Air Quality Technical Advisory Committee for consideration as part of the Suggested List of Measures. Following Regional Council approval of the Suggested List of Measures, the local jurisdictions and the Legislature will be requested to consider the implementation of the measures under their respective authorities. Each jurisdiction determines which measures are feasible for implementation by that jurisdiction. These measures then become the committed measures. The committed control measure package will be incorporated into the emissions inventory for CAMx. Based upon the results of these simulations, it will be determined if the control strategies demonstrate attainment of the eight-hour ozone standard.

If additional control measures are needed, the procedures for selecting the control strategy scenarios will conform to the State Implementation Plans (SIPs) [1,2,3], follow current EPA guidance [12] or any deviation from the guidance will be fully justified, and incorporate our present understanding of the urban/regional ozone problem. The 2008 runs will reflect control measure assumptions for the commitments contained in the SIPs [1,2,3], where appropriate.

4.3 Modeled Attainment Test

To demonstrate attainment of the eight-hour ozone standard in 2008, the future design values near each monitor should not exceed 84 ppb. The future design values will be predicted by multiplying a relative reduction factor (RRF) by the base case monitored design value at each site [12]. The RRF is the ratio of the CAMx-modeled future to base case 8-hour daily maximum concentrations predicted near a monitor (averaged over several days).

"Near a monitor" means within approximately 15 km of each site [12]. In the case of 4 km grid cells, EPA recommends that an array of 7 x 7 grid cells, with the monitor located in the center grid, be considered "near a monitor." Initially, MAG will utilize a 7 x 7 grid cell array to demonstrate attainment near each monitor. If CAMx modeling reveals that the MNA is VOC-limited, the size of the array may have to be altered to avoid RRFs that are unrealistically large or small. Any deviation from the 7 x 7 grid array will be justified in the TSD.

The highest eight-hour ozone maximum predicted by CAMx in the grid cells near a monitor will be computed for each day in the episode period (except initialization days). These daily values will be averaged over the number of days in the episode to obtain the future and base case concentrations used in calculating the RRFs. Predicted base case maxima below 70 ppb will be excluded from the analysis.

The 2002 design value for each monitor will be calculated as the average of the current design values for the periods: 2000-2002, 2001-2003, and 2002-2004. Similarly, the 2001 monitored design values will be calculated as the average of the current design value for the periods: 1999-2001, 2000-2002, and 2001-2003. The current design value for each period is defined as the three year average of the fourth highest daily 8-hour maximum ozone concentration monitored at each site.

The modeled attainment test will be performed for the episode period [4] that represents worst case conditions. Additional tests that may be performed are described in the next Chapter.

4.4 Modeling Reliability and Uncertainties

CAMx is considered to be an appropriate tool for projecting the future air quality impact of changes in emissions [12]. However, future year modeling results should not be considered absolute guarantees of future air quality. Uncertainties in the models used and their inputs, along with meteorological variability, may result in actual future air quality that differs from predicted air quality. Higher concentrations than those modeled may occur for any of the following reasons:

Meteorological variability - In selecting a modeling episode, the goal is to select periods that represent worst-case conditions. If episodes with more severe stagnation occur in the future, emission controls designed to reach attainment for a historical episode may not be adequate.

Emissions variability - Emission estimates are based on average source usage, taking into account seasonal, diurnal, and day-of-week factors. Nonroad and onroad mobile emissions estimates take into account day-specific temperatures as well. However, emissions on a given day may be greater than average due to greater than average usage, lower temperatures, or other factors.

Uncertainty in growth projections - If growth projections underestimate true growth rates, future year emissions may be greater than projected emissions.

Uncertainty in control measure effectiveness - If actual emission reductions from a given control measure are smaller than the estimated emission reductions, future concentration will be greater than modeled concentrations.

Model performance - If the model under-predicted concentrations at a particular site, or has failed to capture a particular aspect of the meteorology, then a level of emission reduction that appeared to be adequate during modeling may not actually be adequate.

By similar reasoning, future measured concentrations may be lower than modeled concentrations because of these variabilities and uncertainties. In addition, future measured concentrations will still be limited to monitoring site locations.

As a result, although modeled future design values below 85 ppb are adequate to demonstrate attainment, modeling results are better thought of as points on a probability distribution. If the modeled peak values are below 80 ppb, the probability that attainment will result, even under differing conditions, is high. If the modeled peak is very close to 85 ppb, however, the probability that attainment will result may be well below 100 percent given the probabilistic nature of meteorology and modeling.

The relative reduction factor approach recently introduced by EPA [12] uses average values (modeled and monitored) that are more likely to result in an accurate assessment of attainment under a variety of conditions. However, if the modeled attainment test shows that some peak concentrations are close to the standard, MAG will conduct additional tests, as described below.

5. SUPPLEMENTAL ANALYSES

When future design values are very close to the standard, EPA recommends that corroboratory tests be performed [12]. If future design values in 2008 exceed 80 ppb, MAG will conduct additional analyses to confirm that attainment of the NAAQS for eight-hour ozone is likely to occur. If the corroboratory tests fail to support the finding of attainment, a weight of evidence approach may be applied. These supplemental analyses are discussed below.

5.1 Corroboratory Tests

EPA recommends that a supplemental screening test be applied in areas where the ozone monitoring network just meets or minimally exceeds the size of the network required to report data to the Air Quality System (AQS) [12]. The ozone monitoring network in the MNA includes more than twenty monitors, which exceeds the minimum requirement for AQS. However, as a corroboratory test, MAG will conduct the EPA-recommended screening test.

5.1.1 Screening Test

The screening test is intended to ensure that ozone will not exceed the standard in locations that are not near (i.e., in the 7 x 7 array surrounding) a monitor. This test requires the identification of areas in the nonattainment area where predicted eight-hour

daily maximum ozone concentrations are "consistently greater" than any predicted in the vicinity of a monitoring site. For each identified area, a location-specific RRF is multiplied times an appropriate current design value to estimate a future design value. If the resulting estimates are less than or equal to 84 ppb at all locations, the screening test is passed.

To identify "consistently greater" grid cells, EPA recommends "flagging" grid cells in the MNA for which the predicted eight-hour daily base case maxima is higher than any predicted maxima near a monitored location on 25 percent or more of the modeled base case days. A 7 x 7 array of grid cells will be constructed around each cell flagged by the screening test. If any of these grid cells show up within an array on 25 percent of more of the modeled days in the same episode, a future design value will be estimated for that cell.

For each flagged cell, the design value will be estimated by multiplying the modeled RRF by the current design value at the closest monitor. Alternatively, spatial interpolation may be performed to estimate the current design values of flagged cells.

5.1.2 Absolute Model Forecasts

If CAMx is able to reproduce observed base case ozone concentrations with relatively little statistical error or bias, the absolute modeling results for the 2008 forecast may be useful in corroborating the results using RRFs. Metrics that compare future year and base case modeled ozone concentrations might include:

- Percent change in total amount of ozone greater than or equal to 85 ppb in the MNA;
- Percent change in number of grid cells greater than or equal to 85 ppb in the MNA;
- Percent change in grid cell hours greater than or equal to 85 ppb in the MNA; and
- Percent change in maximum modeled eight-hour ozone concentration in the MNA.

5.1.3 Other Corroboratory Tests

MAG will perform other tests to confirm and explain the results of the CAMx modeling. The CMAQ model will be applied to corroborate the CAMx results. Other corroboratory tests may include applying the photochemical source apportionment tool in CAMx to determine which sources are contributing to attainment during the worst-case episode period in 2008.

5.2 Weight of Evidence Approach

If the modeling analyses fail to show attainment of the eight-hour ozone standard in 2008, EPA allows a weight of evidence approach to be applied. Past analyses have shown that future design value uncertainties of 2-4 ppb can result from use of alternate, but equally appropriate, emissions inventories, chemical mechanisms, and meteorological inputs [12]. The end product of a weight of evidence determination is a document which describes the analyses performed, the data bases used, key assumptions and outcomes, and why the evidence, viewed as a whole, supports a conclusion that the area will attain the NAAQS despite model-predicted future design values of 85 to 89 ppb.

If modeled future design values exceed 84 ppb, MAG will confer with Region IX EPA and the Air Quality Planning Team to design appropriate weight of evidence tests. It is not anticipated that this will be necessary, because the base case design values are close to the standard and additional reductions in ozone precursor emissions (i.e., Tier 2 and heavy duty diesel vehicle emission controls) are expected to occur by 2008.

6. PROCEDURAL REQUIREMENTS

The following items will be delivered in draft form to the EPA regional office for review and comment during the modeling study. MAG will also provide draft versions of these items to the Air Quality Planning Team for review and comments.

- The modeling protocol.
- The Technical Support Document which addresses the entire modeling analysis, including MM5 and CAMx input preparation and application and the attainment demonstration.

REFERENCES

1. Maricopa Association of Governments (February 2000). "Revised MAG Serious Area Particulate Plan for PM-10 Plan for the Maricopa County Nonattainment Area".

2. Maricopa Association of Governments (March 2001). "Revised MAG 1999 Serious Area Carbon Monoxide Plan for the Maricopa County Nonattainment Area".

3. Maricopa Association of Governments (March 2004). "One-Hour Ozone Redesignation Request and Maintenance Plan for the Maricopa County Nonattainment Area".

4. Maricopa Association of Governments (July 29, 2005). Memo from Ieesuck Jung to Cathy Arthur. "Review of 2000-2004 Ozone Episodes in the Maricopa County 8-Hour Ozone Nonattainment Area".

5. Maricopa Association of Governments (August 24, 2005). Memo from Ieesuck Jung to Cathy Arthur. "Addendum to Review of 2000-2004 Ozone Episodes in the Maricopa County 8-Hour Ozone Nonattainment Area".

6. Maricopa County Air Quality Department (June 2004). "2002 Periodic Emissions Inventory for Ozone Precursors". Available at: http://www.maricopa.gov/aq/ei/periodic.asp.

7. U.S. Environmental Protection Agency (March 1991) "Emissions Inventory Requirements for Ozone State Implementation Plans". EPA-450/4-91-010. Office of Air Quality Planning and Standards, Research Triangle, NC.

8. U.S. Environmental Protection Agency (May 1991) "Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds, Volume II: Emission Inventory Requirements for Photochemical Air Quality Simulation Models". EPA-450/4-91-014. Office of Air Quality Planning and Standards, Research Triangle Park, NC. (NTIS No.: PB91-216176).

9. U.S. Environmental Protection Agency (July 1991) "Procedures for Preparing Emissions Projections". EPA-450/4-91-019. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

10. U.S. Environmental Protection Agency (August 2001) "Draft User's Guide to MOBILE6.0 - Mobile Source Emission Factor Model". EPA420-D-01-003. Assessment and Standards Division, Office of Transportation and Air Quality.

11. U.S. Environmental Protection Agency (January 14, 2005). "Guidance on Limiting Nitrogen Oxides (NOx) Requirements Related to 8-Hour Ozone Implementation".

12. U.S. Environmental Protection Agency (February 17, 2005). Draft Final. "Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS".

13. Tesche, T.W., P. Georgopoulos, F.L. Lurmann and P.M. Roth (1990) "Improvement of Procedures for Evaluating Photochemical Models, Draft Final Report". California Air Resources Board, Sacramento, CA.

ATTACHMENT I

Interagency Memorandum of Agreement

MEMORANDUM OF AGREEMENT
AMONG
THE ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
AND
THE ARIZONA DEPARTMENT OF TRANSPORTATION
AND
MARICOPA COUNTY, BY AND THROUGH THE MARICOPA COUNTY ENVIRONMENTAL QUALITY AND COMMUNITY SERVICES AGENCY
AND
THE MARICOPA ASSOCIATION OF GOVERNMENTS

PURPOSE

The purpose of this Memorandum of Agreement is to provide the framework and guidelines to promote coordinated decision making in planning, development, and implementation, and enforcement of those actions necessary to attain and maintain the National Ambient Air Quality Standards in Maricopa County, hereafter referred to as the Nonattainment Area Plan, or NAP. This Memorandum is required pursuant to A.R.S. 49-406 D. and E. The Memorandum also provides the framework and guidelines for preparing plans designed to address other air pollution problems of regional concern.

SCOPE

This Memorandum is designed to address the control of the following pollutants: Carbon Monoxide, Ozone, Particulates, and Other Air Pollution Problems of Regional Concern.

The geographical area of concern is Maricopa County or the area specifically designated by the Administrator of the U.S. Environmental Protection Agency as not having attained the National Ambient Air Quality Standards for one or more of the pollutants named above.

RESPONSIBILITIES AND AUTHORITIES

The Arizona Department of Environmental Quality (ADEQ) has the primary authority in the State of Arizona for air pollution control and abatement. ADEQ is charged with preparation, development and maintenance of the State Implementation Plan (A.R.S. § 49-404); designation of areas of the state with respect to compliance with the National Ambient Air Quality Standards (A.R.S. § 49-405); and assuring that nonattainment area plans are implemented (A.R.S. § 49-406 J.). ADEQ has original jurisdiction and control over portable, mobile, and specific types of stationary air pollution sources (see A.R.S. § 49-402 A.). In addition, ADEQ is responsible for development of stationary source permitting procedures and standards (see A.R.S. § 49-480 B.). ADEQ is also responsible for providing technical assistance to political subdivisions of the State for implementing air pollution control programs (A.R.S. § 49-424 A.8.), conducting research on the amounts of hazardous air pollutants in ambient air and their impacts on human health (A.R.S. § 49-426.06); management and implementation of programs under the Air Quality Fee Fund (A.R.S. § 49-551), implementation of the Vehicle Emissions Inspections Program (A.R.S. § 49-521 through 550), and conducting research on vehicular emissions and clean burning fuels (A.R.S. § 49-553). The Department may delegate authority to a county for implementing air pollution control statutes (A.R.S. § 49-424 B.)

The Arizona Department of Transportation (ADOT) has exclusive control over state highways and all other state owned transportation systems (A.R.S. § 28-104). This includes the responsibility of multi-modal state transportation planning, cooperation with local governments, coordination of transportation planning with local governments, investigation of new transportation systems, and advising local governments concerning the development and operation of public transit systems (A.R.S. § 28-104).

The ADOT Director shall also enter into agreements on behalf of the state with political subdivisions for the improvement, maintenance and construction of mass transit systems, and shall provide rules for the application for and expenditure of all mass transit funds (A.R.S. § 28-108).

In addition, ADOT is authorized to conduct demonstration projects to evaluate the effectiveness of new, extended, improved or integrated public transportation services and carpooling or vanpooling activities in meeting regional transportation needs or in improving air quality (A.R.S. § 28-2611). These projects are funded by an annual distribution of $400,000 from the air quality fund (A.R.S. § 49-551). ADOT must also support ADEQ on reporting to the Legislature results of mobile source emissions Research, where applicable, per A.R.S. § 49-553.

The Maricopa County Environmental Quality and Community Services Agency (MC EQ&CSA) is the local air pollution control department for Maricopa County. The Agency has jurisdiction over air pollution sources not explicitly reserved for state jurisdiction (A.R.S. § 49-402); the Agency is delegated authority from the State of Arizona to regulate certain portable air pollution sources initially reserved for state jurisdiction (A.R.S. § 49-424); the Agency operates the Regional Travel Reduction Program (A.R.S. § 49-582 et seq), and is the principal government sponsor for the Voluntary No Drive Days Program (A.R.S. § 49-506). The Agency is also responsible for monitoring the ambient air quality of the region (A.R.S. § 49-473) through collecting and analyzing air quality data.

Within the Maricopa County Environmental Quality and Community Services Agency, the Assistant County Manager of the Agency is designated as the Air Pollution Control Officer. The Air Pollution Control Officer has the responsibility and authority to enforce the provisions of Article 3, Chapter 3, Title 49, "County Air Pollution Control", Arizona Revised Statutes. The Control Officer also has the responsibility for assuring adequate nonattainment plan implementation as prescribed by A.R.S. § 49-406.

The Maricopa Association of Governments (MAG) is a nonprofit Arizona corporation composed of elected officials from twenty-four cities and towns, Maricopa County, Gila River Indian Community, and the Arizona Department of Transportation. MAG has been designated by the Governor of Arizona as the lead planning organization for Maricopa County that, together with the State, is responsible for determining which elements of the State Implementation Plan revision will be planned, implemented, and enforced by State and local governments in Arizona (Governor Wesley Bolin, February 7, 1978; Clean Air Act § 174(a); and A.R.S. 49-406)). MAG is responsible for providing assistance to the Maricopa County Travel Reduction Regional Task Force and for recommending third and following year travel reduction targets, policies, standards and criteria for the Maricopa County Travel Reduction Program (A.R.S. § 49-582 and 49-588). Related directly to air quality, MAG is the official designated metropolitan transportation planning organization, and the designated agency for preparing population estimates and projections for the Maricopa County area. MAG is also responsible for making transportation/air quality conformity determinations, subject to the consultation procedures as provided by law (Clean Air Act § 176).

UNDERSTANDING/AGREEMENTS

In recognition and to facilitate the accomplishment of the foregoing, IT IS HEREBY AGREED that:

1. The Arizona Department of Environmental Quality; Arizona Department of Transportation; Maricopa County Environmental Quality and Community Services Agency; and Maricopa Association of Governments will work through a coordinated effort to prepare the MAG regional air quality plans as described in Attachments One, Three, Four, and Five. Attachment One contains a description of the generalized roles and areas of expertise of the agencies, the MAG Air Quality Planning Team, and the MAG Air Quality Policy Team. Attachment Three contains the general implementation authorities for measures in the air quality plans. Attachment Four includes provisions for tracking plan implementation; determining reasonable further progress; assurances for adequate plan implementation, and adoption of control measures. Attachment Five contains the Work Programs for Preparing Air Quality Plans.

2. The Maricopa Association of Governments will maintain the MAG Regional Air Quality Planning Process for decision making as described in Attachment Two. This Attachment contains the roles of the MAG Regional Council, MAG Management Committee, MAG Air Quality Policy Committee, and ad hoc Working Groups. MAG will coordinate the preparation of the NAPs. Representatives from ADEQ, ADOT and MC EQ&CSA will be included as ex-officio members of the MAG Air Quality Policy Committee, and active members of all working groups associated with this MAG committee.

3. The Arizona Department of Environmental Quality; Arizona Department of Transportation; Maricopa County Environmental Quality and Community Services Agency; Maricopa Association of Governments will pursue commitments to implement the measures in the NAPs. The aforementioned agencies will continue to evaluate and pursue the implementation of additional air pollution control measures as a result of the evaluations performed as described in Attachment Four.

EFFECTIVE DATE

The Agreement and all Amendments shall become effective on the date it has been signed by all parties to it.

TERM

This Agreement shall remain in effect from the effective date of the Agreement until such time it is terminated or superseded by a subsequent agreement. This Agreement may be terminated by any party to it, providing written notice of intent to terminate is provided to all other parties to the Agreement thirty days prior to the effective date of withdrawal of that party from the Agreement.

AMENDMENT

This Agreement may be amended at any time upon mutual written agreement of all parties. No agent, employee or other representative of any party to this Agreement is empowered to alter any of the terms of the Agreement, unless it is done in writing and signed by the Designated Officers of the respective parties, their authorized representatives, or duly appointed successors.

ATTEST

All terms of this Memorandum of Agreement are hereby acknowledged and agreed, as certified by the signatures of the Designated Officers affixed hereto:

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

By _____
Edward Z. Fox, Director, Arizona Department of Environmental Quality

Date Nov 9, 1992

ARIZONA DEPARTMENT OF TRANSPORTATION

By _____
James Creedon, Acting Director, Arizona Department of Transportation

Date Nov 9, 1992

MARICOPA COUNTY, BY AND THROUGH THE MARICOPA COUNTY ENVIRONMENTAL QUALITY AND COMMUNITY SERVICES AGENCY

By _____
Betsy Bayless, Chairman, Maricopa County Board of Supervisors

Date 11.2.92

MARICOPA ASSOCIATION OF GOVERNMENTS

By _____
John J. DeBolske, Secretary, Maricopa Association of Governments

Date 11.2.92

MAG REGIONAL AIR QUALITY PLANNING TECHNICAL PROCESS

- All MAG regional air quality plans are prepared through a coordinated effort among the Arizona Department of Environmental Quality, Arizona Department of Transportation, Maricopa County Environmental Quality and Community Services Agency, and Maricopa Association of Governments.

MAG AIR QUALITY POLICY TEAM

Composition: ***Director of Arizona Department of Environmental Quality; Director of Arizona Department of Transportation; Air Pollution Control Officer of Maricopa County; MAG Secretary***

- Oversees preparation of plans and overall technical planning effort
- Resolves technical problems and issues

MAG AIR QUALITY PLANNING TEAM

Composition: ***Staff from the Arizona Department of Environmental Quality, Arizona Department of Transportation; Maricopa County Environmental Quality and Community Services Agency; Maricopa Association of Governments***

Agency Roles

- Arizona Department of Environmental Quality - air quality modeling and technical assistance, mobile source emissions research and inventory, input for the comprehensive list of measures and feasibility analysis, information relating to the Vehicle Emission Inspection Maintenance Program, stationary and portable source control strategies, air quality research studies, State Air Quality Fund administration, adoption and submittal of State Implementation Plans to the Environmental Protection Agency, tracking plan implementation, assurances, special purpose air quality and meteorological monitoring for plan development and compliance
- Arizona Department of Transportation - State Transportation Improvement Program, other transportation plans and programs, input for the comprehensive list of measures and feasibility analysis
- Maricopa County Environmental Quality and Community Services Agency - stationary source emissions inventory and controls, coordinating the comprehensive emissions inventory, air quality monitoring data,input for comprehensive list of measures and feasibility analysis, mandatory travel reduction program, trip reduction data, voluntary no drive days program, tracking plan implementation, reasonable further progress, assurances, special purpose air quality and meteorological monitoring for plan development and compliance
- Maricopa Association of Governments - demographic projections and socioeconomic data, transportation modeling, air quality modeling, Regional Transportation Improvement Program, Regional Transportation Plan, other transportation plans and programs, congestion mangement system, conformity, input for comprehensive list of measures and feasibility analysis, development of the air quality plans, interface with state, county, and local entities, recommending future year travel reduction goals, policies, and standards to Maricopa County, assistance to Maricopa County for the mandatory travel reduction program, review reasonable further progress made to reduce air pollution and plan adjustments if necessary, review plan implementation

The technical planning work is closely coordinated with EPA Region IX staff, Federal Highway Administration, and Federal Transit Administration.

ATTACHMENT TWO

MAG REGIONAL AIR QUALITY PLANNING PROCESS

MAG REGIONAL COUNCIL

***Composition:** Elected officials from 24 cities and towns, Maricopa County, Gila River Indian Community, and Arizona Department of Transportation, Regional Public Transportation Authority*

- Reviews all pertinent air quality data
- Adopts regional air quality plans
- Formally requests that state, county, local, and other appropriate agencies implement measures in the plans
- Approves trip reduction goals and policies and recommends to Maricopa County
- Determines conformity, subject to the consultation procedures as provided by law (Clean Air Act § 176)
- Maintains an air quality/transportation planning process consistent with federal law

MAG MANAGEMENT COMMITTEE

***Composition:** Managers from 24 cities and towns, Maricopa County, Gila River Indian Community, and Arizona Department of Transportation, Regional Public Transportation Authority*

- Reviews all pertinent air quality and transportation data
- Recommends regional air quality and transportation plans
- Recommends trip reduction goals and policies

MAG AIR QUALITY POLICY COMMITTEE

***Composition:** 10 elected officials from cities and towns and Maricopa County and 9 citizen representatives + ex-officio representatives from Arizona Department of Environmental Quality, Arizona Department of Transportation, and Maricopa County Environmental Quality and Community Services Agency*

- Reviews all pertinent air quality data from the technical planning process
- Reviews air quality research studies conducted by MAG, Arizona Department of Environmental Quality, EPA, Maricopa County Environmental Quality and Community Services Agency, etc.
- Reviews related data generated from other MAG regional planning areas such as transportation, transit, population, regional development, water quality, solid waste, etc.
- Studies in detail a comprehensive list of control measures. Data on the measures includes: description of the measures, air quality impacts, complementary measures, implementation responsibility, costs, advantages and disadvantages, etc.
- Recommends air quality measures for the plans
- Conducts public hearings on the plans
- Formally recommends regional air quality plans and control measures
- Recommends trip reduction goals and policies
- Conducts conformity reviews, subject to the consultation procedures as provided by law (Clean Air Act § 176)
- Reviews reasonable further progress made to reduce air pollution and recommends plan adjustments if necessary
- Provides input on the MAG congestion management system

ADDITIONAL WORKING GROUPS AS NECESSARY

IMPLEMENTATION OF MAG REGIONAL AIR QUALITY PLANS
GENERAL IMPLEMENTATION AUTHORITIES

STATE - ARIZONA DEPARTMENT OF ADMINISTRATION

- Travel reduction and adjusted work hours for state employees

STATE - ARIZONA DEPARTMENT OF COMMERCE

- Capitol Ridesharing Program

STATE - ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

- Mobile source emissions controls
- Mobile source emissions research
- Portable and some major stationary source controls
- Ambient air quality monitoring and research
- Assurances

STATE - ARIZONA DEPARTMENT OF TRANSPORTATION

- State and interstate transportation system planning, development and management (includes High Occupancy Vehicle Lanes, Freeway Management Systems, etc.)
- Vehicle registration and licensing
- Transit Assistance Grants

STATE - ARIZONA DEPARTMENT OF WEIGHTS AND MEASURES

- Oxygenated fuels
- Other fuel quality regulation (e.g. Reid Vapor Pressure)
- Stage I and Stage II vapor recovery

MARICOPA COUNTY - ENVIRONMENTAL QUALITY AND COMMUNITY SERVICES AGENCY

- Stationary source controls
- Delegated portable source controls
- Area source controls (e.g. *de minimis* sources, materials storage and handling, construction)
- Open burning control
- Mandatory Travel Reduction Program (TRP) and Voluntary No Drive Days
- Other transportation control measures in unincorporated areas
- Ambient air monitoring
- County roadways system planning, development and management
- Planning and zoning (unincorporated areas)
- Assurances

MAG CITIES AND TOWNS

- Municipal roadways system planning, development and management
- Transportation control measures (besides TRP)
- Planning and zoning
- Some area source controls (e.g. vacant land, construction practices)
- Public transit (including Regional Public Transportation Authority)

MARICOPA ASSOCIATION OF GOVERNMENTS

- Future year travel reduction goals, policies, standards, and criteria
- Ridesharing program
- Conformity determinations, as provided by law (Clean Air Act § 176)
- Allocation of Congestion Mitigation Air Quality Improvement Program Funds and Surface Transportation Program Funds

- As noted in the MAG regional air quality plans, the action taken by the MAG Regional Council to approve the Suggested Measures and Adopted Plan Measures does not commit each jurisdiction to implement those measures. As indicated in the resolutions and commitments, each jurisdiction determines which measures are reasonably available for implementation by that jurisdiction.

OTHER IMPLEMENTATION AND ADOPTION FUNCTIONS

This attachment includes provisions for tracking plan implementation and determining reasonable further progress; assurances for adequate plan implementation, and procedures and responsibilities for adoption of control measures and emissions limitations.

TRACKING PLAN IMPLEMENTATION AND DETERMINING REASONABLE FURTHER PROGRESS

Each agency is afforded a review and comment period for each ongoing portion of a plan or revision to a plan being prepared by another agency. Every effort will be made to incorporate the comments of the reviewing agency into each portion of the plan being prepared by another agency.

Maricopa County will develop monitoring guidelines with respect to reasonable further progress which will be consistent with the needs of the Arizona Department of Environmental Quality and U.S. EPA. Maricopa County will be responsible for tracking emissions from point, area and non-road mobile sources and for tracking implementation of control strategies. MAG will be responsible for tracking on-road mobile source emissions and conformity. Maricopa County will integrate the MAG information and reports with the Maricopa County information and submit it to the Arizona Department of Environmental Quality.

For the EPA, the primary means of demonstrating the rate of progress will be through the periodic inventories (i.e., complete, actual inventories) submitted every 3 years. EPA has indicated in the General Preamble Section III.A.3 (d) that they currently intend to rely on existing reporting requirements such as emission statements, periodic inventories, annual Aerometric Information Retrieval System update, and conformity reviews.

ASSURANCES FOR ADEQUATE PLAN IMPLEMENTATION

In order to comply with the Clean Air Act, State law provides an approach for assurances that State and local committed measures will be adequately implemented (A.R.S. §49-406 L and J.). If any person (includes State, County, local governments, regional agencies, and other entities) fails to implement a committed measure, the County would file an action in Superior Court to have the court order that the measure be implemented. Likewise, the ADEQ Director will backstop the County if it fails to implement a committed measure or if the County fails to backstop the local governments and regional agencies.

Regarding committed measures, A.R.S. §49-406 G. requires that each agency that commits to implement any control measure contained in the State Implementation Plan must describe the commitment in a resolution. The resolution must be adopted by the appropriate governing body of the agency. State law also requires the resolution to specify the following: (1) Its authority for implementing the limitation or measure as provided in statute, ordinance or rule: (2) A program for the enforcement of the limitation or measure; and (3) The level of personnel and funding allocated to the implementation of the measure.

As noted in the MAG regional air quality plans, the action taken by the MAG Regional Council to approve the Suggested Measures and Adopted Plan Measures does not commit each jurisdiction to implement those measures. As indicated in the resolutions and commitments, each jurisdiction determines which measures are reasonably available for implementation by that jurisdiction.

PROCEDURES AND RESPONSIBILITIES FOR ADOPTION OF CONTROL MEASURES AND EMISSIONS LIMITATIONS

According to A.R.S. §49-404 B., the ADEQ Director may adopt rules that describe procedures for adoption of revisions to the State Implementation Plan. The State, in accordance with these rules, and the governing body of the metropolitan planning organization (MAG) are required to adopt the nonattainment area plans (A.R.S. §49-406 H.).

ATTACHMENT II

Review of Eight-Hour Ozone Episodes

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MARICOPA ASSOCIATION OF GOVERNMENTS

OFFICE MEMO

January 24, 2006

TO: Cathy Arthur, Air Quality Modeling Program Manager

FROM: Ieesuck Jung, Air Quality Engineer II

SUBJECT: REVIEW OF 2000-2004 OZONE EPISODES IN THE MARICOPA COUNTY 8-HOUR OZONE NONATTAINMENT AREA

This memorandum is prepared for a review of the characteristics of monitored 8-hour ozone (O_3) episodes that have occurred in the Maricopa Nonattainment Area (MNA) over the five ozone seasons of 2000-2004. A total of 57 days exceeded the 8-hour ozone standard during this period. This document includes information on the following:

1) the characteristics of the 8-hour ozone episodes reflected by the monitored ozone data;

2) the meteorological conditions associated with days having high ozone concentrations; and

3) recommendations on possible 8-hour ozone modeling episodes in accordance with the final draft "Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS" (EPA, February 2005).

As a result of the aggregate consideration of the four primary criteria recommended as the basis for choosing episodes to model and additional secondary selection criteria regarding the EPA's draft guidance (EPA, February 2005), three episodes, August 5-11, 2001; June 3-7, 2002; and July 9-15, 2002, are recommended as the 8-hour ozone modeling episodes.

1. EPA Guidance on 8-Hour Ozone Episode Selection

The EPA's draft guidance (EPA, February 2005) provides the procedures for selecting 8-hour ozone modeling episodes to achieve satisfying model results. The main criteria influencing 8-hour ozone episode selection include:

- Selecting episodes representing a variety of meteorological conditions that frequently correspond with 8-hour ozone exceedances at multiple monitoring sites;

- Selecting episode days with 8-hour ozone concentrations close to each monitors' Design Value and consistent with the form of the NAAQS such as the ozone levels that lead to nonattainment designation;

- Selecting periods having adequate emissions, air quality, and meteorological data available for the attainment test; and

- Selecting episodes having a sufficient number of days to make the modeled attainment test applied at each monitor violating the NAAQS be based on at least several days.

Tradeoffs among the four primary criteria may be necessary in certain applications when conflicts occur among these criteria. Also EPA provides secondary episode selection criteria in case it is hard to select episodes with primary criteria. The secondary criteria include:

- Selecting episodes modeled previously;

- Selecting episodes having ozone concentrations close to the Design Value on as many days and at as many sites as possible;

- Selecting episode days serving as the basis for the current average design value during the five-year period; and

- Selecting episodes including weekend days, if 8-hour ozone exceedances occur on weekends.

2. Episode Selection Methodology

2.1 Episode Selection Procedure

The following procedures have been employed for selecting 8-hour ozone modeling episodes for the MNA:

- Tabulate all days from 2000 to 2004 for any ozone monitor in the MNA that had an 8-hour ozone concentration of 80 ppb or higher.

- Identify multi-day episode periods in which exceedances of the 8-hour ozone standard occurred for several days at monitors in the MNA along with multiple monitors experiencing 8-hour ozone of 80 ppb or higher:

    - Eliminate days in which the 8-hour ozone exceedance was observed at only one monitor with low ozone values at others.

- Summarize the daily maximum 8-hour ozone concentration at each monitor in the MNA for each episode day identified above with the number of exceedance days.

- Perform backward trajectory analysis for the monitoring sites with 8-hour ozone exceedances during each episode identified above using the HYSPLIT model and compare it with meteorological data to identify the following regime:

- General direction of winds;
- Characteristics of ozone episodes (local versus transport)

- Select a subset of the most appropriate episodes as the final candidates satisfying the following conditions:
  - Presenting high and wide-spread 8-hour ozone concentrations with multiple exceedances in the MNA;
  - Representing the different types of meteorological conditions that lead to elevated 8-hour ozone concentrations in the MNA; and
  - Satisfying EPA's episode selection criteria listed above.
- Analyze the meteorological conditions of the final candidates for 8-hour ozone episodes and develop a Conceptual Model of the ozone exceedance days.

Based on this approach, the available episodes were ranked for appropriateness for developing 8-hour ozone control plans.

2.2 Results of Historical Ozone Data Analysis

Monitored ozone data from the period of 2000-2004 in the MNA were examined to identify 8-hour ozone episodes. All days in which any ozone monitors in the MNA experienced 8-hour ozone exceedances of 80 ppb or higher for a daily maximum 8-hour ozone concentration were examined.

Within the 8-hour ozone nonattainment area, there are 27 ozone monitoring sites operated by the Maricopa County Air Quality Department (MCAQD) (22 sites), the Pinal County Air Quality Department (PCAQD) (1 site), and the Arizona Department of Environmental Quality (ADEQ) (4 sites). During the period 2000-2004, 14 sites have complete data sets. Hourly ozone data for these sites have been obtained from the AIRS/AQS database. The MAG air quality modeling group developed web applications to calculate 8-hour forward running averages (storing average in the start hour of the 8-hour period) from hourly ozone data, daily maximum 8-hour ozone values, the annual 4th highest 8-hour ozone value, and 8-hour ozone design values. These web applications satisfying EPA's guidelines (40 CFR-Chapter I-Part50 *"Interpretation of the 8-Hour Primary and Secondary National Ambient Air Quality Standards for Ozone"*) improve the accuracy of the calculations and reduce processing times dramatically compared with conventional methods using Excel spreadsheets. The results from these applications have been verified by comparison with AIRS/AQS reports. The EPA guidance followed in this assessment has been reproduced in Appendix A.

2.2.1 Temporal Patterns

2.2.1.1 Annual Distribution

Annual trends of 8-hour ozone exceedance days (equal to or greater than 85 ppb) from 2000 to 2004 are presented in Figure 1. Eight-hour ozone exceedance days have decreased during this period, especially in 2004. The data were obtained from 27 air quality monitoring sites within the 8-hour ozone nonattainment area. Table 1 shows the annual distribution of 8-hour ozone exceedances for different cut-off values, such as 75, 80, 85, and 90 ppb.

2.2.1.2 Seasonal Distribution

For the period 2000-2004, 8-hour ozone exceedances occurred without exception during the historical ozone season from April to August. Figure 2 shows the seasonal number of 8-hour ozone exceedance days (85 ppb or higher) for 2000-2004. Eight-hour ozone exceedances occurred predominantly in August (36.2%). Table 2 presents the seasonal distribution of 8-hour ozone exceedances for different cut-off values from 75 to 90 ppb. When the cut-off value has decreased to 75 ppb, the ozone season extends into October. Eight-hour ozone exceedances occurred most frequently in August, regardless of cut-off value. This indicates that August has been the major month for 8-hour ozone exceedances.

2.2.1.3 Daily Distribution

Over the five-year period (2000-2004), 8-hour ozone exceedances occurred on every day of the week. To assign exceedances to a day of the week, regional daily maximum 8-hour ozone values (one value per day in the MNA) have been obtained from daily maximum 8-hour ozone values of each site and the days having exceedances have been filtered to assign to a day of the week. Figure 3 indicates the daily number of 8-hour ozone exceedance days (85 ppb or higher) for 2000-2004. Eight-hour ozone exceedances occurred most frequently on Wednesday (12 days). Almost four-fifths (79%) of the 8-hour ozone levels equal to or greater than 85 ppb have occurred on weekdays, while the remainder have occurred on weekend days. Table 3 shows the daily distribution of 8-hour ozone exceedances for different cut-off values, such as 75, 80, 85, and 90 ppb. As the cut-off value is increased, the proportion of 8-hour ozone exceedance days on weekdays has increased, while the proportion of weekend days has decreased. This indicates that high level concentrations of 8-hour ozone occur mostly on weekdays.

2.2.1.4 Diurnal Trends

Over the five-year period (2000-2004), 8-hour ozone exceedances occurred predominantly from late morning (9:00) to early afternoon (15:00). To assign exceedances to a particular hour, daily maximum 8-hour ozone values and the hours in which they occurred (forward running average) have been obtained from each site and the hours having exceedances have been filtered to assign to a particular hour. Figure 4 shows the diurnal distribution of 8-hour ozone exceedance days (85 ppb or higher) for 2000-2004. Eight-hour ozone exceedances occurred most frequently at 11:00 (72 days). Table 4 presents the diurnal distribution of 8-hour ozone exceedances for different cut-off values from 75 ppb to 90 ppb.

2.2.1.5 The Fourth Highest Ozone Values

Table 5 summarizes the fourth highest ozone values at all monitors in the MNA since 1998. October of 1999 had the highest ozone levels since 1998 with the fourth highest levels at the West Phoenix Site above 91 ppb and values at several other monitors (79%) above 80 ppb. Many

of the monitoring sites recorded peak values in 1999 and the values have gradually decreased since then. In 2001 and 2004, values were lower, with fourth highest values less than 80 ppb at most monitoring sites.

Table 6 indicates the highest values at selected ozone monitors during the summer of 2004. There were four days in July (24th, 25th, 26th, and 27th) when ozone readings exceeded 80 ppb at one or more monitors in the region. The Central Phoenix site, the Glendale site, the South Scottsdale site, and the West Phoenix site recorded the top four ozone values on these four days. The North Phoenix site was the only site that recorded a value above 80 ppb for the fourth high, and the site also recorded the maximum ozone value (87 ppb) in the region. On most of these four high days in 2004 high ozone concentrations were also recorded elsewhere in the region. For three of these four days, 8-hour ozone concentrations at the North Phoenix site were higher than values in the remainder of the region. During the previous five years, the maximum ozone concentration at the North Phoenix site ranged from 87 ppb (2004) to 93 ppb (2001,2002, and 2003), while the annual fourth maximum values ranged from 80 ppb (2004) to 86 ppb (2000, 2001, and 2003). More detailed information about the yearly highest ozone concentration for each site is presented in Appendix B.

Table 7 summarizes the 3-year averages of fourth highest values at selected monitors for 2000-2002 to 2002-2004. These values are comparable to the 8-hour ozone National Ambient Air Quality Standard (NAAQS). The Humboldt Mountain site and the North Phoenix site represent the locations of most concern, since their 2002-2004 averages are 85 ppb and 84 ppb, respectively. In 2005, the region would violate the standard if the 4th highest value at the Humboldt Mountain site and the North Phoenix site are greater than 90 ppb and 89 ppb, respectively. These values are labeled as 'Allow (2005)' in Table 7. In 2005 the actual 4th highest value at the Humboldt Mountain and the North Phoenix site were 87 ppb and 84 ppb, respectively. There was a greater cushion for maintaining the standard in 2005 at the other monitoring sites.

Table 8 presents all high ozone days that had at least one monitoring site with ozone concentrations greater than or equal to 80 ppb in the MNA. Numbers in bold text in red are the maximum 8-hour ozone concentrations for the day. Shaded boxes in yellow are all additional 8-hour average ozone concentrations greater than or equal to 80 ppb. To the right of each date is the beginning hour of the regional 8-hour maximum ozone concentration (bold text) for that day. Dates shaded in blue are potential episodes considered for meteorological and air quality modeling.

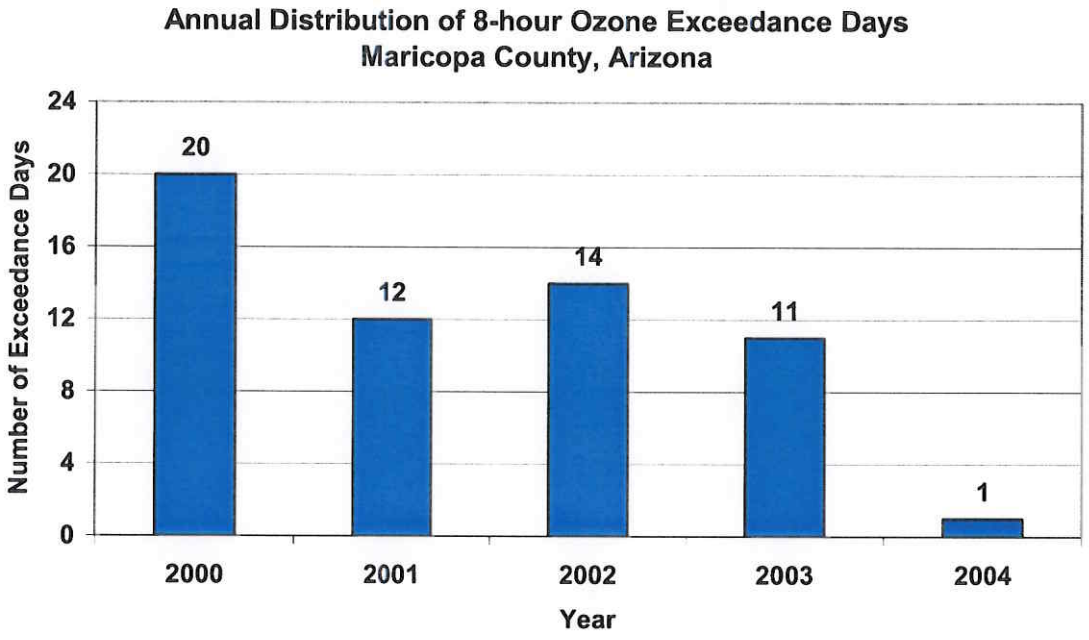


Figure 1. Annual distribution of 8-hour ozone exceedance days (≥85 ppb) for 2000-2004

Table 1. Annual distribution of 8-hour ozone exceedance for each cut-off value

Cut-Off Value (ppb)	Annual Exceedance Days				
	2000	2001	2002	2003	2004
75	70	46	48	52	27
80	50	29	28	24	11
85	20	12	14	11	1
90	7	2	9	2	0

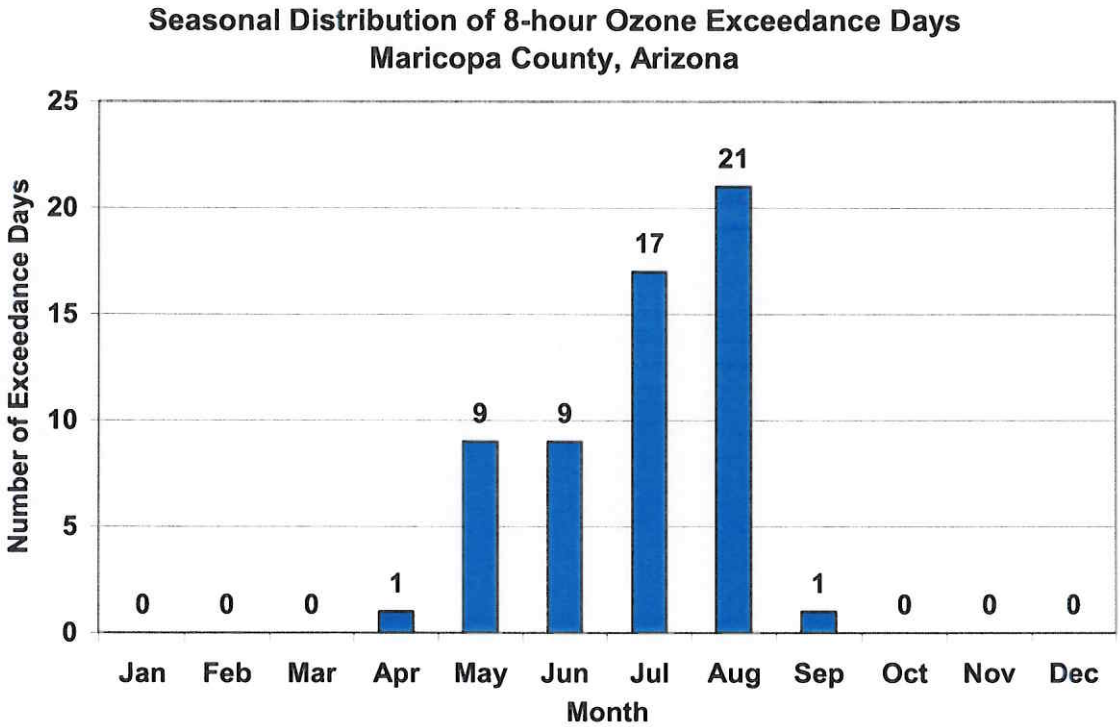


Figure 2. Seasonal distribution of 8-hour ozone exceedance days (≥85 ppb) for 2000-2004

Table 2. Seasonal distribution of 8-hour ozone exceedance for each cut-off value

Cut-Off Value (ppb)	Seasonal Exceedance Days											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
75	0	0	0	17	62	35	47	65	15	2	0	0
80	0	0	0	8	32	22	31	46	3	0	0	0
85	0	0	0	1	9	9	17	21	1	0	0	0
90	0	0	0	0	0	4	8	8	0	0	0	0

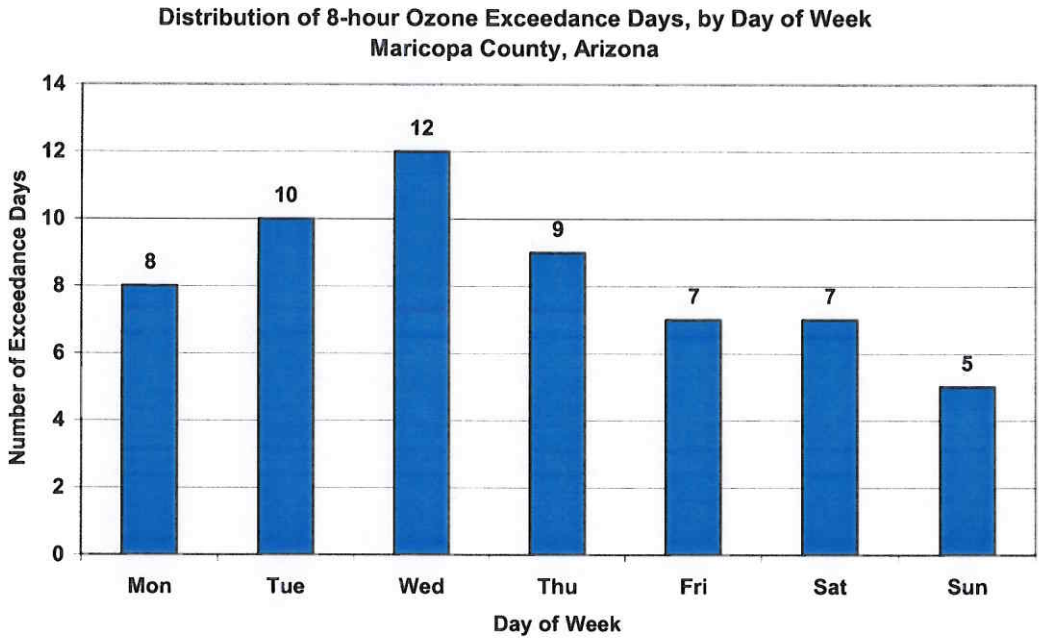


Figure 3. Distribution of 8-hour ozone exceedance days (≥85 ppb), by day of week, for 2000-2004

Table 3. Daily distribution of 8-hour ozone exceedance for each cut-off value

Cut-Off Value (ppb)	Daily Exceedance Days							Proportion (%)	
	Mon	Tues	Wed	Thu	Fri	Sat	Sun	Weekdays	Weekends
75	32	33	32	38	35	40	33	70	30
80	18	23	17	22	24	22	16	73	27
85	8	10	12	9	7	7	5	79	21
90	4	4	4	3	2	2	1	85	15

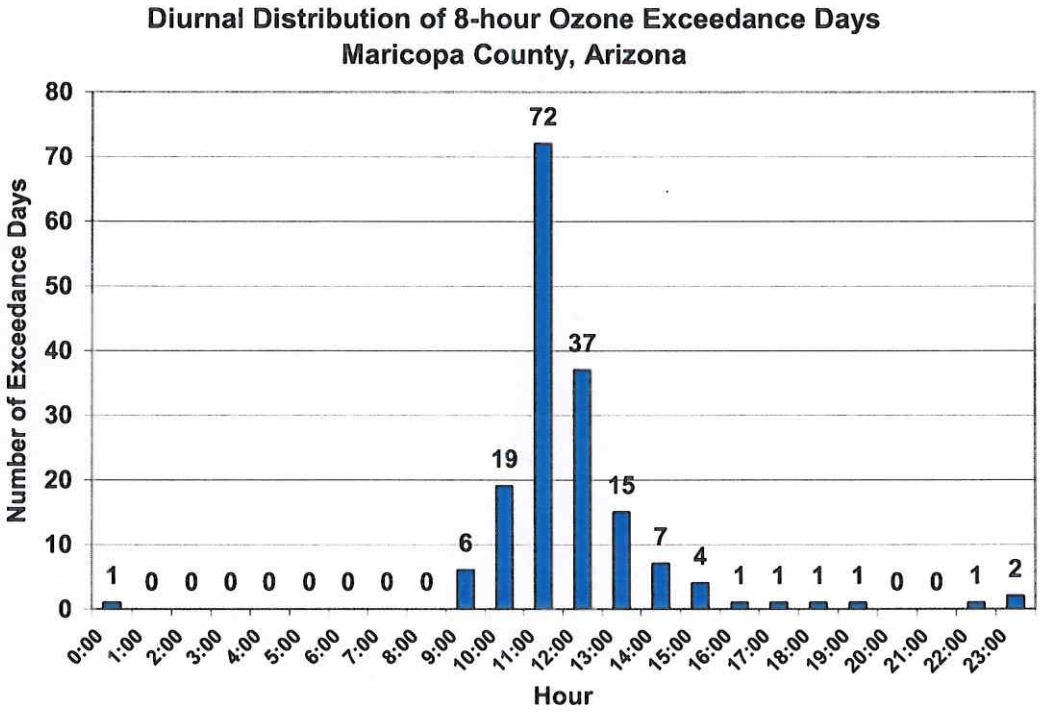


Figure 4. Diurnal distribution of 8-hour ozone exceedance days (≥85 ppb) for 2000-2004

Table 4. Diurnal distribution of 8-hour ozone exceedance for each cut-off value

Cut-Off Value (ppb)	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
75	11	0	0	1	0	0	0	0	3	45	248	508	199	57	19	15	14	6	9	2	3	0	2	3
80	1	0	0	1	0	0	0	0	0	19	83	204	102	28	12	10	7	2	3	1	0	0	1	2
85	1	0	0	0	0	0	0	0	0	6	19	72	37	15	7	4	1	1	1	1	0	0	1	2
90	0	0	0	0	0	0	0	0	0	2	4	14	18	7	0	2	0	0	0	0	0	0	0	1

Table 5. Fourth maximum 8-hour ozone concentrations from 1998 through 2004

(Unit: ppb)

Site	1998 8-hr O_3 4th Max.	1999 8-hr O_3 4th Max.	2000 8-hr O_3 4th Max.	2001 8-hr O_3 4th Max.	2002 8-hr O_3 4th Max.	2003 8-hr O_3 4th Max.	2004 8-hr O_3 4th Max.
Apache Junction (AJ: 04-021-3001)	N/A	N/A	N/A	N/A	79 (6/5/2002)	72 (7/23/2003)	69 (5/13/2004)
Blue Point (BP: 04-013-9702)	89 (7/28/1998)	87 (5/28/1999)	87 (8/15/2000)	80 (8/18/2001)	86 (7/13/2002)	86 (5/27/2003)	75 (5/15/2004)
Buckeye (BE: 04-013-4011)	N/A	N/A	N/A	N/A	N/A	N/A	58 (8/10/2004)
Cave Creek (CC: 04-013-4008)	N/A	N/A	N/A	83 (8/17/2001)	86 (7/9/2002)	83 (7/30/2003)	76 (6/11/2004)
Central Phoenix (CP: 04-013-3002)	79 (5/23/1998)	78 (6/6/1999)	76 (5/13/2000)	75 (6/16/2001)	76 (6/5/2002)	79 (8/17/2003)	74 (7/24/2004)
Dysart (DY: 04-013-4010)	N/A	N/A	N/A	N/A	N/A	73 (8/14/2003)	65 (9/11/2004)
Emergency Management (EM: 04-013-3004)	81 (9/19/1998)	86 (7/15/1999)	66 (8/19/2000)	63 (5/12/2001)	N/A	N/A	N/A
Falcon Field (FF: 04-013-1010)	83 (6/14/1998)	82 (5/28/1999)	75 (8/16/2000)	81 (8/17/2001)	84 (6/6/2002)	79 (8/12/2003)	70 (5/15/2004)
Fountain Hills (FH: 04-013-9704)	86 (5/24/1998)	86 (5/28/1999)	85 (8/1/2000)	83 (8/10/2001)	86 (6/4/2002)	83 (7/23/2003)	75 (8/3/2004)
Glendale (GL: 04-013-2001)	70 (3/22/1998)	81 (6/20/1999)	80 (5/20/2000)	78 (8/2/2001)	83 (7/10/2002)	85 (5/21/2003)	76 (7/27/2004)
Humboldt Mountain (HM: 04-013-9508)	90 (8/5/1998)	86 (5/15/1999)	82 (5/2/2000)	85 (8/16/2001)	90 (6/3/2002)	87 (7/30/2003)	78 (5/12/2004)
Lake Pleasant (LP: 04-013-9805)	82 (8/3/1998)	81 (4/21/1999)	82 (6/29/2000)	73 (6/5/2001)	N/A	N/A	N/A
Maryvale (MV: 04-013-3006)	86 (5/23/1998)	80 (7/5/1999)	80 (5/20/2000)	73 (5/8/2001)	84 (7/12/2002)	83 (7/22/2003)	N/A
Mesa (ME: 04-013-1003)	80 (7/10/1998)	83 (5/26/1999)	75 (4/23/2000)	74 (8/16/2001)	72 (6/6/2002)	N/A	N/A
Mount Ord (MORD: 04-013-9701)	88 (5/24/1998)	87 (4/21/1999)	90 (8/5/2000)	77 (7/13/2001)	N/A	N/A	N/A
North Phoenix (NP: 04-013-1004)	89 (5/24/1998)	84 (5/28/1999)	86 (8/24/2000)	86 (7/2/2001)	85 (6/6/2002)	86 (7/16/2003)	80 (8/1/2004)
Palo Verde (PALV: 04-013-9993)	80 (8/31/1998)	80 (5/28/1999)	80 (6/5/2000)	74 (5/8/2001)	78 (6/18/2002)	75 (6/28/2003)	72 (4/28/2004)
Pinnacle Peak (PP: 04-013-2005)	86 (8/14/1998)	84 (5/26/1999)	86 (7/31/2000)	85 (8/6/2001)	84 (7/11/2002)	83 (7/30/2003)	68 (7/26/2004)
Rio Verde (RV: 04-013-9706)	79 (5/16/1998)	86 (5/28/1999)	86 (8/9/2000)	83 (8/9/2001)	85 (6/5/2002)	83 (7/23/2003)	74 (6/12/2004)
South Phoenix (SP: 04-013-4003)	N/A	63 (10/9/1999)	83 (5/21/2000)	76 (8/1/2001)	81 (6/5/2002)	76 (5/27/2003)	72 (4/25/2004)
South Scottsdale (SS: 04-013-3003)	78 (5/23/1998)	72 (5/28/1999)	80 (8/19/2000)	79 (8/6/2001)	79 (7/11/2002)	79 (7/23/2003)	73 (7/24/2004)
Super Site (SUPR: 04-013-9997)	79 (7/27/1998)	46 (3/14/1999)	76 (5/13/2000)	79 (7/12/2001)	76 (7/10/2002)	75 (5/21/2003)	72 (8/10/2004)
Surprise (SU: 04-013-4007)	N/A	N/A	N/A	71 (5/8/2001)	79 (5/13/2002)	66 (5/10/2003)	N/A
Tempe (TEMP: 04-013-4005)	N/A	N/A	78 (7/30/2000)	79 (8/19/2001)	80 (6/5/2002)	80 (8/12/2003)	71 (4/24/2004)
West Chandler (old) (WC: 04-013-3009)	74 (5/24/1998)	69 (5/28/1999)	74 (4/29/2000)	N/A	N/A	N/A	N/A
West Chandler (WC: 04-013-4004)	N/A	N/A	77 (8/10/2000)	78 (6/16/2001)	83 (8/8/2002)	78 (7/22/2003)	70 (4/25/2004)
West Phoenix (WP: 04-013-0019)	86 (7/10/1998)	91 (10/12/1999)	81 (5/19/2000)	75 (7/12/2001)	84 (7/12/2002)	77 (5/21/2003)	72 (7/27/2004)
Number of sites exceeding 80 ppb (Percentile)	13/18 (72%)	15/19 (79%)	14/21 (67%)	8/23 (35%)	14/20 (70%)	10/20 (50%)	1/18 (6%)

Table 6. Highest ozone concentrations at selected sites in 2004

Site	1st Max (ppb)	2nd Max (ppb)	3rd Max (ppb)	4th Max (ppb)
Apache Junction	70 (5/15/2004)	70 (6/11/2004)	70 (8/3/2004)	69 (5/13/2004)
Blue Point	81 (8/3/2004)	77 (6/11/2004)	76 (7/27/2004)	75 (5/15/2004)
Buckeye	68 (9/6/2004)	67 (9/11/2004)	64 (8/15/2004)	58 (8/10/2004)
Cave Creek	79 (9/10/2004)	77 (8/10/2004)	76 (6/10/2004)	76 (6/11/2004)
Central Phoenix	78 (7/25/2004)	77 (7/26/2004)	75 (7/27/2004)	74 (7/24/2004)
Dysart	74 (7/25/2004)	73 (7/26/2004)	70 (7/24/2004)	65 (9/11/2004)
Falcon Field	77 (7/27/2004)	77 (8/3/2004)	72 (7/26/2004)	70 (5/15/2004)
Fountain Hills	77 (5/15/2004)	77 (6/11/2004)	76 (7/27/2004)	75 (8/3/2004)
Glendale	82 (7/26/2004)	80 (7/24/2004)	79 (7/25/2004)	76 (7/27/2004)
Humboldt Mountain	81 (6/11/2004)	80 (6/10/2004)	80 (9/9/2004)	78 (5/12/2004)
North Phoenix	87 (7/27/2004)	84 (7/26/2004)	82 (7/24/2004)	80 (8/1/2004)
Palo Verde	75 (7/25/2004)	74 (5/1/2004)	73 (5/12/2004)	72 (4/28/2004)
Pinnacle Peak	71 (5/15/2004)	70 (3/19/2004)	69 (5/14/2004)	68 (7/26/2004)
Rio Verde	83 (5/15/2004)	77 (5/13/2004)	77 (5/14/2004)	74 (6/12/2004)
South Phoenix	79 (7/25/2004)	73 (6/11/2004)	73 (9/11/2004)	72 (4/25/2004)
South Scottsdale	81 (7/26/2004)	79 (7/27/2004)	77 (7/25/2004)	73 (7/24/2004)
Super Site	77 (7/26/2004)	76 (7/25/2004)	73 (7/24/2004)	72 (8/10/2004)
Tempe	78 (7/25/2004)	72 (7/26/2004)	72 (7/27/2004)	71 (4/24/2004)
West Chandler	73 (7/25/2004)	72 (4/24/2004)	72 (7/26/2004)	70 (4/25/2004)
West Phoenix	80 (7/25/2004)	77 (7/26/2004)	74 (7/24/2004)	72 (7/27/2004)

Table 7. Three-year average of 4th highest 8-hour ozone concentrations from 2000 through 2004

(Unit: ppb)

Site	2000 8-hr O_3 4th Max.	2001 8-hr O_3 4th Max.	2002 8-hr O_3 4th Max.	2003 8-hr O_3 4th Max.	2004 8-hr O_3 4th Max.	Average 2000~2002	Average 2001~2003	Average 2002~2004	Allow (2005)
Apache Junction	N/A	N/A	79 (6/5/2002)	72 (7/23/2003)	69 (5/13/2004)	N/A	N/A	73	114
Blue Point	87 (8/15/2000)	80 (8/18/2001)	86 (7/13/2002)	86 (5/27/2003)	75 (5/15/2004)	84	84	82	94
Buckeye	N/A	N/A	N/A	N/A	58 (8/10/2004)	N/A	N/A	N/A	N/A
Cave Creek	N/A	83 (8/17/2001)	86 (7/9/2002)	83 (7/30/2003)	76 (6/11/2004)	N/A	84	82	96
Central Phoenix	76 (5/13/2000)	75 (6/16/2001)	76 (6/5/2002)	79 (8/17/2003)	74 (7/24/2004)	76	77	76	102
Dysart	N/A	N/A	N/A	73 (8/14/2003)	65 (9/11/2004)	N/A	N/A	N/A	117
Emergency Management	66 (8/19/2000)	63 (5/12/2001)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Falcon Field	75 (8/16/2000)	81 (8/17/2001)	84 (6/6/2002)	79 (8/12/2003)	70 (5/15/2004)	80	81	78	106
Fountain Hills	85 (8/1/2000)	83 (8/10/2001)	86 (6/4/2002)	83 (7/23/2003)	75 (8/3/2004)	85	84	81	97
Glendale	80 (5/20/2000)	78 (8/2/2001)	83 (7/10/2002)	85 (5/21/2003)	76 (7/27/2004)	80	82	81	94
Humboldt Mountain	82 (5/2/2000)	85 (8/16/2001)	90 (6/3/2002)	87 (7/30/2003)	78 (5/12/2004)	86	87	85	90
Lake Pleasant	82 (6/29/2000)	73 (6/5/2001)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Maryvale	80 (5/20/2000)	73 (5/8/2001)	84 (7/12/2002)	83 (7/22/2003)	N/A	79	80	N/A	N/A
Mesa	75 (4/23/2000)	74 (8/16/2001)	72 (6/6/2002)	N/A	N/A	74	N/A	N/A	N/A
Mount Ord	90 (8/5/2000)	77 (7/13/2001)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
North Phoenix	86 (8/24/2000)	86 (7/2/2001)	85 (6/6/2002)	86 (7/16/2003)	80 (8/1/2004)	86	86	84	89
Palo Verde	80 (6/5/2000)	74 (5/8/2001)	78 (6/18/2002)	75 (6/28/2003)	72 (4/28/2004)	77	76	75	108
Pinnacle Peak	86 (7/31/2000)	85 (8/6/2001)	84 (7/11/2002)	83 (7/30/2003)	68 (7/26/2004)	85	84	78	104
Rio Verde	86 (8/9/2000)	83 (8/9/2001)	85 (6/5/2002)	83 (7/23/2003)	74 (6/12/2004)	85	84	81	98
South Phoenix	83 (5/21/2000)	76 (8/1/2001)	81 (6/5/2002)	76 (5/27/2003)	72 (4/25/2004)	80	78	76	107
South Scottsdale	80 (8/19/2000)	79 (8/6/2001)	79 (7/11/2002)	79 (7/23/2003)	73 (7/24/2004)	79	79	77	103
Super Site	76 (5/13/2000)	79 (7/12/2001)	76 (7/10/2002)	75 (5/21/2003)	72 (8/10/2004)	77	77	74	108
Surprise	N/A	71 (5/8/2001)	79 (5/13/2002)	66 (5/10/2003)	N/A	N/A	72	N/A	N/A
Tempe	78 (7/30/2000)	79 (8/19/2001)	80 (6/5/2002)	80 (8/12/2003)	71 (4/24/2004)	79	80	77	104
West Chandler (old)	74 (4/29/2000)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
West Chandler	77 (8/10/2000)	78 (6/16/2001)	83 (8/8/2002)	78 (7/22/2003)	70 (4/25/2004)	79	80	77	107
West Phoenix	81 (5/19/2000)	75 (7/12/2001)	84 (7/12/2002)	77 (5/21/2003)	72 (7/27/2004)	80	79	78	106
County Max	90 (8/5/2000) Mount Ord	86 (7/2/2001) North Phoenix	90 (6/3/2002) Humboldt Mountain	87 (7/30/2003) Humboldt Mountain	80 (8/1/2004) North Phoenix				

Table **8.** Day with at least one monitored ozone concentrations greater than or equal to 80 ppb in the Maricopa County area.

Date	Day	Hour	AJ	BP	BE	CC	CP	DY	EM	FF	FH	GL	HM	LP	MV	ME	MO RD	NP	PA LV	PP	RV	SP	SS	SU PR	SU	TE MP	WC (old)	WC	WP
4/13/2000	Thu	12	N/A	81	N/A	N/A	60	N/A	62	69	74	63	80	N/A	69	70	N/A	70	N/A	65	N/A	74	58	N/A	N/A	N/A	51	N/A	66
4/20/2000	Thu	15	N/A	69	N/A	N/A	59	N/A	55	N/A	66	60	73	70	N/A	65	N/A	60	N/A	63	81	64	54	N/A	N/A	N/A	62	N/A	59
4/23/2000	Sun	11	N/A	81	N/A	N/A	64	N/A	61	N/A	75	33	74	68	64	75	N/A	70	N/A	72	68	68	70	N/A	N/A	N/A	68	N/A	63
4/24/2000	Mon	21	N/A	81	N/A	N/A	64	N/A	57	N/A	N/A	56	70	58	63	N/A	N/A	68	N/A	78	67	71	63	N/A	N/A	N/A	67	N/A	63
4/25/2000	Tue	12	N/A	82	N/A	N/A	56	N/A	57	N/A	N/A	54	81	64	63	66	N/A	66	71	72	76	70	58	N/A	N/A	N/A	66	N/A	63
4/26/2000	Wed	13	N/A	85	N/A	N/A	59	N/A	58	N/A	79	61	84	65	70	67	N/A	75	74	72	73	74	63	N/A	N/A	N/A	68	N/A	40
4/29/2000	Sat	11	N/A	81	N/A	N/A	71	N/A	63	67	77	71	76	71	74	75	N/A	75	71	71	68	76	68	N/A	N/A	N/A	74	N/A	63
5/1/2000	Mon	20	N/A	73	N/A	N/A	72	N/A	64	64	71	67	79	73	77	73	N/A	74	81	71	68	78	67	N/A	N/A	N/A	72	N/A	N/A
5/2/2000	Tue	12	N/A	85	N/A	N/A	67	N/A	63	72	79	68	82	63	76	78	N/A	77	76	74	81	78	68	N/A	N/A	N/A	N/A	N/A	N/A
5/3/2000	Wed	13	N/A	76	N/A	N/A	62	N/A	57	62	71	63	82	64	68	67	N/A	69	69	69	74	72	60	N/A	N/A	N/A	N/A	N/A	68
5/11/2000	Thu	11	N/A	82	N/A	N/A	66	N/A	61	68	77	70	79	74	77	61	N/A	75	74	74	79	76	66	69	N/A	N/A	67	N/A	73
5/12/2000	Fri	15	N/A	78	N/A	N/A	74	N/A	65	66	74	73	72	70	80	70	N/A	77	79	70	71	80	71	75	N/A	N/A	75	N/A	77
5/13/2000	Sat	15	N/A	86	N/A	N/A	76	N/A	65	73	82	70	86	80	79	75	N/A	80	74	77	82	82	73	76	N/A	N/A	76	N/A	78
5/14/2000	Sun	11	N/A	83	N/A	N/A	70	N/A	64	73	82	69	75	76	75	74	N/A	78	71	75	78	77	74	73	N/A	N/A	73	N/A	74
5/19/2000	Fri	18	N/A	80	N/A	N/A	70	N/A	53	71	78	78	59	77	79	67	79	81	79	74	77	86	74	75	N/A	N/A	N/A	N/A	81
5/20/2000	Sat	16	N/A	86	N/A	N/A	77	N/A	53	73	89	80	61	82	80	68	85	86	80	83	87	86	79	76	N/A	N/A	N/A	N/A	82
5/21/2000	Sun	17	N/A	74	N/A	N/A	70	N/A	50	70	79	81	58	74	81	68	78	87	79	78	77	83	75	73	N/A	N/A	N/A	N/A	82
5/22/2000	Mon	12	N/A	82	N/A	N/A	58	N/A	49	67	79	66	80	73	69	68	77	76	69	76	80	77	68	56	N/A	N/A	N/A	N/A	69
5/23/2000	Tue	12	N/A	83	N/A	N/A	57	N/A	53	67	79	53	75	68	65	65	80	69	67	69	80	69	62	54	N/A	N/A	N/A	N/A	64
5/24/2000	Wed	12	N/A	77	N/A	N/A	55	N/A	53	63	76	53	72	61	57	60	81	68	52	70	79	67	63	50	N/A	N/A	N/A	N/A	59
5/27/2000	Sat	14	N/A	84	N/A	N/A	60	N/A	56	72	80	56	68	52	65	66	69	74	57	71	76	70	69	56	N/A	N/A	N/A	N/A	68
5/30/2000	Tue	12	N/A	83	N/A	N/A	48	N/A	48	65	73	46	72	58	59	59	73	63	56	65	75	62	55	42	N/A	N/A	N/A	N/A	57
6/5/2000	Mon	14	N/A	81	N/A	N/A	64	N/A	61	70	76	74	73	70	77	N/A	71	73	80	77	76	78	65	52	N/A	N/A	N/A	N/A	75
6/6/2000	Tue	11	N/A	81	N/A	N/A	69	N/A	65	71	80	73	77	79	75	64	74	79	66	76	80	78	70	52	N/A	N/A	N/A	N/A	74
6/29/2000	Thu	13	N/A	75	N/A	N/A	62	N/A	62	62	N/A	72	68	82	69	57	68	78	60	79	72	68	68	72	N/A	N/A	N/A	N/A	72
6/30/2000	Fri	13	N/A	83	N/A	N/A	68	N/A	63	64	N/A	64	81	78	68	62	70	73	66	77	83	71	68	68	N/A	N/A	N/A	N/A	70
7/23/2000	Sun	13	N/A	76	N/A	N/A	72	N/A	58	69	78	67	79	68	67	58	74	76	62	79	81	69	69	70	N/A	68	N/A	N/A	70
7/25/2000	Tue	11	N/A	80	N/A	N/A	62	N/A	55	67	75	56	73	65	59	57	81	65	57	73	77	68	56	59	N/A	65	N/A	N/A	N/A
7/29/2000	Sat	16	N/A	72	N/A	N/A	63	N/A	52	68	74	51	71	60	56	73	84	65	55	68	77	60	64	58	N/A	68	N/A	N/A	54
7/30/2000	Sun	17	N/A	78	N/A	N/A	81	N/A	61	73	81	81	85	82	77	79	91	84	66	79	80	79	77	77	N/A	78	N/A	N/A	78
7/31/2000	Mon	12	N/A	80	N/A	N/A	73	N/A	60	68	81	77	78	90	68	58	78	79	95	86	85	75	69	N/A	N/A	72	N/A	N/A	69
8/1/2000	Tue	13	N/A	90	N/A	N/A	73	N/A	65	70	85	69	77	73	72	60	90	80	66	83	86	78	69	69	N/A	73	N/A	71	70
8/2/2000	Wed	12	N/A	81	N/A	N/A	62	N/A	53	63	77	54	76	67	64	49	90	65	56	72	81	65	N/A	59	N/A	65	N/A	69	59
8/3/2000	Thu	13	N/A	77	N/A	N/A	51	N/A	49	57	68	44	69	64	59	45	86	61	58	63	74	63	N/A	55	N/A	57	N/A	32	56
8/4/2000	Fri	23	N/A	86	N/A	N/A	62	N/A	58	71	78	48	73	65	59	N/A	86	62	57	72	81	63	63	57	N/A	63	N/A	67	58
8/5/2000	Sat	12	N/A	85	N/A	N/A	71	N/A	61	82	89	61	N/A	68	66	62	90	72	67	88	83	67	71	64	N/A	73	N/A	75	62
8/6/2000	Sun	11	N/A	77	N/A	N/A	68	N/A	57	67	73	51	70	64	66	56	81	65	60	68	75	68	65	61	N/A	67	N/A	70	62
8/7/2000	Mon	22	N/A	80	N/A	N/A	60	N/A	55	67	71	56	61	57	61	56	70	62	53	72	73	63	58	58	N/A	65	N/A	65	55
8/9/2000	Wed	12	N/A	88	N/A	N/A	68	N/A	64	73	84	63	74	71	64	56	84	71	58	87	86	69	72	67	N/A	67	N/A	70	62
8/10/2000	Thu	14	N/A	78	N/A	N/A	88	N/A	77	73	74	88	78	89	91	N/A	72	91	69	N/A	71	81	87	93	N/A	84	N/A	77	87

Date	Day	Hour	AJ	BP	BE	CC	CP	DY	EM	FF	FH	GL	HM	LP	MV	ME	MO RD	NP	PA LV	PP	RV	SP	SS	SU PR	SU	TE MP	WC (old)	WC	WP
8/12/2000	Sat	16	N/A	66	N/A	N/A	74	N/A	61	65	68	72	72	80	74	74	69	77	70	74	70	78	69	78	N/A	73	N/A	74	76
8/13/2000	Sun	13	N/A	75	N/A	N/A	71	N/A	60	69	72	64	67	66	75	74	69	80	62	72	76	72	70	74	N/A	72	N/A	76	72
8/14/2000	Mon	18	N/A	90	N/A	N/A	72	N/A	72	80	88	70	70	65	74	89	86	76	57	92	89	75	82	69	N/A	83	N/A	79	70
8/15/2000	Tue	13	N/A	87	N/A	N/A	63	N/A	58	69	76	46	69	66	68	51	N/A	66	62	74	80	70	64	61	N/A	66	N/A	72	64
8/16/2000	Wed	11	N/A	81	N/A	N/A	75	N/A	70	75	78	72	72	69	73	71	N/A	74	71	73	75	81	81	71	N/A	86	N/A	89	72
8/18/2000	Fri	13	N/A	75	N/A	N/A	62	N/A	59	65	N/A	69	81	N/A	69	70	71	70	66	74	74	74	70	66	N/A	72	N/A	68	68
8/19/2000	Sat	14	N/A	67	N/A	N/A	76	N/A	66	70	76	70	76	N/A	76	70	70	78	62	70	76	78	80	73	N/A	77	N/A	70	72
8/22/2000	Tue	21	N/A	80	N/A	N/A	53	N/A	53	64	71	55	72	64	61	52	77	57	52	65	73	60	58	55	N/A	59	N/A	65	56
8/24/2000	Thu	14	N/A	76	N/A	N/A	73	N/A	63	70	74	72	71	79	74	70	68	86	N/A	80	77	85	79	N/A	N/A	72	N/A	80	76
4/14/2001	Sat	18	N/A	71	N/A	N/A	67	N/A	60	76	74	67	80	72	68	54	N/A	72	N/A	66	78	65	63	69	70	75	N/A	72	N/A
5/7/2001	Mon	15	N/A	66	N/A	N/A	60	N/A	59	71	71	67	81	72	59	54	N/A	77	70	80	72	58	61	68	52	65	N/A	67	N/A
5/8/2001	Tue	18	N/A	69	N/A	N/A	14	N/A	67	71	70	73	80	73	73	62	N/A	76	74	73	69	68	64	70	71	75	N/A	74	67
5/10/2001	Thu	11	N/A	N/A	N/A	N/A	59	N/A	57	71	72	59	80	55	63	52	N/A	68	60	72	80	57	59	63	67	65	N/A	66	N/A
5/11/2001	Fri	11	N/A	73	N/A	N/A	60	N/A	56	69	70	59	76	51	63	47	N/A	65	58	69	80	58	54	61	65	62	N/A	65	60
6/5/2001	Tue	13	N/A	70	N/A	N/A	64	N/A	N/A	69	74	69	87	73	56	55	N/A	67	63	79	80	N/A	53	67	52	68	N/A	65	64
6/6/2001	Wed	12	N/A	72	N/A	N/A	59	N/A	N/A	72	76	59	81	64	49	55	N/A	65	55	77	83	60	N/A	61	50	66	N/A	67	55
6/15/2001	Fri	18	N/A	75	N/A	N/A	64	N/A	N/A	74	77	66	86	73	66	61	79	72	62	71	81	N/A	N/A	69	65	72	N/A	67	N/A
6/16/2001	Sat	11	N/A	73	N/A	N/A	75	N/A	N/A	77	76	67	81	62	71	68	76	73	62	72	73	N/A	N/A	76	71	76	N/A	78	72
6/21/2001	Thu	12	N/A	78	N/A	N/A	58	N/A	N/A	79	77	51	75	61	56	65	77	65	57	70	80	56	60	62	57	70	N/A	63	N/A
6/22/2001	Fri	13	N/A	80	N/A	N/A	52	N/A	N/A	81	78	55	77	57	60	61	66	64	48	72	77	54	64	61	53	66	N/A	67	59
7/2/2001	Mon	12	N/A	67	N/A	N/A	N/A	N/A	N/A	76	72	75	65	73	74	68	62	86	N/A	78	64	68	75	N/A	62	73	N/A	66	69
7/12/2001	Thu	17	N/A	68	N/A	N/A	71	N/A	N/A	64	67	85	78	71	71	66	66	86	64	73	66	68	65	79	N/A	64	N/A	69	75
7/13/2001	Fri	18	N/A	79	N/A	N/A	66	N/A	N/A	73	79	63	73	64	63	66	77	73	53	78	80	63	67	N/A	N/A	68	N/A	74	65
8/2/2001	Thu	20	N/A	69	N/A	73	68	N/A	N/A	70	71	78	69	N/A	70	66	58	83	N/A	N/A	67	72	75	75	N/A	74	N/A	66	70
8/5/2001	Sun	16	N/A	77	N/A	72	75	N/A	N/A	78	83	65	70	N/A	69	71	71	77	56	81	76	75	81	74	N/A	82	N/A	83	71
8/6/2001	Mon	20	N/A	75	N/A	85	77	N/A	N/A	78	79	92	84	N/A	N/A	78	76	93	62	85	75	82	79	86	N/A	77	N/A	73	81
8/7/2001	Tue	12	N/A	66	N/A	81	47	N/A	N/A	67	70	56	77	N/A	66	62	76	68	76	75	67	62	72	63	N/A	68	N/A	67	60
8/9/2001	Thu	15	N/A	79	N/A	83	64	N/A	N/A	81	86	60	82	N/A	68	65	77	78	65	88	83	67	66	N/A	56	71	N/A	69	61
8/10/2001	Fri	14	N/A	76	N/A	99	79	N/A	N/A	78	83	75	85	N/A	N/A	71	69	87	62	95	83	74	88	81	70	78	N/A	64	73
8/11/2001	Sat	13	N/A	62	N/A	N/A	76	N/A	N/A	77	66	80	69	N/A	83	77	N/A	81	73	68	65	86	78	80	73	88	N/A	86	79
8/15/2001	Wed	18	N/A	85	N/A	70	72	N/A	N/A	85	85	72	66	N/A	69	72	62	81	N/A	77	74	80	79	77	59	82	N/A	84	73
8/16/2001	Thu	15	N/A	75	N/A	80	70	N/A	N/A	75	76	76	85	N/A	71	74	75	80	77	84	77	72	78	79	72	N/A	N/A	70	72
8/17/2001	Fri	16	N/A	81	N/A	83	69	N/A	N/A	81	87	69	82	N/A	68	72	81	78	72	87	83	72	77	75	62	77	N/A	75	69
8/18/2001	Sat	13	N/A	80	N/A	70	62	N/A	N/A	75	82	56	71	N/A	62	59	74	65	67	77	81	59	66	64	58	66	N/A	66	61
8/19/2001	Sun	16	N/A	79	N/A	65	64	N/A	N/A	89	82	59	70	N/A	61	77	76	67	65	72	76	64	76	65	50	79	N/A	72	61
8/23/2001	Thu	19	N/A	60	N/A	69	53	N/A	N/A	59	64	69	80	N/A	61	60	66	62	63	74	63	59	62	62	61	62	N/A	60	60
8/24/2001	Fri	19	N/A	64	N/A	75	61	N/A	N/A	72	68	71	80	N/A	66	66	76	70	62	71	67	74	66	68	63	68	N/A	71	63
8/25/2001	Sat	11	N/A	61	N/A	83	58	N/A	N/A	70	74	66	84	N/A	59	60	74	72	65	77	73	64	66	67	63	60	N/A	64	61
5/3/2002	Fri	13	66	71	N/A	75	63	N/A	N/A	70	75	68	80	N/A	71	60	N/A	72	N/A	69	74	71	64	65	73	68	N/A	5	66
5/4/2002	Sat	12	73	77	N/A	78	70	N/A	N/A	81	83	73	80	N/A	74	69	N/A	77	69	72	75	76	74	71	75	75	N/A	5	72
5/5/2002	Sun	14	71	77	N/A	74	67	N/A	N/A	80	79	68	77	N/A	73	66	N/A	74	70	69	72	73	70	68	74	74	N/A	5	69

Date	Day	Hour	AJ	BP	BE	CC	CP	DY	EM	FF	FH	GL	HM	LP	MV	ME	MO RD	NP	PA LV	PP	RV	SP	SS	SU PR	SU	TE MP	WC (old)	WC	WP
5/11/2002	Sat	12	76	76	N/A	81	72	N/A	N/A	78	82	74	81	N/A	79	60	N/A	78	75	71	76	76	72	72	77	76	N/A	77	76
5/13/2002	Mon	16	68	67	N/A	81	72	N/A	N/A	73	76	83	80	N/A	81	69	N/A	82	80	76	N/A	78	73	75	79	76	N/A	70	79
5/24/2002	Fri	20	76	77	N/A	82	70	N/A	N/A	77	80	73	84	N/A	75	64	N/A	41	74	72	76	73	71	67	78	73	N/A	74	70
6/3/2002	Mon	23	59	65	N/A	73	65	N/A	N/A	62	68	65	90	N/A	73	51	N/A	69	76	74	67	68	60	63	61	66	N/A	64	65
6/4/2002	Tue	11	81	82	N/A	82	72	N/A	N/A	82	86	69	89	N/A	76	68	N/A	76	72	80	85	76	73	70	75	77	N/A	79	71
6/5/2002	Wed	15	79	82	N/A	90	76	N/A	N/A	83	91	76	91	N/A	79	66	N/A	83	78	83	85	81	79	75	78	80	N/A	80	N/A
6/6/2002	Thu	12	79	91	N/A	88	74	N/A	N/A	84	92	77	90	N/A	79	72	N/A	85	75	86	89	76	77	74	83	80	N/A	80	74
6/7/2002	Fri	12	78	88	N/A	89	76	N/A	N/A	86	86	71	89	N/A	80	70	N/A	85	71	83	88	81	77	73	68	83	N/A	80	74
6/17/2002	Mon	22	57	70	N/A	74	63	N/A	N/A	64	71	57	86	N/A	68	N/A	N/A	68	73	73	74	65	61	61	72	66	N/A	63	62
6/18/2002	Tue	13	65	72	N/A	84	66	N/A	N/A	67	75	66	90	N/A	74	57	N/A	75	78	77	78	69	63	68	80	68	N/A	66	70
6/23/2002	Sun	14	68	69	N/A	76	65	N/A	N/A	74	74	71	82	N/A	70	63	N/A	74	64	74	74	71	67	63	70	71	N/A	67	65
6/28/2002	Fri	12	67	71	N/A	82	67	N/A	N/A	73	71	77	79	N/A	75	62	N/A	78	59	73	71	66	63	70	68	66	N/A	63	69
7/5/2002	Fri	14	59	62	N/A	75	59	N/A	N/A	61	62	61	80	N/A	60	58	N/A	66	56	66	63	59	62	60	62	60	N/A	60	58
7/9/2002	Tue	14	65	68	N/A	86	84	N/A	N/A	76	70	94	77	N/A	107	73	N/A	93	80	83	67	80	80	93	80	76	N/A	70	100
7/10/2002	Wed	20	62	69	N/A	N/A	76	N/A	N/A	69	67	83	69	N/A	94	69	N/A	73	85	66	60	86	66	76	65	79	N/A	94	84
7/11/2002	Thu	13	74	82	N/A	N/A	88	N/A	N/A	80	83	88	84	N/A	95	73	N/A	89	74	84	72	90	79	89	75	85	N/A	85	102
7/12/2002	Fri	12	81	89	N/A	N/A	82	N/A	N/A	93	92	81	102	N/A	84	82	N/A	88	71	89	82	82	87	83	68	86	N/A	83	84
7/13/2002	Sat	11	80	86	N/A	N/A	72	N/A	N/A	83	83	58	82	N/A	65	N/A	N/A	73	59	77	79	69	73	67	N/A	76	N/A	78	66
7/15/2002	Mon	12	73	81	N/A	80	N/A	N/A	N/A	70	78	62	82	N/A	66	56	N/A	67	N/A	85	80	66	61	58	60	64	N/A	72	63
7/17/2002	Wed	15	49	57	N/A	69	71	N/A	N/A	60	61	76	66	N/A	81	63	N/A	81	55	64	54	75	58	76	40	65	N/A	64	82
7/24/2002	Wed	12	79	85	N/A	84	74	N/A	N/A	92	80	69	82	N/A	73	72	N/A	83	56	84	74	73	N/A	71	57	73	N/A	77	74
8/8/2002	Thu	12	71	76	N/A	71	70	N/A	N/A	76	N/A	68	69	N/A	70	71	N/A	74	48	71	69	74	72	N/A	45	77	N/A	83	70
8/9/2002	Fri	12	70	79	N/A	74	63	N/A	N/A	74	81	62	66	N/A	61	62	N/A	70	52	N/A	73	65	68	59	52	69	N/A	67	61
8/10/2002	Sat	13	71	79	N/A	81	66	N/A	N/A	79	84	61	76	N/A	67	61	N/A	72	58	N/A	76	67	68	64	63	69	N/A	71	65
8/16/2002	Fri	13	73	81	N/A	66	61	N/A	N/A	76	77	56	69	N/A	63	64	N/A	68	44	73	74	N/A	64	60	45	67	N/A	65	60
5/11/2003	Sun	14	68	82	N/A	87	80	N/A	N/A	76	83	88	89	N/A	86	N/A	N/A	88	80	89	84	83	85	83	79	83	N/A	82	81
5/16/2003	Fri	15	69	78	N/A	74	69	N/A	N/A	73	76	77	76	N/A	74	N/A	N/A	79	73	79	81	75	73	72	N/A	N/A	N/A	76	73
5/20/2003	Tue	15	70	76	N/A	77	64	N/A	N/A	73	61	67	83	N/A	67	N/A	N/A	73	65	78	81	61	64	67	59	65	N/A	76	65
5/21/2003	Wed	17	61	71	N/A	81	71	N/A	N/A	66	64	85	83	N/A	83	N/A	N/A	76	80	77	N/A	71	64	75	61	68	N/A	72	77
5/22/2003	Thu	13	64	76	N/A	83	66	N/A	N/A	67	73	64	87	N/A	71	N/A	N/A	68	62	75	N/A	68	71	64	52	64	N/A	69	64
5/27/2003	Tue	14	69	86	N/A	88	72	N/A	N/A	72	78	66	89	N/A	73	N/A	N/A	77	N/A	85	N/A	76	64	68	57	69	N/A	69	70
6/29/2003	Sun	11	74	80	N/A	74	66	N/A	N/A	77	78	N/A	74	N/A	68	N/A	N/A	70	56	68	78	61	70	65	53	66	N/A	69	64
7/14/2003	Mon	13	66	82	N/A	73	63	N/A	N/A	73	72	47	75	N/A	61	N/A	N/A	65	56	71	77	62	64	56	N/A	63	N/A	61	56
7/16/2003	Wed	15	64	82	N/A	75	73	N/A	N/A	73	77	62	72	N/A	74	N/A	N/A	86	62	74	75	71	75	74	N/A	70	N/A	65	73
7/21/2003	Mon	12	72	88	N/A	74	71	62	N/A	79	83	65	74	N/A	71	N/A	N/A	76	62	80	85	69	N/A	70	N/A	72	N/A	67	68
7/22/2003	Tue	13	90	103	N/A	81	83	75	N/A	99	99	76	80	N/A	83	N/A	N/A	93	62	93	96	79	97	82	N/A	86	N/A	78	81
7/23/2003	Wed	12	72	87	N/A	75	76	60	N/A	79	83	49	77	N/A	74	N/A	N/A	77	65	79	83	73	79	70	N/A	80	N/A	78	70
7/24/2003	Thu	14	67	80	N/A	73	78	63	N/A	73	77	52	73	N/A	78	N/A	N/A	72	75	72	75	76	73	74	N/A	78	N/A	N/A	76
7/25/2003	Fri	12	60	78	N/A	70	58	53	N/A	71	76	40	77	N/A	57	N/A	N/A	60	49	74	80	56	64	57	N/A	65	N/A	N/A	53
7/29/2003	Tue	12	69	82	N/A	69	67	N/A	N/A	N/A	78	39	71	N/A	67	N/A	N/A	66	60	74	79	63	68	62	N/A	N/A	N/A	67	57
7/30/2003	Wed	12	57	N/A	N/A	83	71	N/A	N/A	N/A	76	42	87	N/A	75	N/A	N/A	74	69	83	74	67	74	68	N/A	71	N/A	68	66

Date	Day	Hour	AJ	BP	BE	CC	CP	DY	EM	FF	FH	GL	HM	LP	MV	ME	MO RD	NP	PA LV	PP	RV	SP	SS	SU PR	SU	TE MP	WC (old)	WC	WP
7/31/2003	Thu	11	62	81	N/A	71	63	51	N/A	71	78	32	73	N/A	57	N/A	N/A	65	49	71	79	60	72	58	N/A	62	N/A	72	53
8/12/2003	Tue	11	71	82	N/A	70	69	55	N/A	79	80	58	73	N/A	68	N/A	N/A	72	56	77	81	70	75	N/A	N/A	80	N/A	73	64
8/16/2003	Sat	15	57	69	N/A	73	84	82	N/A	63	72	92	72	N/A	83	N/A	N/A	92	74	73	72	73	85	82	N/A	79	N/A	70	80
8/17/2003	Sun	19	61	70	N/A	75	79	75	N/A	67	68	88	85	N/A	87	N/A	N/A	77	80	71	70	77	74	72	N/A	79	N/A	75	77
8/18/2003	Mon	10	71	77	N/A	80	70	61	N/A	72	75	64	84	N/A	73	N/A	N/A	76	66	78	78	71	73	66	N/A	76	N/A	73	66
8/20/2003	Wed	14	66	82	N/A	73	72	62	N/A	74	76	71	81	N/A	76	N/A	N/A	82	60	79	74	65	75	72	N/A	75	N/A	70	71
8/29/2003	Fri	12	64	83	N/A	54	59	49	N/A	65	62	56	56	N/A	59	N/A	N/A	58	49	N/A	62	52	61	55	N/A	60	N/A	61	53
9/27/2003	Sat	13	64	75	N/A	N/A	60	53	N/A	64	77	62	72	N/A	61	N/A	N/A	68	55	80	74	63	67	60	N/A	64	N/A	62	61
5/15/2004	Sat	12	70	75	N/A	75	68	59	N/A	70	77	71	77	N/A	N/A	N/A	N/A	76	72	71	83	71	71	67	N/A	70	N/A	68	70
6/10/2004	Thu	12	66	71	N/A	76	63	61	N/A	58	68	70	80	N/A	N/A	N/A	N/A	71	69	65	N/A	64	60	N/A	N/A	58	N/A	52	66
6/11/2004	Fri	13	70	77	N/A	76	70	57	N/A	65	77	70	81	N/A	N/A	N/A	N/A	73	69	67	N/A	73	69	66	N/A	69	N/A	65	71
7/24/2004	Sat	14	61	67	N/A	69	74	70	N/A	66	70	80	64	N/A	N/A	N/A	N/A	82	61	64	67	71	73	73	N/A	71	N/A	68	74
7/25/2004	Sun	12	59	65	N/A	69	78	74	N/A	68	68	79	66	N/A	N/A	N/A	N/A	79	75	62	66	79	77	76	N/A	78	N/A	73	80
7/26/2004	Mon	20	62	69	N/A	75	77	73	N/A	72	69	82	69	N/A	N/A	N/A	N/A	84	69	68	64	72	81	77	N/A	72	N/A	72	77
7/27/2004	Tue	12	68	76	N/A	68	75	64	N/A	77	76	76	67	N/A	N/A	N/A	N/A	87	63	67	68	71	79	71	N/A	72	N/A	69	72
8/1/2004	Sun	12	52	62	N/A	73	71	51	N/A	57	64	61	71	N/A	N/A	N/A	N/A	80	48	58	65	70	67	70	N/A	64	N/A	60	68
8/3/2004	Tue	13	70	81	N/A	63	65	49	N/A	77	75	51	62	N/A	N/A	N/A	N/A	72	44	65	69	62	71	63	N/A	68	N/A	63	65
8/10/2004	Tue	12	52	72	58	77	72	61	N/A	64	71	68	64	N/A	N/A	N/A	N/A	80	63	N/A	66	60	64	72	N/A	N/A	N/A	64	69
9/9/2004	Thu	18	51	54	52	76	63	62	N/A	55	65	62	80	N/A	N/A	N/A	N/A	68	58	64	65	57	65	61	N/A	58	N/A	57	65

2.2.2 Spatial Patterns

The spatial distribution of the frequency of the 8-hour ozone exceedances for 2000-2004 in the MNA is presented in Figure 5 and Table 9. Numbers next to each site indicate the number of days in which the 8-hour average ozone concentration was greater than or equal to 80 ppb at each of the monitoring sites for the five-year period. The five sites with the highest number of ozone exceedance days are Blue Point (BP; 60 high ozone days), Humboldt Mountain (HM; 58 high ozone days), Rio Verde (RV; 44 high ozone days), Fountain Hills (FH; 36 high ozone days), and North Phoenix (NP; 36 high ozone days). These five sites with the highest number of ozone exceedance days are located in the northeast portion of the MNA. The northeastern portion is the area of most concern in the 8-hour ozone nonattainment area. Table 9 presents a tabulation of the number of total and annual exceedance days greater than or equal to 80 ppb at each monitoring site for 2000-2004. Numbers in bold text in red indicate the maximum number of annual exceedance days each year. The daily spatial distribution of 8-hour ozone concentrations on selected high ozone days is illustrated in Appendix D.

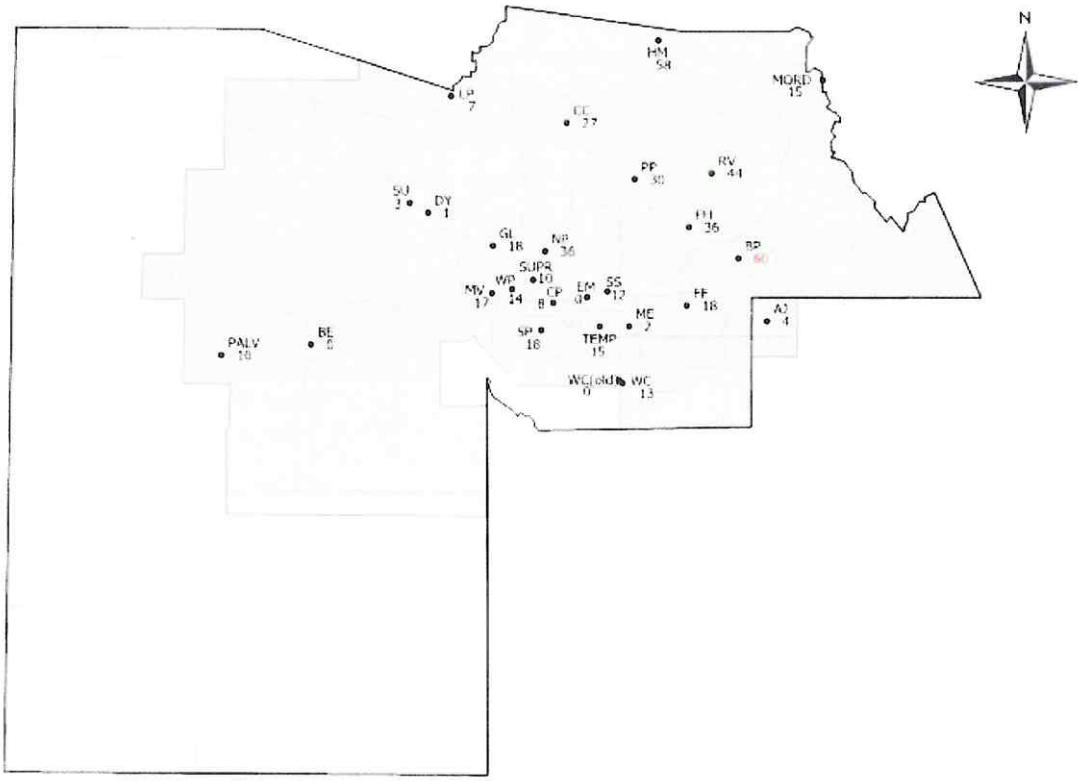


Figure 5. Number of high 8-hour ozone days greater than or equal to 80 ppb at each ozone monitoring site in the MNA for 2000-2004. (The number in red means the maximum count in the region.) (See Table 5 for site abbreviations.)

Table 9. The number of days exceeding 80 ppb at each monitoring site for 2000-2004

Site*	Total Exceedance Days	Annual Exceedance Days				
		2000	2001	2002	2003	2004
BP	60	31	4	10	14	1
HM	58	10	16	19	10	3
RV	44	18	11	6	8	1
FH	36	11	7	13	5	0
NP	36	9	8	9	5	5
PP	29	7	7	9	6	0
CC	27	N/A	7	13	7	0
FF	18	2	5	10	1	0
GL	18	4	3	5	4	2
SP	18	8	3	6	1	0
MV	17	4	1	7	5	N/A
MORD	15	14	1	N/A	N/A	N/A
TEMP	15	3	3	5	4	0
WP	14	4	1	5	3	1
WC	13	2	3	7	1	0
SS	12	4	2	2	3	1
PALV	10	4	0	3	3	0
SUPR	10	1	3	3	3	0
CP	8	2	0	3	3	0
LP	7	7	0	N/A	N/A	N/A
SU	3	N/A	0	3	0	N/A
ME	2	1	0	1	N/A	N/A
DY	1	N/A	N/A	N/A	1	0

* See Table 5 for site abbreviations.

2.3 Meteorological Conditions Associated with 8-Hour Ozone Episodes

This section describes the synoptic-scale and regional-scale meteorology associated with 8-hour ozone episodes that occurred in the MNA during the period 2000-2004. The air quality and meteorological conditions for each day with an 8-hour average ozone concentration greater than or equal to 80 ppb were analyzed to classify the events by meteorological type. Initial conceptual models were developed for meteorological conditions associated with 8-hour average ozone concentrations above 80 ppb and above the standard of 85 ppb.

The meteorological conditions were assessed through review of the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model runs and the Arizona Meteorological Network (AZMET) data, especially the Phoenix Encanto site (Latitude: 33.47 and Longitude: -112.09), available for the time periods. AZMET data was used due to completeness of the data, density of the monitoring sites, and intensive temporal resolution for the hourly average data.

2.3.1 Regional Meteorology

2.3.1.1 Temperature

Temperature data from the AZMET Phoenix Encanto site were reviewed for the high ozone days. Table 10 presents daily maximum, minimum, and average temperatures for the high ozone days during the period 2000-2004. The daily minimum, maximum, and average temperatures ranged from 51 to 87 °F, from 82 to 114 °F, and from 66 to 101 °F, respectively. The mean temperatures for the daily minimum, maximum, and average temperatures were 72.8 °F, 101.2 °F, and 87.7 °F, respectively. During the high ozone days exceeding 80 ppb, 70.9 % of days (100 days out of 141 days) recorded the daily maximum temperatures higher than 100 °F. The proportion of days recording high daily maximum temperatures greater than 100 °F increased to 75.4 % when the high ozone day exceeded 85 ppb. The most days exceeding 80 ppb (36.9 %) occurred when the daily maximum temperature was between 100 °F and 105 °F. The largest proportion of high ozone days exceeding 85 ppb (40.4 %) occurred when the daily maximum temperature was between 105 °F and 110 °F. The profile of the proportion of the high ozone days by temperature is presented in Figure 6.

2.3.1.2 Air Flow Pattern

Surface wind data from the AZMET Phoenix Encanto site were examined for all of the high ozone days whose 8-hour ozone concentration exceeded 80 ppb during the period of 2000-2004. Surface wind for these days (total 141 days) had the following pattern:

- Winds during the early morning hours (0:00~6:00) were mostly calm (82.1%) and calm wind flow was mainly northerly to easterly. (Figure 7 and Table 11)

- Wind flow during the morning hours (7:00~11:00) was mostly calm (64.5%), as in the early morning hours, but calm wind flow was mainly easterly. Easterly wind increased to 20.1%. (Figure 8 and Table 12)

- Major wind flow during the afternoon hours (12:00~18:00) changed to westerly. Calm wind flow was reduced to 24.6% and southwesterly wind flow increased to 18.3%. (Figure 9 and Table 13)

- Wind flow during the evening hours (19:00~23:00) remained westerly but at a reduced wind speed. Therefore, calm wind became predominant. (Figure 10 and Table 14)

Table 10. Temperature observed from the AZMET Phoenix Encanto site for the high 8-hour ozone days during the period of 2000-2004

Date	Temperature (°F)			8-hr Ozone (ppb)
	Daily Max	Daily Min	Daily Average	Daily Max
4/13/2000	92	60	76	81
4/20/2000	87	53	71	81
4/23/2000	85	58	71	81
4/24/2000	91	56	74	81
4/25/2000	95	59	77	82
4/26/2000	99	58	79	85
4/29/2000	86	68	76	81
5/1/2000	96	56	77	81
5/2/2000	98	60	79	85
5/3/2000	98	62	80	82
5/11/2000	82	69	77	82
5/12/2000	85	57	73	80
5/13/2000	90	53	73	86
5/14/2000	96	59	77	83
5/19/2000	93	61	79	86
5/20/2000	99	65	83	89
5/21/2000	104	65	87	87
5/22/2000	107	67	90	82
5/23/2000	104	70	90	83
5/24/2000	100	70	88	81
5/27/2000	102	70	88	84
5/30/2000	104	70	89	83
6/5/2000	106	70	88	81
6/6/2000	106	75	91	81
6/29/2000	100	77	87	82
6/30/2000	100	81	91	83
7/23/2000	106	86	95	81
7/25/2000	109	80	96	81
7/29/2000	104	82	94	84
7/30/2000	105	84	95	91
7/31/2000	104	78	91	95
8/1/2000	105	83	94	90
8/2/2000	105	80	95	90
8/3/2000	106	86	97	86
8/4/2000	108	80	96	86
8/5/2000	109	81	95	90
8/6/2000	101	79	90	81
8/7/2000	100	74	90	80
8/9/2000	103	79	91	88
8/10/2000	104	82	93	93
8/12/2000	101	80	90	80
8/13/2000	104	82	93	80
8/14/2000	105	82	94	92
8/15/2000	104	82	94	87
8/16/2000	107	82	96	89
8/18/2000	96	75	85	81
8/19/2000	103	78	91	80
8/22/2000	99	78	89	80
8/24/2000	101	76	89	86
4/14/2001	83	51	66	80
5/7/2001	100	58	80	81
5/8/2001	103	63	83	80
5/10/2001	101	68	84	80
5/11/2001	103	66	84	80
6/5/2001	96	65	82	87
6/6/2001	101	66	85	83
6/15/2001	100	59	81	86
6/16/2001	105	64	86	81

Date	Temperature (°F)			8-hr Ozone (ppb)
	Daily Max	Daily Min	Daily Average	Daily Max
6/21/2001	103	76	91	80
6/22/2001	104	84	93	81
7/2/2001	114	81	99	86
7/12/2001	102	77	90	86
7/13/2001	106	83	93	80
8/2/2001	105	81	93	83
8/5/2001	103	78	89	83
8/6/2001	108	83	95	93
8/7/2001	104	84	92	81
8/9/2001	93	72	83	88
8/10/2001	97	79	88	99
8/11/2001	103	80	91	88
8/15/2001	102	76	90	85
8/16/2001	105	79	91	85
8/17/2001	103	78	90	87
8/18/2001	99	79	90	82
8/19/2001	102	80	91	89
8/23/2001	104	71	86	80
8/24/2001	106	70	88	80
8/25/2001	108	71	89	84
5/3/2002	85	53	69	80
5/4/2002	88	53	72	83
5/5/2002	90	57	74	80
5/11/2002	86	65	77	82
5/13/2002	101	62	82	83
5/24/2002	91	59	75	84
6/3/2002	93	70	83	90
6/4/2002	97	64	81	89
6/5/2002	103	69	87	91
6/6/2002	107	68	89	92
6/7/2002	106	72	91	89
6/17/2002	106	70	90	86
6/18/2002	105	71	89	90
6/23/2002	104	70	88	82
6/28/2002	108	69	90	82
7/5/2002	104	74	90	80
7/9/2002	109	82	97	107
7/10/2002	106	80	94	94
7/11/2002	108	82	95	102
7/12/2002	108	81	95	102
7/13/2002	108	85	98	86
7/15/2002	97	75	87	85
7/17/2002	101	83	91	82
7/24/2002	102	76	90	92
8/8/2002	106	73	91	83
8/9/2002	108	76	94	81
8/10/2002	108	83	95	84
8/16/2002	105	82	94	81
5/11/2003	89	52	71	89
5/16/2003	97	60	79	81
5/20/2003	100	62	82	83
5/21/2003	104	65	86	85
5/22/2003	101	71	88	87
5/27/2003	106	66	88	89
6/29/2003	107	74	91	80
7/14/2003	112	87	101	82
7/16/2003	114	86	99	86
7/21/2003	107	85	96	88
7/22/2003	107	83	95	103
7/23/2003	108	86	98	87
7/24/2003	103	86	94	80
7/25/2003	105	84	96	80
7/29/2003	98	72	86	82

Date	Temperature (°F)			8-hr Ozone (ppb)
	Daily Max	Daily Min	Daily Average	Daily Max
7/30/2003	95	74	85	87
7/31/2003	100	79	90	81
8/12/2003	105	85	97	82
8/16/2003	96	77	87	92
8/17/2003	102	77	90	88
8/18/2003	105	79	92	84
8/20/2003	97	75	87	82
8/29/2003	100	76	89	83
9/27/2003	99	70	84	80
5/15/2004	98	61	81	83
6/10/2004	90	62	77	80
6/11/2004	95	62	80	81
7/24/2004	103	80	91	82
7/25/2004	105	78	92	80
7/26/2004	100	76	89	84
7/27/2004	101	77	89	87
8/1/2004	106	78	94	80
8/3/2004	104	82	95	81
8/10/2004	108	78	94	80
9/9/2004	104	77	90	80
Range	**82~114**	**51~87**	**66~101**	
Mean	**101.2**	**72.8**	**87.7**	

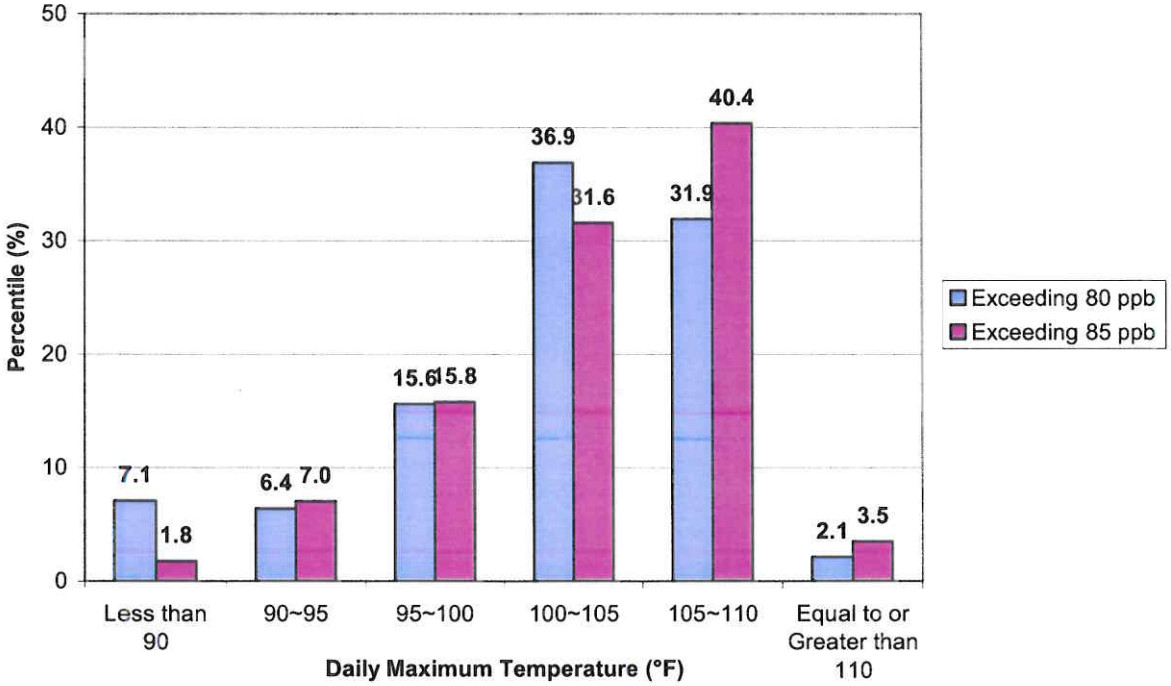


Figure 6. The proportion of the high ozone days by daily maximum temperature.

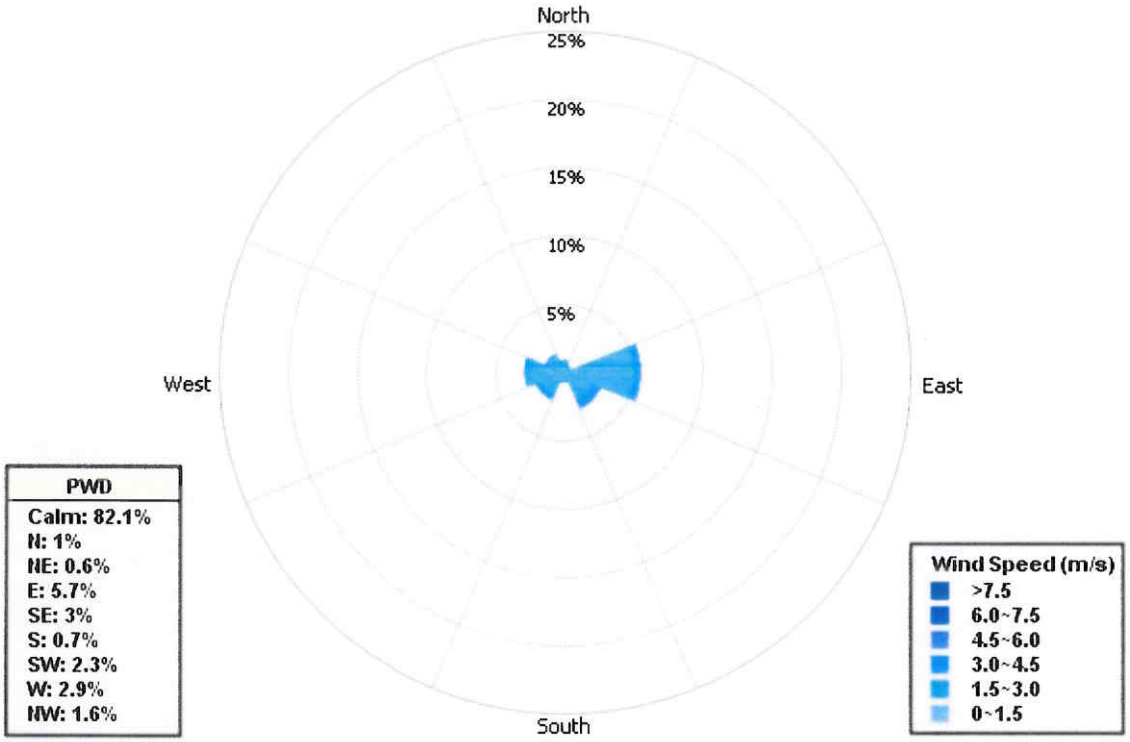


Figure 7. The early morning (0:00~6:00) wind pattern for all of the high ozone days during the period of 2000-2004.

Table 11. Categorization of primary wind direction and calm wind during the early morning hours (0:00~6:00) for all of the high ozone days (2000-2004)

	Primary Wind Direction								
	Calm	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**
Percentile	82.1%	1%	0.6%	5.7%	3%	0.7%	2.3%	2.9%	1.6%
Calm Wind		26.5%	27.3%	20%	5.1%	2.1%	3.1%	7%	8.9%

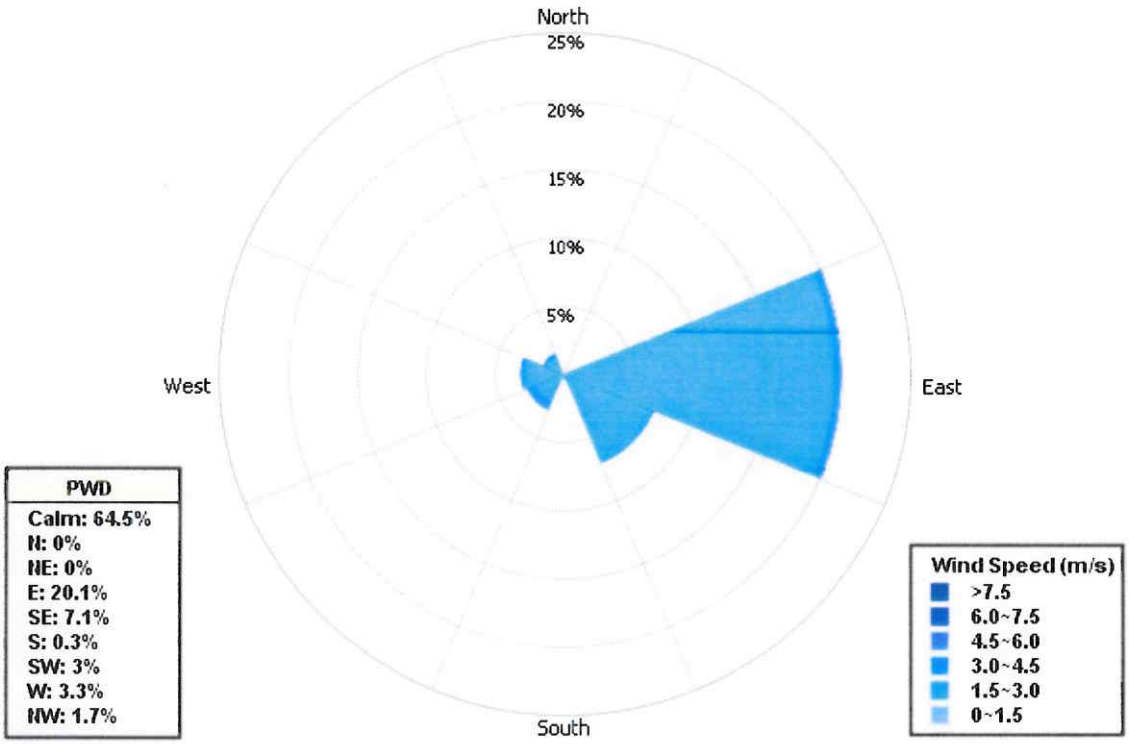


Figure 8. The morning (7:00~11:00) wind pattern for all of the high ozone days during the period of 2000-2004.

Table 12. Categorization of primary wind direction and calm wind during the morning hours (7:00~11:00) for all of the high ozone days (2000-2004)

	Primary Wind Direction								
	Calm	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**
Percentile	64.5%	0%	0%	20.1%	7.1%	0.3%	3%	3.3%	1.7%
Calm Wind		6.8%	13%	45.5%	17.8%	4.2%	2.2%	5.3%	5.3%

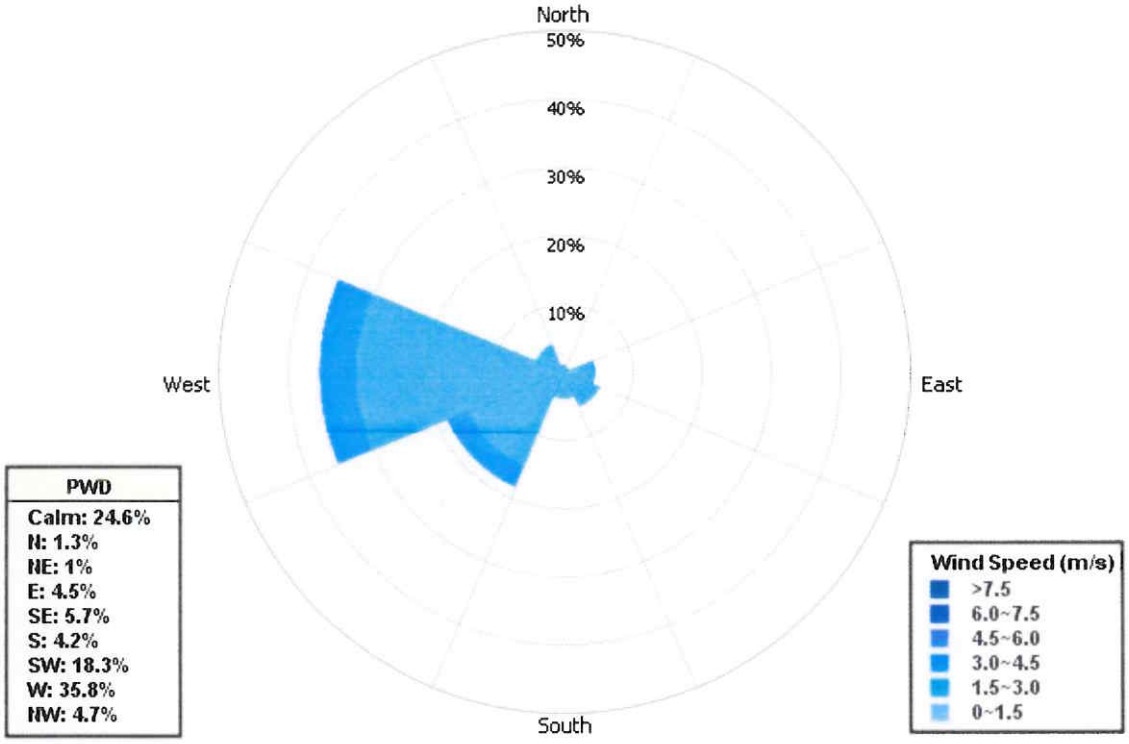


Figure 9. The afternoon (12:00~18:00) wind pattern for all of the high ozone days during the period of 2000-2004.

Table 13. Categorization of primary wind direction and calm wind during the afternoon hours (12:00~18:00) for all of the high ozone days (2000-2004)

	Primary Wind Direction								
	Calm	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**
Percentile	24.6%	1.3%	1%	4.5%	5.7%	4.2%	18.3%	35.8%	4.7%
Calm Wind		5.3%	8.2%	22.2%	17.3%	14%	11.5%	12.3%	9.1%

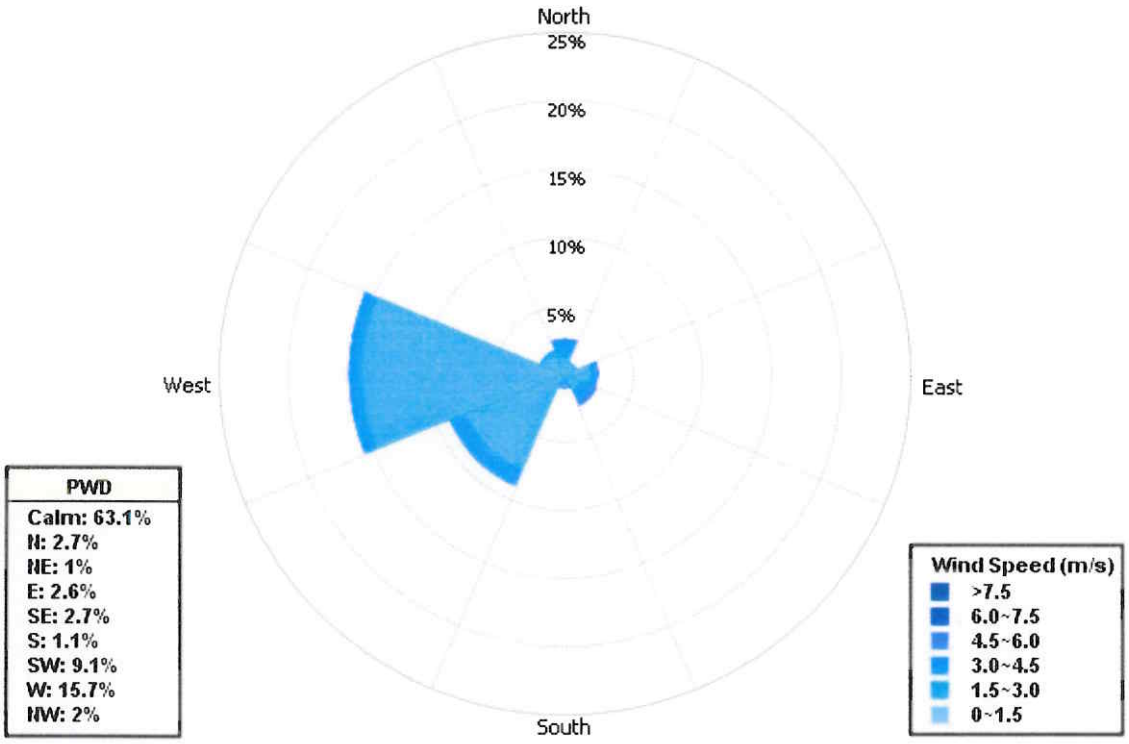


Figure 10. The evening (19:00~23:00) wind pattern for all of the high ozone days during the period of 2000-2004.

Table 14. Categorization of primary wind direction and calm wind during the evening hours (19:00~23:00) for all of the high ozone days (2000-2004)

	Primary Wind Direction								
	Calm	N	NE	E	SE	S	SW	W	NW
Percentile	63.1%	2.7%	1%	2.6%	2.7%	1.1%	9.1%	15.7%	2%
Calm Wind		12.6%	15.1%	13%	3.1%	2.9%	15.3%	26.1%	11.9%

2.3.2 Identification of Meteorological Regimes

Identification of meteorological regimes associated with high ozone episodes is a major component of the modeling protocol. Meteorological classification corresponding with high ozone episodes is used for selecting episodes for air quality modeling and assists in examining the relationship between certain types of meteorological regimes and high ozone episodes.

The approach for selecting episode days recommended in Appendix B of the UAM EPA Guideline (EPA, 1991) was applied to identify the different types of surface meteorological regimes. The guideline recommends constructing a climatological windrose of high ozone days as the first step to identify meteorological regimes. The climatological windrose of all high ozone days was constructed by grouping the calculated morning resultant wind velocities for all of the exceedance days into eight compass directions plus calm. Calm winds, defined as those with speeds less than 1.5 m/s in the EPA guideline reproduced in Appendix C, were also identified. The resultant wind velocity for the morning hours from 7:00 am to 10:00 am was calculated using the following equations:

$$V_e = -\frac{1}{N}\sum_{i=1}^{N} u_i SIN(\theta_i)$$ Mean east-west component of wind

$$V_n = -\frac{1}{N}\sum_{i=1}^{N} u_i COS(\theta_i)$$ Mean north-south component of wind

where,

u_i = wind speed;

θ_i = wind direction in degrees (0 degree representing northerly winds); and

N = number of valid observations.

Then the resultant wind velocity was converted to the resultant mean wind speed and direction using the following equations:

$$\overline{U_{RV}} = \sqrt{V_e^2 + V_n^2}$$ Resultant mean wind speed

$$\overline{\theta_{RV}} = TAN^{-1}\left(\frac{V_e}{V_n}\right) + FLOW$$ Resultant mean wind direction

where,

FLOW = +180; for $TAN^{-1}(V_e/V_n) < 180$, and
FLOW = -180; for $TAN^{-1}(V_e/V_n) < 180$

Table 15 presents the resultant wind velocities for all of the exceedance days grouped by the procedure above. A red dot identifies an exceedance of the 8-hour ozone standard, while a black dot identifies concentrations greater than or equal to 80 ppb. The predominant wind directions (PWD), defined as the bins with frequencies significantly higher than the average frequency for all nine bins (0-8), were identified as shown at the bottom of Table 15. Calm and easterly winds were classified as PWD and the rest of the winds as "others". Calm wind was the most predominant among the nine bins and accounted for 112 out of the 141 high ozone days (79.4%). The climatological windrose of all high ozone days constructed by this analysis is depicted in Figure 11. Tables 16-17 summarize the results of the primary wind direction categorizations. The 8-hour ozone exceedances in the MNA during the 2000-2004 period were characterized by the following conditions:

- Calm conditions comprised 78.9% of the exceedances –
    - 40% of exceedances under calm conditions had an air mass originating in the east.
    - 22.2% of exceedances under calm conditions had an air mass originating in the west.
- Surface winds from the east comprised 10.5% of ozone exceedances.

Each exceedance day within each PWD category and within the "others" category was ranked according to its areawide daily maximum 8-hour ozone concentration as shown in Table 18. The two PWD categories, calm and easterly winds, and the "others" category became the three meteorological regimes to consider in the attainment test. The top 3-ranked exceedance days from within each of the three meteorological regimes are July 30, 2000, August 2, 2000, August 10, 2000, August 6, 2001, August 9, 2001, June 6, 2002, July 9, 2002, July 11, 2002, and July 22, 2003. These days are candidates for modeling in the attainment test.

The daily surface weather maps for all of the high ozone days over the five ozone seasons of 2000-2004 were examined and provided in Appendix E. There was a distinctive synoptic pattern identified by the examination of 141 surface weather maps. The pattern is characterized by a low sea level pressure system over southwestern Arizona and a high sea level pressure system over northeastern Arizona. In the 500-millibar height contours, the pattern is characterized by a low 500-millibar height over northern Arizona and a high 500-millibar height over southern Arizona.

The average of sea level pressure for all of the high ozone days over the five years is 1009.59 millibars (mb), which is lower than the average pressure at sea level, 1013.25 mb (1.0 atm). The range of sea level pressure is from 1003.4 mb to 1014.9 mb. The average of the difference between air and dew point temperatures is 30.27 °F, which indicates air with low relative humidity. The average dew point temperature is 50.42 °F, while its range is from 17 °F to 73 °F. However, the top 3-ranked exceedance days from within each of the three meteorological regimes occurred when dew point temperatures were usually higher than the average 88.9 % (8 out of 9 days). For the number of high ozone days covered by cloud, 57.4 % (81 out of 141 days) of the high ozone days and the 88.9 % (8 out of 9 days) of the top 3-ranked exceedance days from within each of the three meteorological regimes were observed when the weather conditions were covered by 25 % of cloud cover (scattered cloud) or more. This shows that high ozone exceedances are likely to occur when there is partial cloud cover.

Table 15. Classification of resultant wind velocities

Date	Calm	N	NE	E	SE	S	SW	W	NW	8-hr Ozone Conc. (ppb)
2000										
4/13/2000	●									81
4/20/2000	●									81
4/23/2000	●									81
4/24/2000	●									81
4/25/2000	●									82
4/26/2000	●									85
4/29/2000							●			81
5/1/2000	●									81
5/2/2000	●									85
5/3/2000				●						82
5/11/2000								●		82
5/12/2000	●									80
5/13/2000	●									86
5/14/2000	●									83
5/19/2000	●									86
5/20/2000	●									89
5/21/2000	●									87
5/22/2000	●									82
5/23/2000	●									83
5/24/2000	●									81
5/27/2000	●									84
5/30/2000	●									83
6/5/2000	●									81
6/6/2000				●						81
6/29/2000	●									82
6/30/2000					●					83
7/23/2000				●						81
7/25/2000	●									81
7/29/2000	●									84
7/30/2000				●						91
7/31/2000	●									95
8/1/2000	●									90
8/2/2000								●		90
8/3/2000								●		86
8/4/2000	●									86
8/5/2000	●									90
8/6/2000	●									81
8/7/2000								●		80
8/9/2000	●									88
8/10/2000					●					93
8/12/2000				●						80
8/13/2000	●									80
8/14/2000	●									92
8/15/2000	●									87
8/16/2000	●									89

Date	Calm	N	NE	E	SE	S	SW	W	NW	8-hr Ozone Conc. (ppb)
8/18/2000				●						81
8/19/2000	●									80
8/22/2000	●									80
8/24/2000	●									86
2001										
4/14/2001	●									80
5/7/2001	●									81
5/8/2001					●					80
5/10/2001	●									80
5/11/2001	●									80
6/5/2001				●						87
6/6/2001	●									83
6/15/2001					●					86
6/16/2001	●									81
6/21/2001	●									80
6/22/2001	●									81
7/2/2001				●						86
7/12/2001	●									86
7/13/2001	●									80
8/2/2001	●									83
8/5/2001				●						83
8/6/2001				●						93
8/7/2001				●						81
8/9/2001					●					88
8/10/2001	●									99
8/11/2001	●									88
8/15/2001	●									85
8/16/2001				●						85
8/17/2001	●									87
8/18/2001	●									82
8/19/2001	●									89
8/23/2001	●									80
8/24/2001				●						80
8/25/2001	●									84
2002										
5/3/2002	●									80
5/4/2002	●									83
5/5/2002	●									80
5/11/2002	●									82
5/13/2002	●									83
5/24/2002	●									84
6/3/2002	●									90
6/4/2002	●									89
6/5/2002	●									91
6/6/2002				●						92
6/7/2002	●									89
6/17/2002	●									86
6/18/2002	●									90

Date	Calm	N	NE	E	SE	S	SW	W	NW	8-hr Ozone Conc. (ppb)
6/23/2002	●									82
6/28/2002	●									82
7/5/2002	●									80
7/9/2002	●									107
7/10/2002	●									94
7/11/2002	●									102
7/12/2002	●									102
7/13/2002	●									86
7/15/2002	●									85
7/17/2002	●									82
7/24/2002	●									92
8/8/2002	●									83
8/9/2002	●									81
8/10/2002	●									84
8/16/2002	●									81
2003										
5/11/2003	●									89
5/16/2003	●									81
5/20/2003	●									83
5/21/2003								●		85
5/22/2003	●									87
5/27/2003	●									89
6/29/2003	●									80
7/14/2003	●									82
7/16/2003	●									86
7/21/2003	●									88
7/22/2003	●									103
7/23/2003	●									87
7/24/2003				●						80
7/25/2003	●									80
7/29/2003	●									82
7/30/2003	●									87
7/31/2003	●									81
8/12/2003	●									82
8/16/2003	●									92
8/17/2003	●									88
8/18/2003	●									84
8/20/2003	●									82
8/29/2003	●									83
9/27/2003	●									80
2004										
5/15/2004	●									83
6/10/2004	●									80
6/11/2004	●									81
7/24/2004				●						82
7/25/2004	●									80
7/26/2004	●									84
7/27/2004	●									87

Date	Calm	N	NE	E	SE	S	SW	W	NW	8-hr Ozone Conc. (ppb)
8/1/2004	●									80
8/3/2004	●									81
8/10/2004				●						80
9/9/2004					●					80
Frequency	112	0	0	17	6	0	1	5	0	
Category	PWD	Other	Other	PWD	Other	Other	Other	Other	Other	

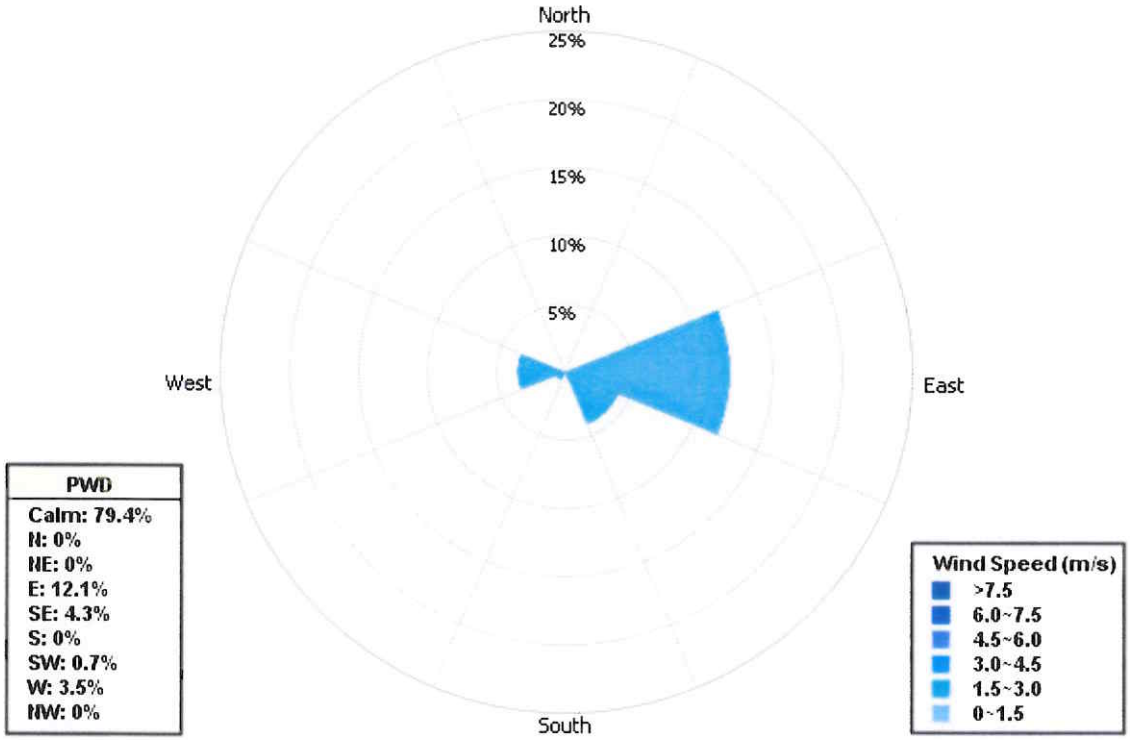


Figure 11. Climatological wind rose for AZMET Phoenix Encanto site for 2000-2004

Table 16. Categorization of primary wind direction

Primary Wind Direction	Percentile (Daily Max 8-hr Ozone ≥ 80 ppb)	Percentile (Daily Max 8-hr Ozone ≥ 85 ppb)
North	0	0
Northeast	0	0
East	12.1	10.5
Southeast	4.3	5.3
South	0	0
Southwest	0.7	0
West	3.5	5.3
Northwest	0	0
Calm	79.4	78.9

Table 17. Analysis of Calm wind category

Primary Wind Direction	Percentile (Daily Max 8-hr Ozone ≥ 80 ppb)	Percentile (Daily Max 8-hr Ozone ≥ 85 ppb)
North	0.9	0
Northeast	0	0
East	45.5	40
Southeast	22.3	20
South	6.2	8.9
Southwest	6.2	8.9
West	18.8	22.2
Northwest	0	0

Table 18. Ranking of each exceedance day within each PWD category

Regime 1
(Bin 0: Calm Wind)

Rank	Date	Day	8-hr Ozone Conc. (ppb)
1	7/9/2002	Tuesday	107
2	7/22/2003	Tuesday	103
3	7/11/2002	Thursday	102
4	7/12/2002	Friday	102
5	8/10/2001	Friday	99
6	7/31/2000	Monday	95
7	7/10/2002	Wednesday	94
8	8/14/2000	Monday	92
9	7/24/2002	Wednesday	92
10	8/16/2003	Saturday	92
11	6/5/2002	Wednesday	91
12	8/1/2000	Tuesday	90
13	8/5/2000	Saturday	90
14	6/3/2002	Monday	90
15	6/18/2002	Tuesday	90
16	5/20/2000	Saturday	89
17	8/16/2000	Wednesday	89
18	8/19/2001	Sunday	89
19	6/4/2002	Tuesday	89
20	6/7/2002	Friday	89
21	5/11/2003	Sunday	89
22	5/27/2003	Tuesday	89
23	8/9/2000	Wednesday	88
24	8/11/2001	Saturday	88
25	7/21/2003	Monday	88
26	8/17/2003	Sunday	88
27	5/21/2000	Sunday	87
28	8/15/2000	Tuesday	87
29	8/17/2001	Friday	87
30	5/22/2003	Thursday	87
31	7/23/2003	Wednesday	87
32	7/30/2003	Wednesday	87
33	7/27/2004	Tuesday	87
34	5/13/2000	Saturday	86
35	5/19/2000	Friday	86
36	8/4/2000	Friday	86
37	8/24/2000	Thursday	86
38	7/12/2001	Thursday	86
39	6/17/2002	Monday	86
40	7/13/2002	Saturday	86
41	7/16/2003	Wednesday	86
42	4/26/2000	Wednesday	85
43	5/2/2000	Tuesday	85
44	8/15/2001	Wednesday	85
45	7/15/2002	Monday	85
46	5/27/2000	Saturday	84
47	7/29/2000	Saturday	84
48	8/25/2001	Saturday	84
49	5/24/2002	Friday	84
50	8/10/2002	Saturday	84
51	8/18/2003	Monday	84
52	7/26/2004	Monday	84
53	5/14/2000	Sunday	83

Regime 2
(Bin 3: Easterly Wind)

Rank	Date	Day	8-hr Ozone Conc. (ppb)
1	8/6/2001	Monday	93
2	6/6/2002	Thursday	92
3	7/30/2000	Sunday	91
4	6/5/2001	Tuesday	87
5	7/2/2001	Monday	86
6	8/16/2001	Thursday	85
7	8/5/2001	Sunday	83
8	5/3/2000	Wednesday	82
9	7/24/2004	Saturday	82
10	6/6/2000	Tuesday	81
11	7/23/2000	Sunday	81
12	8/18/2000	Friday	81
13	8/7/2001	Tuesday	81
14	8/12/2000	Saturday	80
15	8/24/2001	Friday	80
16	7/24/2003	Thursday	80
17	8/10/2004	Tuesday	80

Regime 3
(Bin 1,2,4,5,6,7,8: Others)

Rank	Date	Day	8-hr Ozone Conc. (ppb)
1	8/10/2000	Thursday	93
2	8/2/2000	Wednesday	90
3	8/9/2001	Thursday	88
4	6/15/2001	Friday	86
5	8/3/2000	Thursday	86
6	5/21/2003	Wednesday	85
7	6/30/2000	Friday	83
8	5/11/2000	Thursday	82
9	4/29/2000	Saturday	81
10	5/8/2001	Tuesday	80
11	9/9/2004	Thursday	80
12	8/7/2000	Monday	80

Rank	Date	Day	8-hr Ozone
54	5/23/2000	Tuesday	83
55	5/30/2000	Tuesday	83
56	6/6/2001	Wednesday	83
57	8/2/2001	Thursday	83
58	5/4/2002	Saturday	83
59	5/13/2002	Monday	83
60	8/8/2002	Thursday	83
61	5/20/2003	Tuesday	83
62	8/29/2003	Friday	83
63	5/15/2004	Saturday	83
64	4/25/2000	Tuesday	82
65	5/22/2000	Monday	82
66	6/29/2000	Thursday	82
67	8/18/2001	Saturday	82
68	5/11/2002	Saturday	82
69	6/23/2002	Sunday	82
70	6/28/2002	Friday	82
71	7/17/2002	Wednesday	82
72	7/14/2003	Monday	82
73	7/29/2003	Tuesday	82
74	8/12/2003	Tuesday	82
75	8/20/2003	Wednesday	82
76	4/13/2000	Thursday	81
77	4/20/2000	Thursday	81
78	4/23/2000	Sunday	81
79	4/24/2000	Monday	81
80	5/1/2000	Monday	81
81	5/24/2000	Wednesday	81
82	6/5/2000	Monday	81
83	7/25/2000	Tuesday	81
84	8/6/2000	Sunday	81
85	5/7/2001	Monday	81
86	6/16/2001	Saturday	81
87	6/22/2001	Friday	81
88	8/9/2002	Friday	81
89	8/16/2002	Friday	81
90	5/16/2003	Friday	81
91	7/31/2003	Thursday	81
92	6/11/2004	Friday	81
93	8/3/2004	Tuesday	81
94	5/12/2000	Friday	80
95	8/13/2000	Sunday	80
96	8/19/2000	Saturday	80
97	8/22/2000	Tuesday	80
98	4/14/2001	Saturday	80
99	5/10/2001	Thursday	80
100	5/11/2001	Friday	80
101	6/21/2001	Thursday	80
102	7/13/2001	Friday	80
103	8/23/2001	Thursday	80
104	5/3/2002	Friday	80
105	5/5/2002	Sunday	80
106	7/5/2002	Friday	80
107	6/29/2003	Sunday	80
108	7/25/2003	Friday	80
109	9/27/2003	Saturday	80
110	6/10/2004	Thursday	80
111	7/25/2004	Sunday	80
112	8/1/2004	Sunday	80

2.4 Recommendations

As seen in Table 8, there were 141 days between 2000 and 2004 that had at least one monitor along the MNA with an 8-hour ozone concentration equal to or greater than 80 ppb. The highest concentration for a given day is identified in Table 8 in bold text. Ozone concentrations that are less than the maximum daily ozone concentration but greater than 80 ppb are identified by shaded boxes. During the period of 2000-2004, there were six episodes of two days or greater that can be used for episode selection identified in Table 8. These six episodes are in accordance with the high ozone episode candidates from the identification of meteorological regimes. These six episodes include all days recording the highest ozone levels of each monitoring site over the 2000-2004 period. The six episodes are as follows:

- July 8-14, 2002
- August 5-11, 2001
- August 9-15, 2000
- July 30-August 5, 2000
- June 3-7, 2002
- July 21-23, 2003

3. Summary of the Six Highest Ranked 8-Hour Ozone Episodes

In order to select one episode day from each meteorological regime, the candidates for 8-hour high ozone episode days within each regime were ranked according to the magnitude of the peak ozone concentrations as shown in Table 18. Detailed analyses for the top six episodes are discussed in this section. Regarding the availability and quality of meteorological and air quality databases, the top-ranked episode days within each meteorological regime only have routine air quality and meteorological databases available for use in the modeling. There was no intensive field study conducted during the candidate days. Therefore, the availability and quality of meteorological and air quality databases do not favor any day among all the candidate days.

3.1 July 8-14, 2002

During the episode, the highest ozone concentration occurred in the MNA on July 9 where the Maryvale site recorded a value of 107 ppb. This is the highest ozone concentration recorded over the entire network during the 2000-2004 period and characterizes this episode. On July 9, eleven other monitors recorded 8-hour ozone concentrations over 80 ppb including Cave Creek (86 ppb), Central Phoenix (84 ppb), Glendale (94 ppb), North Phoenix (93 ppb), Palo Verde (80 ppb), Pinnacle Peak (83 ppb), South Phoenix (80 ppb), South Scottsdale (80 ppb), Super Site (93 ppb), Surprise (80 ppb), and West Phoenix (100 ppb). On July 9, six monitors, Central Phoenix (84 ppb), Palo Verde (80 ppb), Pinnacle Peak (83 ppb), South Phoenix (80 ppb), South Scottsdale (80 ppb), and Surprise (80 ppb), had 8-hour ozone concentrations equal to or greater than 80 ppb but less than 85 ppb.

There were five days in a row where at least one monitor recorded a value equal to or greater than 80 ppb. During this episode among all six candidates, the greatest number of sites (8 sites) recorded their highest 8-hour ozone concentration over the 2000-2004 period. On July 9, four monitoring sites recorded their highest ozone levels over the five-year period including Glendale (94 ppb), Maryvale (107 ppb), North Phoenix (93 ppb), and Super Site (93 ppb). On July 10, the West Chandler site recorded its highest ozone concentration of 94 ppb. On July 11, South Phoenix and West Phoenix recorded 8-hour ozone concentrations of 90 ppb and 102 ppb, respectively, which were their highest value over the five-year period. On July 12, the value of 102 ppb, which is the third highest ozone level among all sites and the highest ozone level for the site itself, was recorded at the Humboldt Mountain site.

On July 9, the daily maximum temperature reached 109 °F when the highest 8-hour ozone concentration occurred. During the whole episode, high daily maximum temperatures, greater than 105 °F, were recorded consecutively.

Backward trajectories were computed for the period. These composite backward trajectory analyses revealed that at lower levels up to 100 m, the origin of the air mass was from the northeast during the early day of the episode (July 9) and then shifted to clockwise during the following days of the episode (the southeast on July 10, the southwest on July 11, the west on July 12, and the southwest on July 13). The fact that most of the air mass originated within 100 miles, except on July 11, indicated that this episode was caused by local sources. Upper layers of flow were from the northwest, west, and southwest and mostly originated from the surface layer. The mid-level air mass was mixed up from ground level by the time it reached central Phoenix.

3.2 August 5-11, 2001

During this episode, there were six days in a row where at least one monitor exceeded 80 ppb. On the last day of the episode (August 11) the Tempe site had its highest 8-hour ozone concentration of 88 ppb over the five-year period. The North Phoenix site recorded the value of 93 ppb, which was the highest ozone level over the 2000-2004 period, on August 6. On August 10, Cave Creek and Pinnacle Peak observed their highest ozone exceedances, 99 ppb and 95 ppb, respectively. On August 6 and 10, eight monitors had recorded 8-hour ozone concentrations over 80 ppb and five of these sites including Cave Creek, Humboldt Mountain, North Phoenix, Pinnacle Peak, and Super Site observed ozone exceedances on both days. On August 10, the Cave Creek site recorded the annual maximum 8-hour ozone level of 99 ppb among all sites in 2001.

During the first three days, when ozone readings above 80 ppb were monitored, the daily maximum temperature reached 103 °F, 108 °F, and 104 °F, respectively. Despite cooler temperatures on August 9 and 10, ozone readings above 80 ppb, including the yearly maximum 8-hour ozone concentration in 2001 (99 ppb) on August 10, were monitored on these days. The daily maximum temperatures recorded on August 9 and 10 were 93 °F and 97 °F, respectively. Ozone readings were below 80 ppb on August 8 when the daily maximum temperature was 94 °F.

This episode was strongly influenced by air flow from western, southwestern, and southern Maricopa County, as well as northern Mexico, Yuma County, and Pima County. Only the flow

on August 9 was from the east. At ground level, the origin of the air mass was from long distance (further than 100 miles) during the early days of the episode and from short distance (within 100 miles) during the late part of the episode. There was no significant vertical movement of air mass among the various layers (surface, 100 m, and 800 m).

3.3 August 9-15, 2000

In this episode, there were six days in a row where at least one monitor exceeded 80 ppb. Only on August 11, was an 8-hour ozone reading lower than 80 ppb. On the second day of the episode (August 10) the Super Site recorded its highest ozone level of 93 ppb over the 2000-2004 period. The Mesa site observed the 8-hour ozone concentration of 89 ppb, which was its highest ozone value, on August 14. On August 10, ten monitors observed 8-hour ozone values over 80 ppb including Central Phoenix (88 ppb), Glendale (88 ppb), Lake Pleasant (89 ppb), Maryvale (91 ppb), North Phoenix (91 ppb), South Phoenix (81 ppb), South Scottsdale (87 ppb), Super Site (93 ppb), Tempe (84 ppb), and West Phoenix (87 ppb).

Daily maximum temperatures equal to or greater than 100 °F were recorded consecutively during the entire episode.

The flow from the various layers (surface, 100 m, and 800 m) came from various directions (east, southwest, and west) and various distances (local and transport). During the last four days of the episode, the flow at the ground level was mixed down from the mid-level air parcels around 50 m and the flow at the 100 m was mixed down from the upper layers. A similar pattern was observed at the 800 m on the last two days of the episode. However, from August 10 through 13, the flow at 800 m was mixed up from the ground level. On August 13 there was some indication that flow at the mid-level circulated vertically and horizontally.

3.4 July 30-August 5, 2000

This episode had the longest period of exceedance days when compared to the other episodes. There were seven days in a row where at least one monitor exceeded 80 ppb. On the first day of the episode (July 30) the Mount Ord site had its highest ozone level of 91 ppb over the five-year period. On the next day (July 31) two monitoring sites had recorded their highest ozone concentrations over the 2000-2004 period including Lake Pleasant (90 ppb) and Palo Verde (95 ppb). On July 31, the Palo Verde site recorded the annual maximum 8-hour ozone level of 95 ppb among all sites in 2000. Eight sites including Central Phoenix (81 ppb), Fountain Hills (81 ppb), Glendale (81 ppb), Humboldt Mountain (85 ppb), Lake Pleasant (82 ppb), Mount Ord (91 ppb), North Phoenix (84 ppb), and Rio Verde (80 ppb) recorded 8-hour ozone exceedances on July 30.

A stretch of 30 consecutive days of 100 °F or higher occurred from July 9 through August 7. The daily maximum temperature exceeded 105 °F during the whole episode except on July 31 (104 °F).

This episode was strongly influenced by flow from southwestern Maricopa County, as well as northern Mexico, southern California, Yuma County, and Pima County. On July 30, subsidence over Pinal County mixed surface and upper level layers down to the surface. At the same time similar subsidence occurred mixing mid-level and upper level layers down to the mid-level layer.

For the rest of the episode days, except on August 3, mid-level air mass was mixed down to ground level by the time it reached the MNA. The 800 m air parcels did not mix down to ground level but elevated from the ground level on August 2 and the mid-level on August 3. The origin of the air mass was from short distance (shorter than 100 miles) on July 31 and August 1, while for the rest of episode days, it came from long distance.

3.5 June 3-7, 2002

During this episode, all of the five days recorded at least one monitor exceeding 80 ppb. On June 6, the Surprise site monitored its highest ozone level of 83 ppb over the five-year period. On June 6, the episode maximum ozone concentration was monitored at the Fountain Hills site (92 ppb). On the last day (June 7), twelve monitors detected 8-hour ozone exceedances including Blue Point (88 ppb), Cave Creek (89 ppb), Falcon Field (86 ppb), Fountain Hills (86 ppb), Humboldt Mountain (89 ppb), Maryvale (80 ppb), North Phoenix (85 ppb), Pinnacle Peak (83 ppb), Rio Verde (88 ppb), South Phoenix (81 ppb), Tempe (83 ppb), and West Chandler (80 ppb).

The daily maximum temperature exceeded 100 °F on June 5 (103 °F), June 6 (107 °F), and June 7 (106 °F).

For the whole episode, the origin of the air mass at lower levels up to 100 m was transported from the southwest from a long distance (further than 100 miles). The flow from the various layers (surface, 100 m, and 800 m) were generally from the southwest. The flow at 800 m was elevated from the lower and mid-level layers. However, for June 3 through 7 except two days (June 5 and 7), the air mass on the ground level was mixed down from the mid- and upper layers.

3.6 July 21-23, 2003

The second highest 8-hour ozone concentration of 103 ppb over the 2000-2004 period was recorded at the Blue Point site on July 22. On the same day, fourteen monitoring sites exceeded 80 ppb of 8-hour ozone level including Blue Point (103 ppb), Cave Creek (81 ppb), Central Phoenix (83 ppb), Falcon Field (99 ppb), Fountain Hills (99 ppb), Humboldt Mountain (80 ppb), Maryvale (83 ppb), North Phoenix (93 ppb), Pinnacle Peak (93 ppb), Rio Verde (96 ppb), South Scottsdale (97 ppb), Super Site (82 ppb), Tempe (86 ppb), and West Phoenix (81 ppb).

There were three days in a row where at least one monitor exceeded 80 ppb. On July 22, six monitoring sites observed their highest ozone levels over the five year period including Blue Point (103 ppb), Falcon Field (99 ppb), Fountain Hills (99 ppb), North Phoenix (93 ppb), Rio Verde (96 ppb), and South Scottsdale (97 ppb).

Daily maximum temperatures exceeding 100 °F were recorded for 33 consecutive days from June 25 through July 27. All of the three days in this episode had daily maximum temperatures exceeding 105 °F. On July 22, when the annual highest ozone reading of 103 ppb in 2003 occurred, the maximum temperature reached 107 °F.

This episode had the similar trajectory pattern to the previous episode in which the air mass at various layers (surface, 100 m, and 800 m) was transported from the southwest for a long

distance (further than 100 miles). The mid-level air mass was mixed down to ground level for the first two days of this episode, but flow at 800 m did not mix down to the ground.

4. Strengths and Limitations of Recommended 8-Hour Ozone Modeling Episodes

Based on EPA's episode selection criteria, the main advantages and disadvantages for the six highest priority episodes were identified.

4.1 July 8-14, 2002

Advantages:

- Contains the highest ozone concentration (107 ppb at the Maryvale site) over the five-year period among all of the monitoring sites as demonstrated in Table 8.

- Contains the third highest ozone concentration (102 ppb at the West Phoenix site and the Humboldt Mountain site) over the five-year period among all of the monitoring sites.

- As shown in Table 19, eight monitors recorded their fourth highest values for 2002 during this period including Blue Point (86 ppb on July 13), Cave Creek (86 ppb on July 9), Glendale (83 ppb on July 10), Maryvale (84 ppb on July 12), Pinnacle Peak (84 ppb on July 11), South Scottsdale (79 ppb on July 11), Super Site (79 ppb on July 10), and West Phoenix (84 ppb on July 12).

- Table 20 shows that the average 8-hour ozone concentration over the episode at the West Phoenix site (78 ppb) is very close to the average of the fourth highest concentrations for 2000-2002 (80 ppb). This is also the similar case for Falcon Field, Mesa, Super Site, and West Chandler, although the episode average for Central Phoenix and Maryvale are slightly higher than the average of the fourth highest concentrations for 2000-2002.

- The widespread network exceedances on three days in this episode provide a basis for the 8-hour ozone attainment test at all of the monitoring sites. This starts from July 9, when 12 out of the 24 monitors exceeded 80 ppb. On July 11, 14 monitors exceeded 80 ppb. Finally, the widest spread of network exceedances for 2000-2004 occurred on July 12, when 17 monitors were equal to or greater than 80 ppb.

- The Pinnacle Peak site had the fourth highest concentration for 2002, 84 ppb on July 11, which contributes significantly to the average of the fourth highest concentrations for the 2000-2002 period.

- Good case study to evaluate the local production of ozone.

Disadvantages:

- Five monitoring sites including Dysart, Emergency Management, Lake Pleasant, Mount Ord, and West Chandler (old) did not operate during this episode.

4.2 August 5-11, 2001

Advantages:

- The highest 8-hour ozone concentration recorded during the 1999-2001 period occurred at the Cave Creek site on August 10 with a concentration of 99 ppb.
- Six days out of the seven episode days had high 8-hour ozone concentrations equal to or greater than 80 ppb.
- On August 6 and 10, 8 out of 24 monitors exceeded 80 ppb. On August 11, 7 monitors were equal to or greater than 80 ppb.
- During this episode, four monitoring sites including Fountain Hills, Pinnacle Peak, Rio Verde, and South Scottsdale had the fourth highest concentration for 2001, 83 ppb on August 10, 85 ppb on August 6, 83 ppb on August 9, and 79 ppb on August 6, respectively, which contributes significantly to the average of the fourth highest concentrations for the 1999-2001, 2000-2002, and 2001-2003 periods.
- Good case study to evaluate the local production of ozone and transport of ozone from northern Mexico (August 5 and 6).

Disadvantages:

- The Cave Creek site does not have an average value of the fourth highest concentrations for 1999-2001 since there is no monitoring data recorded before 2001.
- Table 21 shows that the averages over the episode at the South Phoenix site (71 ppb) and the South Scottsdale site (74 ppb) are close to the averages of the fourth highest concentrations for 1999-2001 (74 ppb and 77 ppb, respectively). However, at other sites the episode average is far below the average of the fourth highest concentrations.
- Four monitoring sites including Dysart, Emergency Management, Lake Pleasant, and West Chandler (old) did not operate during this episode.

4.3 August 9-15, 2000

Advantages:

- Six days out of the seven episode days had high 8-hour ozone concentrations equal to or greater than 80 ppb.
- Concentrations at the Blue Point site were 90 ppb and 87 ppb for the last two days of the episode (June 14 and 15, respectively) which contributes significantly to the average of the fourth highest concentrations for 1998-2000, 1999-2001, and 2000-2002.
- Good case study to evaluate the local production of ozone and transport of ozone from northern Mexico (August 15) and southeastern Arizona (August 12).

Disadvantages:

- Table 22 shows that the average over the episode at the South Scottsdale site (72 ppb) is close to the average of the fourth highest concentrations for 1998-2000 (76 ppb). However, at other sites the episode average is far below the average of the fourth highest concentrations.

- Three monitoring sites including Cave Creek, Dysart, and Surprise did not operate during this episode.

- During this episode, the 4th highest ozone concentrations occurred at the least amount of sites, 3 sites including Blue Point (87 ppb on August 15), Rio Verde (86 ppb on August 9), and West Chandler (77 ppb on August 10), compared with other candidate episodes.

4.4 July 30-August 5, 2000

Advantages:

- All seven days consecutively recorded high 8-hour ozone concentrations equal to or greater than 80 ppb, which was the longest period of exceedance days among all candidate episodes.

- During this episode, four monitors, Fountain Hills, Mount Ord, Pinnacle Peak, and Tempe, had the fourth highest concentration for 2000, 85 ppb on August 1, 90 ppb on August 5, 86 ppb on July 31, and 78 ppb on July 30, respectively, which contributes significantly to the average of the fourth highest concentrations for the 1998-2000, 1999-2001, and 2000-2002 periods.

- Good case study to evaluate the local production of ozone (July 31 and August 1) and transport of ozone from northern Mexico.

Disadvantages:

- Table 23 shows that the average over the episode at the Mount Ord site (87 ppb) is close to the average of the fourth highest concentrations for 1998-2000 (88 ppb). However, the episode averages at other sites are far below the average of the fourth highest concentrations.

- Five monitoring sites including Cave Creek, Dysart, Emergency Management, Surprise, and West Chandler (old) did not operate during this episode.

4.5 June 3-7, 2002

Advantages:

- During this episode, the 4th highest ozone concentrations occurred at the largest amount of sites, 9 sites, among all six candidate episodes.

- Four sites including Central Phoenix, Rio Verde, South Phoenix-2, and Tempe have the 4th highest ozone concentration on June 5. It is the greatest number of sites having their 4th highest ozone level occurring on one day over the five-year period.

- Contains the 4th highest 8-hour ozone concentration of 90 ppb for Humboldt Mountain on June 3 which contributes significantly to the averages of the fourth highest concentrations for 2000-2002, 2001-2003, and 2002-2004 and endangers attainment for the 8-hour ozone nonattainment area.

- Table 24 shows that the average 8-hour ozone concentration over the episode at the Falcon Field site (79 ppb) is very close to the average of the fourth highest concentrations for 2000-2002 (80 ppb). This is also the similar case for Blue Point, Central Phoenix, Maryvale, Palo Verde, Pinnacle Peak, Rio Verde, South Phoenix, Tempe, and West Chandler, although the episode averages for Fountain Hills and Humboldt Mountain are slightly higher than the averages of the fourth highest concentrations for 2000-2002.

- During this episode, nine monitors had the fourth highest concentration for 2002 including Central Phoenix (76 ppb on June 5), Falcon Field (84 ppb on June 6), Fountain Hills (86 ppb on June 4), Humboldt Mountain (90 ppb on June 3), Mesa (72 ppb on June 6), North Phoenix (85 ppb on June 6), Rio Verde (85 ppb on June 5), South Phoenix (81 ppb on June 5), and Tempe (80 ppb on June 5). These values contribute significantly to the averages of the fourth highest concentrations for the 2000-2002, 2001-2003, and 2002-2004 periods.

- Good case study to evaluate the transport of ozone from northern Mexico.

Disadvantages:

- Five monitoring sites including Dysart, Emergency Management, Lake Pleasant, Mount Ord, and West Chandler (old) did not operate during this episode.

4.6 July 21-23, 2003

Advantages:

- Table 25 shows that the average 8-hour ozone concentration over the episode at the Pinnacle Peak site (84 ppb) is in accordance with the average of the fourth highest concentrations for 2001-2003 (84 ppb). Similar cases occur at South Phoenix, Super Site, and Tempe, although the episode averages for Blue Point, Central Phoenix, Falcon Field, Fountain Hills, Rio Verde, and South Scoottsdale are slightly higher than the averages of the fourth highest concentrations for 2001-2003.

- During this episode, five monitors, Fountain Hills, Maryvale, Rio Verde, South Scottsdale, and West Chandler, had the fourth highest concentration for 2003, 83 ppb on July 23, 83 ppb on July 22, 83 ppb on July 23, 79 ppb on July 23, and 78 ppb on July 22, respectively, which contributes significantly to the average of the fourth highest concentrations for the 2001-2003 and 2002-2004 periods.

- Good case study to evaluate the transport of ozone from northern Mexico.

Disadvantages:

- Three-day episode is a short duration.
- Six monitoring sites including Dysart, Emergency Management, Lake Pleasant, Mesa, Mount Ord, and West Chandler (old) did not operate during this episode.

Table 19. Number of sites having the 4th highest 8-hour ozone concentration by date

Year	Date	Number of Sites	Sites	Episode
2000	4/23/2000	1	ME	
	4/29/2000	1	WC (old)	
	5/2/2000	1	HM	
	5/13/2000	2	CP, SUPR	
	5/19/2000	1	WP	
	5/20/2000	2	GL, MV	
	5/21/2000	1	SP	
	6/5/2000	1	PALV	
	6/29/2000	1	LP	
	7/30/2000	1	TEMP	July 30-August 5, 2000
	7/31/2000	1	PP	
	8/1/2000	1	FH	
	8/5/2000	1	MORD	
	8/9/2000	1	RV	August 9-15, 2000
	8/10/2000	1	WC	
	8/15/2000	1	BP	
	8/16/2000	1	FF	
	8/19/2000	2	EM, SS	
	8/24/2000	1	NP	
2001	5/8/2001	3	MV, PALV, SU	
	5/12/2001	1	EM	
	6/5/2001	1	LP	
	6/16/2001	2	CP, WC	
	7/2/2001	1	NP	
	7/12/2001	2	SUPR, WP	
	7/13/2001	1	MORD	
	8/1/2001	1	SP	
	8/2/2001	1	GL	
	8/6/2001	2	PP, SS	August 5-11, 2001
	8/9/2001	1	RV	
	8/10/2001	1	FH	
	8/16/2001	2	HM, ME	
	8/17/2001	2	CC, FF	
	8/18/2001	1	BP	
	8/19/2001	1	TEMP	
2002	5/13/2002	1	SU	
	6/3/2002	1	HM	June 3-7, 2002
	6/4/2002	1	FH	
	6/5/2002	4	CP, RV, SP, TEMP	
	6/6/2002	3	FF, ME, NP	
	6/18/2002	1	PALV	
	7/9/2002	1	CC	July 8-14, 2002
	7/10/2002	2	GL, SUPR	
	7/11/2002	2	PP, SS	
	7/12/2002	2	MV, WP	
	7/13/2002	1	BP	
	8/8/2002	1	WC	
2003	5/10/2003	1	SU	
	5/21/2003	3	GL, SUPR, WP	
	5/27/2003	2	BP, SP	
	6/28/2003	1	PALV	
	7/16/2003	1	NP	
	7/22/2003	2	MV, WC	July 21-23, 2003
	7/23/2003	3	FH, RV, SS	
	7/30/2003	3	CC, HM, PP	
	8/12/2003	2	FF, TEMP	
	8/17/2003	1	CP	

Year	Date	Number of Sites	Sites	Episode
2004	4/24/2004	1	TEMP	
	4/25/2004	2	SP, WC	
	4/28/2004	1	PALV	
	5/12/2004	1	HM	
	5/15/2004	2	BP, FF	
	6/11/2004	1	CC	
	6/12/2004	1	RV	
	7/24/2004	2	CP, SS	
	7/26/2004	1	PP	
	7/27/2004	2	GL, WP	
	8/1/2004	1	NP	
	8/3/2004	1	FH	
	8/10/2004	1	SUPR	

Table 20. Episode (July 8-14, 2002) average maximum 8-hour ozone concentrations versus average of fourth highest concentration from 2000-2002.

Monitor	Episode Average Concentration (ppb)	Average of Fourth Highest Concentration from 2000-2002 (ppb)	Deviation
Blue Point (BP)	77	84	-7
Cave Creek (CC)	N/A	N/A	N/A
Central Phoenix (CP)	75.83	75	+0.83
Emergency Management (EM)	N/A	N/A	N/A
Falcon Field (FF)	77.43	80	-2.57
Fountain Hills (FH)	76	84	-8
Glendale (GL)	72.43	80	-7.57
Humboldt Mountain (HM)	79.14	85	-5.86
Lake Pleasant (LP)	N/A	N/A	N/A
Maryvale (MV)	80.14	79	+1.14
Mesa (ME)	70.4	73	-2.6
Mount Ord (MORD)	N/A	N/A	N/A
North Phoenix (NP)	77.14	85	-7.86
Palo Verde (PALV)	67.29	77	-9.71
Pinnacle Peak (PP)	76.14	85	-8.86
Rio Verde (RV)	71	84	-13
South Phoenix (SP)	75.29	80	-4.71
South Scottsdale (SS)	75	79	-4
Super Site (SUPR)	73.86	77	-3.14
Surprise (SU)	65.33	N/A	N/A
Tempe (TEMP)	75.14	79	-3.86
West Chandler (WC (old))	N/A	N/A	N/A
West Chandler (WC)	76.43	79	-2.57
West Phoenix (WP)	78.14	80	-1.86

Table 21. Episode (August 5-11, 2001) average maximum 8-hour ozone concentrations versus average of fourth highest concentration from 1999-2001.

Monitor	Episode Average Concentration (ppb)	Average of Fourth Highest Concentration from 1999-2001 (ppb)	Deviation
Blue Point (BP)	70.57	84	-13.43
Cave Creek (CC)	80.5	N/A	N/A
Central Phoenix (CP)	65.14	76	-10.86
Emergency Management (EM)	N/A	71	N/A
Falcon Field (FF)	73.29	79	-5.71
Fountain Hills (FH)	75.14	84	-8.86
Glendale (GL)	67.71	79	-11.29
Humboldt Mountain (HM)	76.14	84	-7.86
Lake Pleasant (LP)	N/A	78	N/A
Maryvale (MV)	66	77	-11
Mesa (ME)	67.71	77	-9.29
Mount Ord (MORD)	72.5	84	-11.5
North Phoenix (NP)	76.43	85	-8.57
Palo Verde (PALV)	65.29	78	-12.71
Pinnacle Peak (PP)	79.14	85	-5.86
Rio Verde (RV)	72.57	85	-12.43
South Phoenix (SP)	70.86	74	-3.14
South Scottsdale (SS)	73.71	77	-3.29
Super Site (SUPR)	72	67	+5
Surprise (SU)	N/A	N/A	N/A
Tempe (TEMP)	73.43	N/A	N/A
West Chandler (WC (old))	N/A	N/A	N/A
West Chandler (WC)	70.14	N/A	N/A
West Phoenix (WP)	67	82	-15

Table 22. Episode (August 9-15, 2000) average maximum 8-hour ozone concentrations versus average of fourth highest concentration from 1998-2000.

Monitor	Episode Average Concentration (ppb)	Average of Fourth Highest Concentration from 1998-2000 (ppb)	Deviation
Blue Point (BP)	78.71	87	-8.29
Cave Creek (CC)	N/A	N/A	N/A
Central Phoenix (CP)	70.57	77	-6.43
Emergency Management (EM)	64.29	77	-12.71
Falcon Field (FF)	69.86	80	-10.14
Fountain Hills (FH)	75.29	85	-9.71
Glendale (GL)	66.71	77	-10.29
Humboldt Mountain (HM)	71.29	86	-14.71
Lake Pleasant (LP)	73.57	81	-7.43
Maryvale (MV)	73	82	-9
Mesa (ME)	68.8	79	-10.2
Mount Ord (MORD)	74.33	88	-13.67
North Phoenix (NP)	75.14	86	-10.86
Palo Verde (PALV)	63.14	80	-16.86
Pinnacle Peak (PP)	77.67	85	-7.33
Rio Verde (RV)	77	83	-6
South Phoenix (SP)	72.71	N/A	N/A
South Scottsdale (SS)	72.43	76	-3.57
Super Site (SUPR)	72.14	67	+5.14
Surprise (SU)	N/A	N/A	N/A
Tempe (TEMP)	72.71	N/A	N/A
West Chandler (WC (old))	N/A	72	N/A
West Chandler (WC)	72.86	N/A	N/A
West Phoenix (WP)	70.29	86	-15.71

Table 23. Episode (July 30-August 5, 2000) average maximum 8-hour ozone concentrations versus average of fourth highest concentration from 1998-2000.

Monitor	Episode Average Concentration (ppb)	Average of Fourth Highest Concentration from 1998-2000 (ppb)	Deviation
Blue Point (BP)	82.43	87	-4.57
Cave Creek (CC)	N/A	N/A	N/A
Central Phoenix (CP)	67.57	77	-9.43
Emergency Management (EM)	N/A	77	N/A
Falcon Field (FF)	69.14	80	-10.86
Fountain Hills (FH)	79.86	85	-5.14
Glendale (GL)	62	77	-15
Humboldt Mountain (HM)	76.33	86	-9.67
Lake Pleasant (LP)	72.71	81	-8.29
Maryvale (MV)	66.43	82	-15.57
Mesa (ME)	58.83	79	-20.17
Mount Ord (MORD)	87.29	88	-0.71
North Phoenix (NP)	71.86	86	-14.14
Palo Verde (PALV)	66.43	80	-13.57
Pinnacle Peak (PP)	77.57	85	-7.43
Rio Verde (RV)	81.43	83	-1.57
South Phoenix (SP)	70	N/A	N/A
South Scottsdale (SS)	69.8	76	-6.2
Super Site (SUPR)	63.5	67	-3.5
Surprise (SU)	N/A	N/A	N/A
Tempe (TEMP)	68.71	N/A	N/A
West Chandler (WC (old))	N/A	72	N/A
West Chandler (WC)	62.8	N/A	N/A
West Phoenix (WP)	64.57	86	-21.43

Table 24. Episode (June 3-7, 2002) average maximum 8-hour ozone concentrations versus average of fourth highest concentration from 2000-2002.

Monitor	Episode Average Concentration (ppb)	Average of Fourth Highest Concentration from 2000-2002 (ppb)	Deviation
Blue Point (BP)	81.6	84	-2.4
Cave Creek (CC)	84.4	N/A	N/A
Central Phoenix (CP)	72.6	75	-2.4
Emergency Management (EM)	N/A	N/A	N/A
Falcon Field (FF)	79.4	80	-0.6
Fountain Hills (FH)	84.6	84	+0.6
Glendale (GL)	71.6	80	-8.4
Humboldt Mountain (HM)	89.8	85	+4.8
Lake Pleasant (LP)	N/A	N/A	N/A
Maryvale (MV)	77.4	79	-1.6
Mesa (ME)	65.4	73	-7.6
Mount Ord (MORD)	N/A	N/A	N/A
North Phoenix (NP)	79.6	85	-5.4
Palo Verde (PALV)	74.4	77	-2.6
Pinnacle Peak (PP)	81.2	85	-3.8
Rio Verde (RV)	82.8	84	-1.2
South Phoenix (SP)	76.4	80	-3.6
South Scottsdale (SS)	73.2	79	-5.8
Super Site (SUPR)	71	77	-6
Surprise (SU)	73	N/A	N/A
Tempe (TEMP)	77.2	79	-1.8
West Chandler (WC (old))	N/A	N/A	N/A
West Chandler (WC)	76.6	79	-2.4
West Phoenix (WP)	71	80	-9

Table 25. Episode (July 21-23, 2003) average maximum 8-hour ozone concentrations versus average of fourth highest concentration from 2001-2003.

Monitor	Episode Average Concentration (ppb)	Average of Fourth Highest Concentration from 2001-2003 (ppb)	Deviation
Blue Point (BP)	92.67	84	+8.67
Cave Creek (CC)	76.67	84	-7.33
Central Phoenix (CP)	76.67	76	+0.67
Emergency Management (EM)	N/A	N/A	N/A
Falcon Field (FF)	85.67	81	+4.67
Fountain Hills (FH)	88.33	84	+4.33
Glendale (GL)	63.33	82	-18.67
Humboldt Mountain (HM)	77	87	-10
Lake Pleasant (LP)	N/A	N/A	N/A
Maryvale (MV)	76	80	-4
Mesa (ME)	N/A	N/A	N/A
Mount Ord (MORD)	N/A	N/A	N/A
North Phoenix (NP)	82	85	-3
Palo Verde (PALV)	63	75	-12
Pinnacle Peak (PP)	84	84	0
Rio Verde (RV)	88	83	+5
South Phoenix (SP)	73.67	77	-3.33
South Scottsdale (SS)	88	79	+9
Super Site (SUPR)	74	76	-2
Surprise (SU)	N/A	72	N/A
Tempe (TEMP)	79.33	79	+0.33
West Chandler (WC (old))	N/A	N/A	N/A
West Chandler (WC)	74.33	79	-4.67
West Phoenix (WP)	73	78	-5

5. Summary of the Conceptual Model of 8-Hour Ozone Episodes for the Maricopa Nonattainment Area

Major features of the conceptual model are as follows. High ozone concentrations generally occur in the MNA when the weather is hot, covered by clouds, and with stagnant to light winds blowing from east and southeast. Most high ozone days occur when a low sea level pressure system resides over southwestern Arizona and a high sea level pressure system occurs over northeastern Arizona. Also more than 90 % of high-ozone events occur when the daily maximum temperatures are above 90 °F. Ozone episode days occur when the daily maximum temperatures above 100 °F persist for several days in a row. Dew points on high ozone days range from 17 °F to 73 °F. However, high ozone levels occur when dew point temperatures are higher than the average. Relatively high dew point temperatures are probably necessary for efficient photochemistry production. The highest ozone levels usually occur from May through September. A detailed conceptual description for each episode is provided in Appendix G.

6. Recommended 8-Hour Ozone Modeling Episodes

The six episodes were reviewed in detail to select three modeling episodes representing each meteorological regime, which are Regime 1 (calm wind), Regime 2 (easterly wind), and Regime 3 (others). These episodes were evaluated according to the five selection criteria such as 'Maximum number of sites exceeding 85 ppb in one day', 'Number of sites exceeding 85 ppb for whole episode days', 'Number of sites having the 4th highest 8-hour ozone', 'How close to the 4th highest 8-hour ozone (average deviation)', and 'Episode maximum 8-hour ozone concentration'. A simple scoring system was utilized for the evaluation; the scores range from 0 to 5, with 0, the lowest score, and 5, the highest. Except 'How close to the 4th highest 8-hour ozone (average deviation)', which assigns the higher score to the episode having the lower absolute values, all criteria assign the higher score to the episode having the higher values. Table 26 summarizes the ozone episode selection scheme.

The three modeling episodes selected are July 8-14, 2002 (Regime 1) having the highest score (22), June 3-7, 2002 (Regime 2) having the third highest score (13), and August 5-11, 2001 (Regimes 2 and 3) having the fourth highest score (11). The July 21-23, 2003 episode showing the second highest score (18) was not selected because the July 8-14, 2002 episode having the highest score already represented Regime 1.

Meteorological inputs from the MM5 model will be produced on the 36/12/4 km grid for the following periods:

- 1200 UTC (0500 MST) on August 3 through 1200 UTC (0500 MST) on August 13, 2001;
- 1200 UTC (0500 MST) on June 1 through 1200 UTC (0500 MST) on June 9, 2002; and
- 1200 UTC (0500 MST) on July 6 through 1200 UTC (0500 MST) on July 16, 2002.

The CAMx model will be run at 12 km resolution with 4 km nest grid for the following periods:

- 0000 MST on August 5 through 2400 MST on August 11, 2001 (i.e., August 5-11, 2001);

- 0000 MST on June 3 through 2400 MST on June 7, 2002 (i.e., June 3-7, 2002); and
- 0000 MST on July 8 through 2400 MST on July 14, 2002 (i.e., July 8-14, 2002).

Table 26. Summary of modeling episode selection

Criteria	Episode 1	Episode 2	Episode 3	Episode 4	Episode 5	Episode 6
Number of days	7 days (July 8-14, 2002)	7 days (August 5-11, 2001)	7 days (August 9-15, 2000)	7 days (July 30-August 5, 2000)	5 days (June 3-7, 2002)	3 days (July 21-23, 2003)
Reflecting meteorological condition	Regime1	Regime 2, Regime 3	Regime 3	Regime 2, Regime 3	Regime 2	Regime 1
Local or Transport?	Local	Local & Transport	Local & Transport	Local & Transport	Transport	Transport
Include weekend days exceeding 85 ppb?	Yes (86 ppb on July 13 Saturday)	Yes (88 ppb on August 11 Saturday)	No	Yes (91 ppb on July 30 Sunday & 90 ppb on August 5 Saturday)	No	No
Maximum number of sites exceeding 85 ppb in one day*	9 sites (1st = 5)	5 sites (5th = 1)	8 sites (2nd = 4)	4 sites (6th = 0)	7 sites (4th = 2)	8 sites (2nd = 4)
Number of sites exceeding 85 ppb for whole episode days*	17 sites (1st = 5)	11 sites (3rd = 3)	14 sites (2nd = 4)	8 sites (4th = 2)	8 sites (4th = 2)	8 sites (4th = 2)
Number of sites having the 4th highest 8-hour ozone*	8 sites (2nd = 4)	4 sites (4th = 2)	3 sites (6th = 0)	4 sites (4th = 2)	9 sites (1st = 5)	5 sites (3rd = 3)
How close to the 4th highest 8-hour ozone (average deviation)*	-5.07 (3rd = 3)	-8.58 (4th = 2)	-9.32 (5th = 1)	-9.84 (6th = 0)	-3.29 (2nd = 4)	-2.07 (1st = 5)
Episode maximum 8-hour ozone concentration*	107 ppb (1st = 5)	99 ppb (3rd = 3)	93 ppb (5th = 1)	95 ppb (4th = 2)	92 ppb (6th = 0)	103 ppb (2nd = 4)
Total Episode score	22 (1st)	11 (4th)	10 (5th)	6 (6th)	13 (3rd)	18 (2nd)
Final selection	**Yes** (The best episode and it represents Regime 1)	**Yes** (Fourth best episode and it represents Regime 3)	No	No	**Yes** (Third best episode and it represents Regime 2)	No (Second best episode but it represents Regime 1 as the episode 1)

* Five selection criteria used to evaluate episodes.

REFERENCES

EPA, 1991. "Guideline for Regulatory Application of the Urban Airshed Model (UAM)". U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, N.C.

EPA, 2005. "Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS". Draft final (February 2005), U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, N.C.

GPO, 1997. "Code of Federal Regulations (CFR)-Title 40-Protection of Environment, Part 50 – National Primary and Secondary Ambient Air Quality Standards". Office of the Federal Register, 62 FR 38895.

ATTACHMENT II

Review of Eight-Hour Ozone Episodes

APPENDIX A

40 CFR-Appendix I to Part 50
"Interpretation of the 8-Hour Primary and Secondary National Ambient Air Quality Standards for Ozone"

1. ***General.***

This appendix explains the data handling conventions and computations necessary for determining whether the national 8-hour primary and secondary ambient air quality standards for ozone specified in §50.10 are met at an ambient ozone air quality monitoring site. Ozone is measured in the ambient air by a reference method based on appendix D of this part. Data reporting, data handling, and computation procedures to be used in making comparisons between reported ozone concentrations and the level of the ozone standard are specified in the following sections. Whether to exclude, retain, or make adjustments to the data affected by stratospheric ozone intrusion or other natural events is subject to the approval of the appropriate Regional Administrator.

2. ***Primary and Secondary Ambient Air Quality Standards for Ozone.***

2.1 ***Data Reporting and Handling Conventions.***

2.1.1 ***Computing 8-hour averages.*** Hourly average concentrations shall be reported in parts per million (ppm) to the third decimal place, with additional digits to the right being truncated. Running 8-hour averages shall be computed from the hourly ozone concentration data for each hour of the year and the result shall be stored in the first, or start, hour of the 8-hour period. An 8-hour average shall be considered valid if at least 75% of the hourly averages for the 8-hour period are available. In the event that only 6 (or 7) hourly averages are available, the 8-hour average shall be computed on the basis of the hours available using 6 (or 7) as the divisor. (8-hour periods with three or more missing hours shall not be ignored if, after substituting one-half the minimum detectable limit for the missing hourly concentrations, the 8-hour average concentration is greater than the level of the standard.) The computed 8-hour average ozone concentrations shall be reported to three decimal places (the insignificant digits to the right of the third decimal place are truncated, consistent with the data handling procedures for the reported data.)

2.1.2 ***Daily maximum 8-hour average concentrations.*** (a) There are 24 possible running 8-hour average ozone concentrations for each calendar day during the ozone monitoring season. (Ozone monitoring seasons vary by geographic location as designated in part 58, appendix D to this chapter.) The daily maximum 8-hour concentration for a given calendar day is the highest of the 24 possible 8-hour average concentrations computed for that day. This process is repeated, yielding a daily maximum 8-hour average ozone concentration for each calendar day with ambient ozone monitoring data. Because the 8-hour averages are recorded in the start hour, the daily maximum 8-hour concentrations from two consecutive days may have some hourly concentrations in common. Generally, overlapping daily maximum 8-hour averages are not likely, except in those non-urban monitoring locations with less pronounced diurnal variation in hourly concentrations.

(b) An ozone monitoring day shall be counted as a valid day if valid 8-hour averages are available for at least 75% of possible hours in the day (i.e., at least 18 of the 24 averages). In the event that less than 75% of the 8-hour averages are available, a day shall also be

counted as a valid day if the daily maximum 8-hour average concentration for that day is greater than the level of the ambient standard.

2.2 ***Primary and Secondary Standard-related Summary Statistic.*** The standard-related summary statistic is the annual fourth-highest daily maximum 8-hour ozone concentration, expressed in parts per million, averaged over three years. The 3-year average shall be computed using the three most recent, consecutive calendar years of monitoring data meeting the data completeness requirements described in this appendix. The computed 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentrations shall be expressed to three decimal places (the remaining digits to the right are truncated.)

2.3 ***Comparisons with the Primary and Secondary Ozone Standards.*** (a) The primary and secondary ozone ambient air quality standards are met at an ambient air quality monitoring site when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.08 ppm. The number of significant figures in the level of the standard dictates the rounding convention for comparing the computed 3-year average annual fourth-highest daily maximum 8-hour average ozone concentration with the level of the standard. The third decimal place of the computed value is rounded, with values equal to or greater than 5 rounding up. Thus, a computed 3-year average ozone concentration of 0.085 ppm is the smallest value that is greater than 0.08 ppm.

(b) This comparison shall be based on three consecutive, complete calendar years of air quality monitoring data. This requirement is met for the three year period at a monitoring site if daily maximum 8-hour average concentrations are available for at least 90%, on average, of the days during the designated ozone monitoring season, with a minimum data completeness in any one year of at least 75% of the designated sampling days. When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard. Missing days assumed less than the level of the standard are counted for the purpose of meeting the data completeness requirement, subject to the approval of the appropriate Regional Administrator.

(c) Years with concentrations greater than the level of the standard shall not be ignored on the ground that they have less than complete data. Thus, in computing the 3-year average fourth maximum concentration, calendar years with less than 75% data completeness shall be included in the computation if the average annual fourth maximum 8-hour concentration is greater than the level of the standard.

(d) Comparisons with the primary and secondary ozone standards are demonstrated by examples 1 and 2 in paragraphs (d)(1) and (d) (2) respectively as follows:

(1) As shown in example 1, the primary and secondary standards are met at this monitoring site because the 3-year average of the annual fourth-highest daily maximum

8-hour average ozone concentrations (i.e., 0.084 ppm) is less than or equal to 0.08 ppm. The data completeness requirement is also met because the average percent of days with valid ambient monitoring data is greater than 90%, and no single year has less than 75% data completeness.

Example 1. Ambient monitoring site attaining the primary and secondary ozone standards

Year	Percent Valid Days	1st Highest Daily Max 8-hour Conc. (ppm)	2nd Highest Daily Max 8-hour Conc. (ppm)	3rd Highest Daily Max 8-hour Conc. (ppm)	4th Highest Daily Max 8-hour Conc. (ppm)	5th Highest Daily Max 8-hour Conc. (ppm)
1993	100%	0.092	0.091	0.090	0.088	0.085
1994	96%	0.090	0.089	0.086	0.084	0.080
1995	98%	0.087	0.085	0.083	0.080	0.075
Average	98%					

(2) As shown in example 2, the primary and secondary standards are not met at this monitoring site because the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations (i.e., 0.093 ppm) is greater than 0.08 ppm. Note that the ozone concentration data for 1994 is used in these computations, even though the data capture is less than 75%, because the average fourth-highest daily maximum 8-hour average concentration is greater than 0.08 ppm.

Example 2. Ambient Monitoring Site Failing to Meet the Primary and Secondary Ozone Standards

Year	Percent Valid Days	1st Highest Daily Max 8-hour Conc. (ppm)	2nd Highest Daily Max 8-hour Conc. (ppm)	3rd Highest Daily Max 8-hour Conc. (ppm)	4th Highest Daily Max 8-hour Conc. (ppm)	5th Highest Daily Max 8-hour Conc. (ppm)
1993	96%	0.105	0.103	0.103	0.102	0.102
1994	74%	0.090	0.085	0.082	0.080	0.078
1995	98%	0.103	0.101	0.101	0.097	0.095
Average	89%					

3. Design Values for Primary and Secondary Ambient Air Quality Standards for Ozone. The air quality design value at a monitoring site is defined as that concentration that when reduced to the level of the standard ensures that the site meets the standard. For a concentration-based standard, the air quality design value is simply the standard-related test statistic. Thus, for the primary and secondary ozone standards, the 3-year average annual fourth-highest daily maximum 8-hour average ozone concentration is also the air quality design value for the site.

APPENDIX B

Highest Ozone Concentrations and Data Availability

Table B.1. Highest ozone concentrations at the Apache Junction site (AIRS Code: 04-021-3001)

Year	1st Max (ppb)	2nd Max (ppb)	3rd Max (ppb)	4th Max (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
2002	81 (6/4/2002)	81 (7/12/2002)	80 (7/13/2002)	79 (6/5/2002)	343	365	93		
2003	90 (7/22/2003)	74 (6/29/2003)	72 (7/21/2003)	72 (7/23/2003)	365	365	100		
2004	70 (5/15/2004)	70 (6/11/2004)	70 (8/3/2004)	69 (5/13/2004)	357	365	97	73	97

Table B.2. Highest ozone concentrations at the Blue Point site (AIRS Code: 04-013-9702)

Year	1st Max (ppb)	2nd Max (ppb)	3rd Max (ppb)	4th Max (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1997	84 (6/16/1997)	84 (6/18/1997)	84 (9/8/1997)	83 (6/17/1997)	327	365	89		
1998	93 (8/25/1998)	92 (7/27/1998)	90 (5/23/1998)	89 (7/28/1998)	350	365	95		
1999	92 (5/26/1999)	90 (5/27/1999)	88 (6/6/1999)	87 (5/28/1999)	356	365	97	86	94
2000	90 (8/1/2000)	90 (8/14/2000)	88 (8/9/2000)	87 (8/15/2000)	152	366	41	88	78
2001	85 (8/15/2001)	81 (8/17/2001)	80 (6/22/2001)	80 (8/18/2001)	359	365	98	85	79
2002	91 (6/6/2002)	89 (7/12/2002)	88 (6/7/2002)	86 (7/13/2002)	364	365	99	84	79
2003	103 (7/22/2003)	88 (7/21/2003)	87 (7/23/2003)	86 (5/27/2003)	358	365	98	84	98
2004	81 (8/3/2004)	77 (6/11/2004)	76 (7/27/2004)	75 (5/15/2004)	351	366	95	82	97

Table B.3. Highest ozone concentrations at the Buckeye site (AIRS Code: 04-013-4011)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
2004	68 (9/6/2004)	67 (9/11/2004)	64 (8/15/2004)	58 (8/10/2004)	88	365	24		

Table B.4. Highest ozone concentrations at the Cave Creek site (AIRS Code: 04-013-4008)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
2001	99 (8/10/2001)	85 (8/6/2001)	83 (8/9/2001)	83 (8/17/2001)	92	104	88		
2002	90 (6/5/2002)	89 (6/7/2002)	88 (6/6/2002)	86 (7/9/2002)	197	214	92		
2003	88 (5/27/2003)	87 (5/11/2003)	83 (5/22/2003)	83 (7/30/2003)	204	214	95	84	92
2004	79 (9/10/2004)	77 (8/10/2004)	76 (6/10/2004)	76 (6/11/2004)	213	214	99	82	95

Table B.5. Highest ozone concentrations at the Central Phoenix site (AIRS Code: 04-013-3002)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1994	82 (5/29/1994)	82 (6/22/1994)	77 (7/29/1994)	77 (9/1/1994)	364	365	99		
1995	88 (8/9/1995)	86 (8/31/1995)	85 (8/29/1995)	85 (9/1/1995)	362	365	99		
1996	81 (4/29/1996)	81 (5/11/1996)	80 (7/28/1996)	76 (5/21/1996)	345	366	94	79	97
1997	94 (6/16/1997)	85 (6/8/1997)	79 (9/7/1997)	77 (6/18/1997)	354	365	96	79	96
1998	87 (7/17/1998)	84 (5/24/1998)	84 (7/26/1998)	79 (5/23/1998)	345	365	94	77	95
1999	88 (8/17/1999)	81 (8/19/1999)	79 (7/22/1999)	78 (6/6/1999)	341	365	93	78	94
2000	88 (8/10/2000)	81 (7/30/2000)	77 (5/20/2000)	76 (5/13/2000)	150	366	40	78	76
2001	79 (8/10/2001)	77 (8/6/2001)	76 (8/11/2001)	75 (6/16/2001)	352	365	96	76	76
2002	88 (7/11/2002)	84 (7/9/2002)	82 (7/12/2002)	76 (6/5/2002)	347	365	95	76	77
2003	84 (8/16/2003)	83 (7/22/2003)	80 (5/11/2003)	79 (8/17/2003)	355	365	97	77	96
2004	78 (7/25/2004)	77 (7/26/2004)	75 (7/27/2004)	74 (7/24/2004)	357	366	97	76	96

Table B.6. Highest ozone concentrations at the Dysart site (AIRS Code: 04-013-4010)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
2003	82 (8/16/2003)	75 (7/22/2003)	75 (8/17/2003)	73 (8/14/2003)	94	103	91		
2004	74 (7/25/2004)	73 (7/26/2004)	70 (7/24/2004)	65 (9/11/2004)	209	214	97		

Table B.7. Highest ozone concentrations at the Emergency Management site (AIRS Code: 04-013-3004)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1997	99 (6/16/1997)	90 (6/18/1997)	88 (9/7/1997)	85 (5/16/1997)	349	365	95		
1998	83 (5/23/1998)	83 (9/12/1998)	82 (5/24/1998)	81 (9/19/1998)	351	365	96		
1999	97 (8/17/1999)	94 (8/24/1999)	88 (7/19/1999)	86 (7/15/1999)	300	365	82	84	91
2000	77 (8/10/2000)	72 (8/14/2000)	70 (8/16/2000)	66 (8/19/2000)	146	214	68	78	82
2001	67 (5/8/2001)	65 (5/22/2001)	64 (5/5/2001)	63 (5/12/2001)	60	93	64	72	71

Table B.8. Highest ozone concentrations at the Falcon Field site (AIRS Code: 04-013-1010)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1997	86 (6/18/1997)	83 (6/17/1997)	82 (6/16/1997)	81 (9/7/1997)	354	365	96		
1998	90 (8/25/1998)	85 (8/28/1998)	83 (5/23/1998)	83 (6/14/1998)	355	365	97		
1999	84 (8/24/1999)	83 (5/26/1999)	83 (5/27/1999)	82 (5/28/1999)	293	365	80	82	91
2000	82 (8/5/2000)	80 (8/14/2000)	77 (8/26/2000)	75 (8/16/2000)	138	214	64	80	80
2001	89 (8/19/2001)	85 (8/15/2001)	81 (6/22/2001)	81 (8/17/2001)	213	214	99	79	81
2002	93 (7/12/2002)	92 (7/24/2002)	86 (6/7/2002)	84 (6/6/2002)	206	214	96	80	86
2003	99 (7/22/2003)	79 (7/21/2003)	79 (7/23/2003)	79 (8/12/2003)	210	214	98	81	98
2004	77 (7/27/2004)	77 (8/3/2004)	72 (7/26/2004)	70 (5/15/2004)	210	214	98	78	97

Table B.9. Highest ozone concentrations at the Fountain Hills site (AIRS Code: 04-013-9704)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1997	92 (6/16/1997)	89 (8/6/1997)	88 (6/17/1997)	88 (9/8/1997)	362	365	99		
1998	94 (8/25/1998)	93 (7/27/1998)	88 (5/23/1998)	86 (5/24/1998)	360	365	98		
1999	90 (5/26/1999)	89 (6/6/1999)	88 (5/27/1999)	86 (5/28/1999)	361	365	98	87	98
2000	89 (5/20/2000)	89 (8/5/2000)	88 (8/14/2000)	85 (8/1/2000)	141	366	38	86	78
2001	87 (8/17/2001)	86 (8/9/2001)	85 (8/15/2001)	83 (8/10/2001)	362	365	99	85	78
2002	92 (6/6/2002)	92 (7/12/2002)	91 (6/5/2002)	86 (6/4/2002)	359	365	98	85	78
2003	99 (7/22/2003)	83 (5/11/2003)	83 (7/21/2003)	83 (7/23/2003)	363	365	99	84	99
2004	77 (5/15/2004)	77 (6/11/2004)	76 (7/27/2004)	75 (8/3/2004)	362	366	98	81	98

Table B.10. Highest ozone concentrations at the Glendale site (AIRS Code: 04-013-2001)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1994	87 (7/20/1994)	82 (7/21/1994)	80 (7/22/1994)	80 (7/29/1994)	356	365	97		
1995	87 (6/12/1995)	82 (6/10/1995)	80 (6/11/1995)	80 (6/23/1995)	336	365	92		
1996	85 (5/11/1996)	76 (5/21/1996)	72 (5/10/1996)	72 (6/6/1996)	337	366	92	77	94
1997	83 (8/4/1997)	82 (6/16/1997)	77 (6/8/1997)	76 (8/22/1997)	258	365	70	76	85
1998	73 (5/17/1998)	72 (8/28/1998)	71 (5/16/1998)	70 (3/22/1998)	356	365	97	73	86
1999	83 (8/25/1999)	82 (6/6/1999)	82 (8/26/1999)	81 (6/20/1999)	285	365	78	76	82
2000	88 (8/10/2000)	81 (5/21/2000)	81 (7/30/2000)	80 (5/20/2000)	151	214	70	77	82
2001	92 (8/6/2001)	85 (7/12/2001)	80 (8/11/2001)	78 (8/2/2001)	212	214	99	80	82
2002	94 (7/9/2002)	88 (7/11/2002)	83 (5/13/2002)	83 (7/10/2002)	210	214	98	80	89
2003	92 (8/16/2003)	88 (5/11/2003)	88 (8/17/2003)	85 (5/21/2003)	210	214	98	82	98
2004	82 (7/26/2004)	80 (7/24/2004)	79 (7/25/2004)	76 (7/27/2004)	213	214	99	81	98

Table B.11. Highest ozone concentrations at the Humboldt Mountain site (AIRS Code: 04-013-9508)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1997	85 (8/9/1997)	82 (8/6/1997)	81 (8/4/1997)	81 (8/7/1997)	159	365	43		
1998	94 (6/5/1998)	90 (6/18/1998)	90 (6/6/1998)	90 (8/5/1998)	347	365	95		
1999	91 (6/6/1999)	88 (5/17/1999)	86 (4/21/1999)	86 (5/15/1999)	293	365	80	86	73
2000	86 (5/13/2000)	85 (7/30/2000)	84 (4/26/2000)	82 (5/2/2000)	150	214	70	86	82
2001	87 (6/5/2001)	86 (6/15/2001)	85 (8/10/2001)	85 (8/16/2001)	211	214	98	84	83
2002	102 (7/12/2002)	91 (6/5/2002)	90 (6/18/2002)	90 (6/3/2002)	212	214	99	86	89
2003	89 (5/11/2003)	89 (5/27/2003)	87 (5/22/2003)	87 (7/30/2003)	206	214	96	87	98
2004	81 (6/11/2004)	80 (6/10/2004)	80 (9/9/2004)	78 (5/12/2004)	211	214	98	85	98

Table B.12. Highest ozone concentrations at the Lake Pleasant site (AIRS Code: 04-013-9805)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1998	88 (7/16/1998)	85 (6/18/1998)	82 (6/24/1998)	82 (8/3/1998)	189	220	85		
1999	84 (5/17/1999)	83 (6/14/1999)	82 (5/28/1999)	81 (4/21/1999)	291	365	79		
2000	90 (7/31/2000)	89 (8/10/2000)	82 (5/20/2000)	82 (6/29/2000)	142	214	66	82	77
2001	76 (7/3/2001)	73 (5/8/2001)	73 (6/15/2001)	73 (6/5/2001)	107	124	86	79	77

Table B.13. Highest ozone concentrations at the Maryvale site (AIRS Code: 04-013-3006)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1997	85 (6/16/1997)	81 (8/4/1997)	79 (8/6/1997)	78 (8/5/1997)	286	365	78		
1998	98 (7/17/1998)	90 (8/28/1998)	89 (5/24/1998)	86 (5/23/1998)	352	365	96		
1999	85 (8/17/1999)	84 (8/26/1999)	80 (5/28/1999)	80 (7/5/1999)	297	365	81	81	85
2000	91 (8/10/2000)	81 (5/21/2000)	80 (5/12/2000)	80 (5/20/2000)	149	214	69	82	82
2001	83 (8/11/2001)	75 (8/1/2001)	74 (7/2/2001)	73 (5/8/2001)	207	214	96	78	82
2002	107 (7/9/2002)	95 (7/11/2002)	94 (7/10/2002)	84 (7/12/2002)	210	214	98	79	88
2003	87 (8/17/2003)	86 (5/11/2003)	83 (5/21/2003)	83 (7/22/2003)	213	214	99	80	98

Table B.14. Highest ozone concentrations at the Mesa site (AIRS Code: 04-013-1003)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1994	95 (6/22/1994)	90 (7/29/1994)	89 (6/2/1994)	88 (7/20/1994)	288	365	78		
1995	96 (8/31/1995)	94 (8/29/1995)	92 (6/10/1995)	92 (7/28/1995)	343	365	93		
1996	99 (4/29/1996)	98 (5/11/1996)	95 (5/21/1996)	90 (6/1/1996)	327	366	89	90	87
1997	91 (6/16/1997)	87 (6/18/1997)	85 (6/8/1997)	84 (9/7/1997)	346	365	94	89	92
1998	89 (7/17/1998)	84 (5/23/1998)	80 (5/24/1998)	80 (7/10/1998)	361	365	98	85	94
1999	96 (8/24/1999)	89 (8/17/1999)	85 (8/25/1999)	83 (5/26/1999)	353	365	96	82	96
2000	89 (8/14/2000)	79 (7/30/2000)	78 (5/2/2000)	75 (4/23/2000)	140	366	38	79	77
2001	78 (8/6/2001)	77 (8/11/2001)	77 (8/19/2001)	74 (8/16/2001)	320	365	87	77	74
2002	82 (7/12/2002)	73 (7/11/2002)	73 (7/9/2002)	72 (6/6/2002)	286	306	93	74	73

Table B.15. Highest ozone concentrations at the Mount Ord site (AIRS Code: 04-013-9701)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1997	86 (6/16/1997)	86 (8/6/1997)	85 (5/28/1997)	84 (5/27/1997)	236	365	64		
1998	92 (6/18/1998)	90 (5/22/1998)	89 (5/23/1998)	88 (5/24/1998)	338	365	92		
1999	93 (6/6/1999)	90 (5/26/1999)	88 (6/12/1999)	87 (4/21/1999)	263	275	95	86	84
2000	91 (7/30/2000)	90 (8/1/2000)	90 (8/2/2000)	90 (8/5/2000)	101	166	60	88	82
2001	81 (8/17/2001)	79 (6/15/2001)	77 (6/21/2001)	77 (7/13/2001)	135	214	63	85	73

Table B.16. Highest ozone concentrations at the North Phoenix site (AIRS Code: 04-013-1004)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1994	91 (7/29/1994)	82 (7/13/1994)	82 (8/5/1994)	80 (7/15/1994)	349	365	95		
1995	97 (8/9/1995)	96 (8/31/1995)	95 (6/12/1995)	92 (8/29/1995)	353	365	96		
1996	106 (7/26/1996)	102 (5/11/1996)	96 (8/28/1996)	95 (5/21/1996)	352	366	96	89	96
1997	94 (6/16/1997)	92 (6/9/1997)	91 (8/6/1997)	91 (9/7/1997)	349	365	95	93	96
1998	95 (7/27/1998)	94 (7/17/1998)	90 (8/28/1998)	89 (5/24/1998)	352	365	96	92	96
1999	89 (8/24/1999)	87 (7/22/1999)	87 (8/22/1999)	84 (5/28/1999)	352	365	96	88	96
2000	91 (8/10/2000)	87 (5/21/2000)	86 (5/20/2000)	86 (8/24/2000)	145	366	39	86	77
2001	93 (8/6/2001)	87 (8/10/2001)	86 (7/12/2001)	86 (7/2/2001)	364	365	99	85	78
2002	93 (7/9/2002)	89 (7/11/2002)	88 (7/12/2002)	85 (6/6/2002)	357	365	97	86	78
2003	93 (7/22/2003)	92 (8/16/2003)	88 (5/11/2003)	86 (7/16/2003)	358	365	98	86	98
2004	87 (7/27/2004)	84 (7/26/2004)	82 (7/24/2004)	80 (8/1/2004)	355	366	96	84	97

Table B.17. Highest ozone concentrations at the Palo Verde site (AIRS Code: 04-013-9993)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1996	77 (7/31/1996)	75 (7/28/1996)	71 (9/28/1996)	70 (7/29/1996)	64	159	40		
1997	91 (9/4/1997)	83 (8/5/1997)	78 (6/16/1997)	77 (8/4/1997)	240	365	65		
1998	91 (7/17/1998)	81 (8/28/1998)	80 (6/24/1998)	80 (8/31/1998)	186	214	86	76	64
1999	82 (5/26/1999)	81 (4/21/1999)	81 (5/27/1999)	80 (5/28/1999)	204	214	95	79	82
2000	95 (7/31/2000)	81 (5/1/2000)	80 (5/20/2000)	80 (6/5/2000)	119	214	55	80	79
2001	77 (8/16/2001)	76 (8/7/2001)	74 (5/5/2001)	74 (5/8/2001)	180	214	84	78	78
2002	85 (7/10/2002)	80 (5/13/2002)	80 (7/9/2002)	78 (6/18/2002)	213	214	99	77	79
2003	80 (5/11/2003)	80 (5/21/2003)	80 (8/17/2003)	75 (6/28/2003)	212	214	99	76	95
2004	75 (7/25/2004)	74 (5/1/2004)	73 (5/12/2004)	72 (4/28/2004)	212	214	99	75	100

Table B.18. Highest ozone concentrations at the Pinnacle Peak site (AIRS Code: 04-013-2005)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1994	96 (6/28/1994)	84 (9/27/1994)	83 (7/29/1994)	82 (5/27/1994)	354	365	96		
1995	97 (8/29/1995)	96 (7/28/1995)	96 (8/9/1995)	91 (8/31/1995)	315	365	86		
1996	99 (5/21/1996)	94 (6/1/1996)	94 (6/2/1996)	91 (7/26/1996)	360	366	98	88	93
1997	85 (8/7/1997)	84 (6/16/1997)	84 (6/17/1997)	82 (8/6/1997)	352	365	96	88	93
1998	95 (7/27/1998)	89 (8/3/1998)	87 (8/25/1998)	86 (8/14/1998)	360	365	98	86	97
1999	90 (8/23/1999)	88 (8/24/1999)	87 (6/6/1999)	84 (5/26/1999)	360	365	98	84	97
2000	92 (8/14/2000)	88 (8/5/2000)	87 (8/9/2000)	86 (7/31/2000)	150	366	40	85	79
2001	95 (8/10/2001)	88 (8/9/2001)	87 (8/17/2001)	85 (8/6/2001)	356	365	97	85	78
2002	89 (7/12/2002)	86 (6/6/2002)	85 (7/15/2002)	84 (7/11/2002)	356	365	97	85	78
2003	93 (7/22/2003)	89 (5/11/2003)	85 (5/27/2003)	83 (7/30/2003)	350	365	95	84	96
2004	71 (5/15/2004)	70 (3/19/2004)	69 (5/14/2004)	68 (7/26/2004)	343	366	93	78	95

Table B.19. Highest ozone concentrations at the Rio Verde site (AIRS Code: 04-013-9706)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1997	91 (6/17/1997)	87 (8/6/1997)	85 (6/16/1997)	85 (9/7/1997)	143	365	39		
1998	89 (5/22/1998)	88 (5/23/1998)	88 (5/24/1998)	70 (5/25/1998)	16	365	4		
1999	92 (5/26/1999)	88 (6/6/1999)	86 (5/27/1999)	86 (5/28/1999)	183	214	85	80	43
2000	89 (8/14/2000)	87 (5/20/2000)	86 (8/1/2000)	86 (8/9/2000)	150	214	70	81	53
2001	83 (6/6/2001)	83 (8/10/2001)	83 (8/17/2001)	83 (8/9/2001)	214	214	100	85	85
2002	89 (6/6/2002)	88 (6/7/2002)	85 (6/4/2002)	85 (6/5/2002)	209	214	97	85	89
2003	96 (7/22/2003)	85 (7/21/2003)	84 (5/11/2003)	83 (7/23/2003)	205	214	95	84	97
2004	83 (5/15/2004)	77 (5/13/2004)	77 (5/14/2004)	74 (6/12/2004)	178	214	83	81	92

Table B.20. Highest ozone concentrations at the South Phoenix site (AIRS Code: 04-013-4003)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1999	70 (10/10/1999)	69 (10/2/1999)	63 (10/1/1999)	63 (10/9/1999)	93	92	101		
2000	86 (5/19/2000)	86 (5/20/2000)	85 (8/24/2000)	83 (5/21/2000)	153	366	41		
2001	86 (8/11/2001)	82 (8/6/2001)	80 (8/15/2001)	76 (8/1/2001)	354	365	96	74	79
2002	90 (7/11/2002)	86 (7/10/2002)	82 (7/12/2002)	81 (6/5/2002)	361	365	98	80	78
2003	83 (5/11/2003)	79 (7/22/2003)	77 (8/17/2003)	76 (5/27/2003)	362	365	99	78	98
2004	79 (7/25/2004)	73 (6/11/2004)	73 (9/11/2004)	72 (4/25/2004)	361	366	98	76	98

Table B.21. Highest ozone concentrations at the South Scottsdale site (AIRS Code: 04-013-3003)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1994	89 (7/29/1994)	82 (6/28/1994)	82 (7/21/1994)	81 (7/22/1994)	334	365	91		
1995	98 (8/31/1995)	90 (8/9/1995)	89 (8/8/1995)	89 (9/1/1995)	353	365	96		
1996	98 (5/11/1996)	92 (7/30/1996)	91 (5/21/1996)	87 (6/1/1996)	360	366	98	86	95
1997	87 (6/16/1997)	80 (9/7/1997)	77 (6/8/1997)	76 (6/18/1997)	339	365	92	84	95
1998	84 (7/27/1998)	83 (8/23/1998)	79 (7/26/1998)	78 (5/23/1998)	343	365	93	80	94
1999	77 (6/6/1999)	75 (6/19/1999)	72 (5/26/1999)	72 (5/28/1999)	341	365	93	75	93
2000	87 (8/10/2000)	82 (8/14/2000)	81 (8/16/2000)	80 (8/19/2000)	150	366	40	77	75
2001	88 (8/10/2001)	81 (8/5/2001)	79 (8/15/2001)	79 (8/6/2001)	321	365	87	77	73
2002	87 (7/12/2002)	80 (7/9/2002)	79 (6/5/2002)	79 (7/11/2002)	350	365	95	79	74
2003	97 (7/22/2003)	85 (5/11/2003)	85 (8/16/2003)	79 (7/23/2003)	356	365	97	79	93
2004	81 (7/26/2004)	79 (7/27/2004)	77 (7/25/2004)	73 (7/24/2004)	345	366	94	77	95

Table B.22. Highest ozone concentrations at the Super Site site (AIRS Code: 04-013-9997)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1996	95 (5/11/1996)	93 (7/28/1996)	89 (7/26/1996)	87 (5/21/1996)	181	366	49		
1997	89 (6/16/1997)	83 (8/6/1997)	80 (6/9/1997)	80 (8/25/1997)	237	365	64		
1998	88 (7/17/1998)	81 (5/24/1998)	80 (8/28/1998)	79 (7/27/1998)	229	365	62	82	58
1999	51 (2/28/1999)	48 (2/27/1999)	46 (2/21/1999)	46 (3/14/1999)	72	365	19	68	48
2000	93 (8/10/2000)	78 (8/12/2000)	77 (7/30/2000)	76 (5/13/2000)	111	366	30	67	37
2001	86 (8/6/2001)	81 (8/10/2001)	80 (8/11/2001)	79 (7/12/2001)	349	365	95	67	48
2002	93 (7/9/2002)	89 (7/11/2002)	83 (7/12/2002)	76 (7/10/2002)	362	365	99	77	75
2003	83 (5/11/2003)	82 (7/22/2003)	82 (8/16/2003)	75 (5/21/2003)	362	365	99	77	98
2004	77 (7/26/2004)	76 (7/25/2004)	73 (7/24/2004)	72 (8/10/2004)	361	366	98	74	99

Table B.23. Highest ozone concentrations at the Surprise site (AIRS Code: 04-013-4007)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
2001	73 (8/11/2001)	73 (8/14/2001)	72 (8/16/2001)	71 (5/8/2001)	252	365	69		
2002	83 (6/6/2002)	80 (6/18/2002)	80 (7/9/2002)	79 (5/13/2002)	193	214	90		
2003	79 (5/11/2003)	70 (5/9/2003)	67 (5/1/2003)	66 (5/10/2003)	100	108	92	72	84

Table B.24. Highest ozone concentrations at the Tempe site (AIRS Code: 04-013-4005)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
2000	86 (8/16/2000)	84 (8/10/2000)	83 (8/14/2000)	78 (7/30/2000)	61	184	33		
2001	88 (8/11/2001)	82 (8/15/2001)	82 (8/5/2001)	79 (8/19/2001)	300	365	82		
2002	86 (7/12/2002)	85 (7/11/2002)	83 (6/7/2002)	80 (6/5/2002)	211	214	98	79	71
2003	86 (7/22/2003)	83 (5/11/2003)	80 (7/23/2003)	80 (8/12/2003)	205	214	95	80	92
2004	78 (7/25/2004)	72 (7/26/2004)	72 (7/27/2004)	71 (4/24/2004)	205	214	95	77	96

Table B.25. Highest ozone concentrations at the West Chandler (old) site (AIRS Code: 04-013-3009)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1997	78 (6/8/1997)	78 (6/16/1997)	78 (6/18/1997)	77 (9/9/1997)	344	365	94		
1998	79 (7/17/1998)	75 (5/23/1998)	75 (7/26/1998)	74 (5/24/1998)	348	365	95		
1999	75 (8/17/1999)	71 (6/6/1999)	71 (8/24/1999)	69 (5/28/1999)	300	365	82	73	90
2000	76 (4/30/2000)	76 (5/13/2000)	75 (5/12/2000)	74 (4/29/2000)	32	63	50	72	76

Table B.26. Highest ozone concentrations at the West Chandler site (AIRS Code: 04-013-4004)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
2000	89 (8/16/2000)	80 (8/24/2000)	79 (8/14/2000)	77 (8/10/2000)	32	123	26		
2001	86 (8/11/2001)	84 (8/15/2001)	83 (8/5/2001)	78 (6/16/2001)	204	214	95		
2002	94 (7/10/2002)	85 (7/11/2002)	83 (7/12/2002)	83 (8/8/2002)	207	214	96	79	72
2003	82 (5/11/2003)	79 (5/31/2003)	79 (8/7/2003)	78 (7/22/2003)	211	214	98	80	96
2004	73 (7/25/2004)	72 (4/24/2004)	72 (7/26/2004)	70 (4/25/2004)	212	214	99	77	98

Table B.27. Highest ozone concentrations at the West Phoenix site (AIRS Code: 04-013-0019)

Year	1st (ppb)	2nd (ppb)	3rd (ppb)	4th (ppb)	Count (days/365days)	Required Days	Completeness (%)	3-year avg of 4th highest Ozone (ppb)	3-year avg of Completeness (%)
1994	76 (7/15/1994)	75 (5/12/1994)	75 (7/7/1994)	74 (5/21/1994)	353	365	96		
1995	84 (8/1/1995)	84 (8/29/1995)	84 (8/31/1995)	84 (9/1/1995)	351	365	96		
1996	88 (5/21/1996)	86 (5/11/1996)	82 (4/29/1996)	81 (6/1/1996)	340	366	92	80	95
1997	90 (6/16/1997)	81 (8/6/1997)	79 (8/5/1997)	78 (6/24/1997)	323	365	88	81	92
1998	103 (7/17/1998)	93 (5/24/1998)	93 (8/28/1998)	86 (7/10/1998)	364	365	99	82	93
1999	99 (10/17/1999)	92 (10/16/1999)	92 (8/17/1999)	91 (10/12/1999)	352	365	96	85	94
2000	87 (8/10/2000)	82 (5/20/2000)	82 (5/21/2000)	81 (5/19/2000)	144	366	39	86	78
2001	81 (8/6/2001)	79 (8/11/2001)	76 (9/9/2001)	75 (7/12/2001)	334	365	91	82	75
2002	102 (7/11/2002)	100 (7/9/2002)	84 (7/10/2002)	84 (7/12/2002)	358	365	98	80	76
2003	81 (5/11/2003)	81 (7/22/2003)	80 (8/16/2003)	77 (5/21/2003)	342	365	93	79	94
2004	80 (7/25/2004)	77 (7/26/2004)	74 (7/24/2004)	72 (7/27/2004)	363	366	99	78	97

APPENDIX C

Identification of Meteorological Regimes Corresponding with High Observed Ozone

The following is a procedure that may be used to assist in selecting modeling episodes. Other techniques may be considered on a case-by-case basis; they should be described in the Modeling Protocol and approved by the appropriate EPA Regional Office.

Identification of meteorological regimes for a given area under review begins with constructing a climatological windrose of high ozone days. The windrose is constructed by first selecting all days from the period 1987 to present during which at least one ozone monitor within the area recorded an exceedance of the ozone NAAQS or some other cutoff level (e.g., 100 ppb). Additional years of data are encouraged in constructing the climatological windrose (e.g., 1980-1991). Next, for each exceedance day, calculate the morning (i.e., 7:00 A.M. - 10:00 A.M.) resultant wind velocity. Then group the resultant wind velocities for all of the exceedance days into eight compass directions plus calm, to establish a climatic windrose of high-ozone days for the area under review. Calm winds are defined as those with speeds less than 1.5 m/s and referred to as the null wind direction. The windrose will include nine bins (0-8); place the wind directions corresponding to the eight compass points into bins 1-8, and the calm or null wind direction into bin 0. The bins with frequencies significantly higher than the average frequency for all bins should be defined as the "predominant wind directions" (PWD).

Next, compare the morning (i.e., 7:00 A.M. - 10:00 A.M.) resultant wind velocity for each exceedance day during 1987-89 and more recent years with the climatic windrose of high-ozone days. Categorize exceedance days with wind directions corresponding to previously identified climatic PWD's as belonging to that PWD. Lump all other exceedance days occurring during 1987-89 and later into a category called "other." Rank each exceedance day within each PWD category and within the "other" category according to its areawide daily maximum ozone observation. Within each category, the day with the highest areawide daily maximum concentration is ranked first.

After the steps described in the two preceding paragraphs are completed, meteorological regimes can be defined for use in the attainment demonstration test described in Section 6.4. This may be done as follows:

1. Choose the two PWD's which contain the highest areawide daily maximum ozone values from 1987 to the most recent year with data available. These represent two of the meteorological regimes to consider in the attainment test.

2. The third "meteorological regime" to be considered in the attainment test is comprised of all exceedance days previously categorized as "other" plus those belonging to any PWD not chosen in step 1.

3. Identify the top 3-ranked exceedance days from within each of the three meteorological regimes identified in steps 1 and 2. These days are candidates for modeling in the attainment test. Final choice from among these candidates is based on criteria identified in Section 3.1.

4. It may happen that one or more of the meteorological regimes identified in step 1 contains fewer than 3 exceedance days. If this occurs, exceedance days included

within PWD's which have been lumped in the third meteorological regime (see step 2) may be added to one or both of the first two regimes. If this proves necessary, selection of days to supplement those in one or both of the first two regimes needs to be decided on a case-by-case basis keeping in mind the goal of this exercise: to provide a choice of exceedance days reflecting high ozone concentrations with meteorological conditions which frequently coincide with observed exceedances.

APPENDIX D

Spatial Distribution of Maximum Ozone Readings on High Ozone Days in 2000-2004

D.1 Episode 1 (July 8-14, 2002)

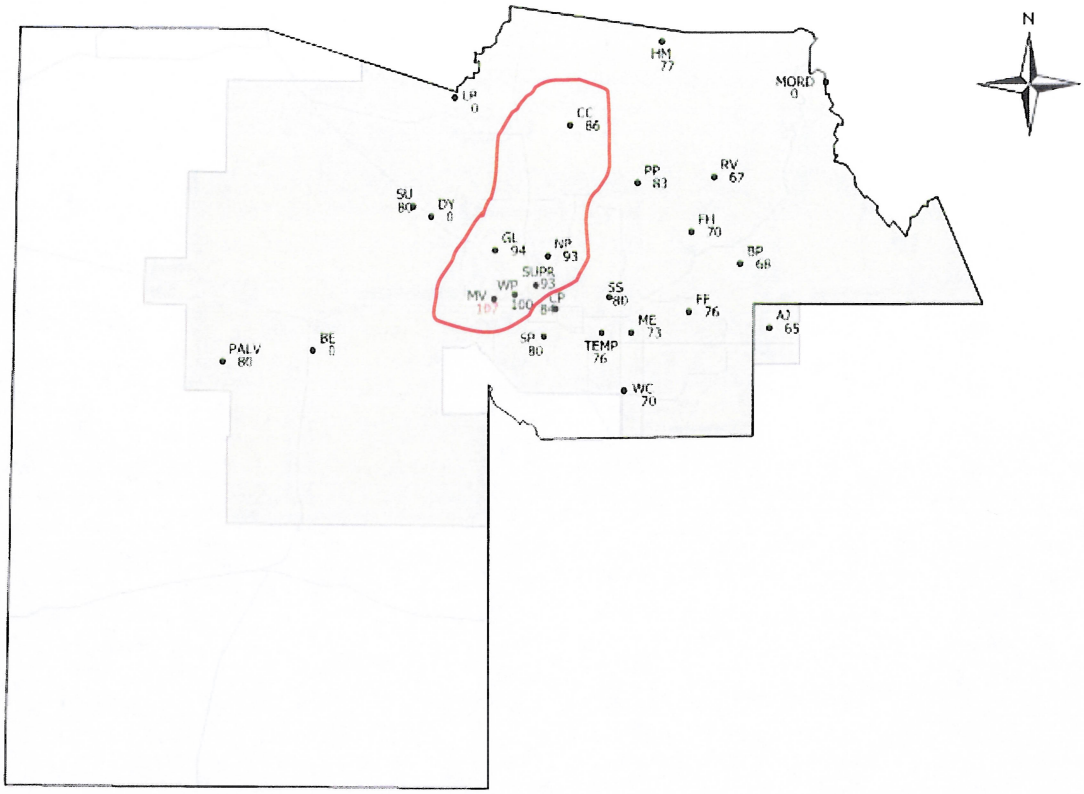


Figure D.1.1. Spatial distribution of daily maximum 8-hr ozone value on 7/9/2002 (unit: ppb)

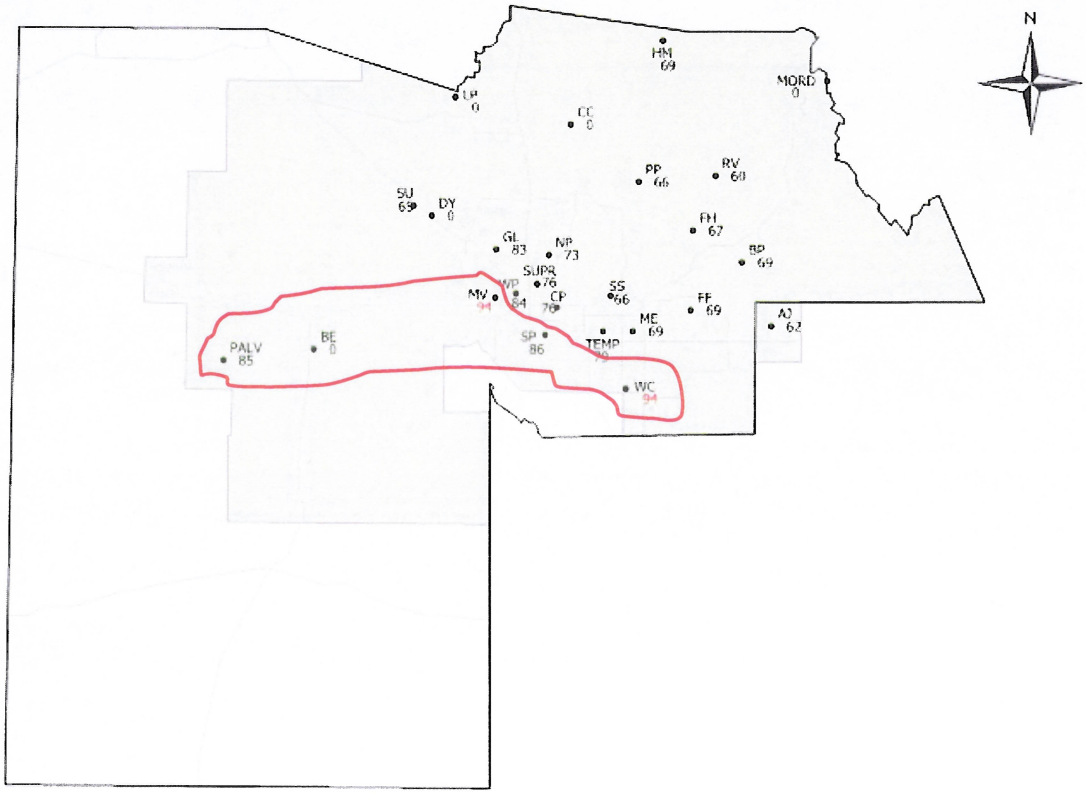


Figure D.1.2. Spatial distribution of daily maximum 8-hr ozone value on 7/10/2002 (unit: ppb)

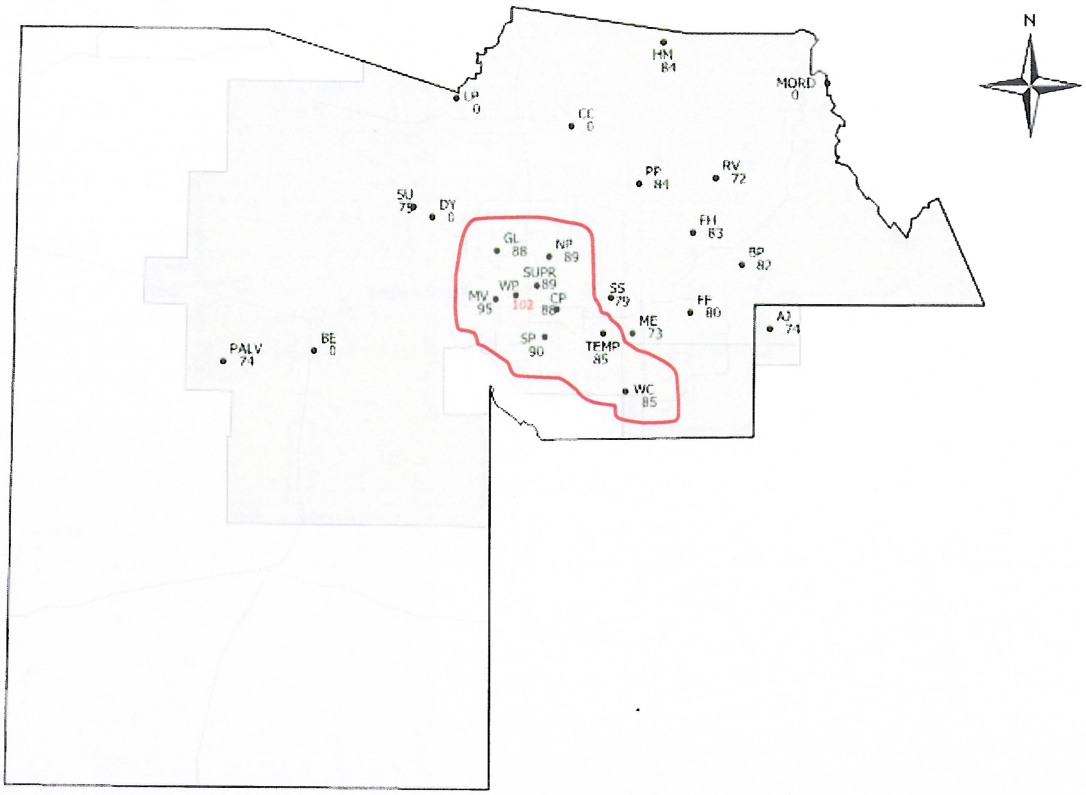


Figure D.1.3. Spatial distribution of daily maximum 8-hr ozone value on 7/11/2002 (unit: ppb)

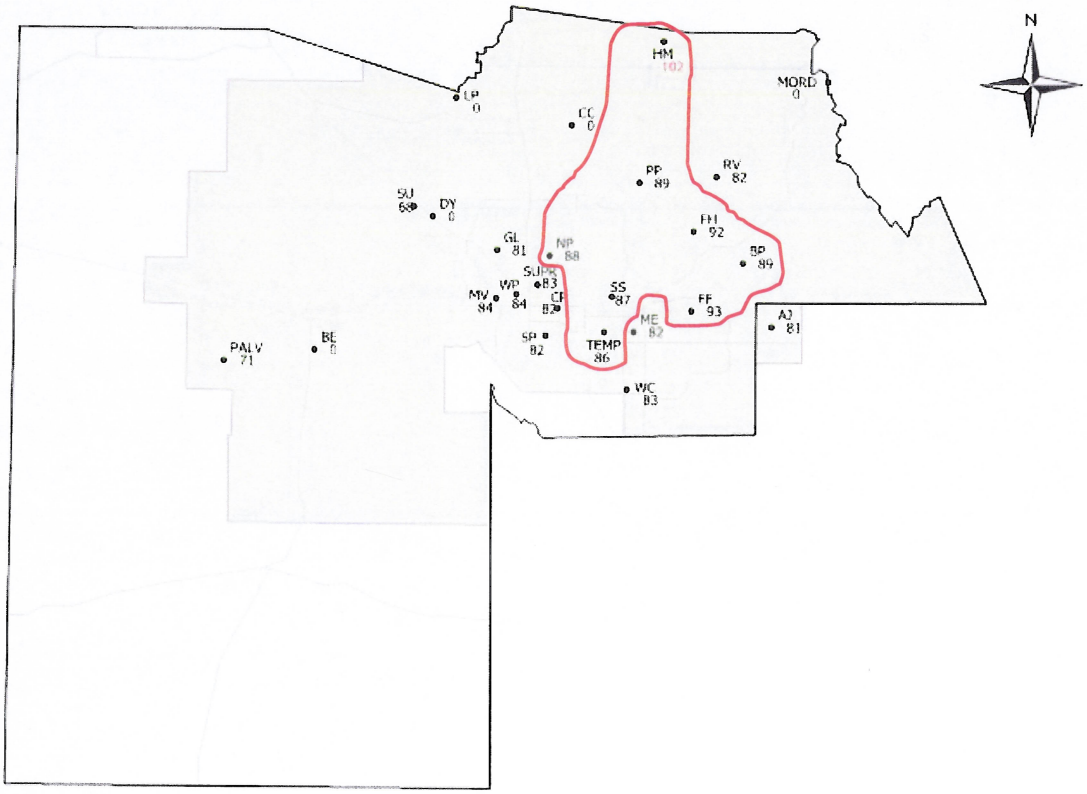


Figure D.1.4. Spatial distribution of daily maximum 8-hr ozone value on 7/12/2002 (unit: ppb)

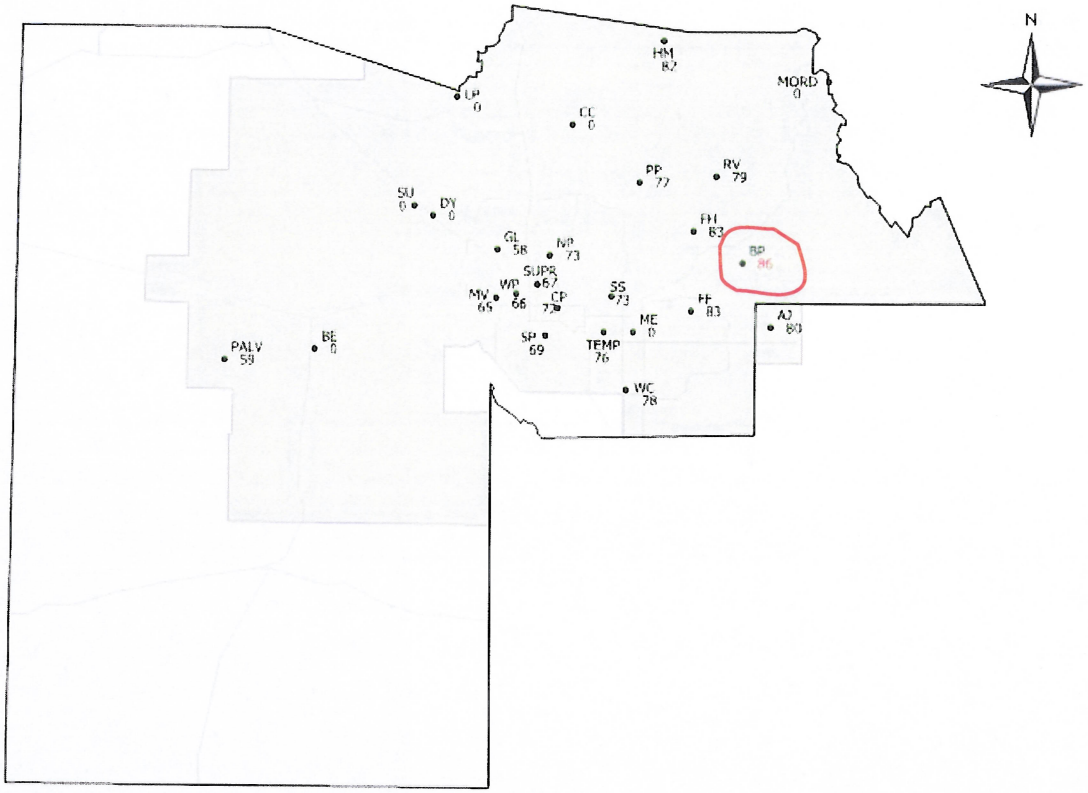


Figure D.1.5. Spatial distribution of daily maximum 8-hr ozone value on 7/13/2002 (unit: ppb)

D.2 Episode 2 (August 5-11, 2001)

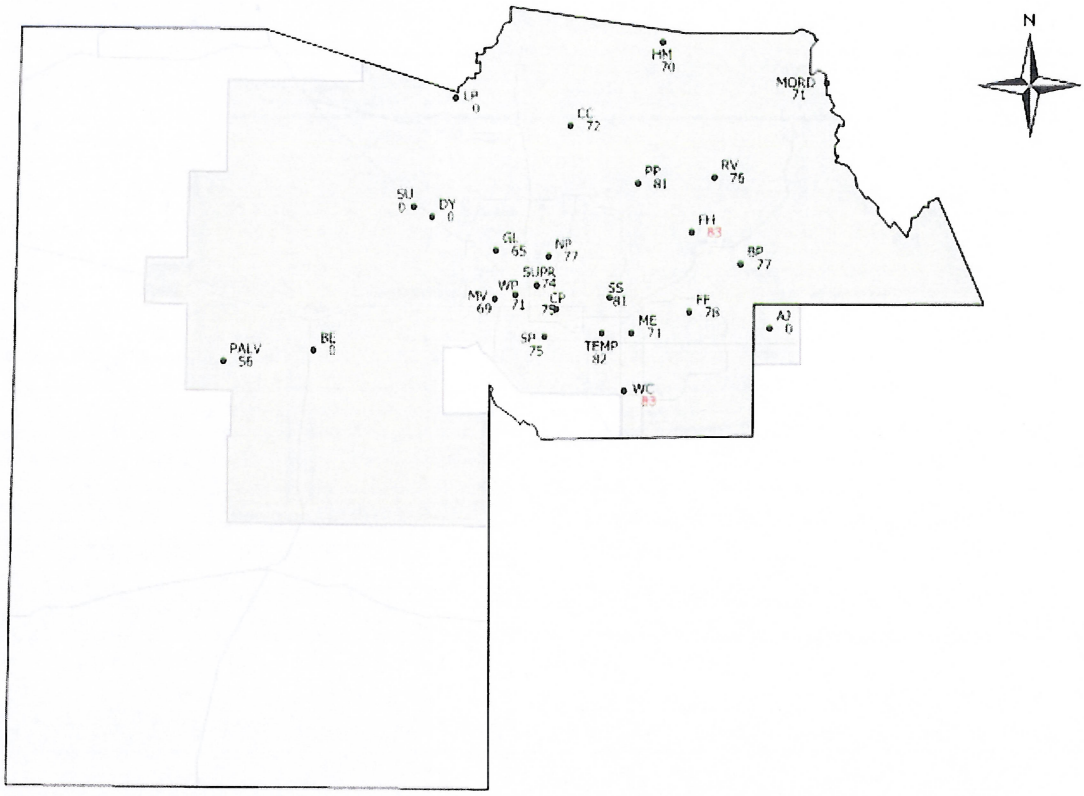


Figure D.2.1. Spatial distribution of daily maximum 8-hr ozone value on 8/5/2001 (unit: ppb)

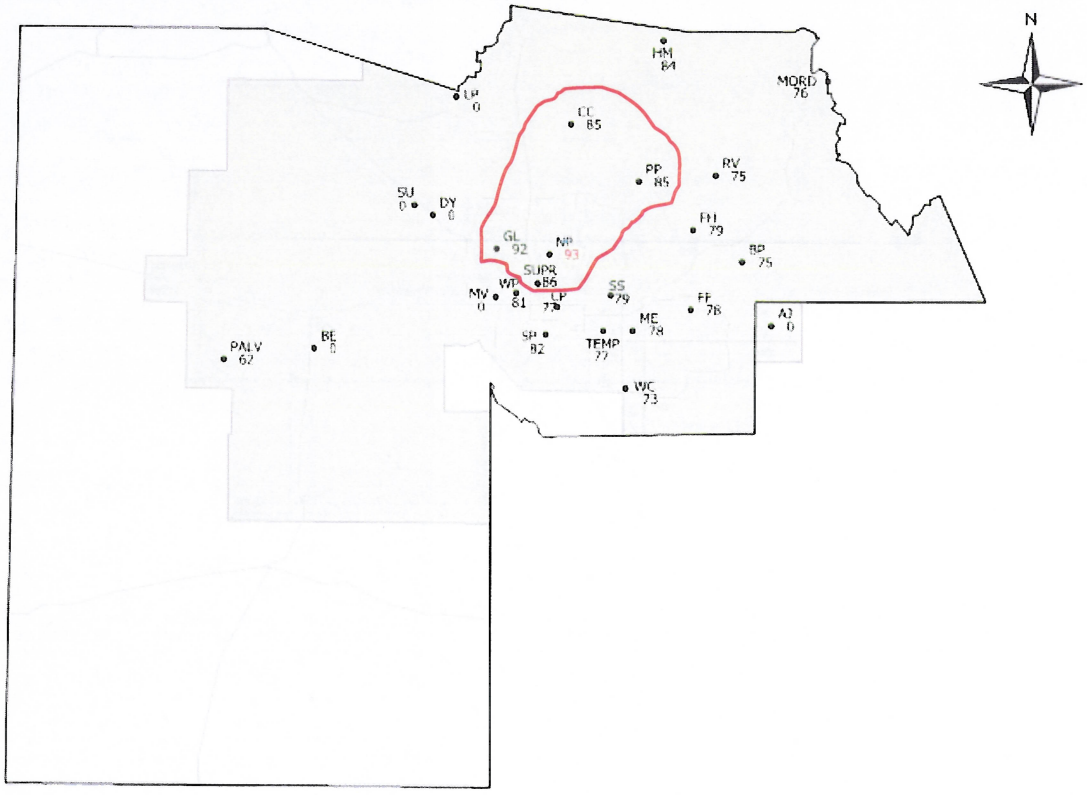


Figure D.2.2. Spatial distribution of daily maximum 8-hr ozone value on 8/6/2001 (unit: ppb)

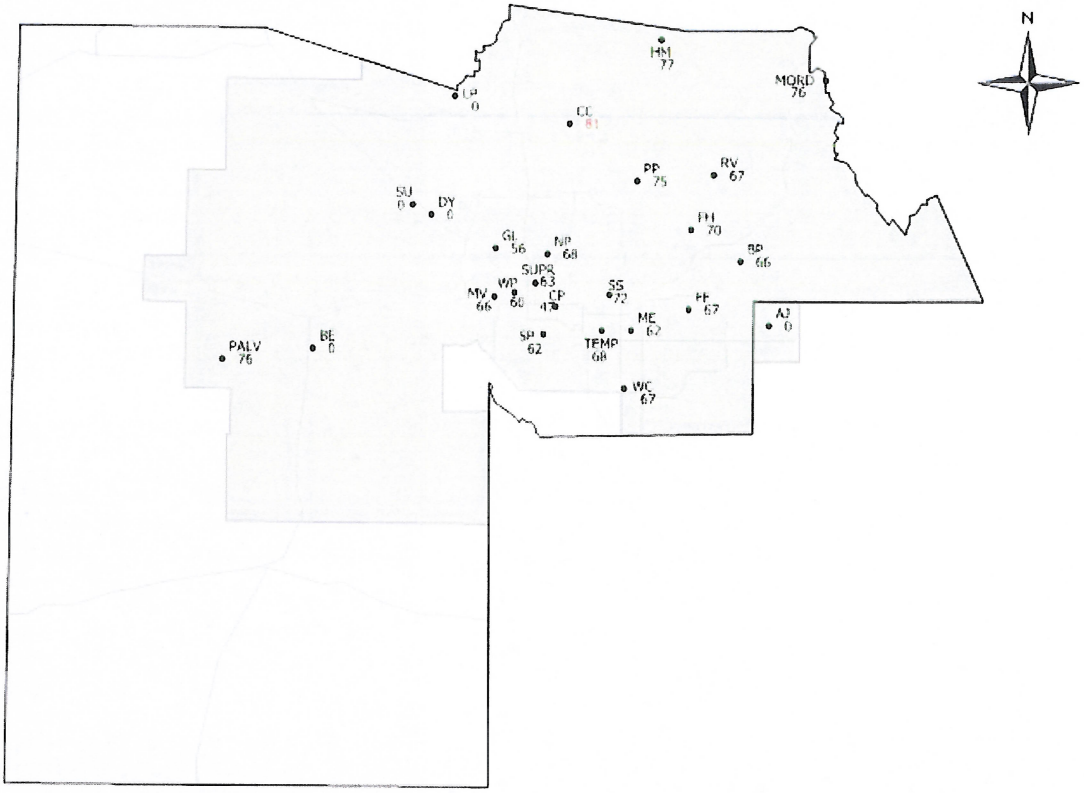


Figure D.2.3. Spatial distribution of daily maximum 8-hr ozone value on 8/7/2001 (unit: ppb)

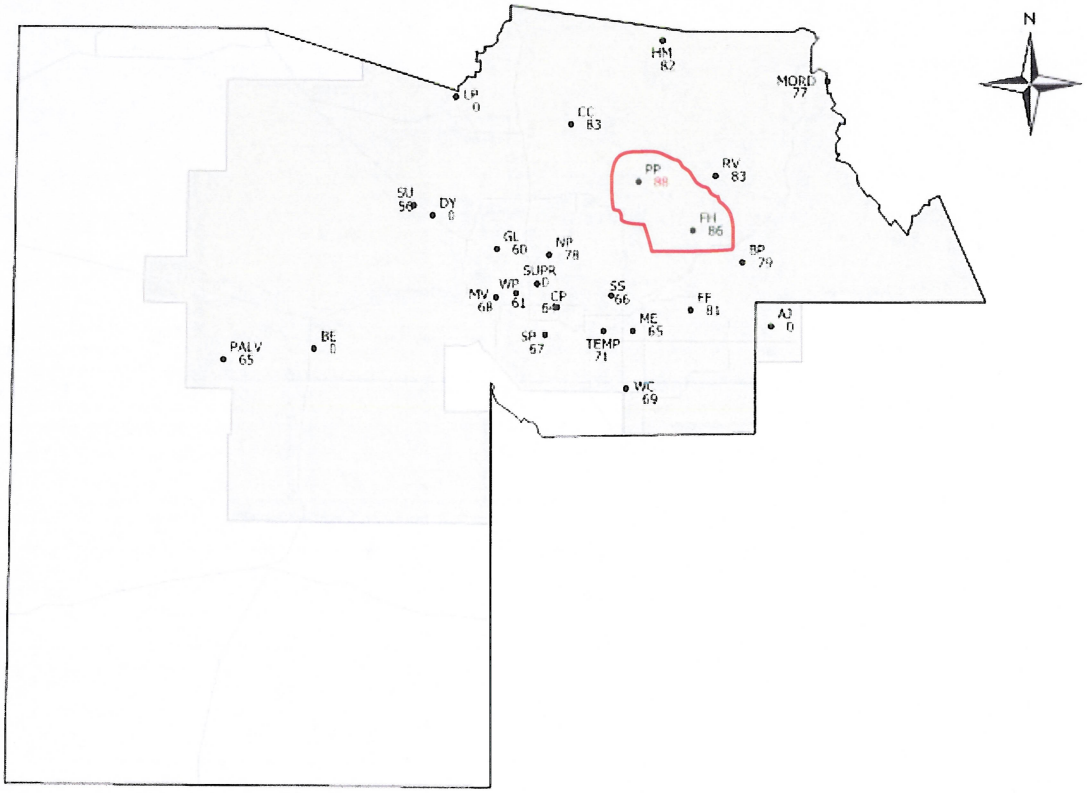


Figure D.2.4. Spatial distribution of daily maximum 8-hr ozone value on 8/9/2001 (unit: ppb)

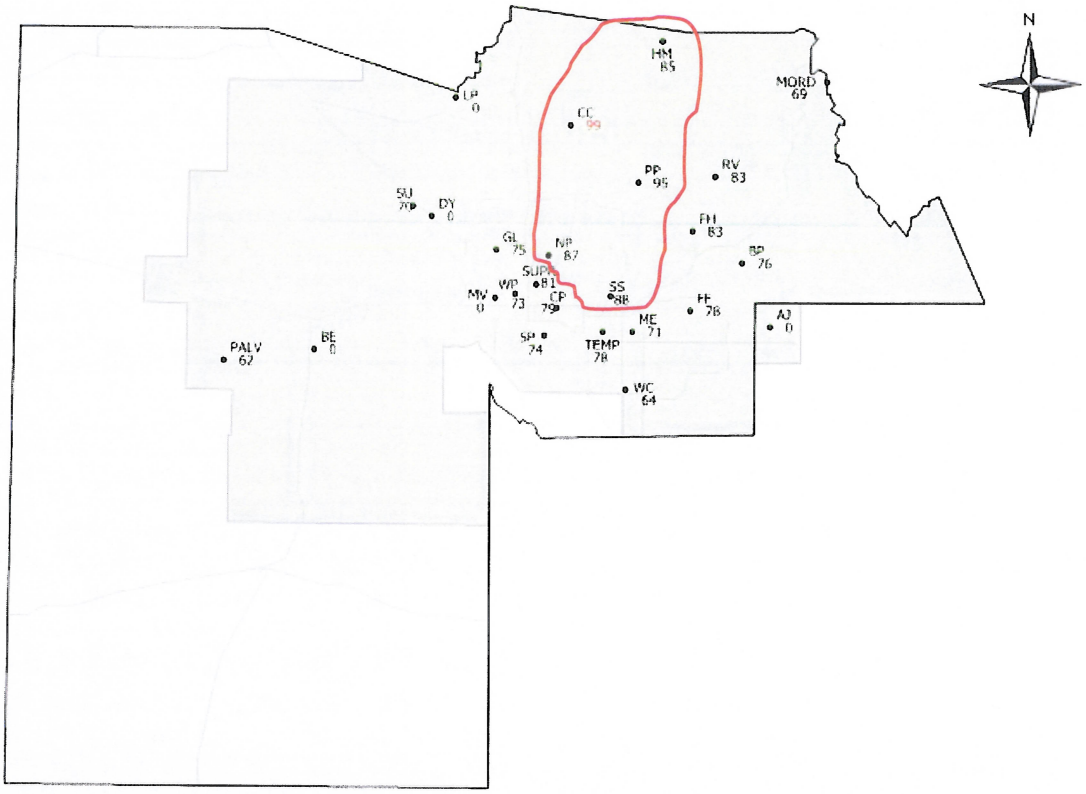


Figure D.2.5. Spatial distribution of daily maximum 8-hr ozone value on 8/10/2001 (unit: ppb)

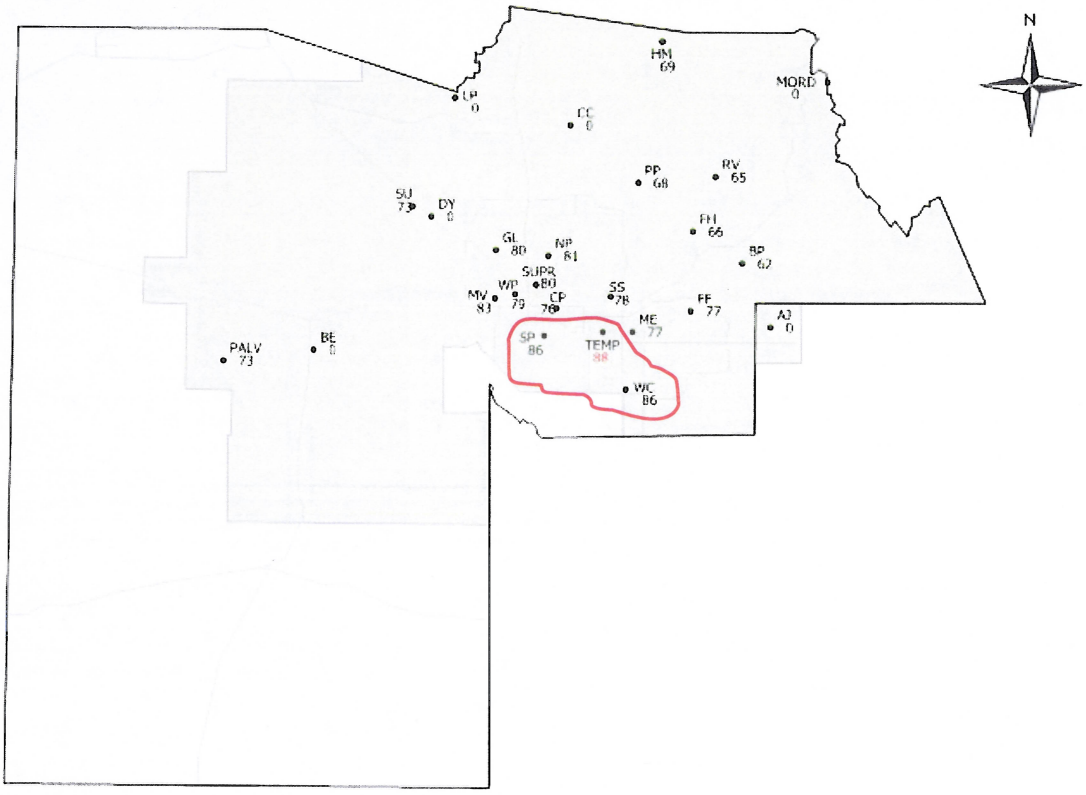


Figure D.2.6. Spatial distribution of daily maximum 8-hr ozone value on 8/11/2001 (unit: ppb)

D.3 Episode 3 (August 9-15, 2000)

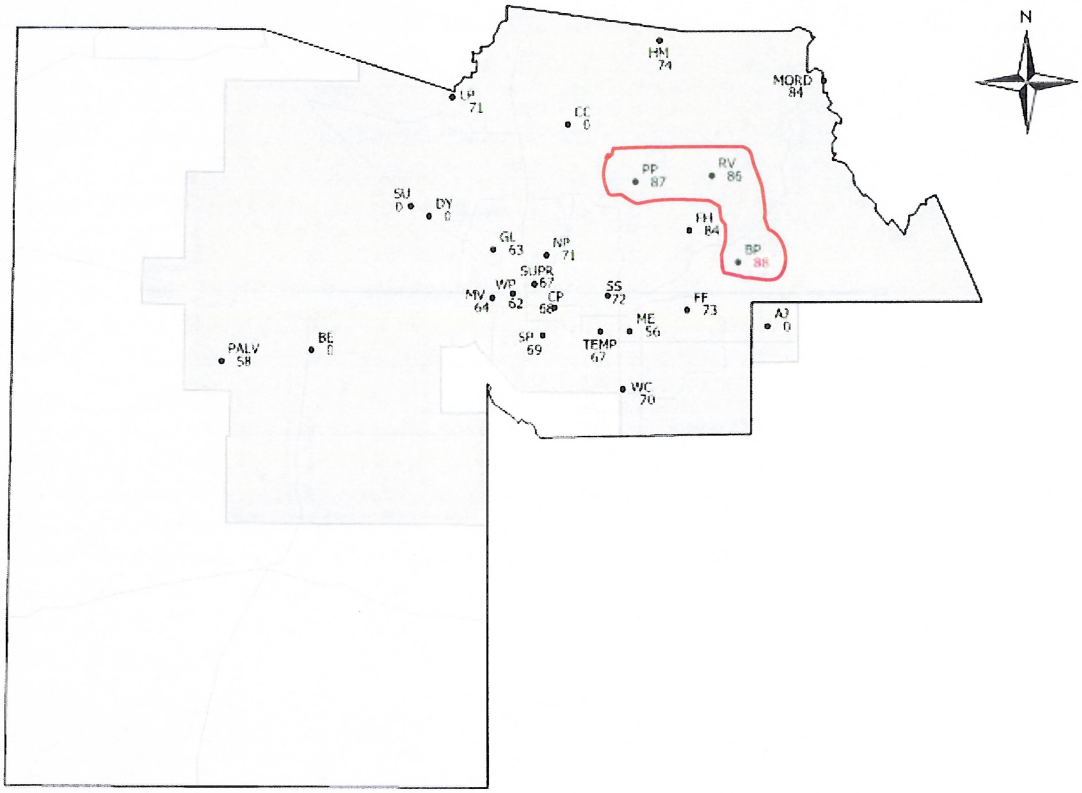


Figure D.3.1. Spatial distribution of daily maximum 8-hr ozone value on 8/9/2000 (unit: ppb)

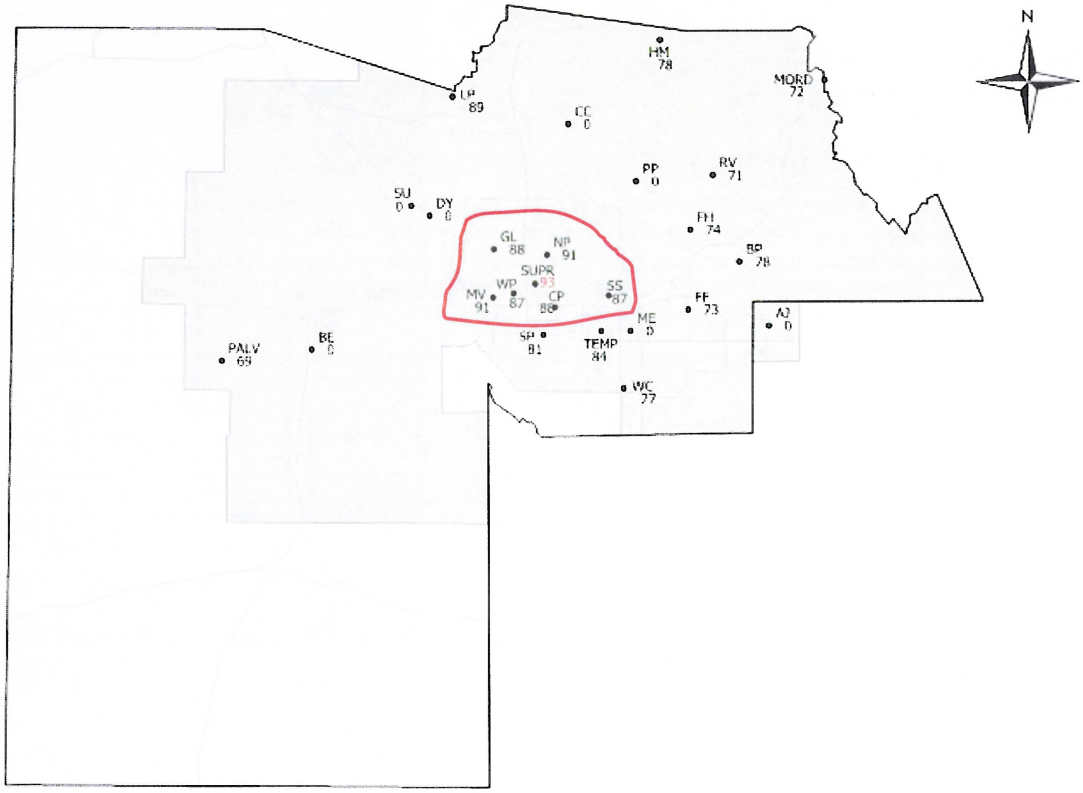


Figure D.3.2. Spatial distribution of daily maximum 8-hr ozone value on 8/10/2000 (unit: ppb)

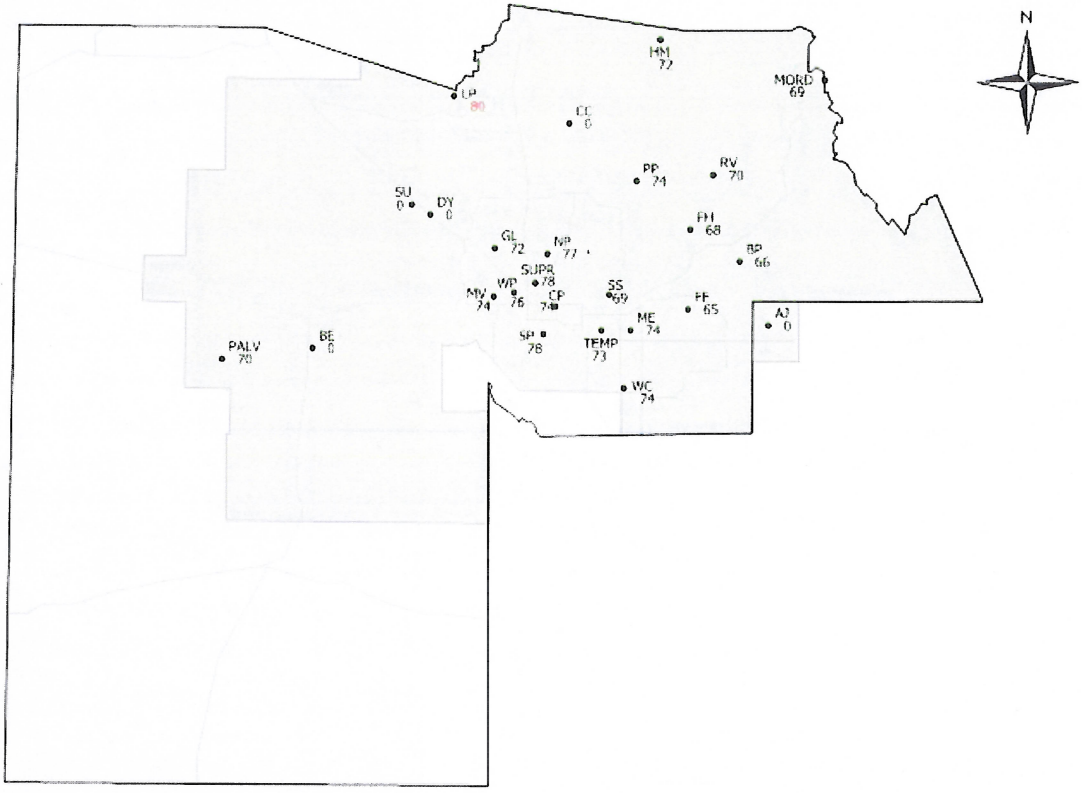


Figure D.3.3. Spatial distribution of daily maximum 8-hr ozone value on 8/12/2000 (unit: ppb)

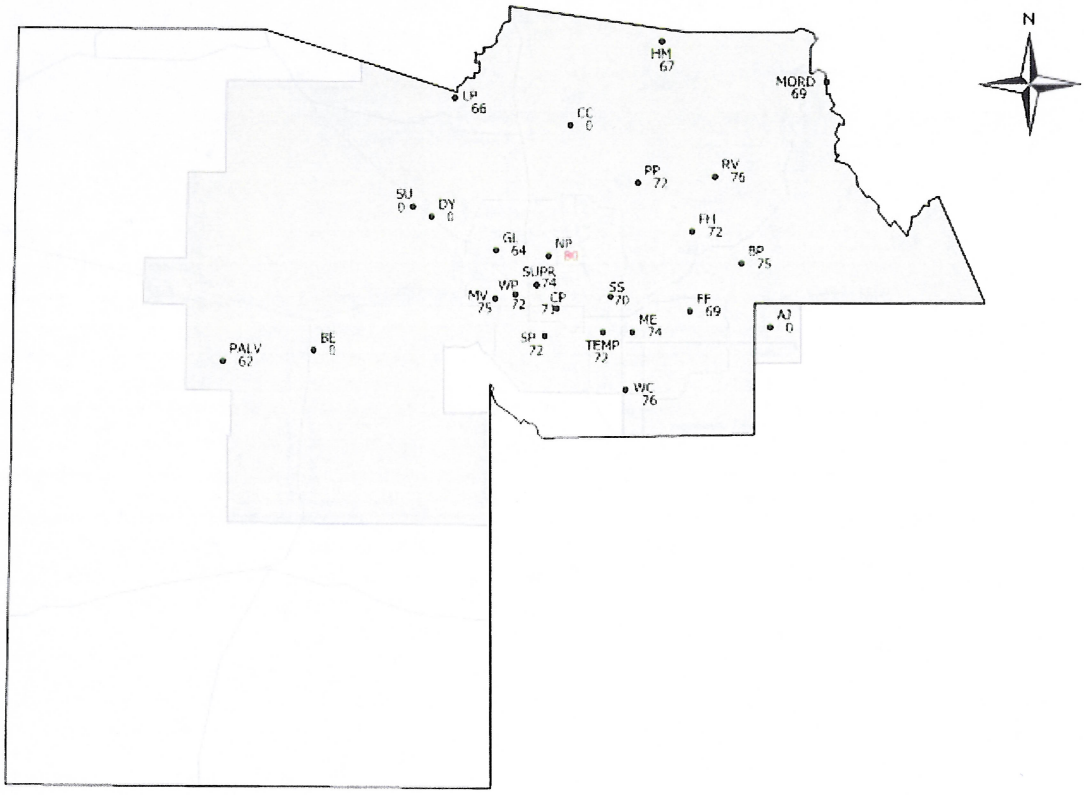


Figure D.3.4. Spatial distribution of daily maximum 8-hr ozone value on 8/13/2000 (unit: ppb)

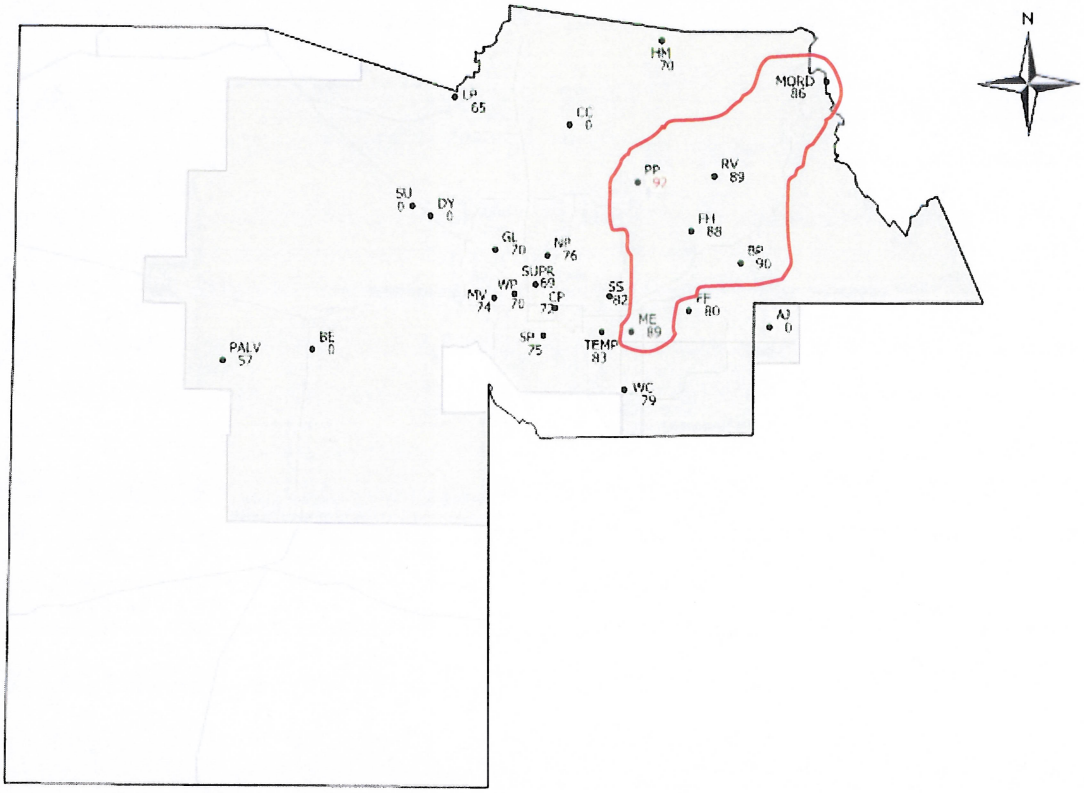


Figure D.3.5. Spatial distribution of daily maximum 8-hr ozone value on 8/14/2000 (unit: ppb)

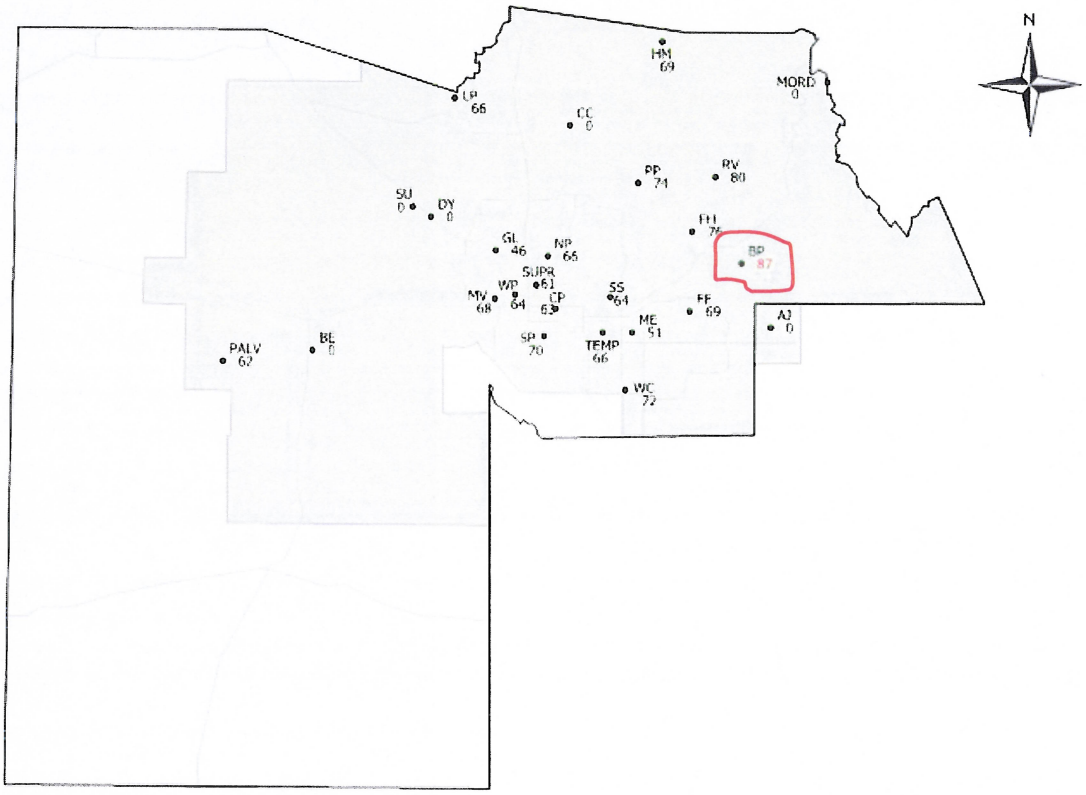


Figure D.3.6. Spatial distribution of daily maximum 8-hr ozone value on 8/15/2000 (unit: ppb)

D.4 Episode 4 (July 30-August 5, 2000)

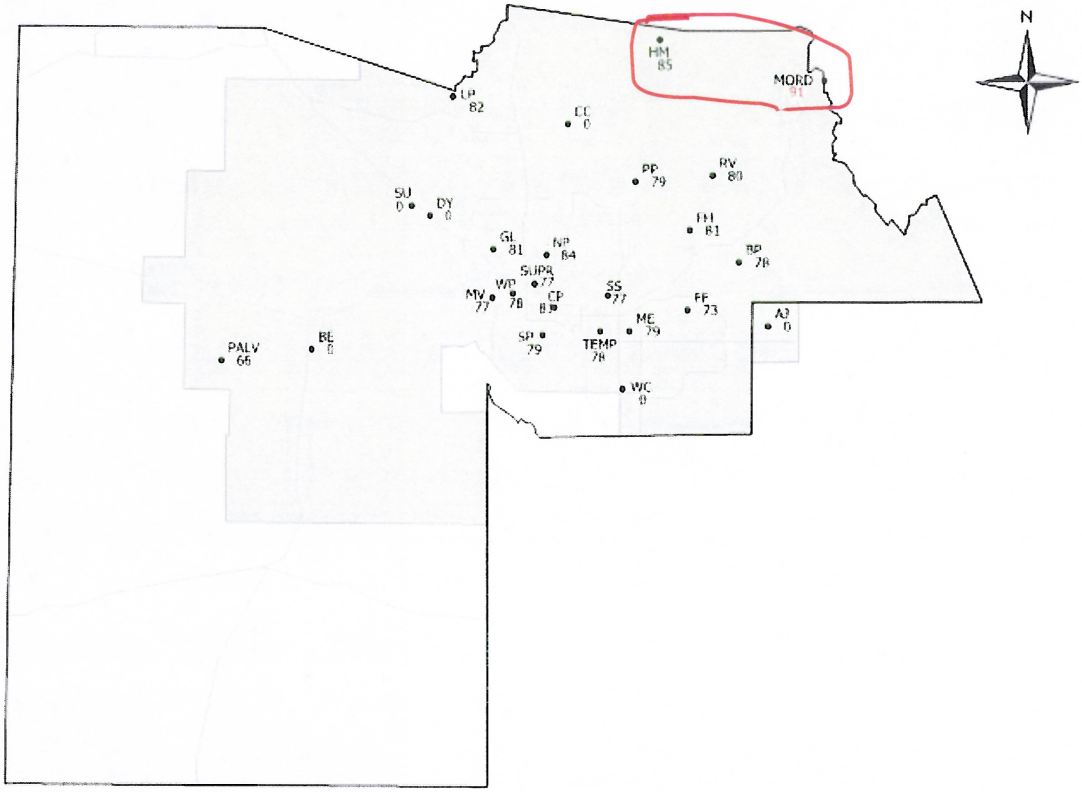


Figure D.4.1. Spatial distribution of daily maximum 8-hr ozone value on 7/30/2000 (unit: ppb)

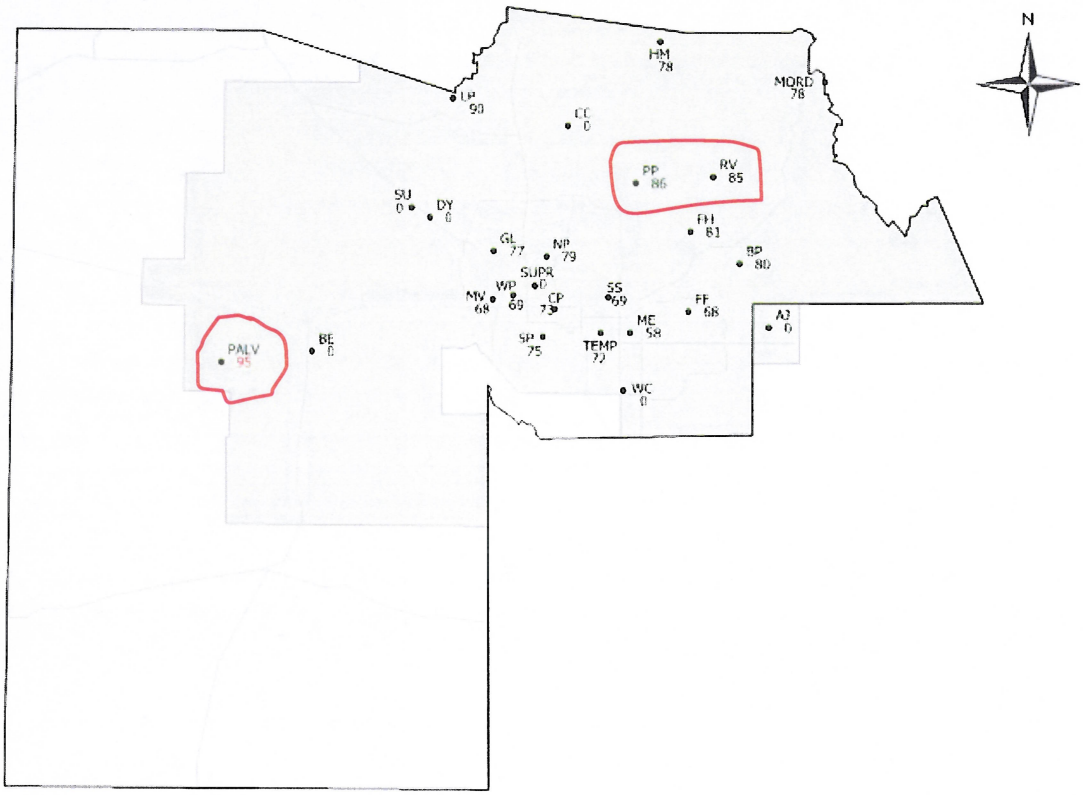


Figure D.4.2. Spatial distribution of daily maximum 8-hr ozone value on 7/31/2000 (unit: ppb)

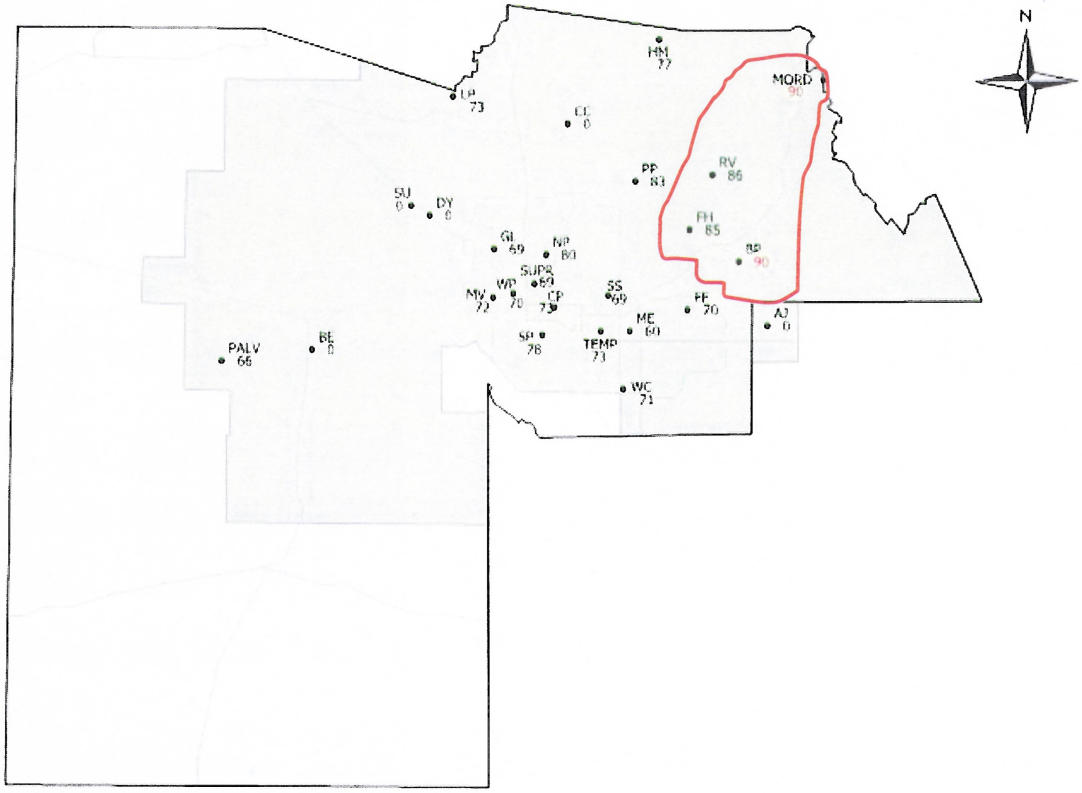


Figure D.4.3. Spatial distribution of daily maximum 8-hr ozone value on 8/1/2000 (unit: ppb)

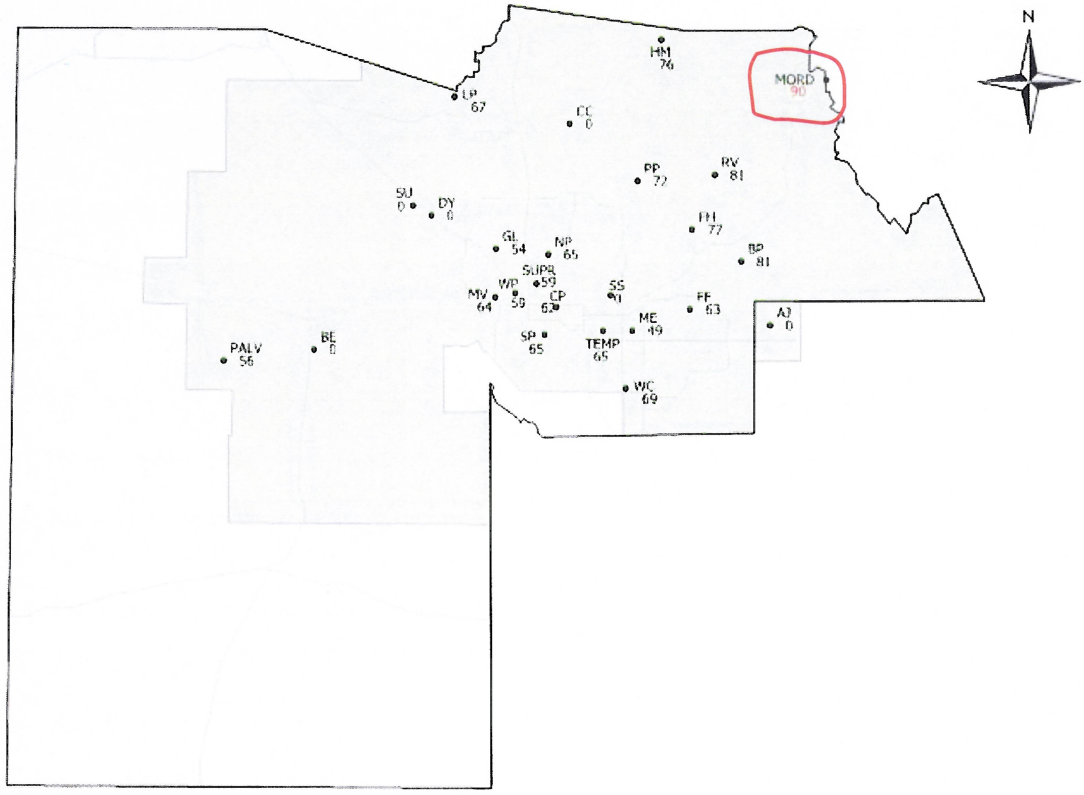


Figure D.4.4. Spatial distribution of daily maximum 8-hr ozone value on 8/2/2000 (unit: ppb)

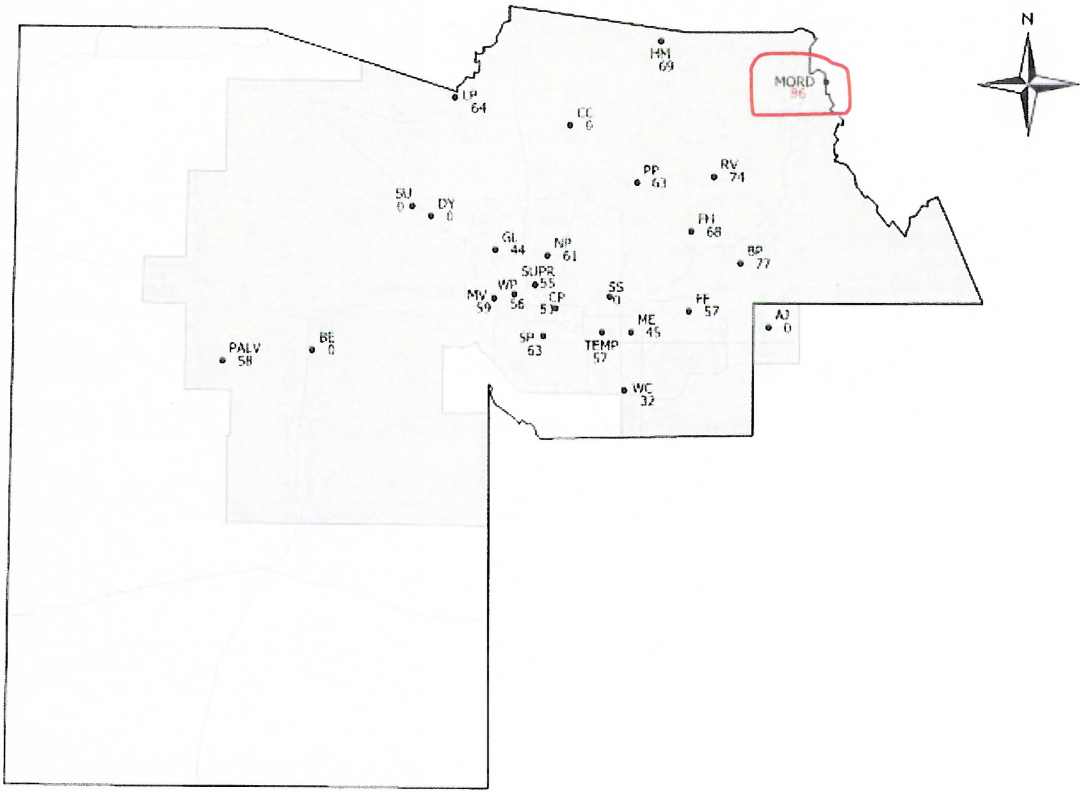


Figure D.4.5. Spatial distribution of daily maximum 8-hr ozone value on 8/3/2000 (unit: ppb)

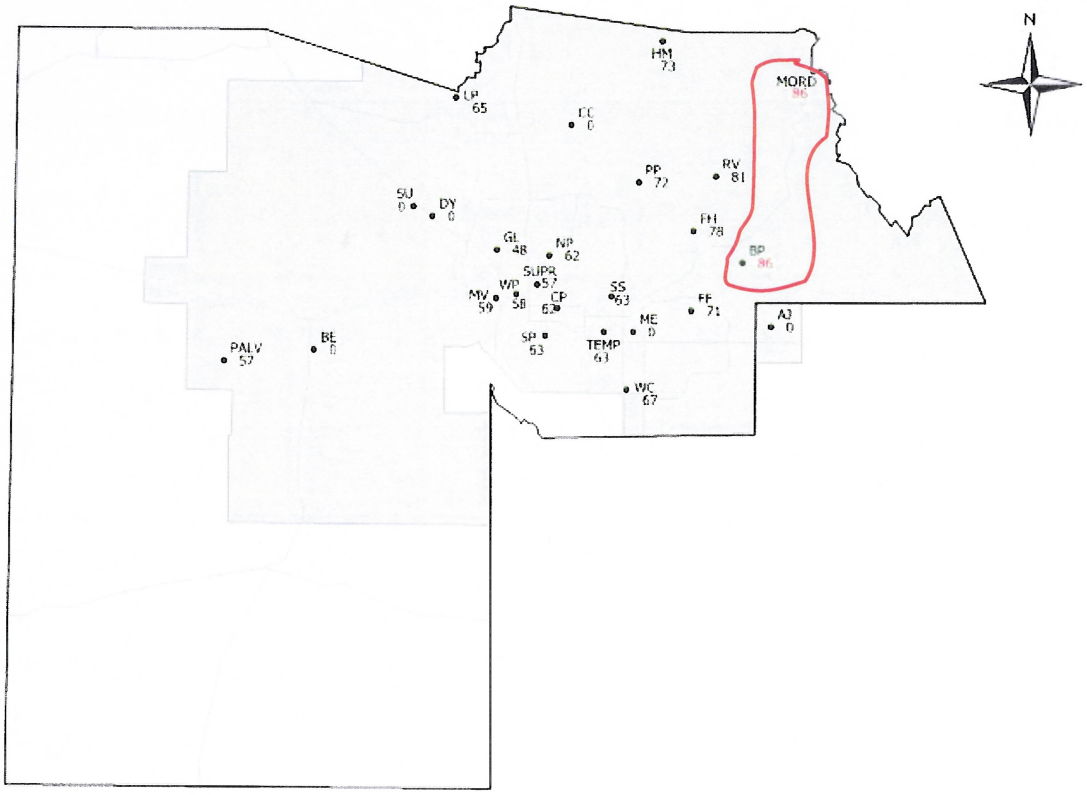


Figure D.4.6. Spatial distribution of daily maximum 8-hr ozone value on 8/4/2000 (unit: ppb)

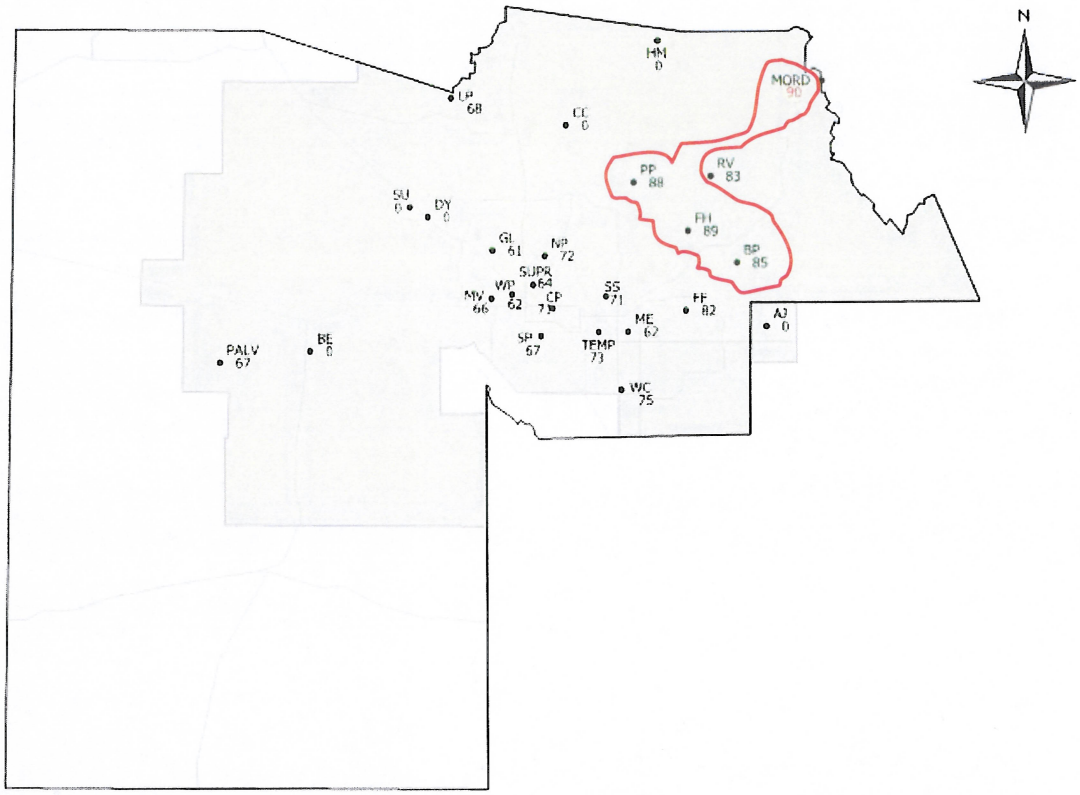


Figure D.4.7. Spatial distribution of daily maximum 8-hr ozone value on 8/5/2000 (unit: ppb)

D.5 Episode 5 (June 3-7, 2002)

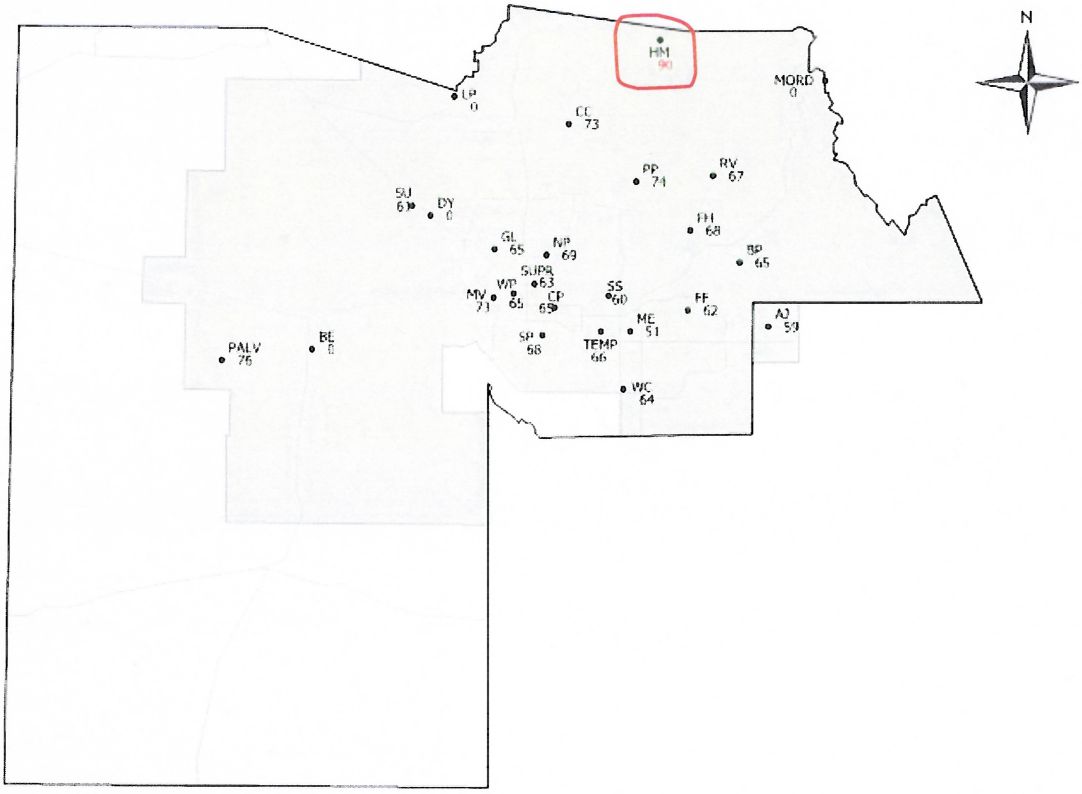


Figure D.5.1. Spatial distribution of daily maximum 8-hr ozone value on 6/3/2002 (unit: ppb)

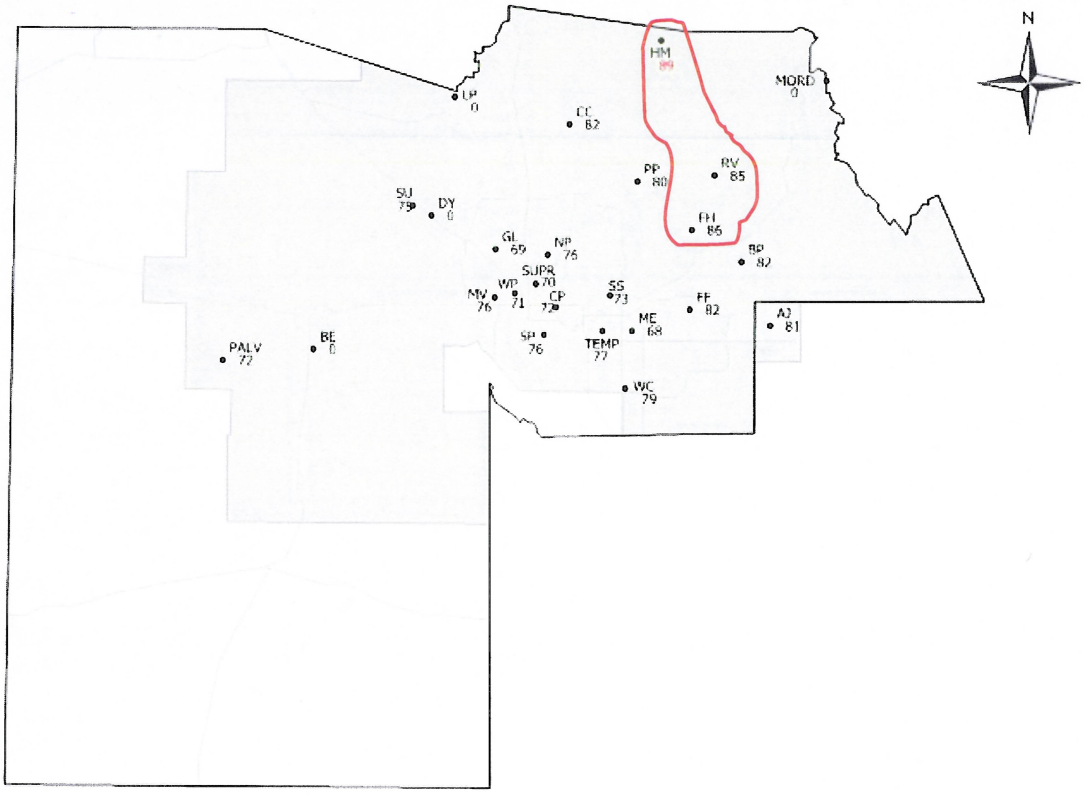


Figure D.5.2. Spatial distribution of daily maximum 8-hr ozone value on 6/4/2002 (unit: ppb)

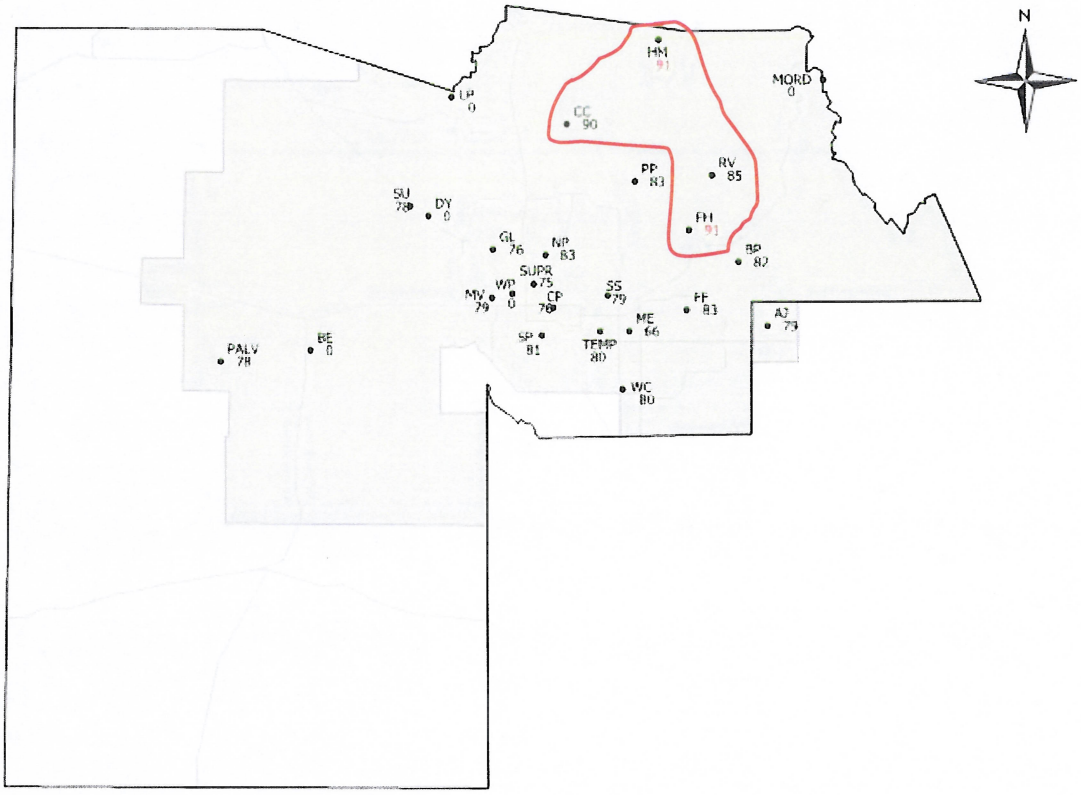


Figure D.5.3. Spatial distribution of daily maximum 8-hr ozone value on 6/5/2002 (unit: ppb)

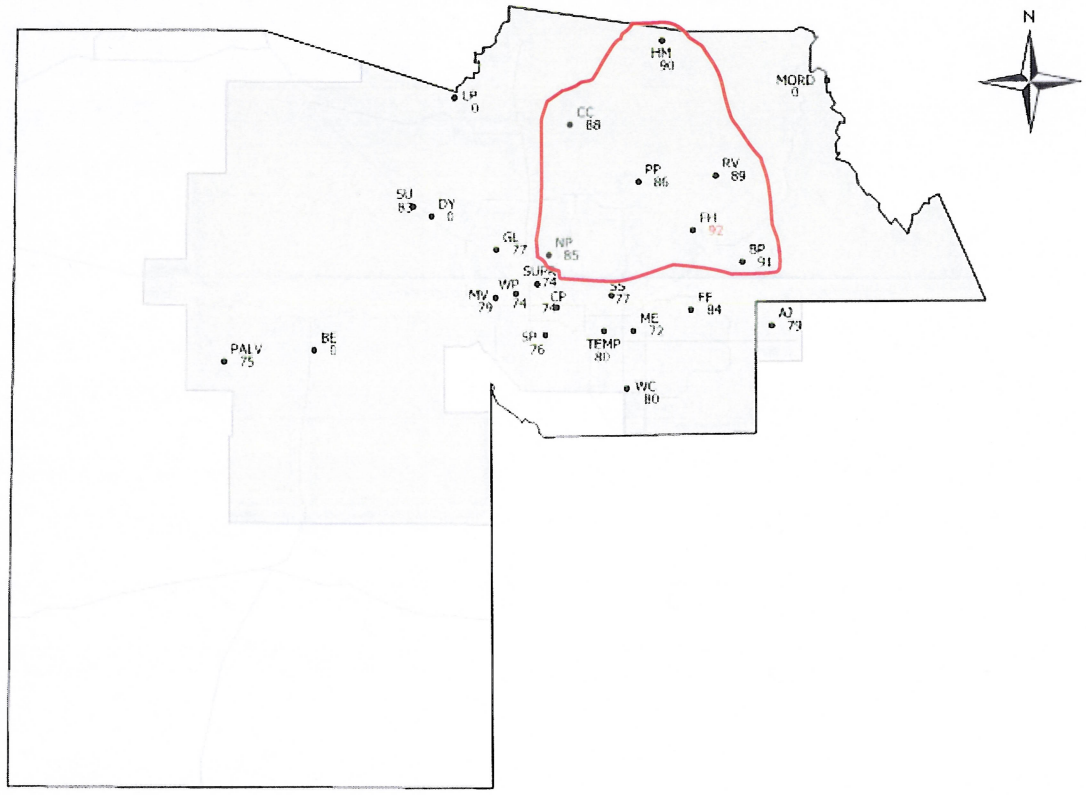


Figure D.5.4. Spatial distribution of daily maximum 8-hr ozone value on 6/6/2002 (unit: ppb)

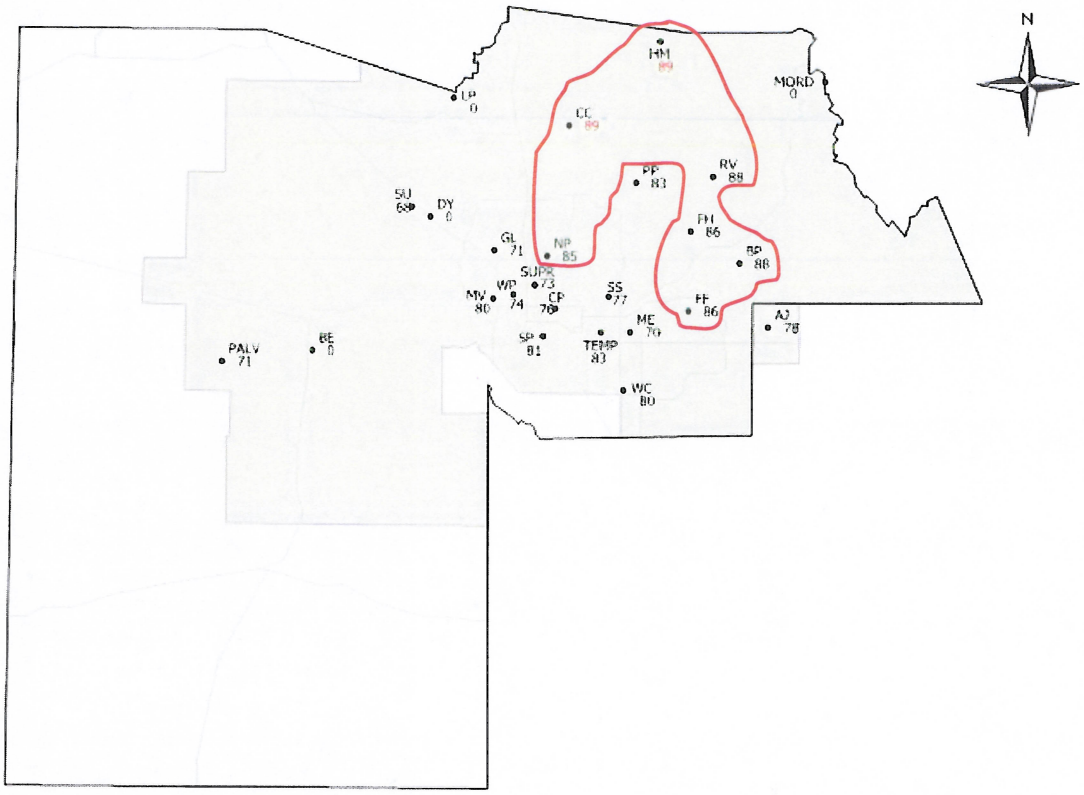


Figure D.5.5. Spatial distribution of daily maximum 8-hr ozone value on 6/7/2002 (unit: ppb)

D.6 Episode 6 (July 21-23, 2003)

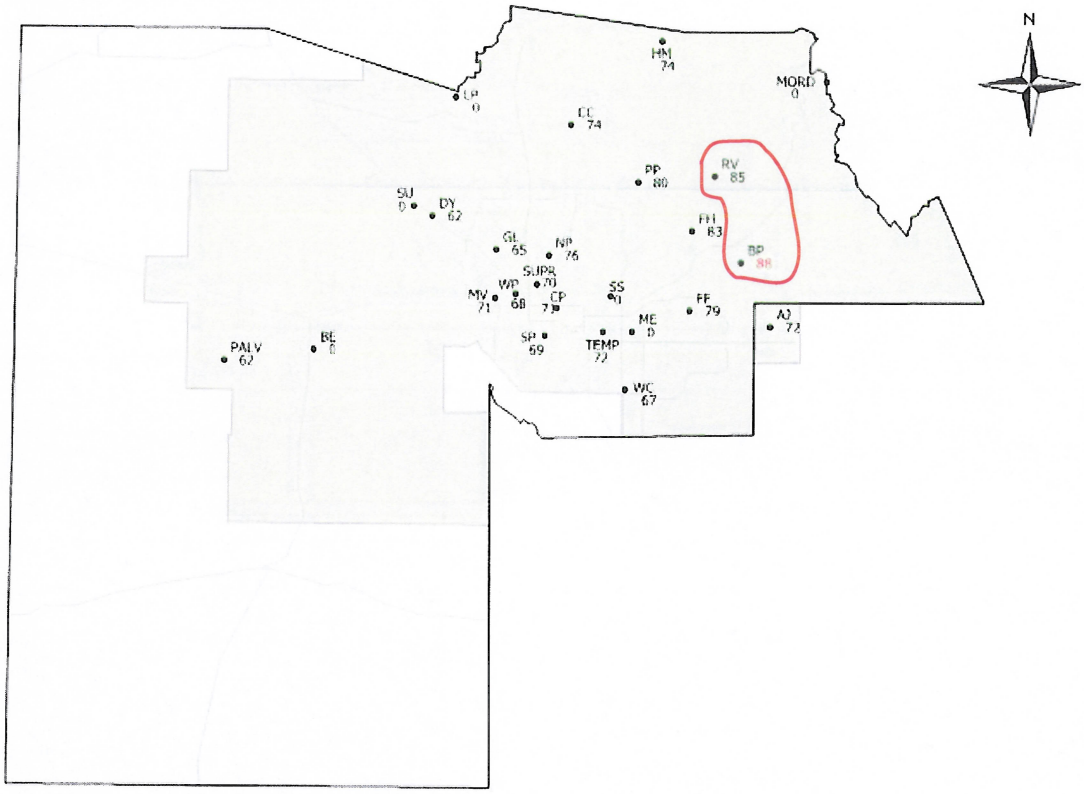


Figure D.6.1. Spatial distribution of daily maximum 8-hr ozone value on 7/21/2003 (unit: ppb)

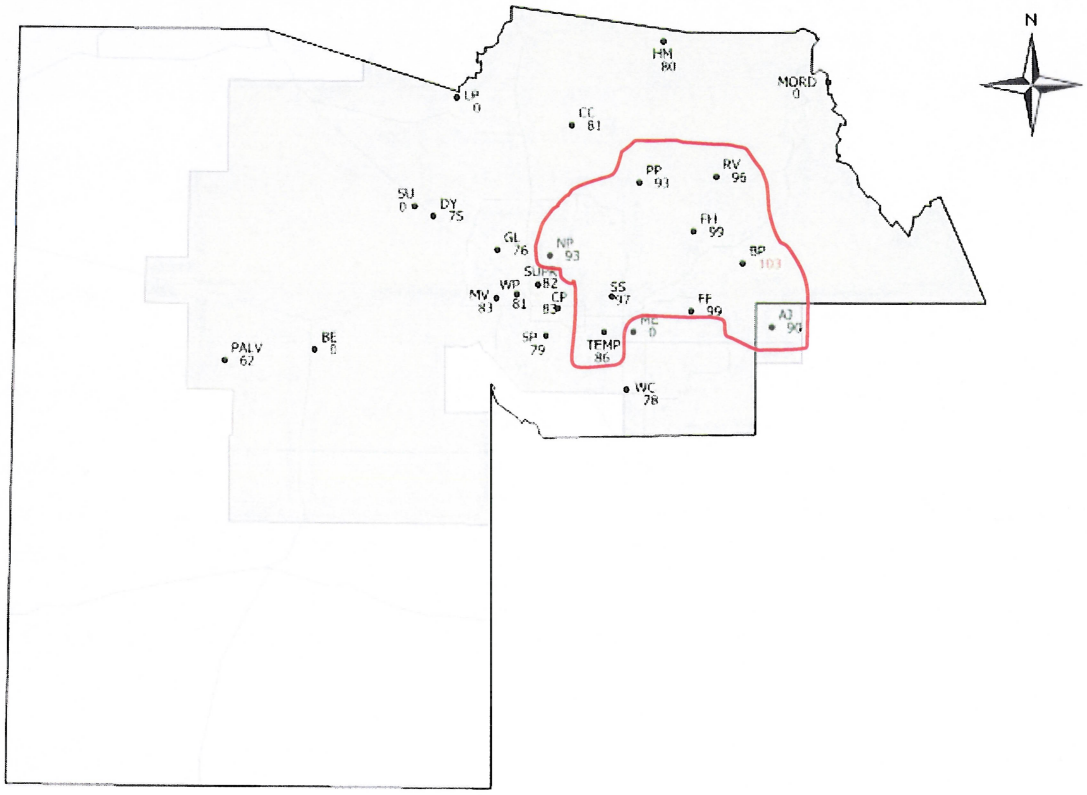


Figure D.6.2. Spatial distribution of daily maximum 8-hr ozone value on 7/22/2003 (unit: ppb)

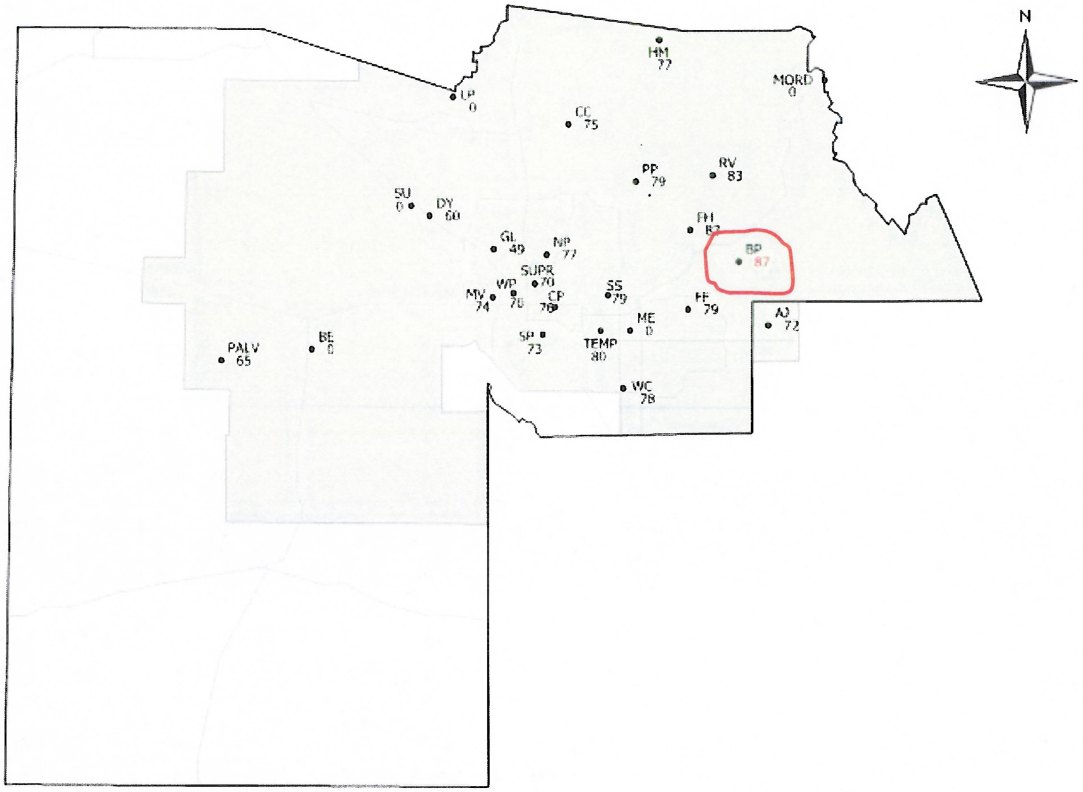


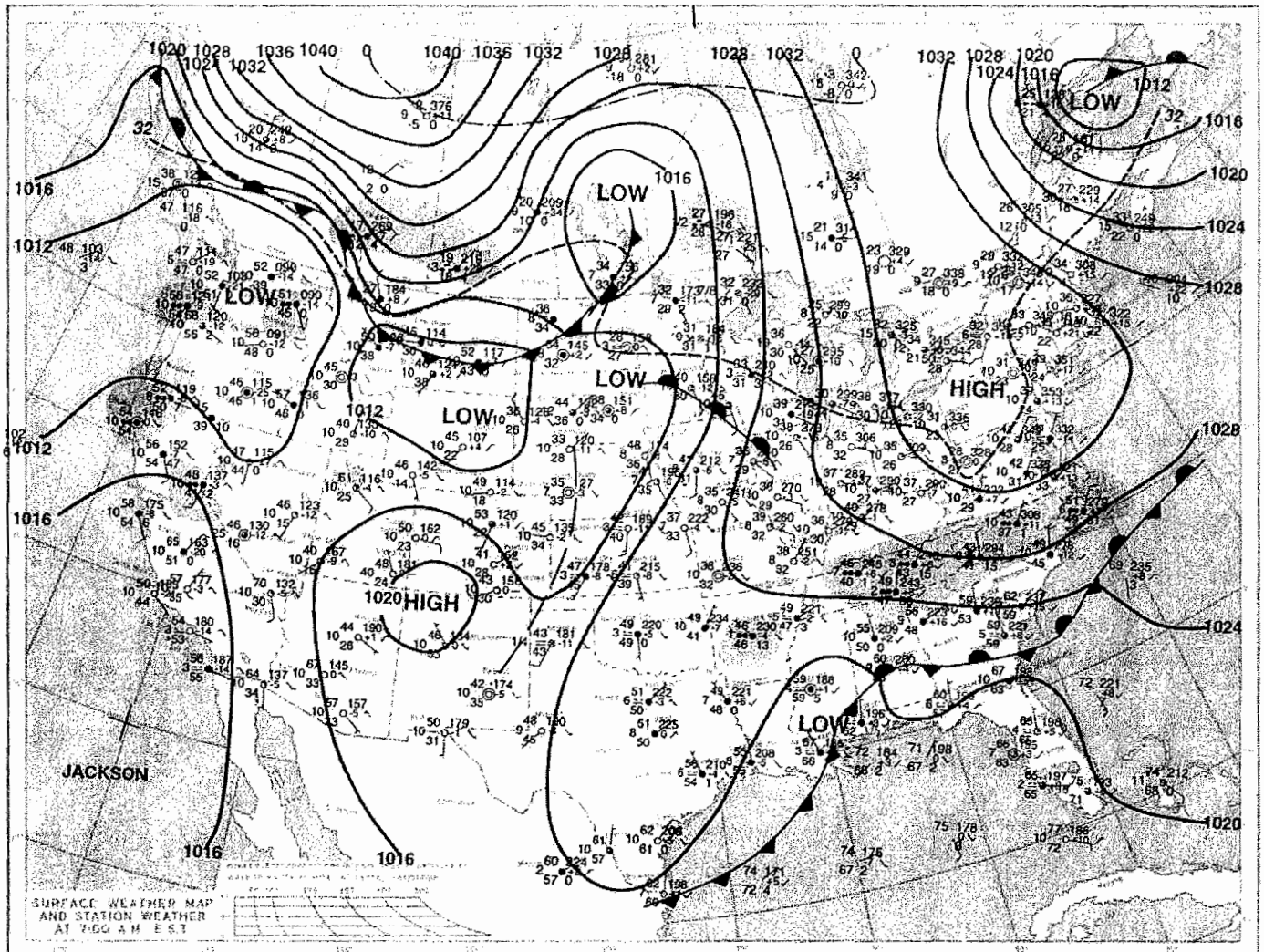
Figure D.6.3. Spatial distribution of daily maximum 8-hr ozone value on 7/23/2003 (unit: ppb)

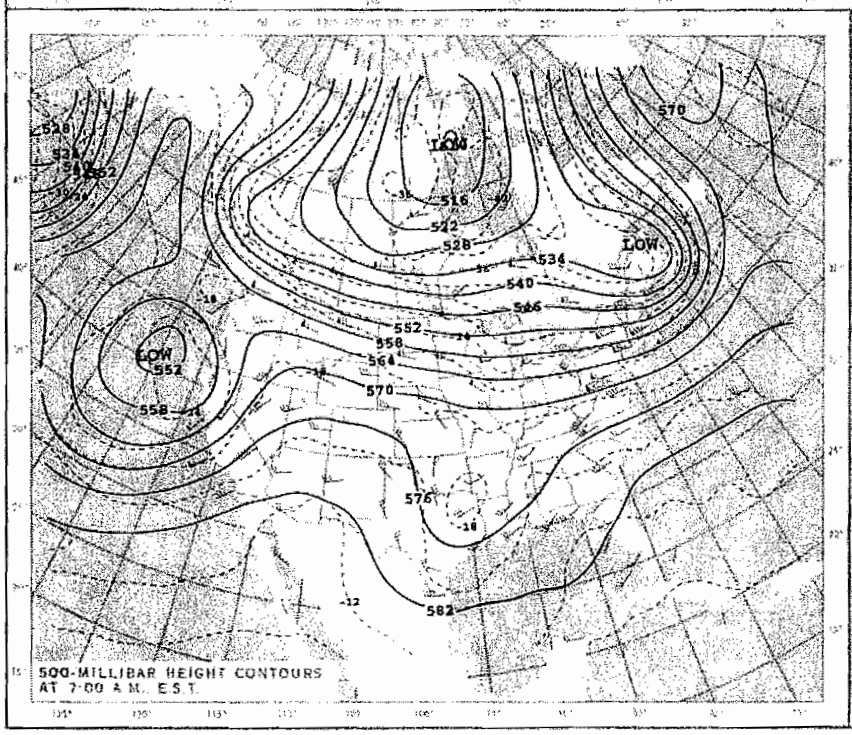
APPENDIX E

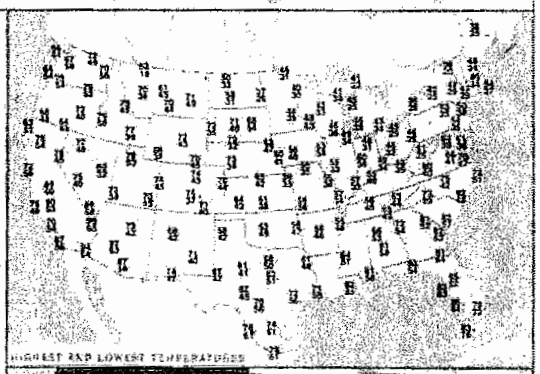
Surface Maps for High Ozone Days over the Five Ozone Seasons of 2000-2004

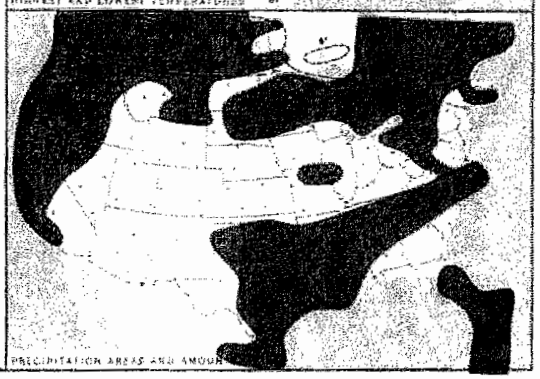
(Source: Daily Weather Maps, Weekly Series, Dept. of Commerce)

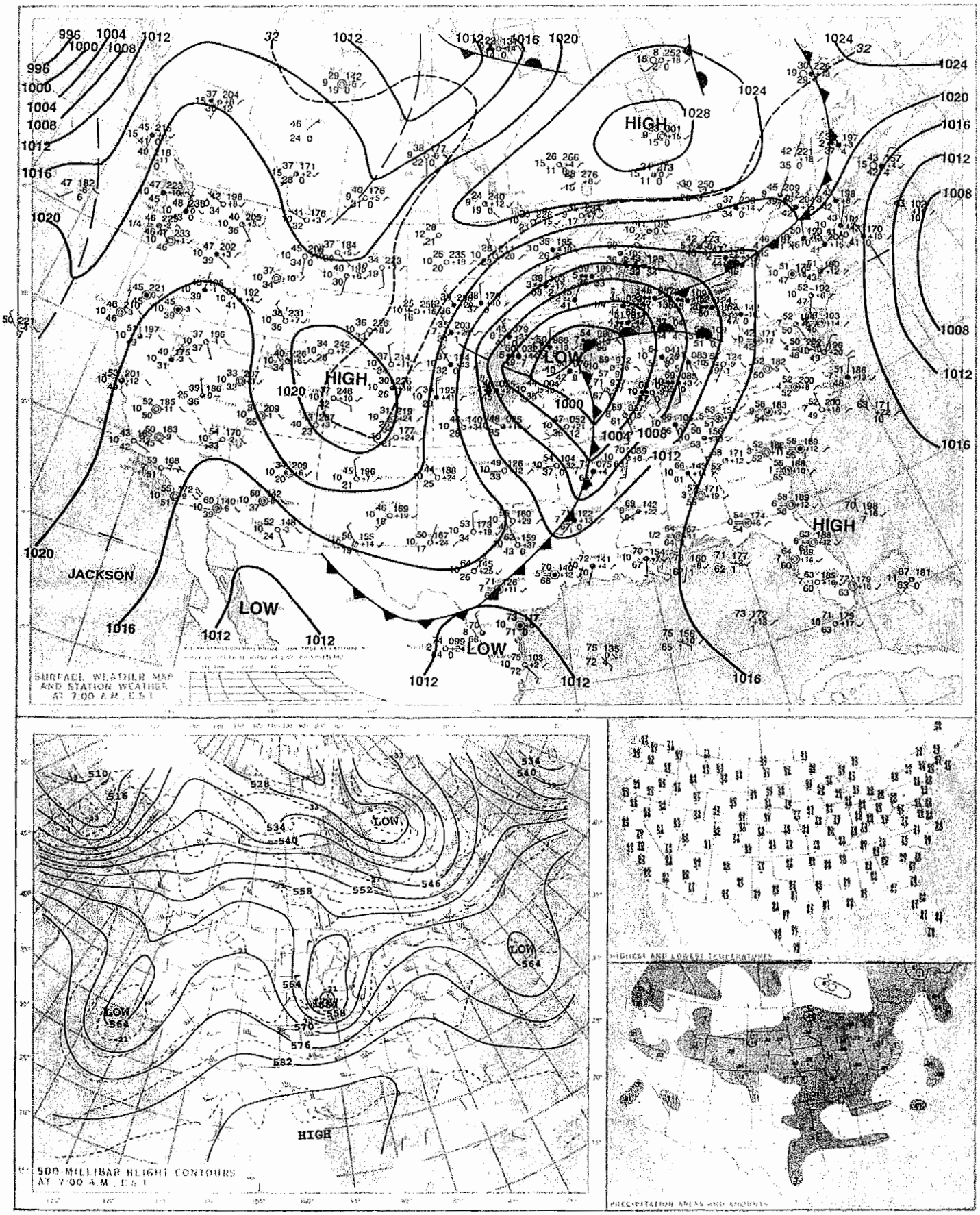
THURSDAY, APRIL 13, 2000



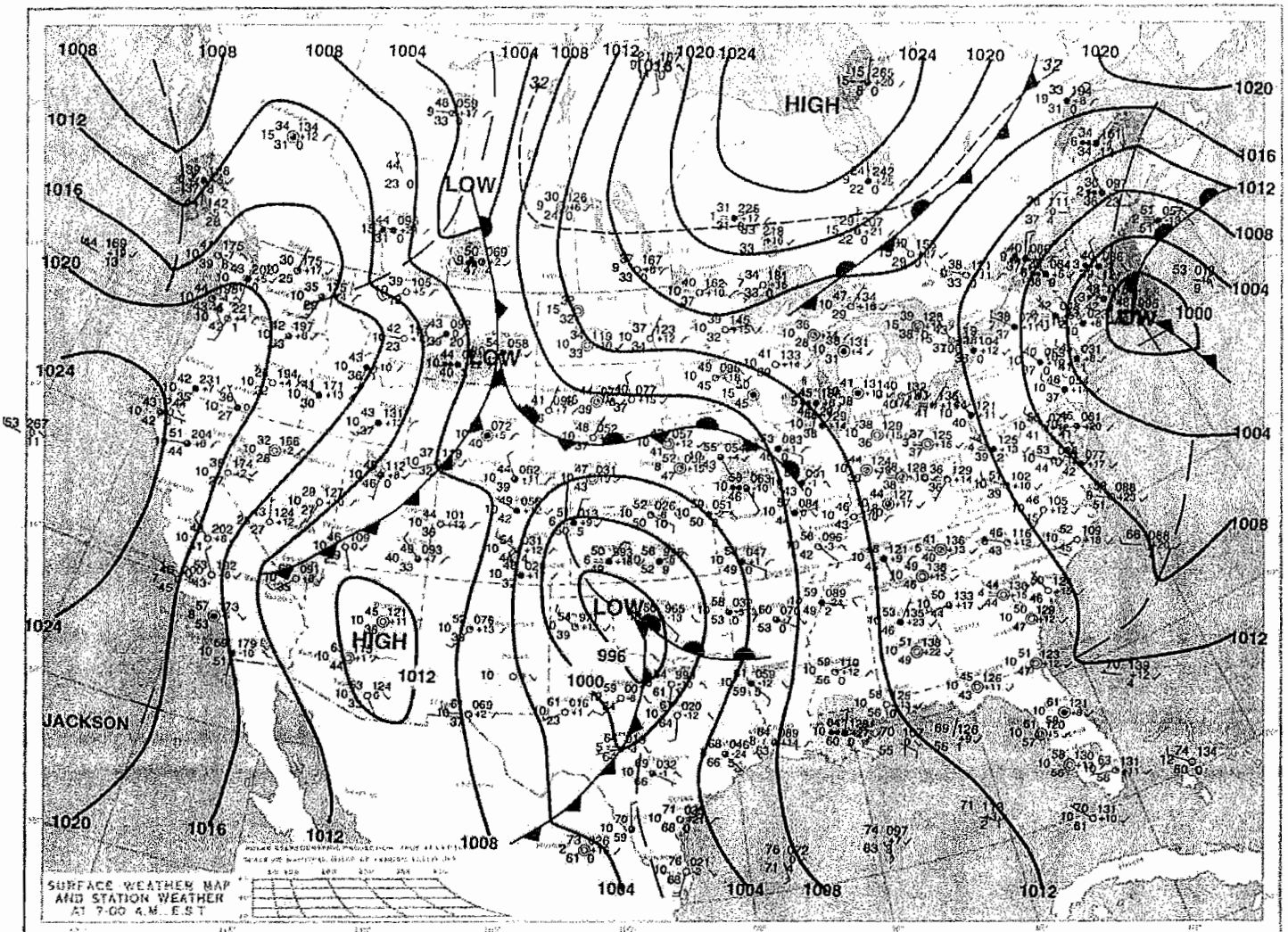


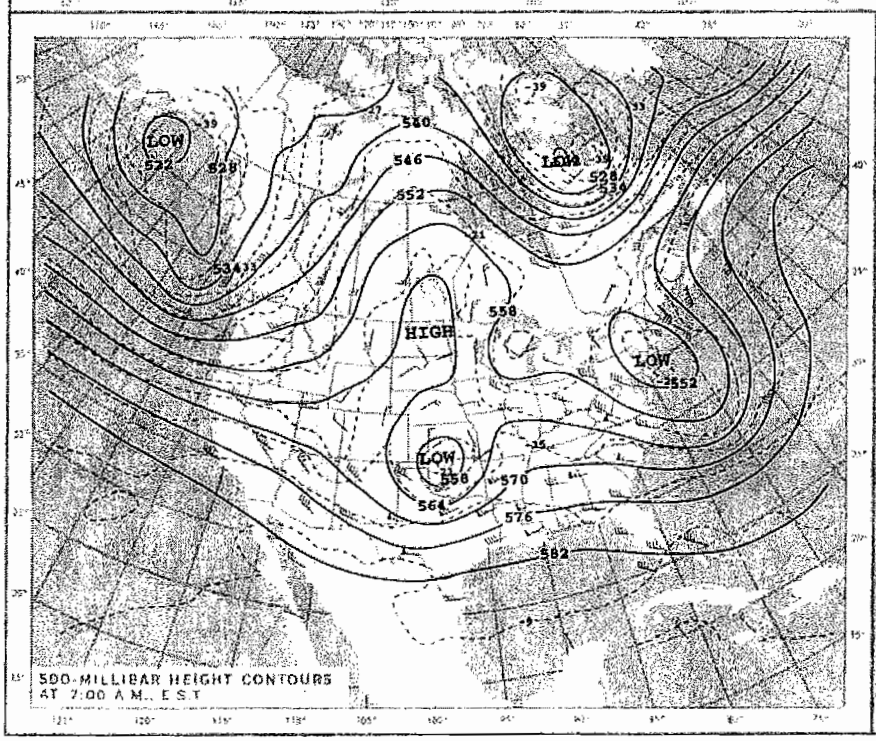


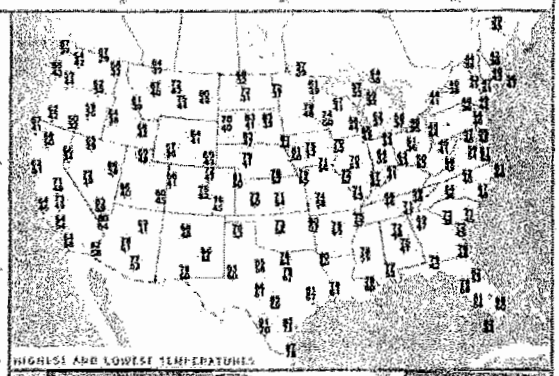


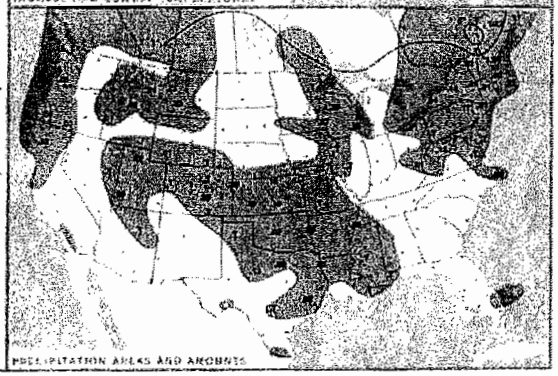

HIGH
LOW
JACKSON
SURFACE WEATHER MAP
AND STATION WEATHER
AT 7:00 A.M. EST
500-MILLIBAR HEIGHT CONTOURS
AT 7:00 A.M. EST
HIGHEST AND LOWEST TEMPERATURES
PRECIPITATION AREAS AND AMOUNTS

SUNDAY, APRIL 23, 2000

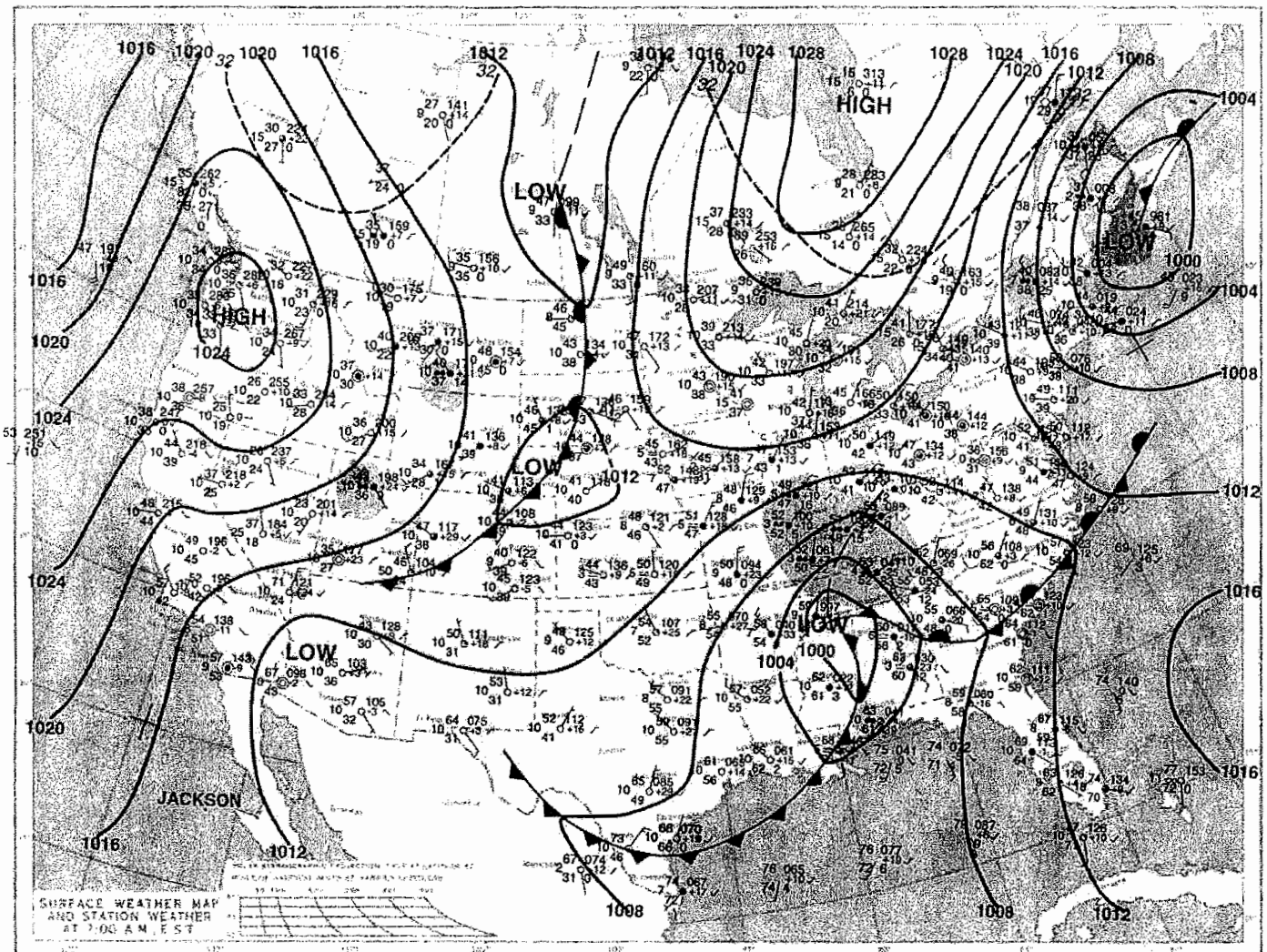


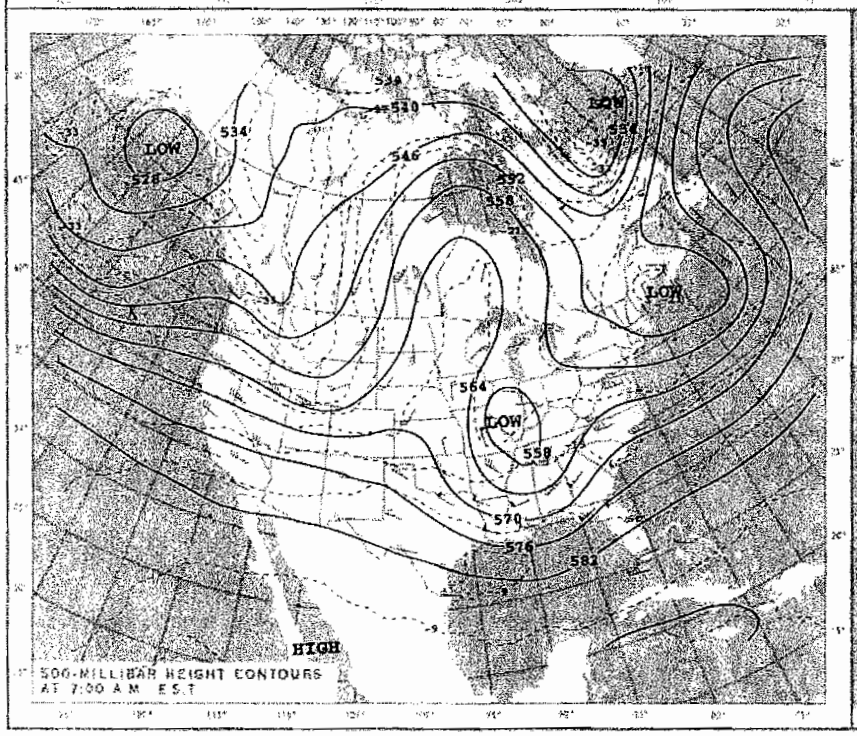


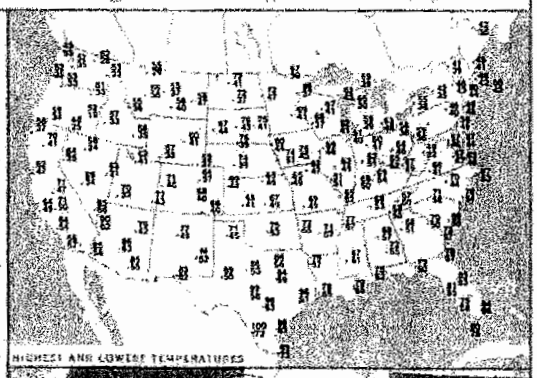




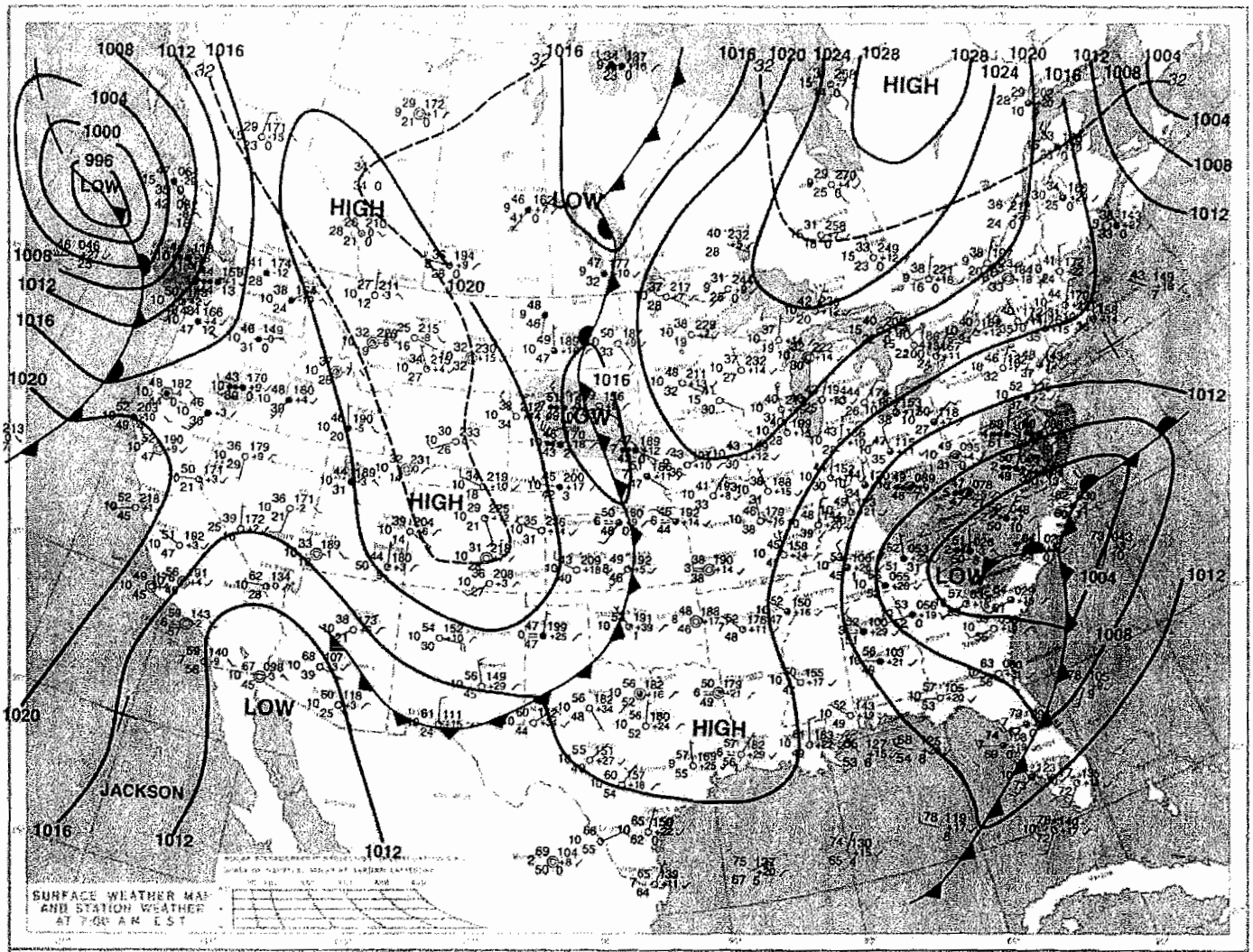
MONDAY, APRIL 24, 2000

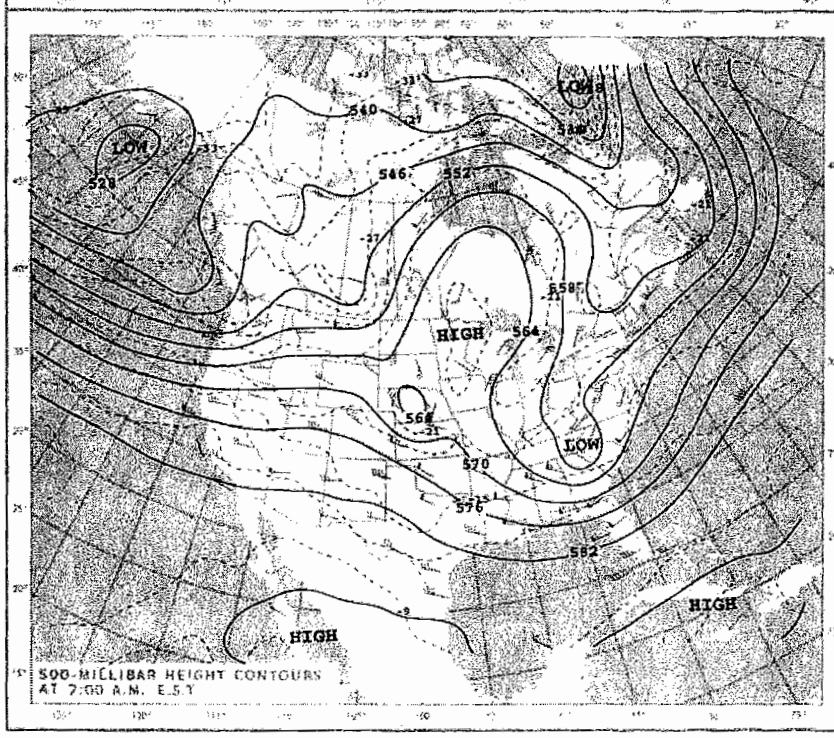


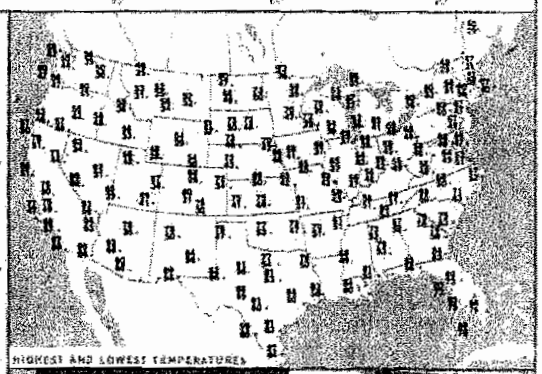


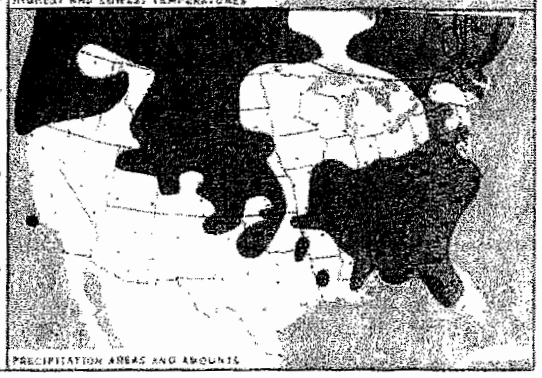


TUESDAY, APRIL 25, 2000

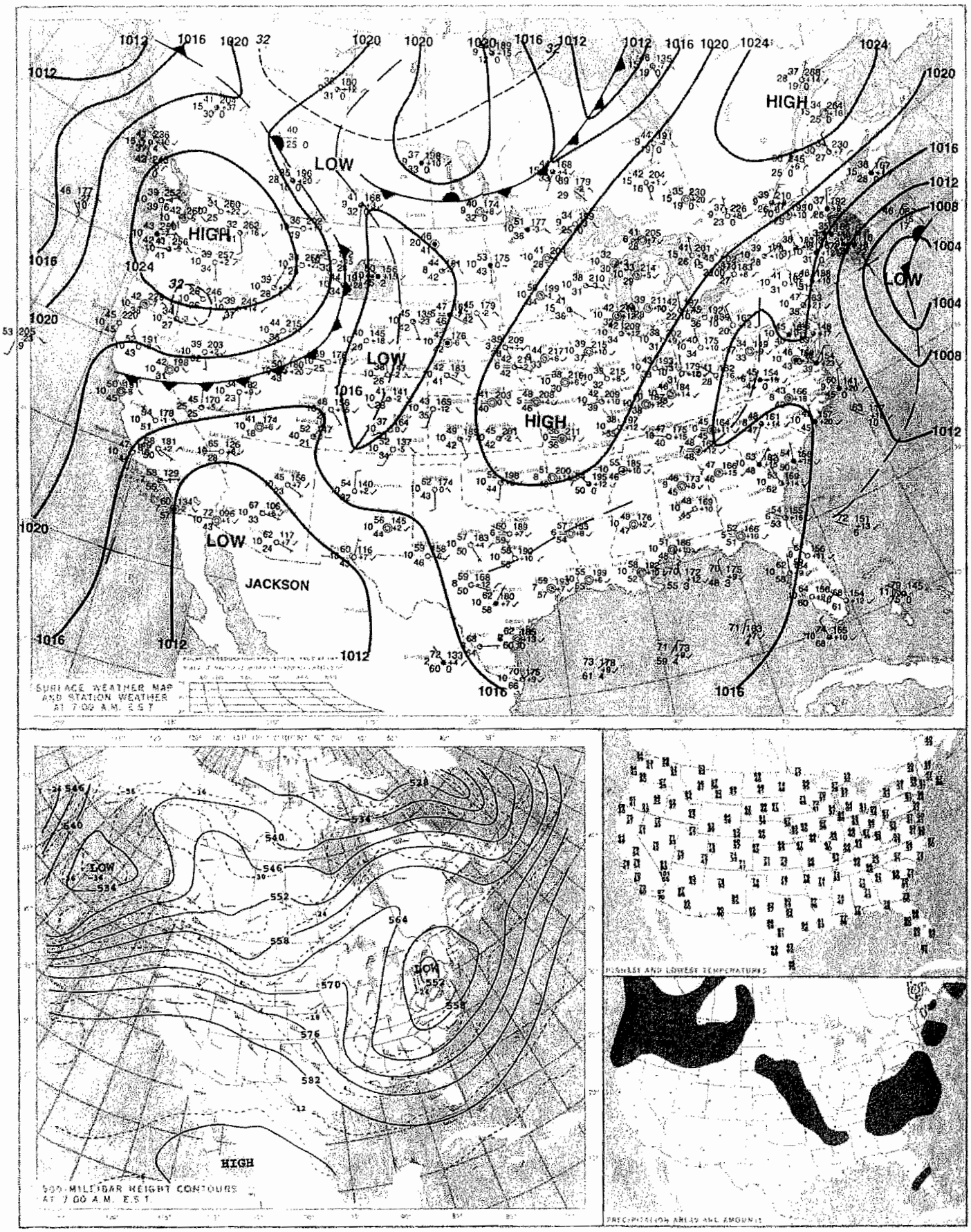


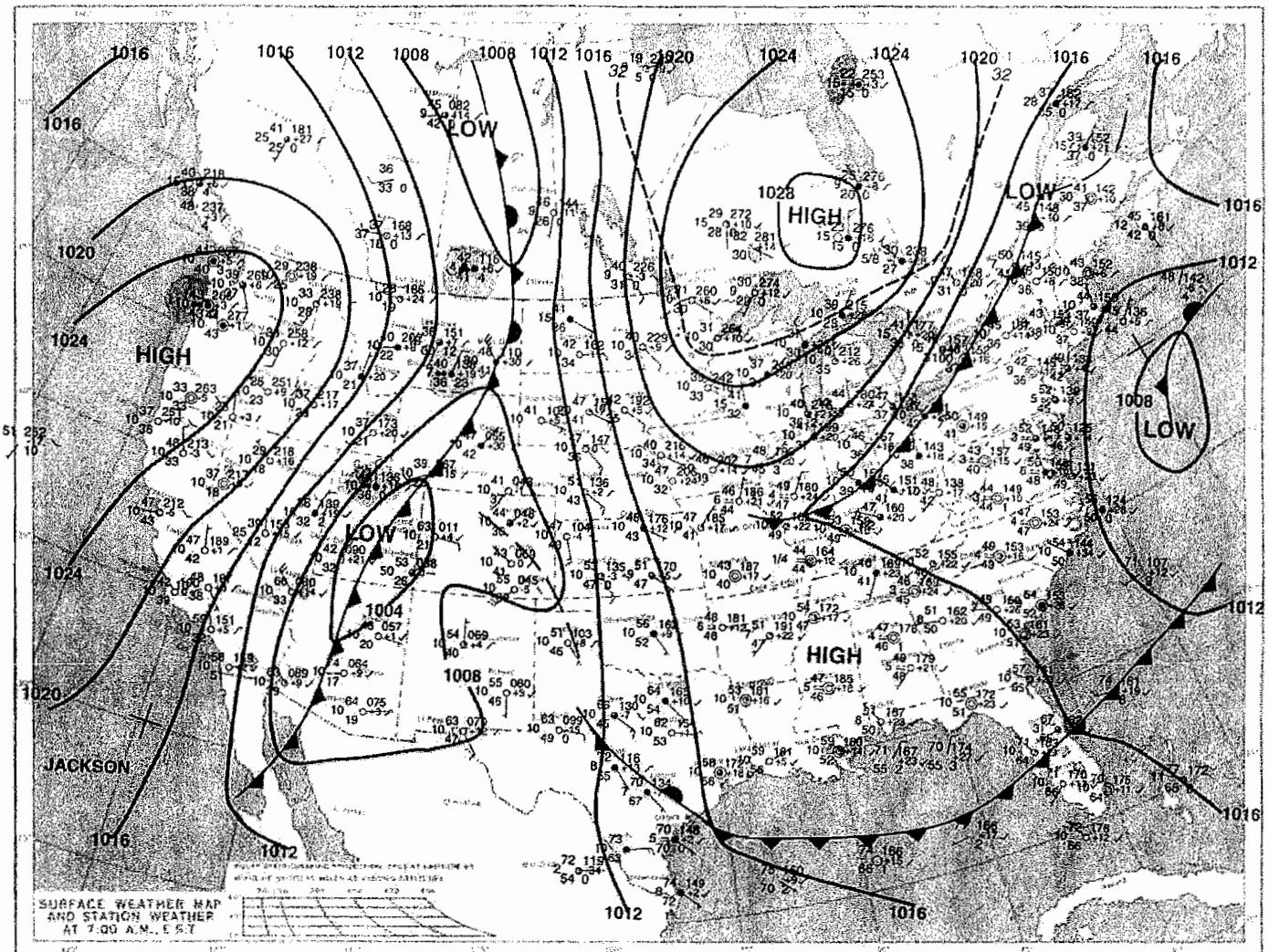


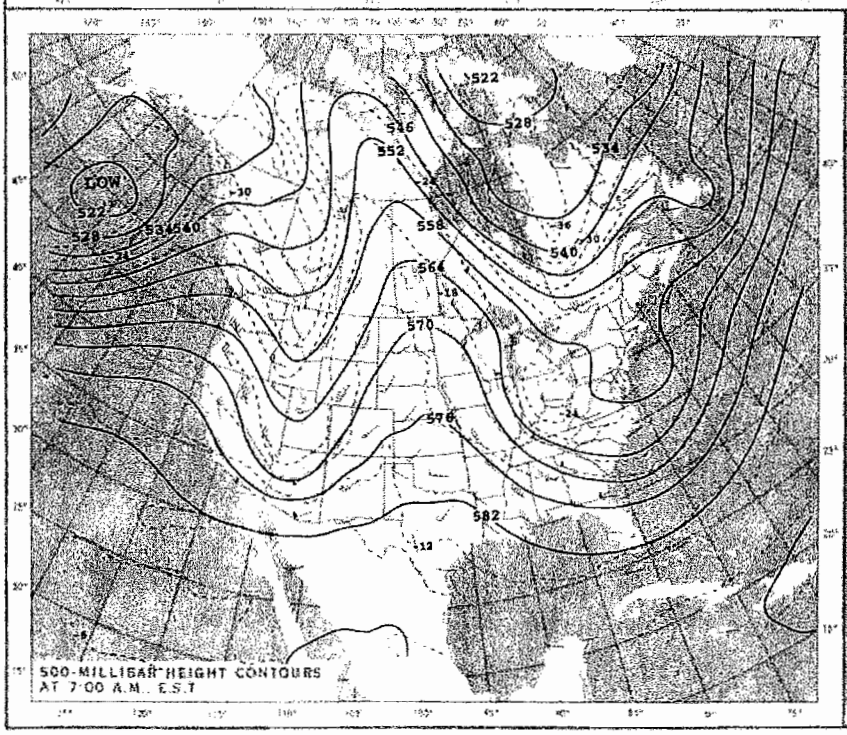


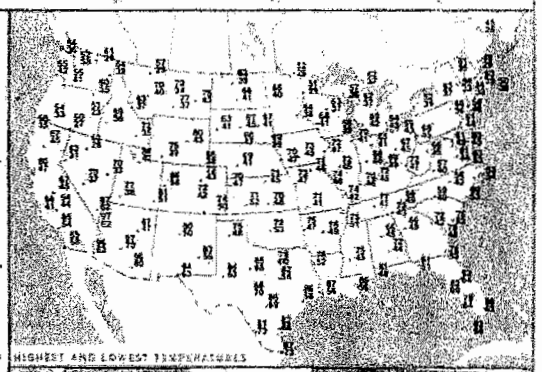


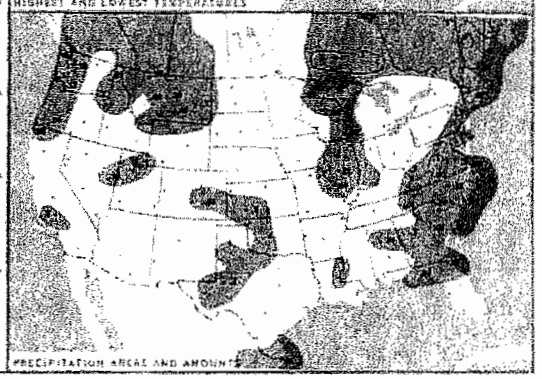
WEDNESDAY, APRIL 26, 2000



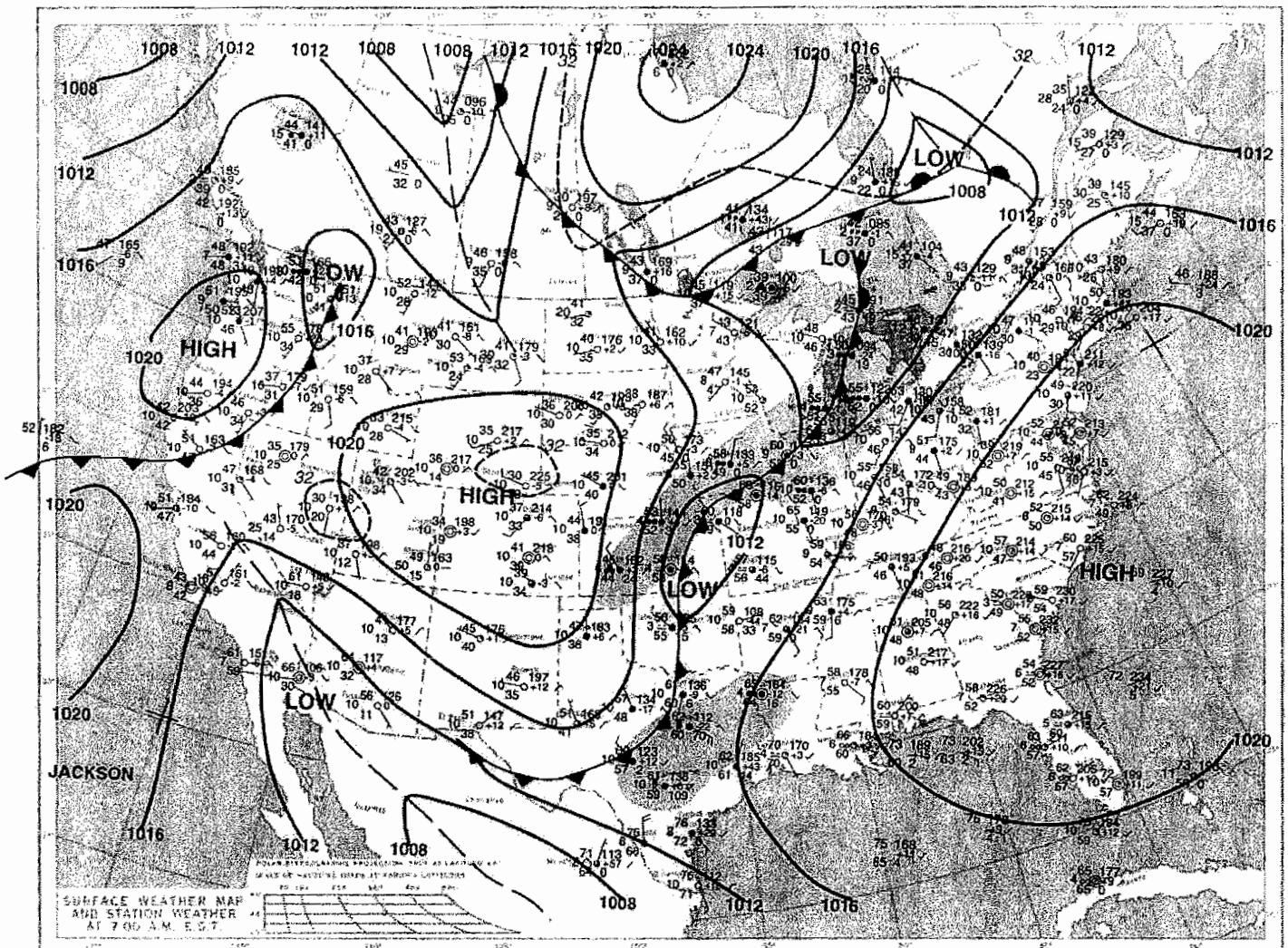

HIGH
LOW
HIGH
LOW
LOW
HIGH
LOW
JACKSON
SURFACE WEATHER MAP
AND STATION WEATHER
AT 7:00 A.M., E.S.T.

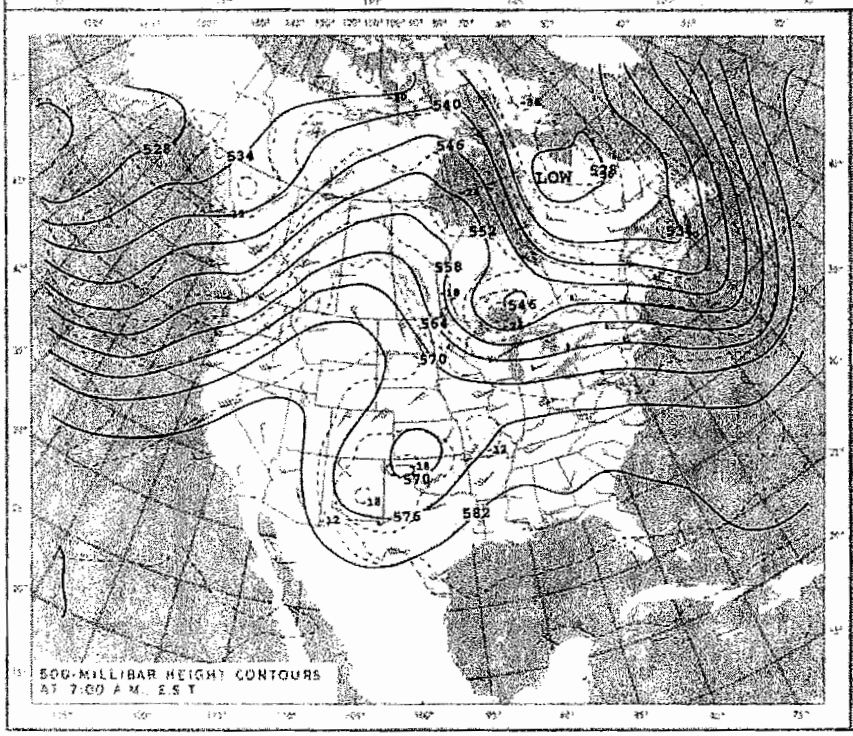

LOW
500-MILLIBAR HEIGHT CONTOURS
AT 7:00 A.M., E.S.T.

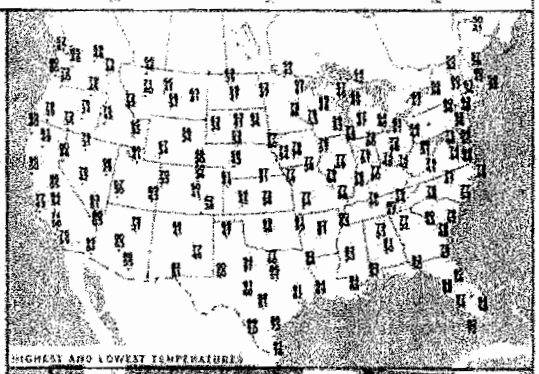

HIGHEST AND LOWEST TEMPERATURES

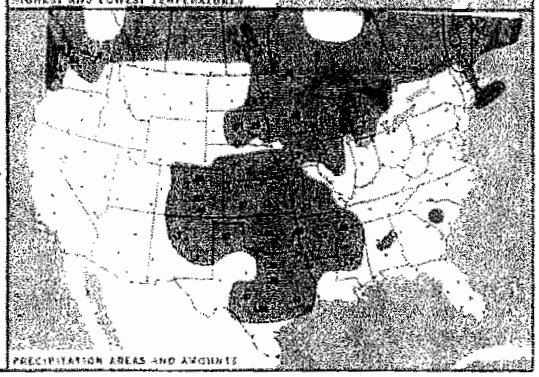

PRECIPITATION AREAS AND AMOUNTS

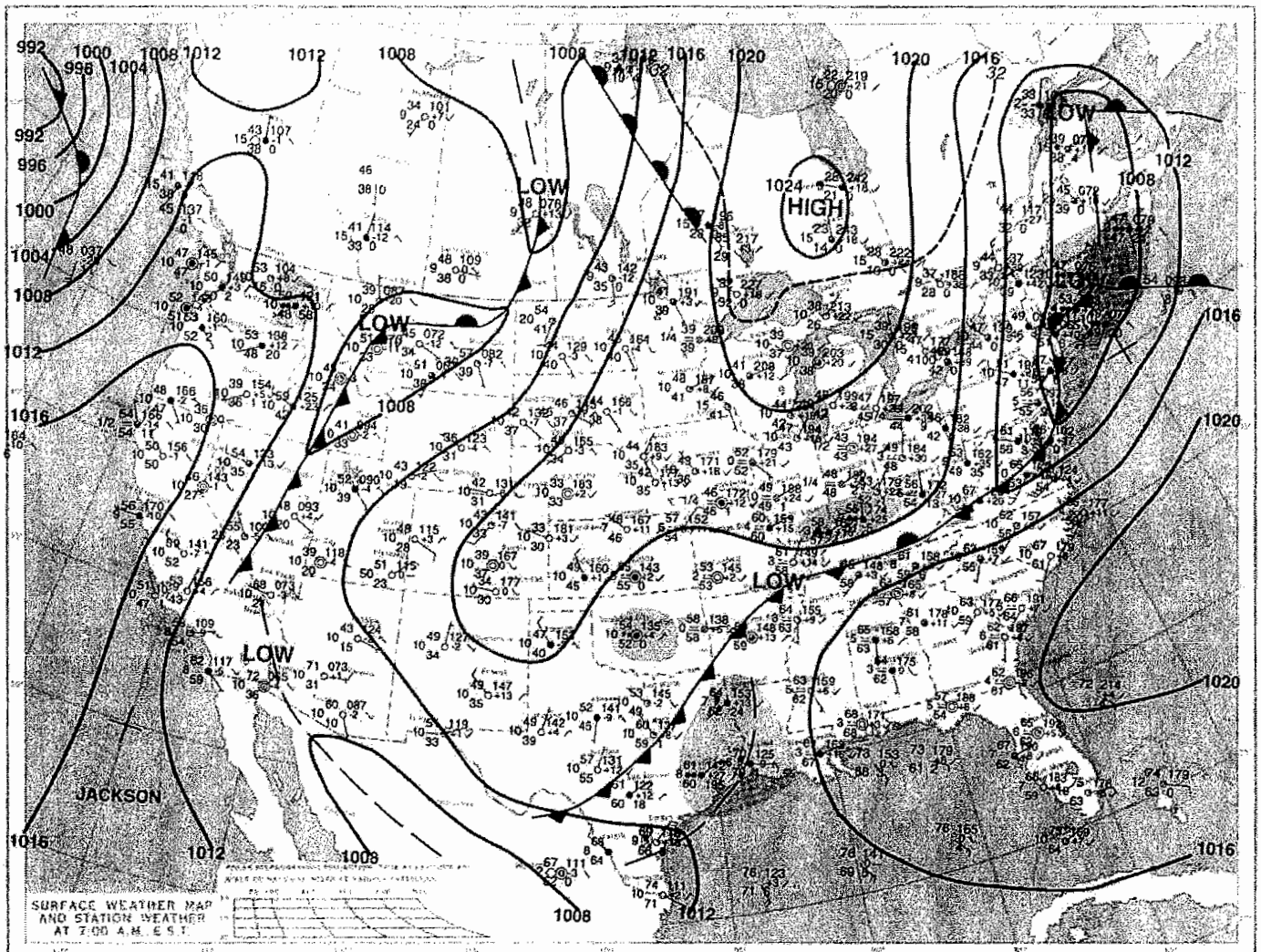
MONDAY, MAY 1, 2000

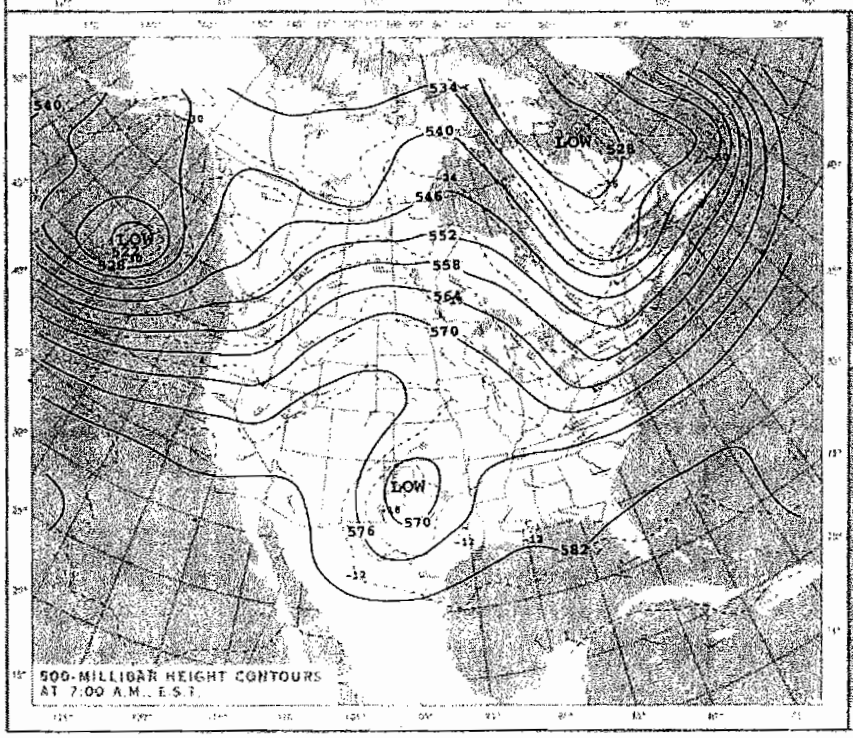


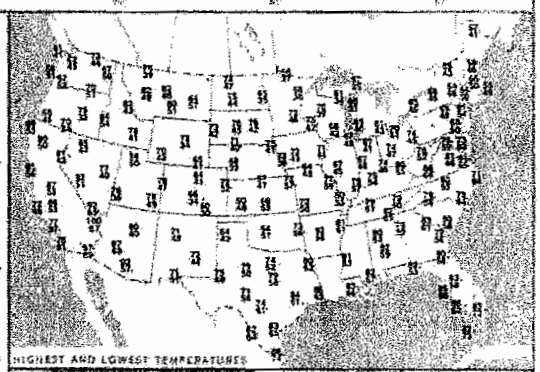






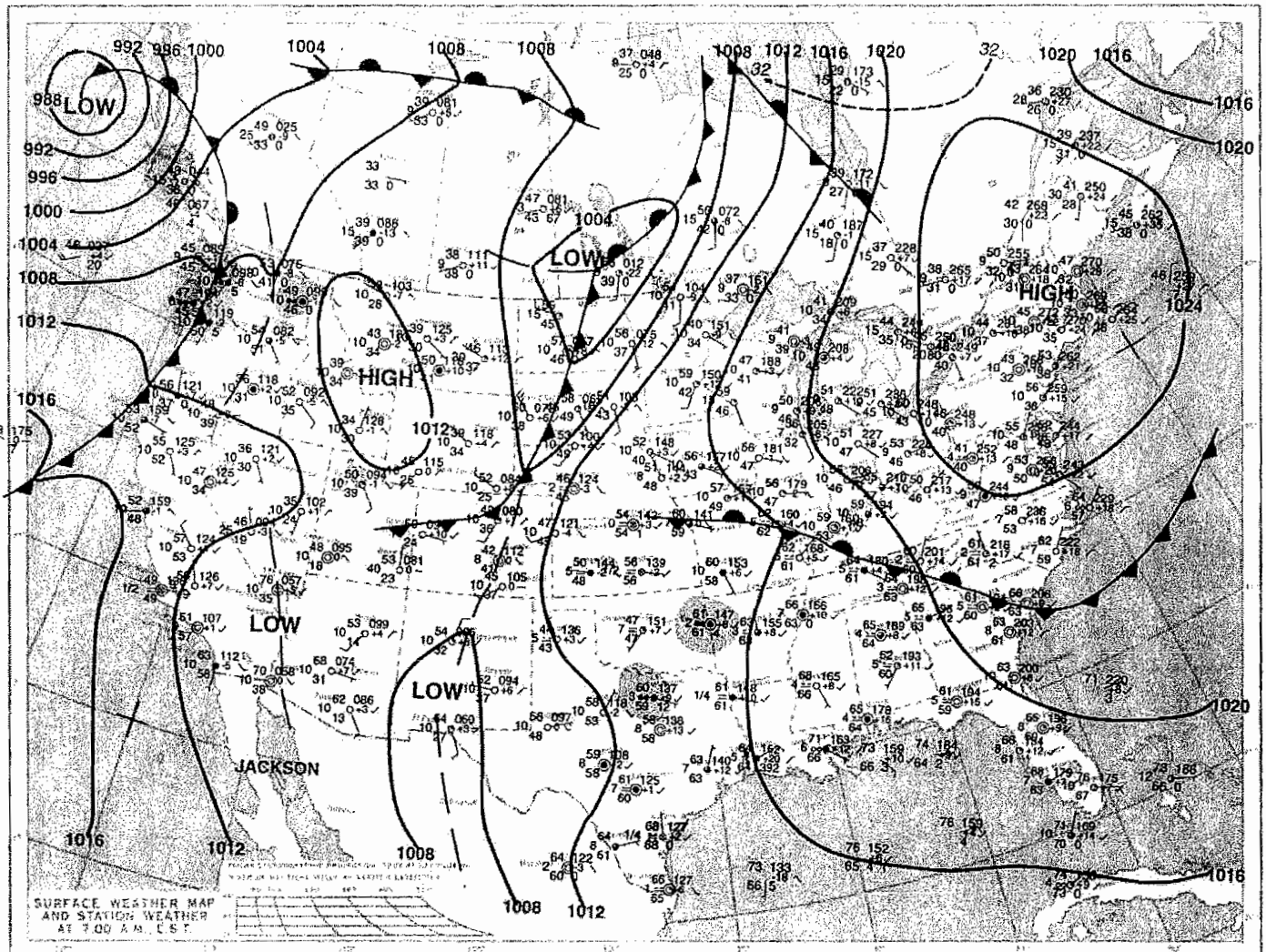

LOW
HIGH
JACKSON
SURFACE WEATHER MAP
AND STATION WEATHER
AT 7:00 A.M. E.S.T.

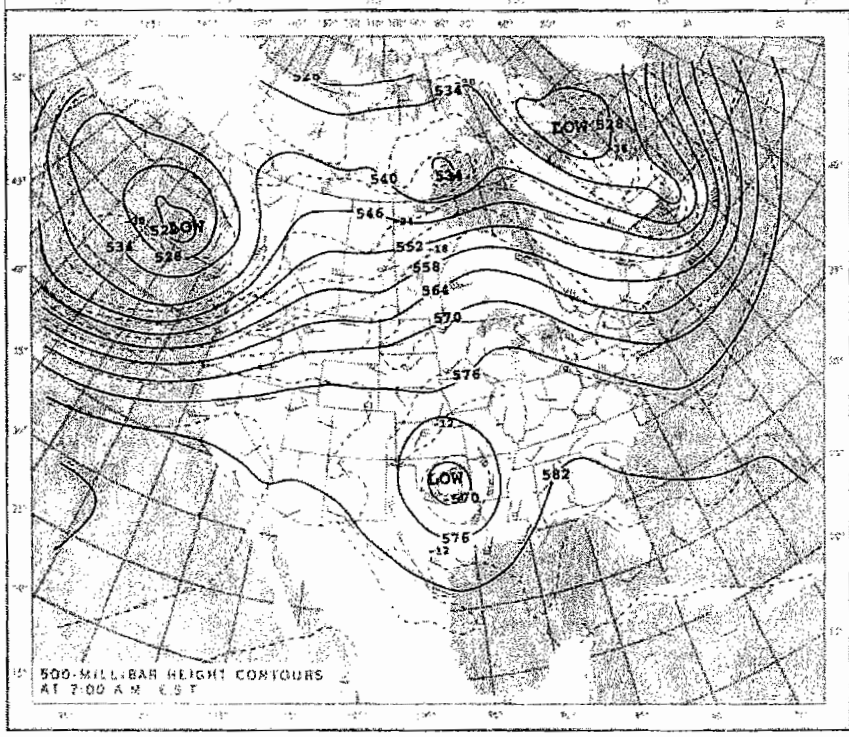

LOW
500-MILLIBAR HEIGHT CONTOURS
AT 7:00 A.M. E.S.T.

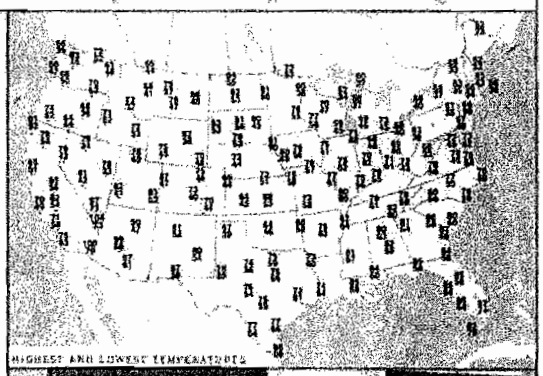

HIGHEST AND LOWEST TEMPERATURES

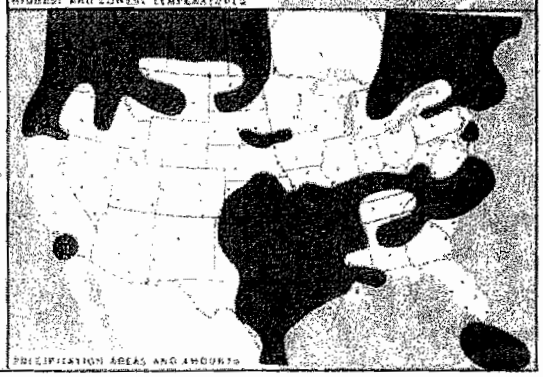
PRECIPITATION AREAS AND AMOUNTS

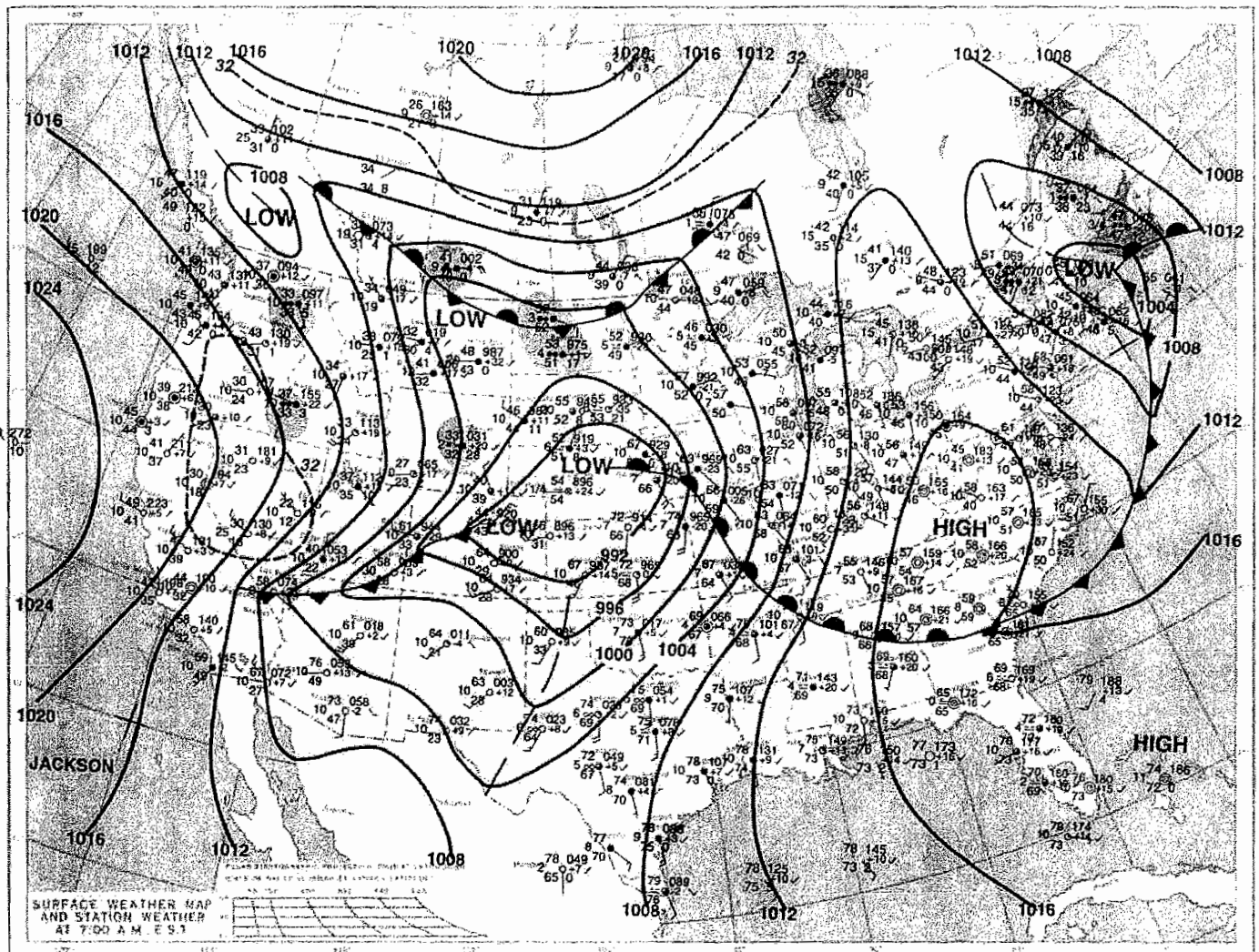
WEDNESDAY, MAY 3, 2000

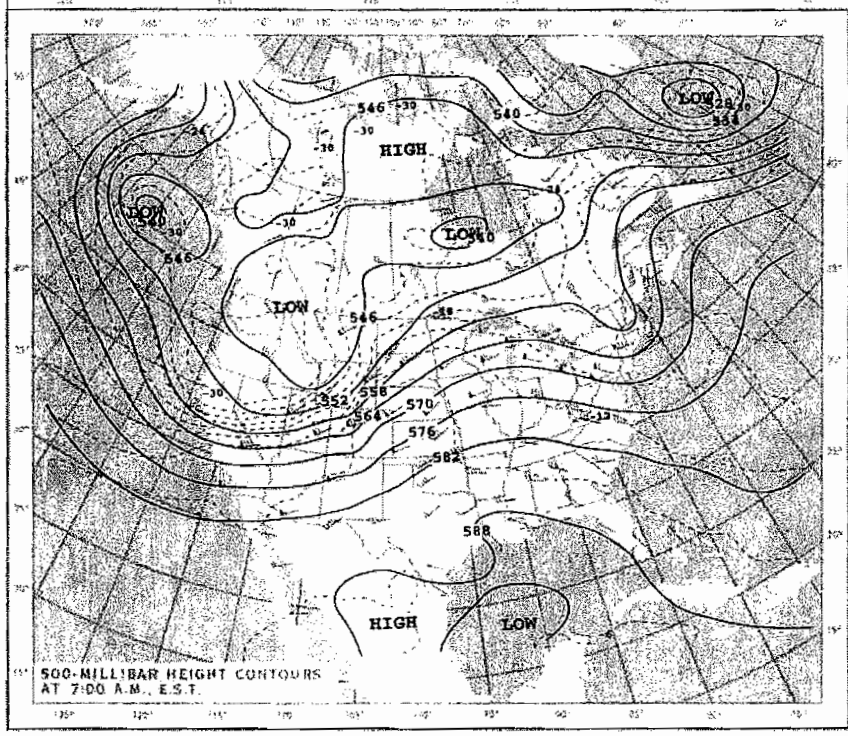


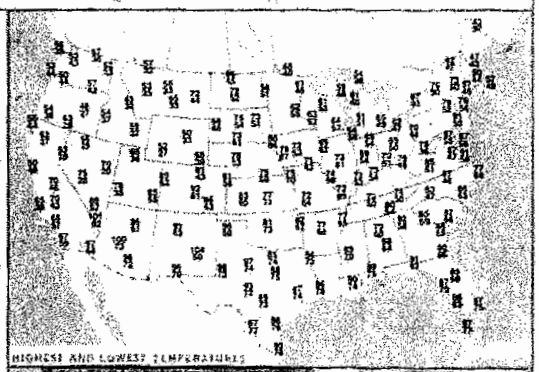


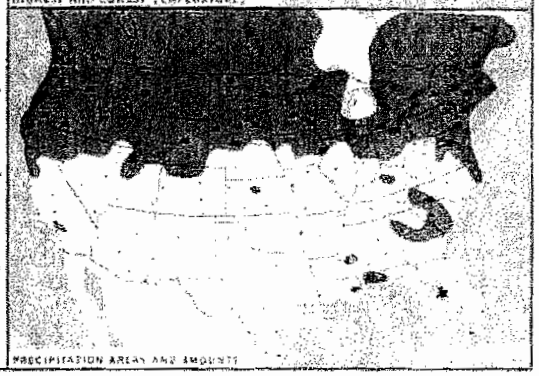




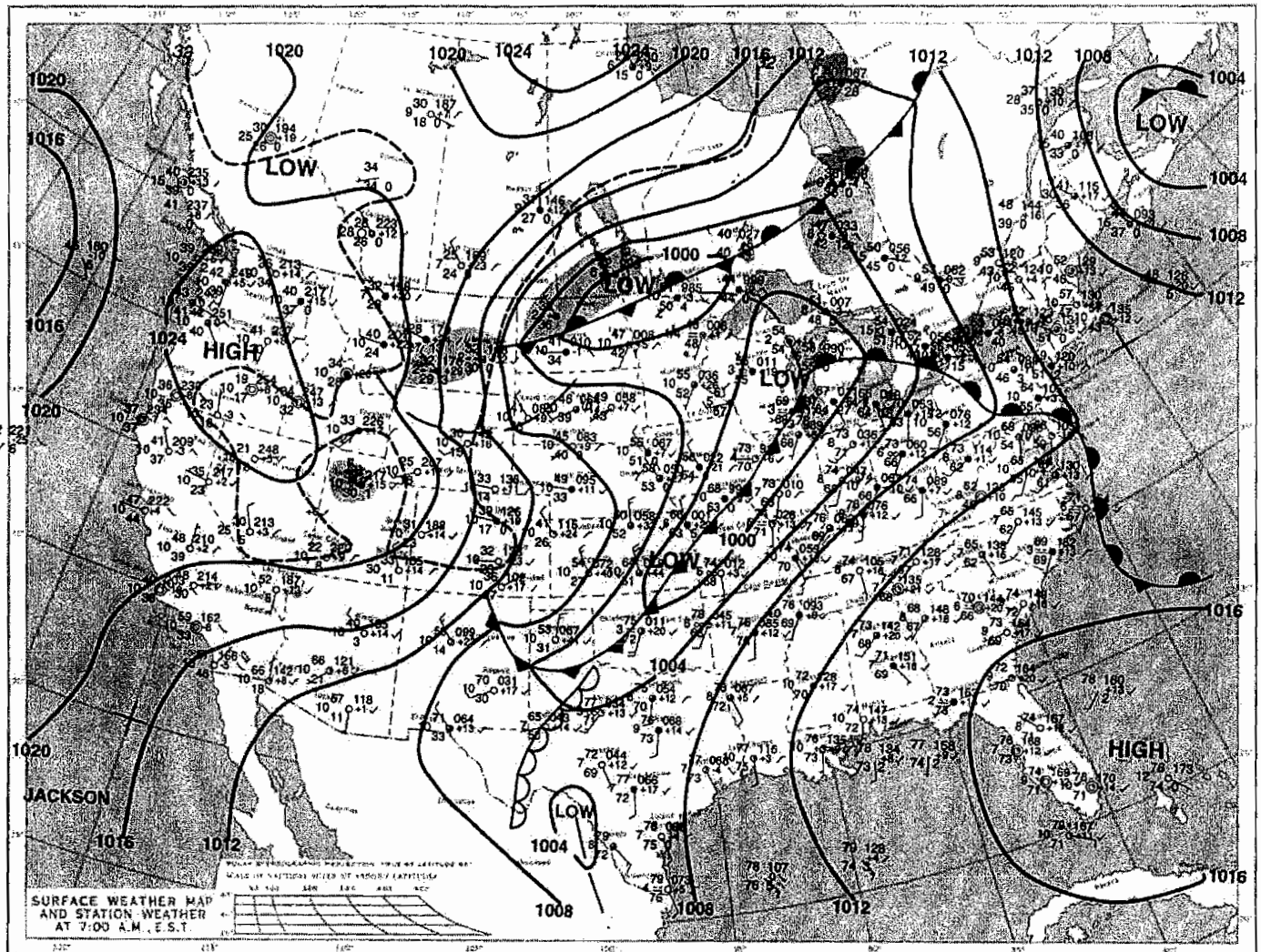

LOW
HIGH
JACKSON
SURFACE WEATHER MAP
AND STATION WEATHER
AT 7:00 A.M. E.S.T.

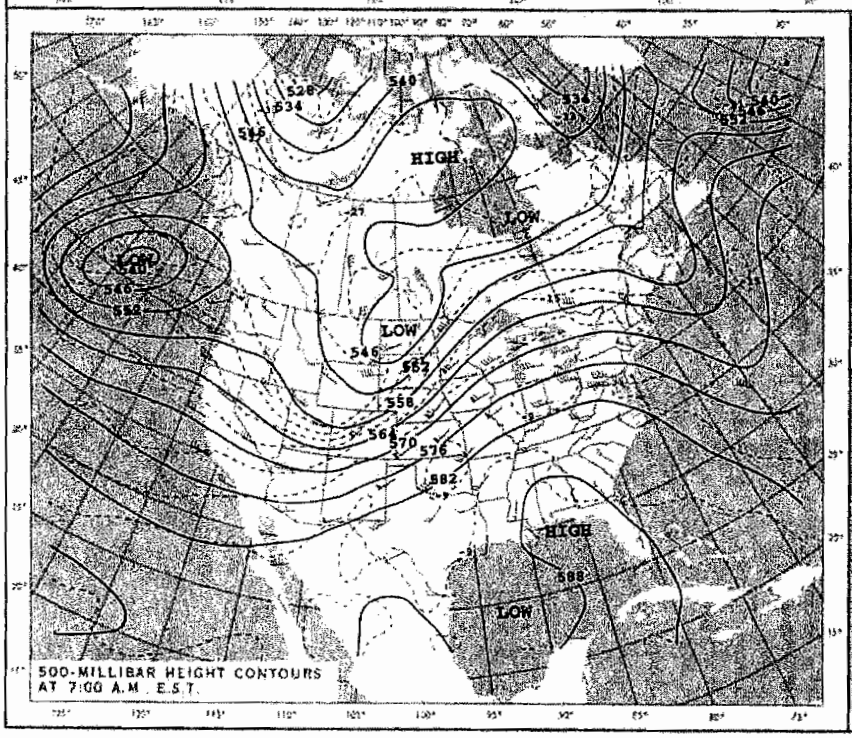

HIGH
LOW
500-MILLIBAR HEIGHT CONTOURS
AT 7:00 A.M., E.S.T.

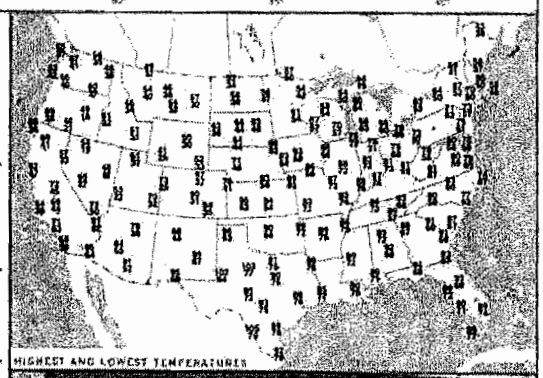

HIGHEST AND LOWEST TEMPERATURES

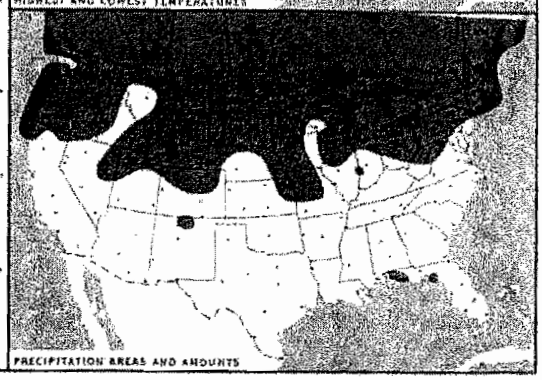

PRECIPITATION AREAS AND AMOUNTS

FRIDAY, MAY 12, 2000

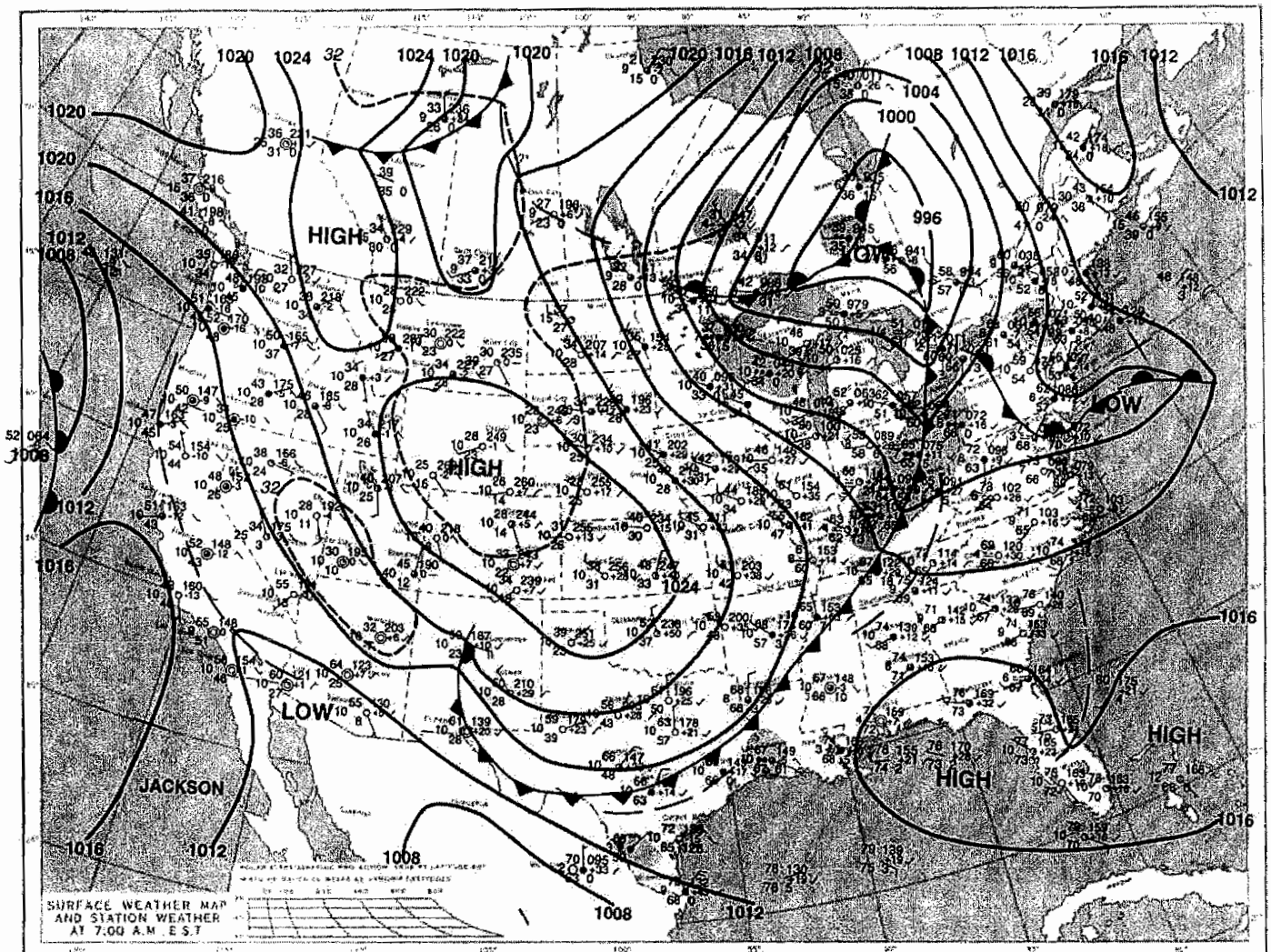


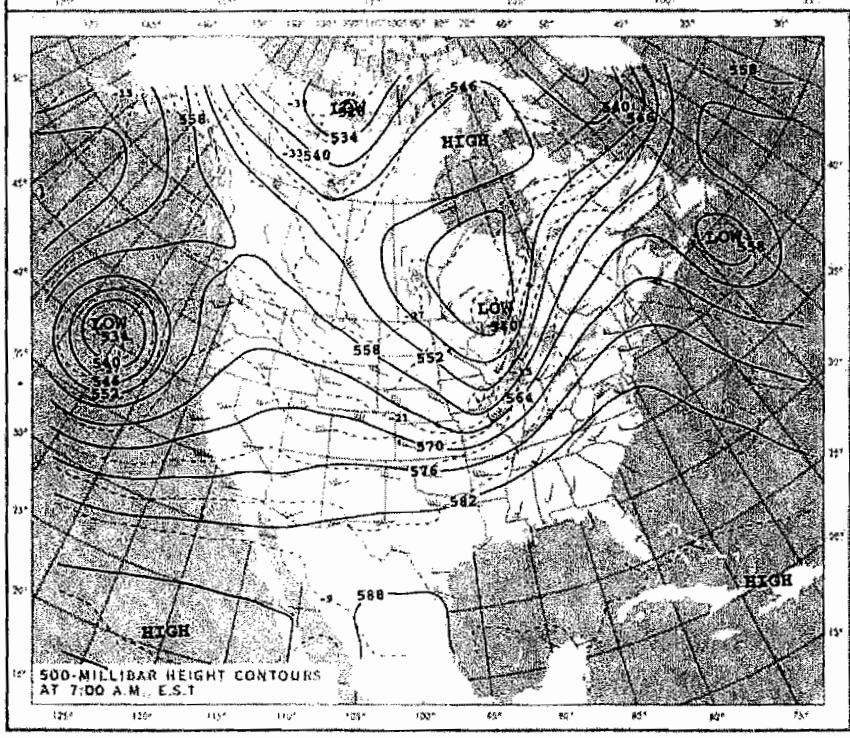


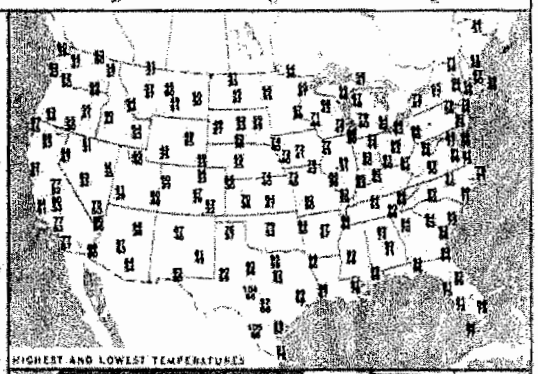


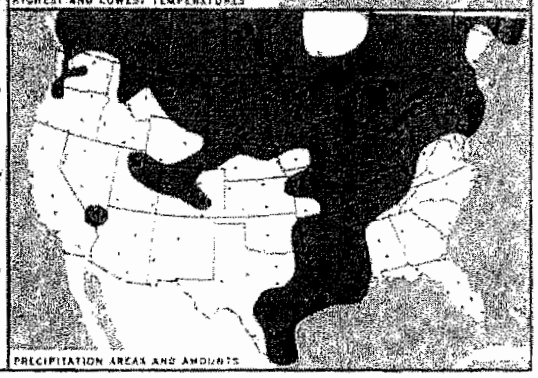


SATURDAY, MAY 13, 2000

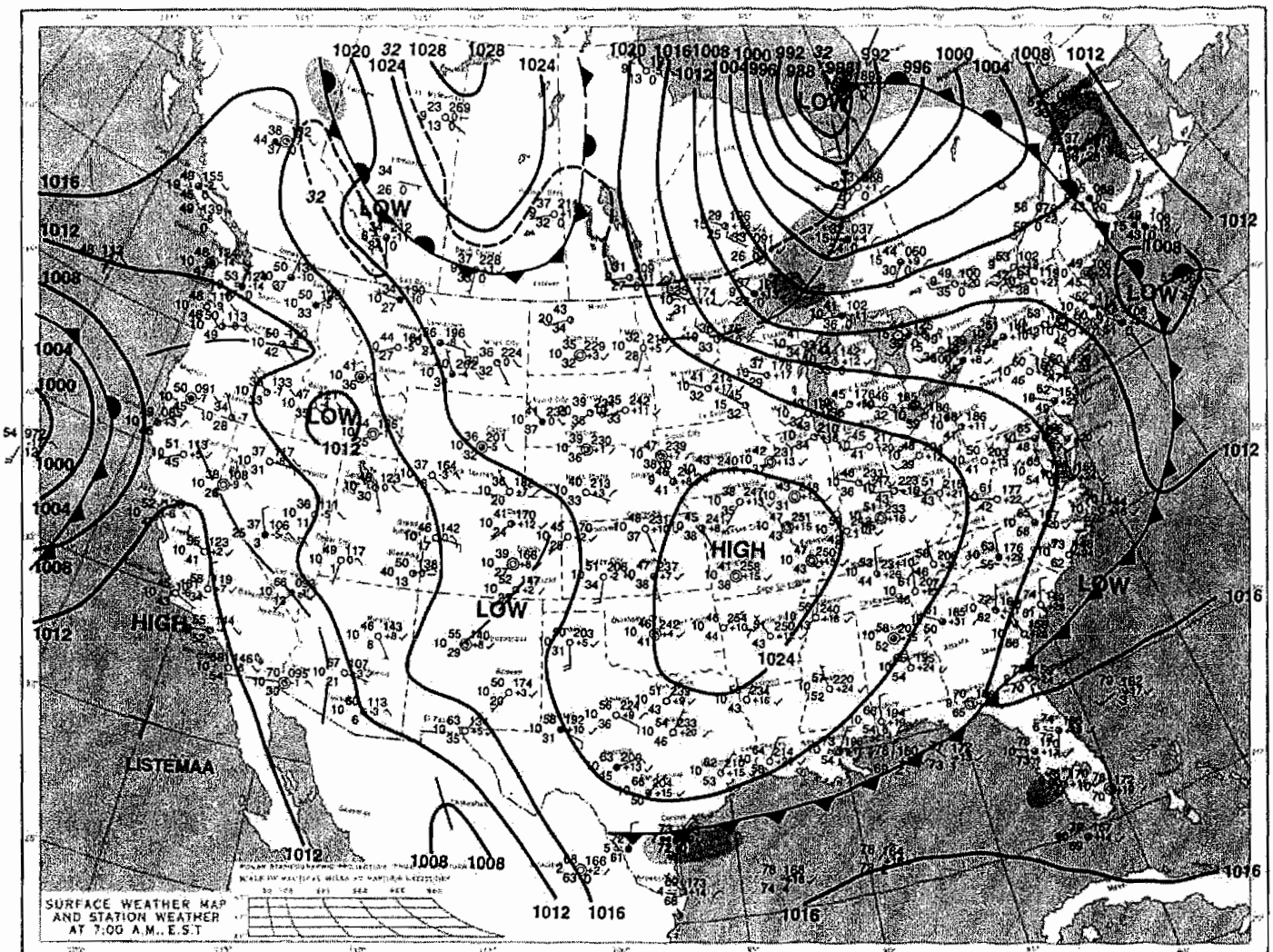


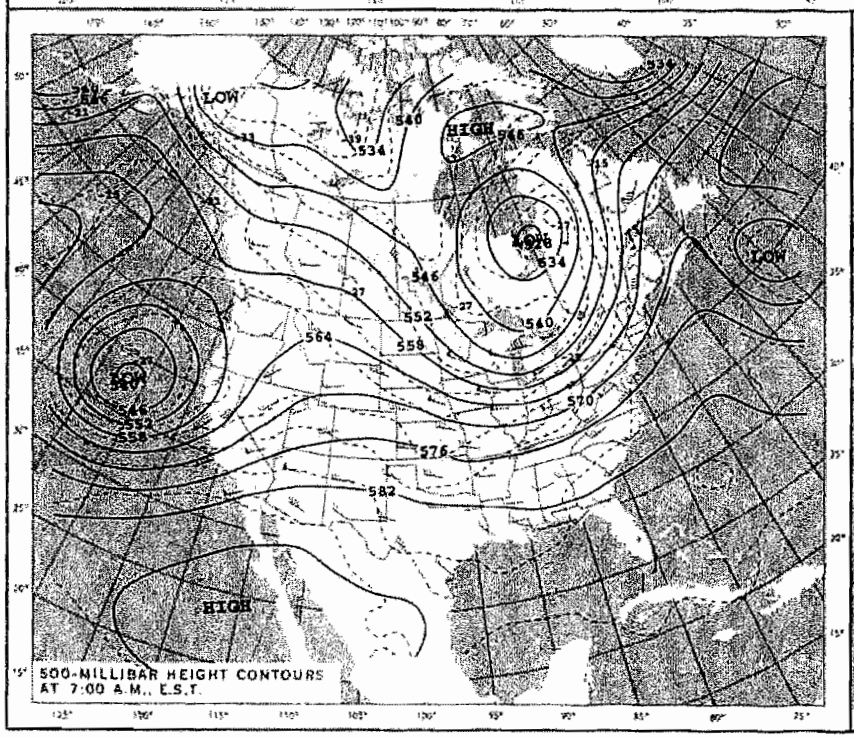


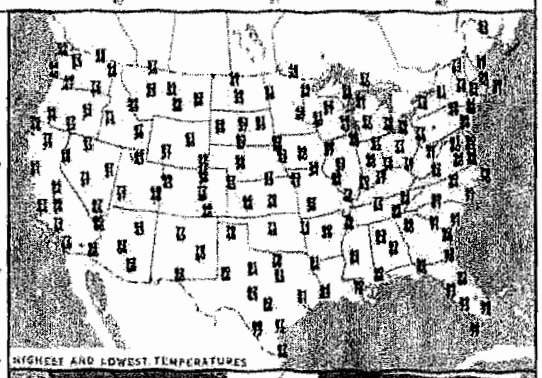




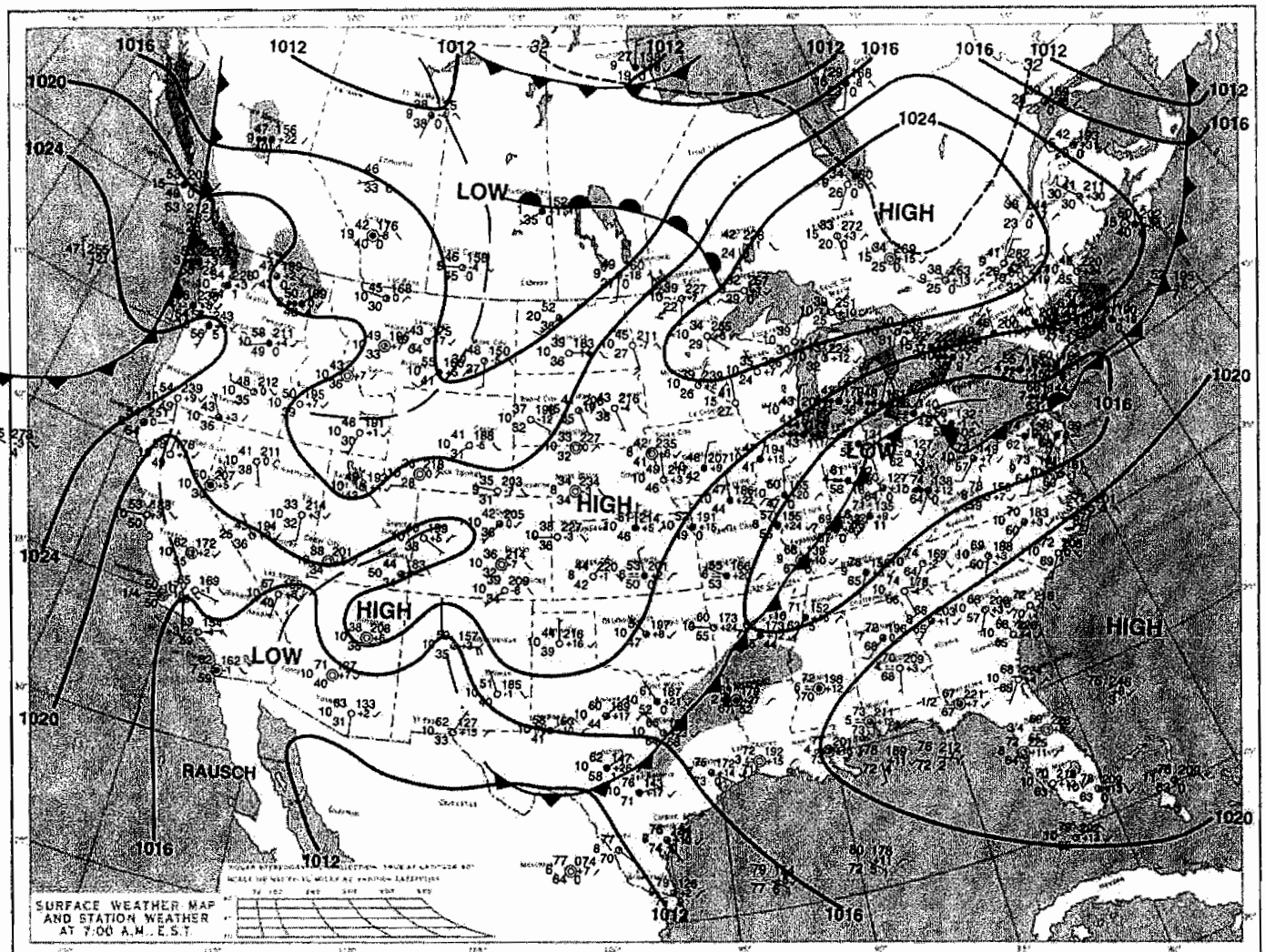
SUNDAY, MAY 14, 2000

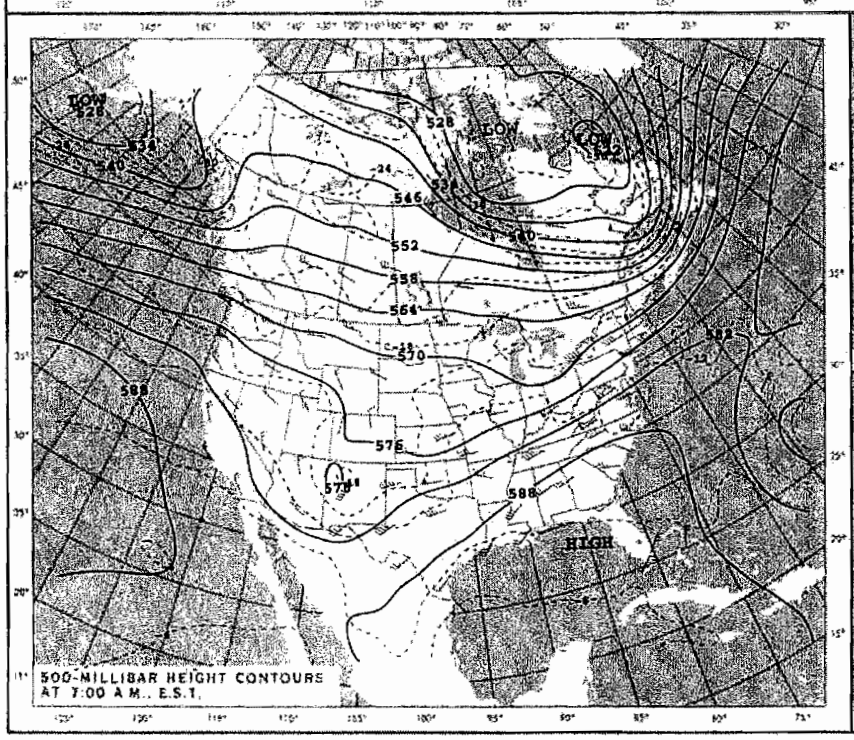


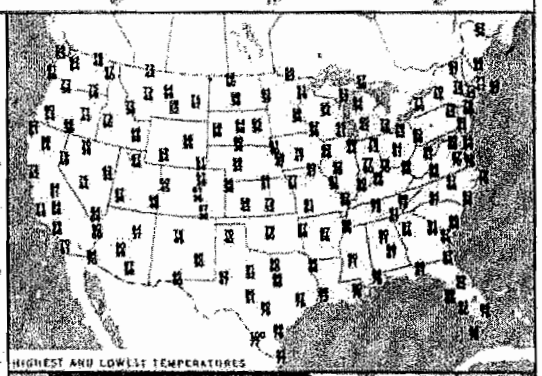




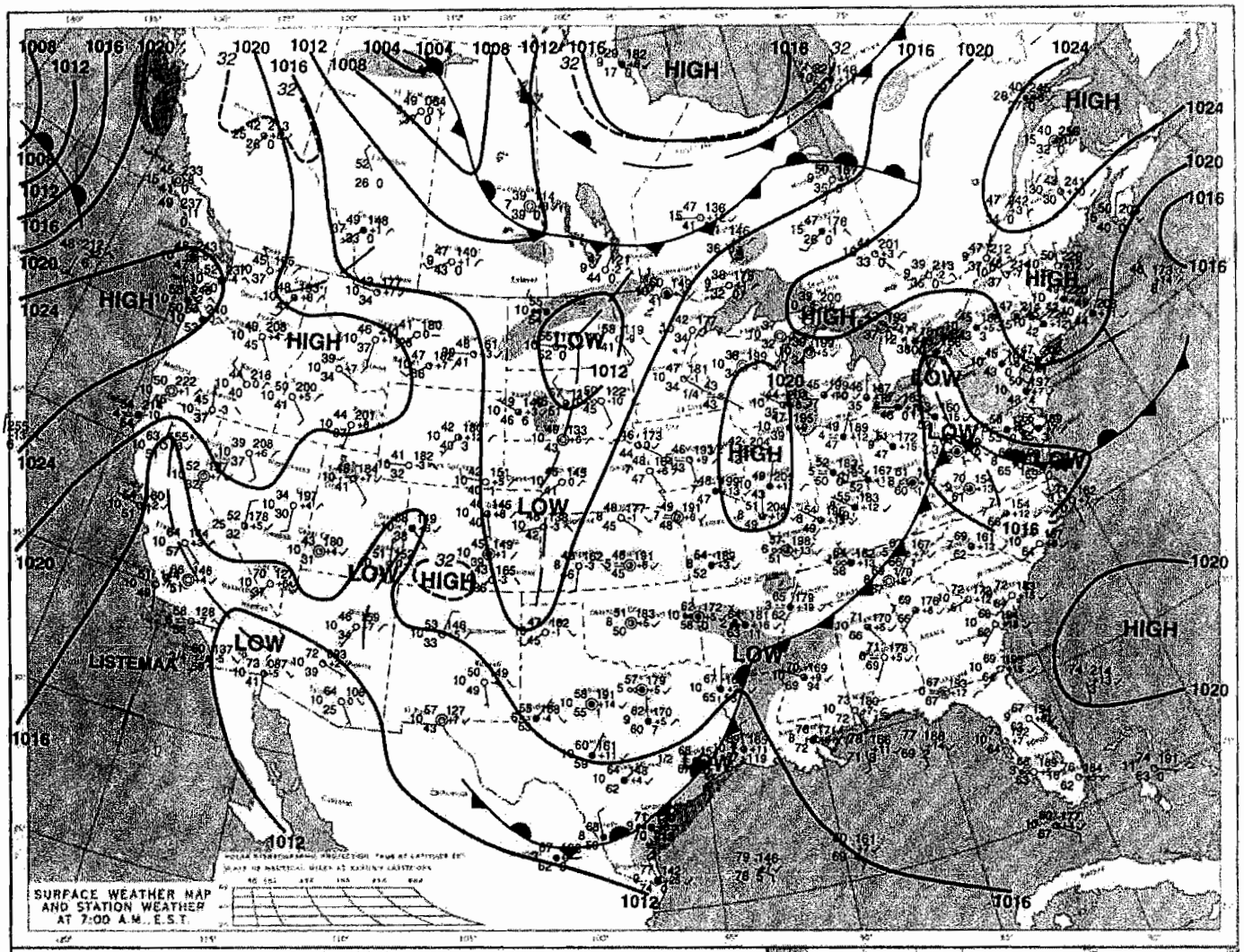
FRIDAY, MAY 19, 2000

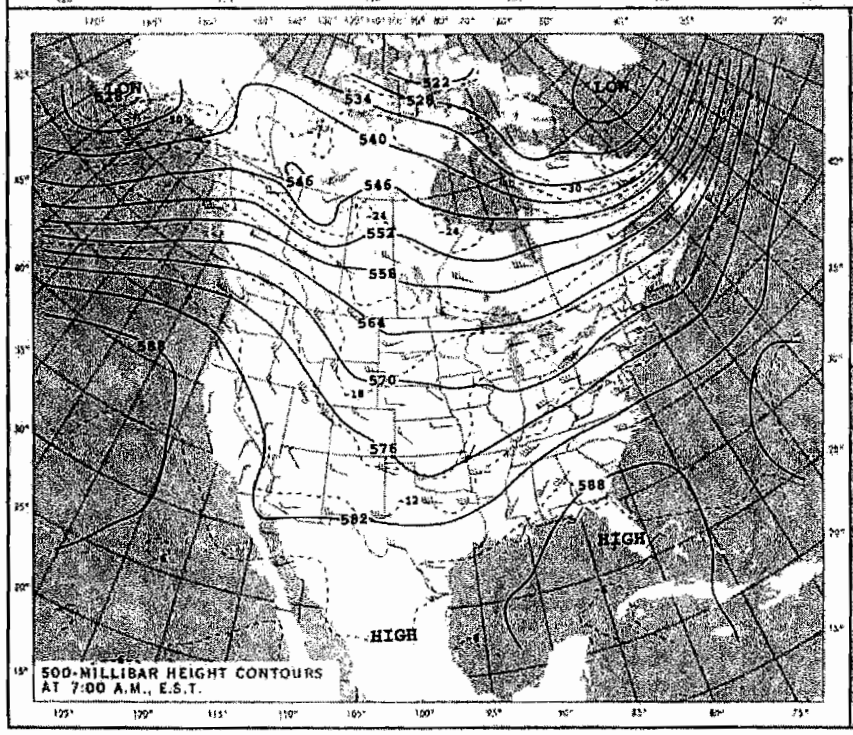


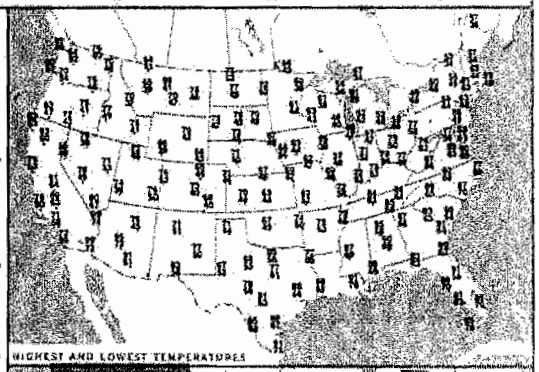




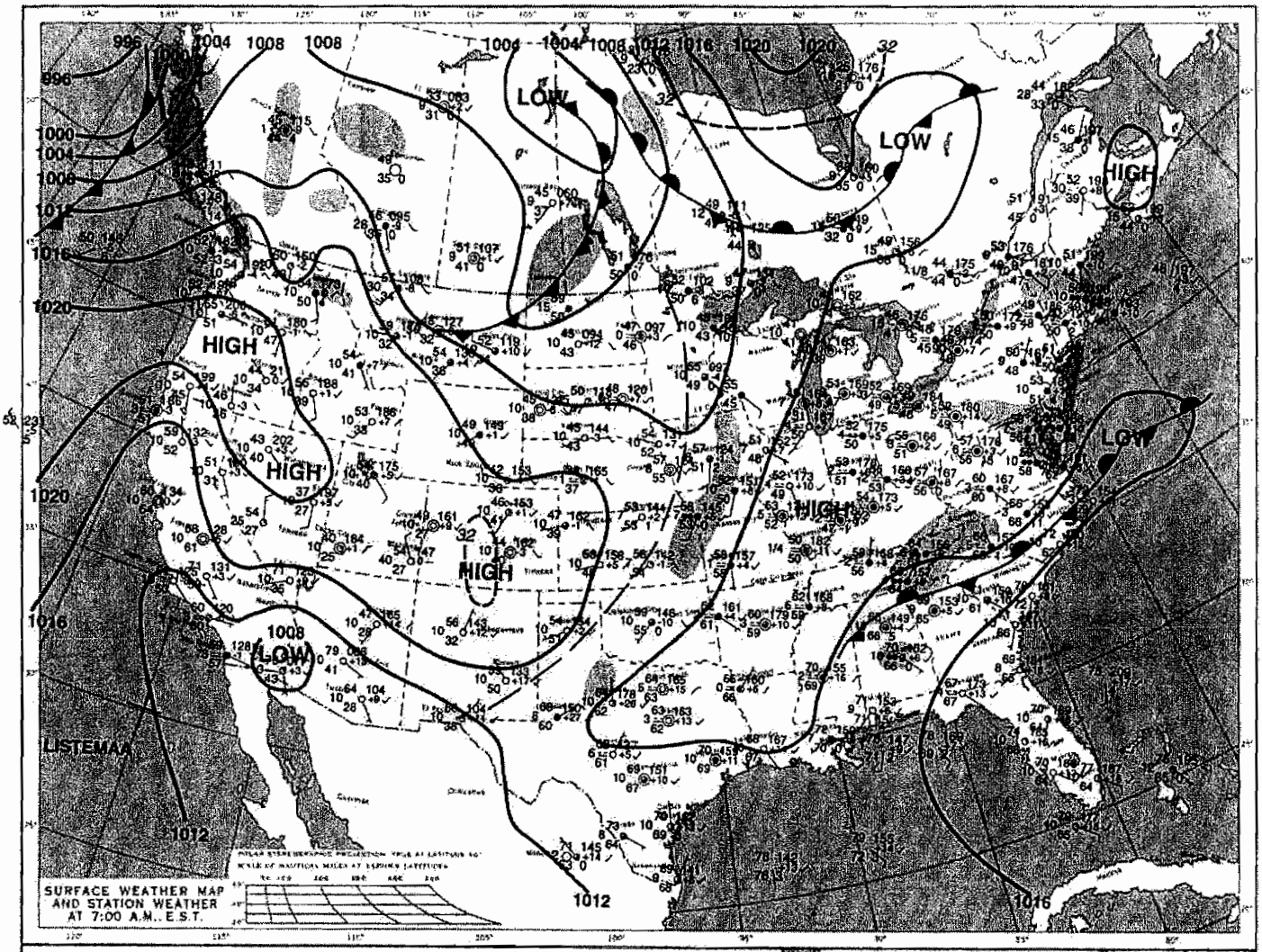
SATURDAY, MAY 20, 2000

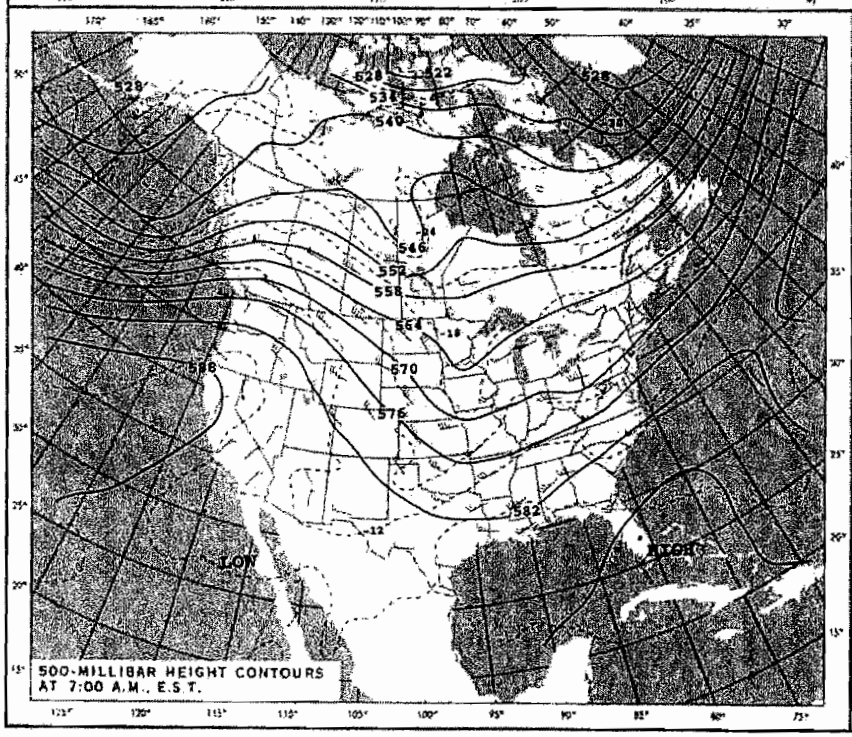


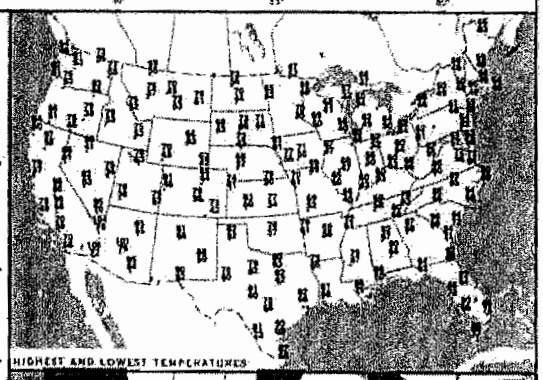




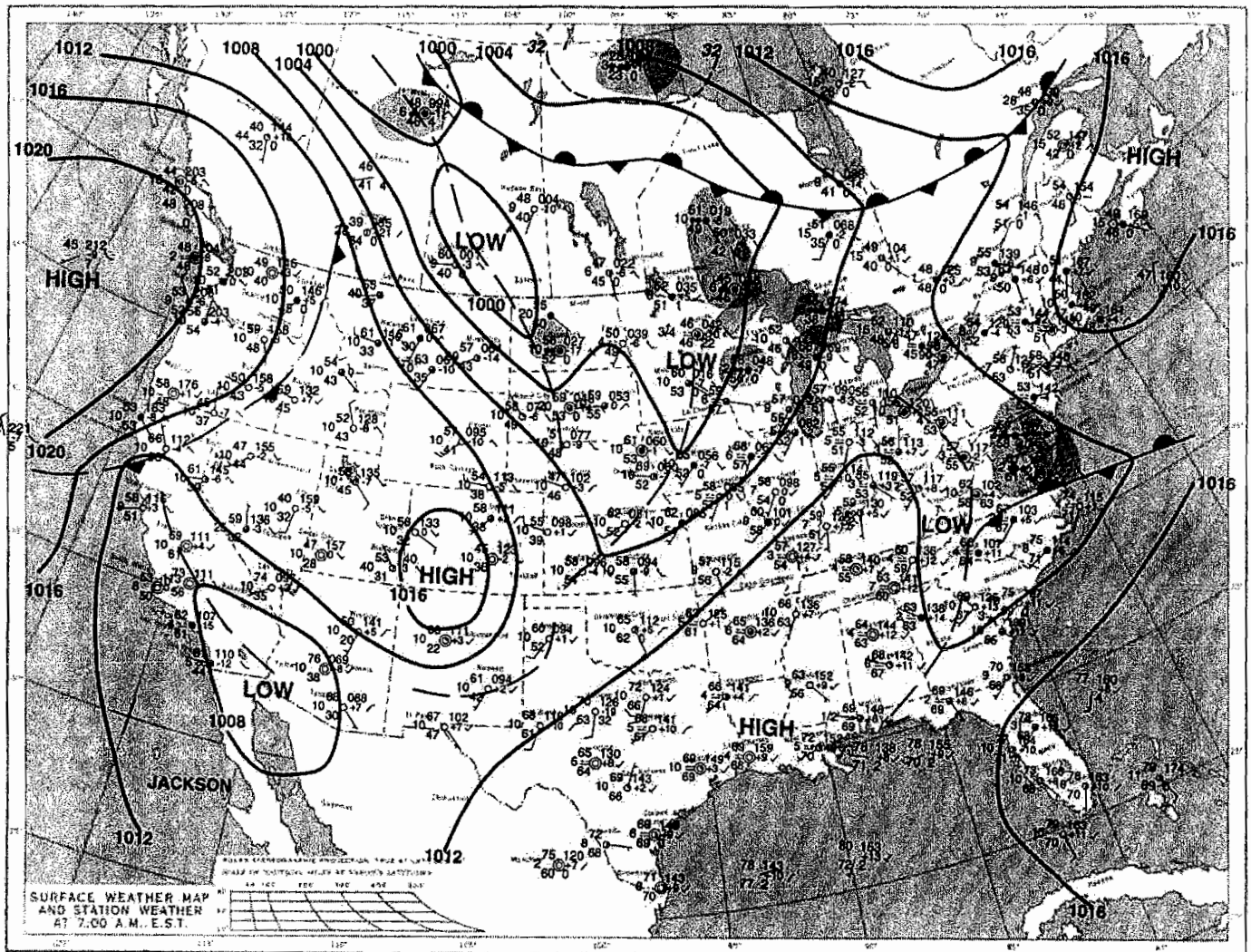
SUNDAY, MAY 21, 2000

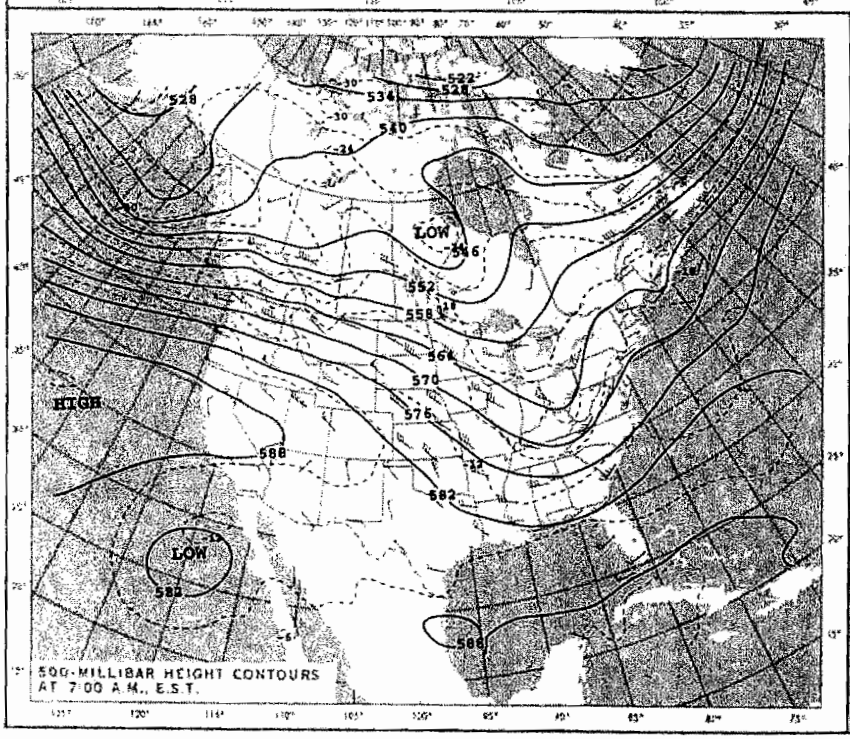


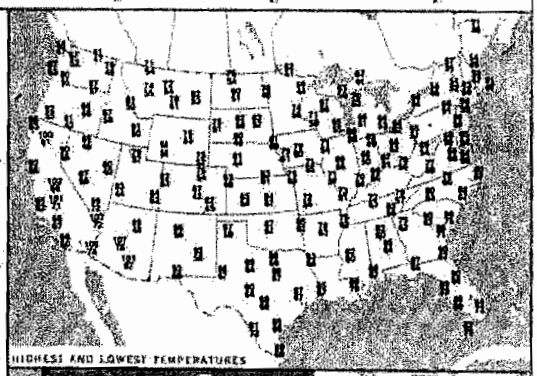




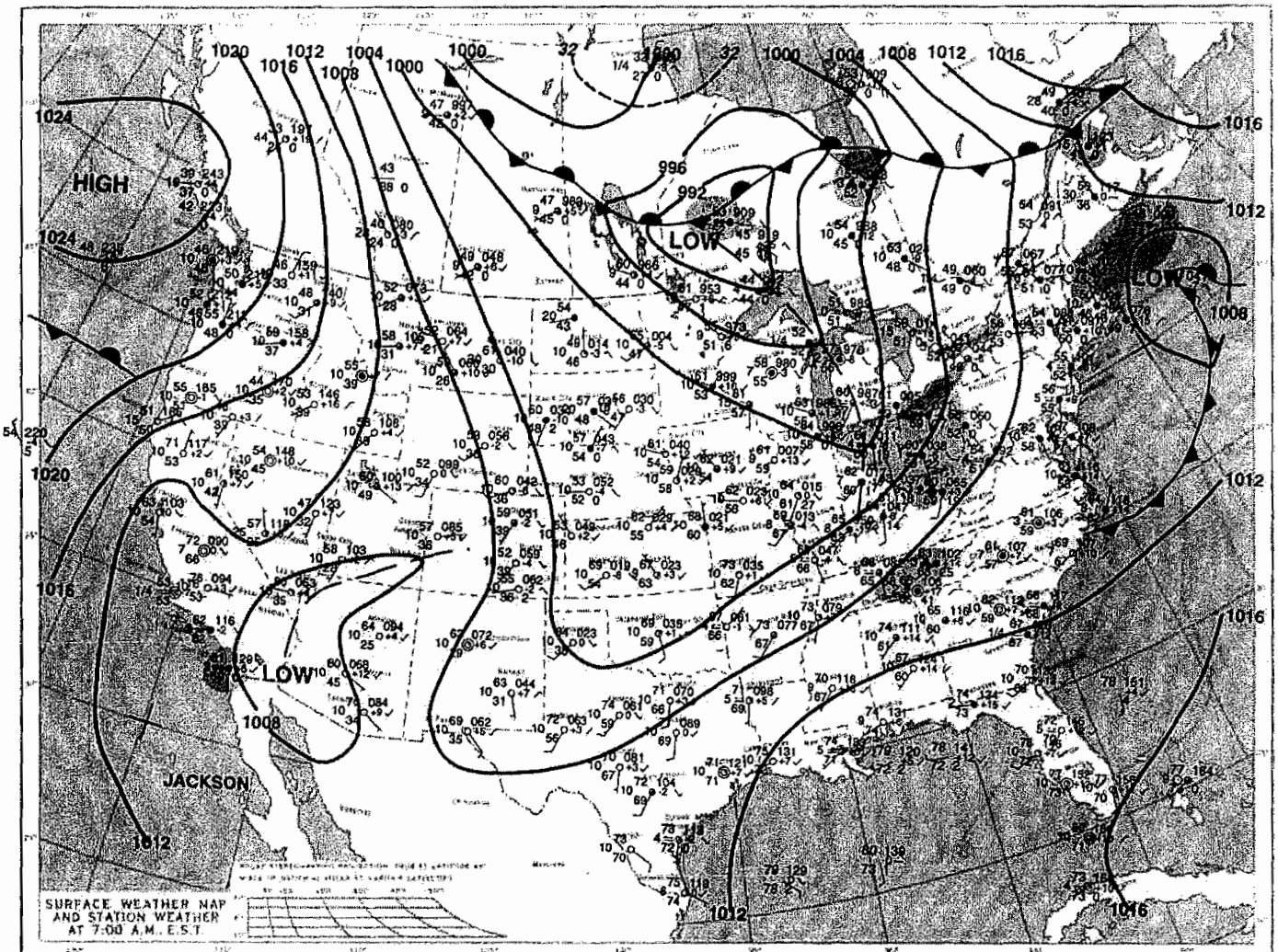
MONDAY, MAY 22, 2000

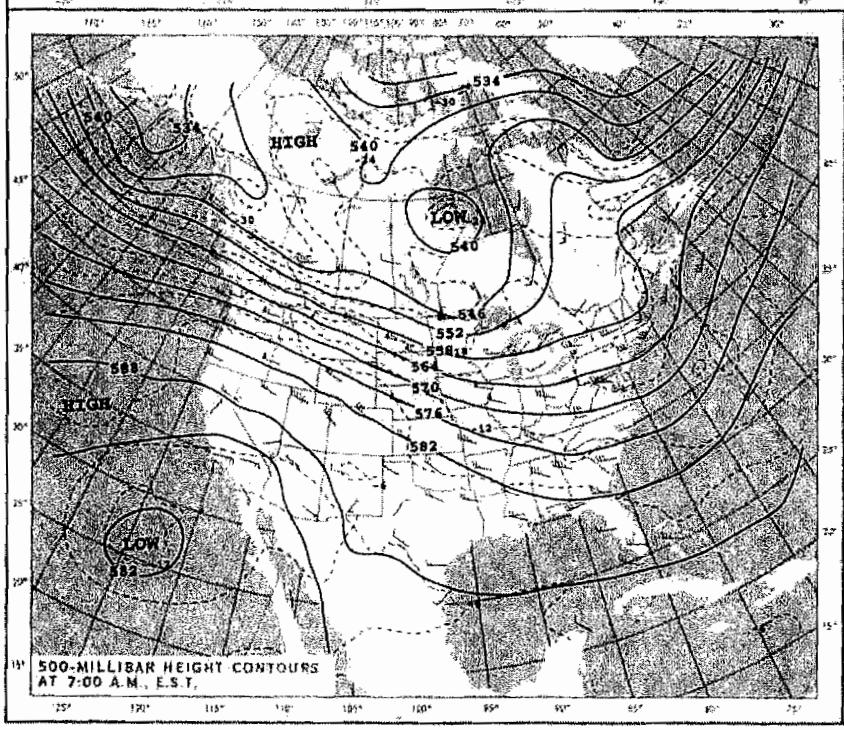


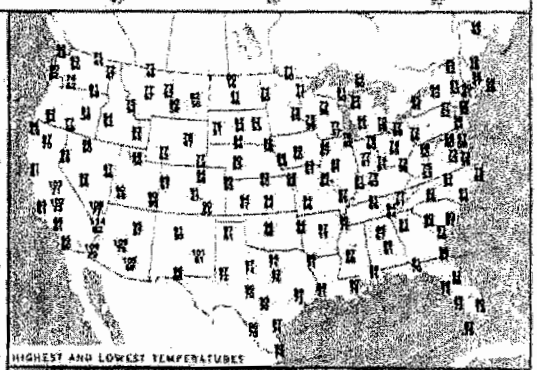




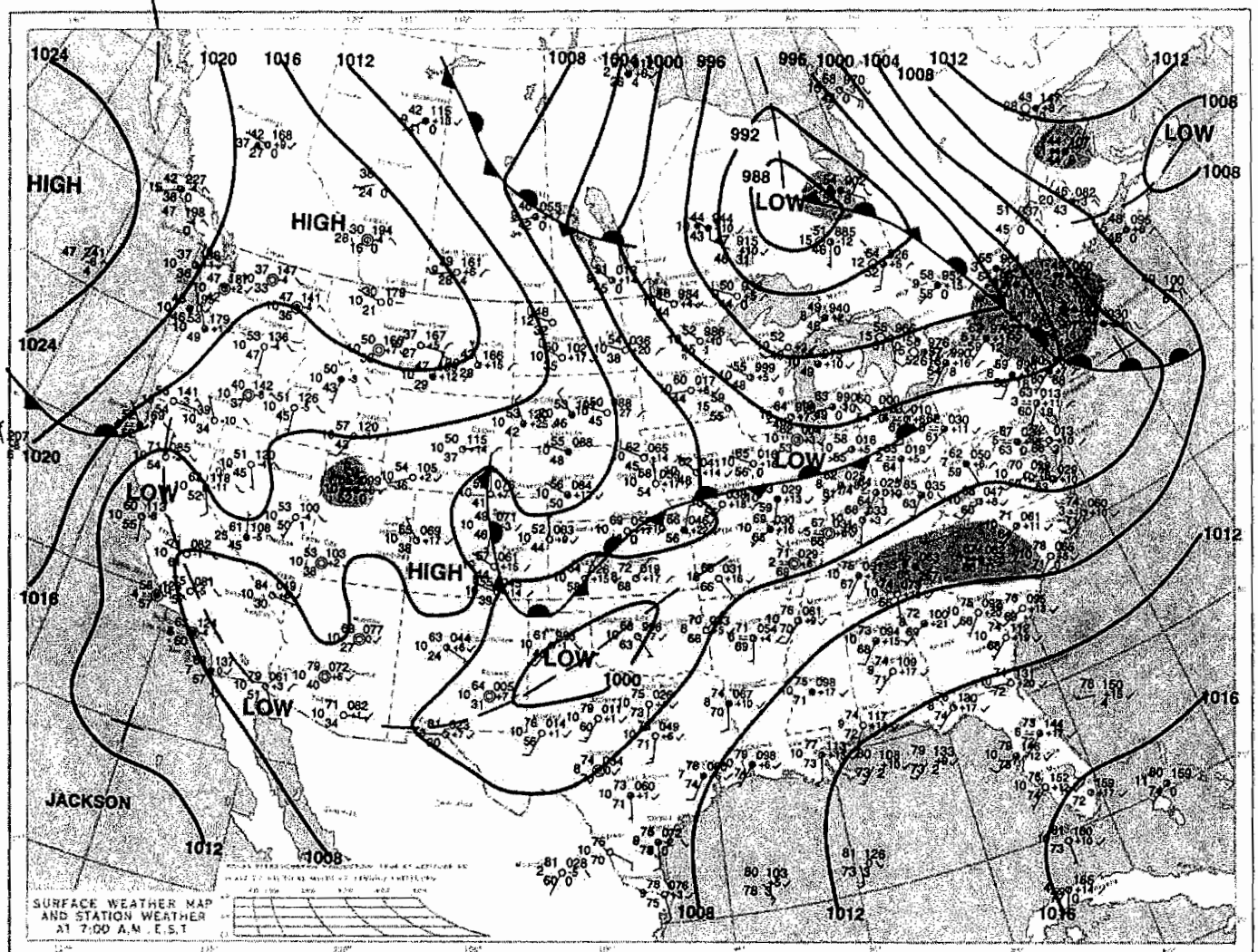
TUESDAY, MAY 23, 2000

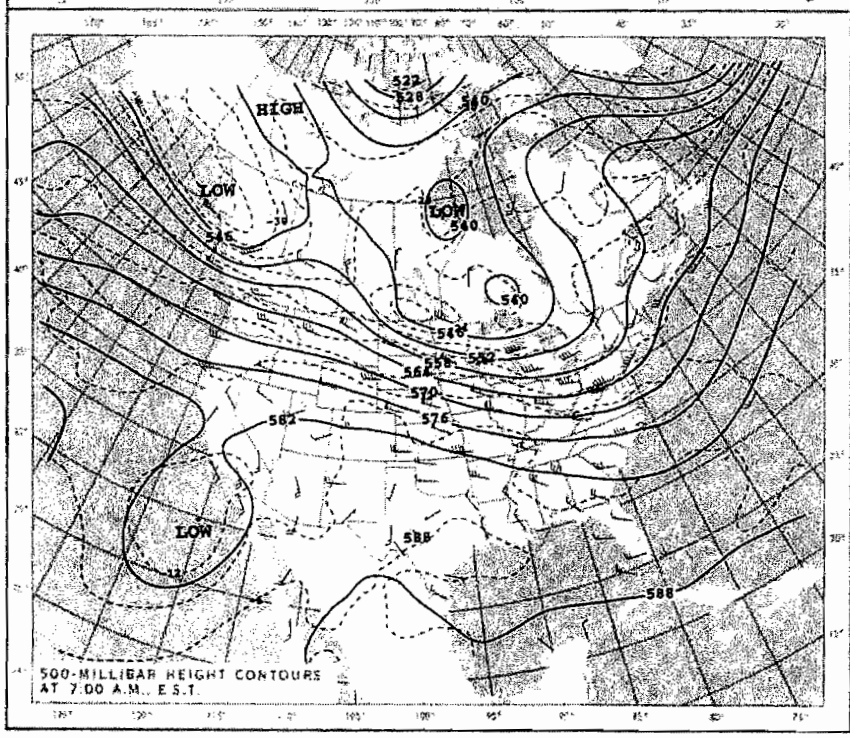


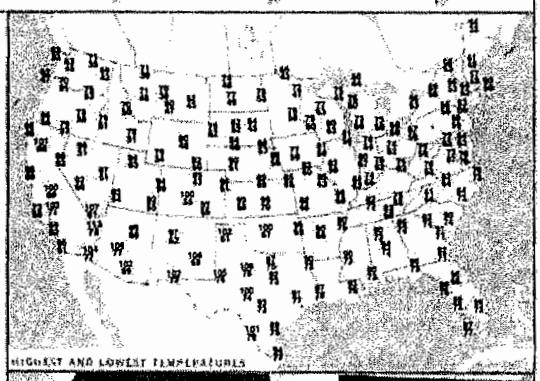


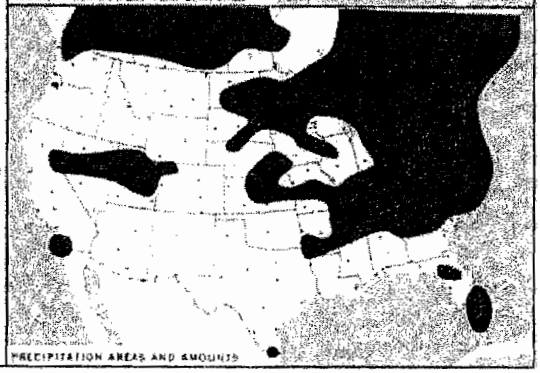


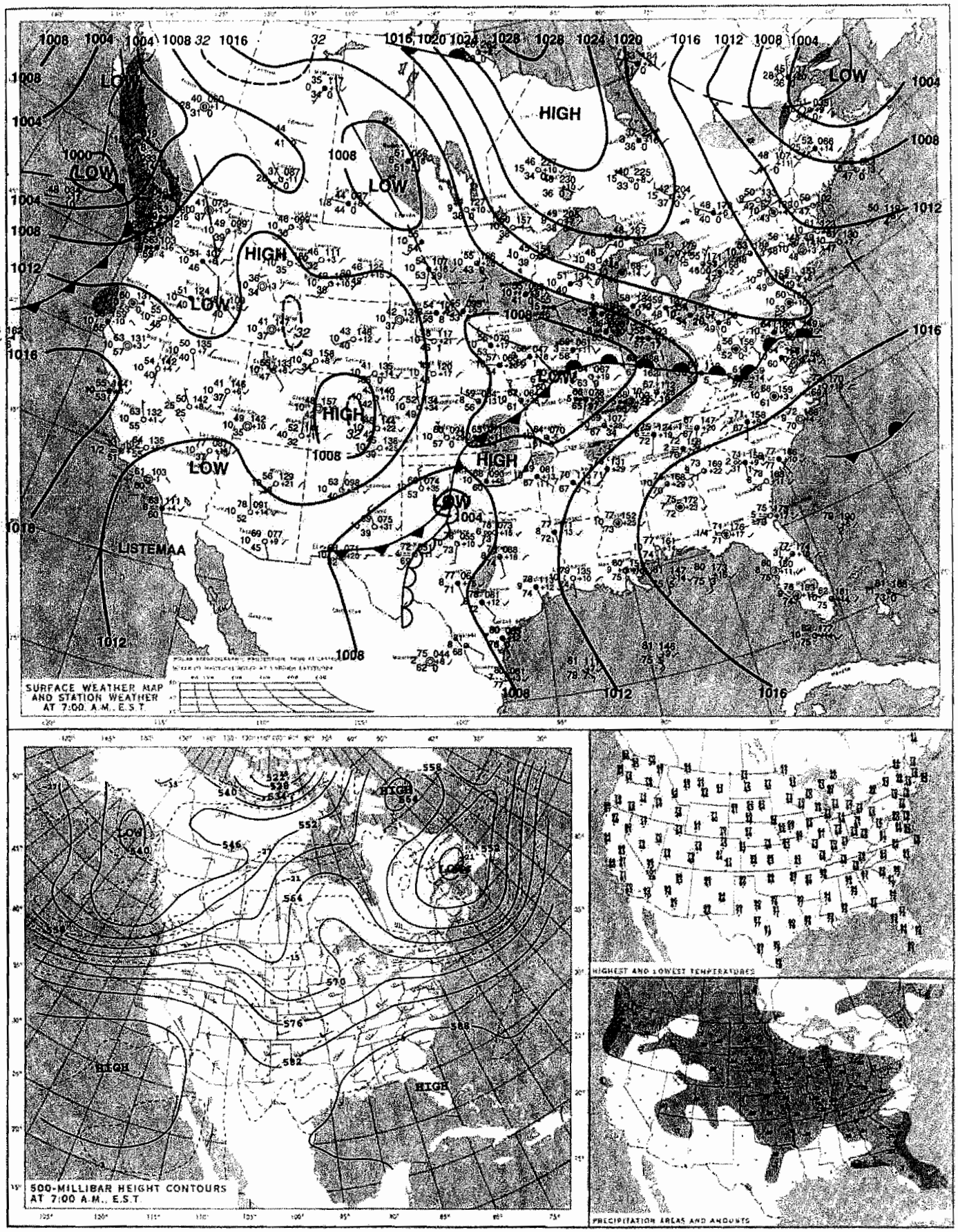
WEDNESDAY, MAY 24, 2000



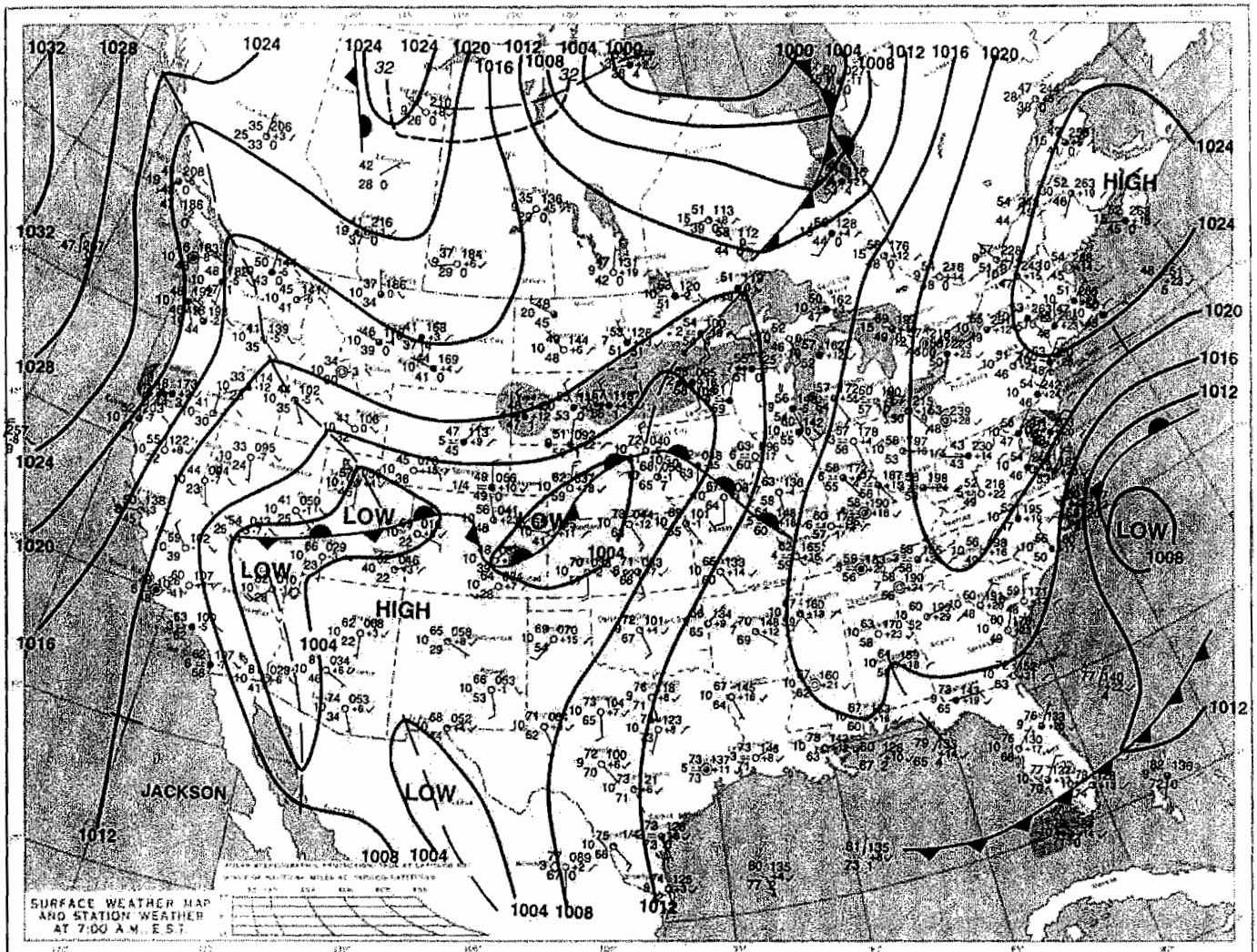


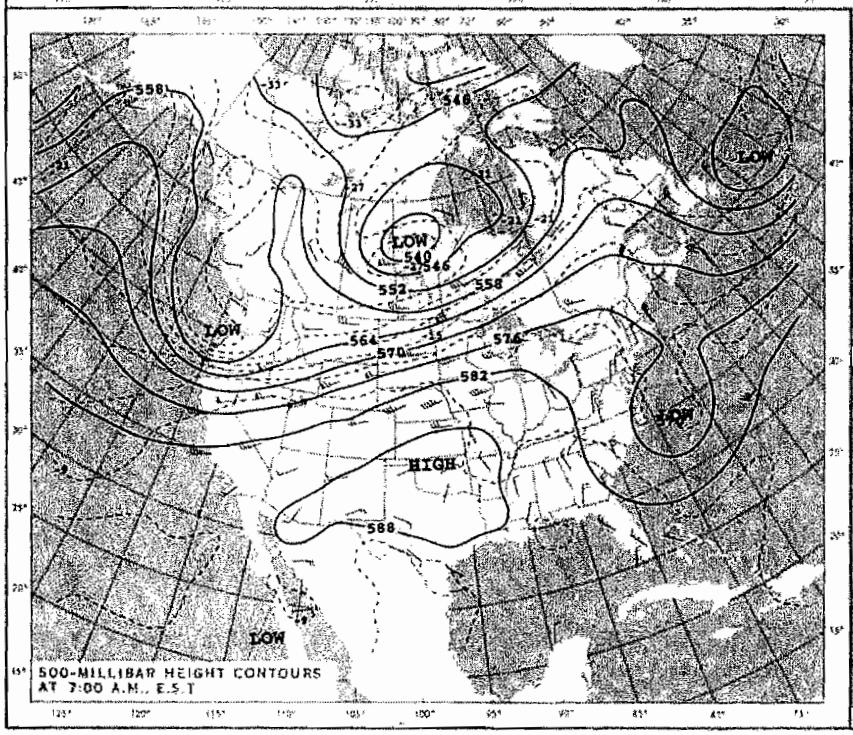


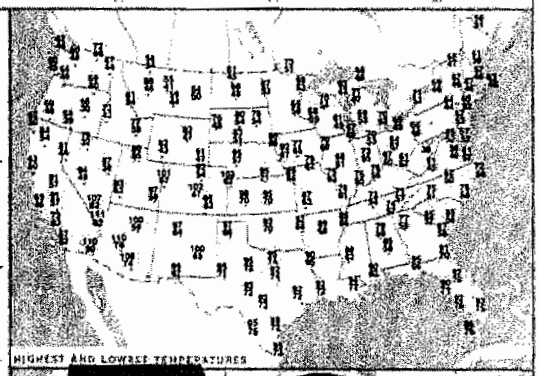


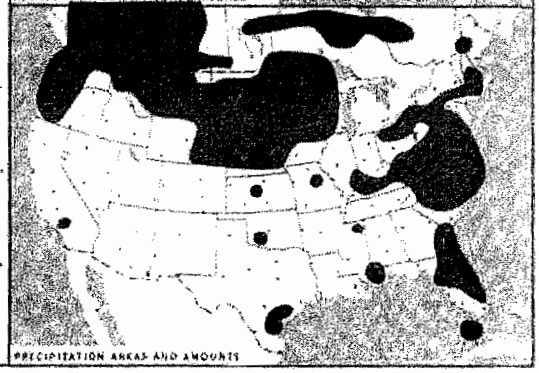

SURFACE WEATHER MAP
AND STATION WEATHER
AT 7:00 A.M. E.S.T.
LISTEMAA
HIGH
LOW
500-MILLIBAR HEIGHT CONTOURS
AT 7:00 A.M. E.S.T.
HIGHEST AND LOWEST TEMPERATURES
PRECIPITATION AREAS AND AMOUNTS

TUESDAY, MAY 30, 2000

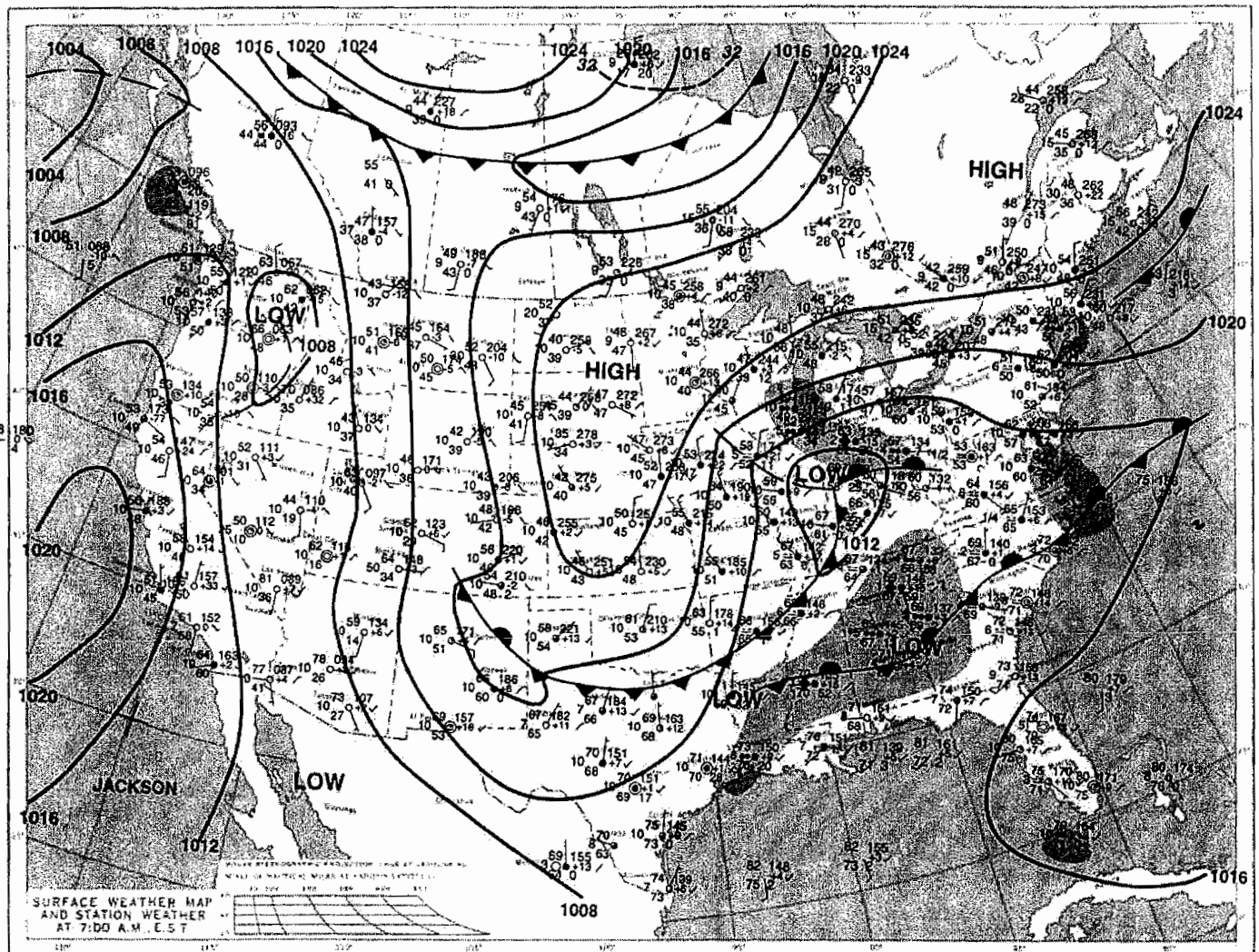


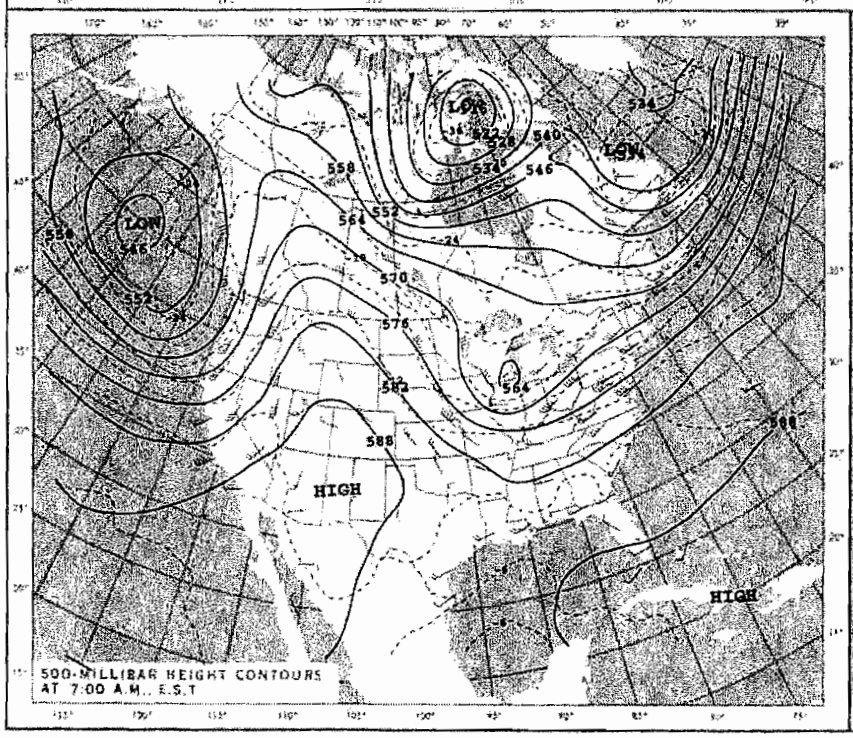


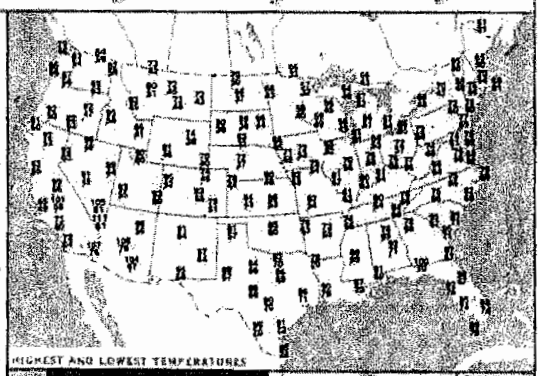




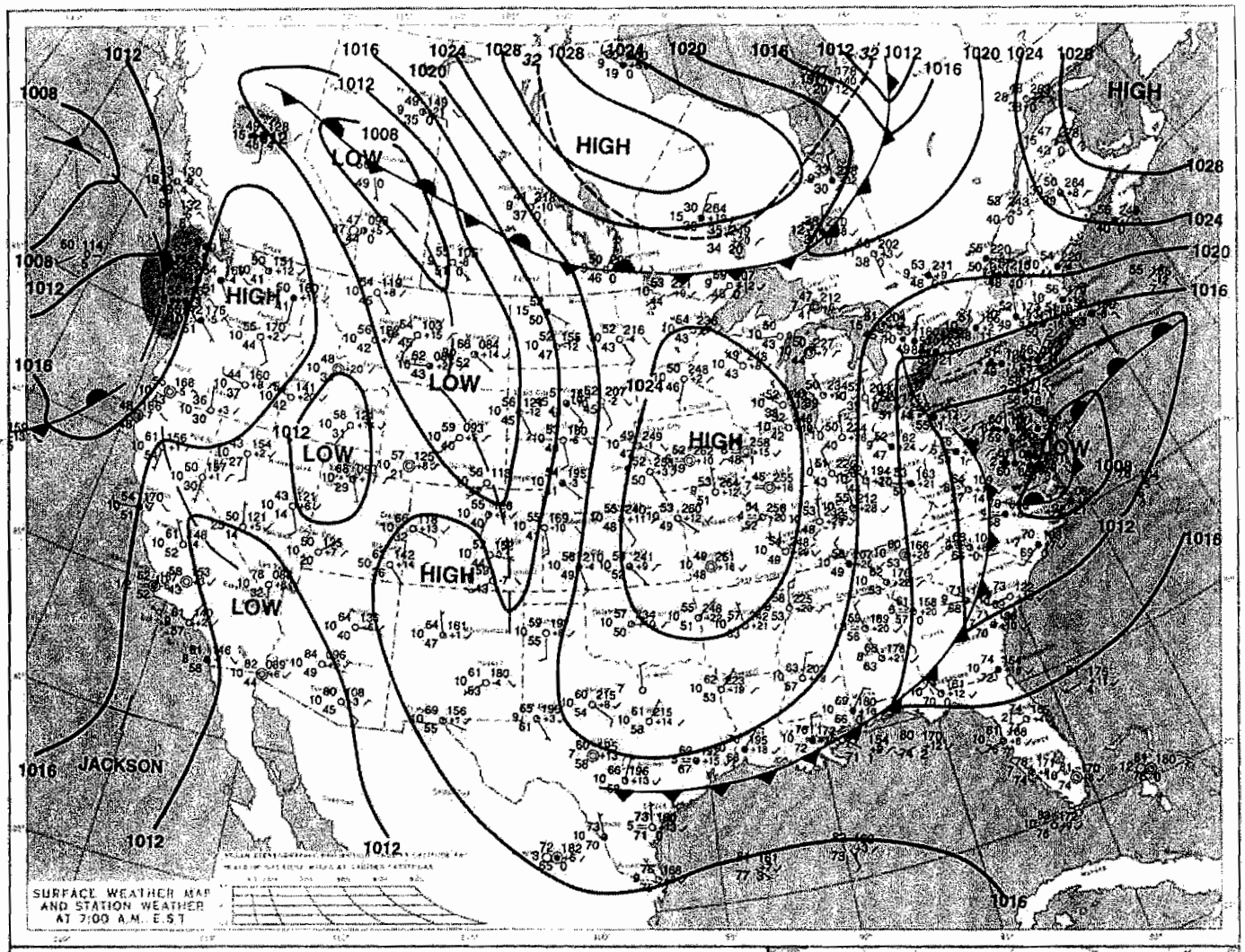
MONDAY, JUNE 5, 2000

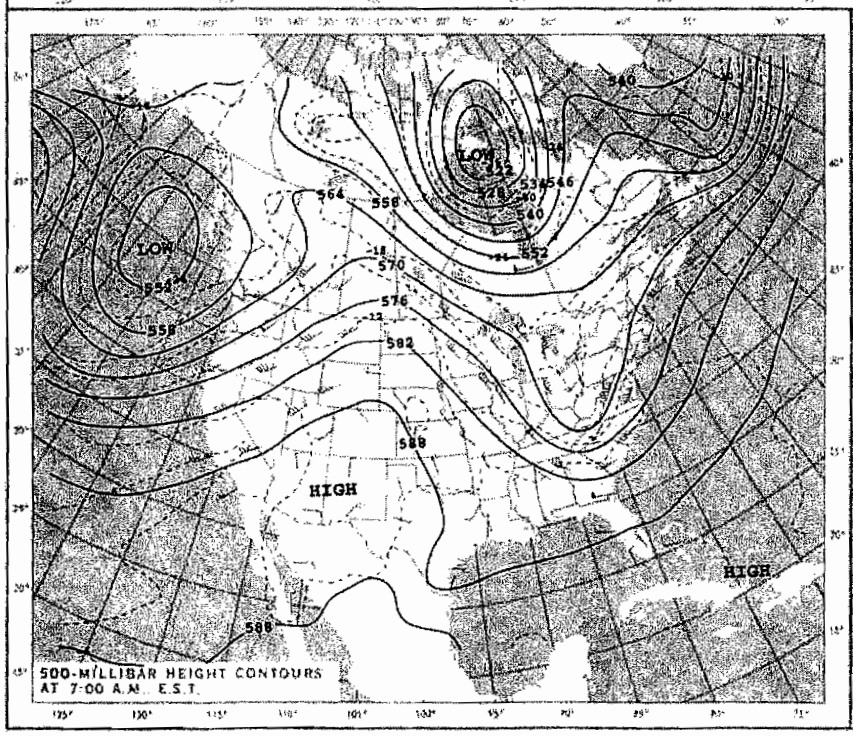


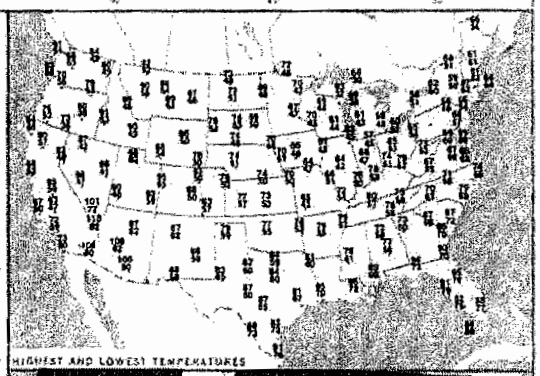




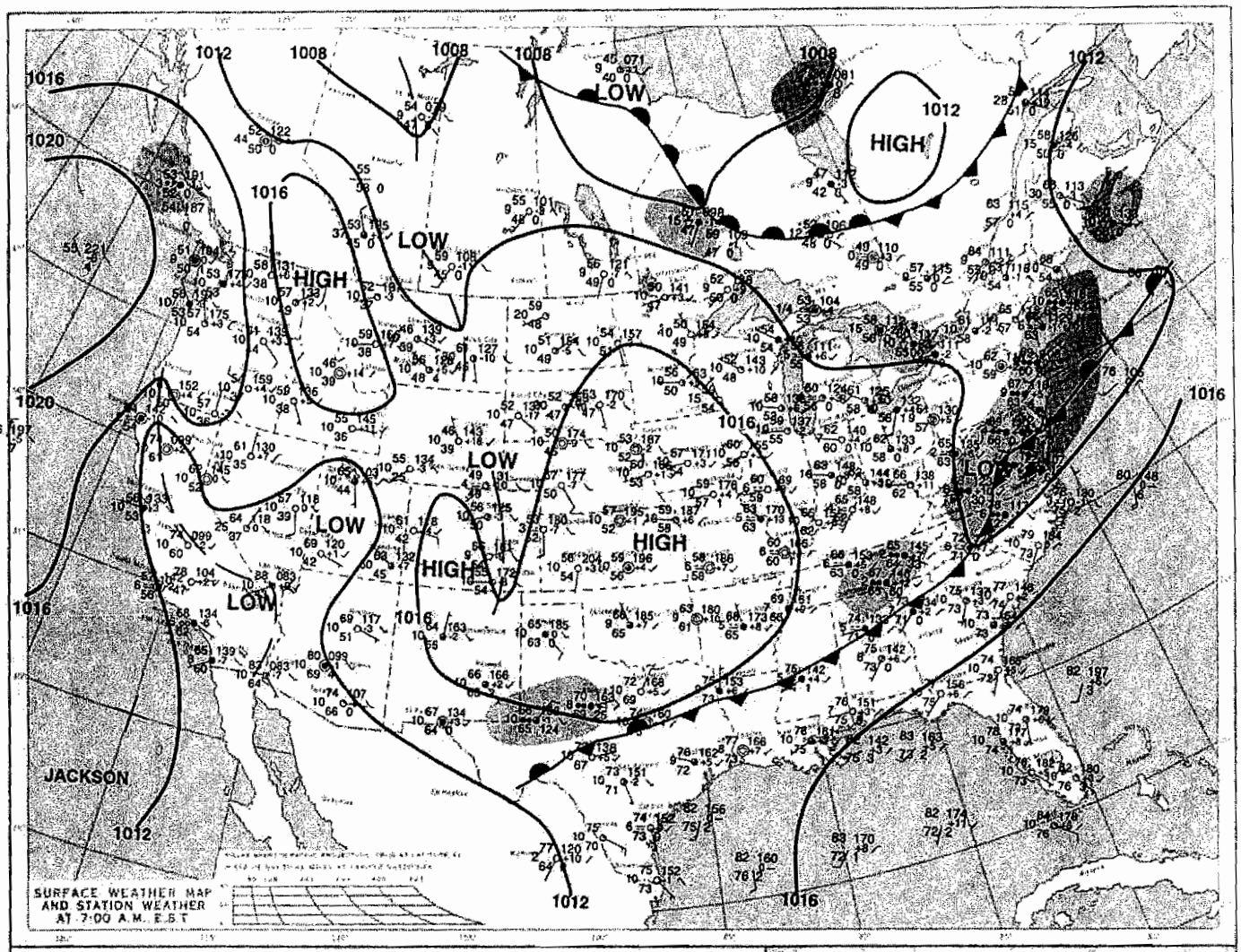
TUESDAY, JUNE 6, 2000

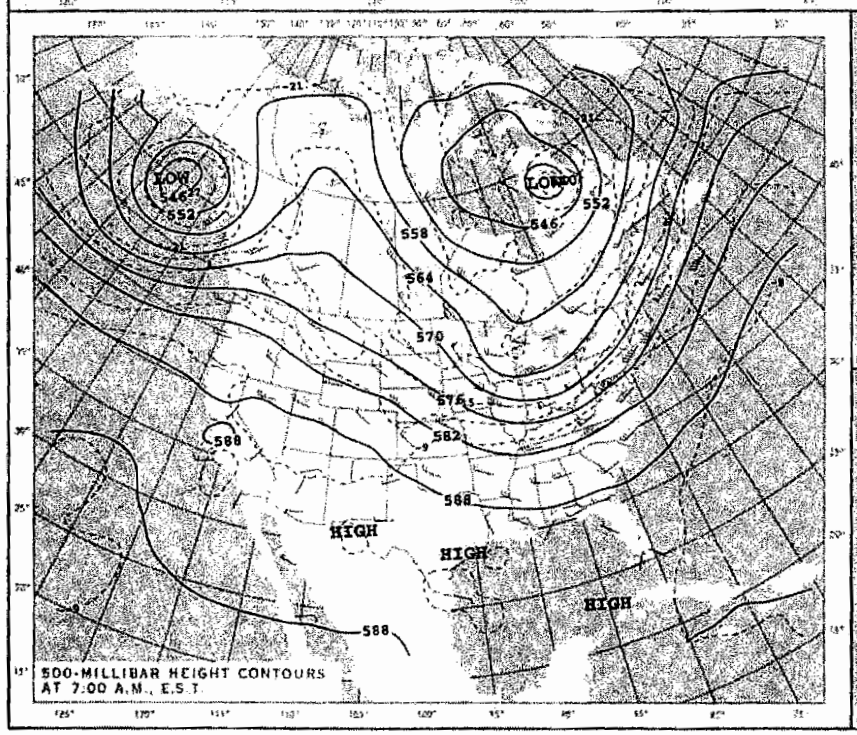


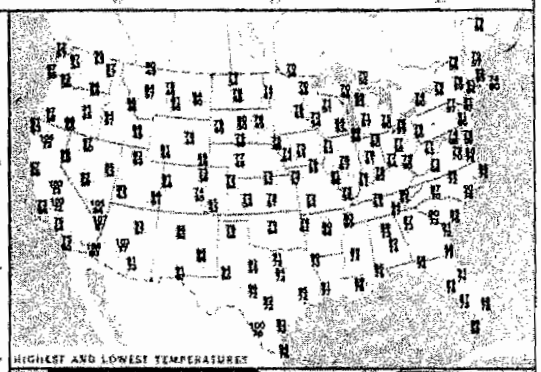




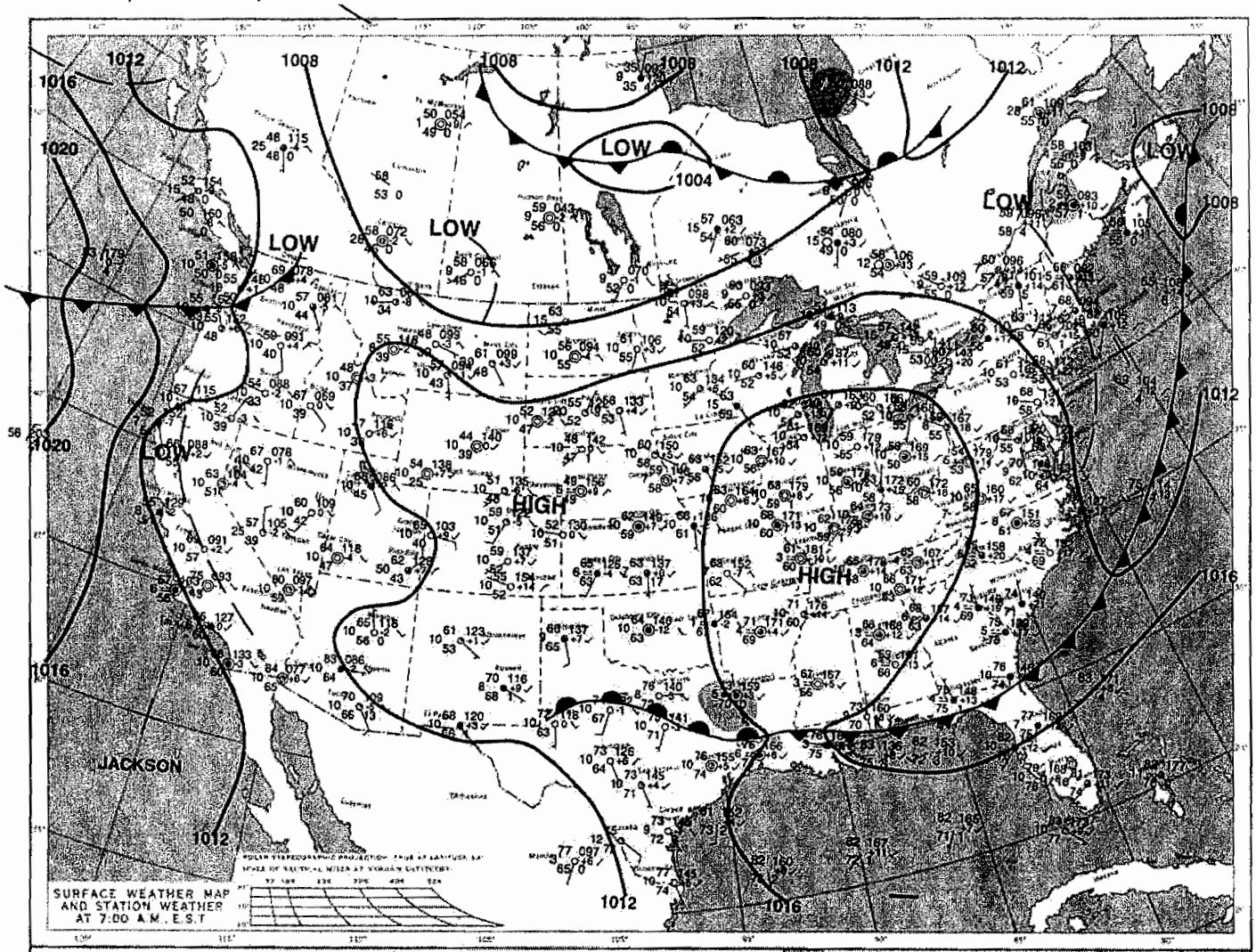
THURSDAY, JUNE 29, 2000



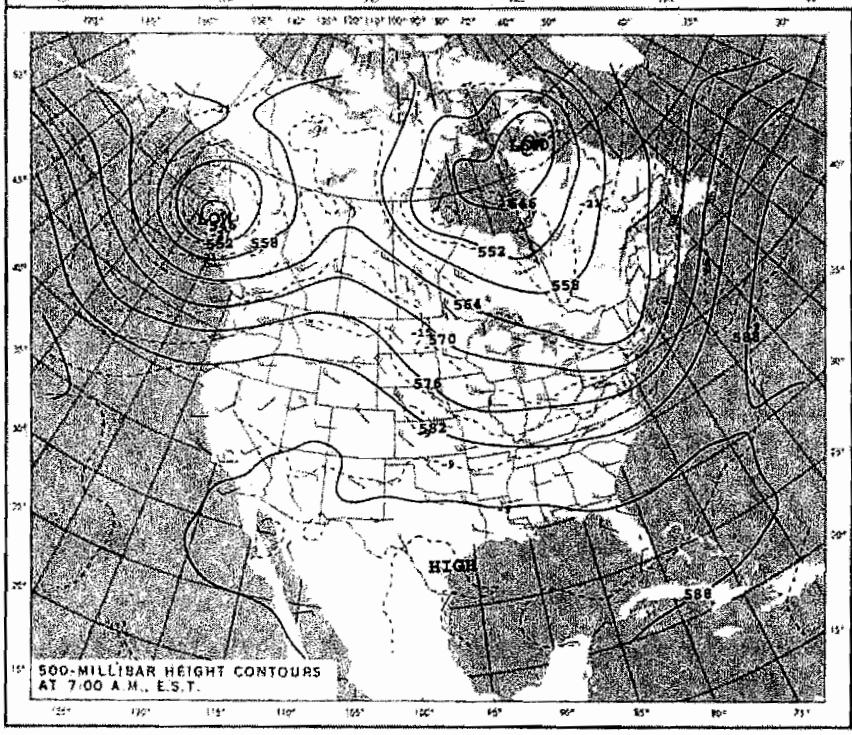




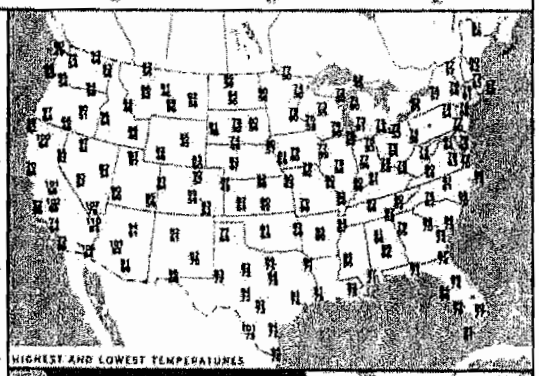
FRIDAY, JUNE 30, 2000



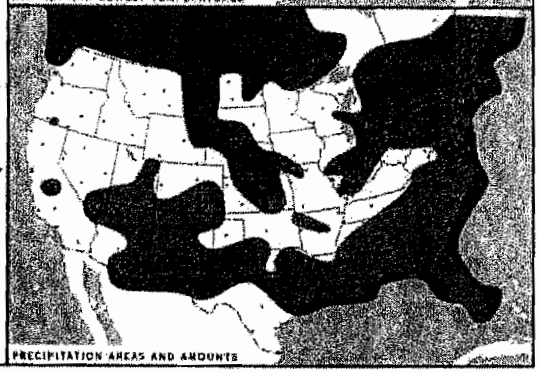
SURFACE WEATHER MAP AND STATION WEATHER AT 7:00 A.M., E.S.T.



500-MILLIBAR HEIGHT CONTOURS AT 7:00 A.M., E.S.T.

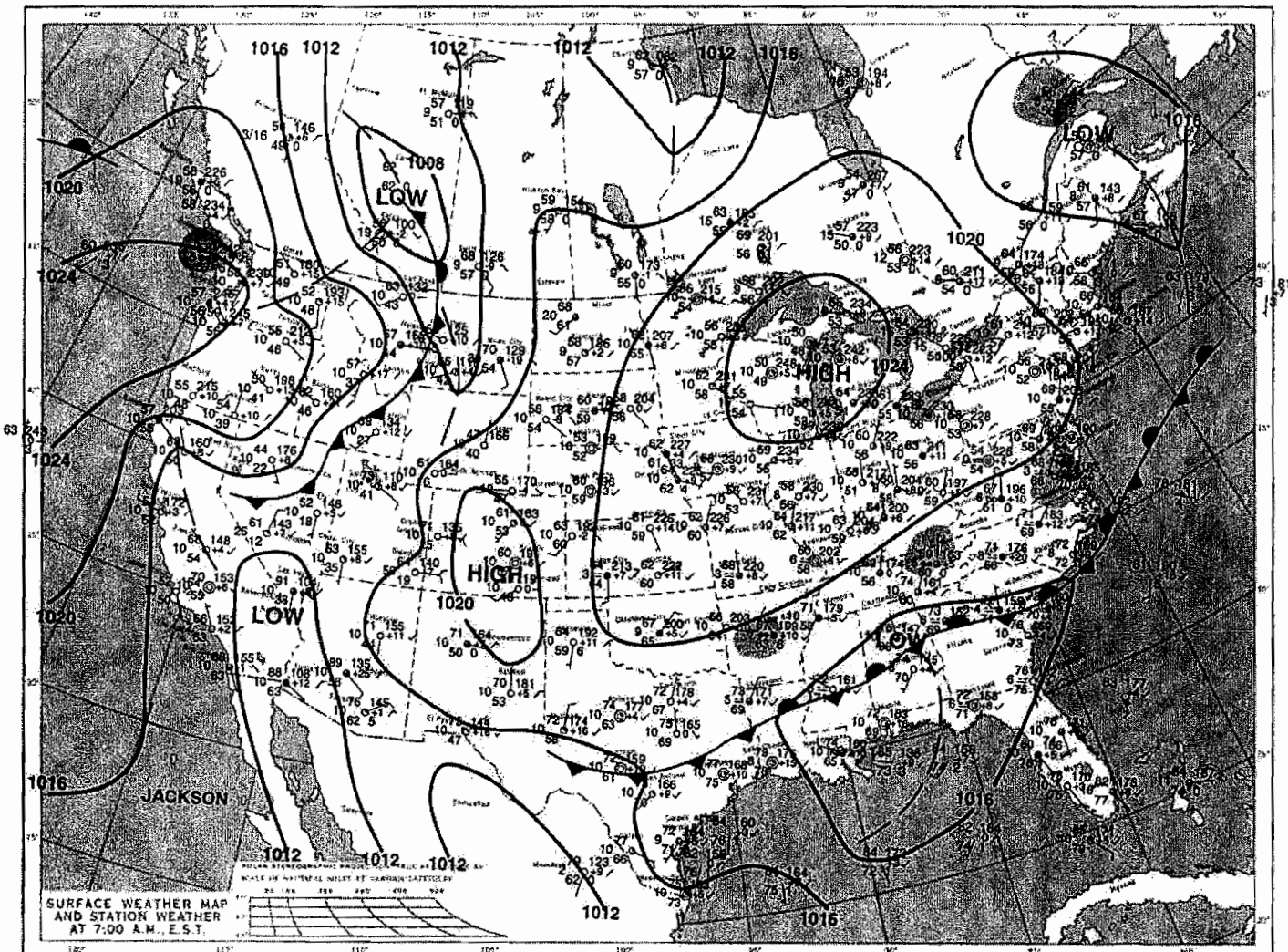


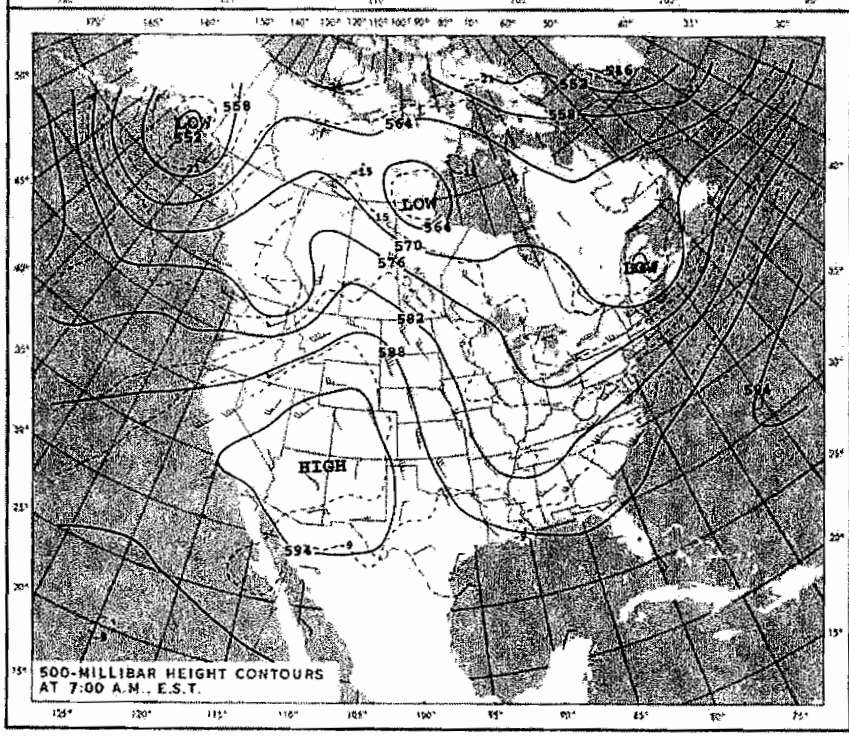
HIGHEST AND LOWEST TEMPERATURES

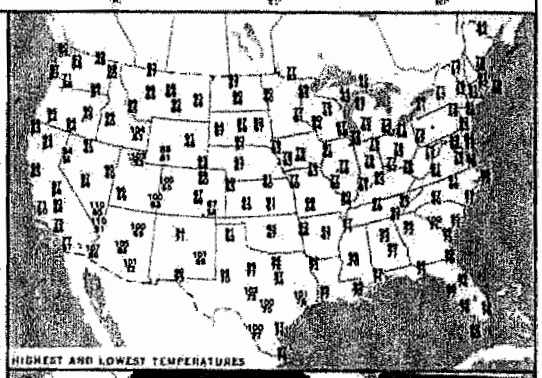


PRECIPITATION AREAS AND AMOUNTS

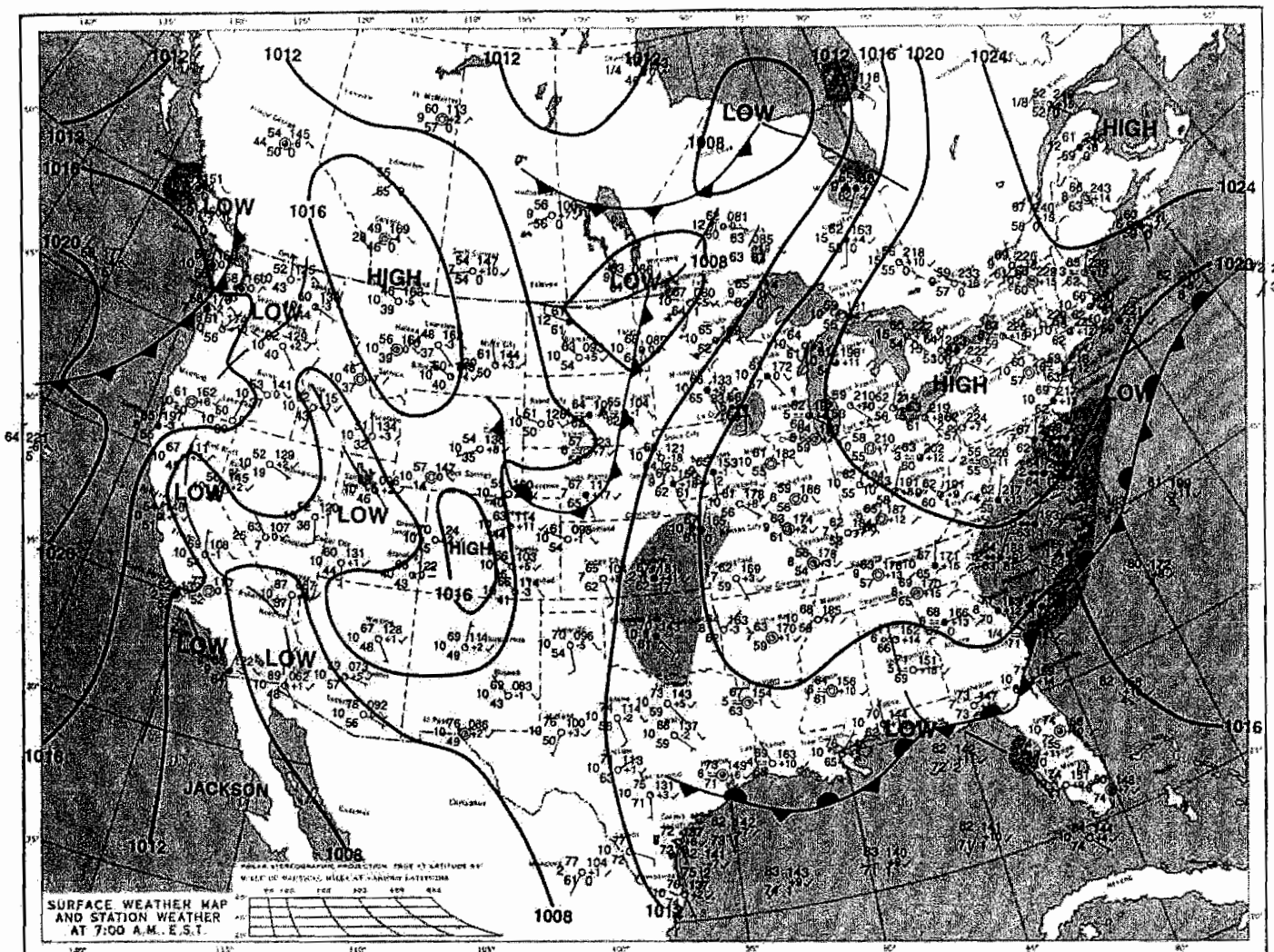
SUNDAY, JULY 23, 2000

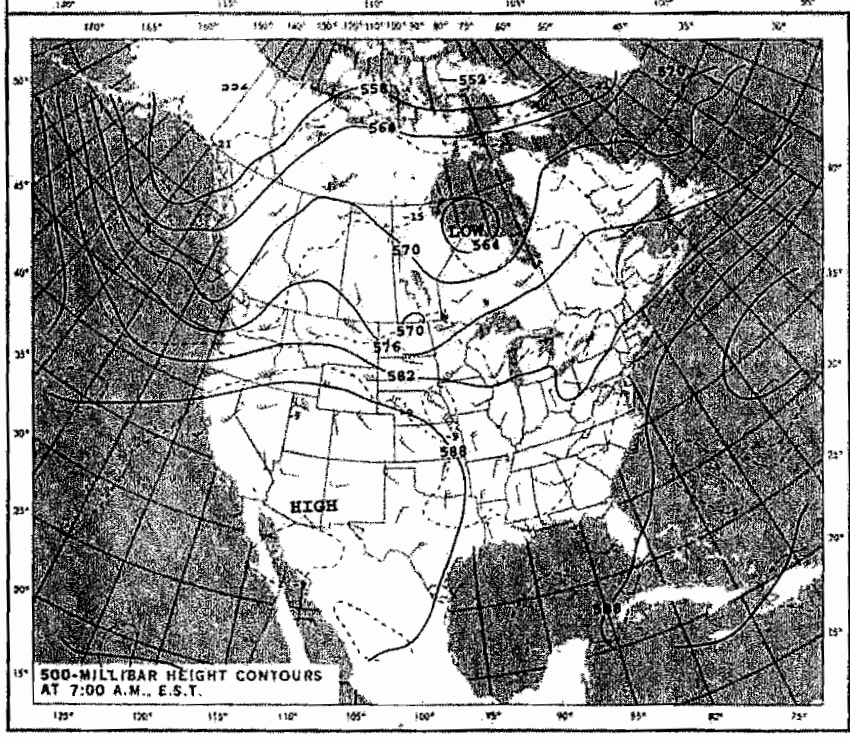


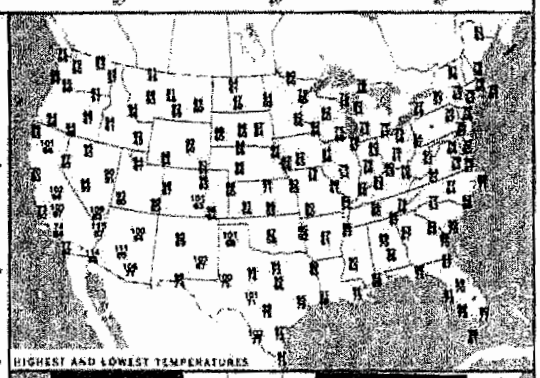




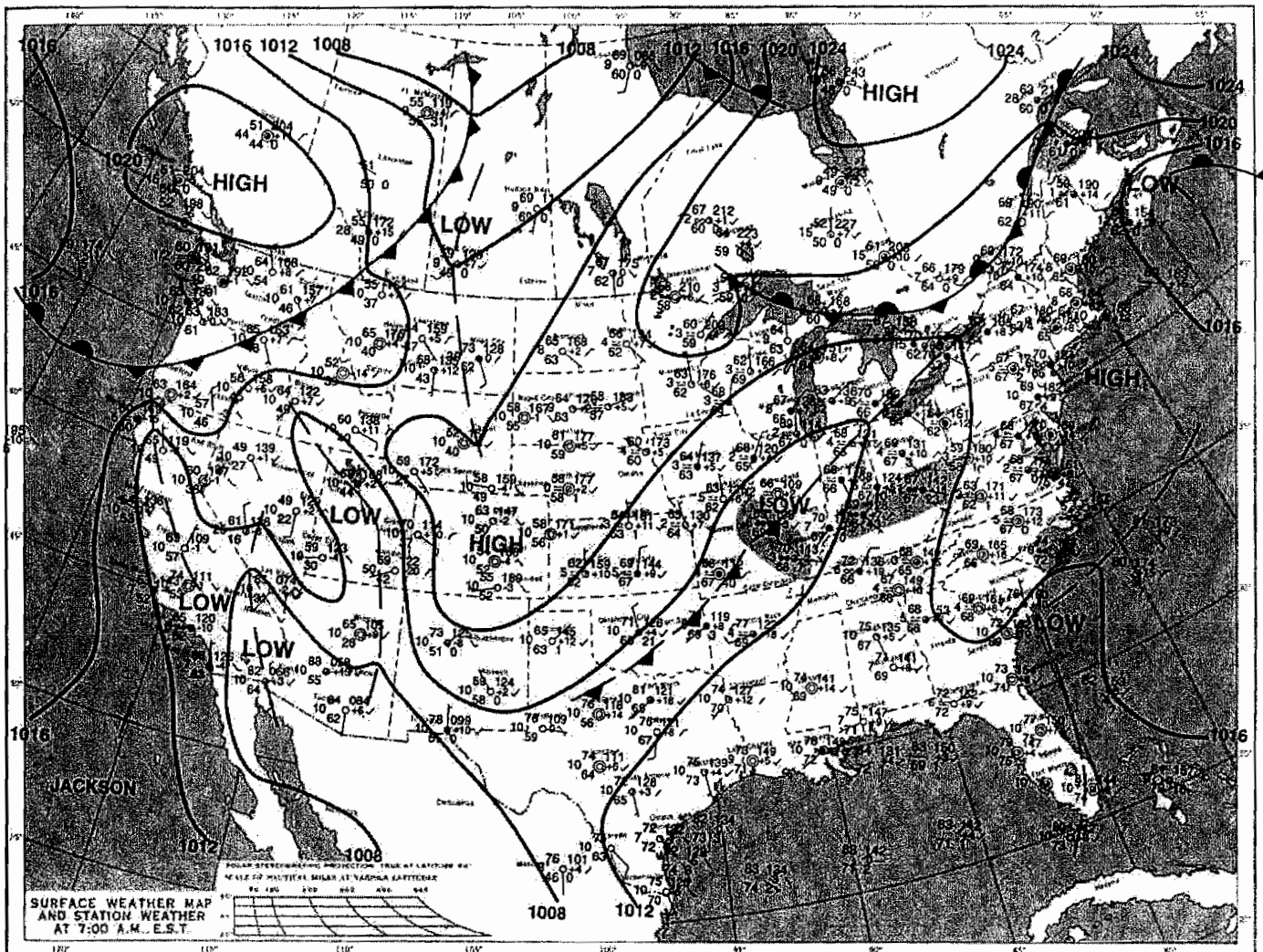
TUESDAY, JULY 25, 2000

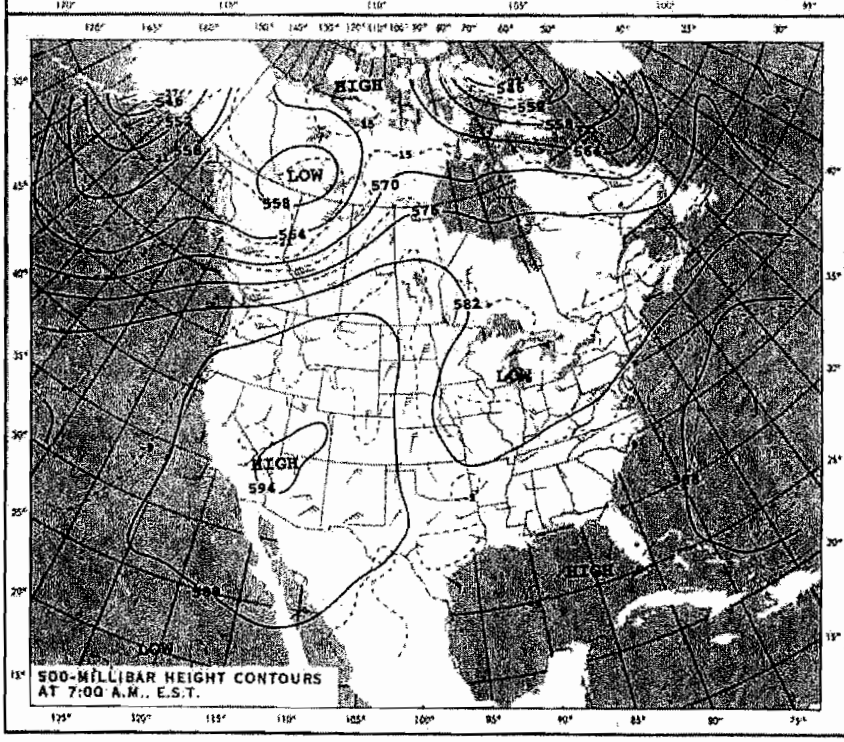


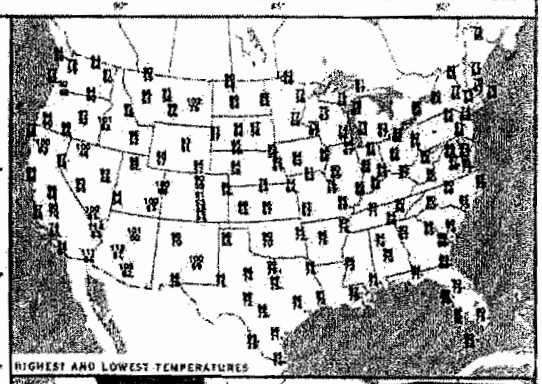


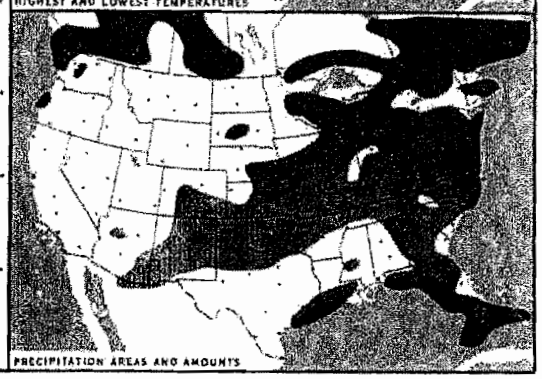


SATURDAY, JULY 29, 2000

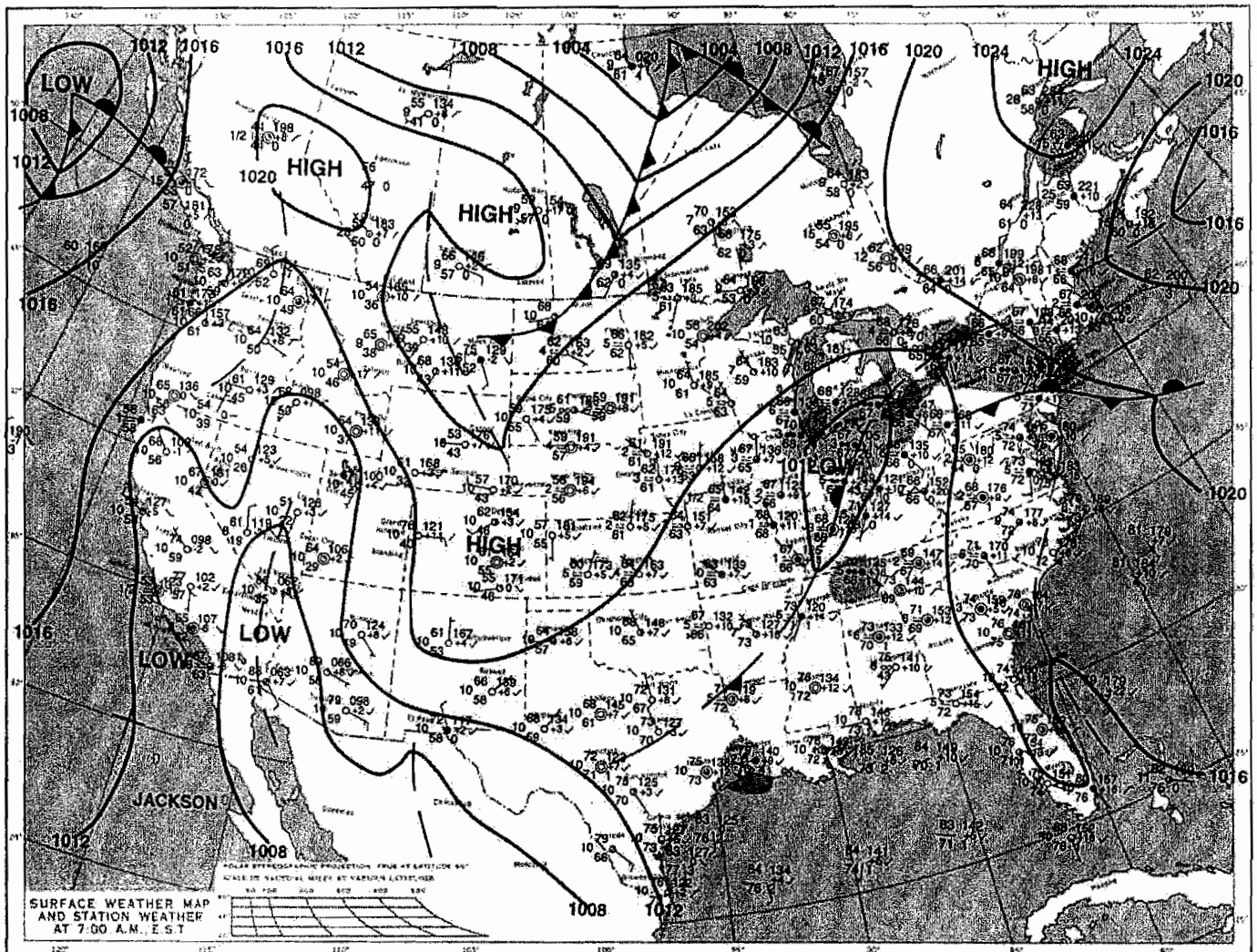


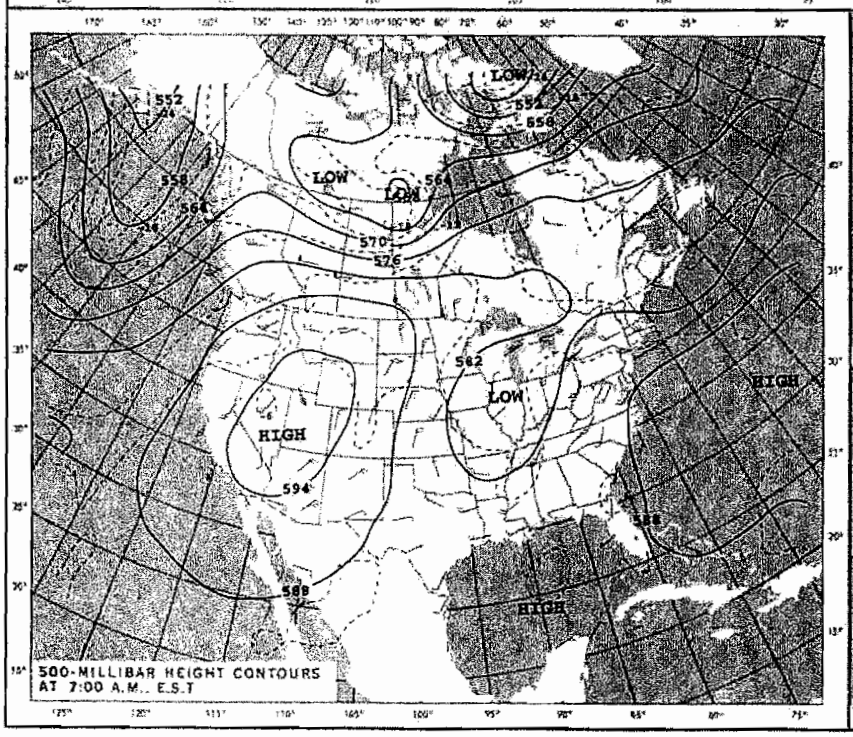


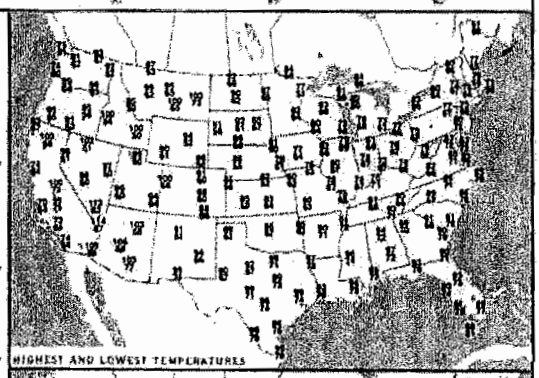


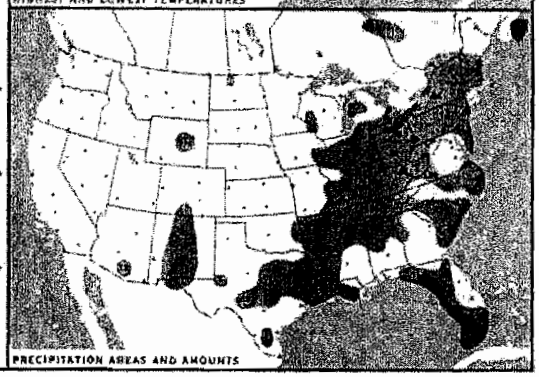


SUNDAY, JULY 30, 2000

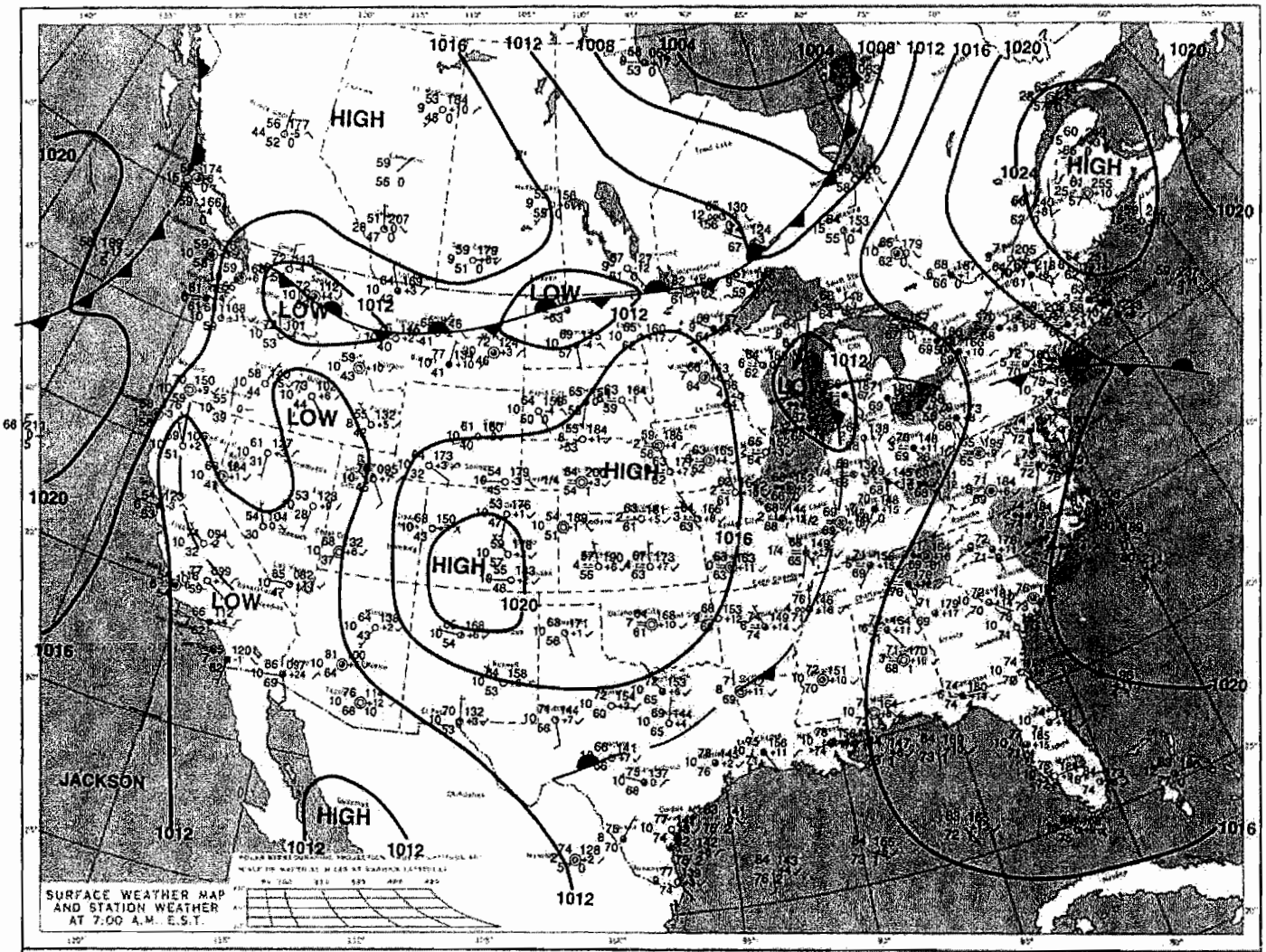


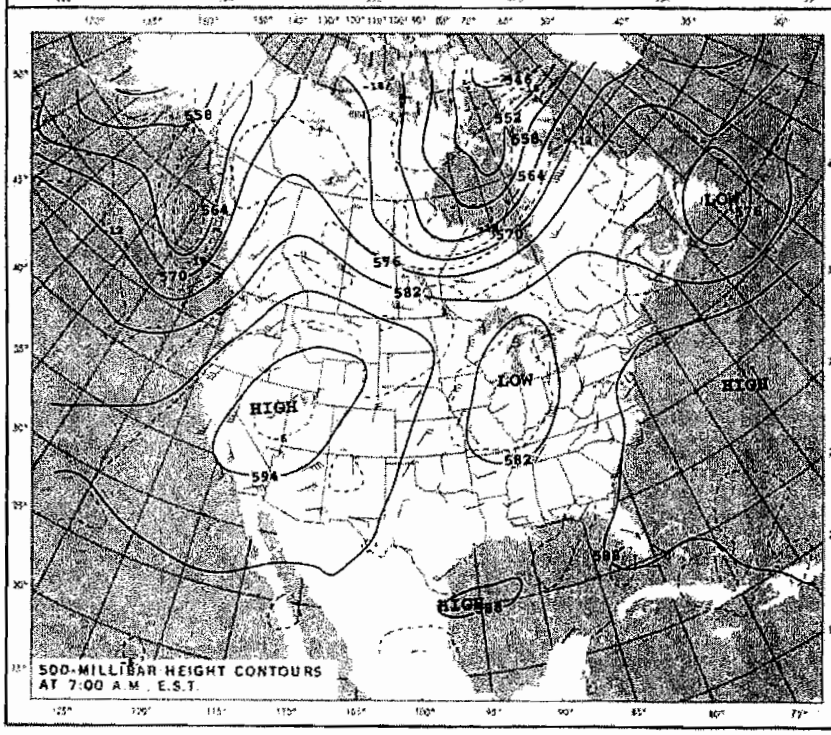


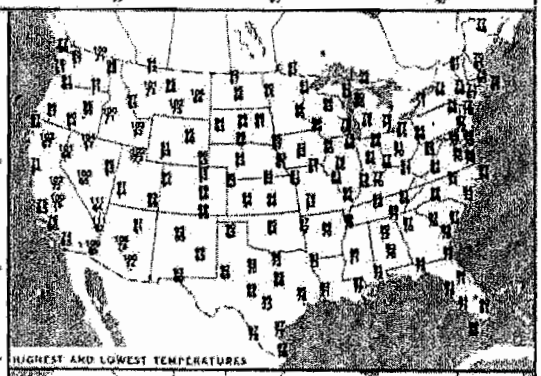


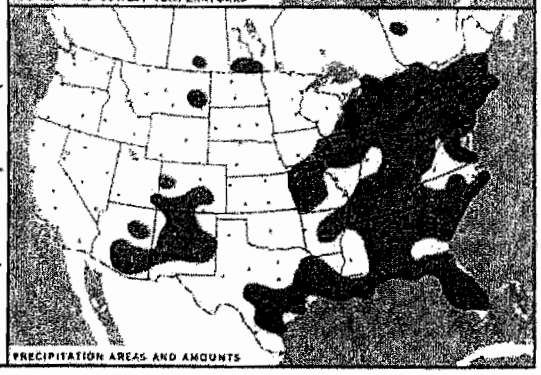


MONDAY, JULY 31, 2000

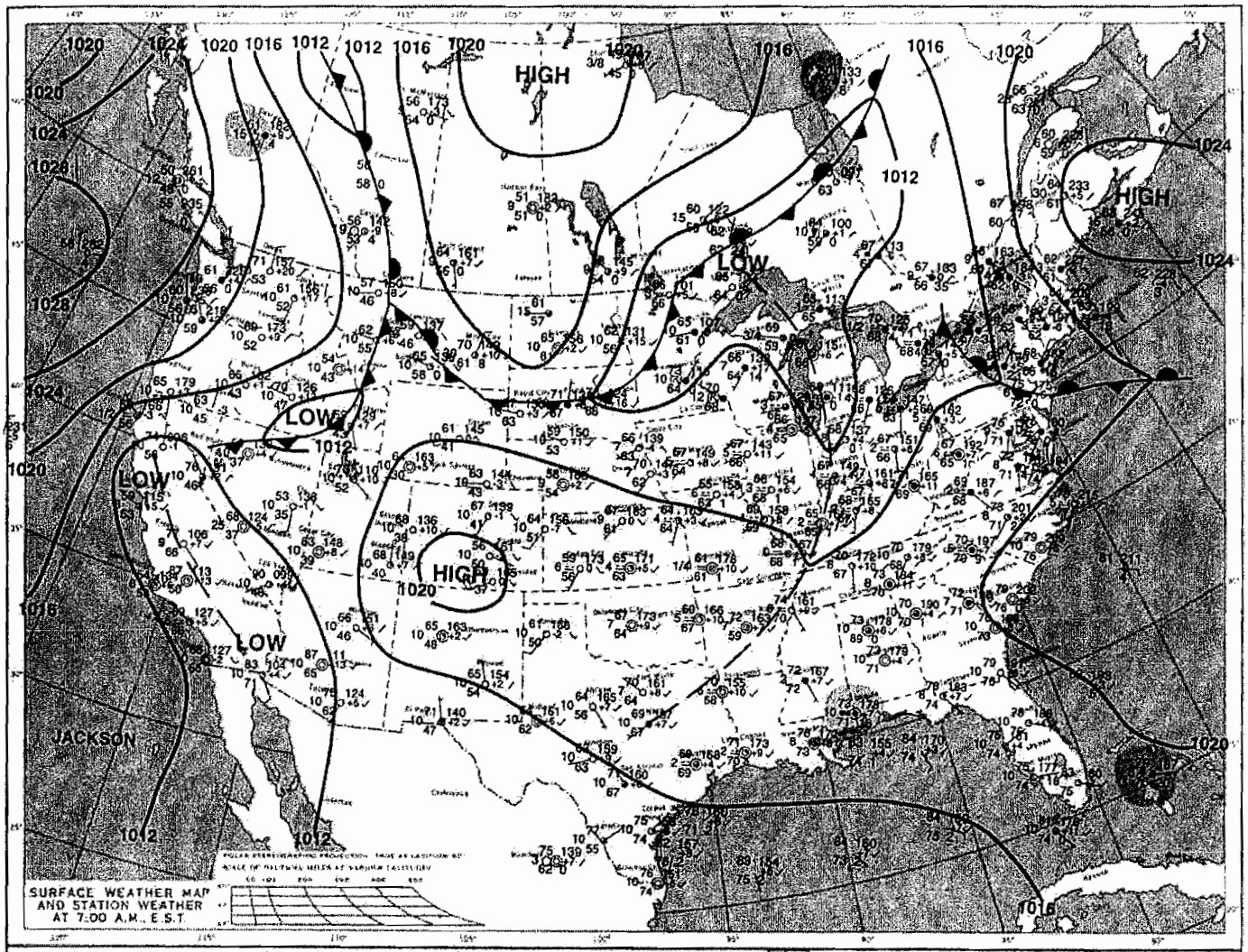


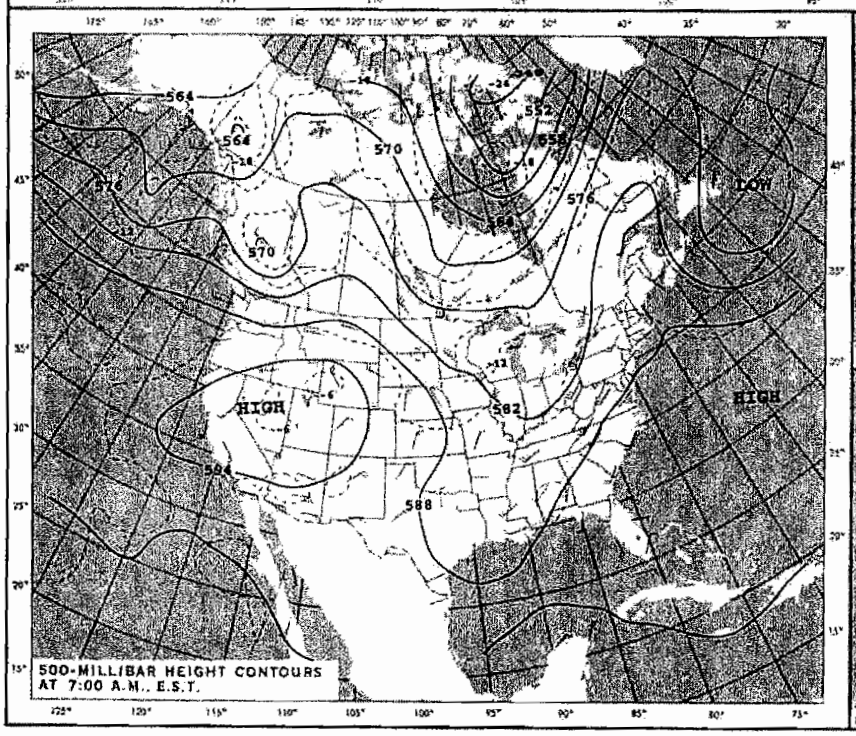


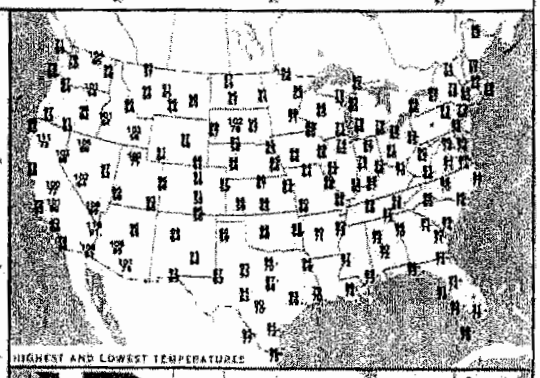


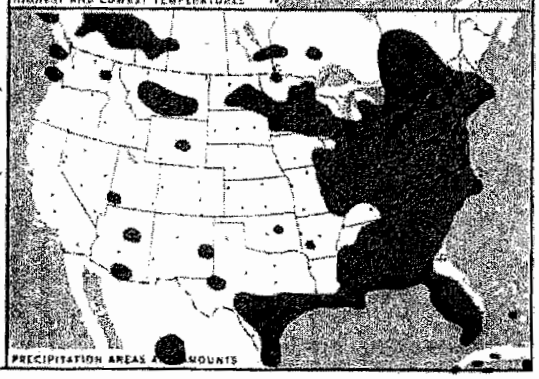


TUESDAY, AUGUST 1, 2000

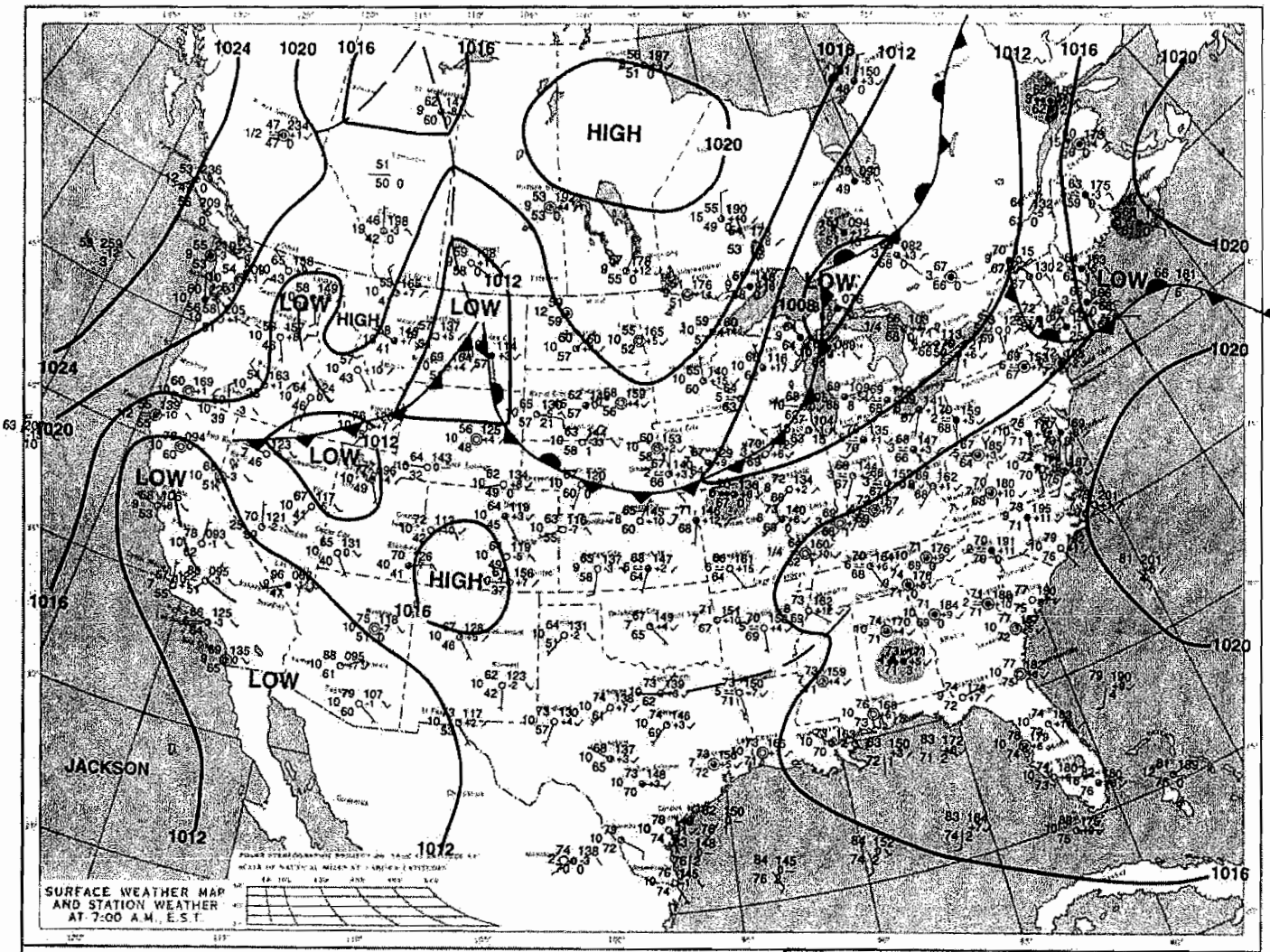


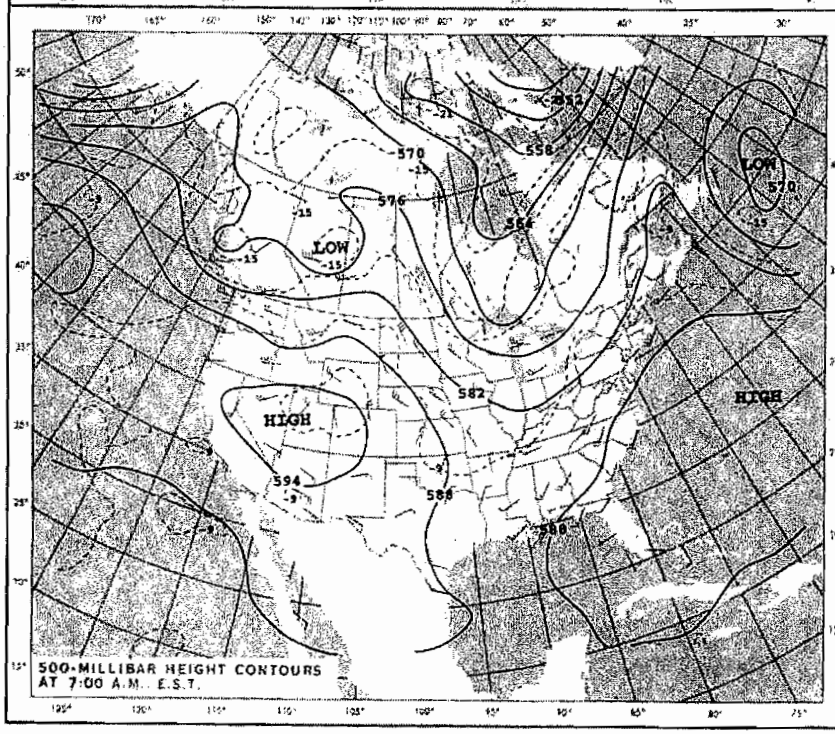


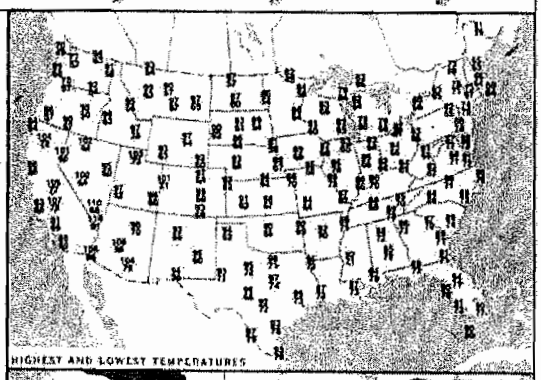


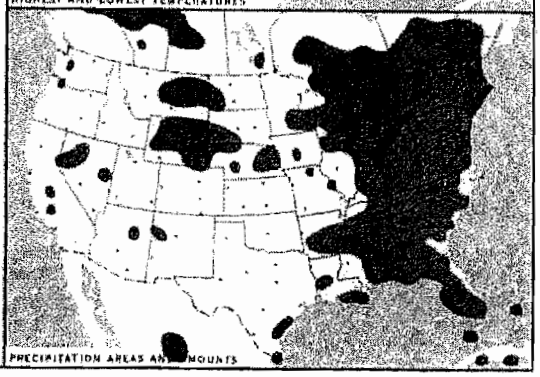


WEDNESDAY, AUGUST 2, 2000

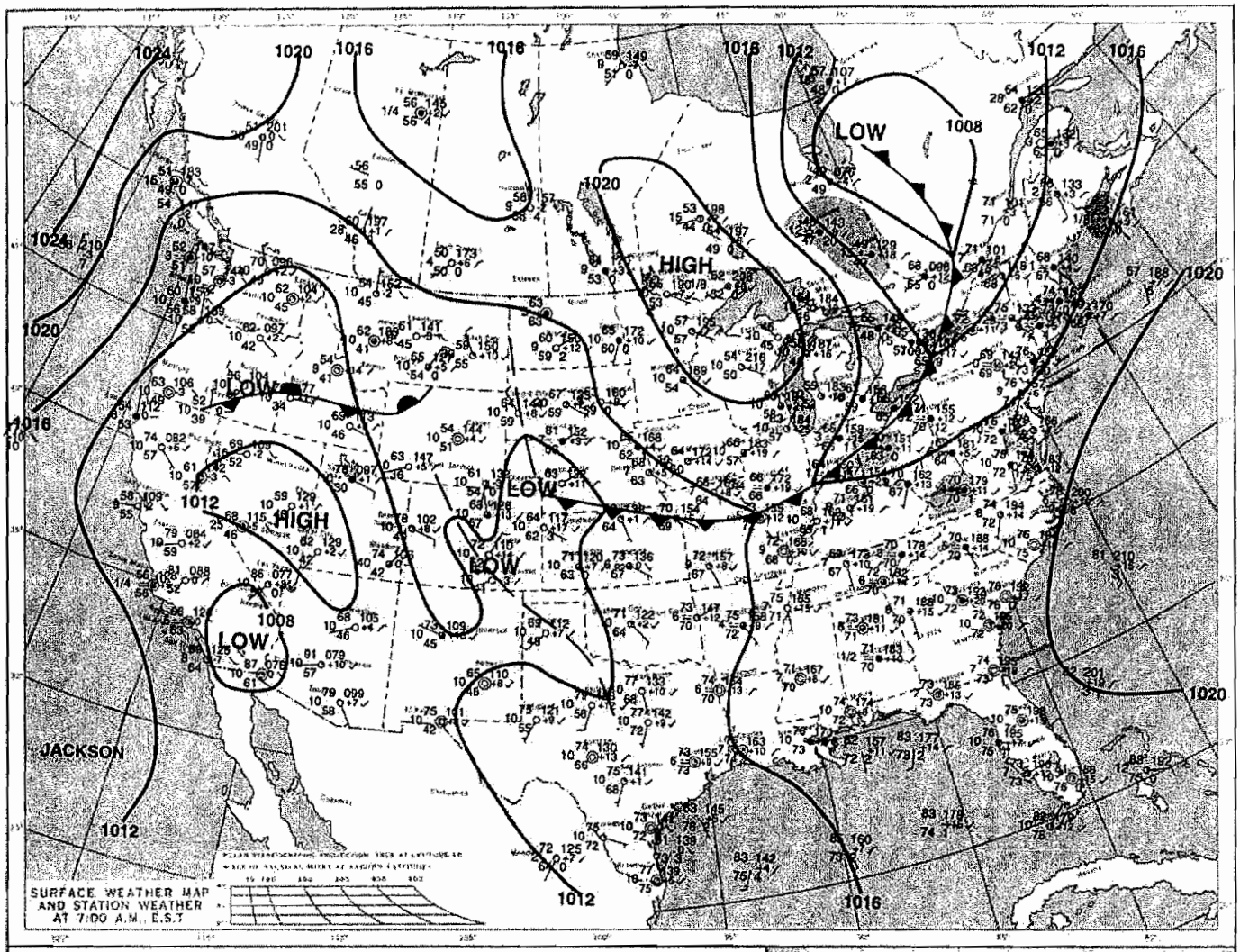


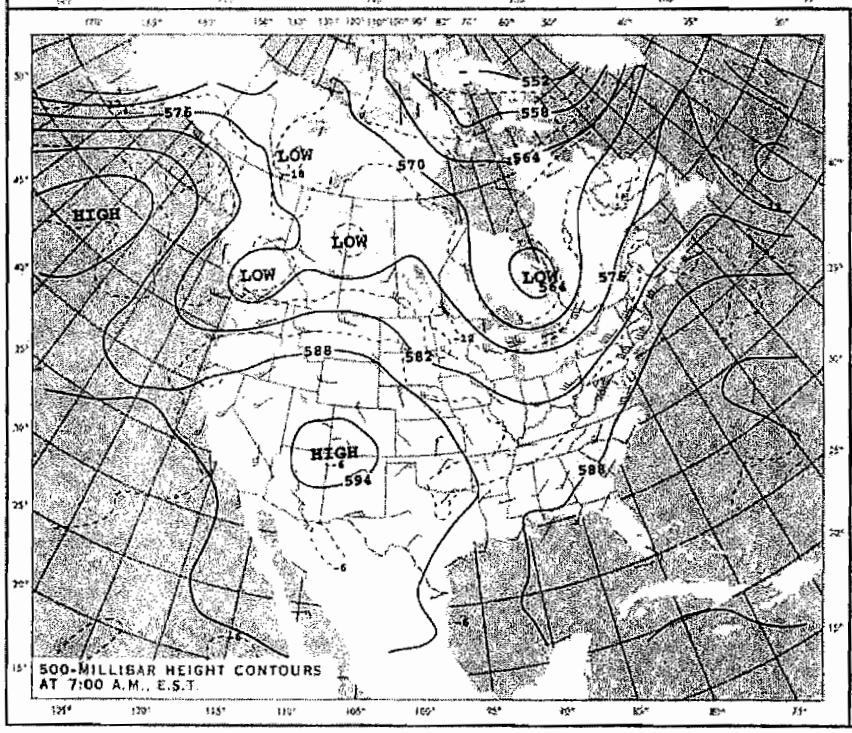


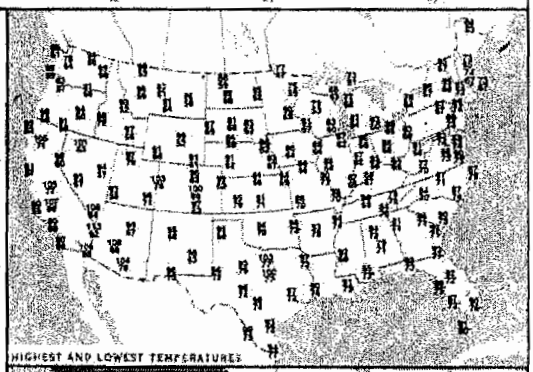


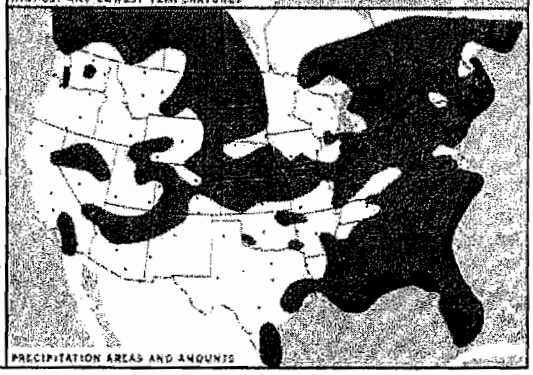


THURSDAY, AUGUST 3, 2000

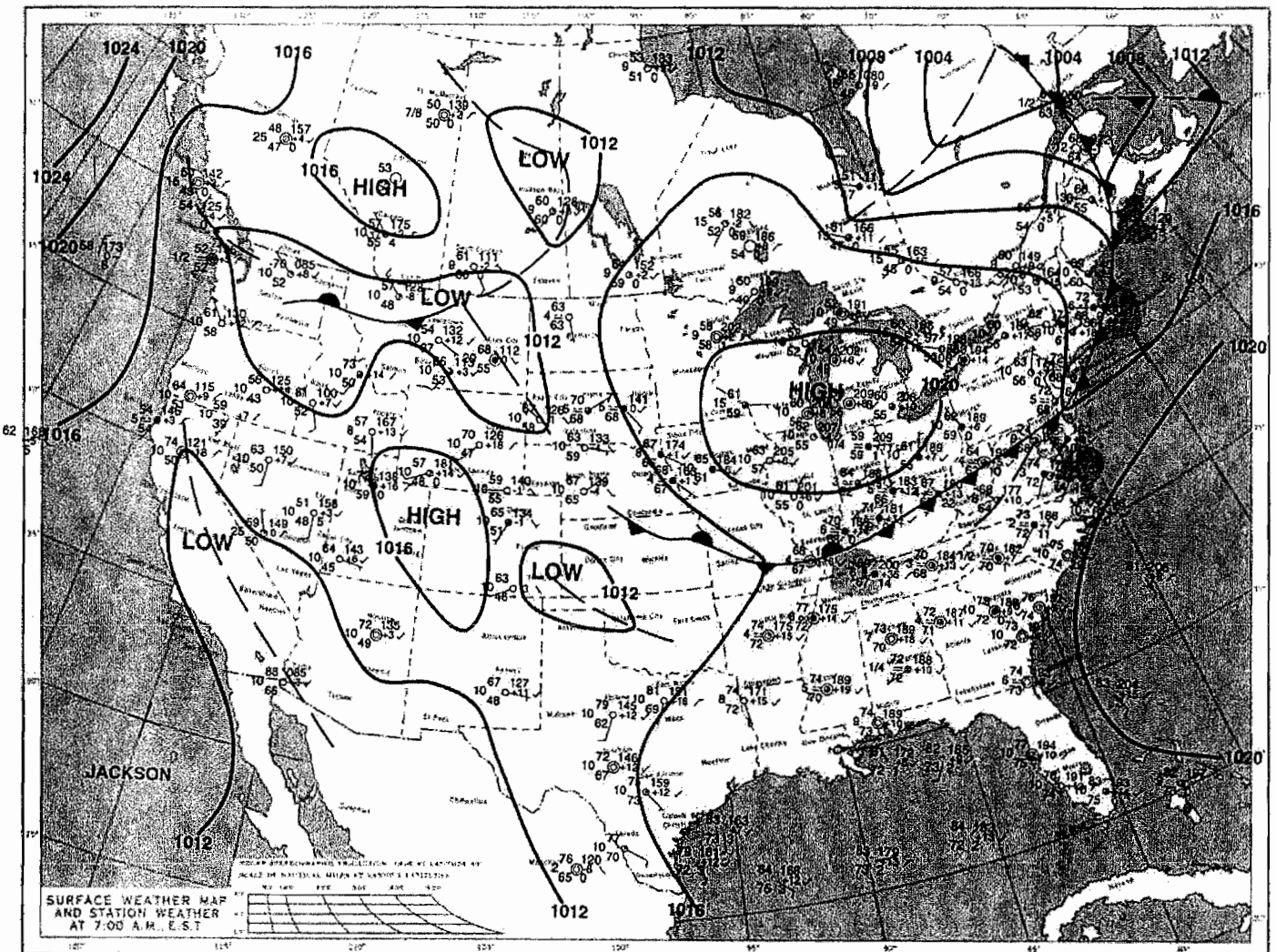


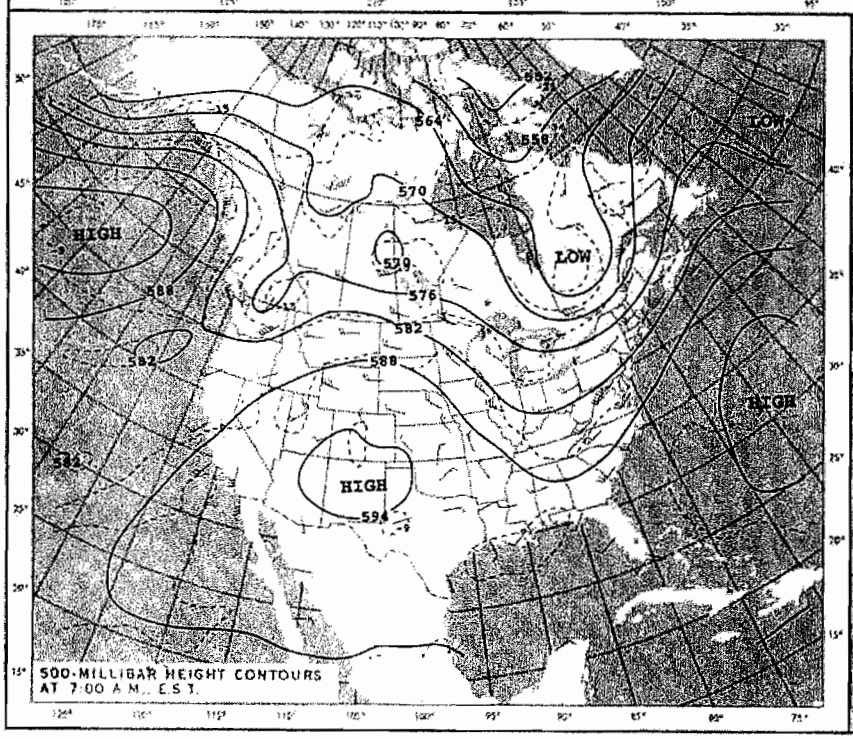


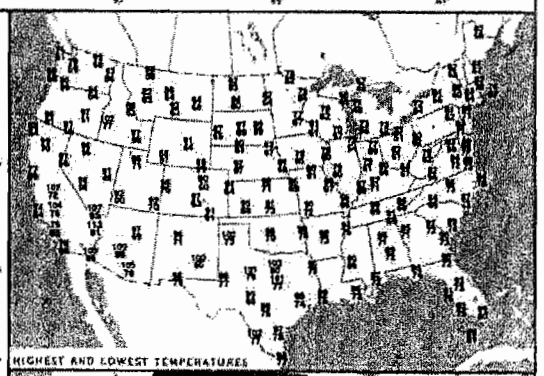


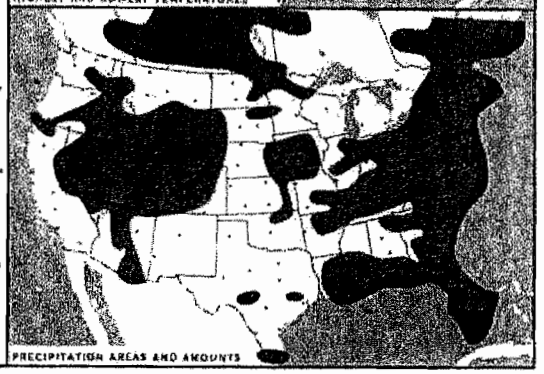


FRIDAY, AUGUST 4, 2000

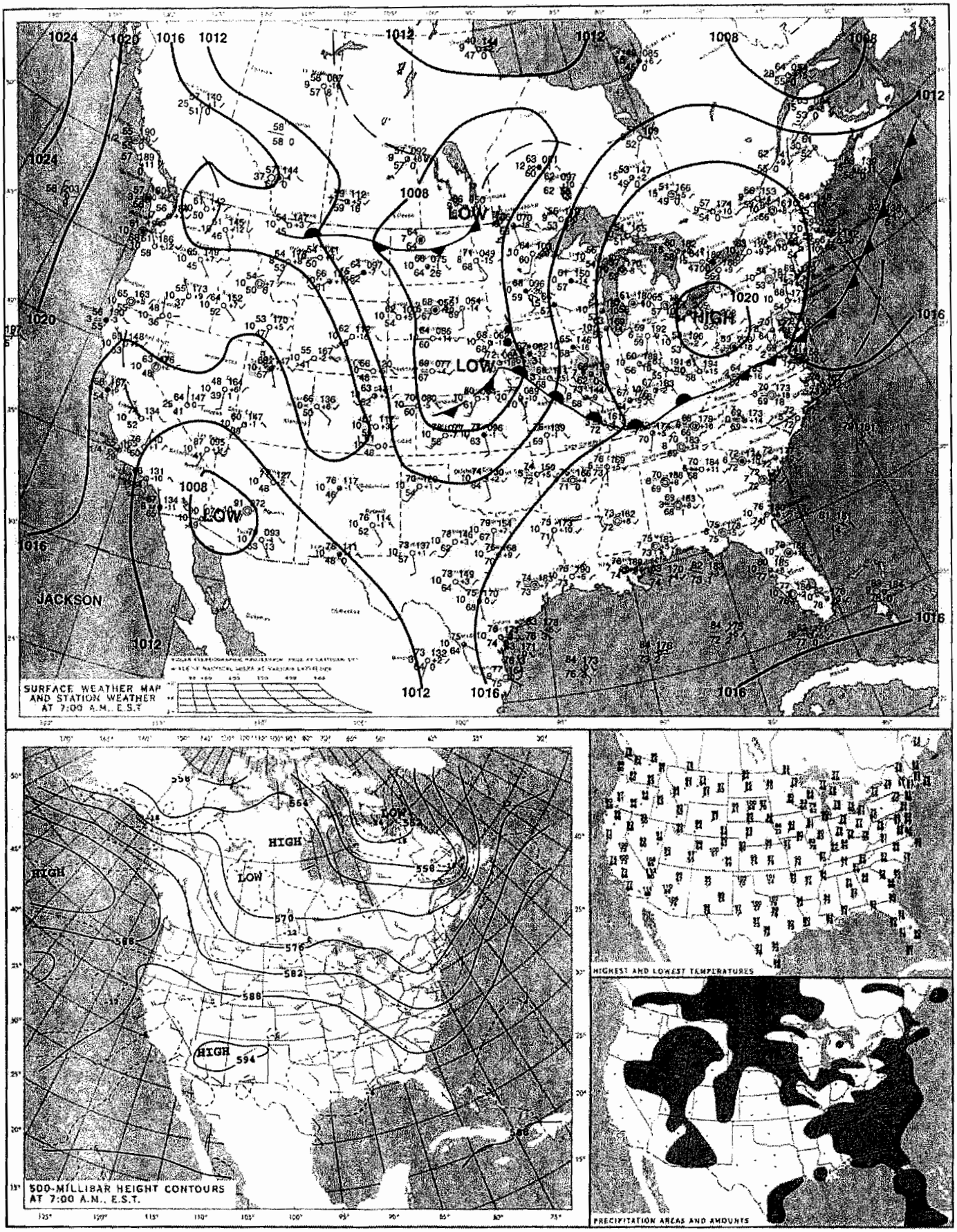




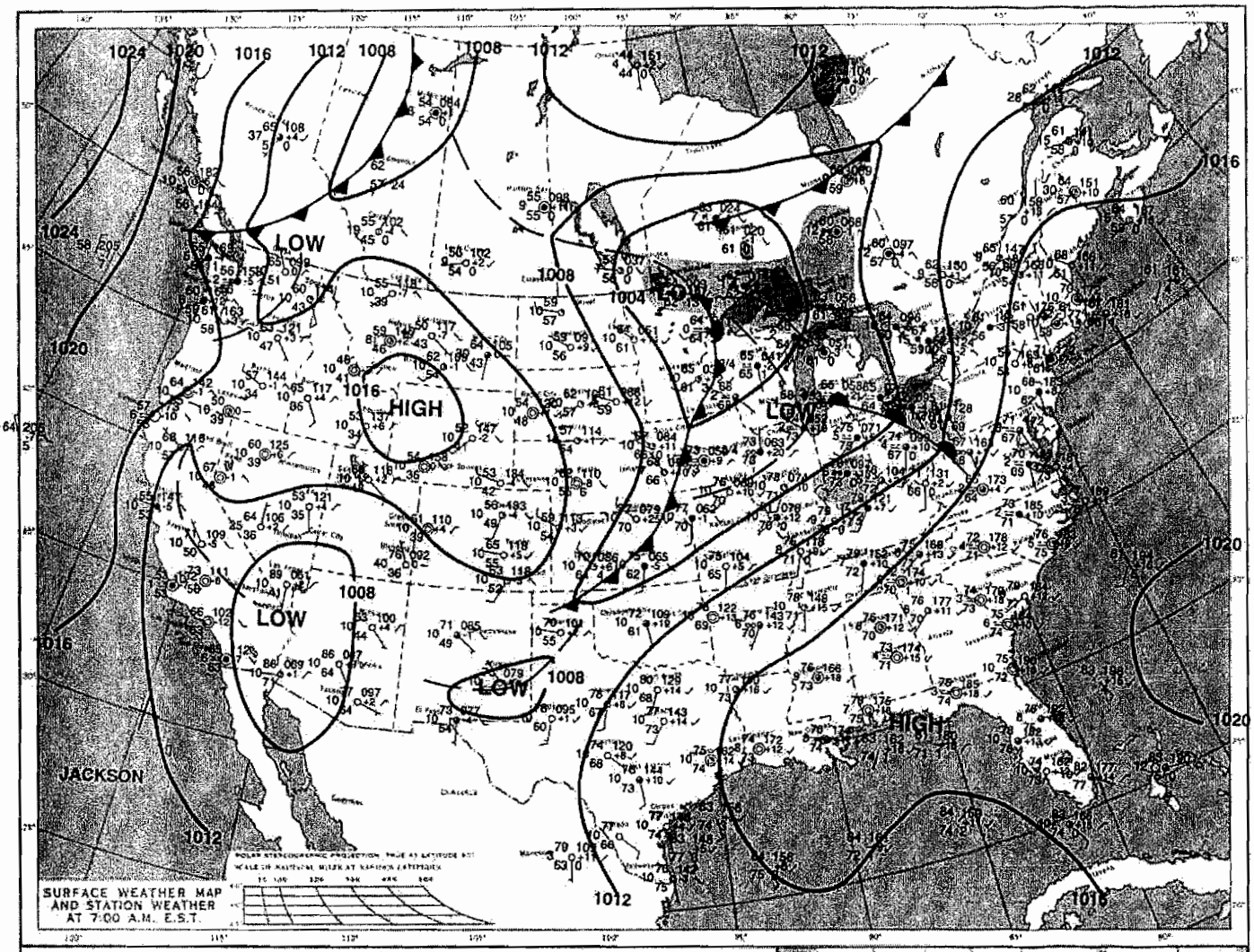


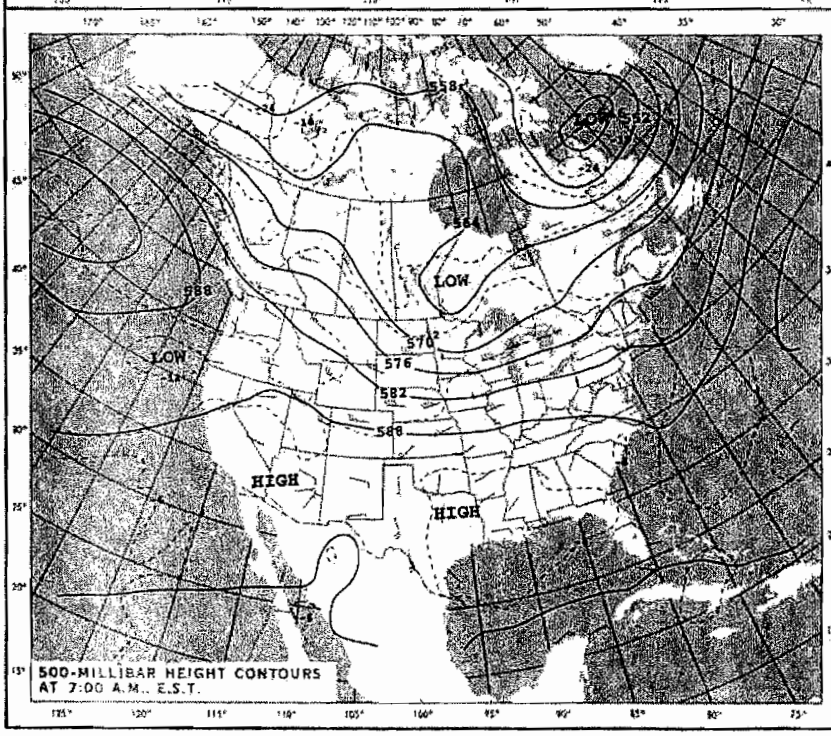


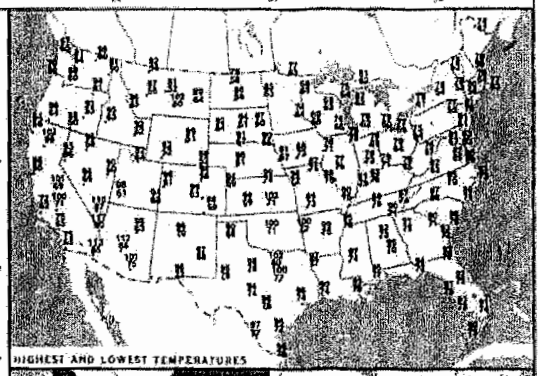
SATURDAY, AUGUST 5, 2000



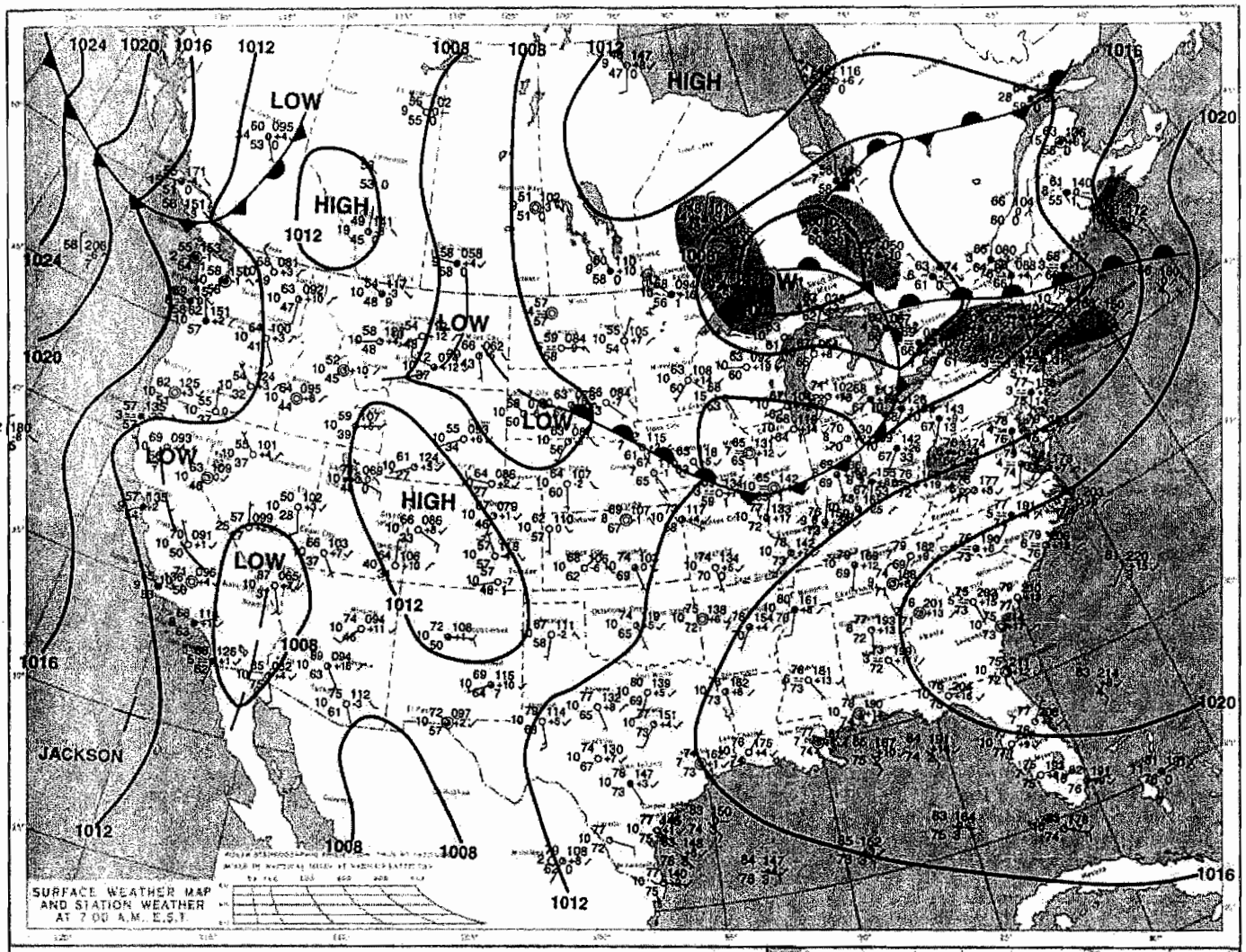
SUNDAY, AUGUST 6, 2000

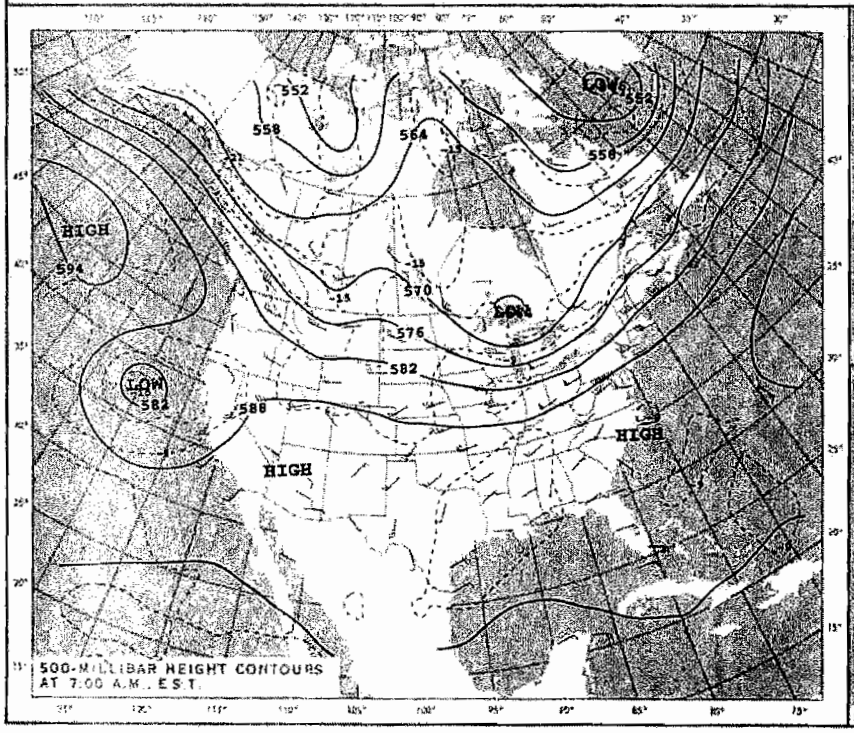


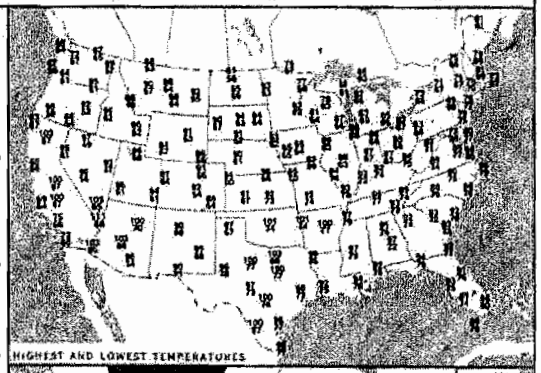


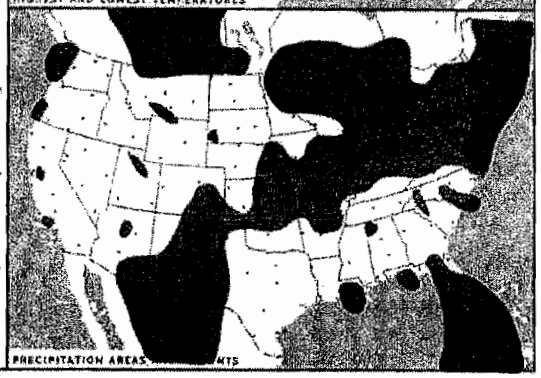


MONDAY, AUGUST 7, 2000

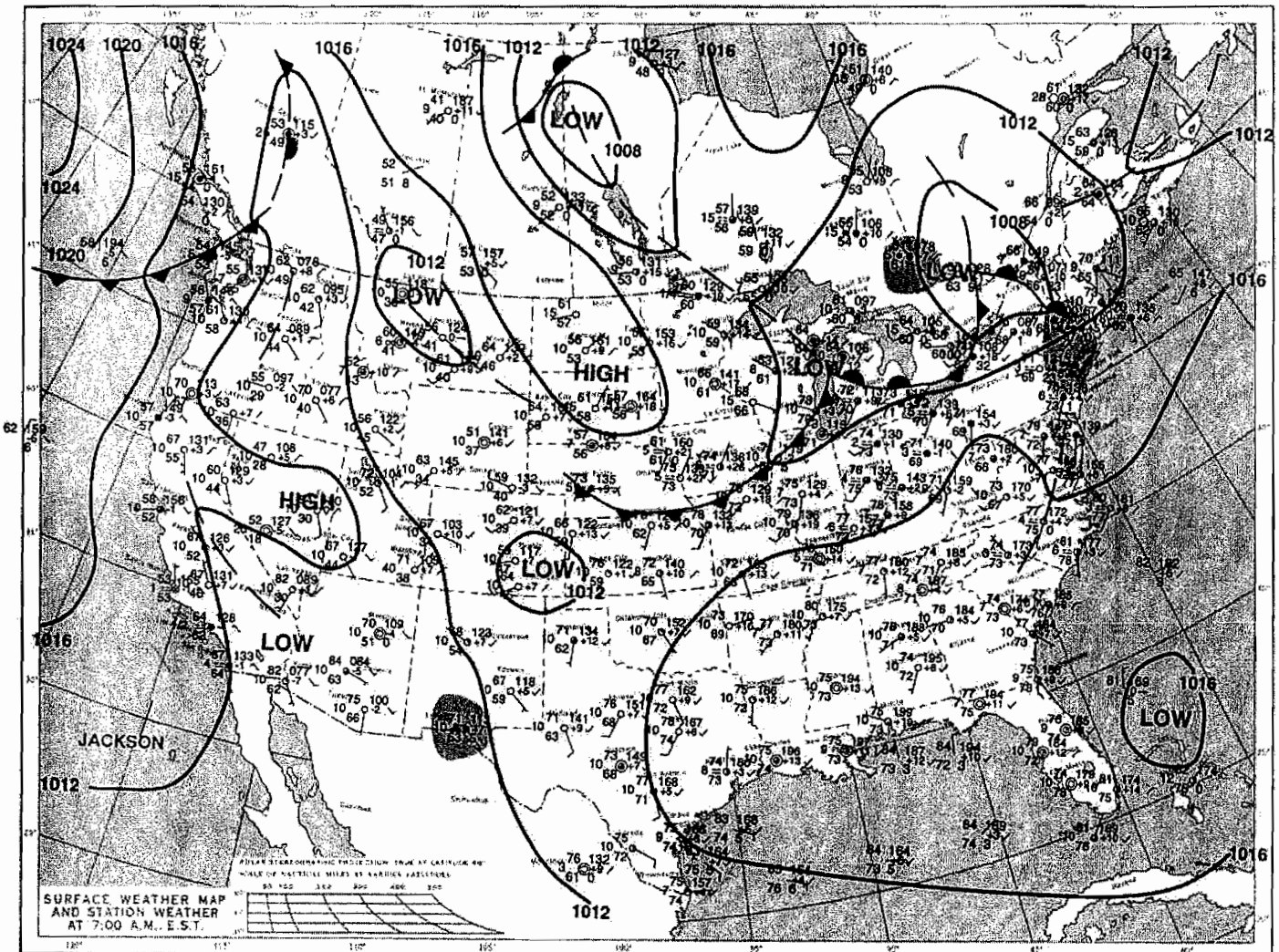


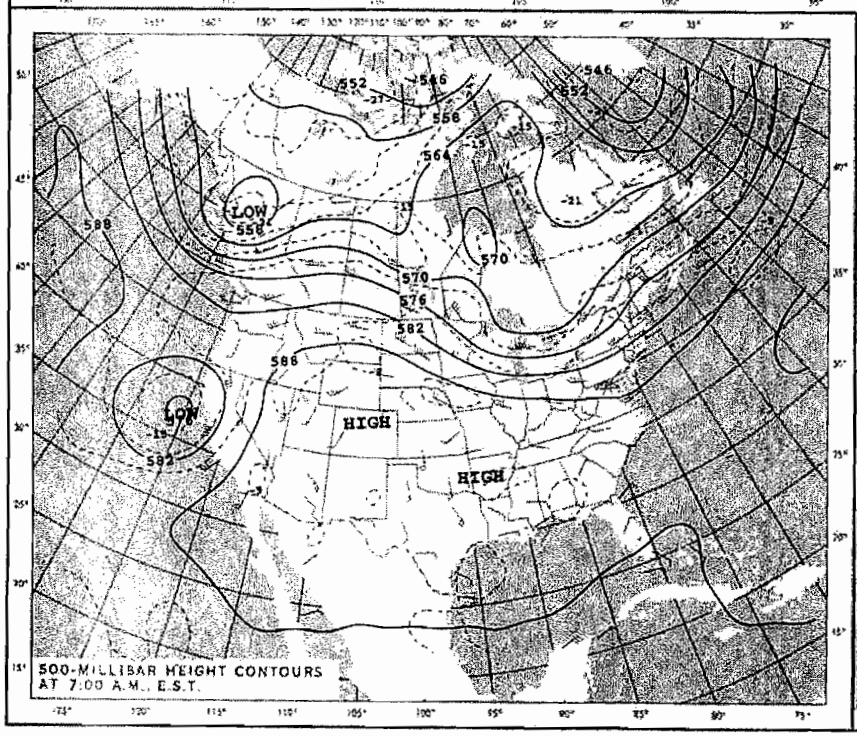


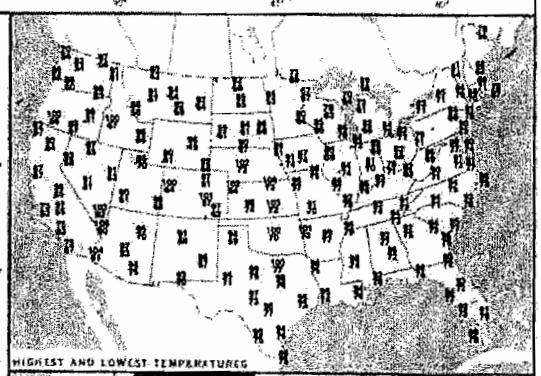




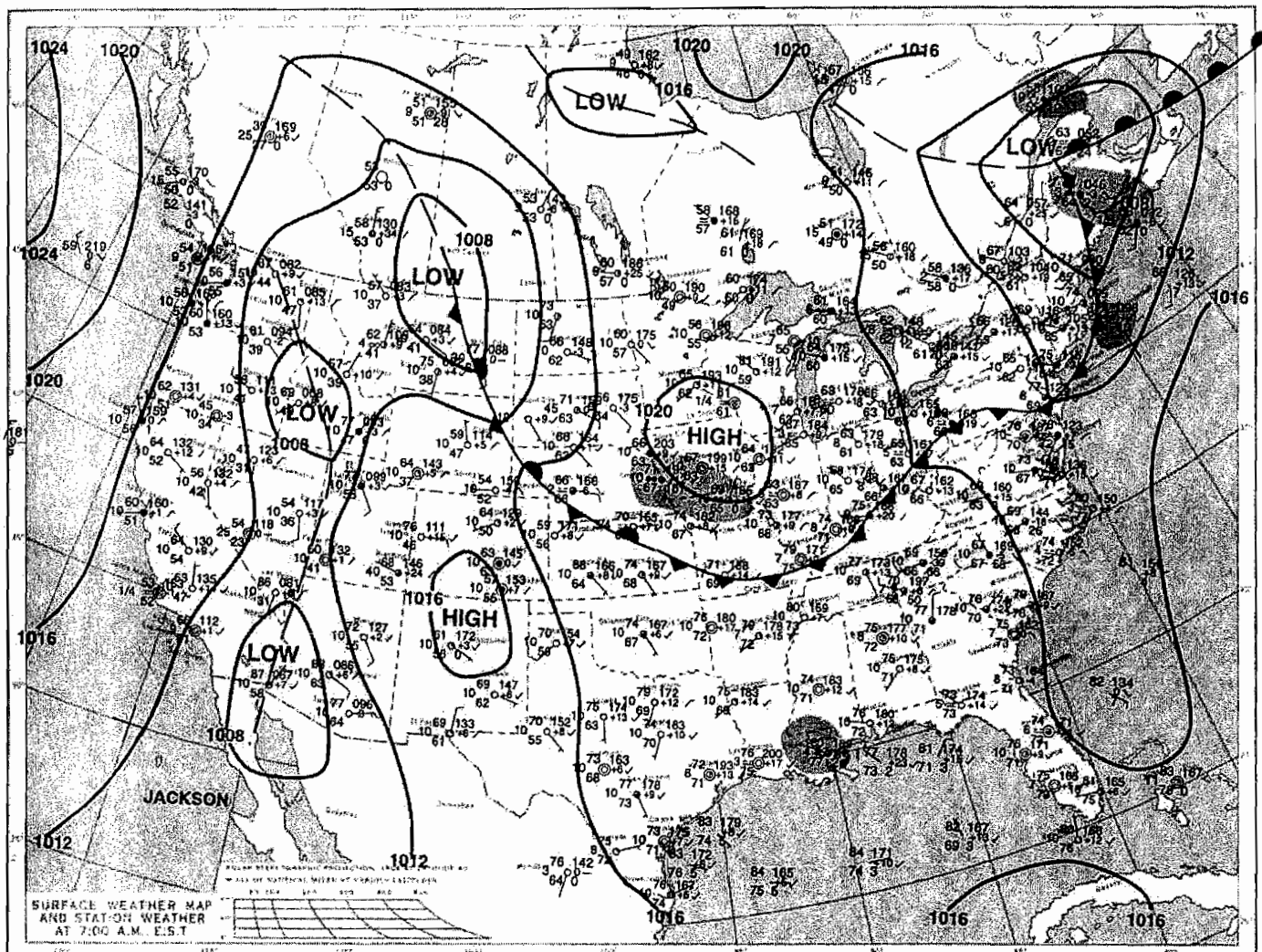
WEDNESDAY, AUGUST 9, 2000

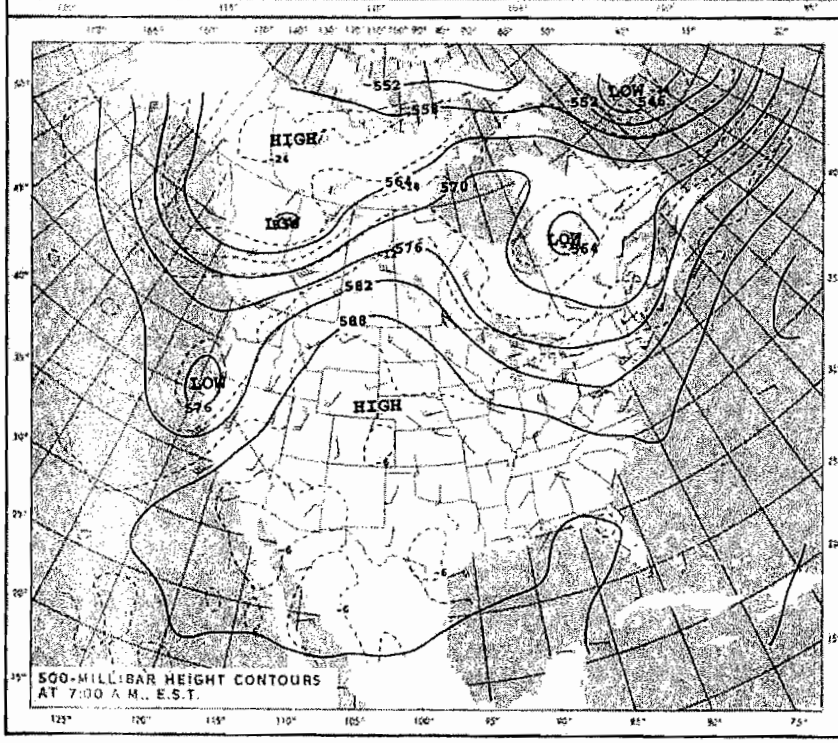


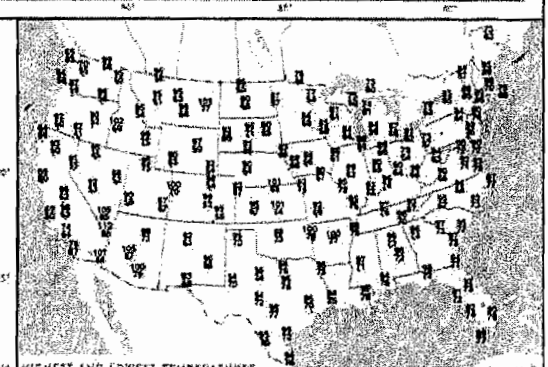


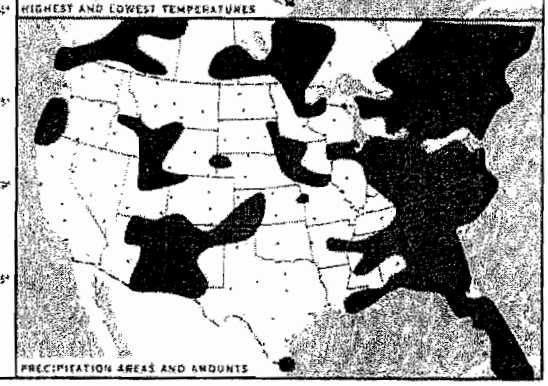


THURSDAY, AUGUST 10, 2000

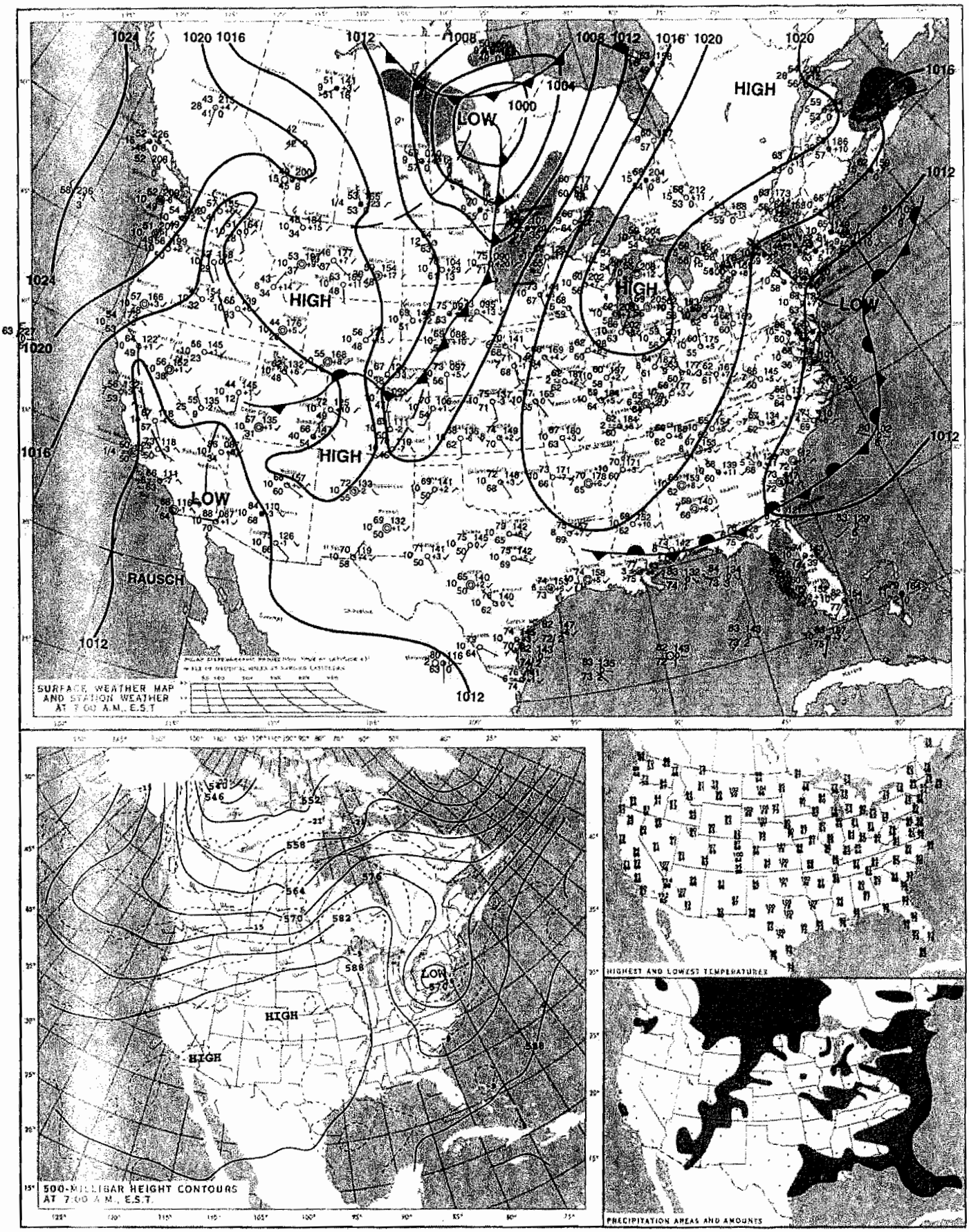




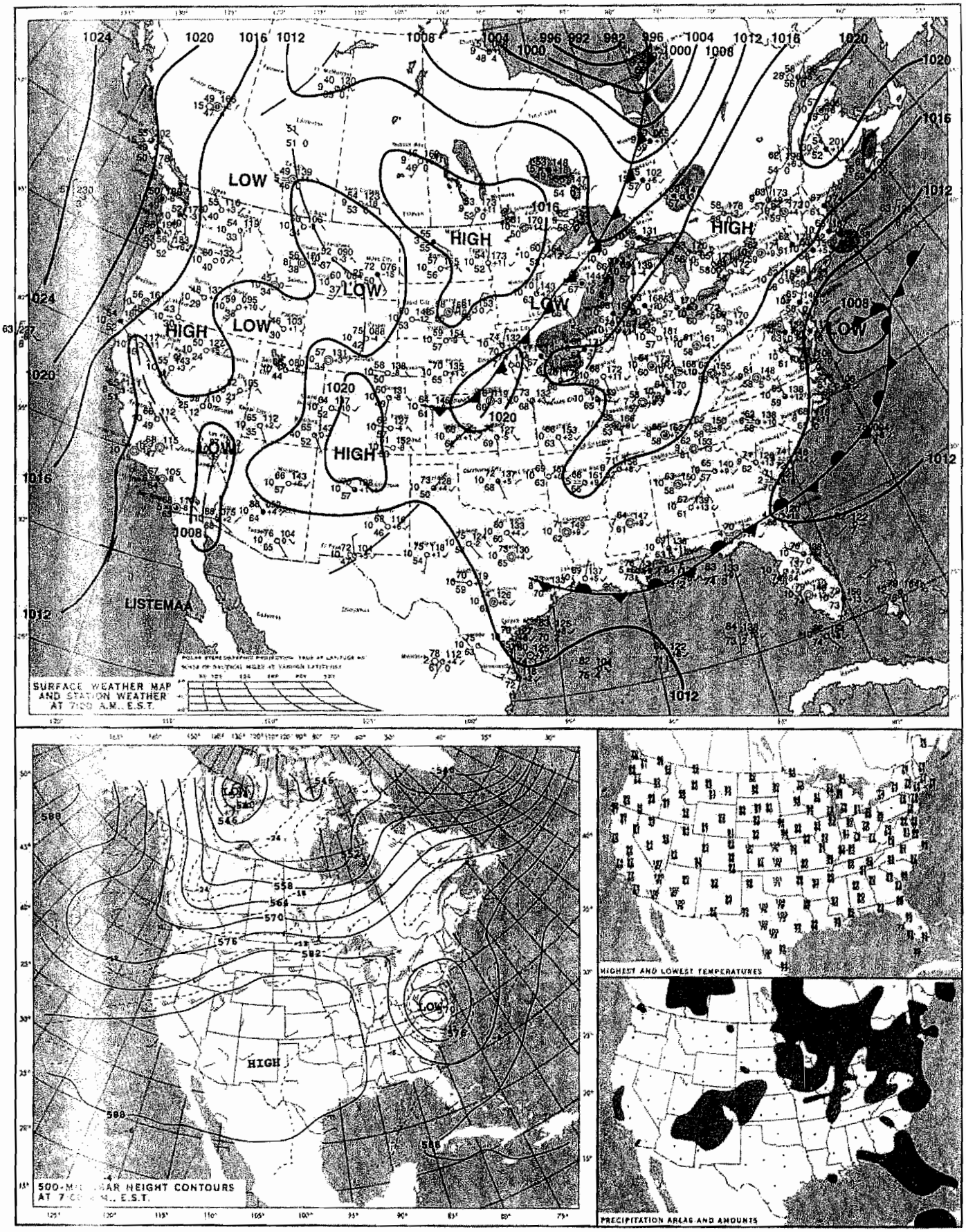




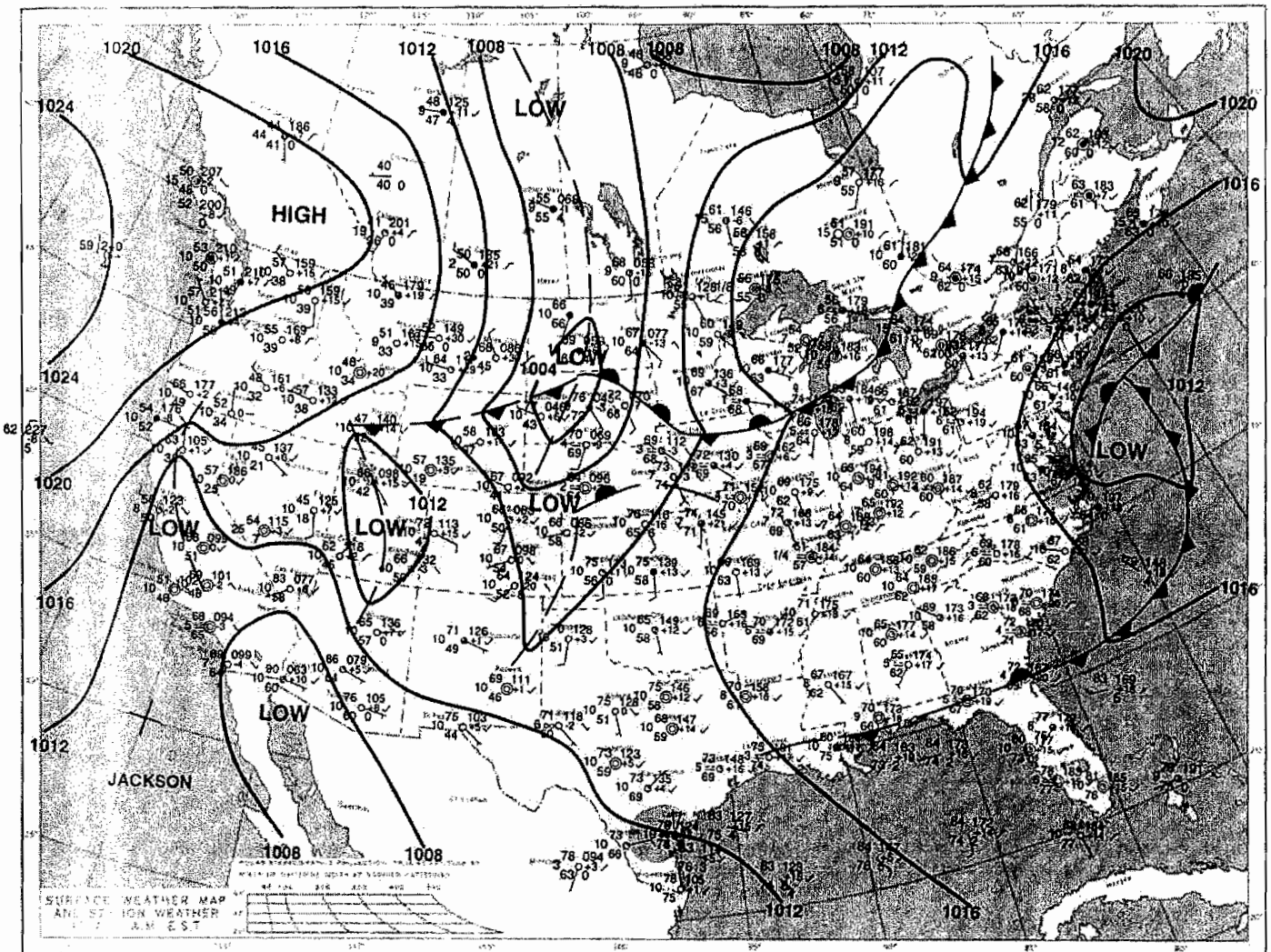
SATURDAY, AUGUST 12, 2000

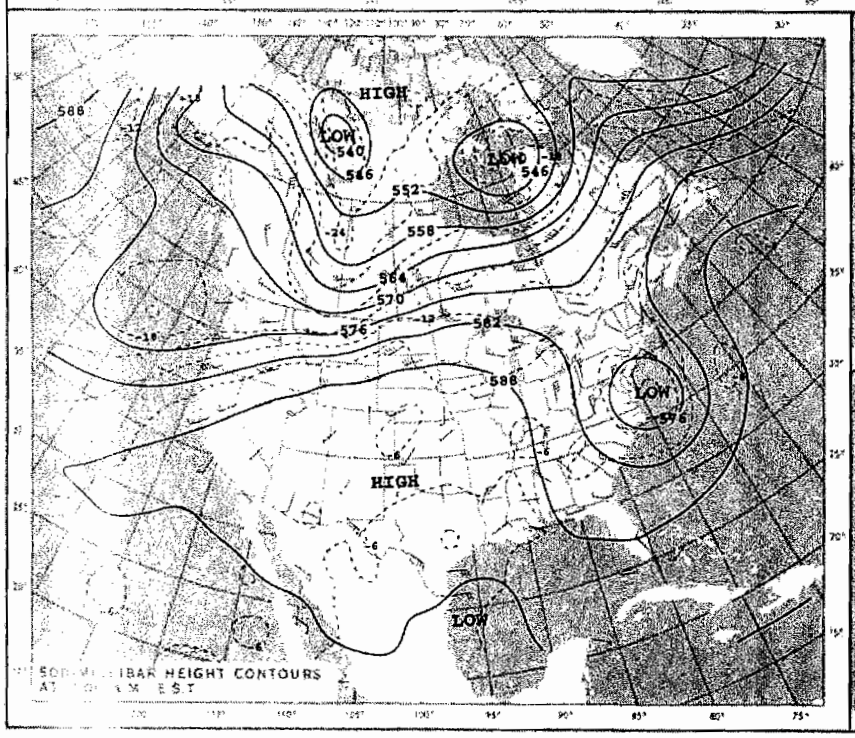


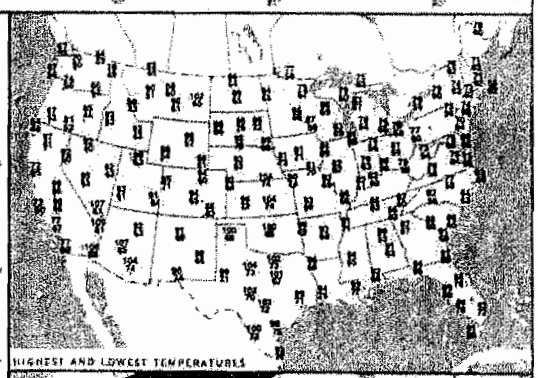
SUNDAY, AUGUST 13, 2000



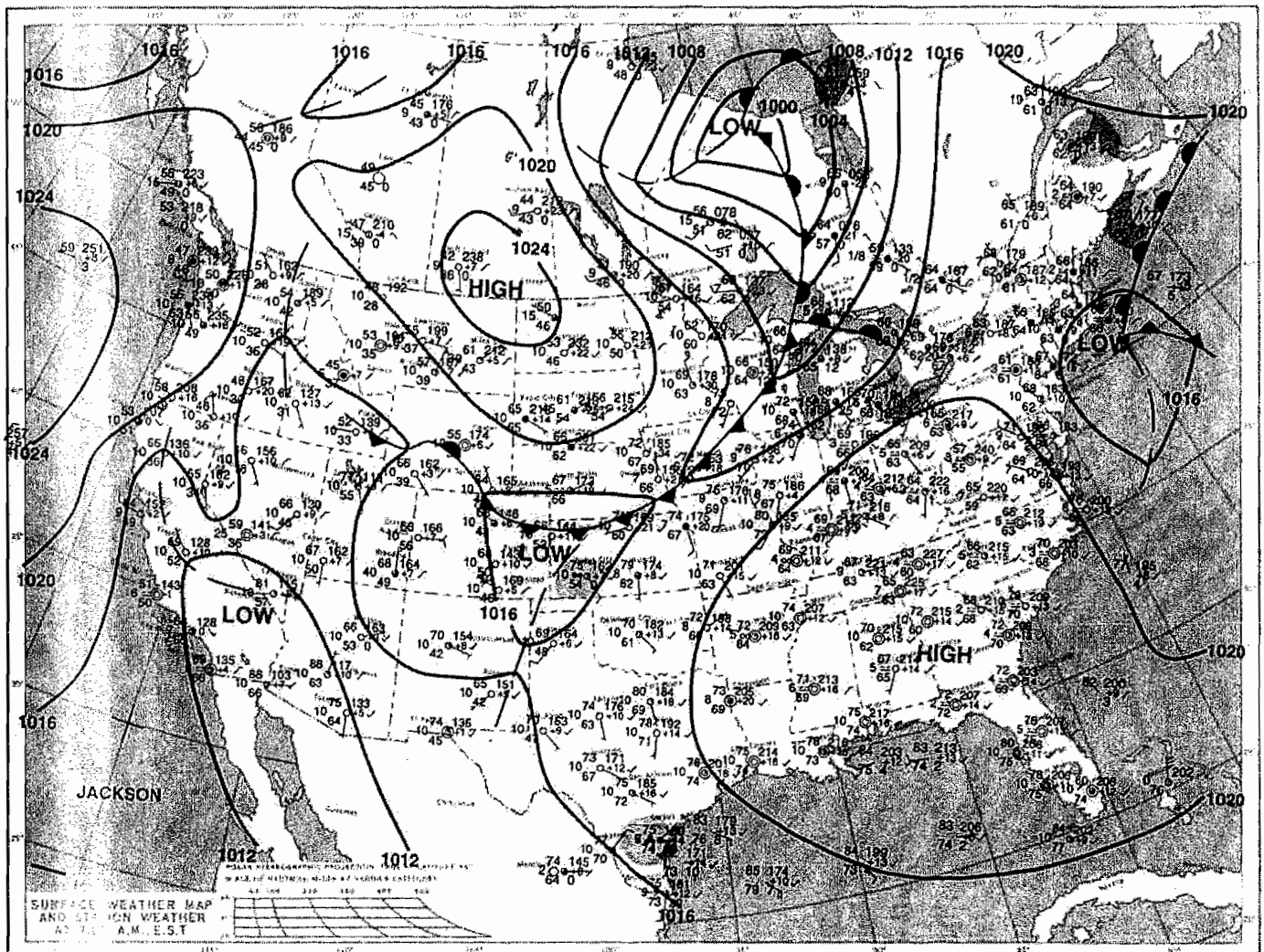
MONDAY, AUGUST 14, 2000

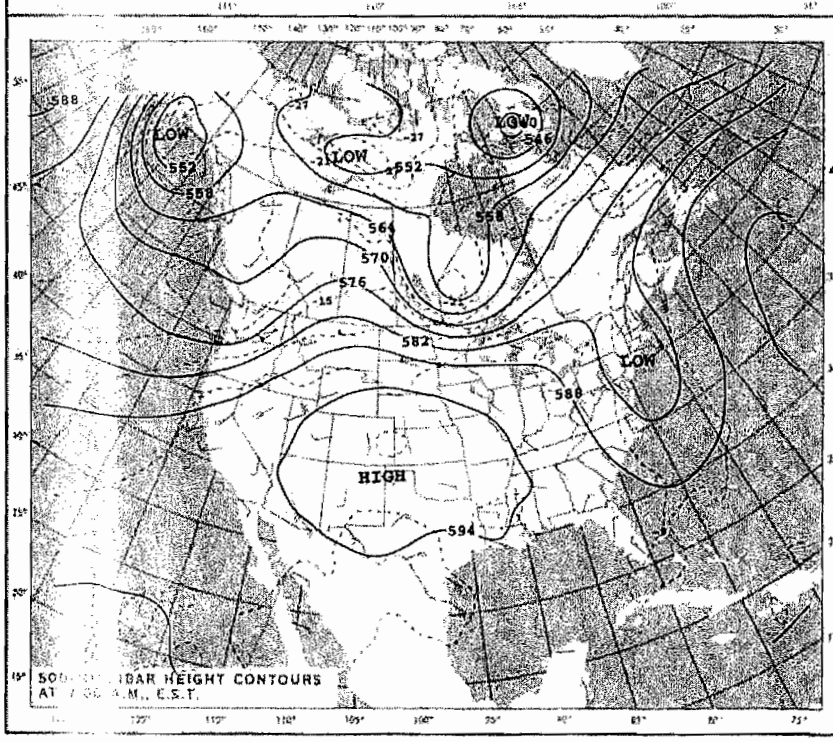


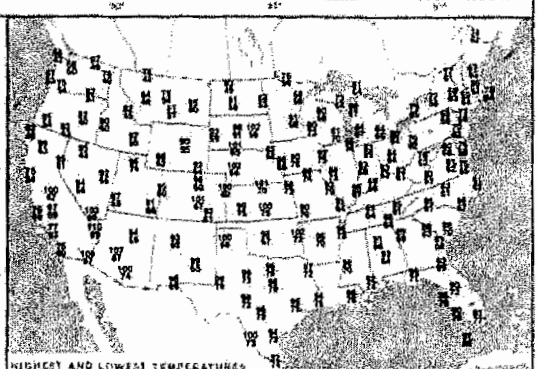


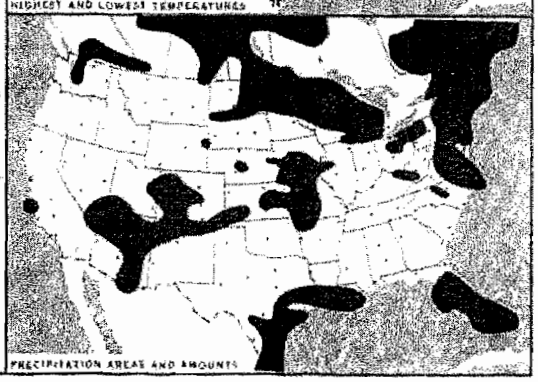


TUESDAY, AUGUST 15, 2000

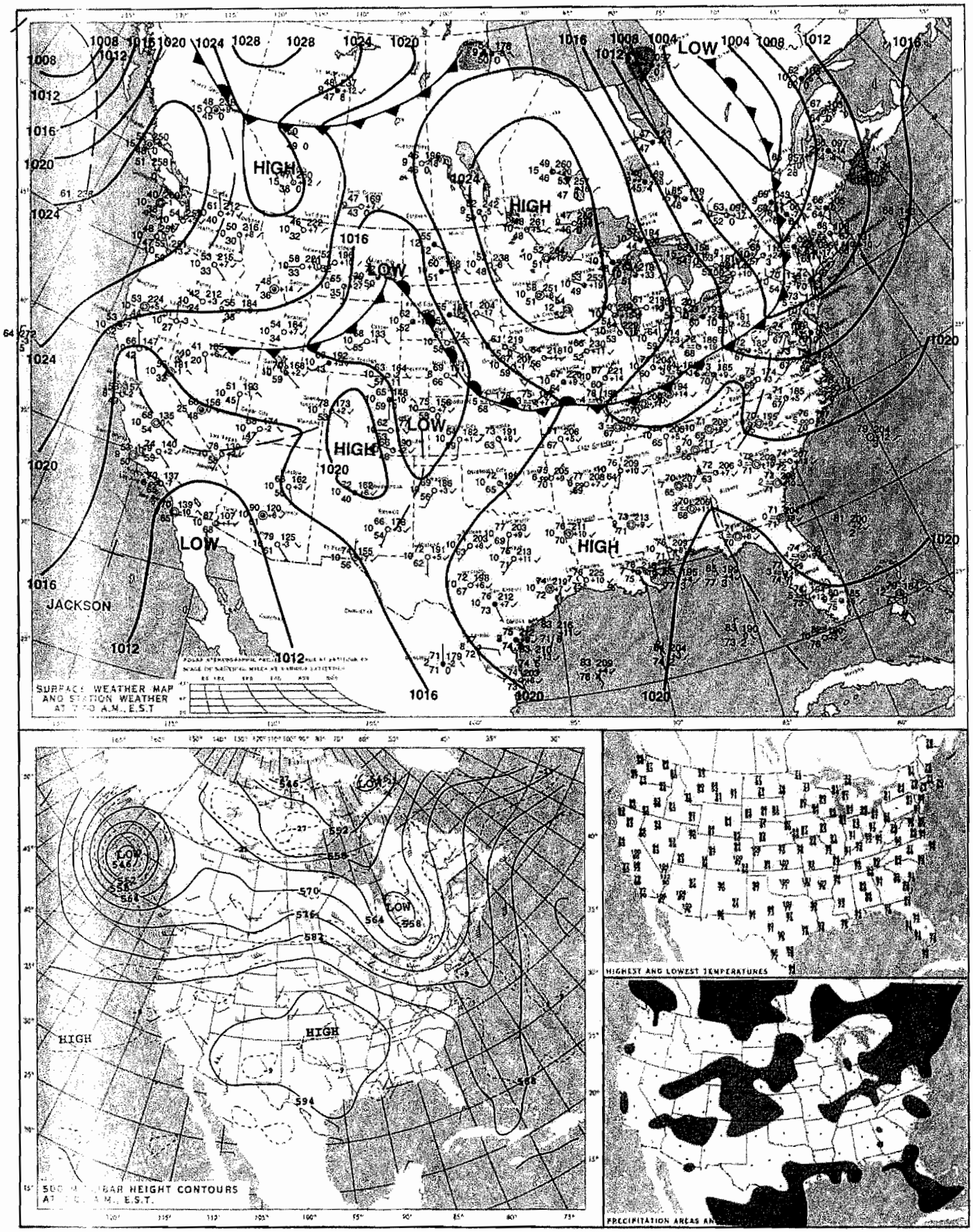




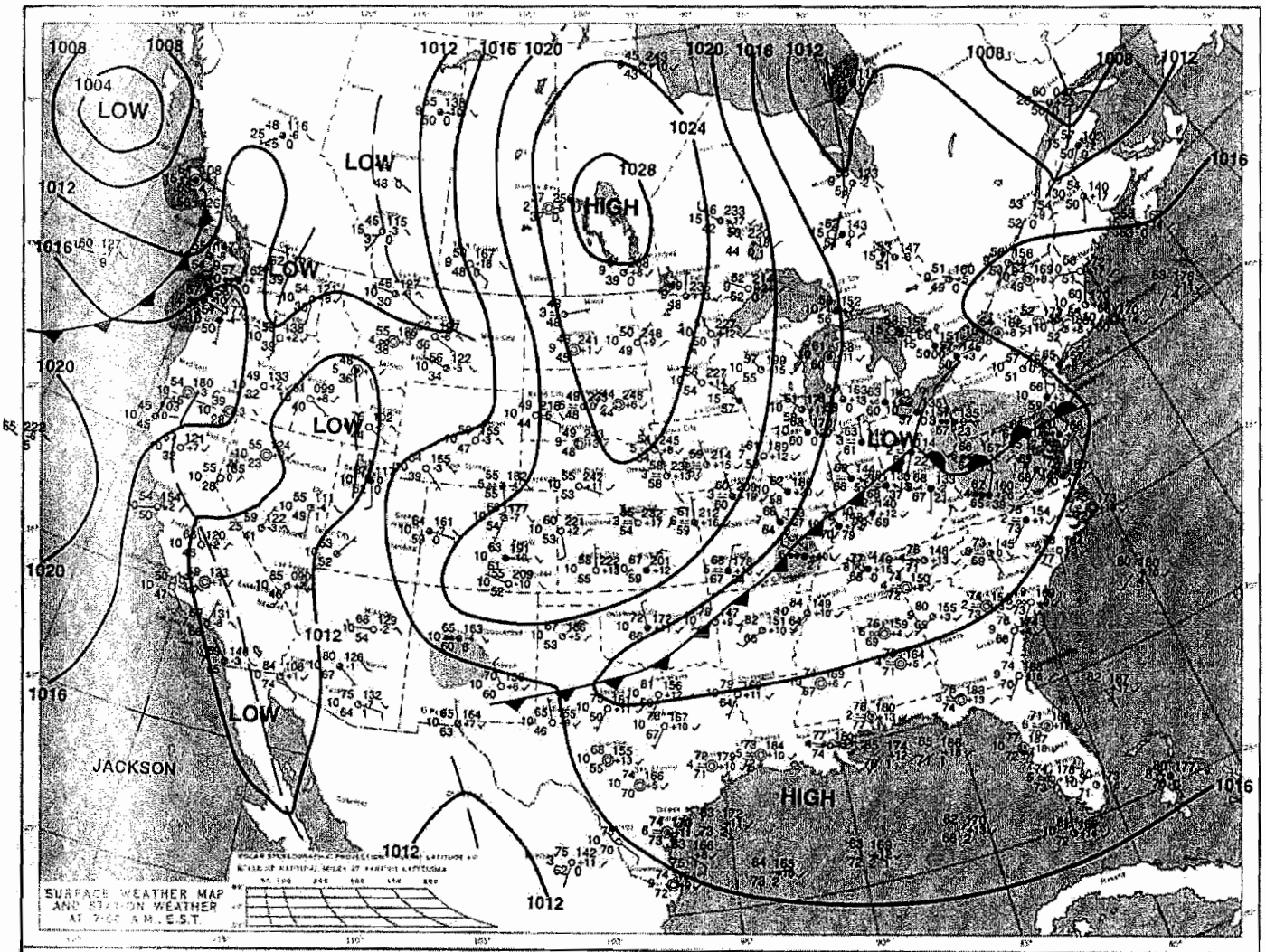


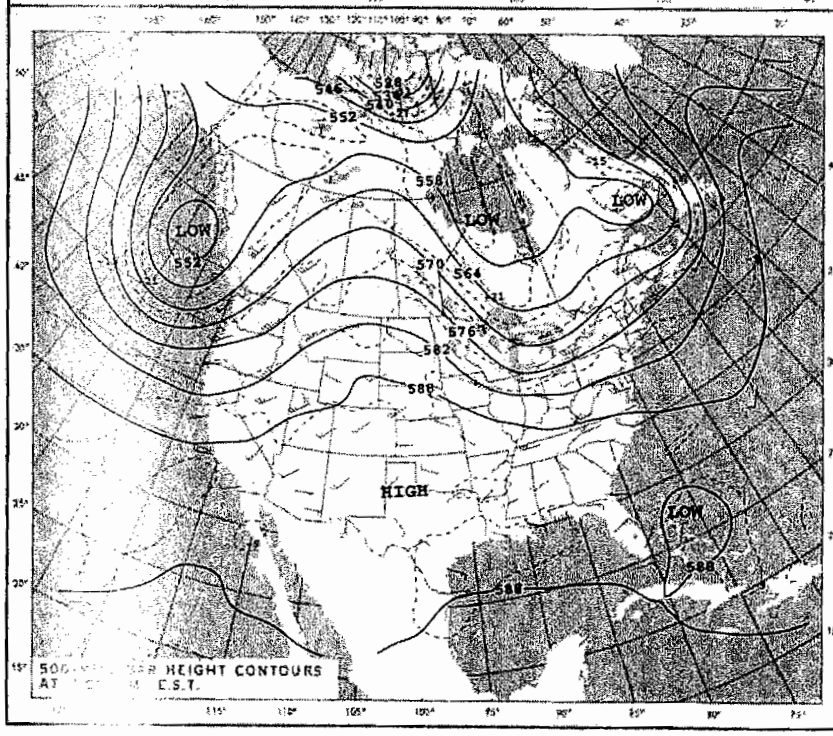


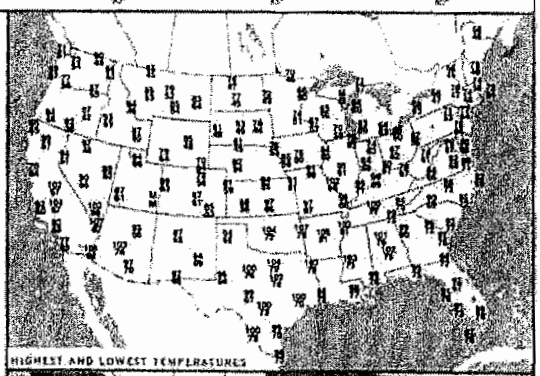
WEDNESDAY, AUGUST 16, 2000



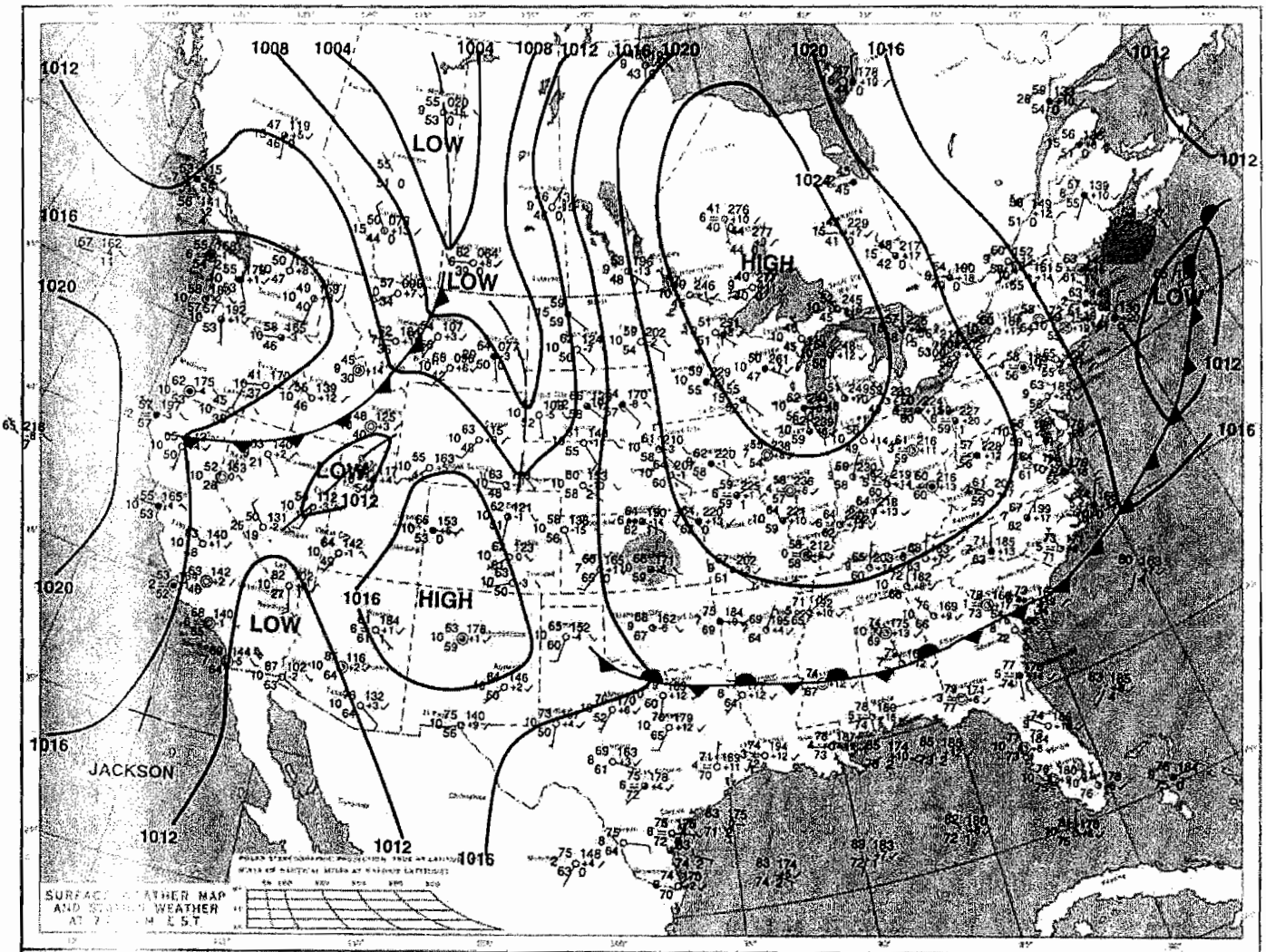
FRIDAY, AUGUST 18, 2000

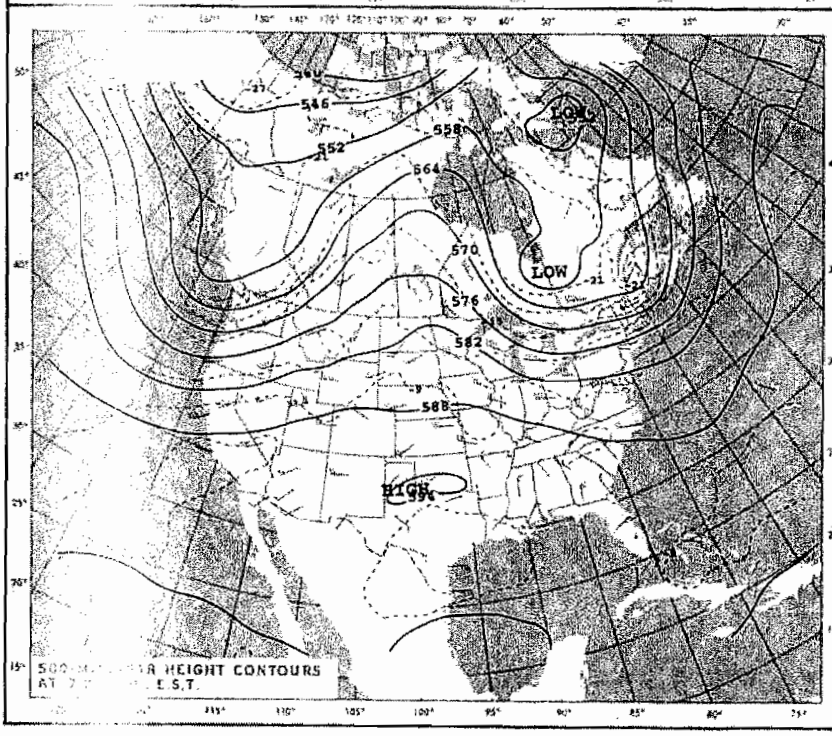


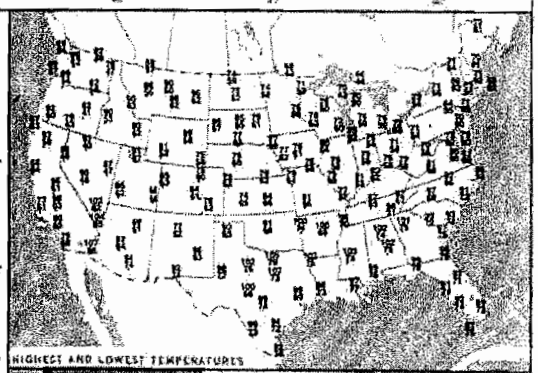


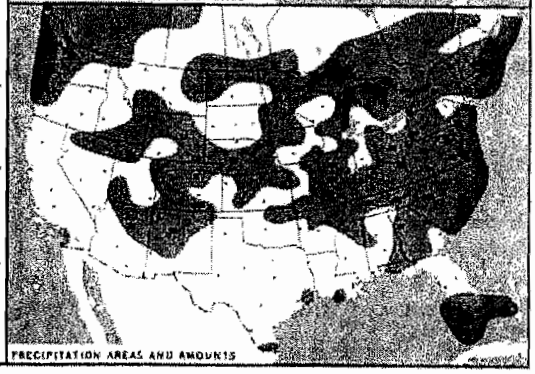


SATURDAY, AUGUST 19, 2000

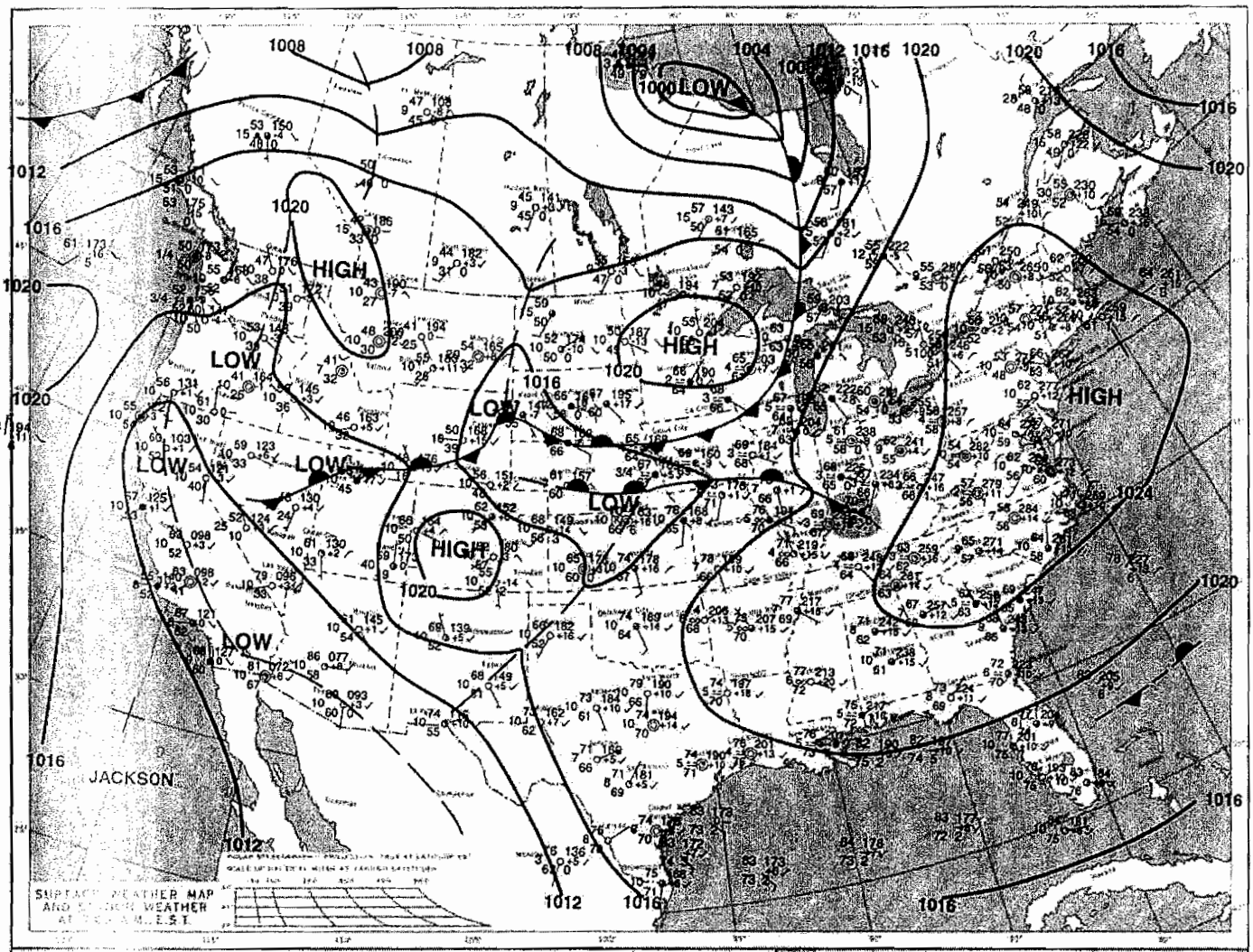


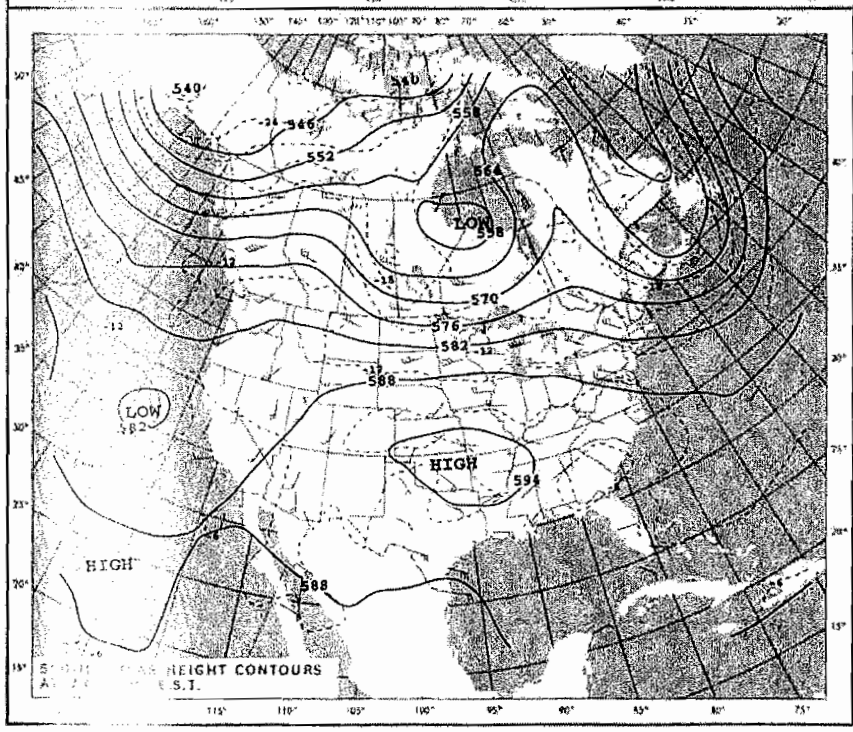


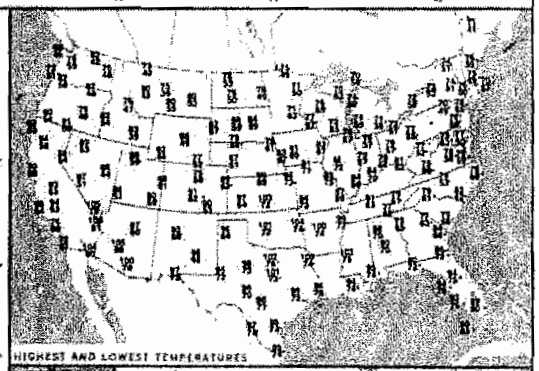


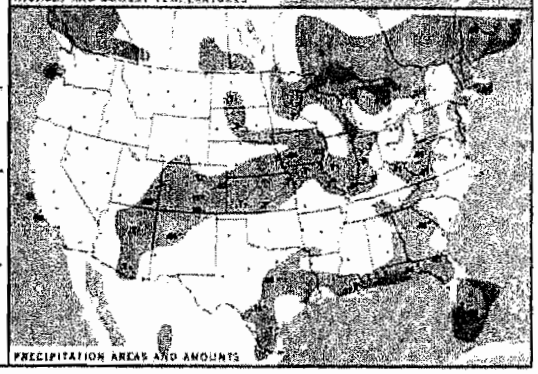


TUESDAY, AUGUST 22, 2000

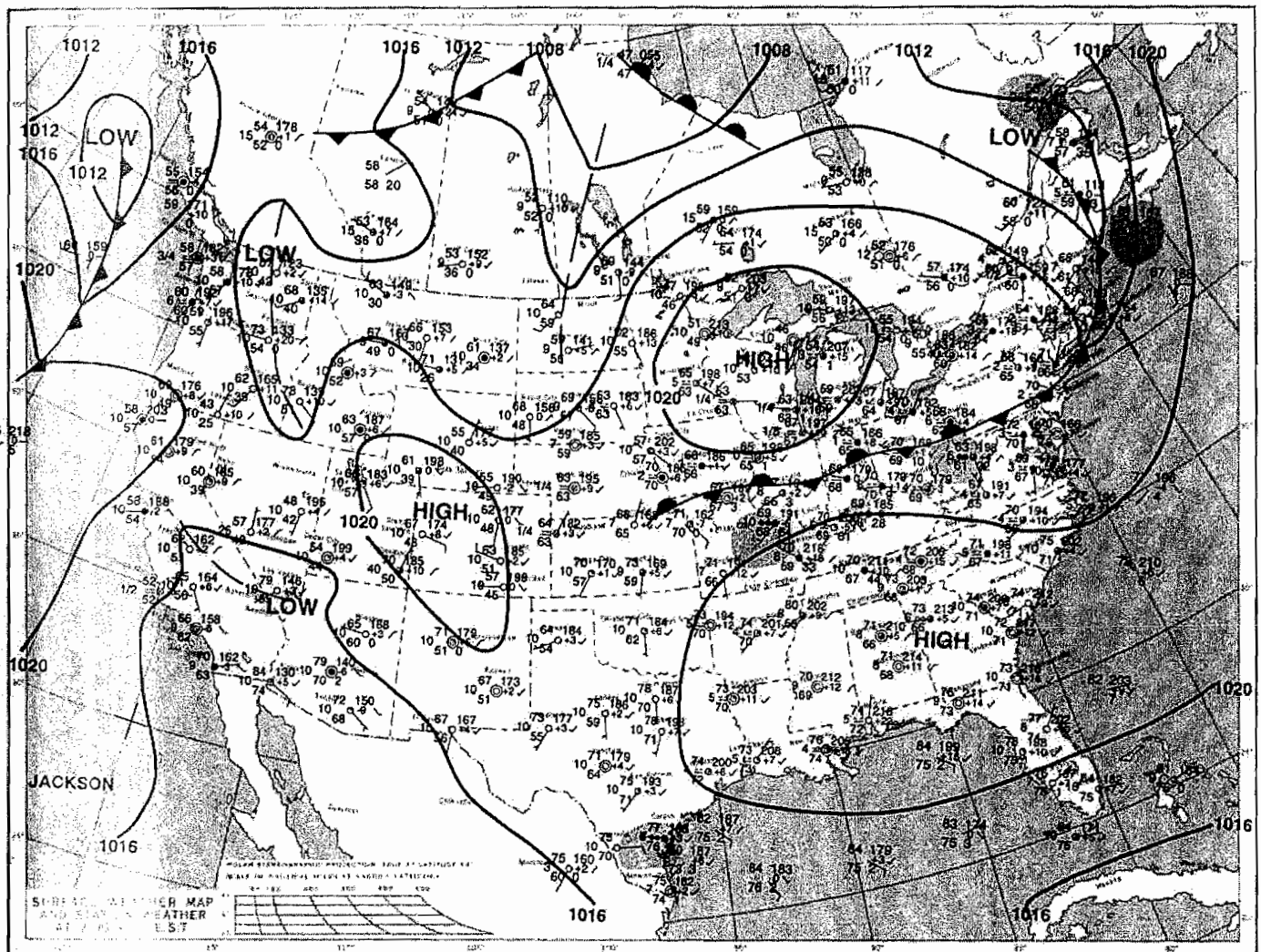


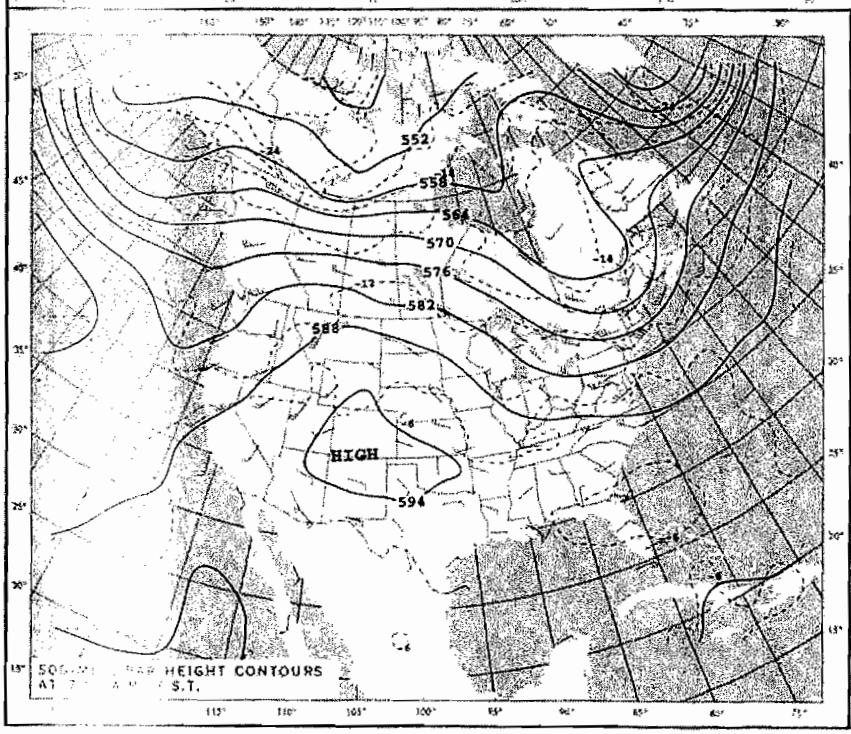


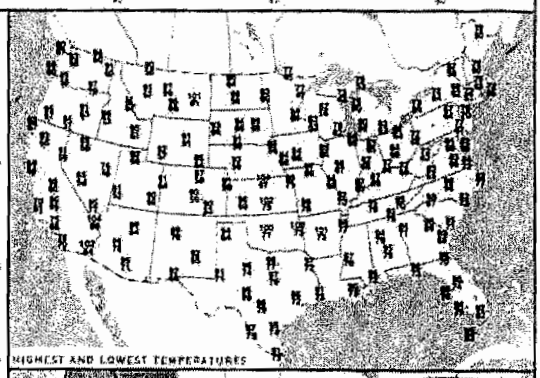


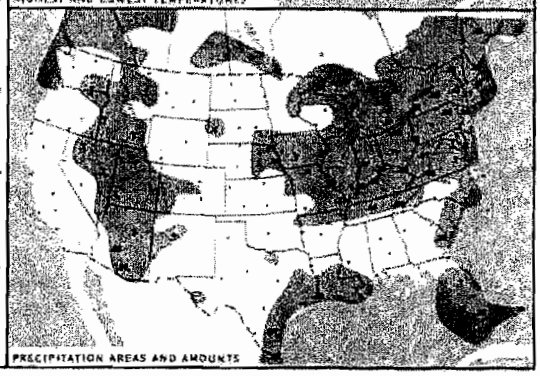


THURSDAY, AUGUST 24, 2000

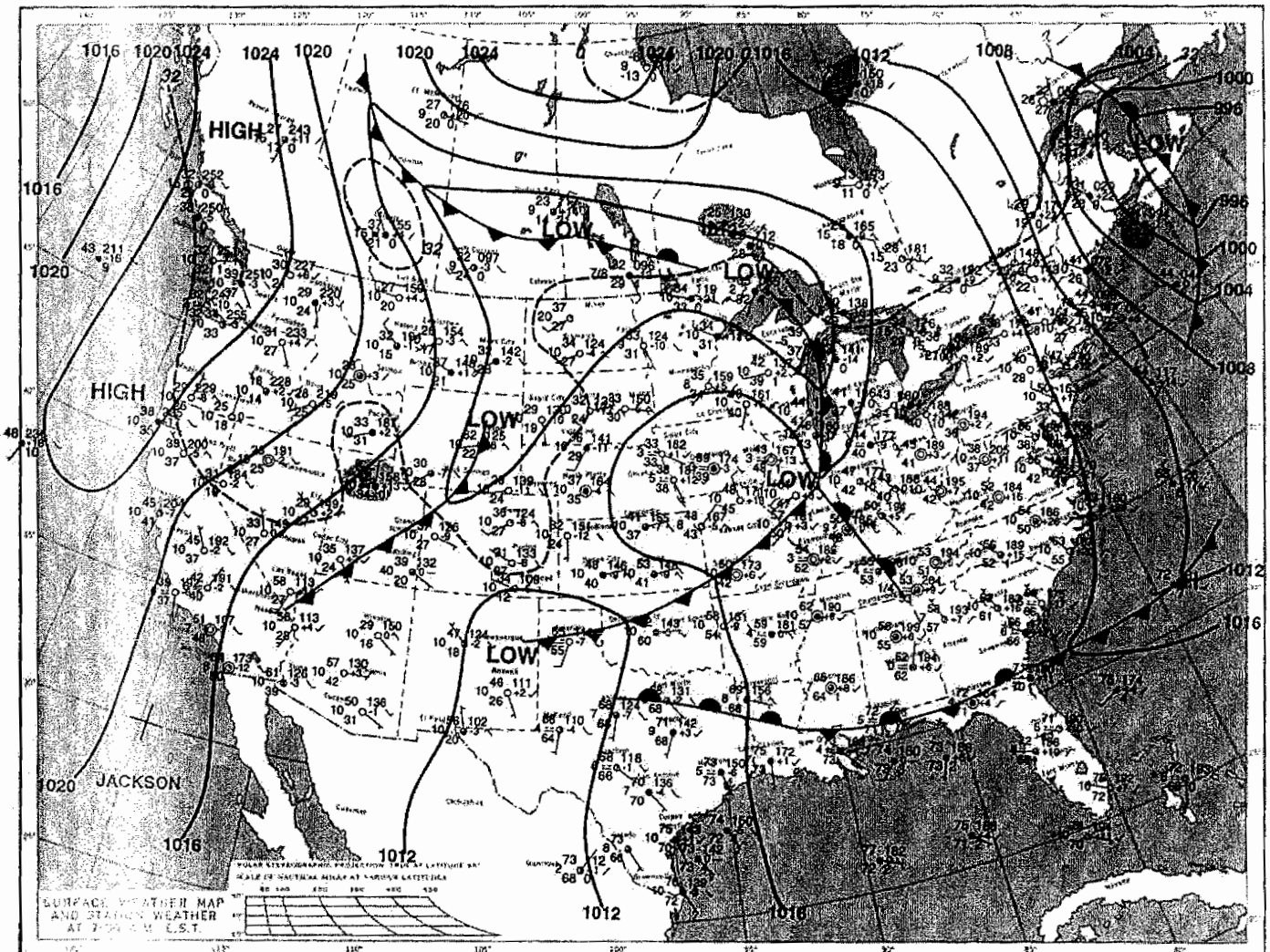


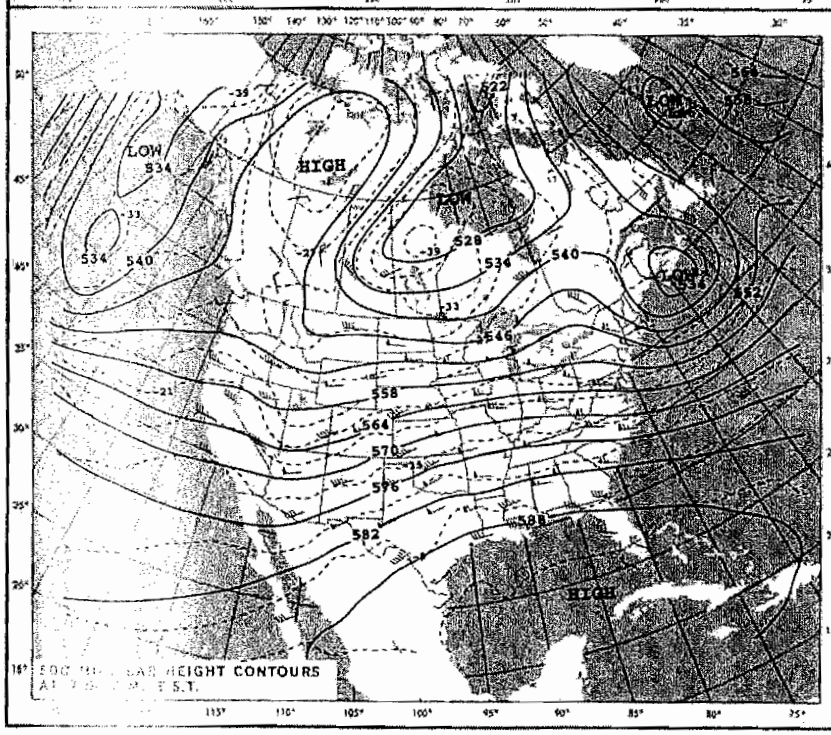


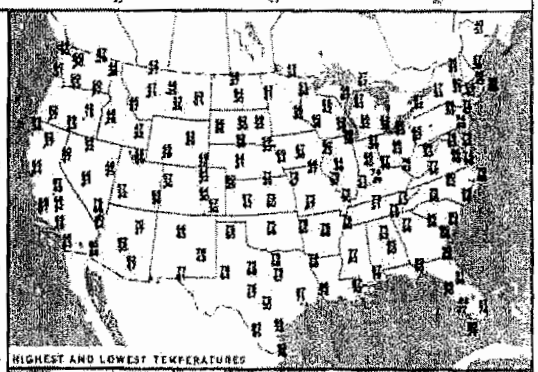


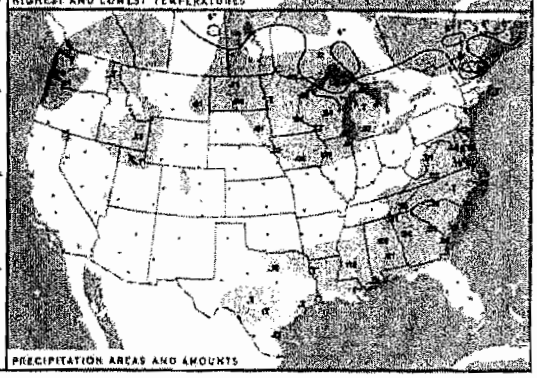


SATURDAY, APRIL 14, 2001

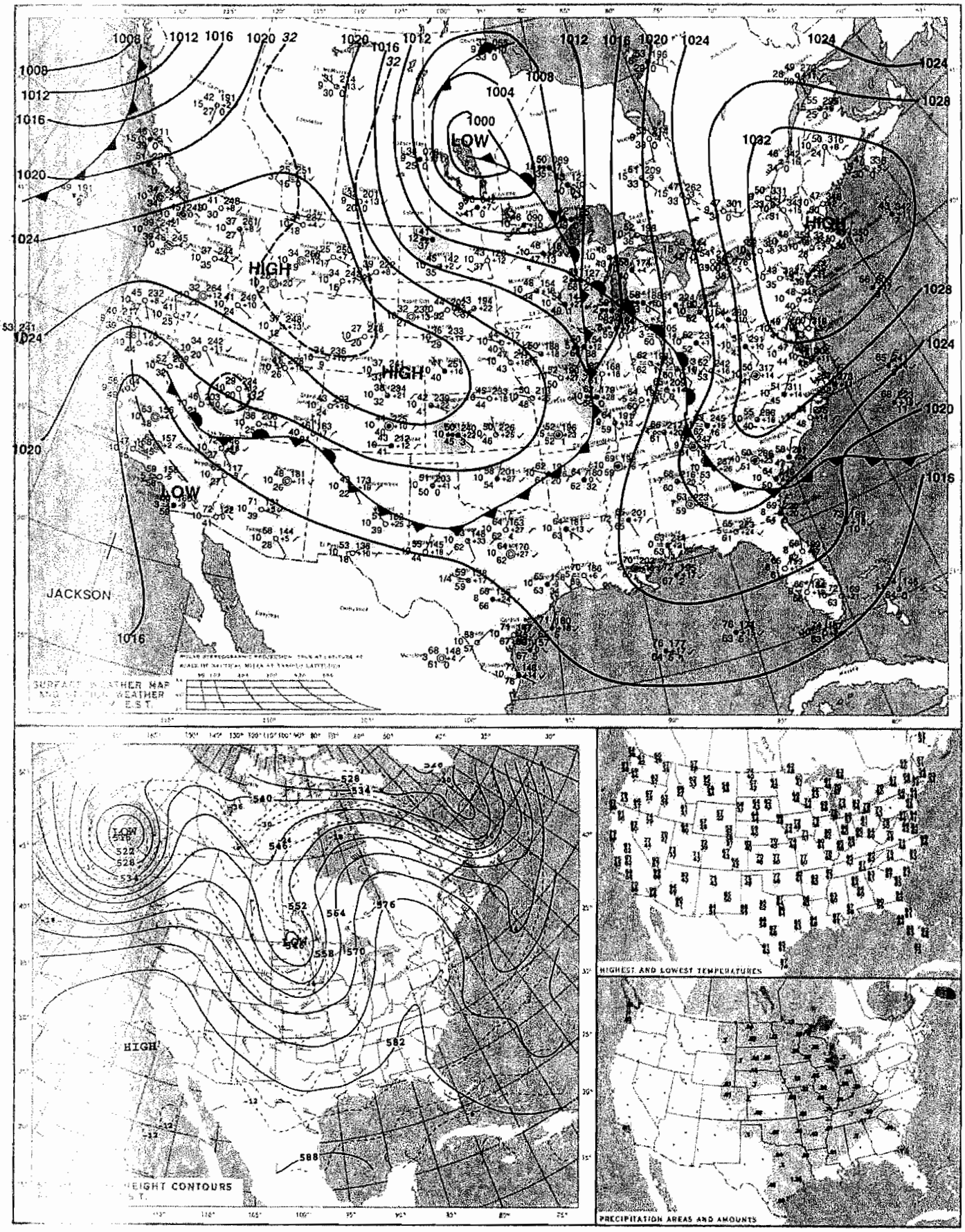




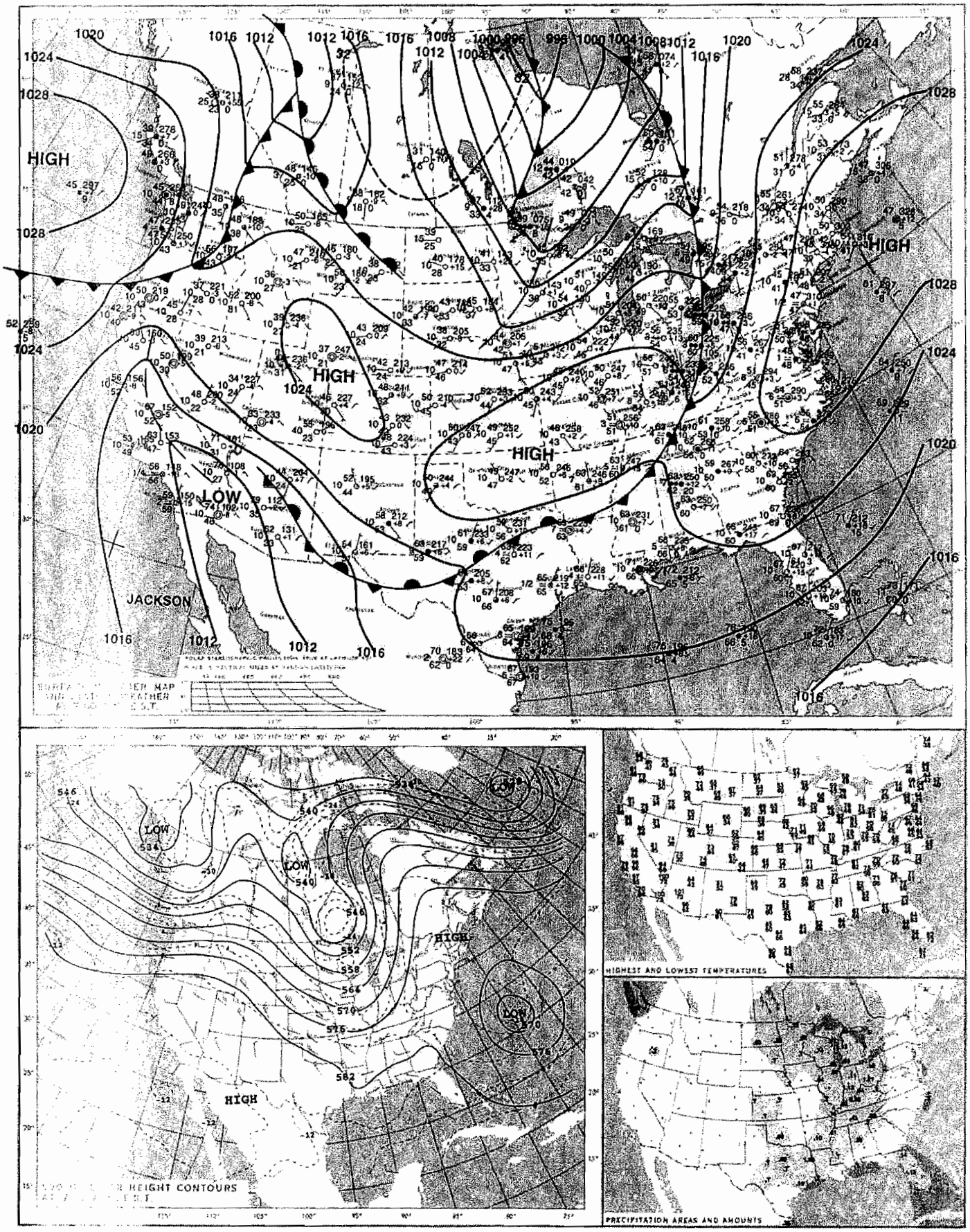




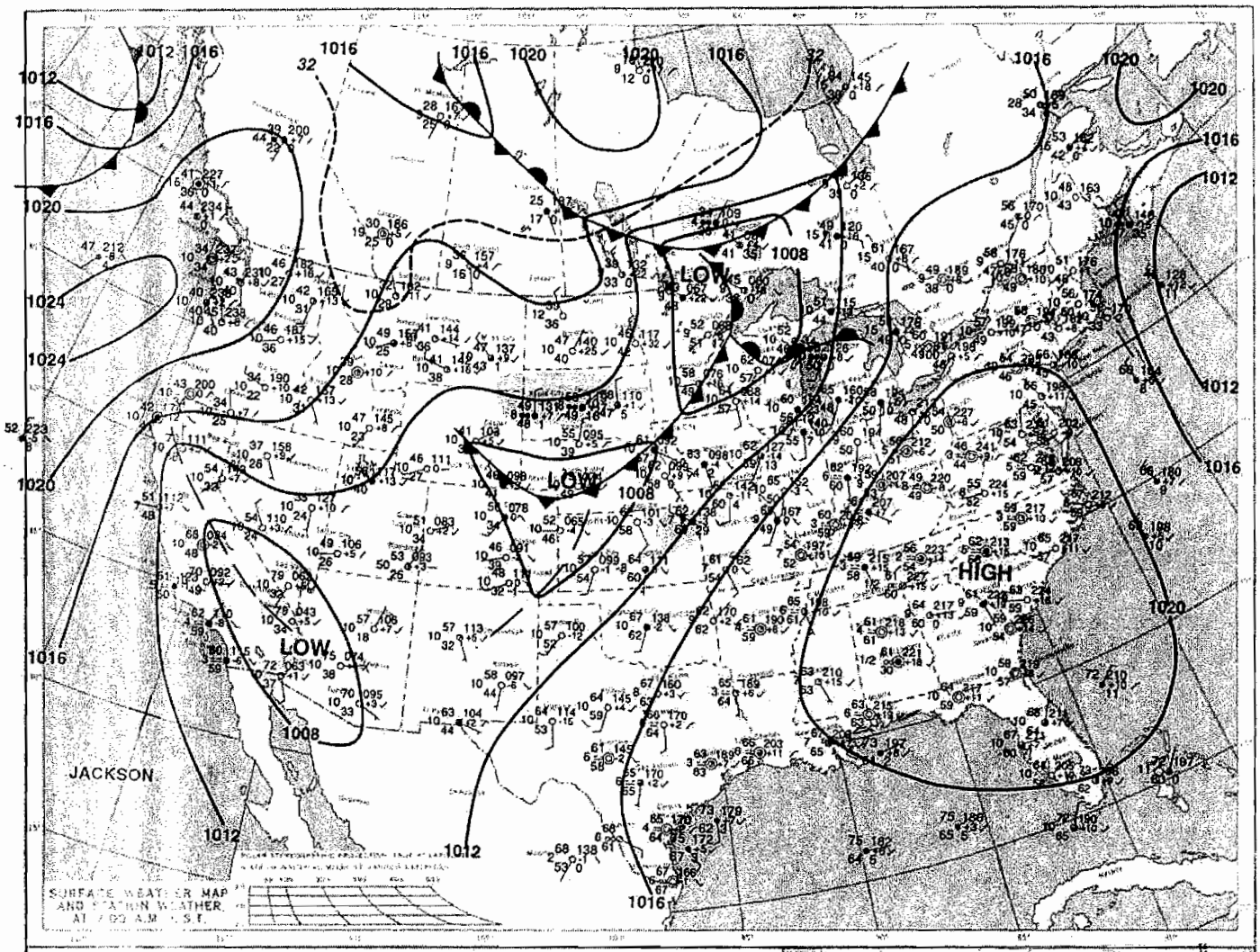
MONDAY, MAY 7, 2001

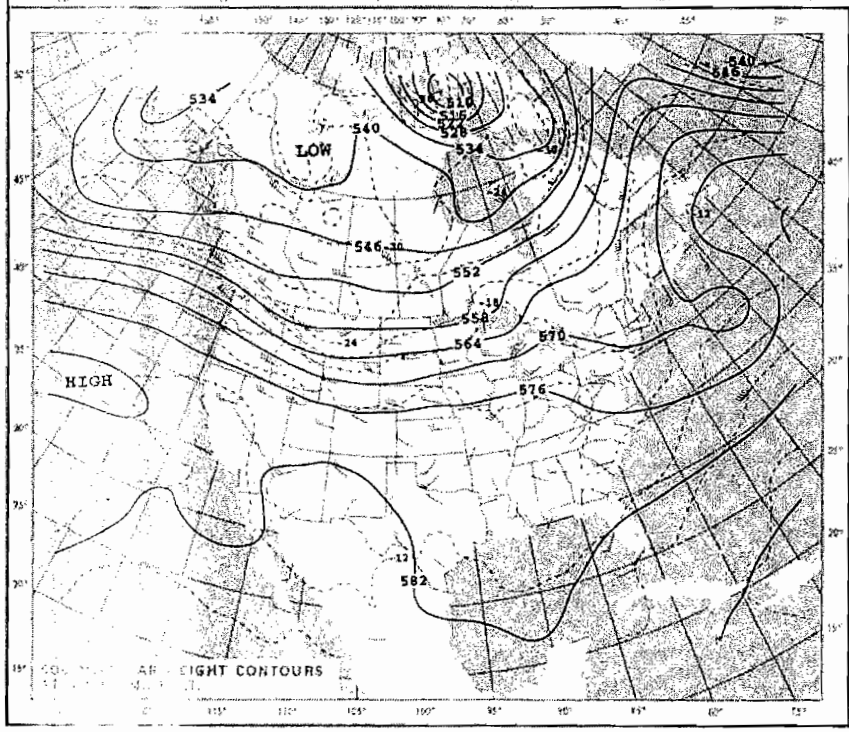


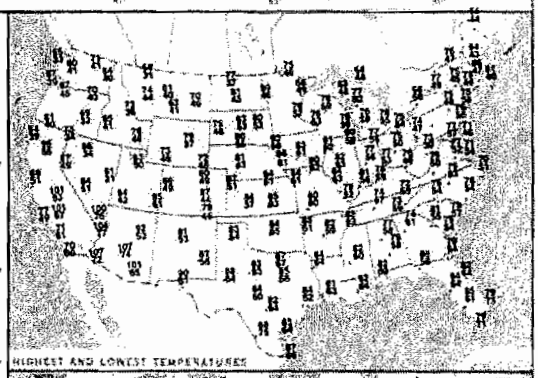
TUESDAY, MAY 8, 2001

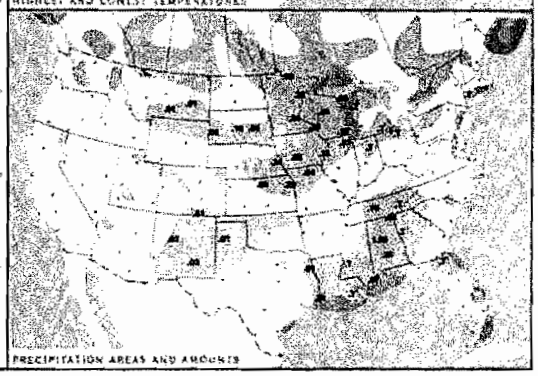


THURSDAY, MAY 10, 2001

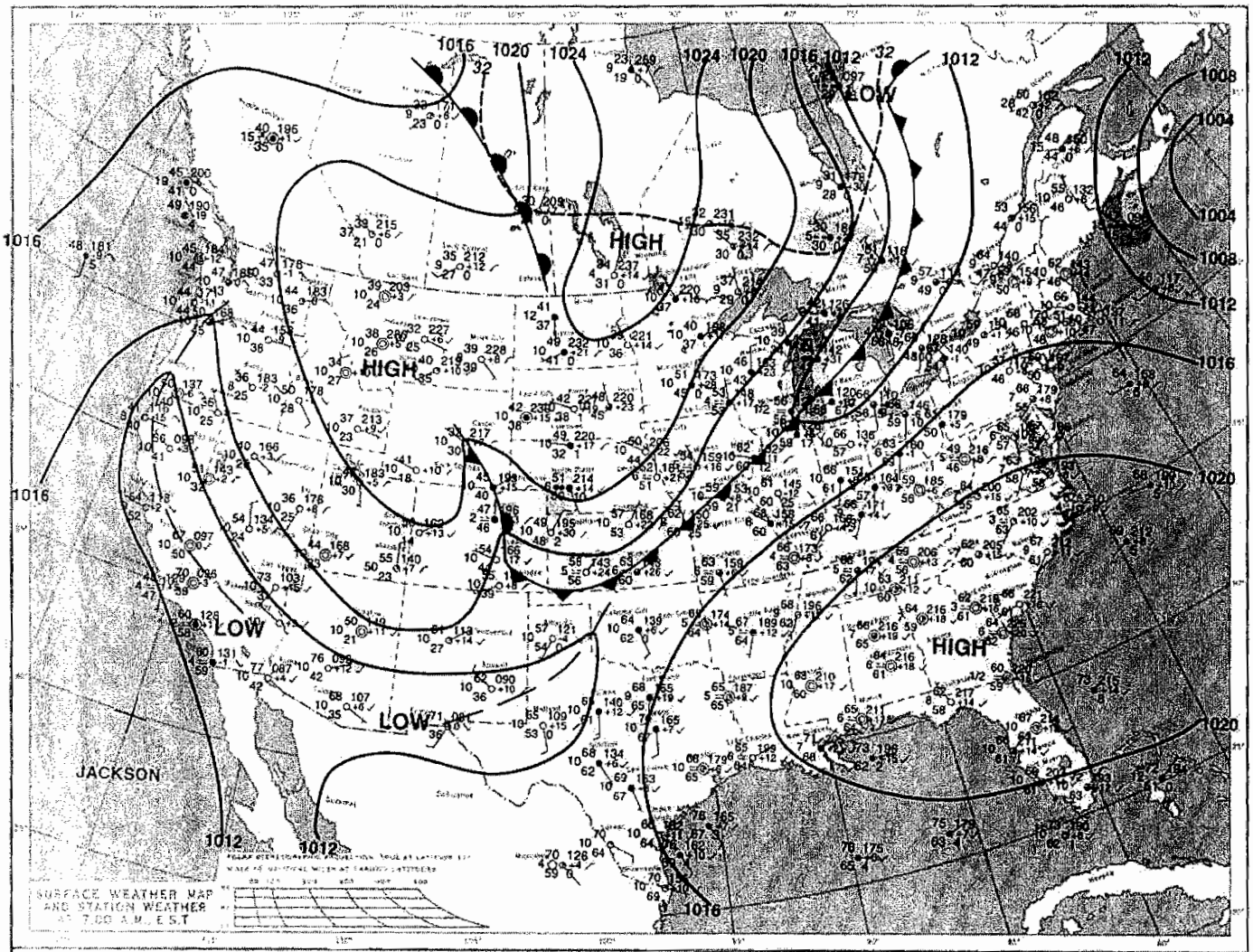


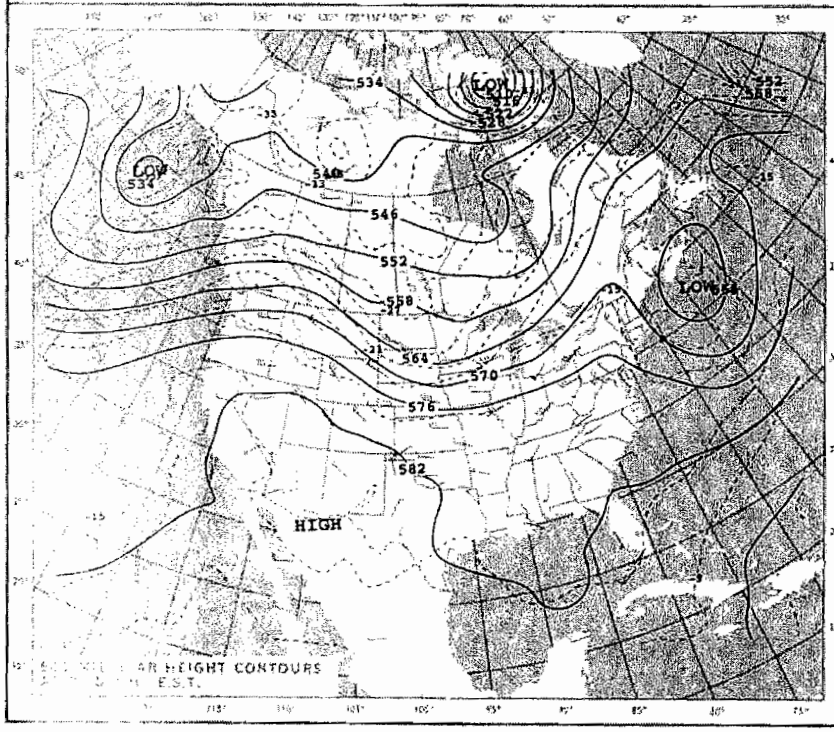


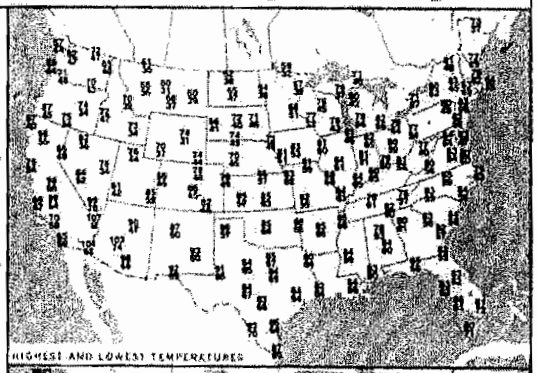


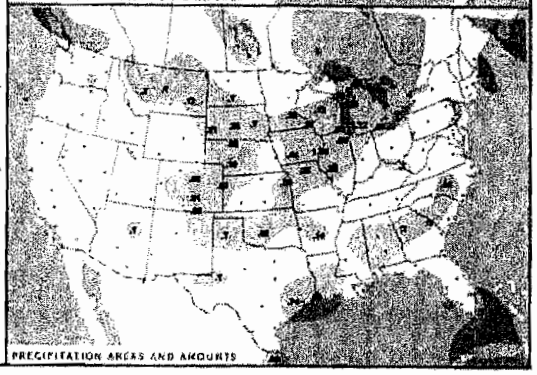


FRIDAY, MAY 11, 2001

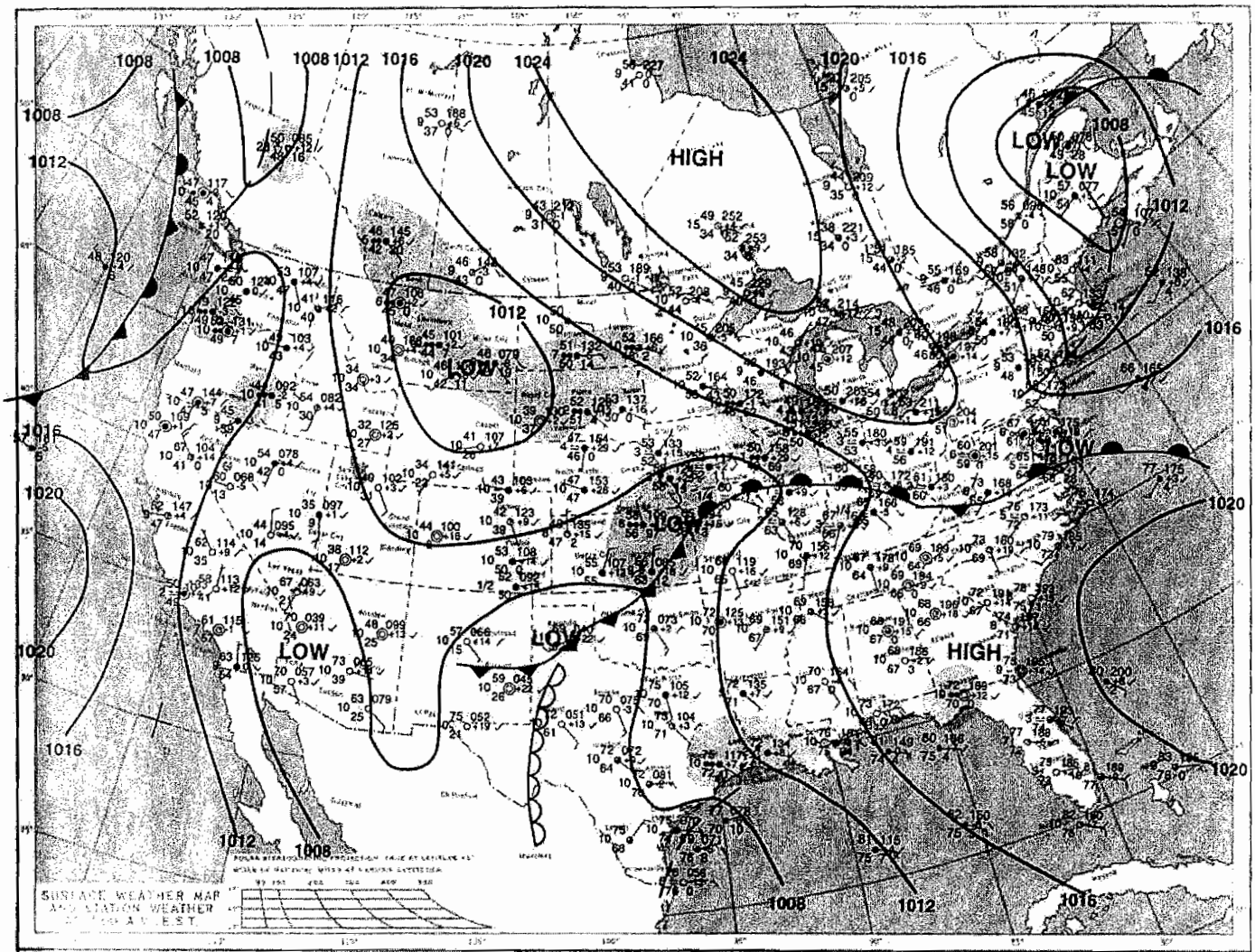


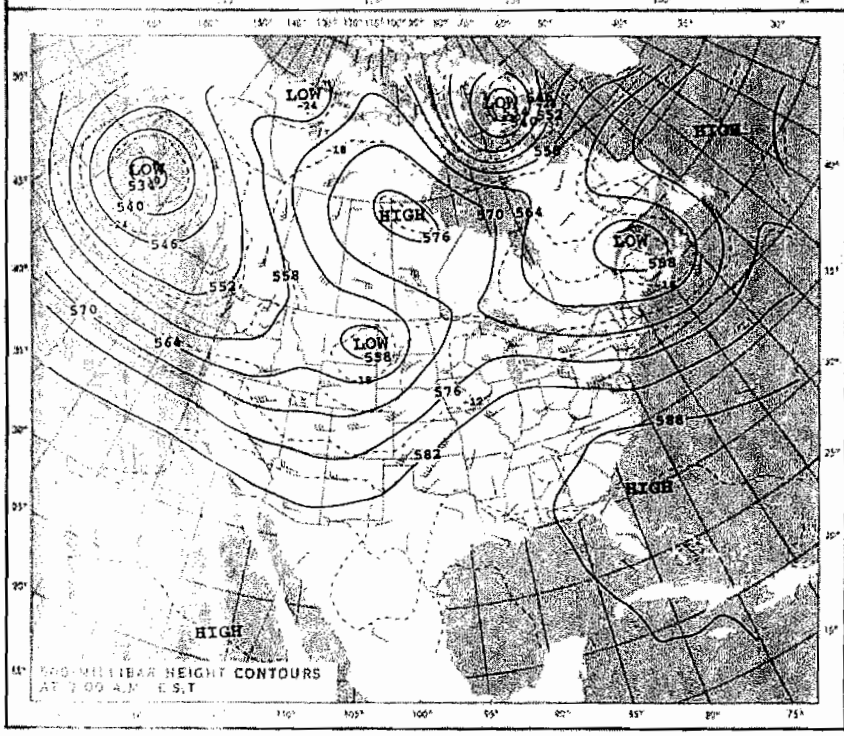


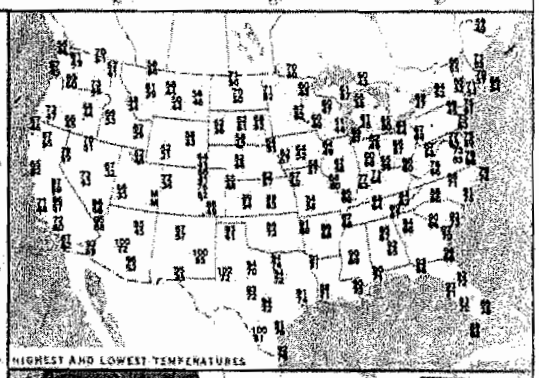


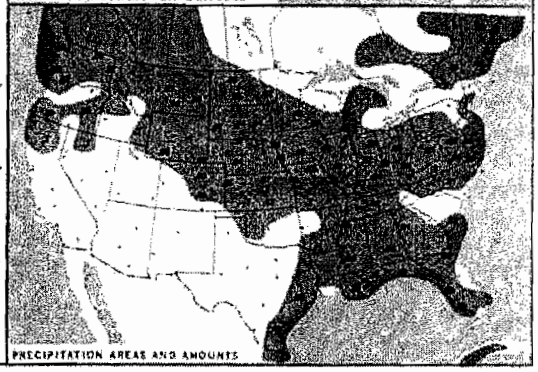


TUESDAY, JUNE 5, 2001

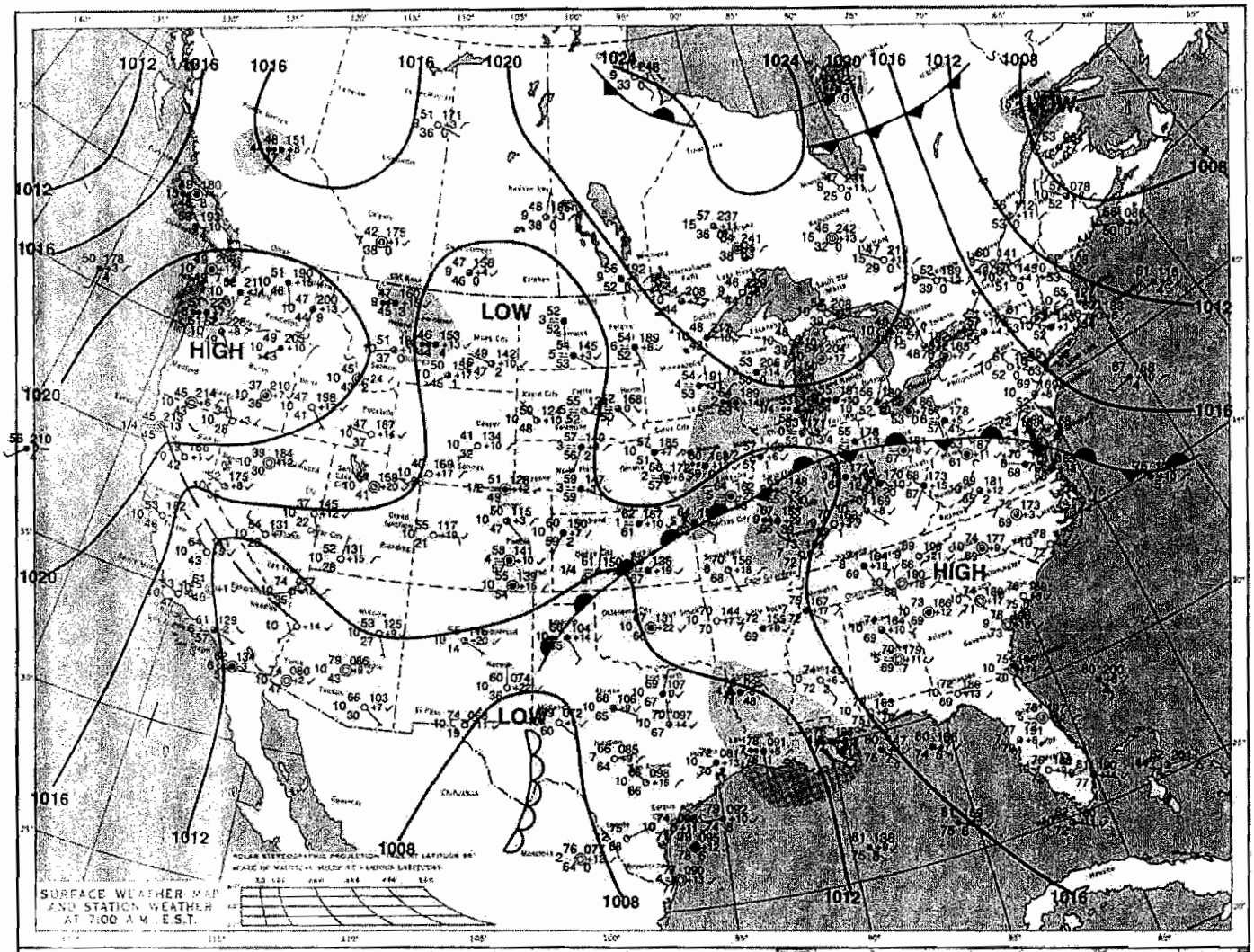


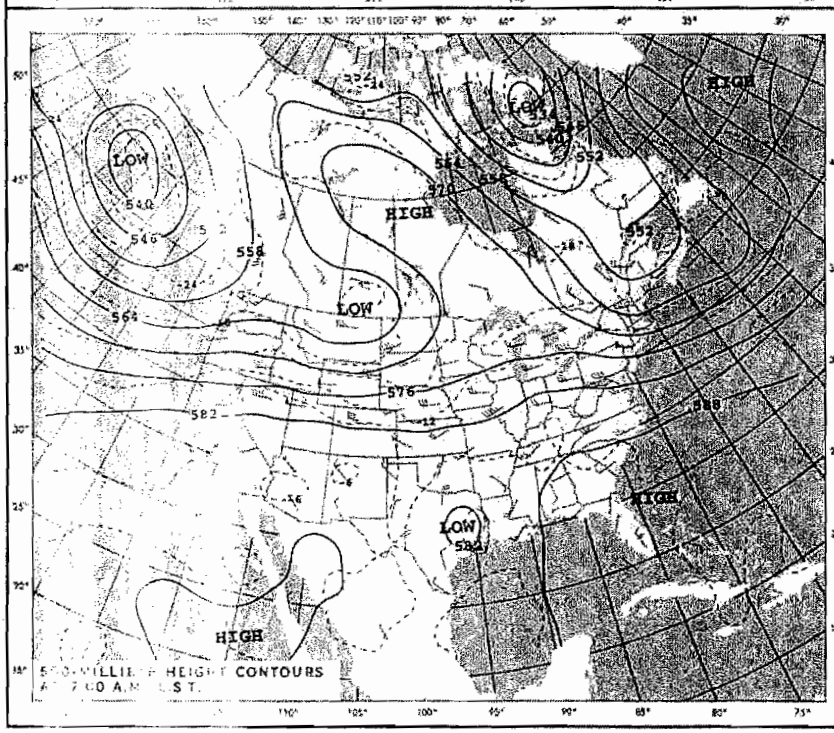


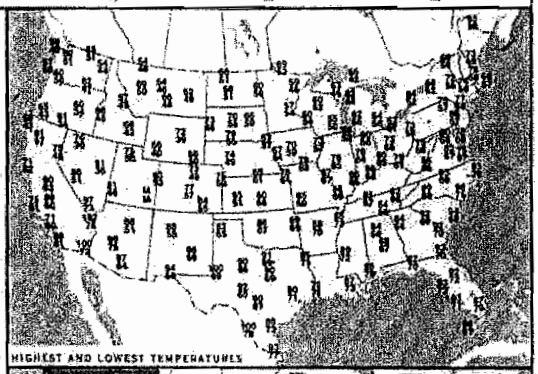




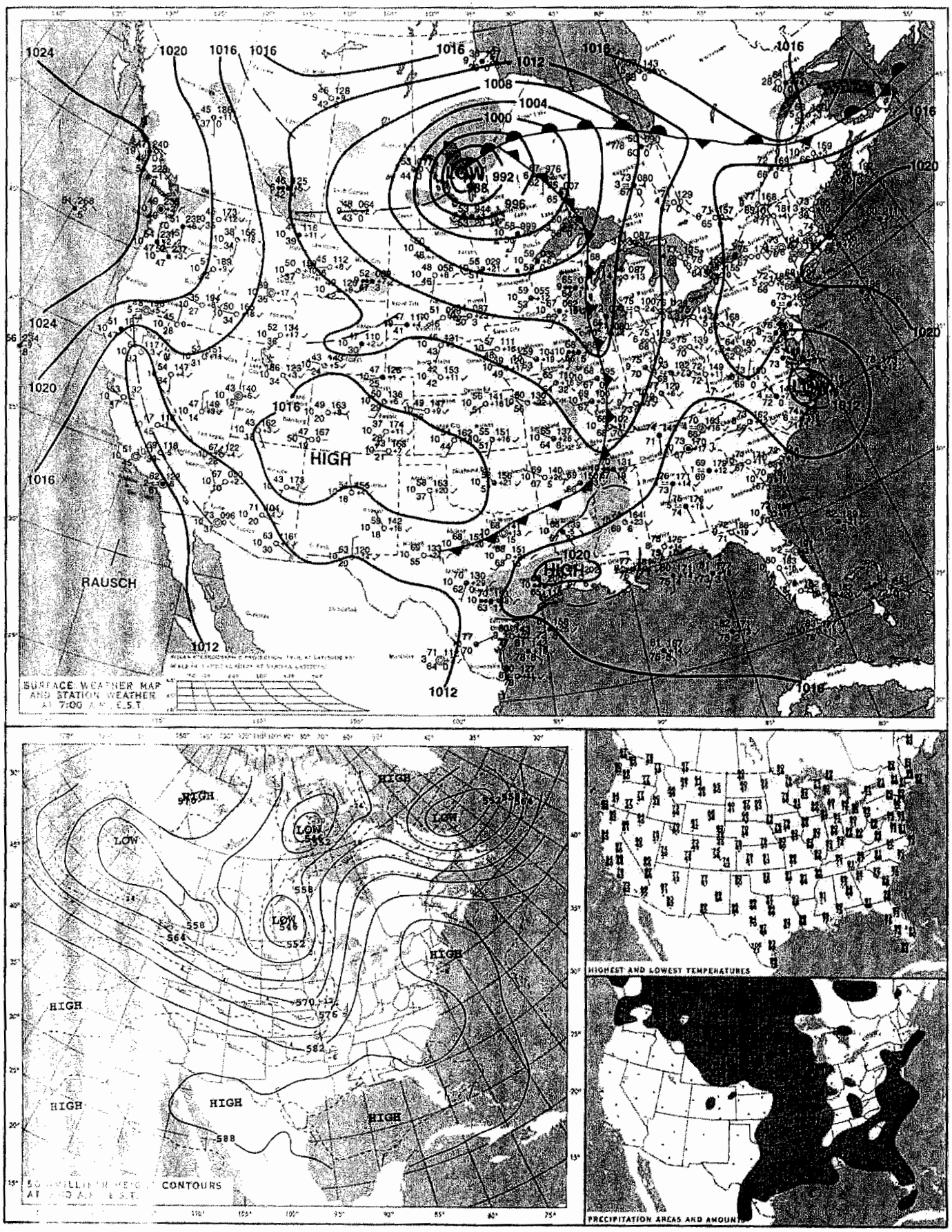
WEDNESDAY, JUNE 6, 2001



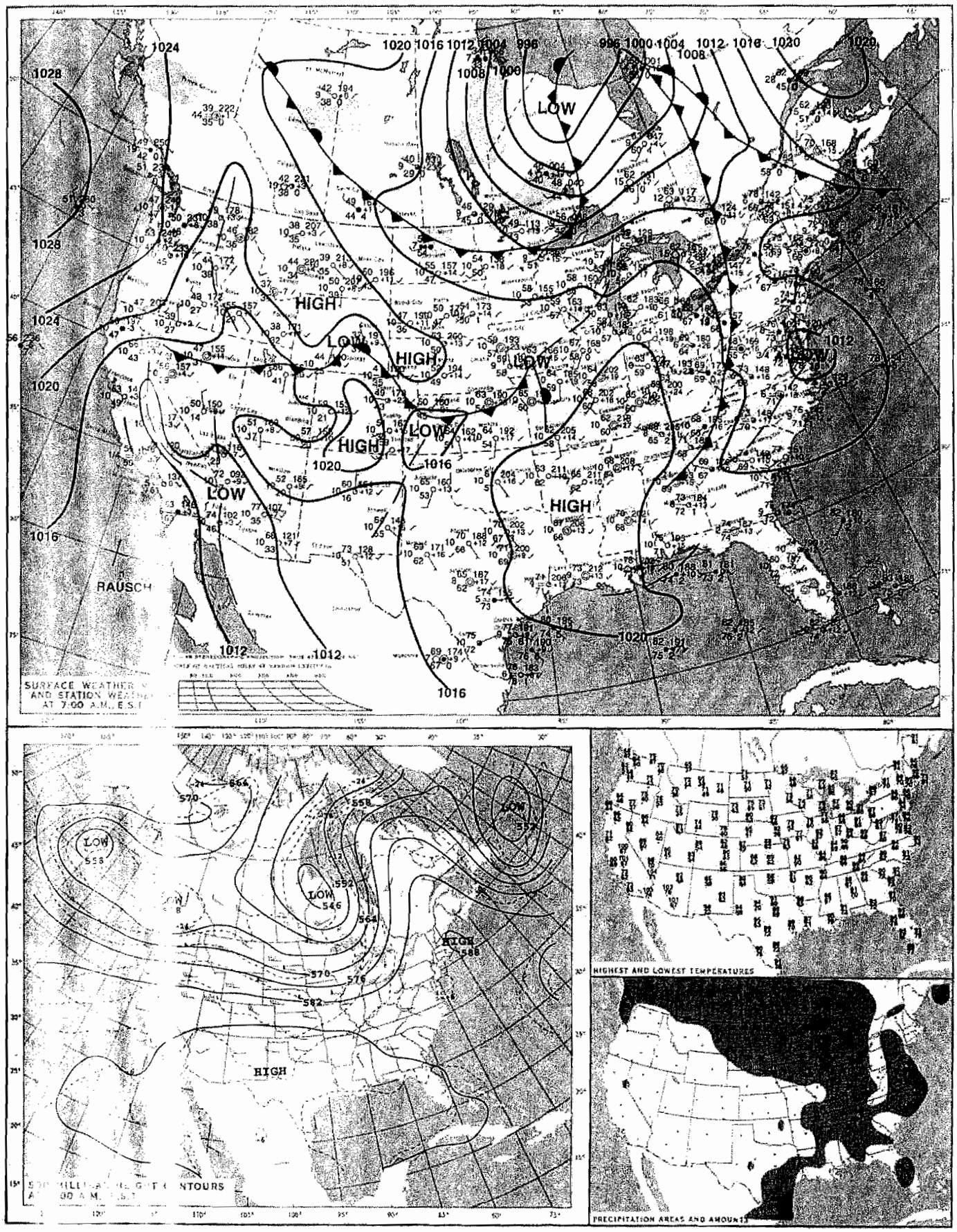




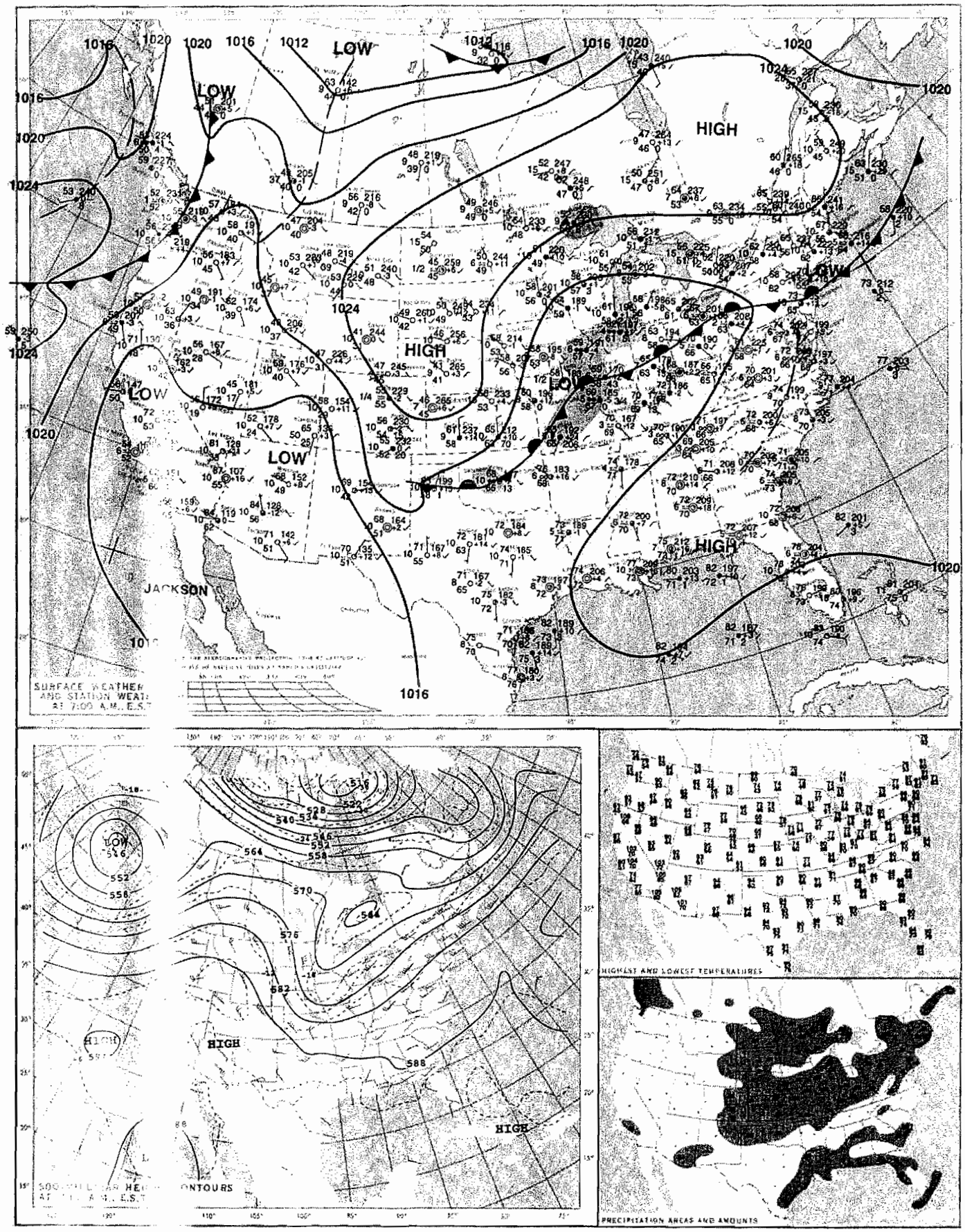
FRIDAY, JUNE 15, 2001



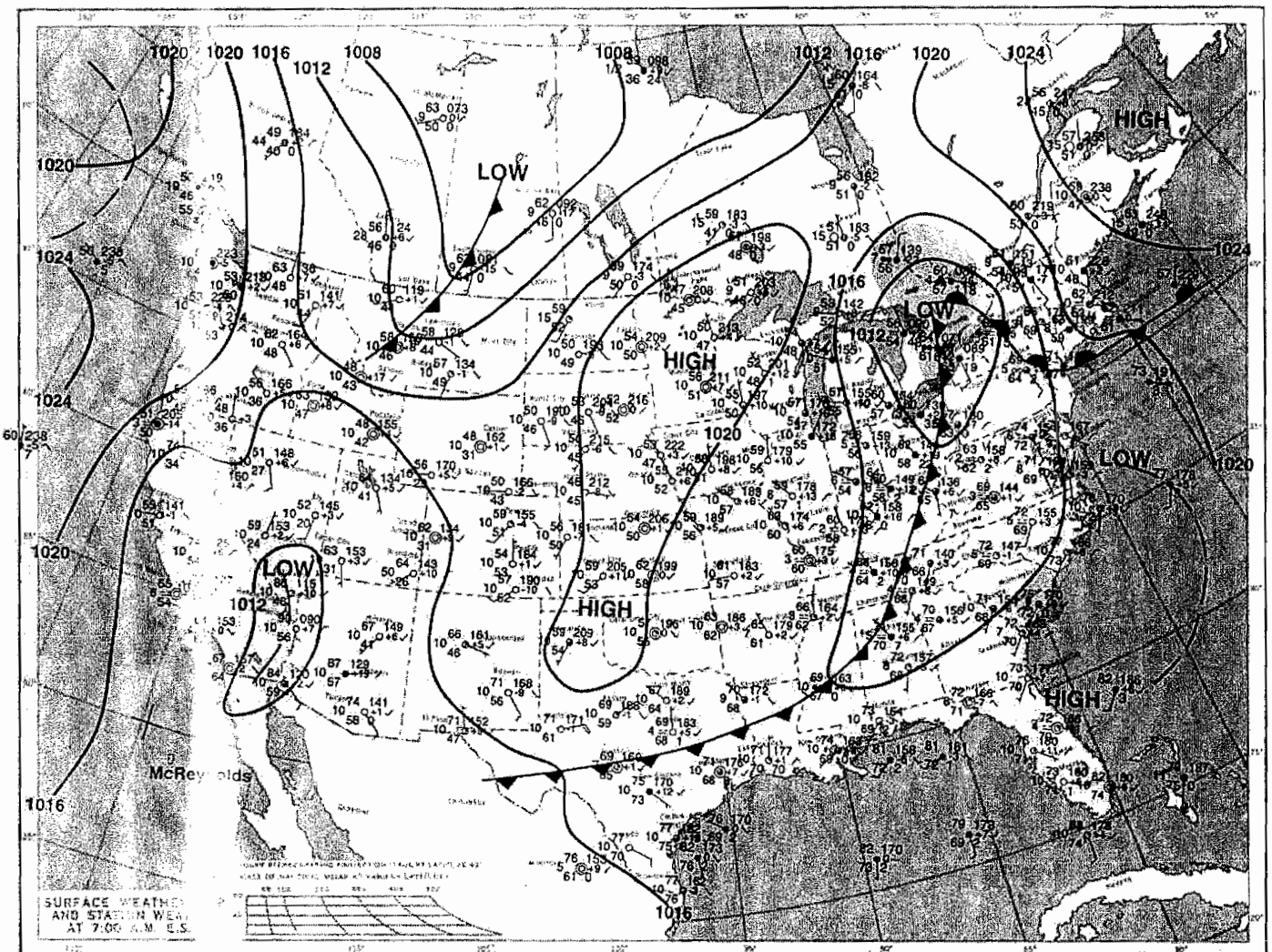
SATURDAY, JUNE 16, 2001

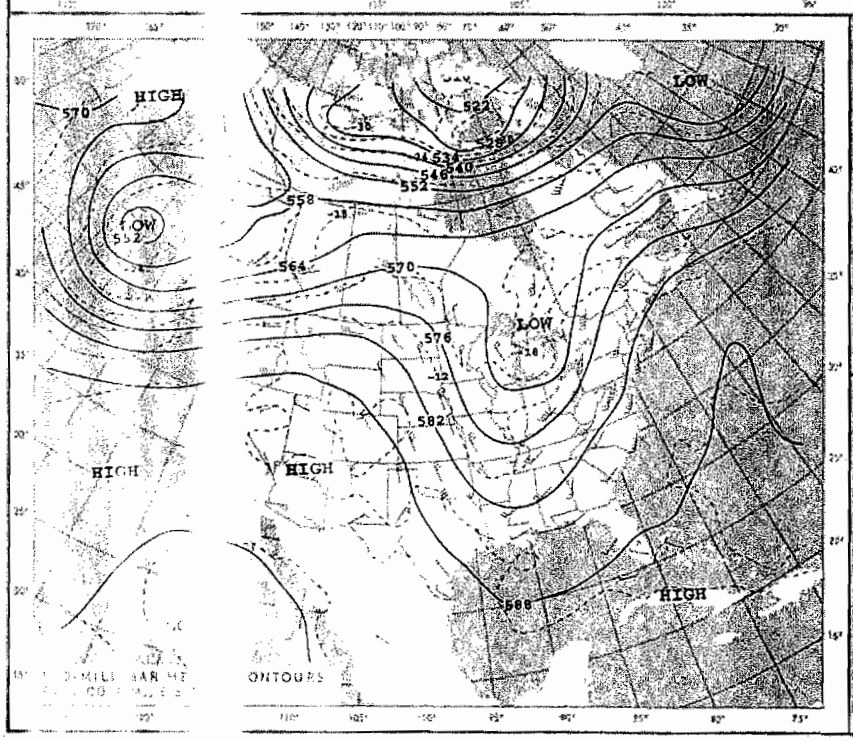


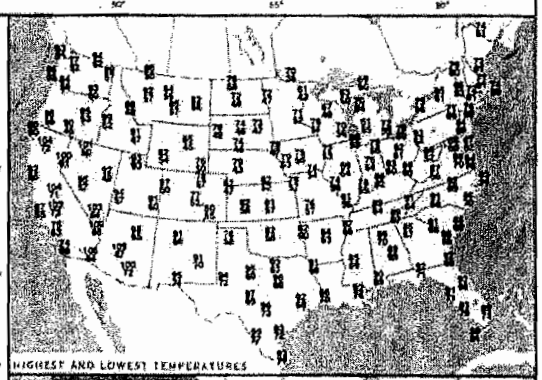
THURSDAY, JUNE 21, 2001

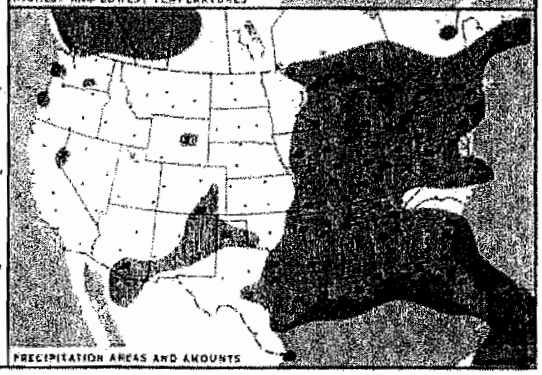


FRIDAY, JUNE 22, 2001

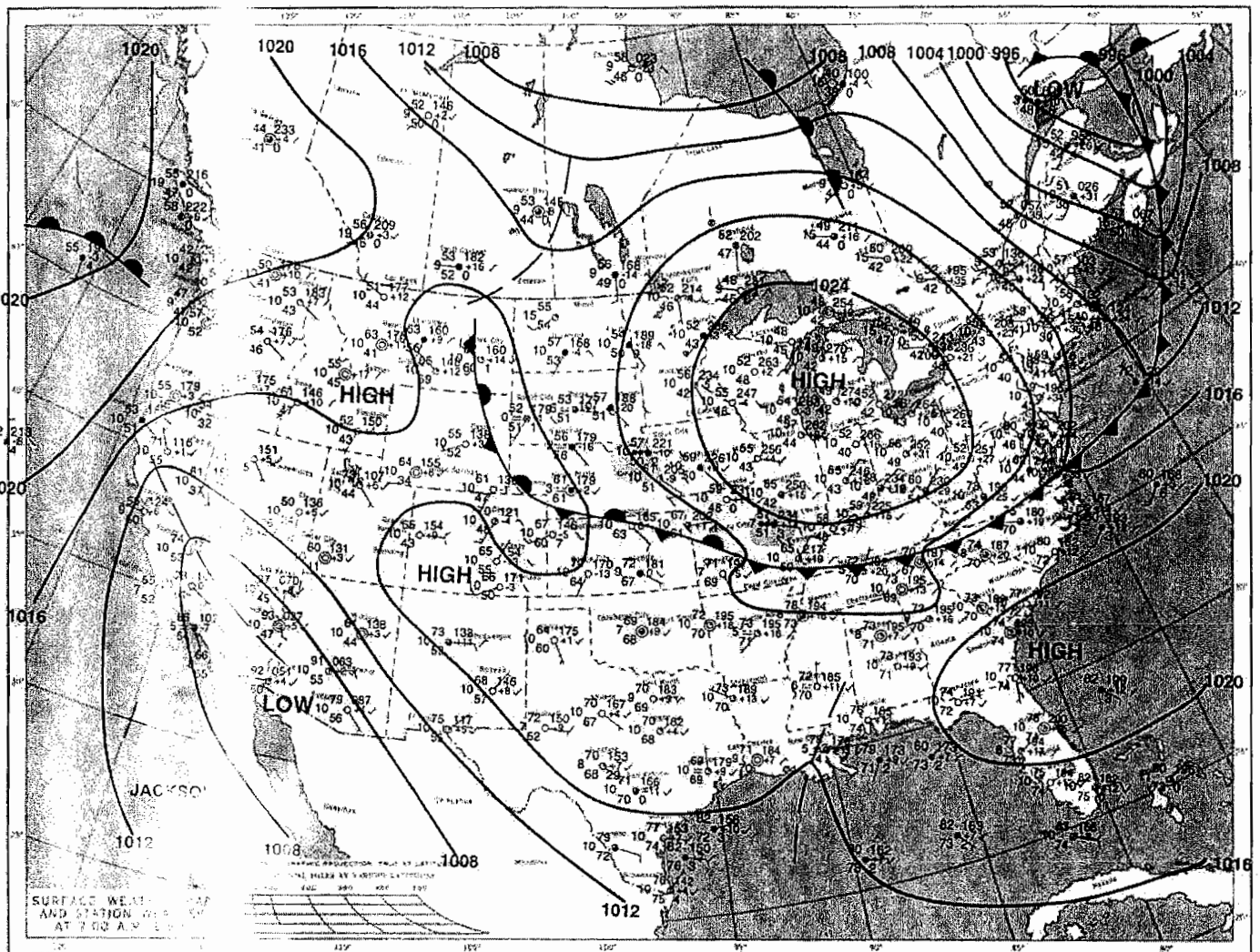


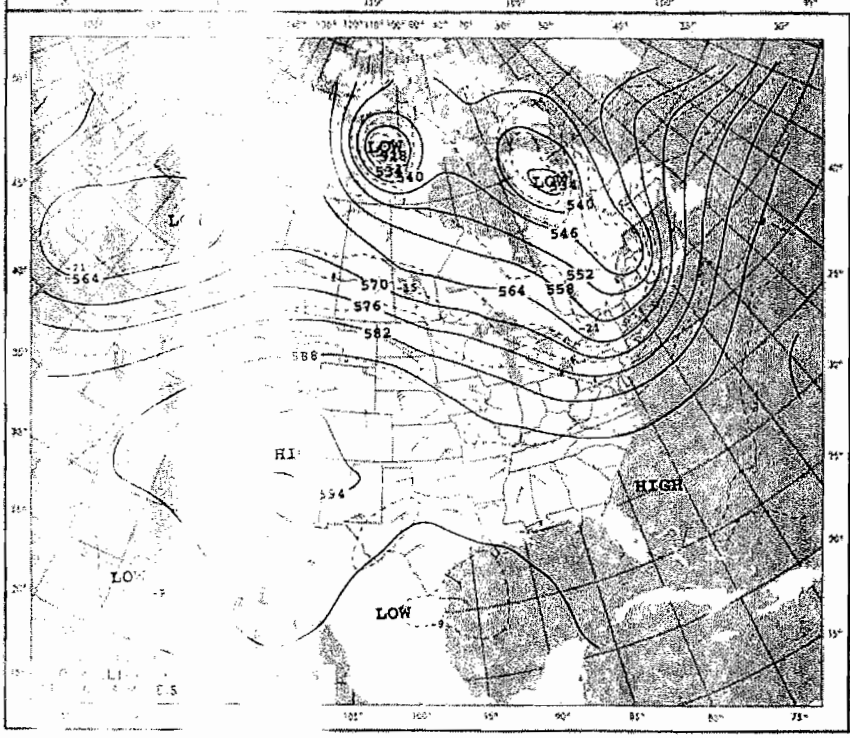


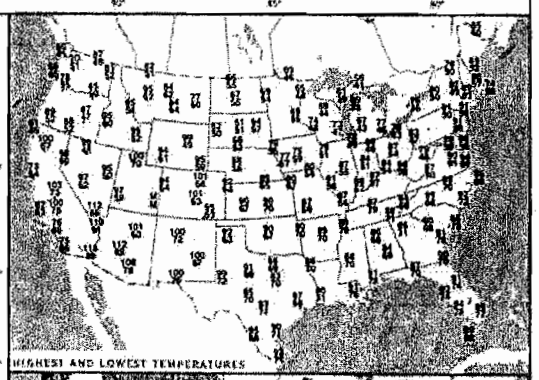




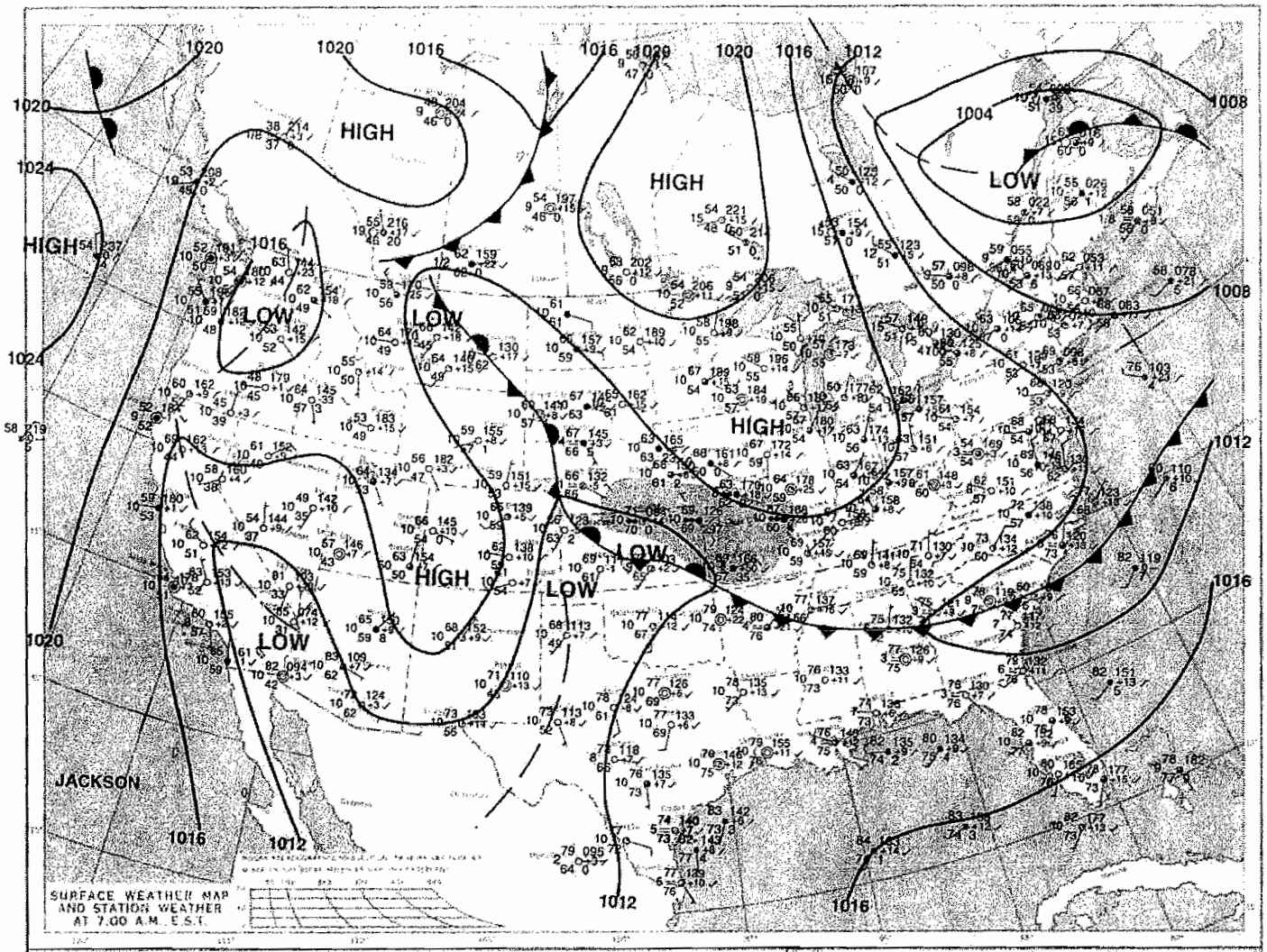
MONDAY, JULY 2, 2001

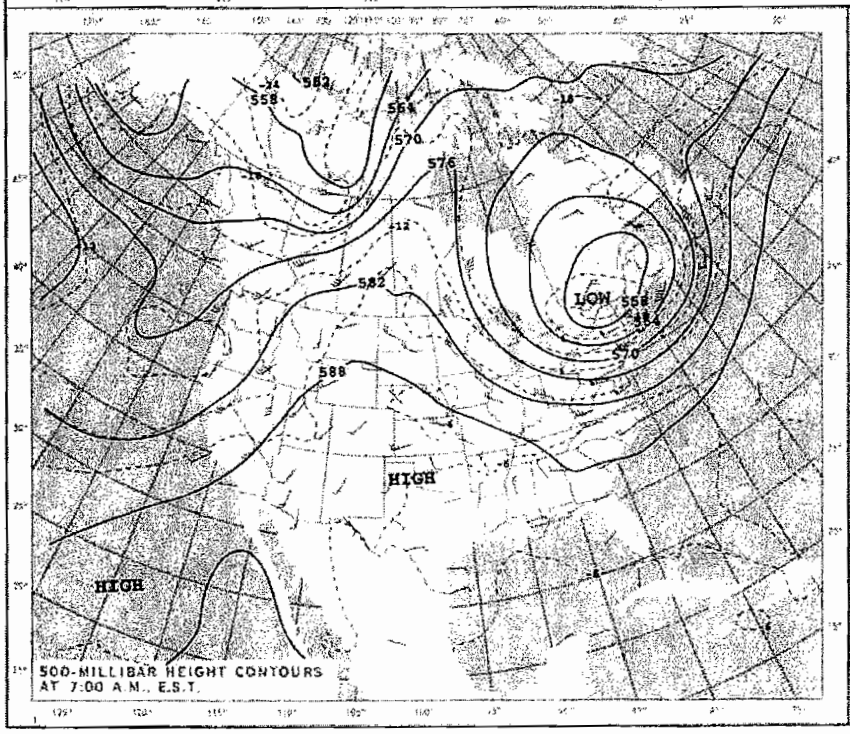


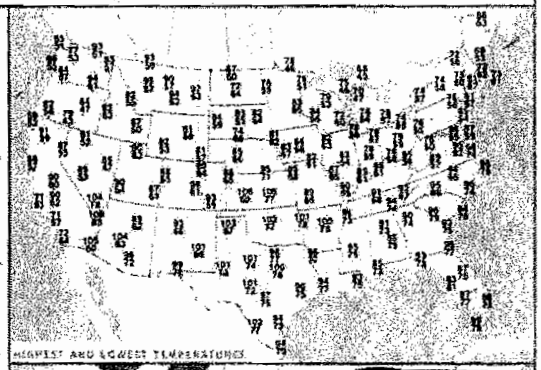




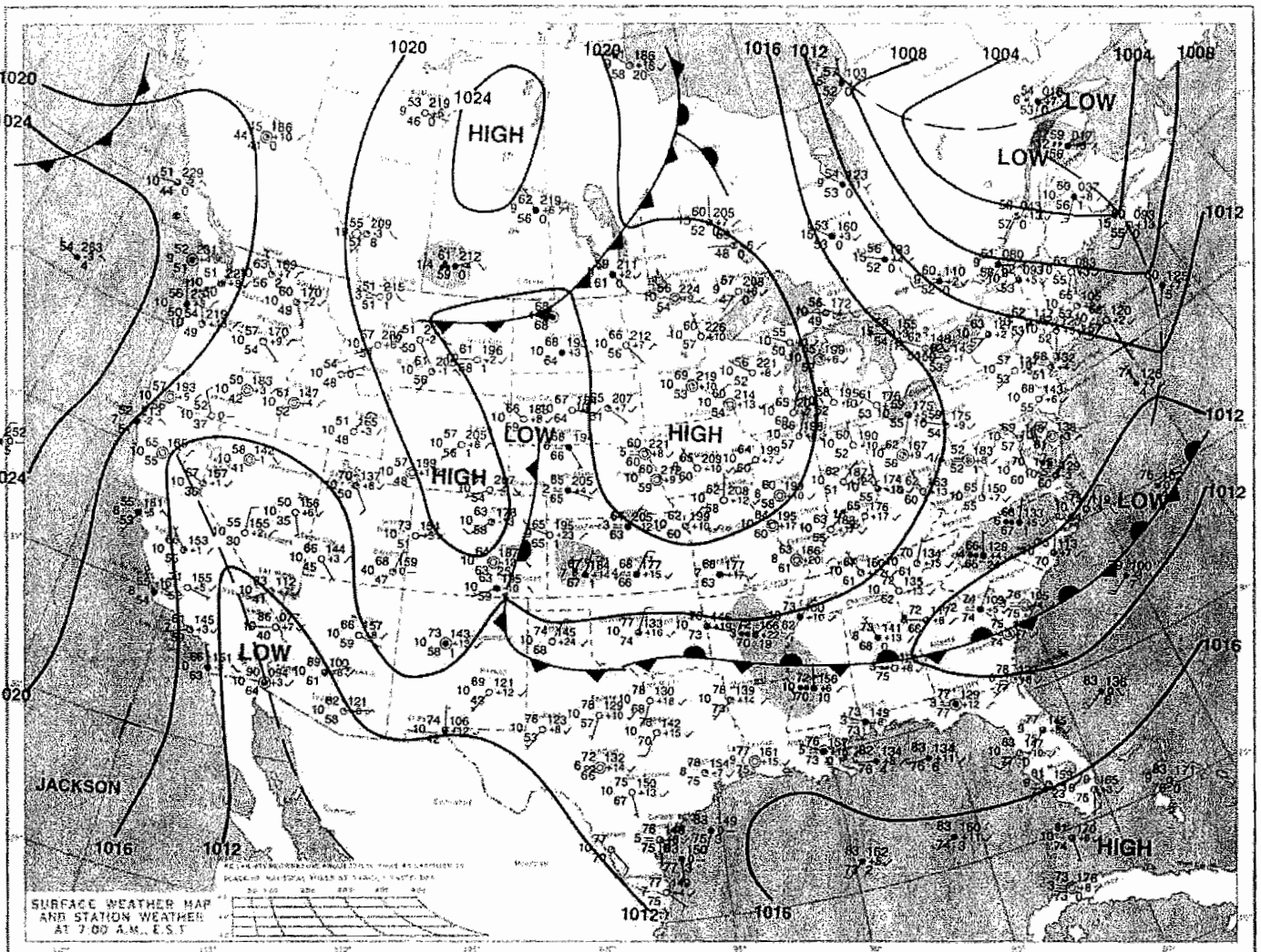
THURSDAY, JULY 12, 2001

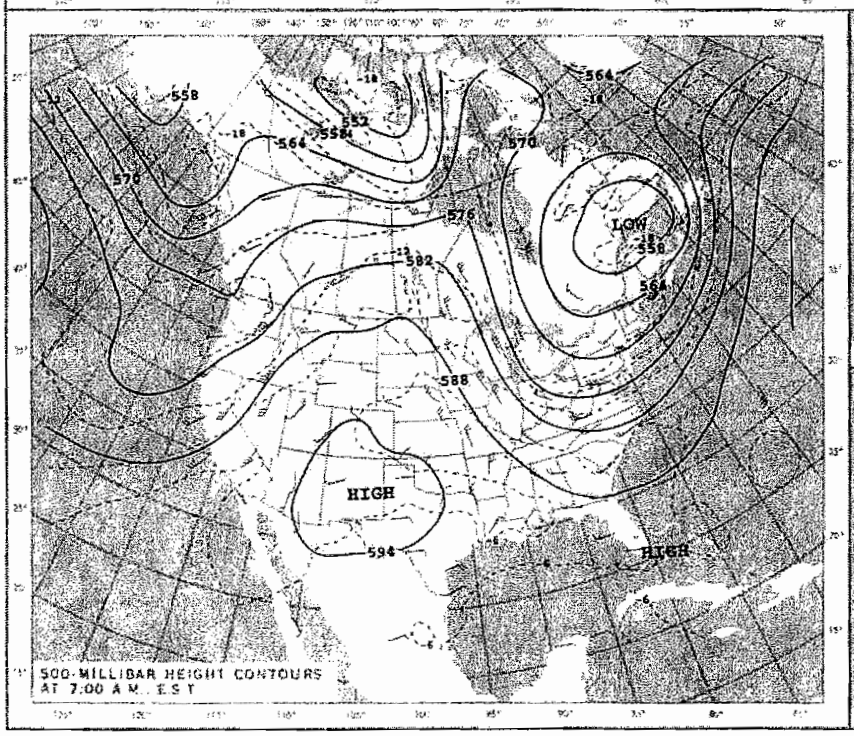


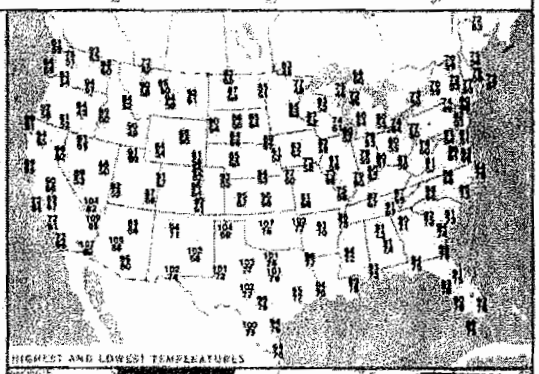


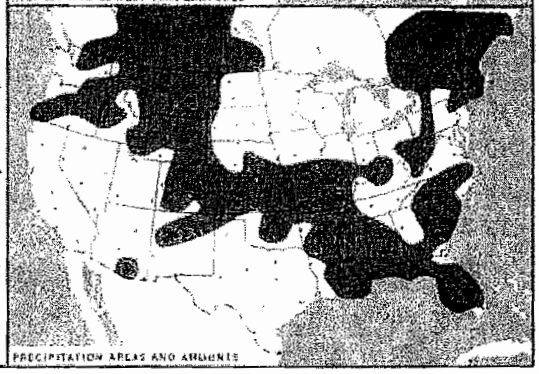


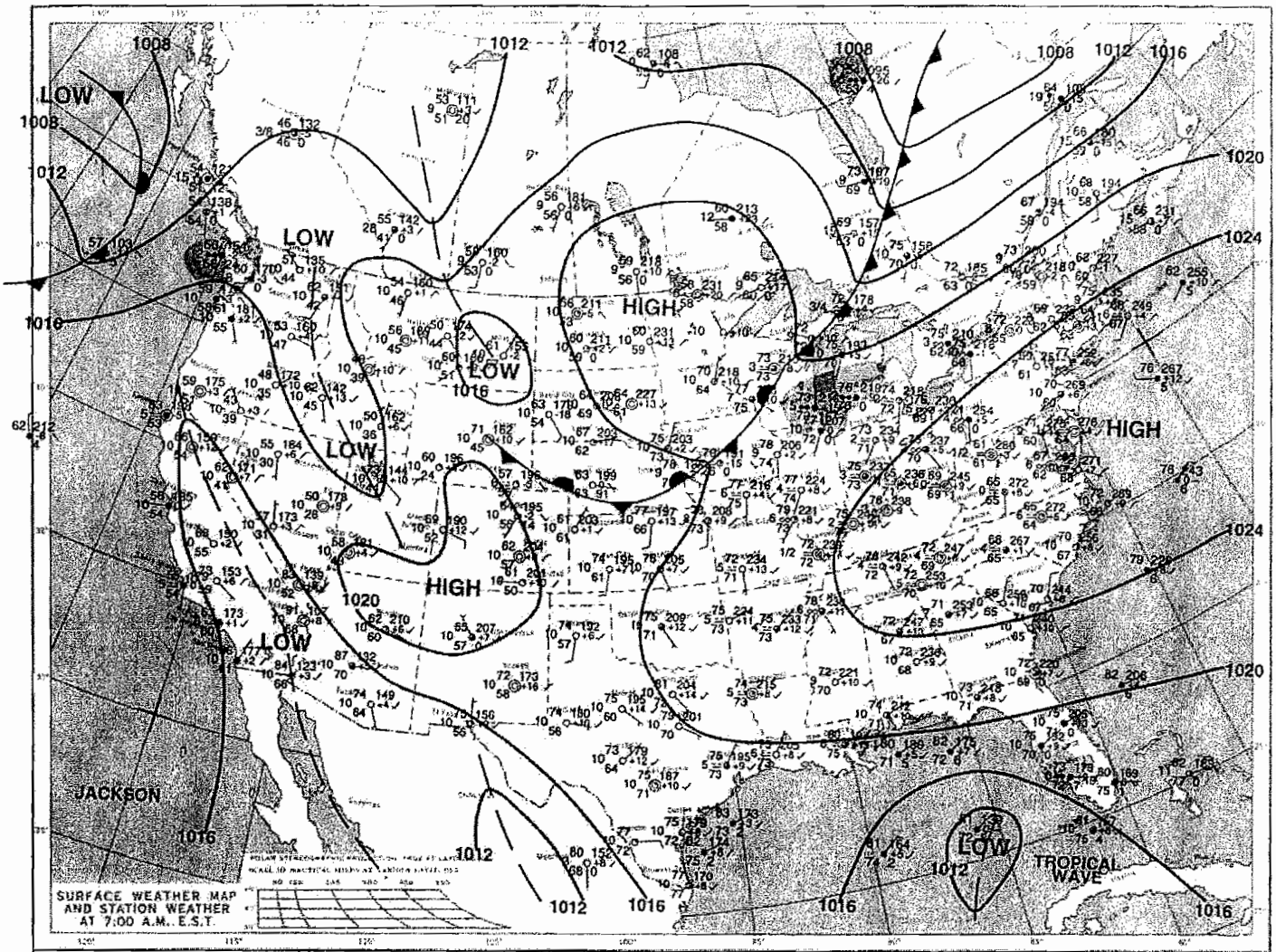
FRIDAY, JULY 13, 2001

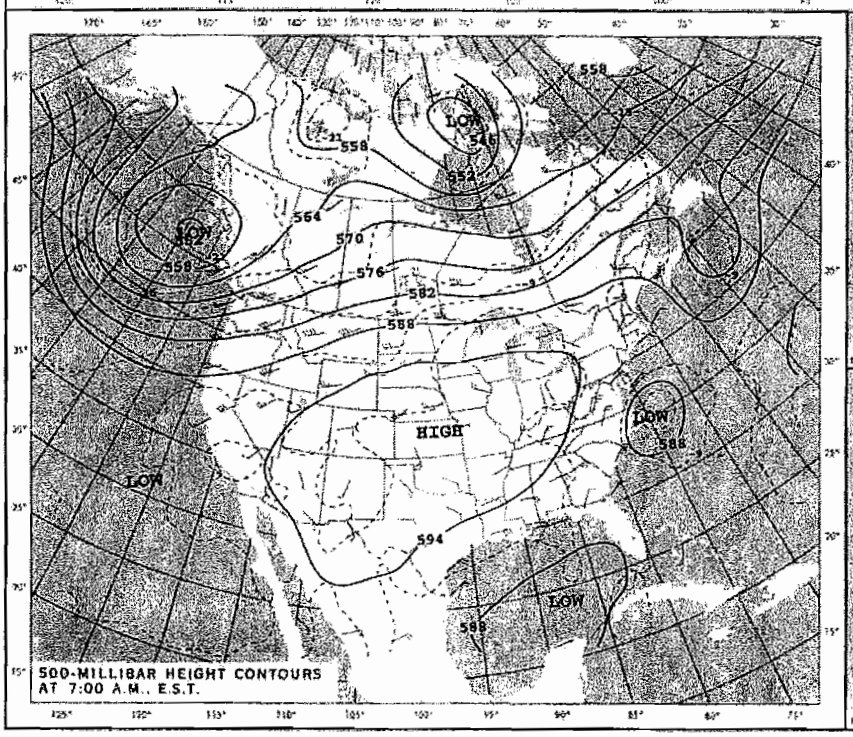


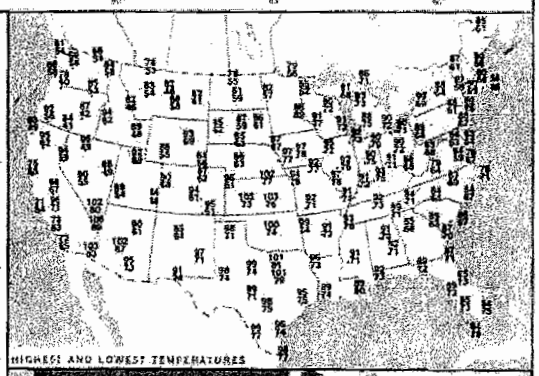






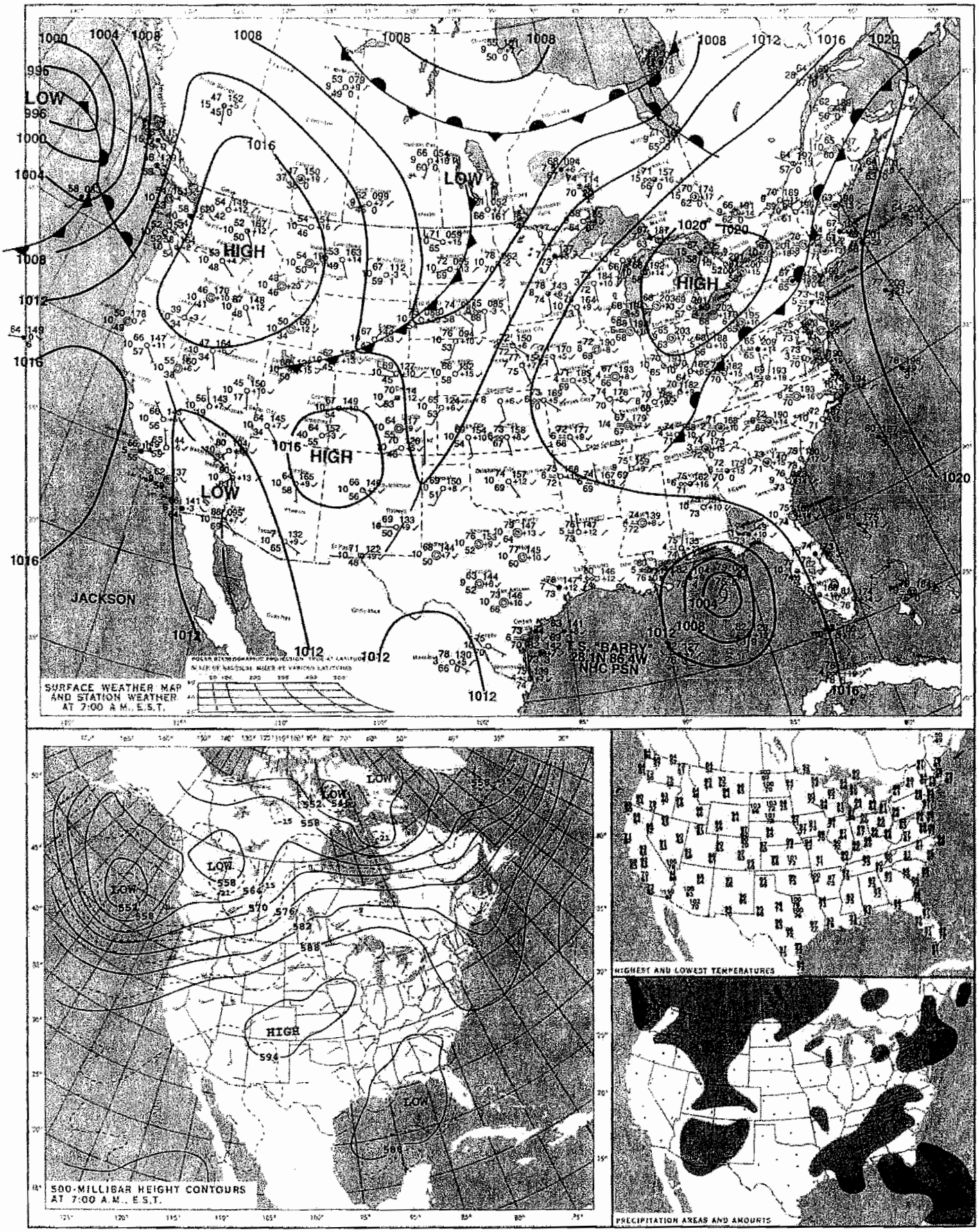

LOW
HIGH
JACKSON
TROPICAL WAVE
SURFACE WEATHER MAP
AND STATION WEATHER
AT 7:00 A.M., E.S.T.


LOW
HIGH
500-MILLIBAR HEIGHT CONTOURS
AT 7:00 A.M., E.S.T.

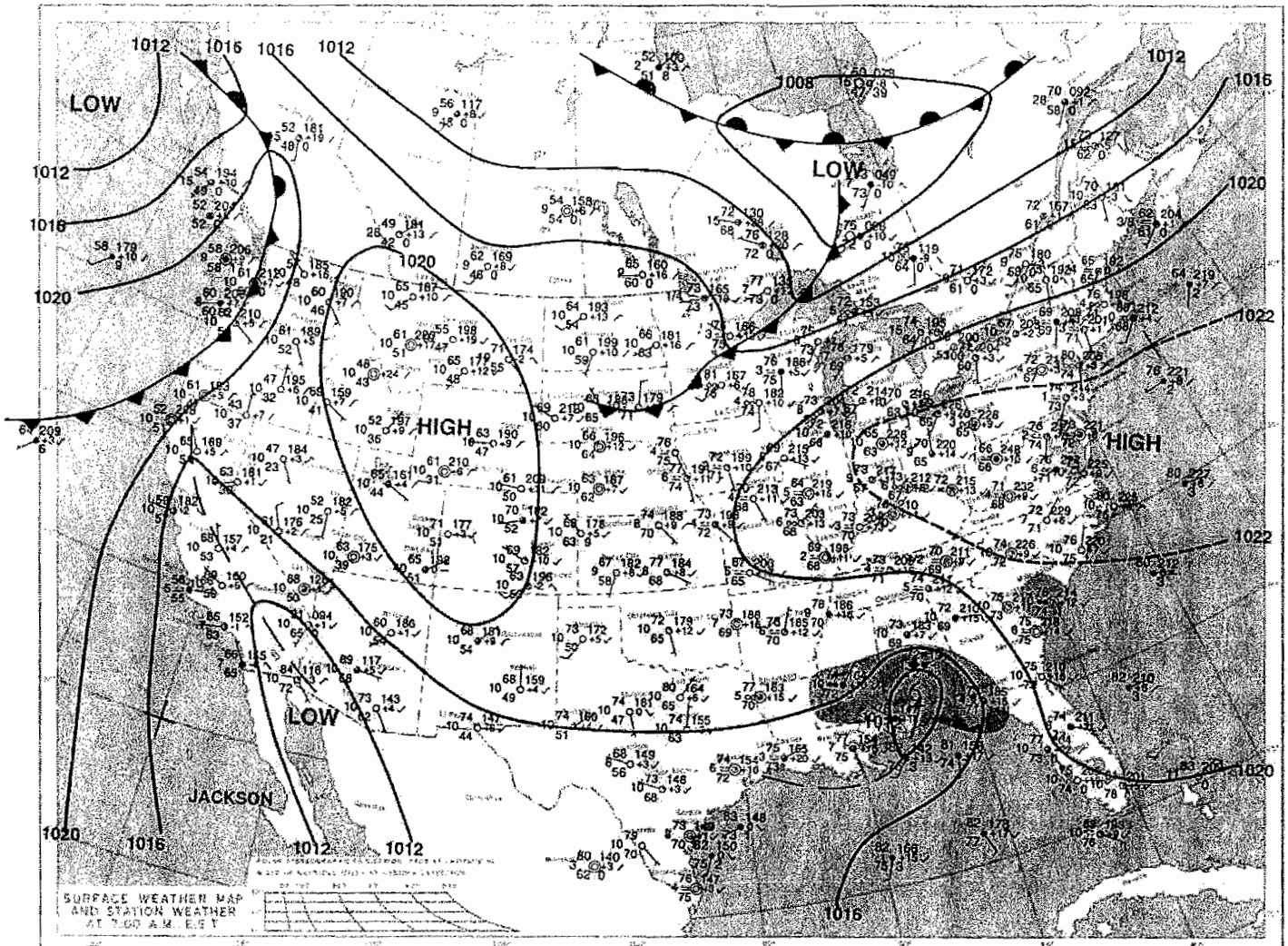

HIGHEST AND LOWEST TEMPERATURES

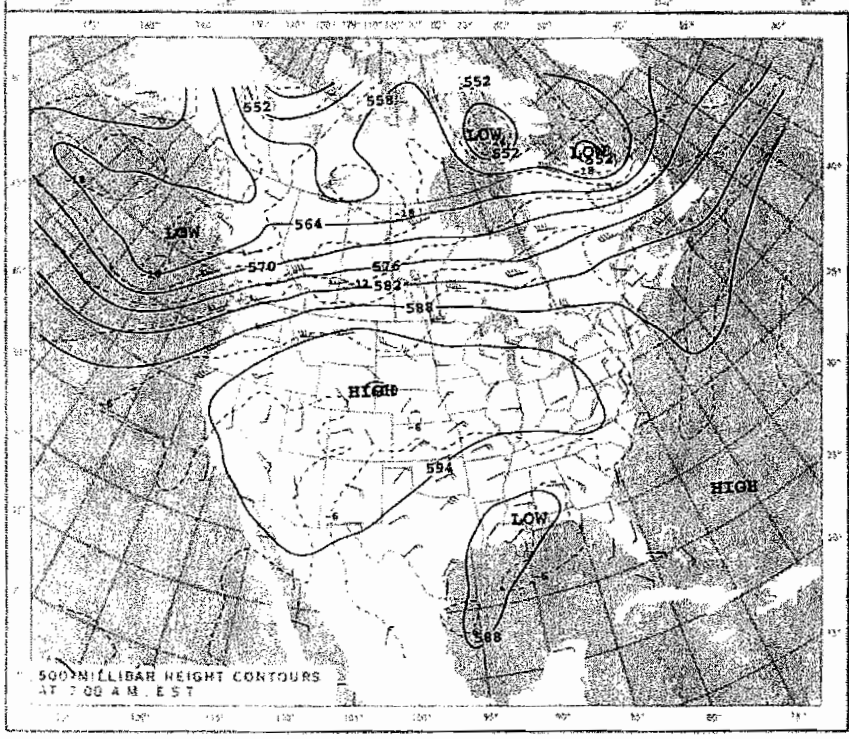
PRECIPITATION AREAS AND AMOUNTS

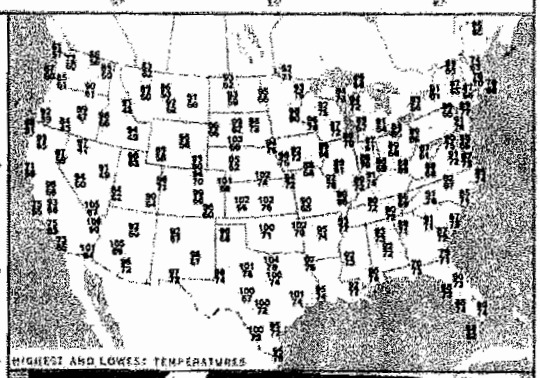
SUNDAY, AUGUST 5, 2001

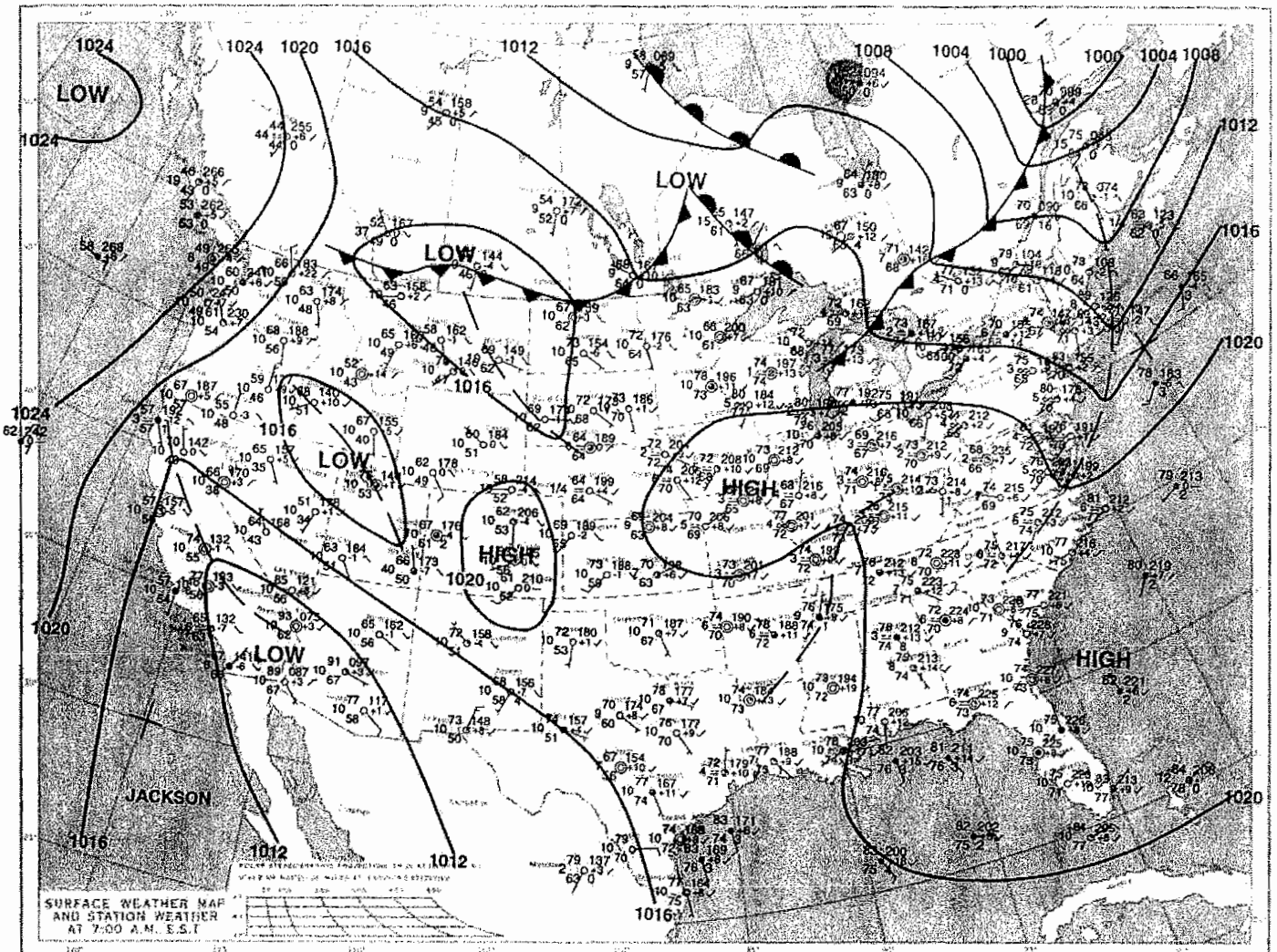


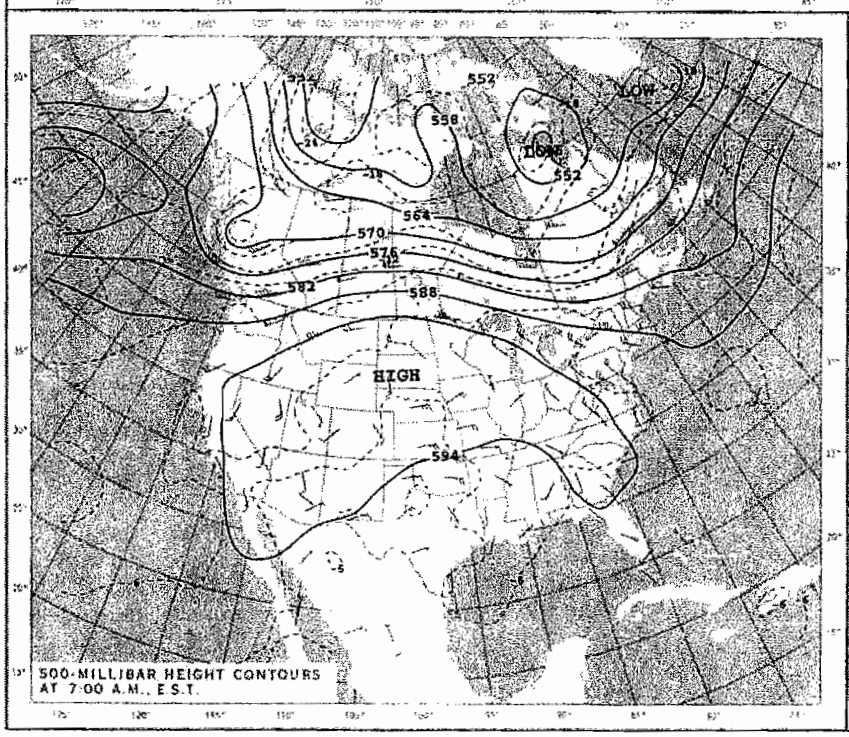
MONDAY, AUGUST 6, 2001

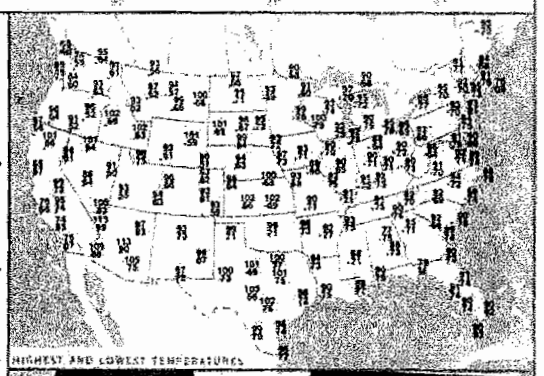






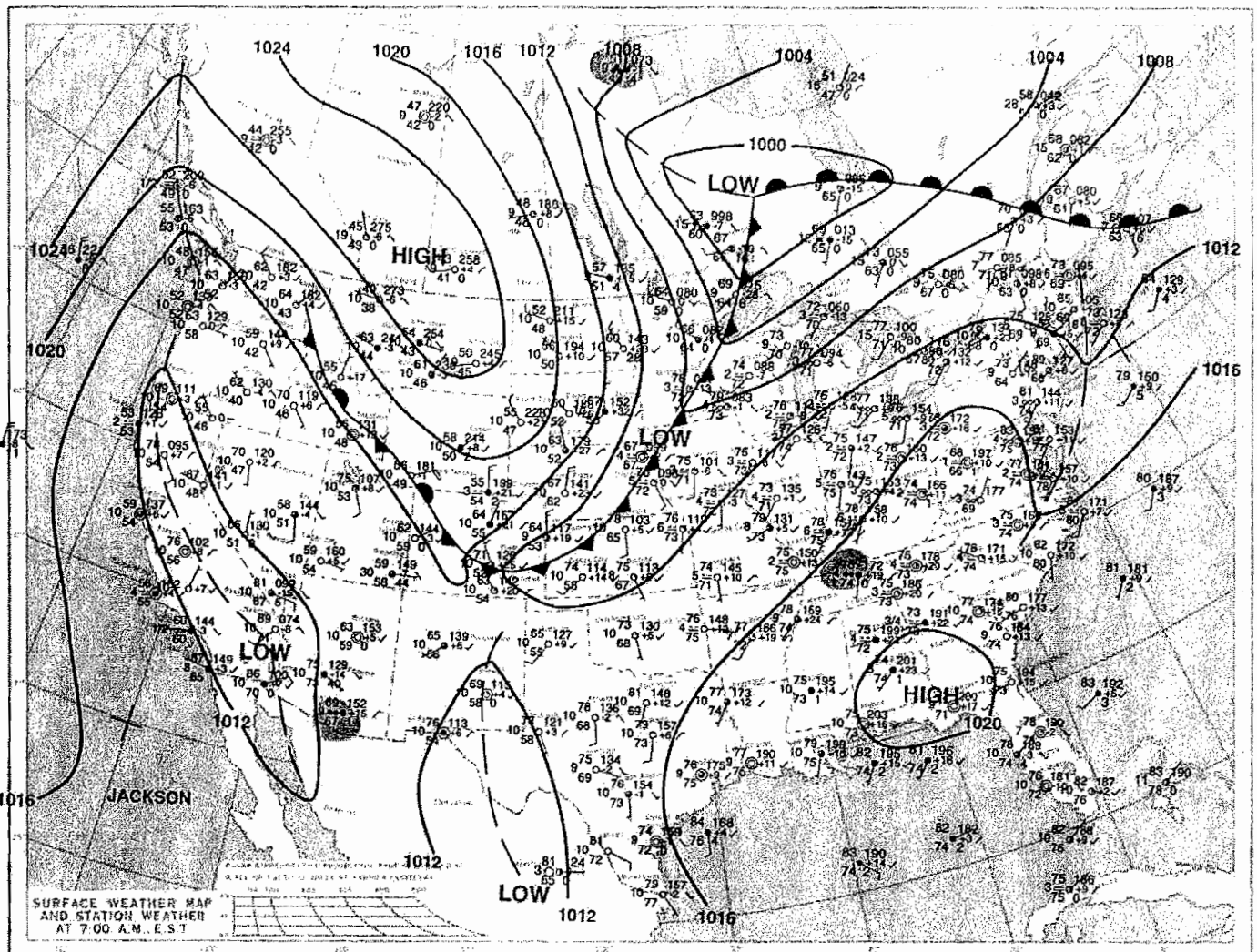

LOW
LOW
LOW
LOW
HIGH
HIGH
HIGH
JACKSON
1024
1020
1016
1012
1008
1004
1000
SURFACE WEATHER MAP
AND STATION WEATHER
AT 7:00 A.M. E.S.T.

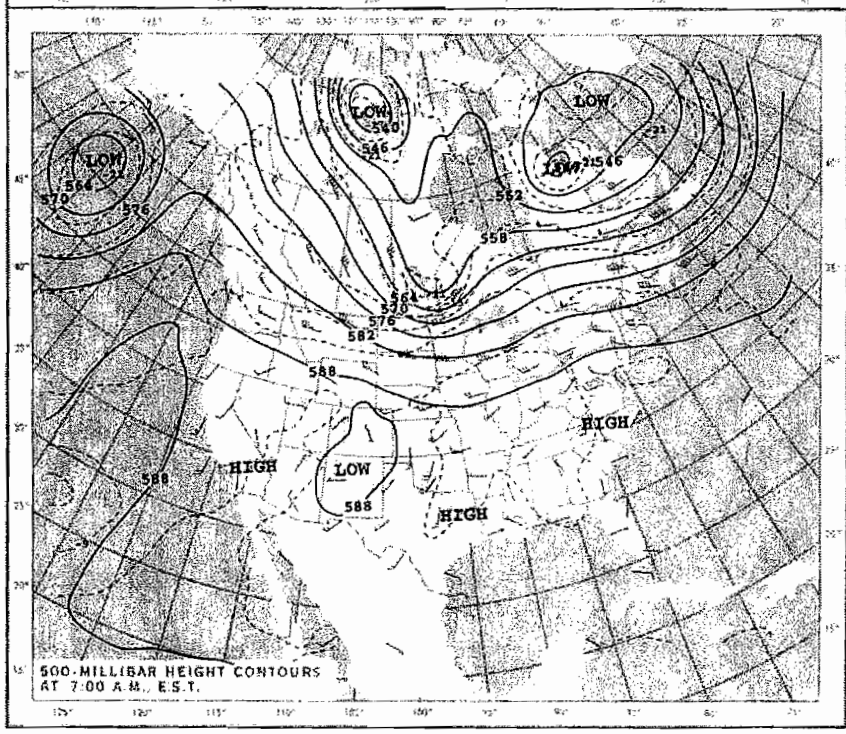

LOW
HIGH
HIGH
552
558
564
570
576
582
588
594
500-MILLIBAR HEIGHT CONTOURS
AT 7:00 A.M. E.S.T.

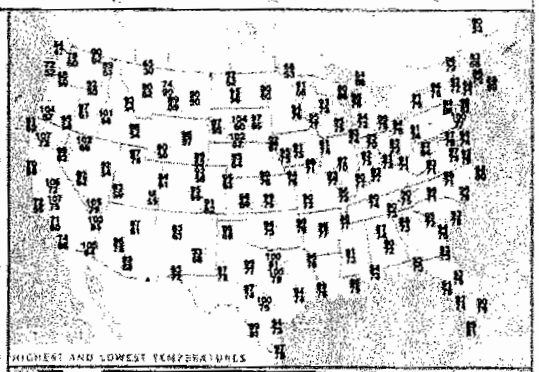

HIGHEST AND LOWEST TEMPERATURES

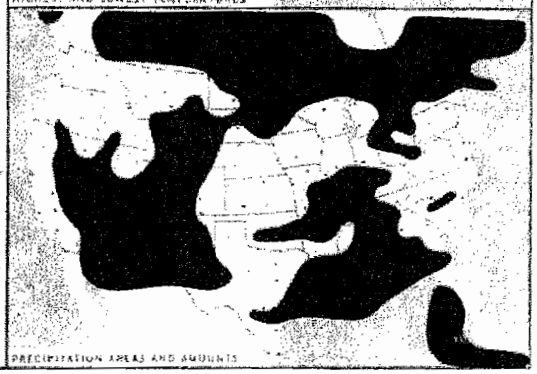
PRECIPITATION AREAS AND AMOUNTS

THURSDAY, AUGUST 9, 2001

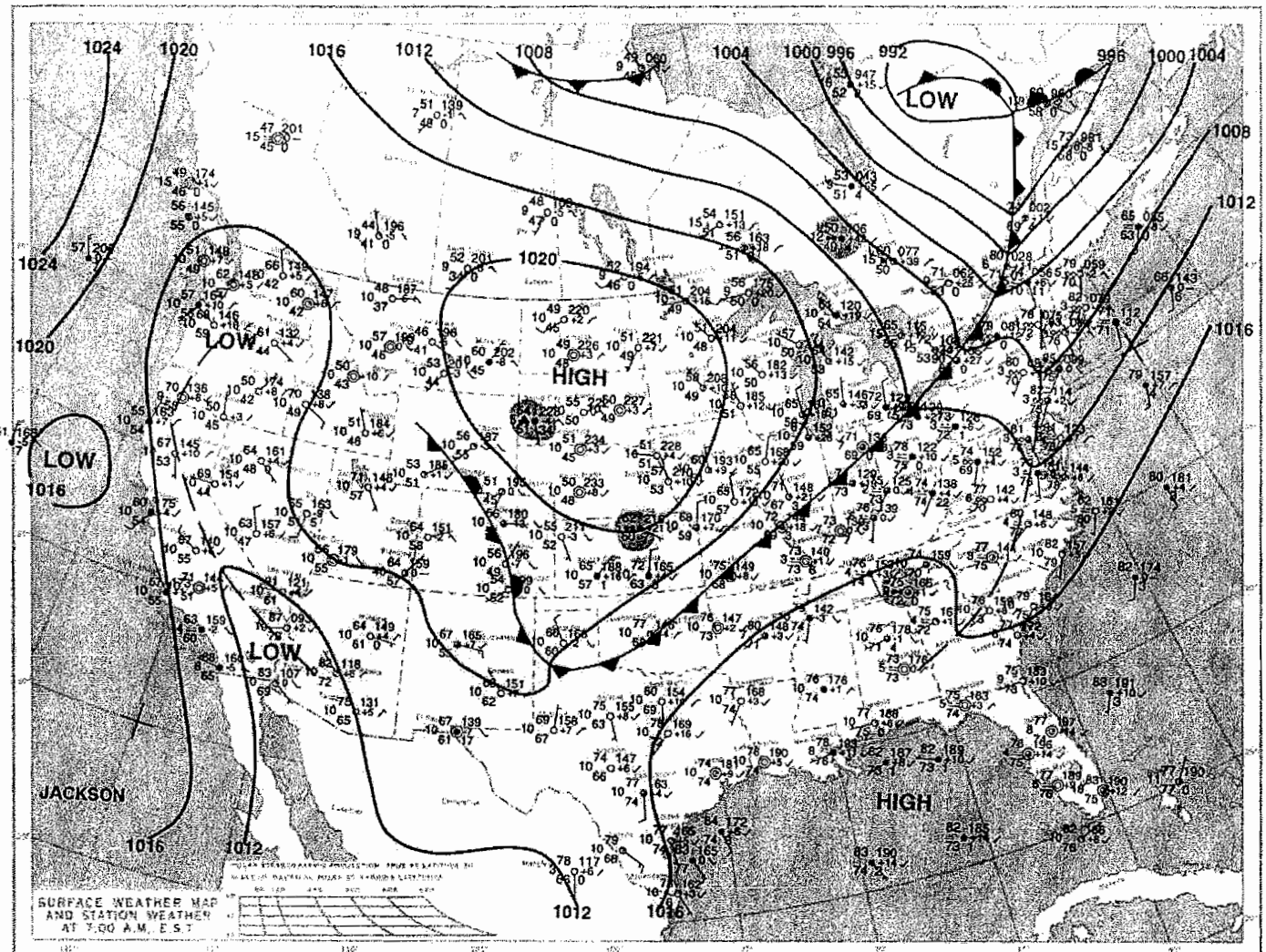


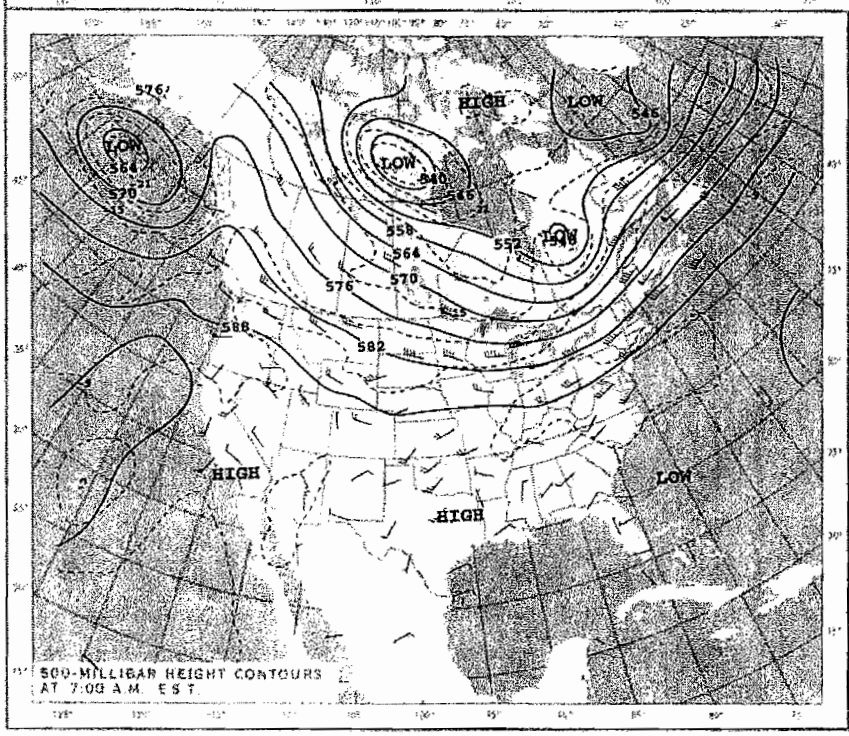


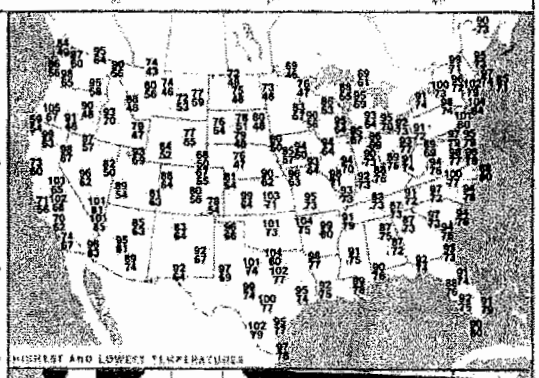


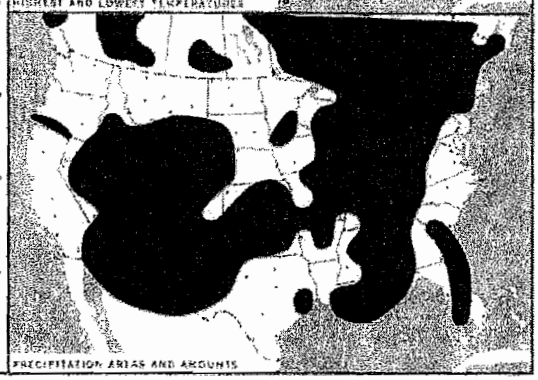


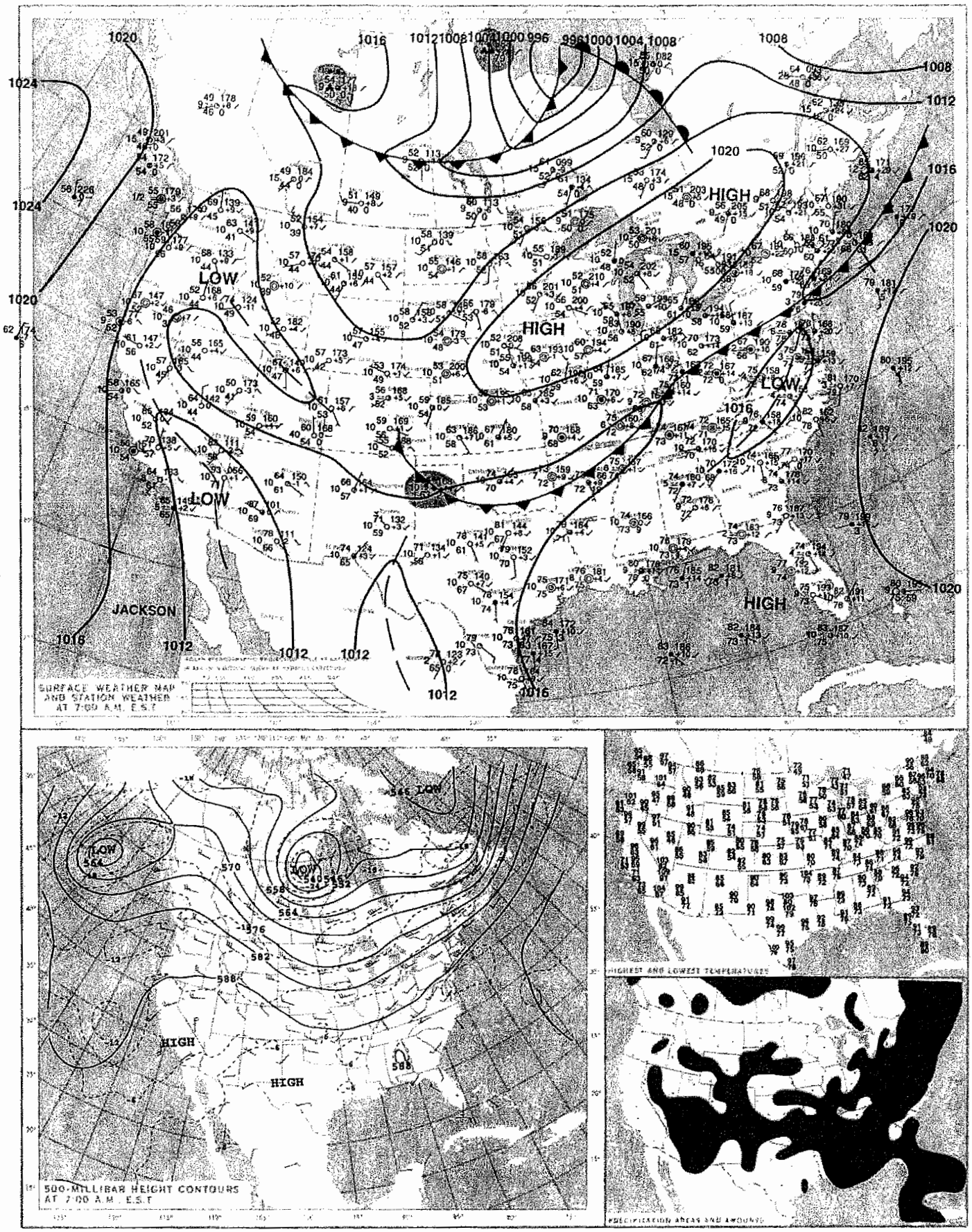
FRIDAY, AUGUST 10, 2001



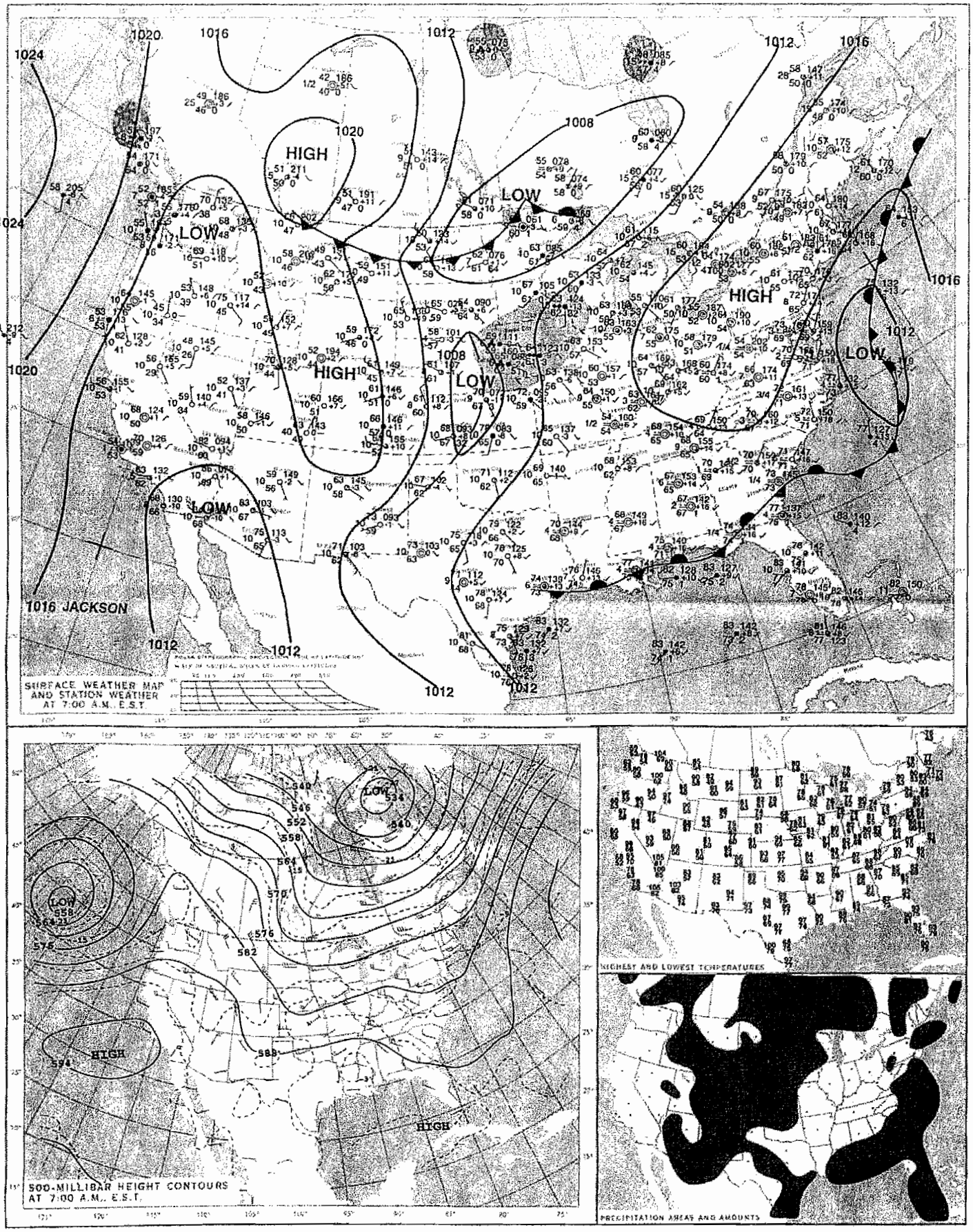


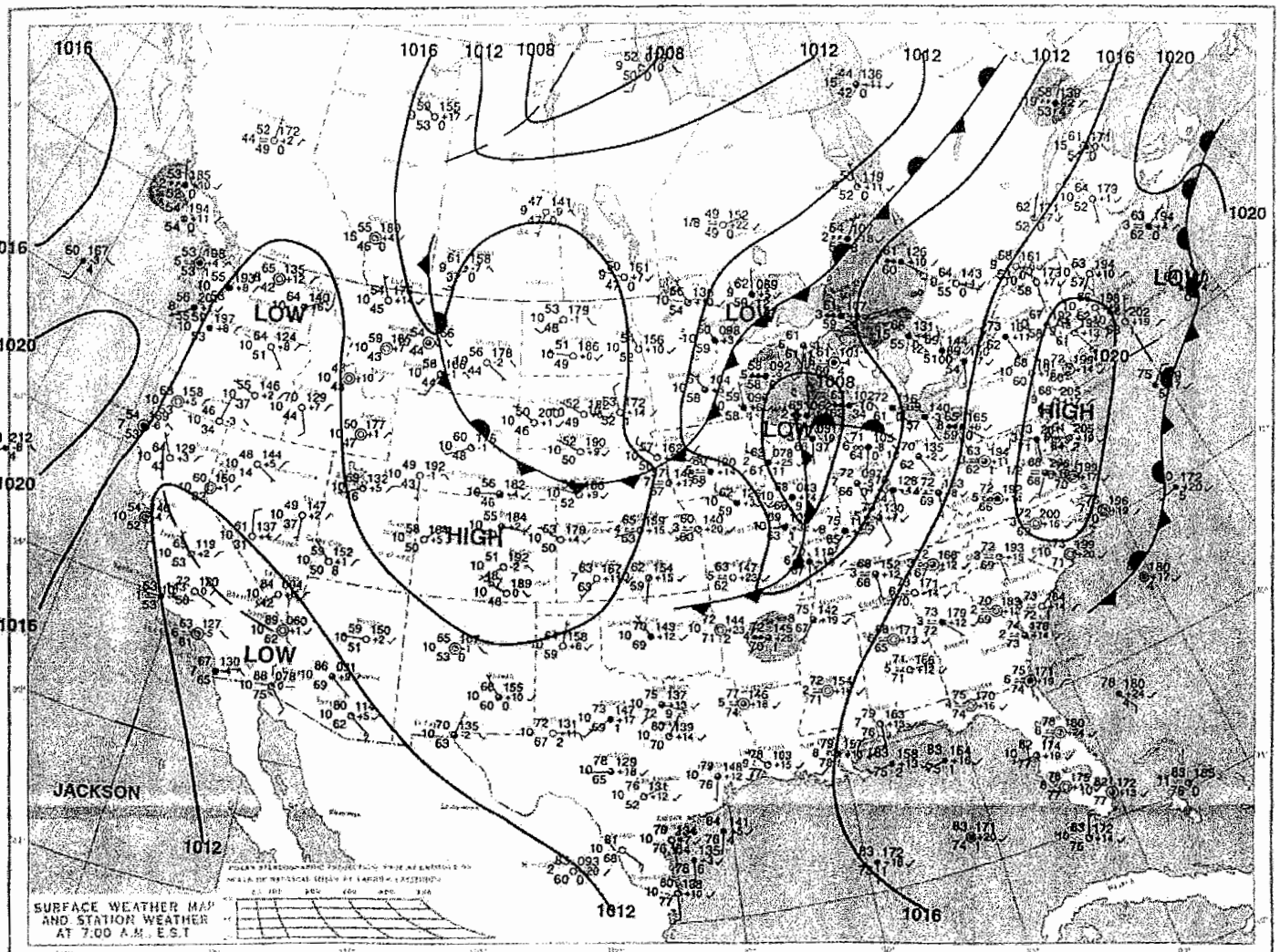




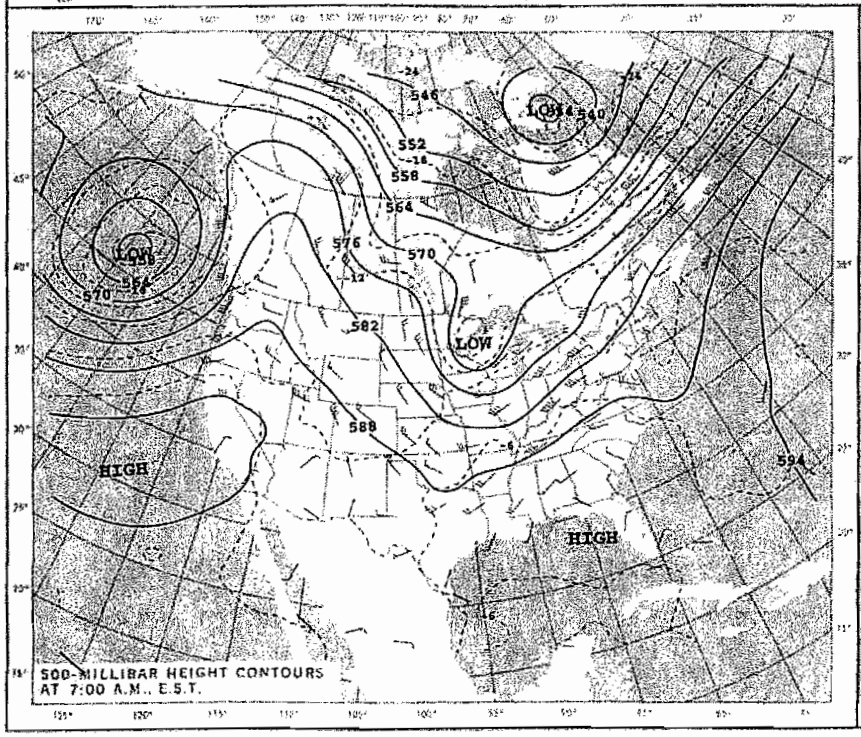

SURFACE WEATHER MAP
AND STATION WEATHER
AT 7:00 A.M. E.S.T.
LOW
HIGH
JACKSON
500-MILLIBAR HEIGHT CONTOURS
AT 7:00 A.M. E.S.T.
HIGHEST AND LOWEST TEMPERATURES
PRECIPITATION AREAS AND AMOUNTS

WEDNESDAY, AUGUST 15, 2001

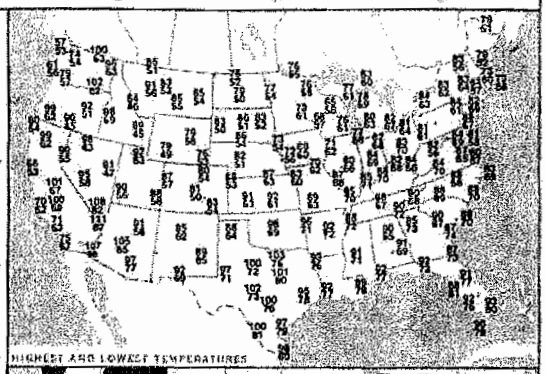




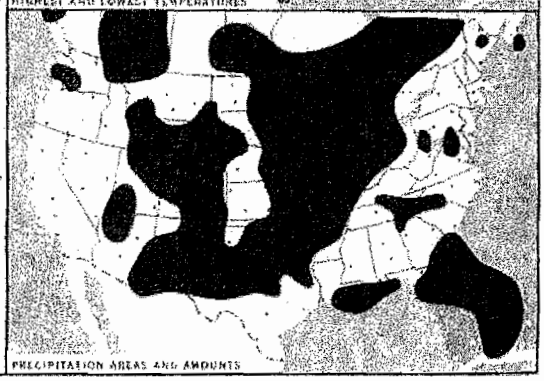
SURFACE WEATHER MAP AND STATION WEATHER AT 7:00 A.M., E.S.T



500-MILLIBAR HEIGHT CONTOURS AT 7:00 A.M., E.S.T.

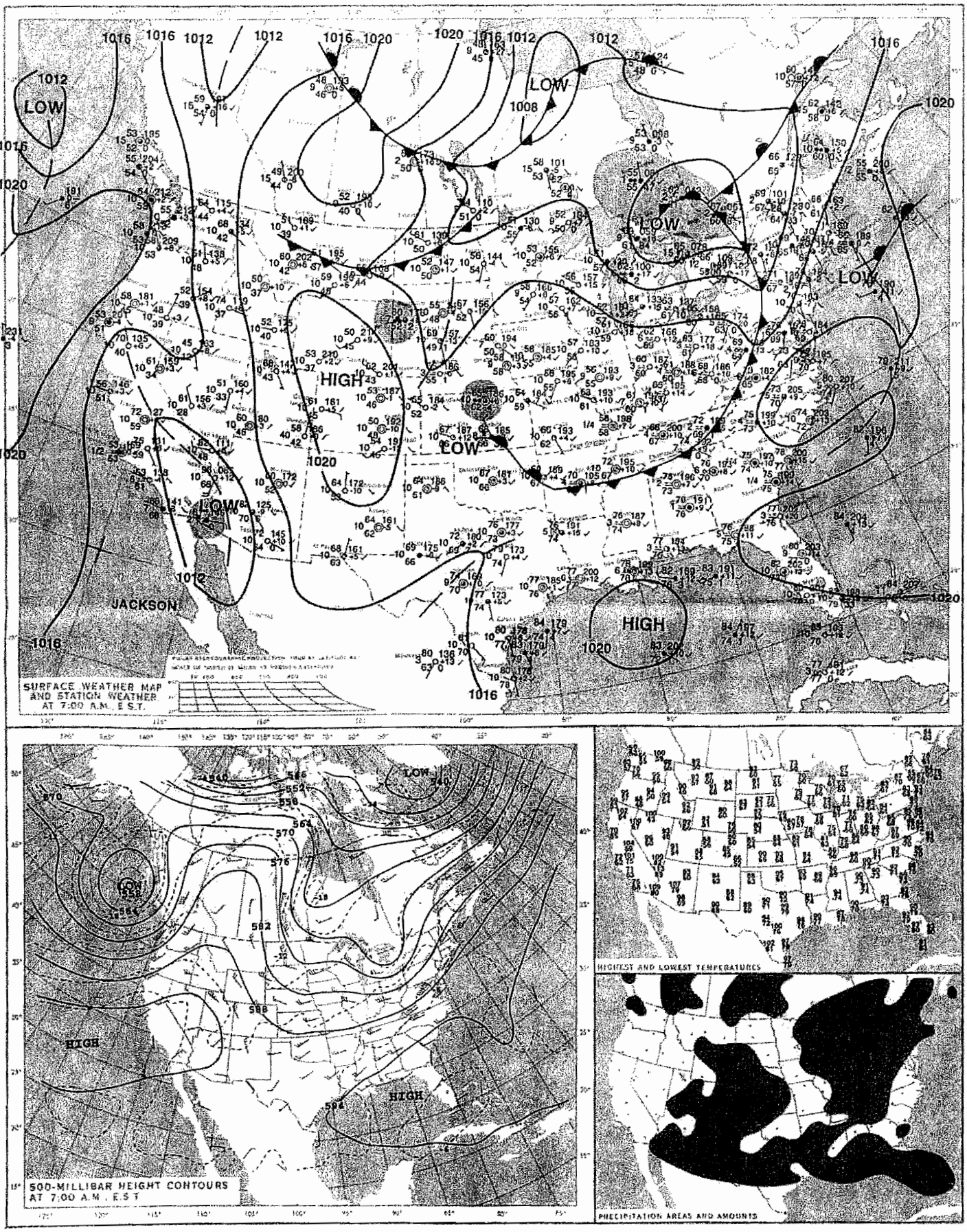


HIGHEST AND LOWEST TEMPERATURES

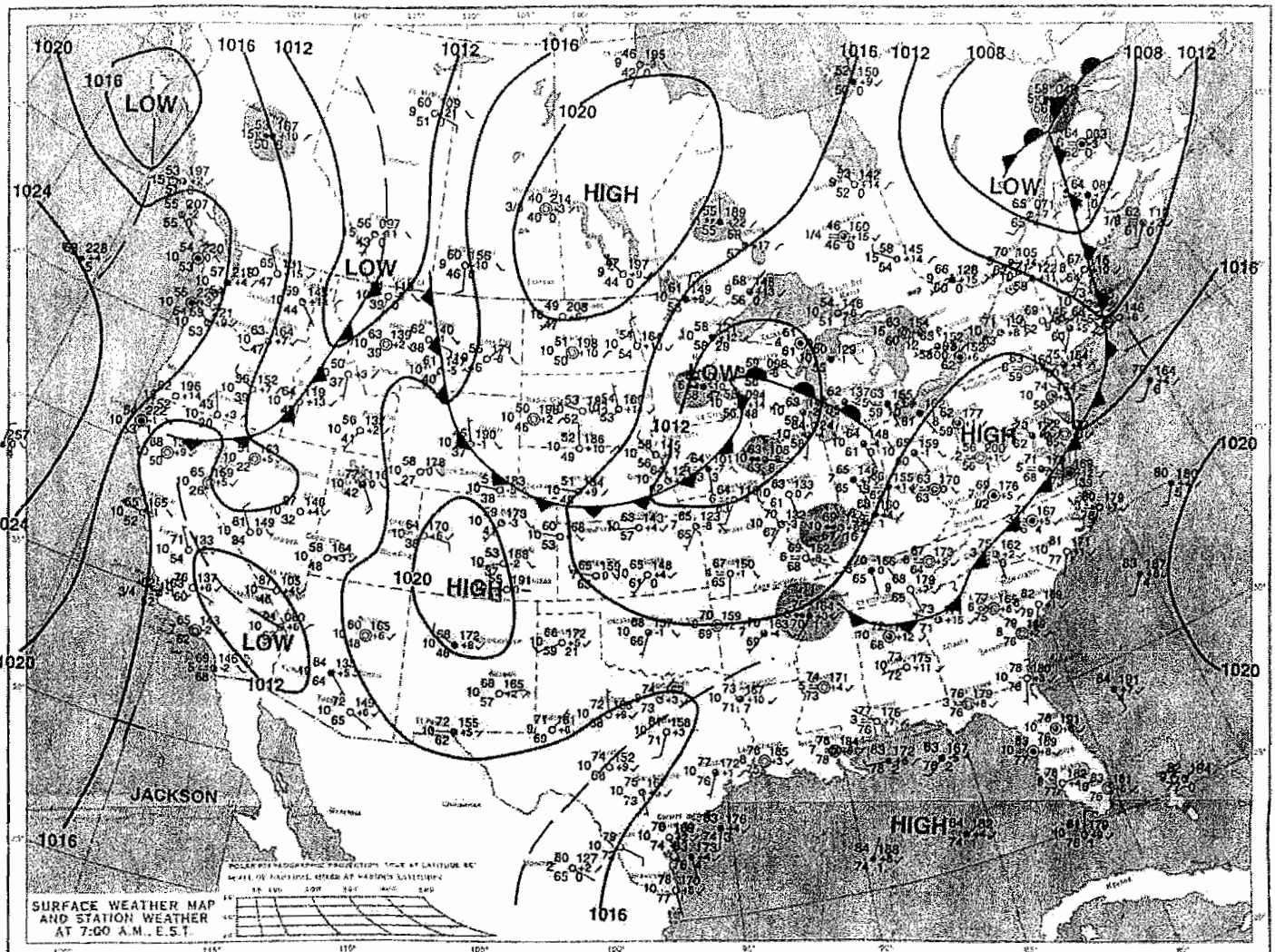


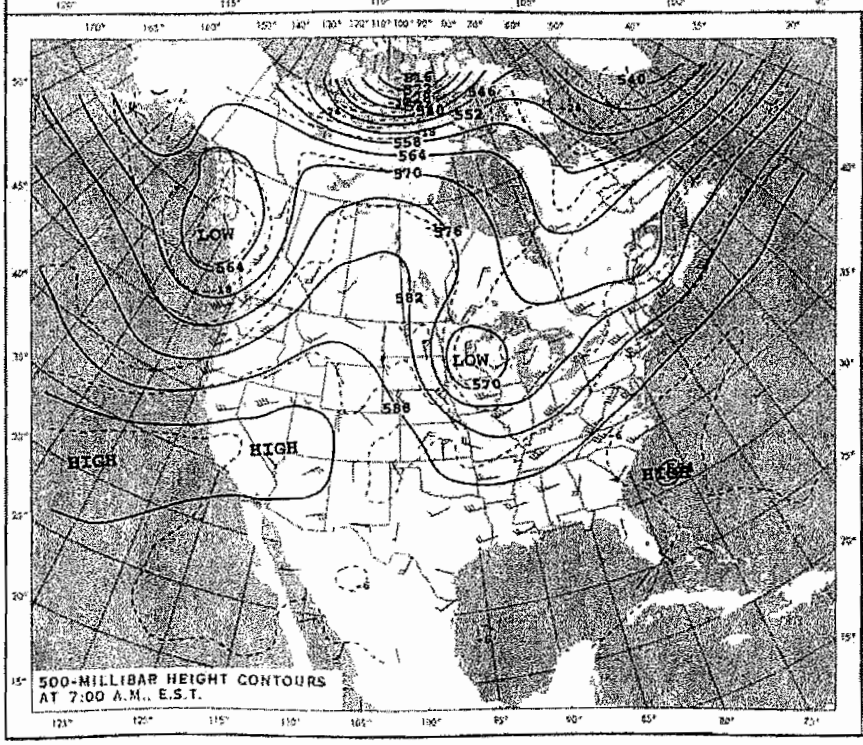
PRECIPITATION AREAS AND AMOUNTS

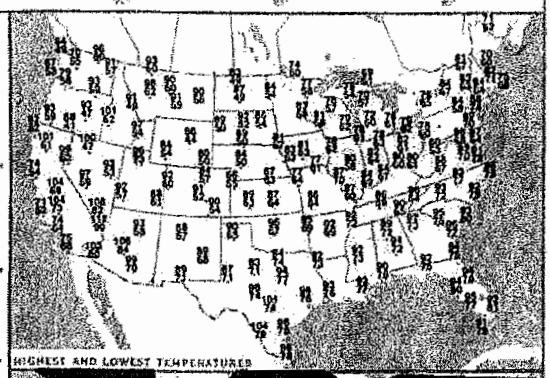
FRIDAY, AUGUST 17, 2001

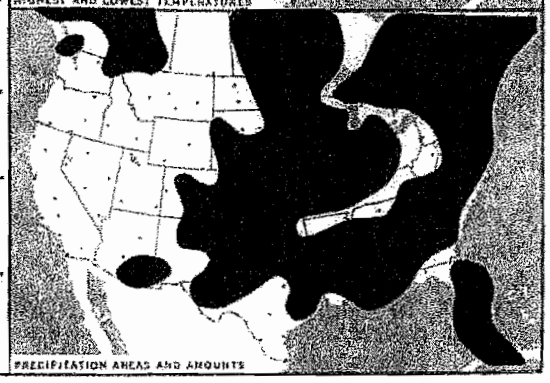


SATURDAY, AUGUST 18, 2001

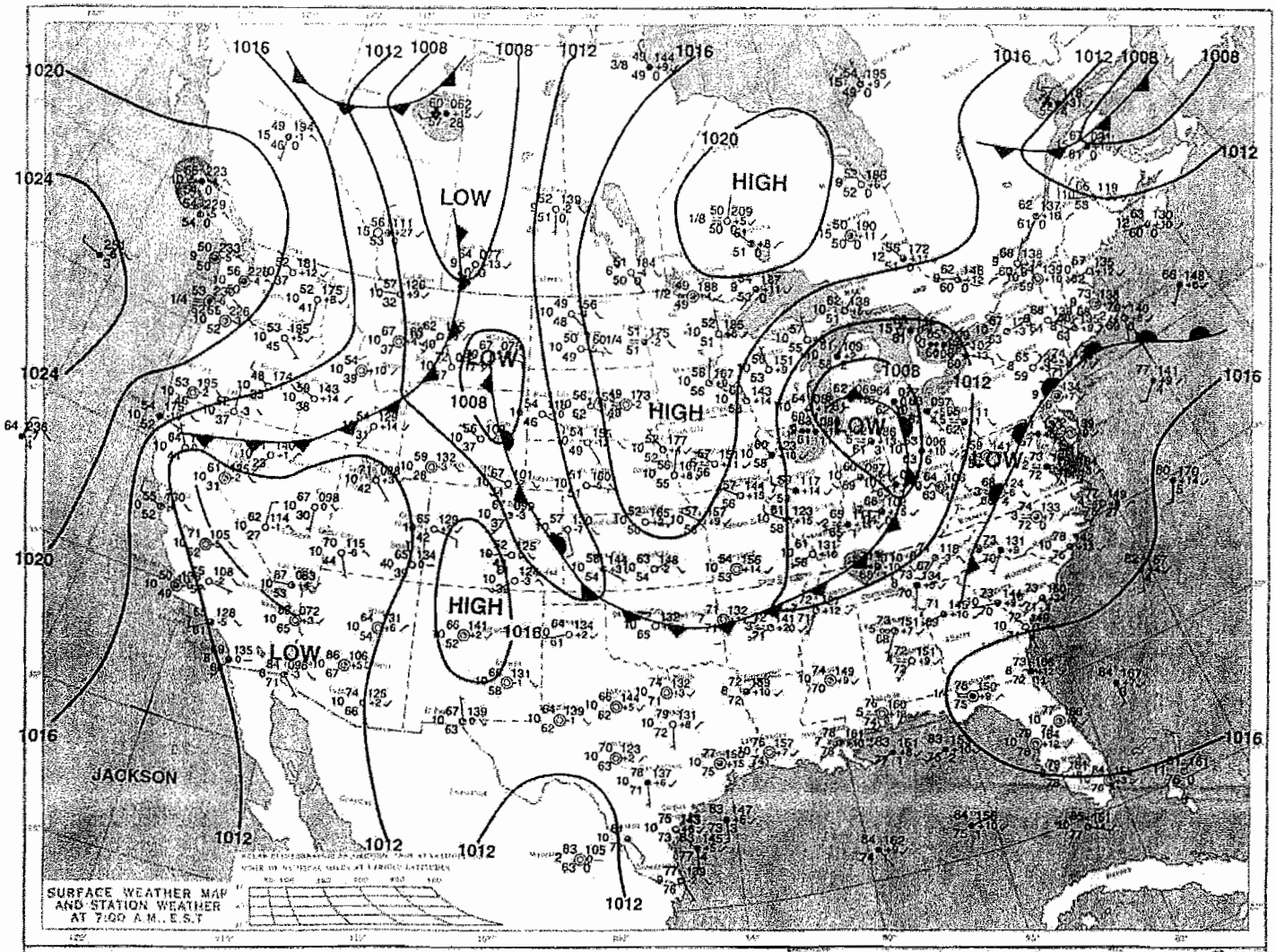


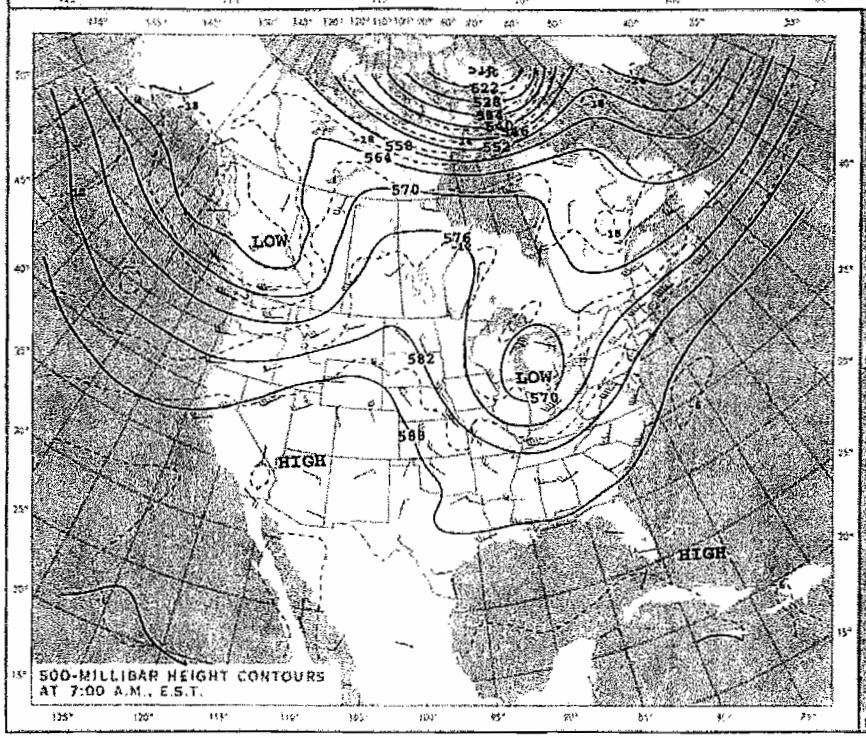


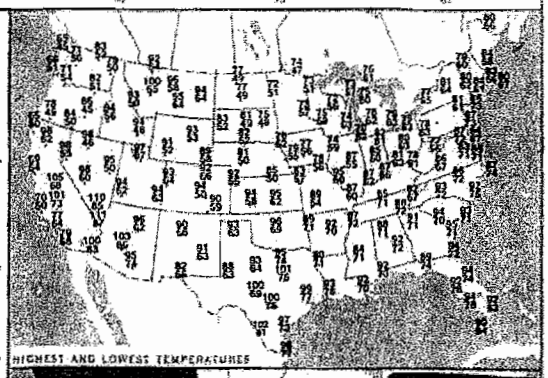


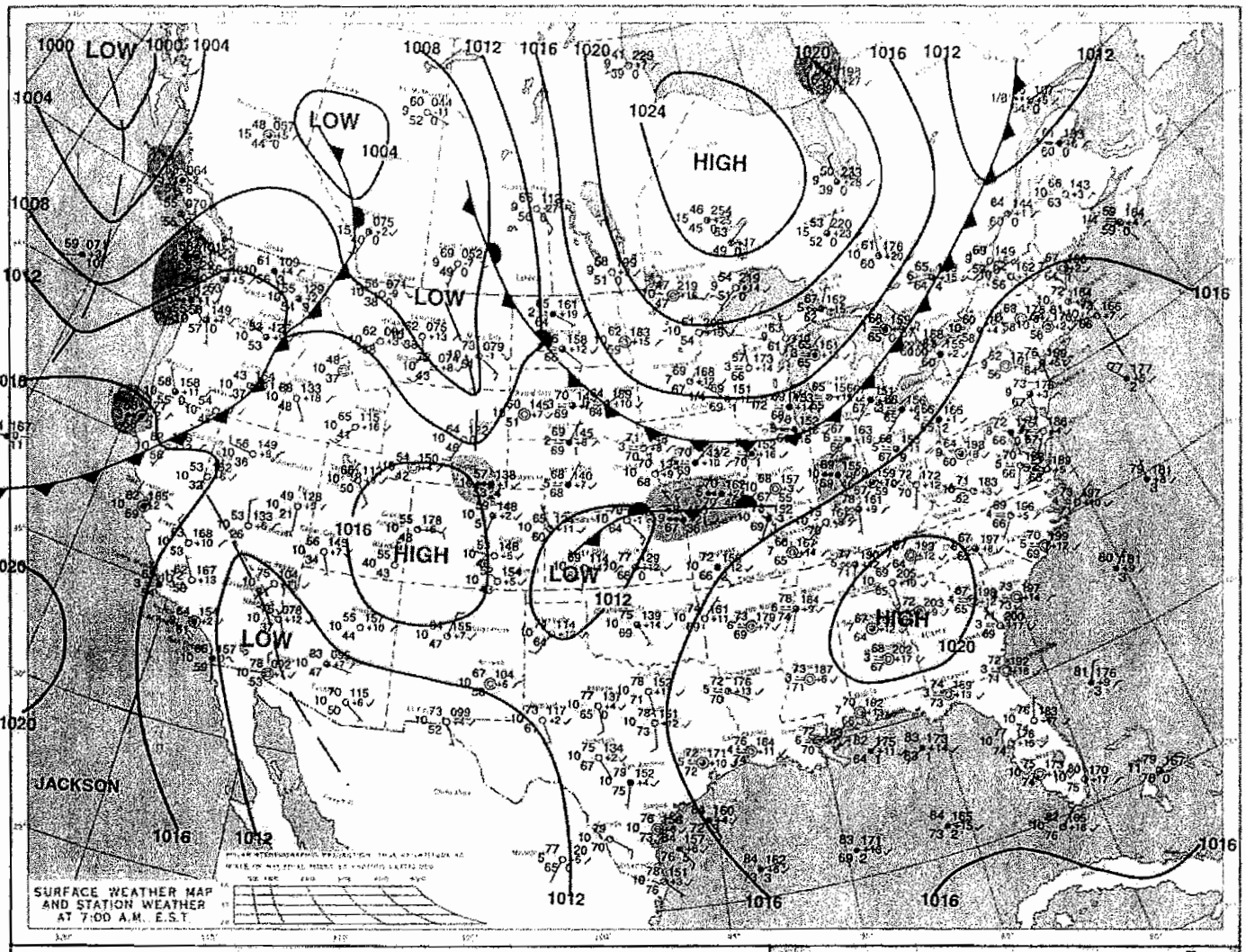


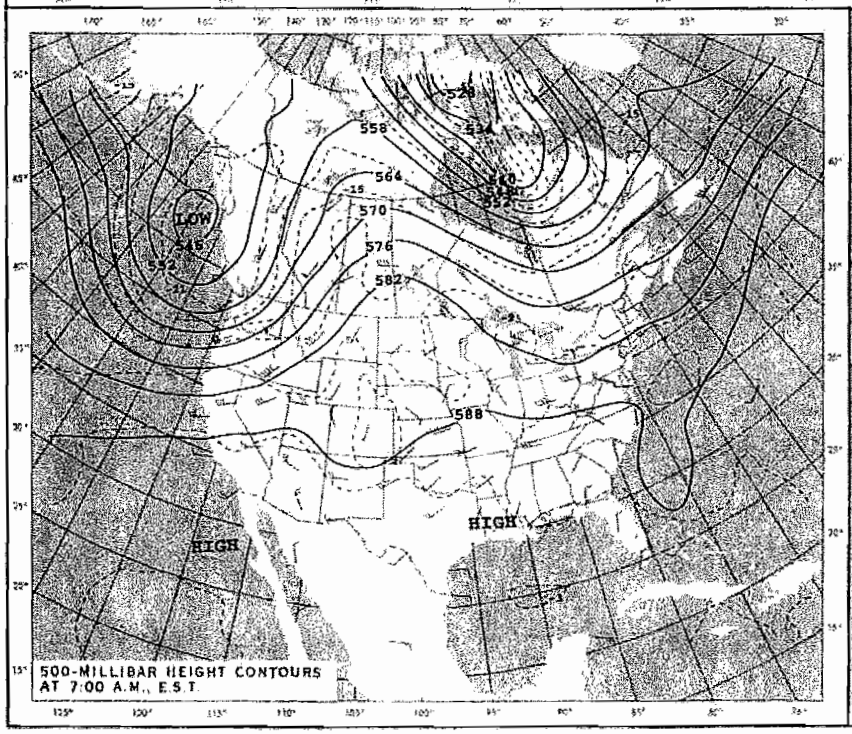
SUNDAY, AUGUST 19, 2001

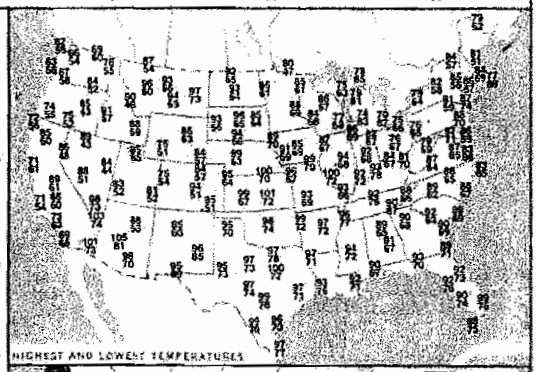


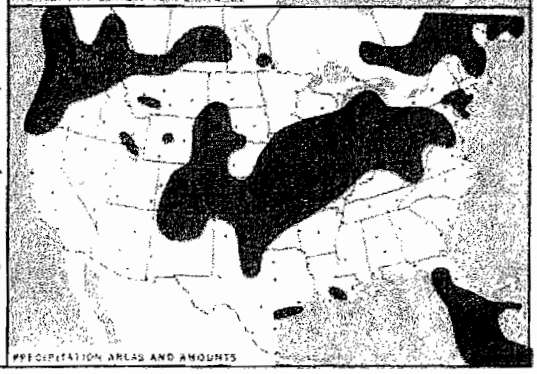




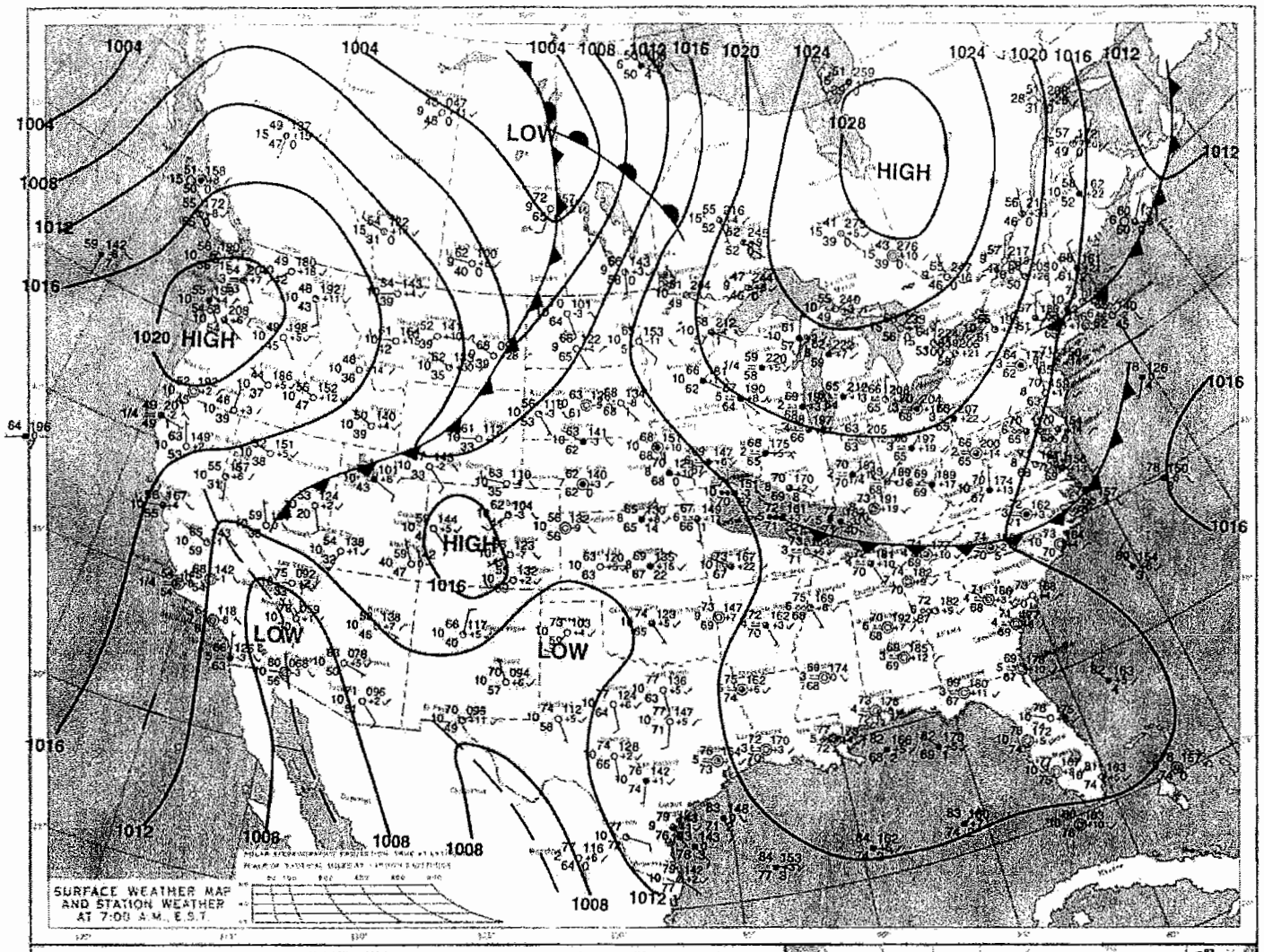

LOW
HIGH
JACKSON
SURFACE WEATHER MAP
AND STATION WEATHER
AT 7:00 A.M., E.S.T.


LOW
HIGH
500-MILLIBAR HEIGHT CONTOURS
AT 7:00 A.M., E.S.T.

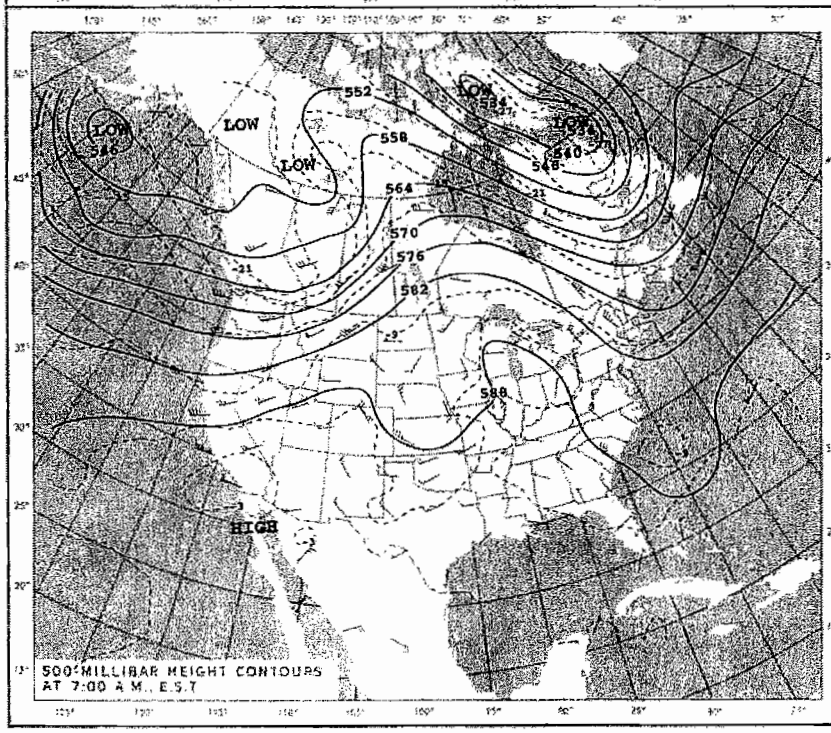

HIGHEST AND LOWEST TEMPERATURES


PRECIPITATION AREAS AND AMOUNTS

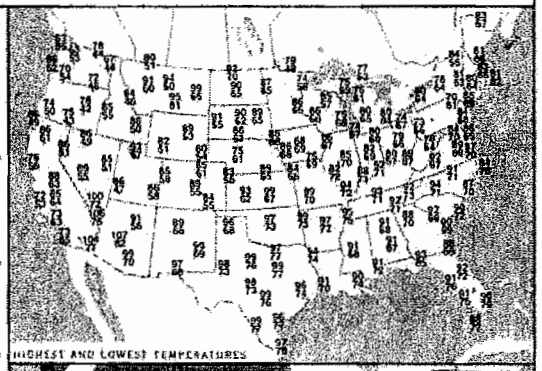
FRIDAY, AUGUST 24, 2001



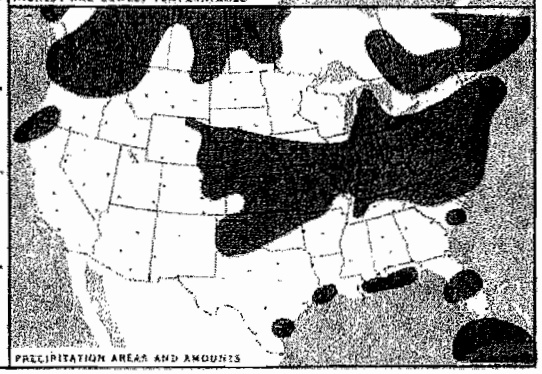
SURFACE WEATHER MAP AND STATION WEATHER AT 7:00 A.M., E.S.T.



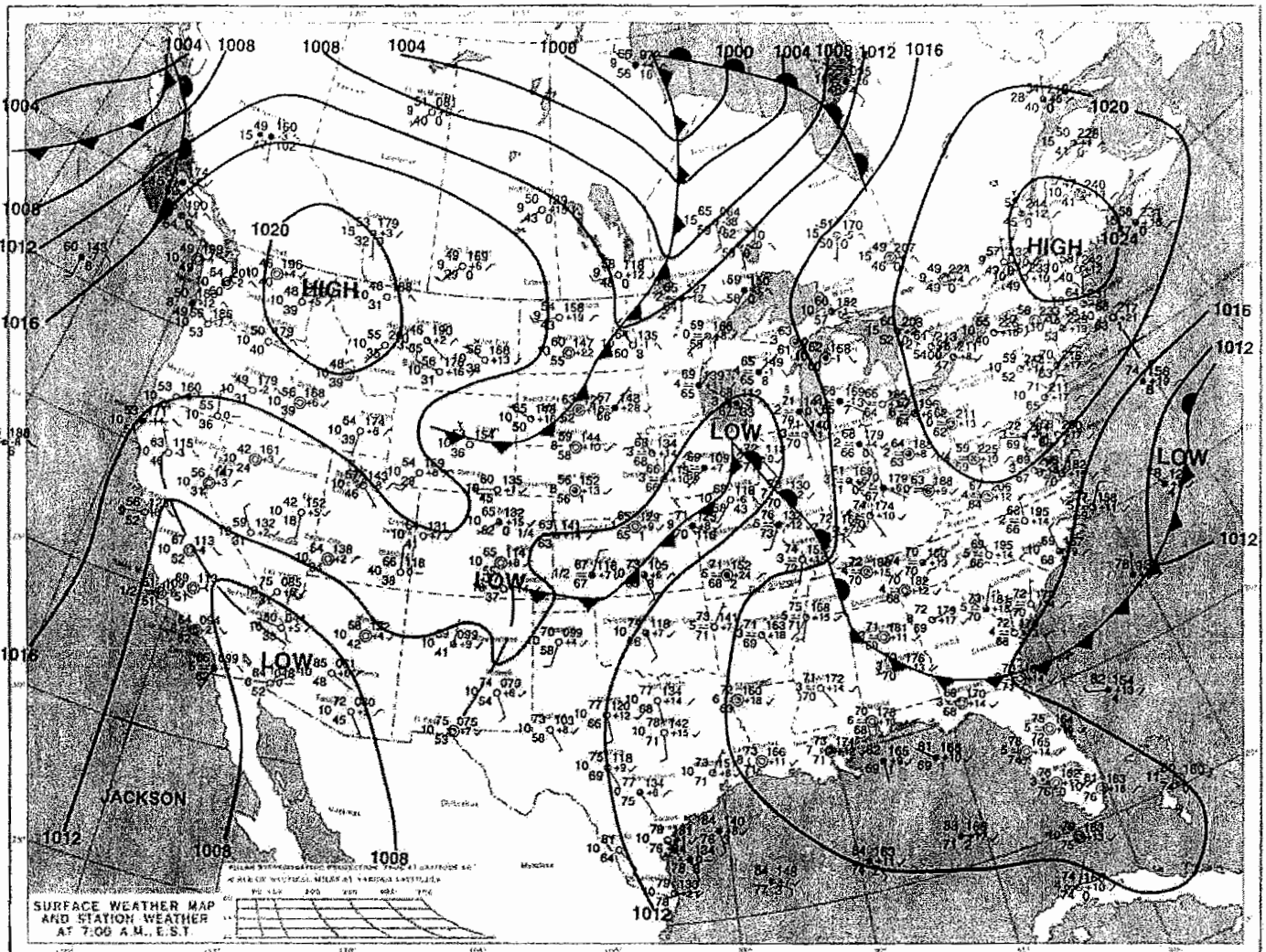
500 MILLIBAR HEIGHT CONTOURS AT 7:00 A.M., E.S.T.



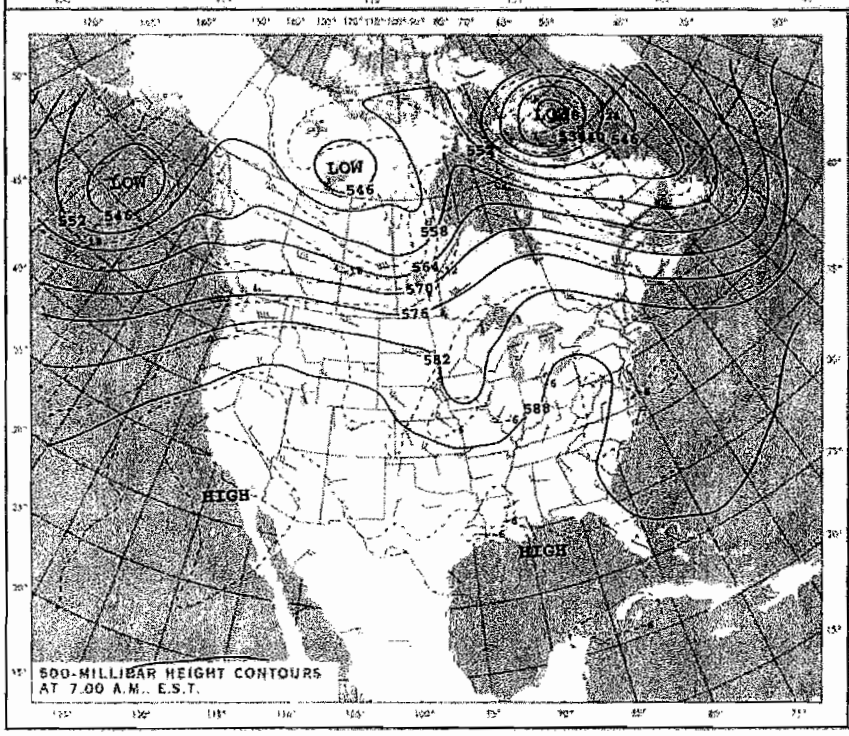
HIGHEST AND LOWEST TEMPERATURES



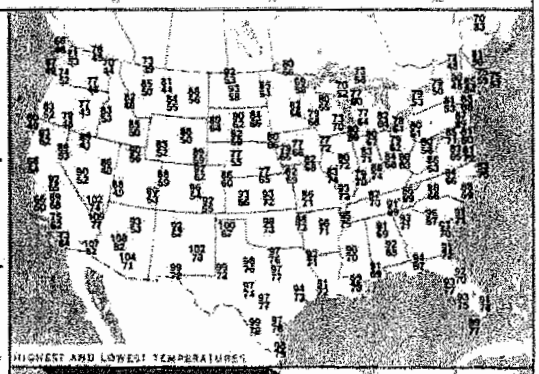
PRECIPITATION AREAS AND AMOUNTS



SURFACE WEATHER MAP AND STATION WEATHER AT 7:00 A.M., E.S.T.



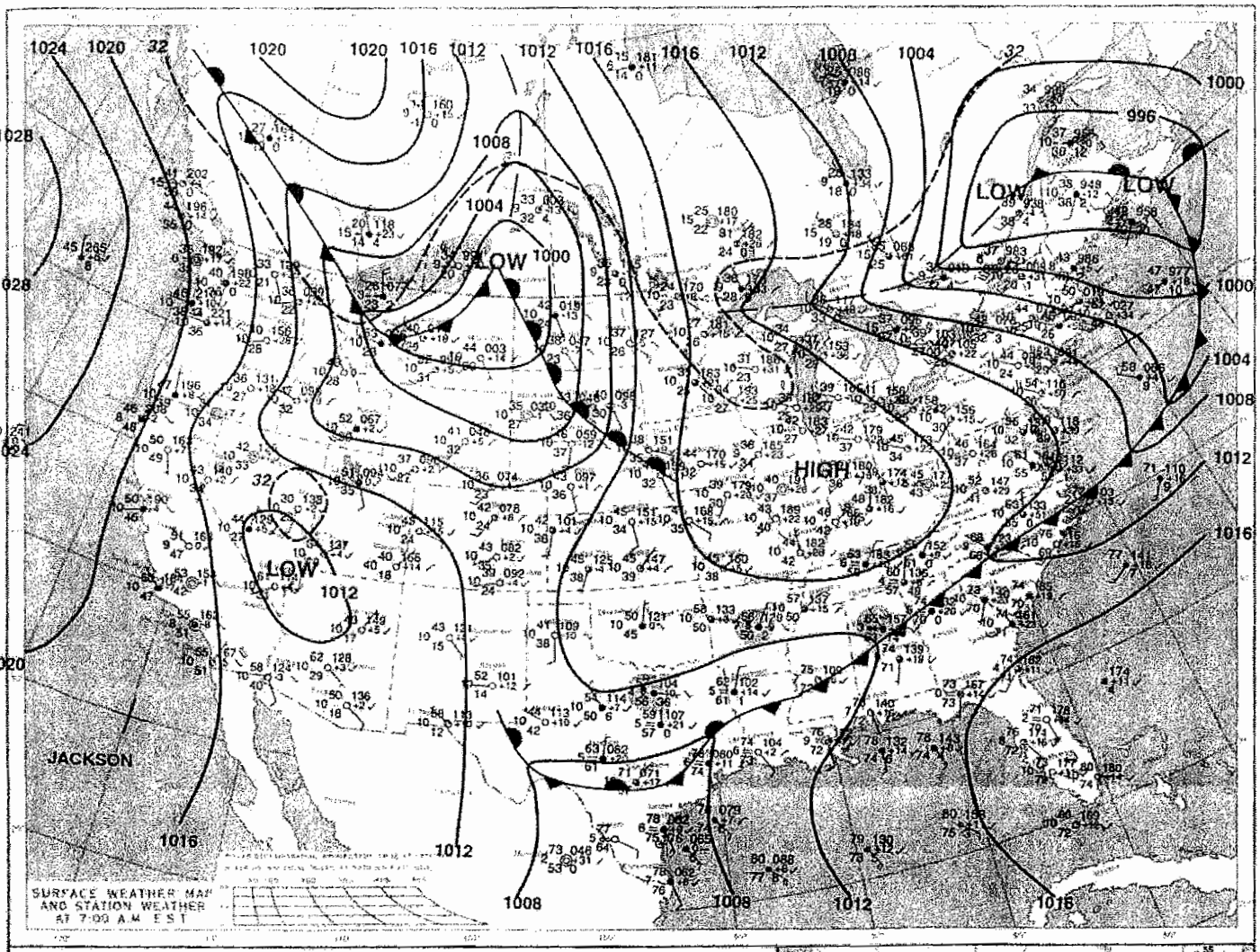
500-MILLIBAR HEIGHT CONTOURS AT 7:00 A.M., E.S.T.

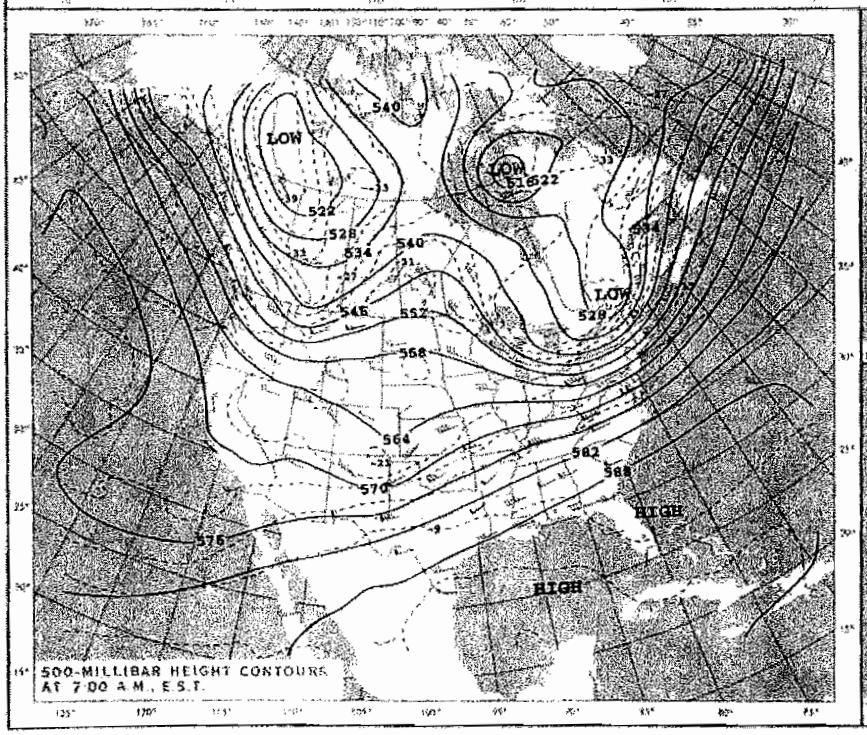


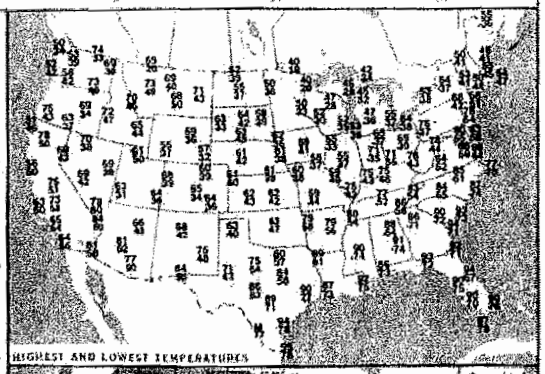
HIGHEST AND LOWEST TEMPERATURES

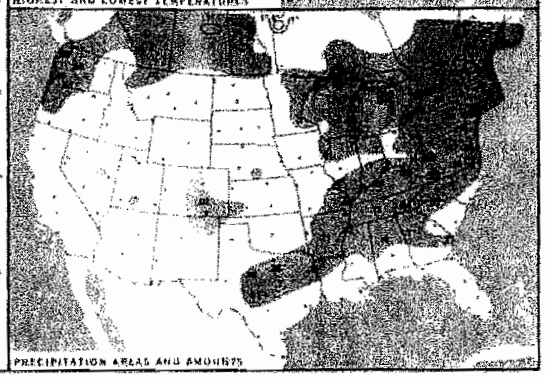
PRECIPITATION AREAS AND AMOUNTS

FRIDAY, MAY 3, 2002

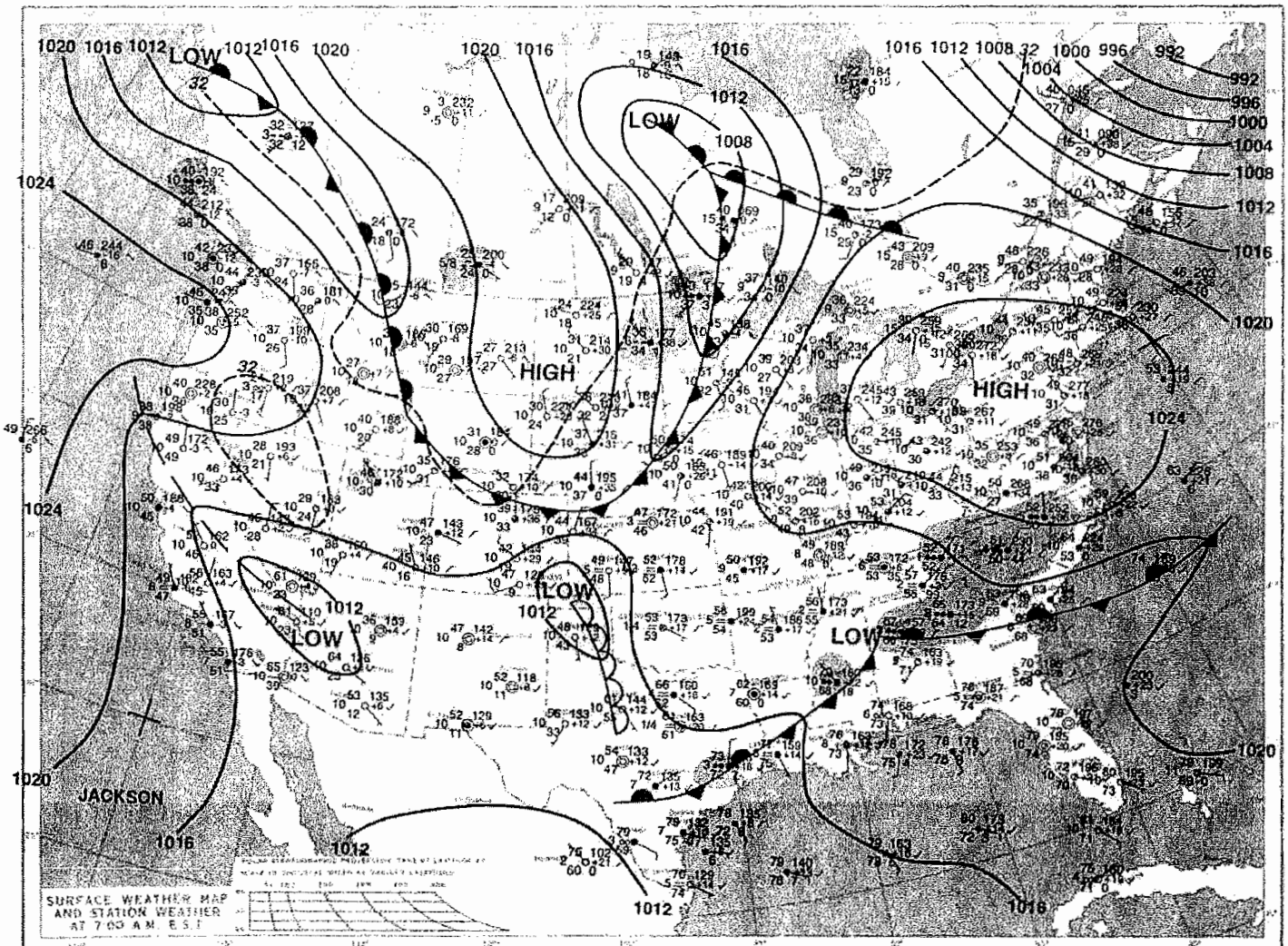


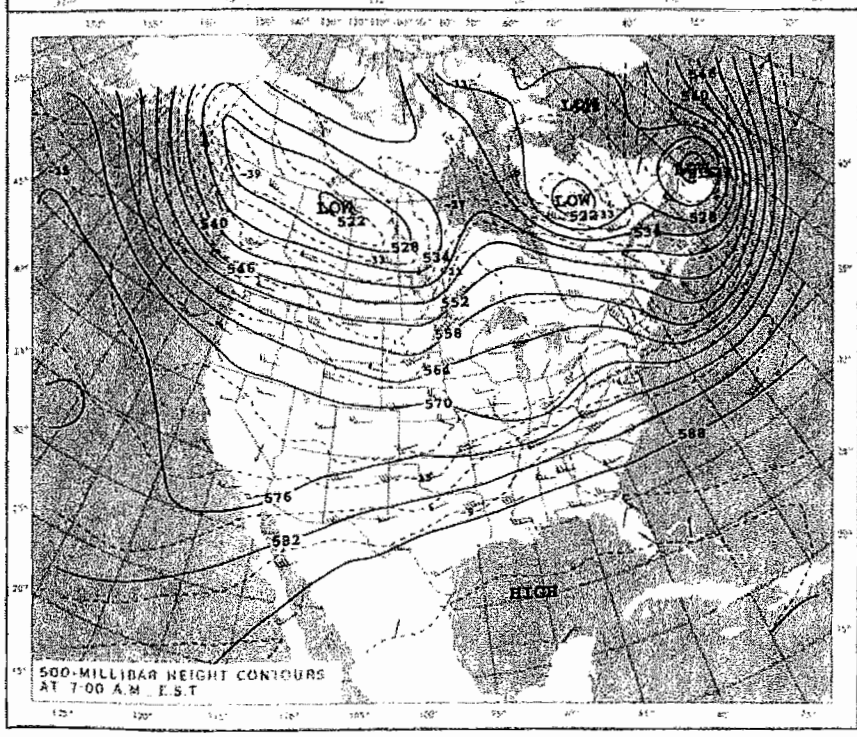


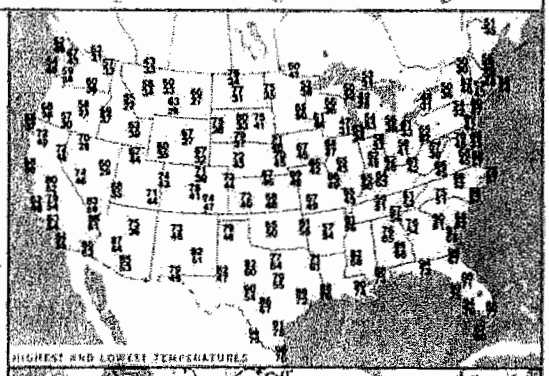


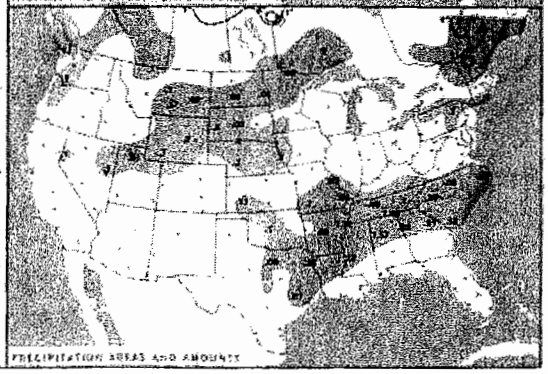


SATURDAY, MAY 4, 2002

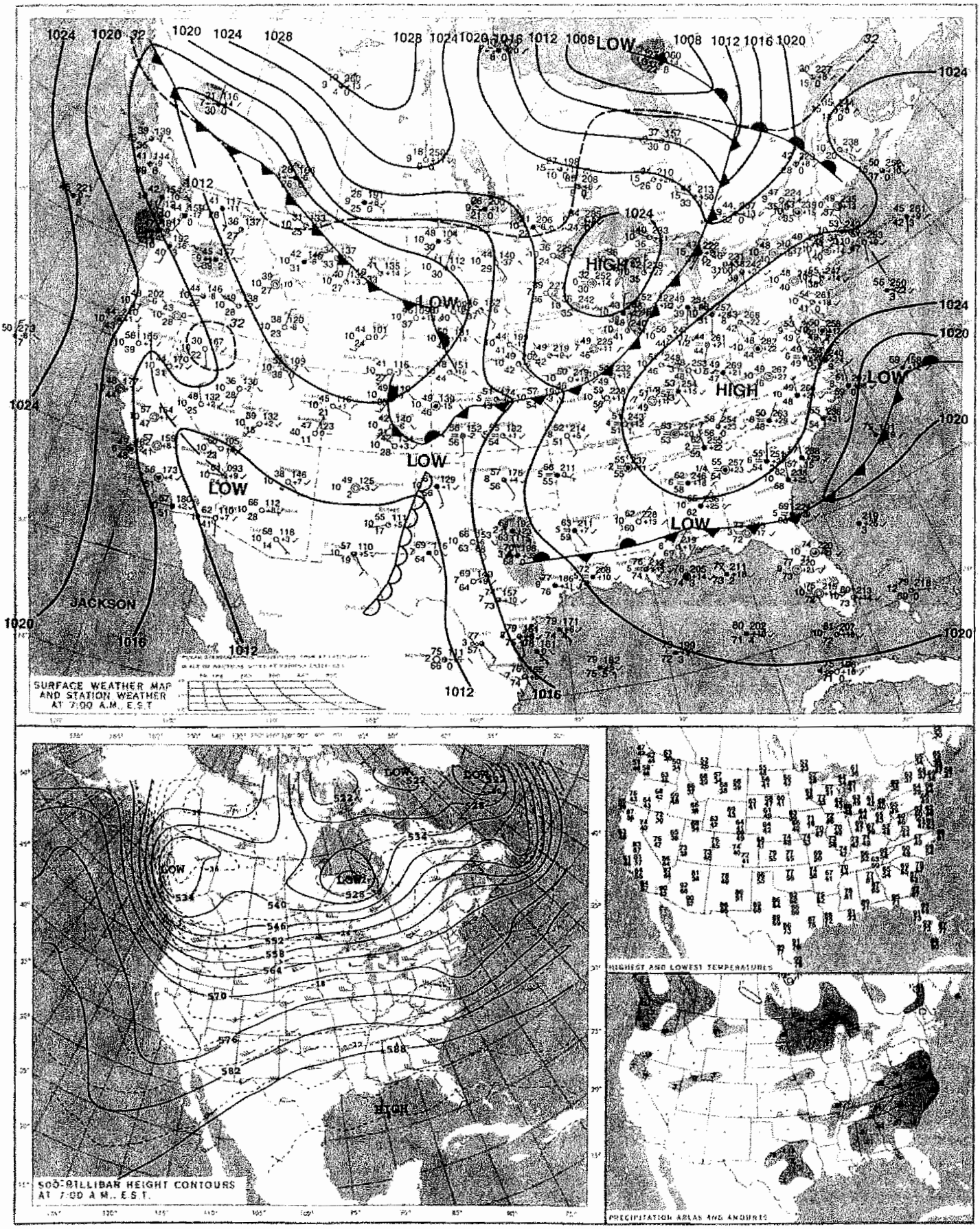




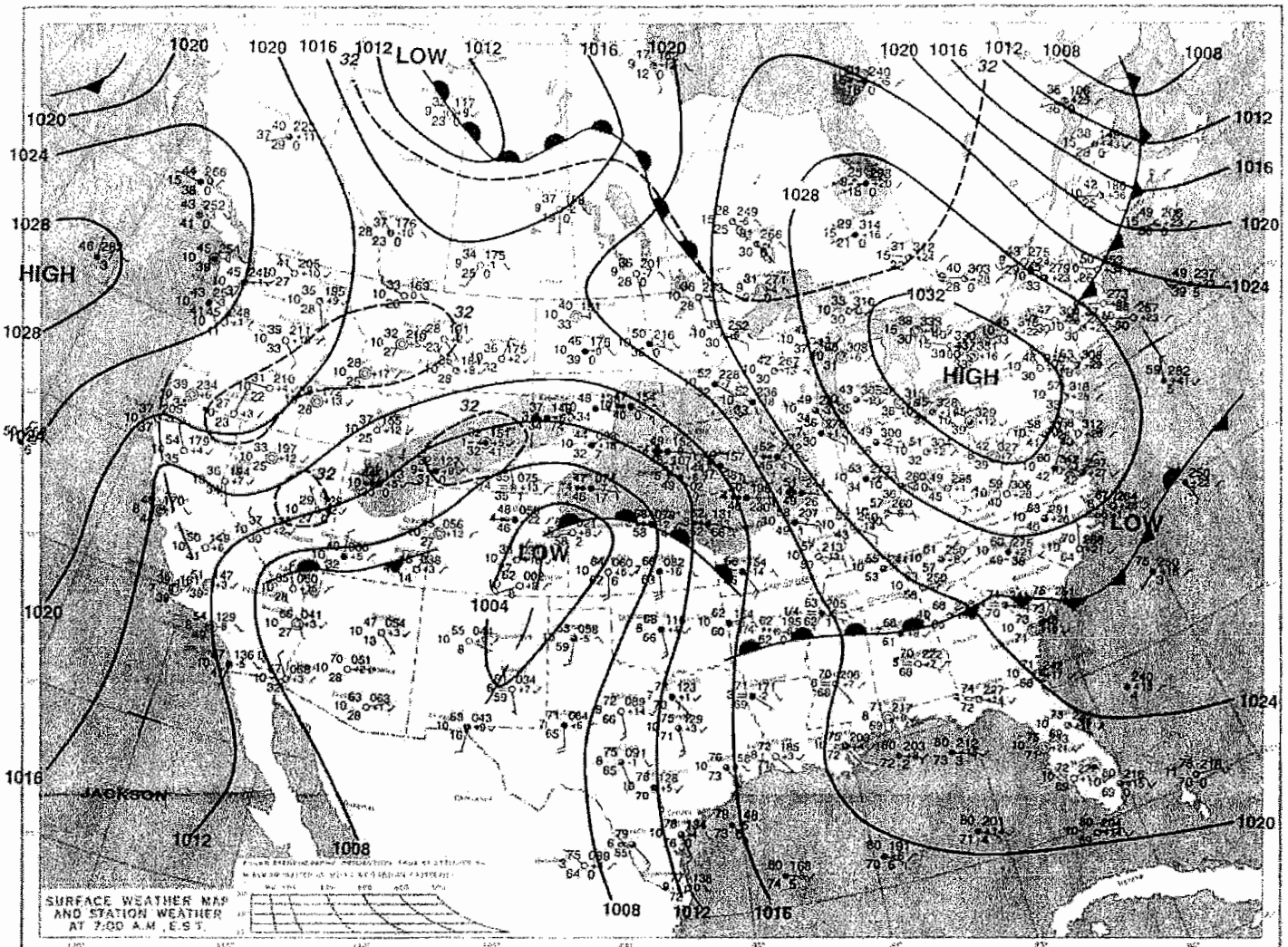


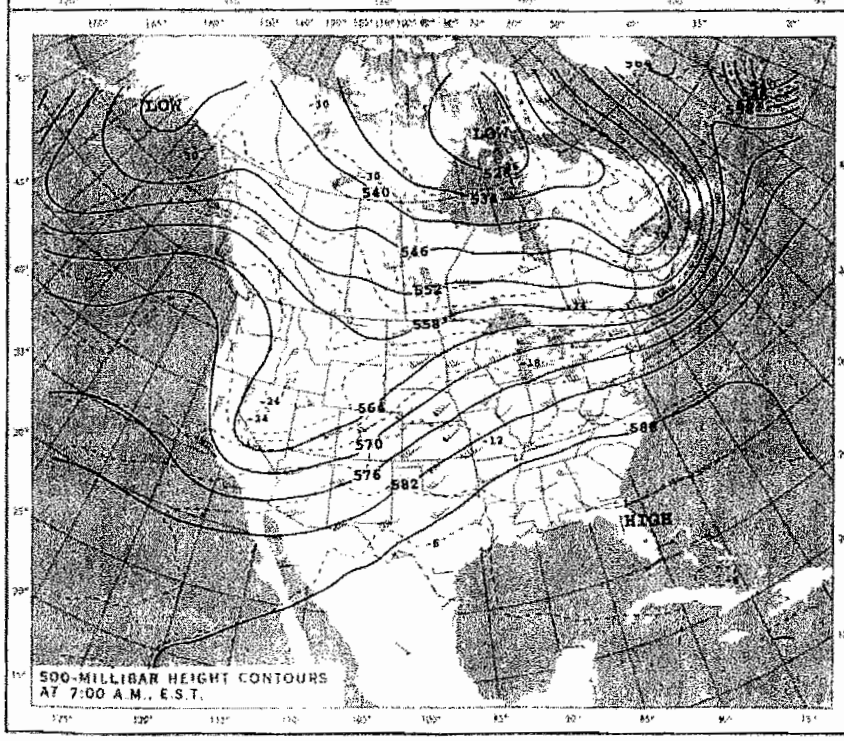


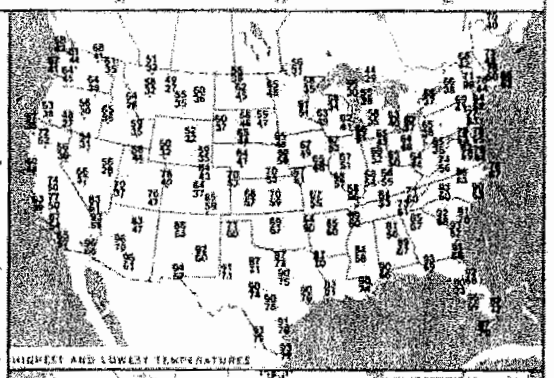
SUNDAY, MAY 5, 2002

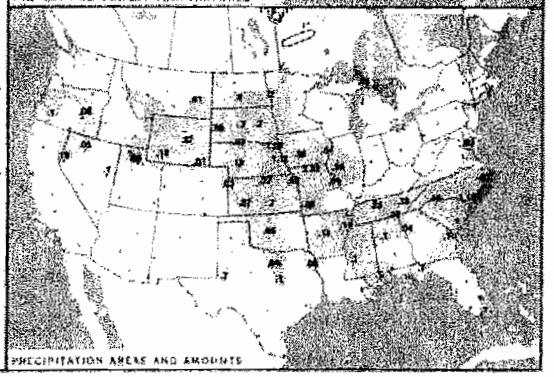


SATURDAY, MAY 11, 2002

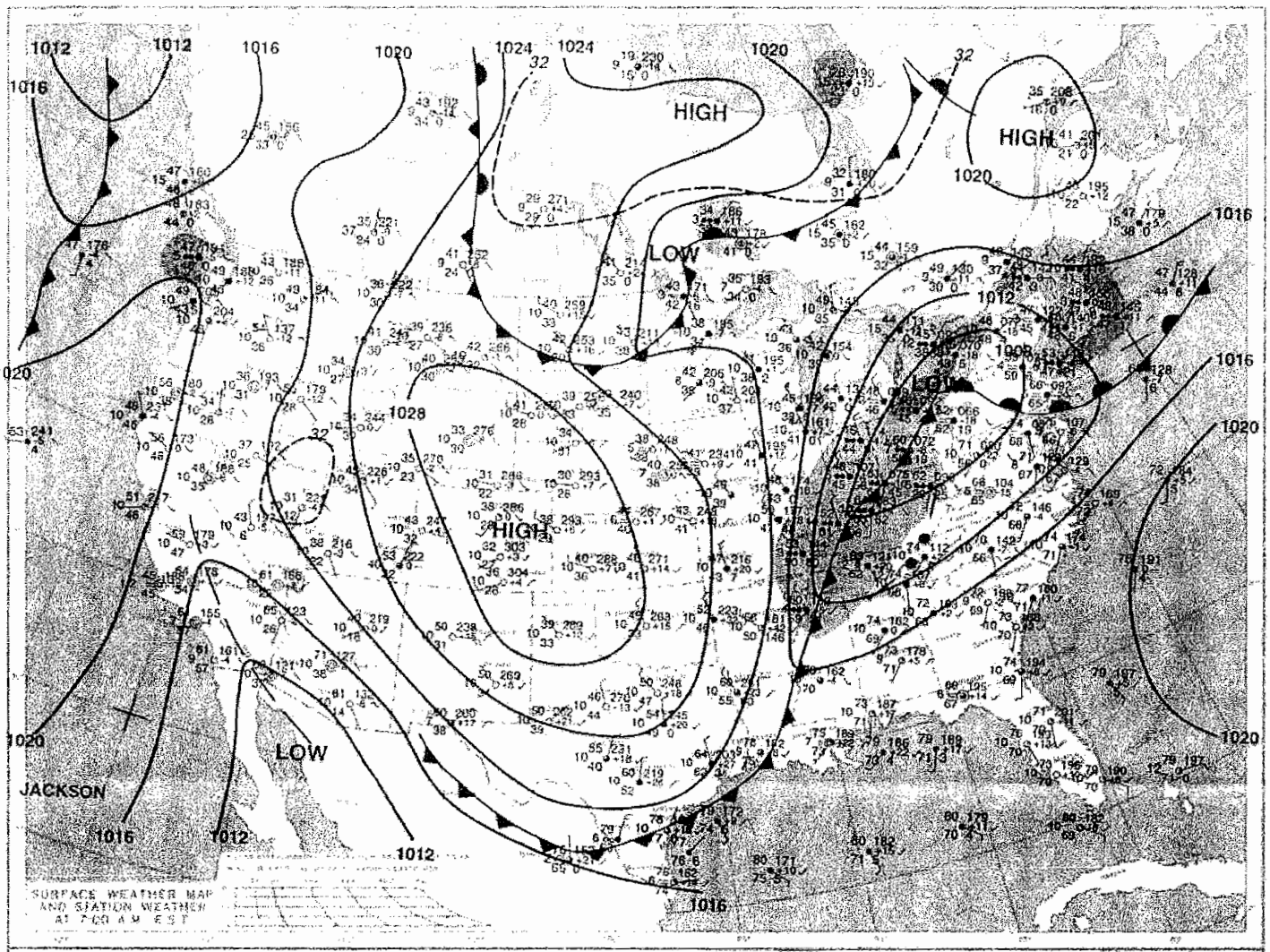


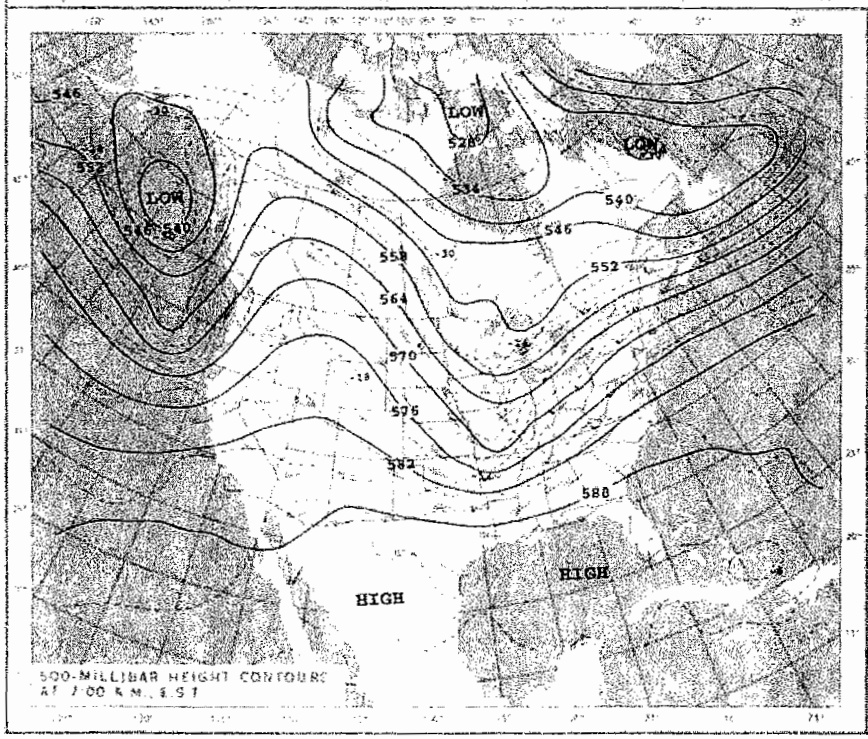


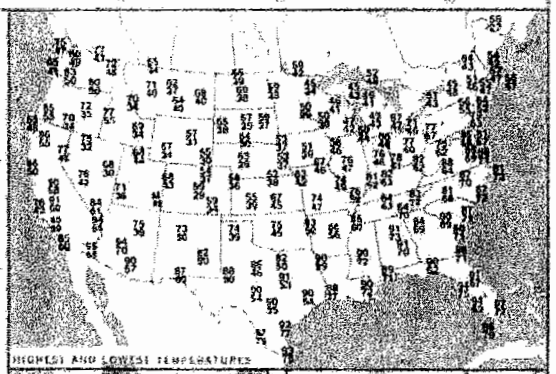


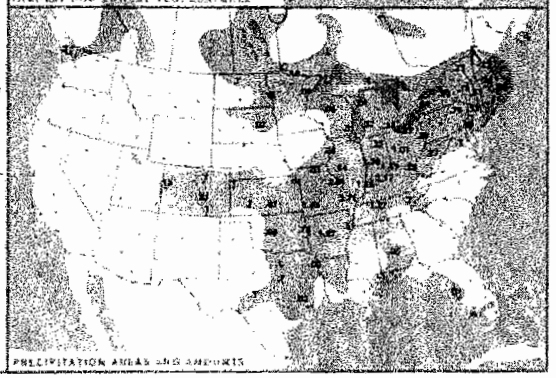


MONDAY, MAY 13, 2002

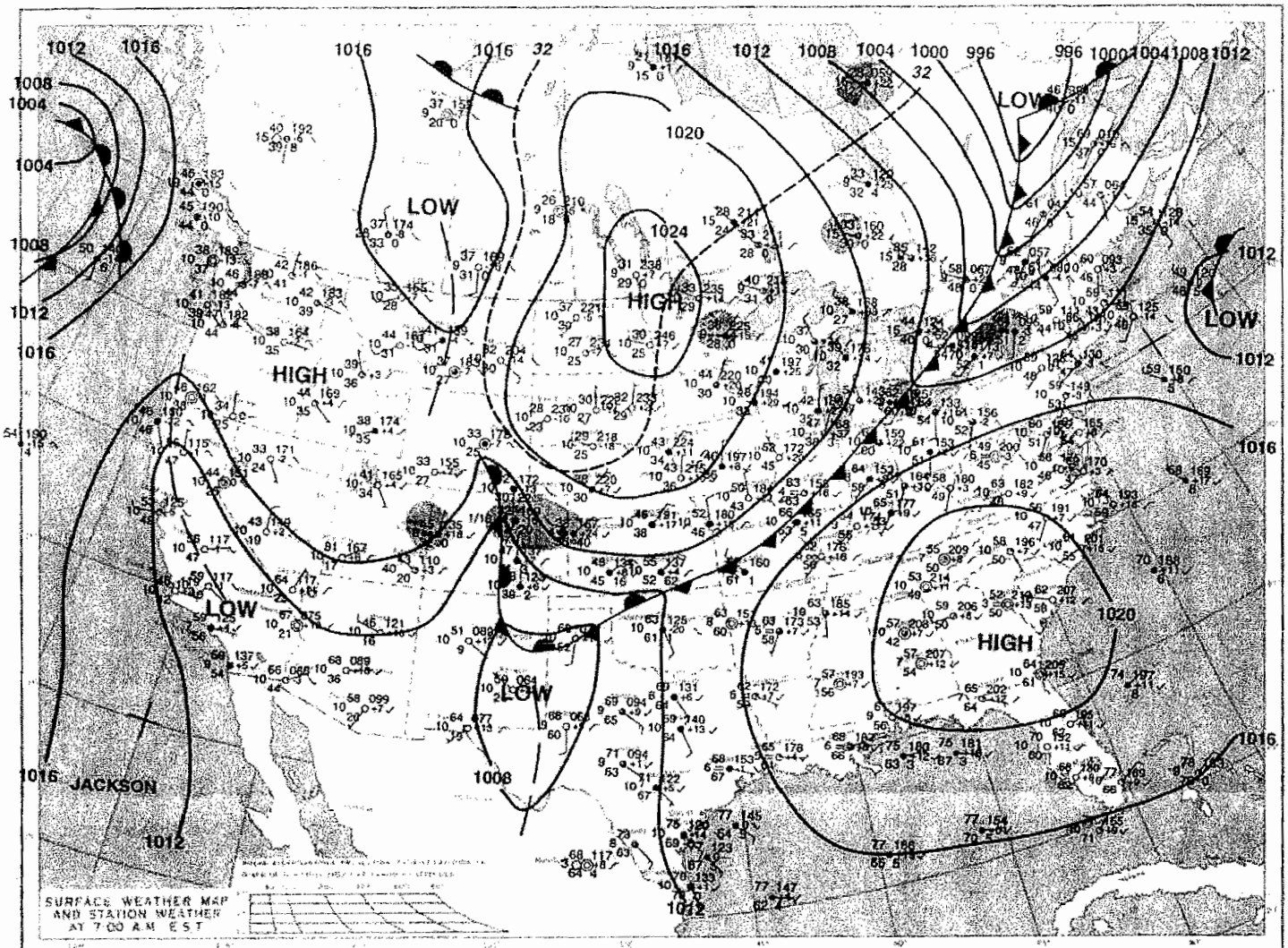


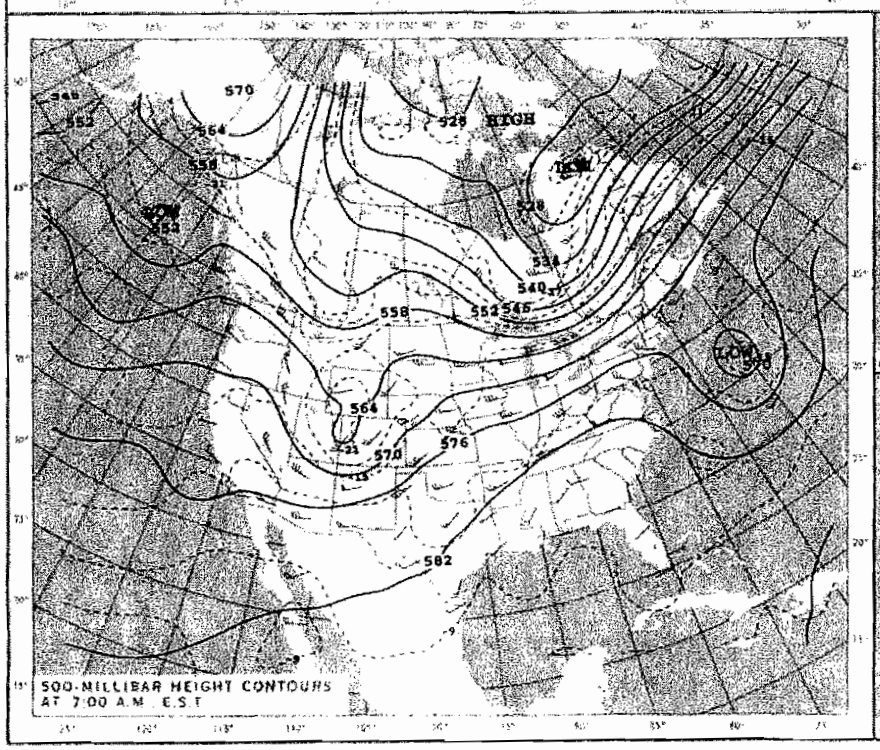


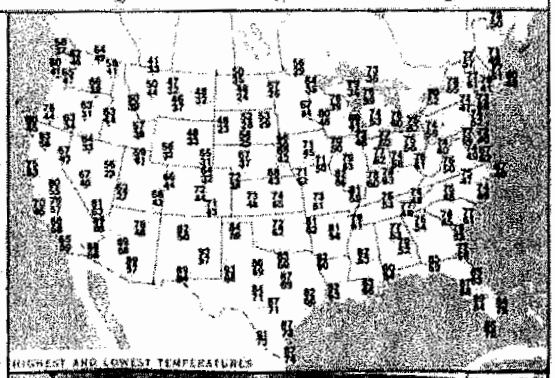




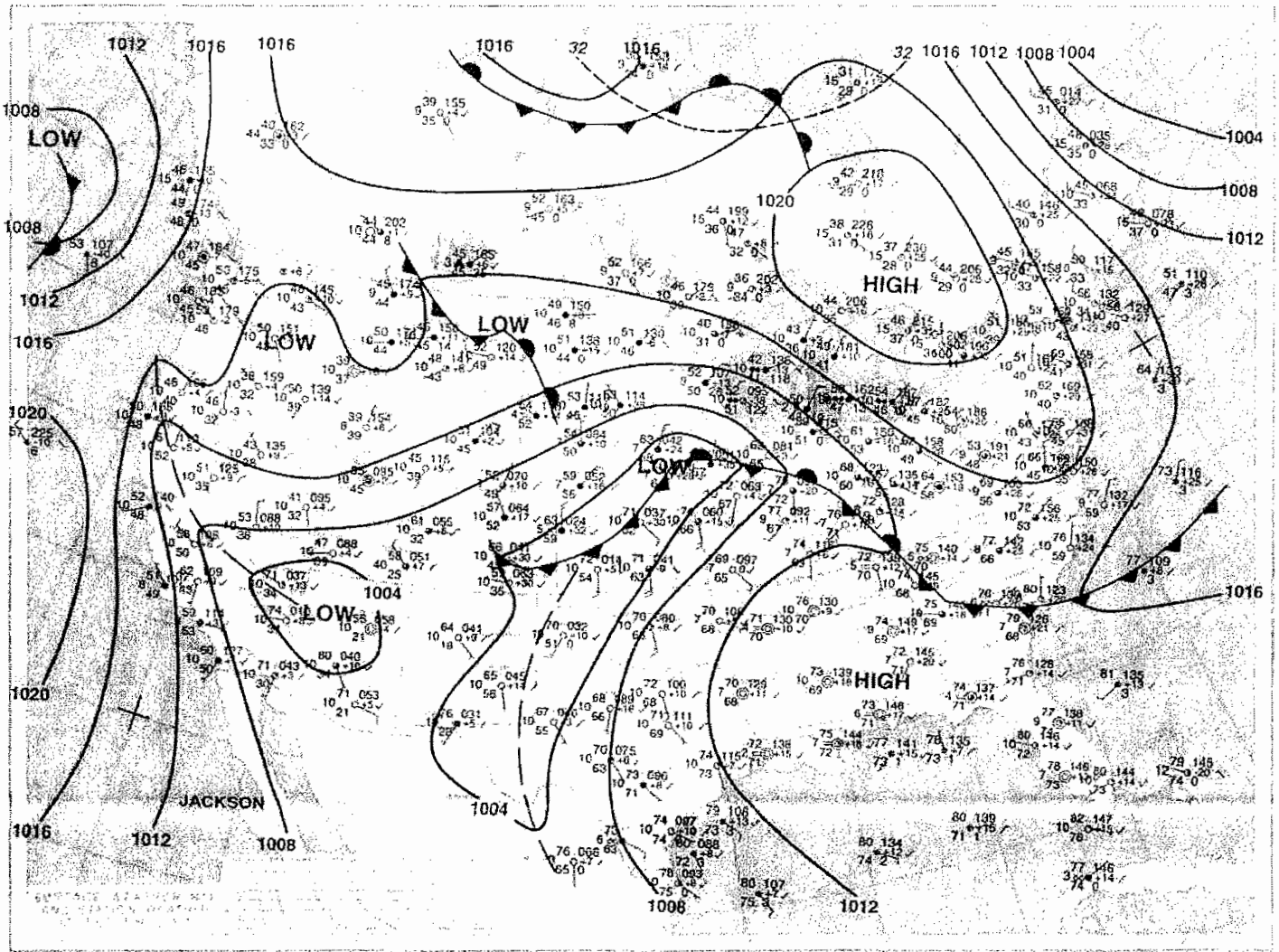
FRIDAY, MAY 24, 2002

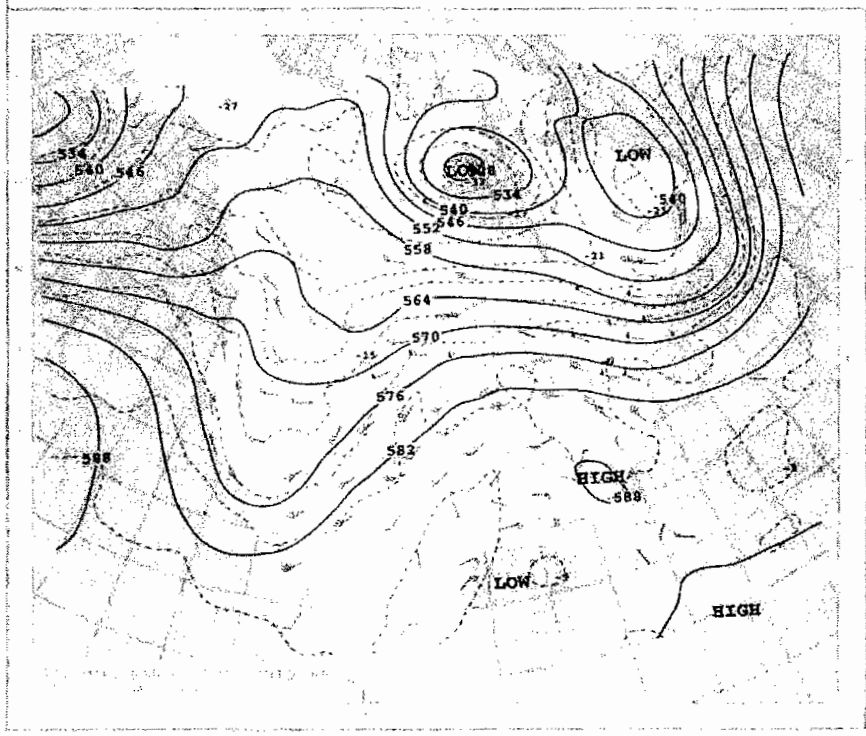


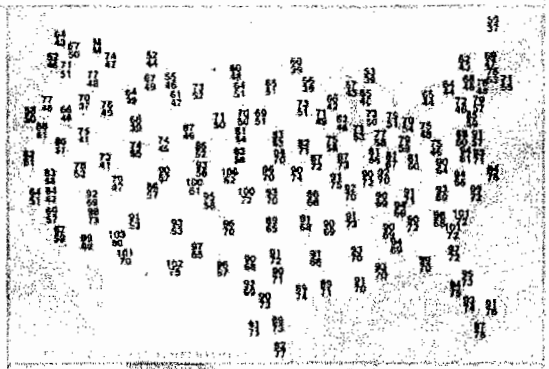


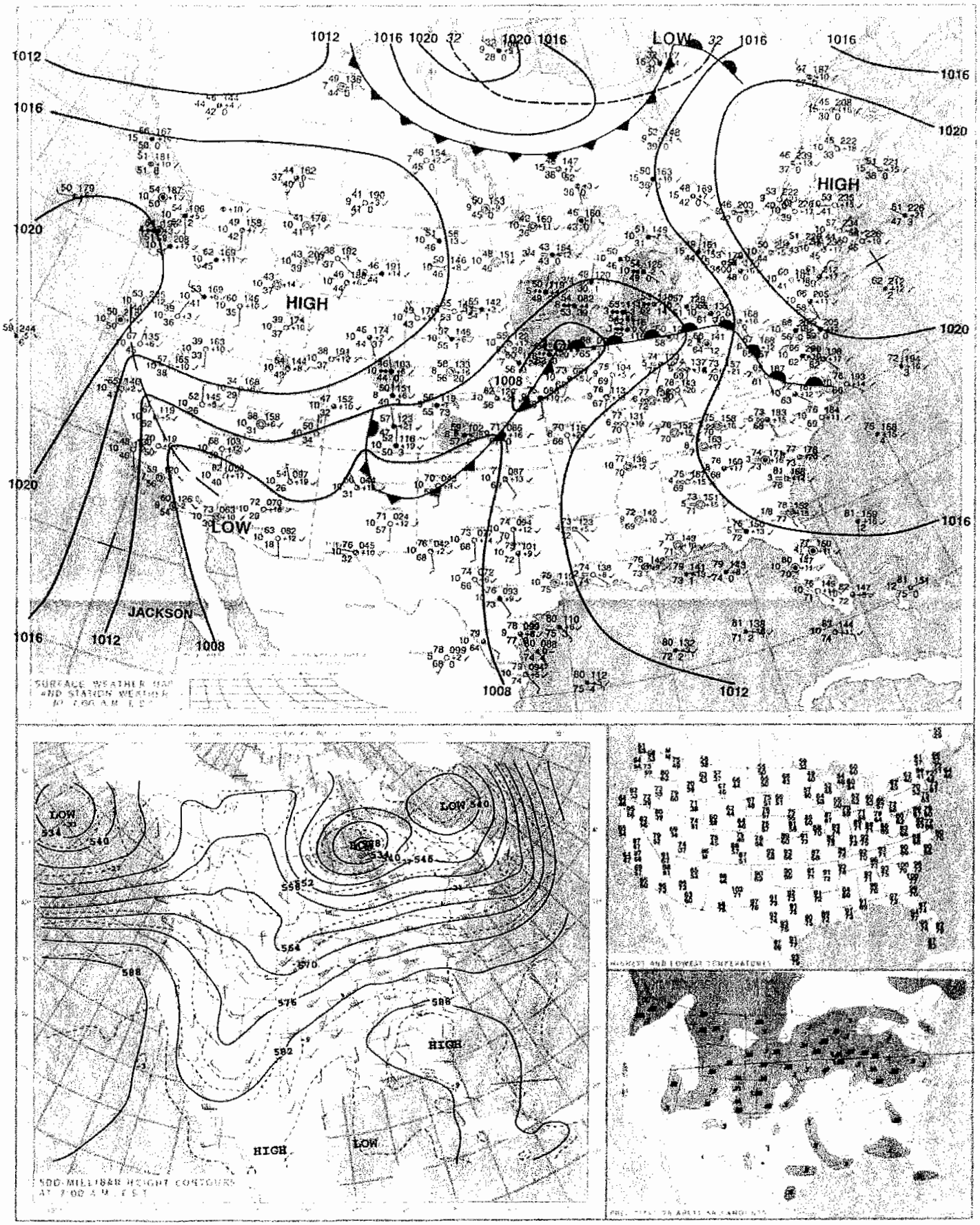


MONDAY, JUNE 3, 2002

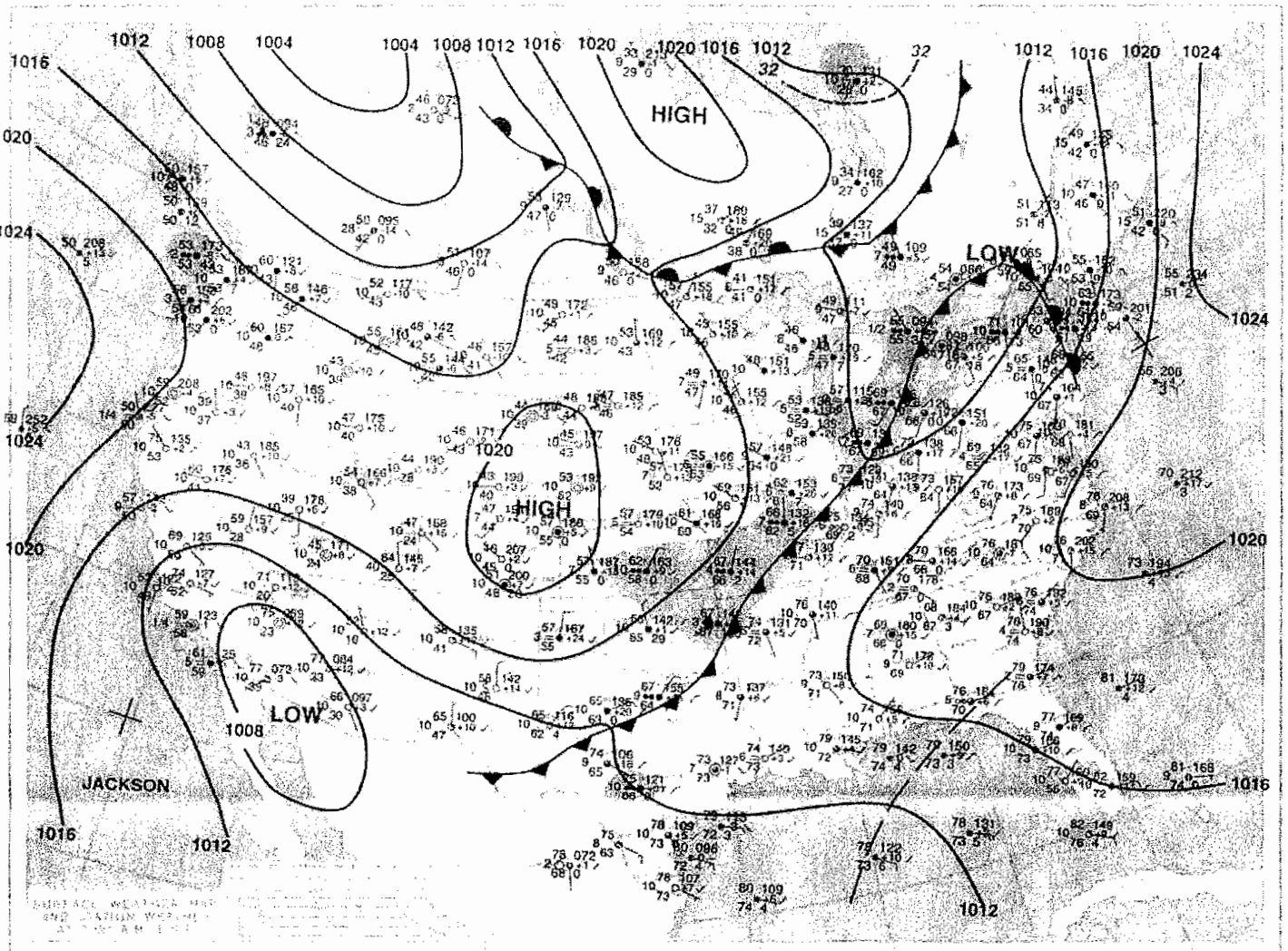


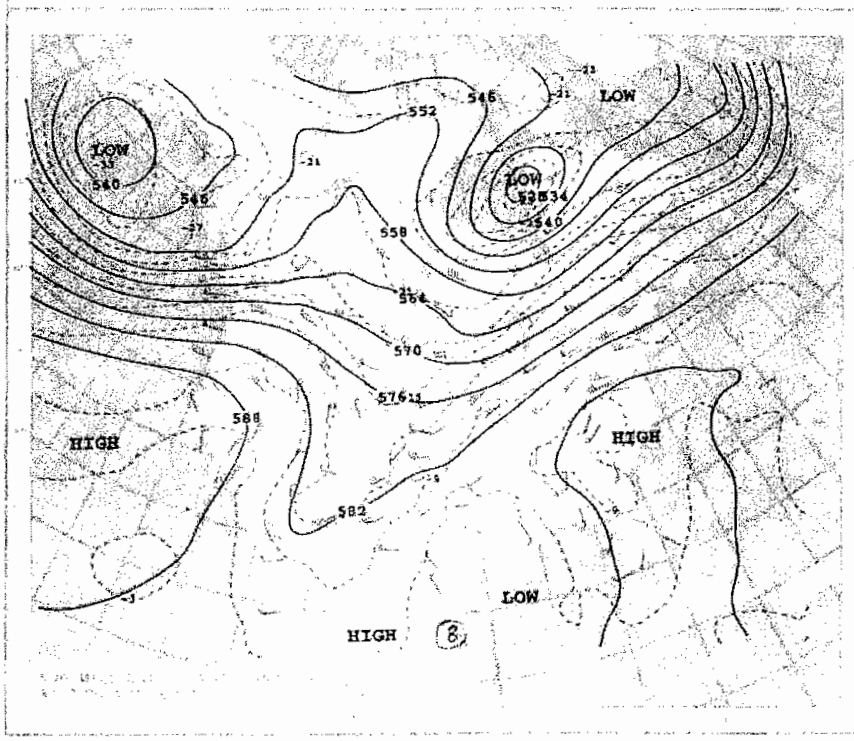


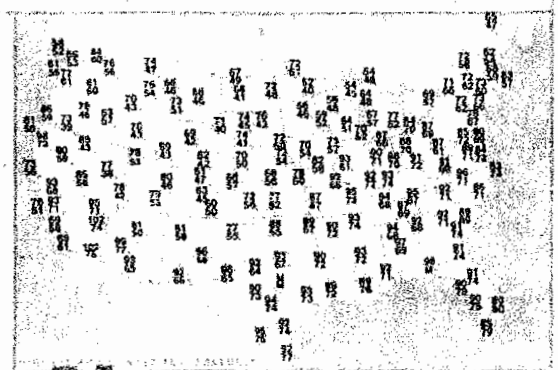


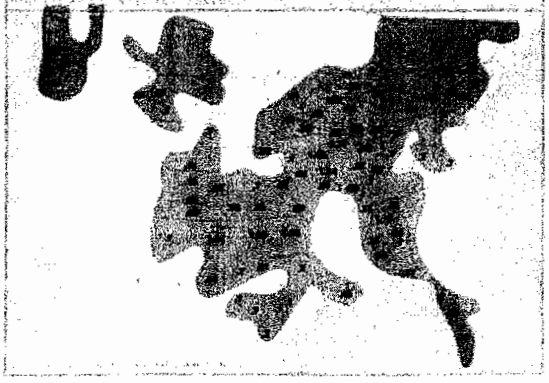

LOW
HIGH
JACKSON
1012
1016
1020
1008
LOW 540
HIGH
LOW
500-MILLIBAR HEIGHT CONTOURS

WEDNESDAY, JUNE 5, 2002

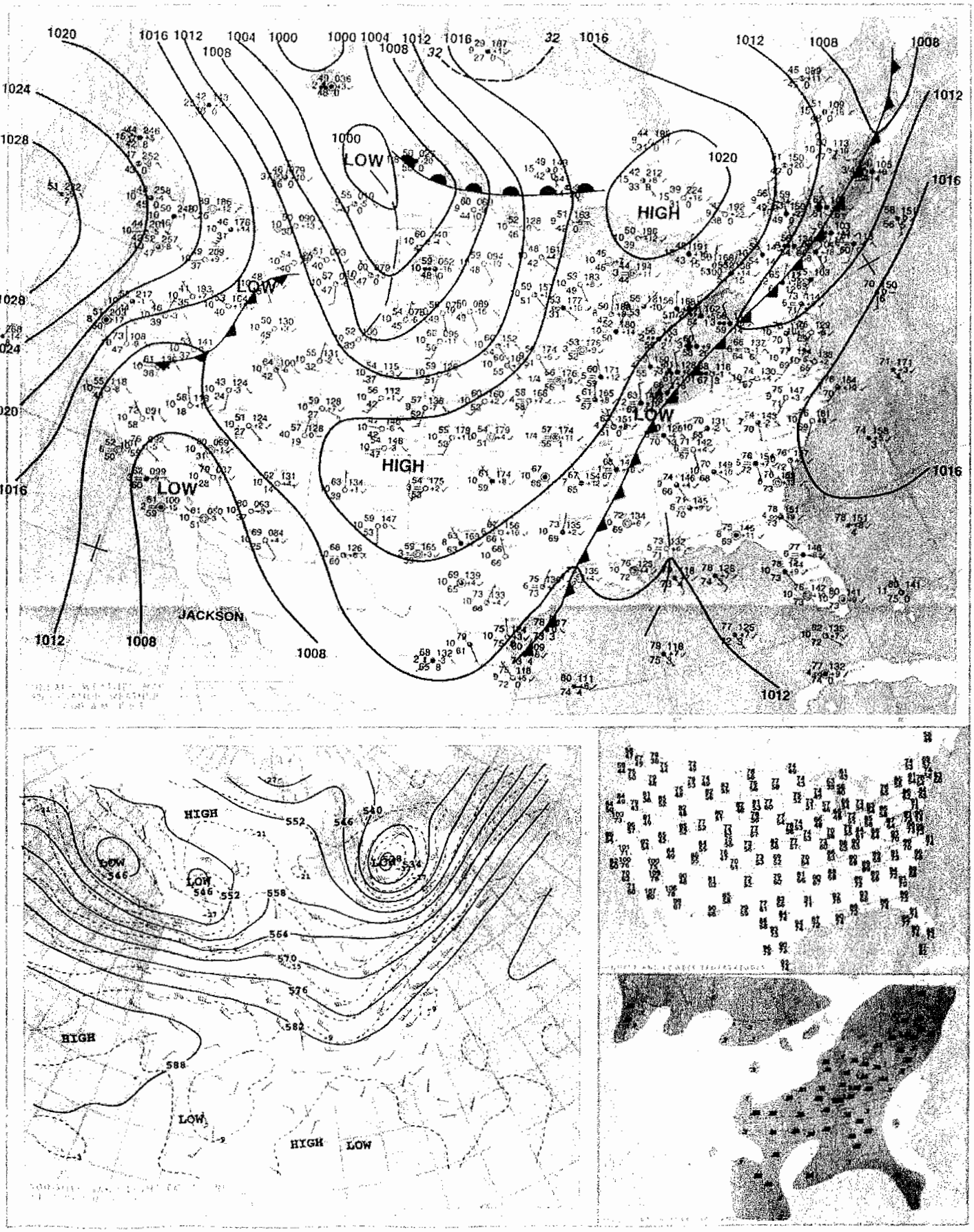




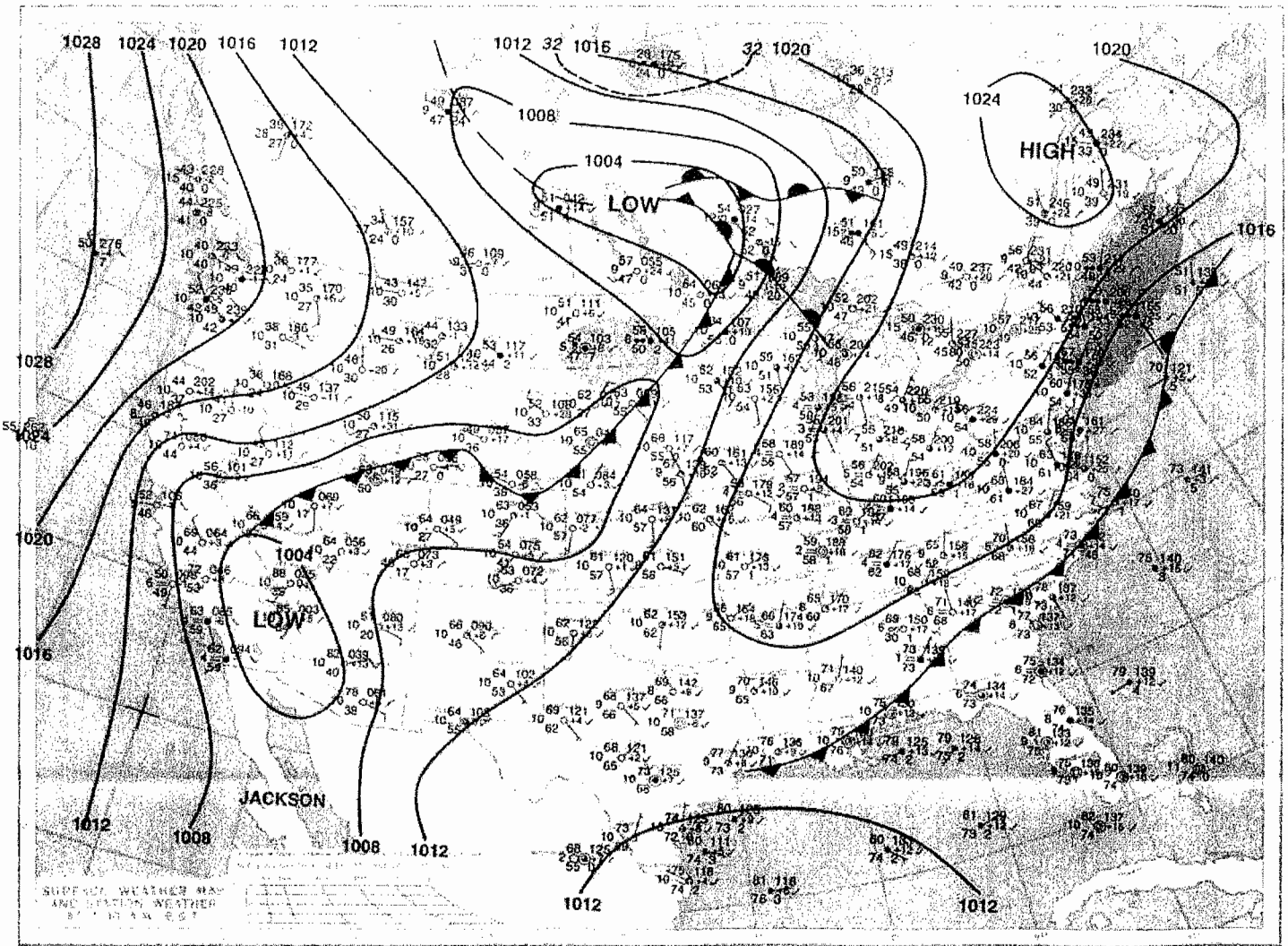


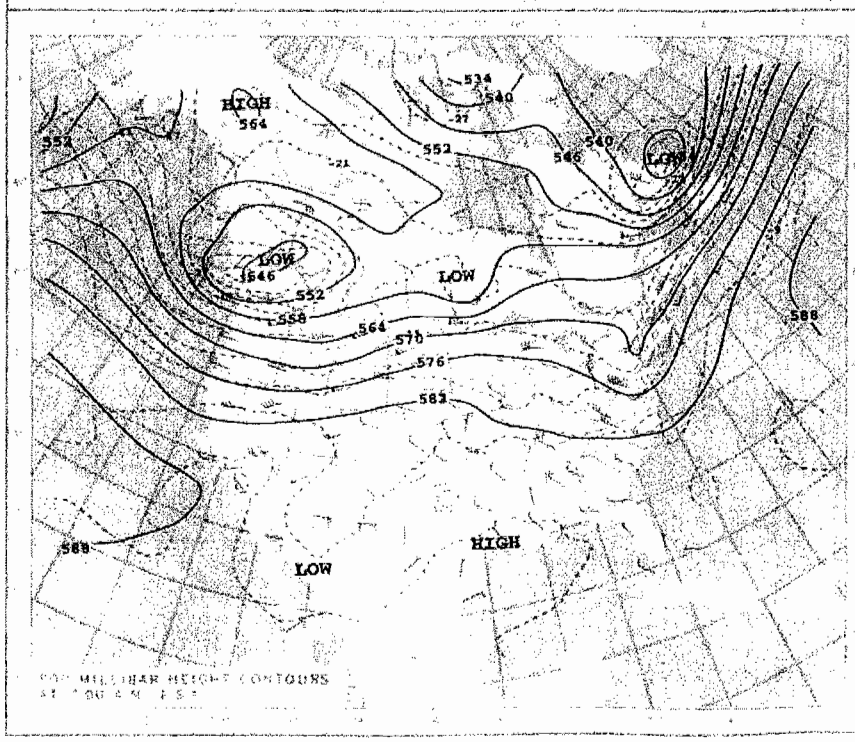


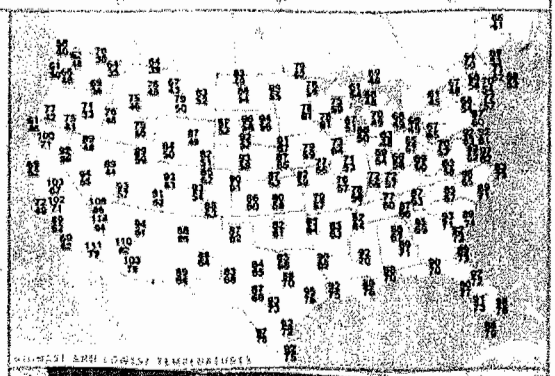
THURSDAY, JUNE 6, 2002



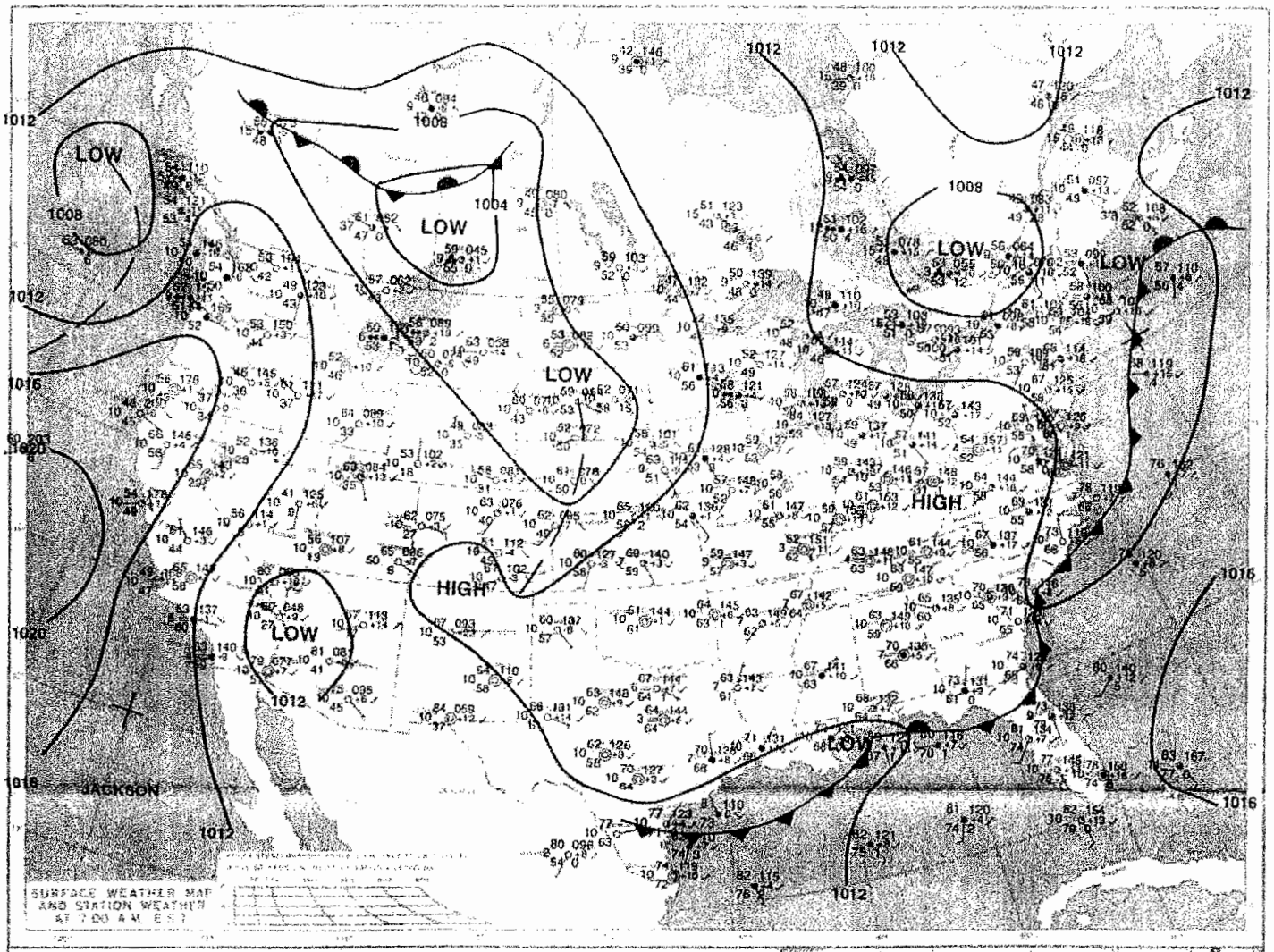
FRIDAY, JUNE 7, 2002

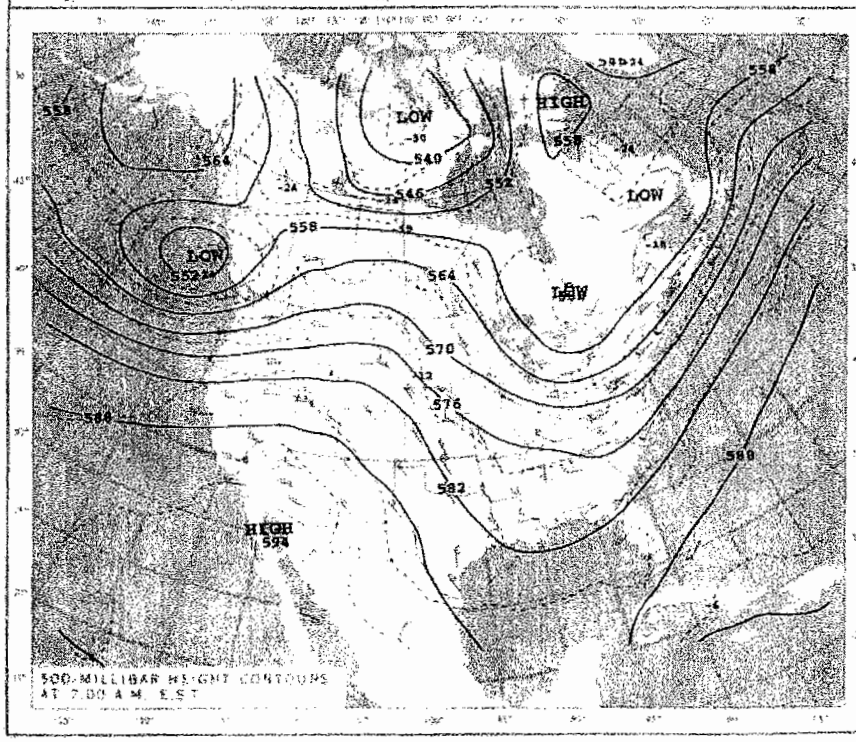


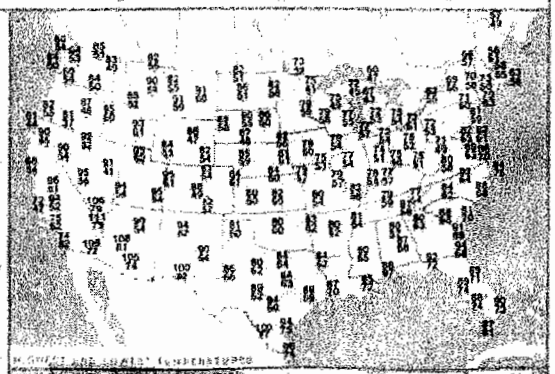


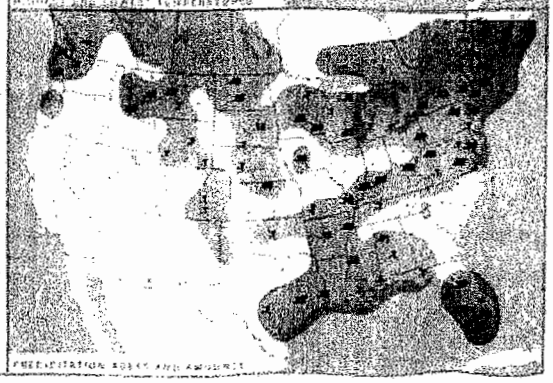


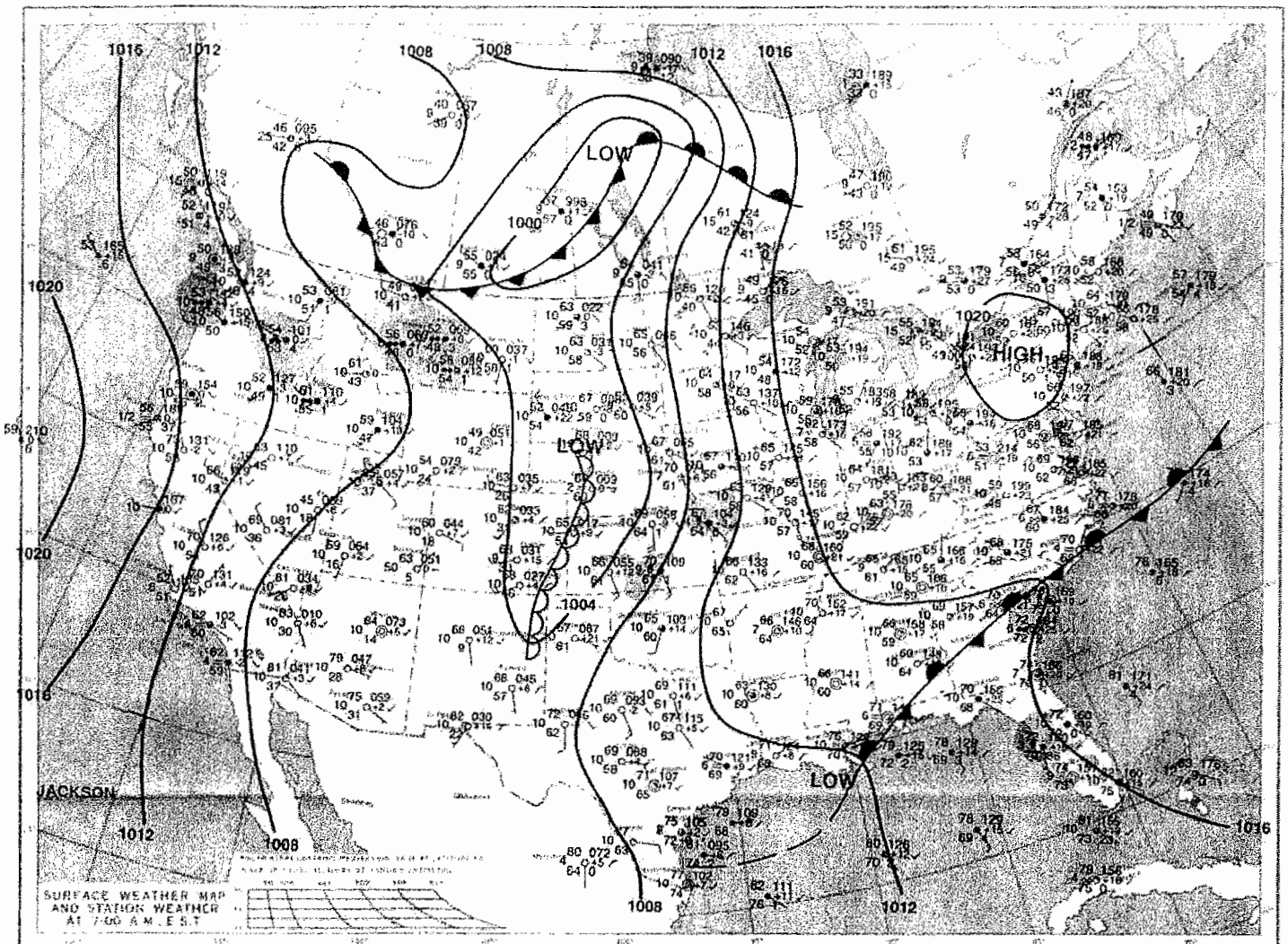
MONDAY, JUNE 17, 2002

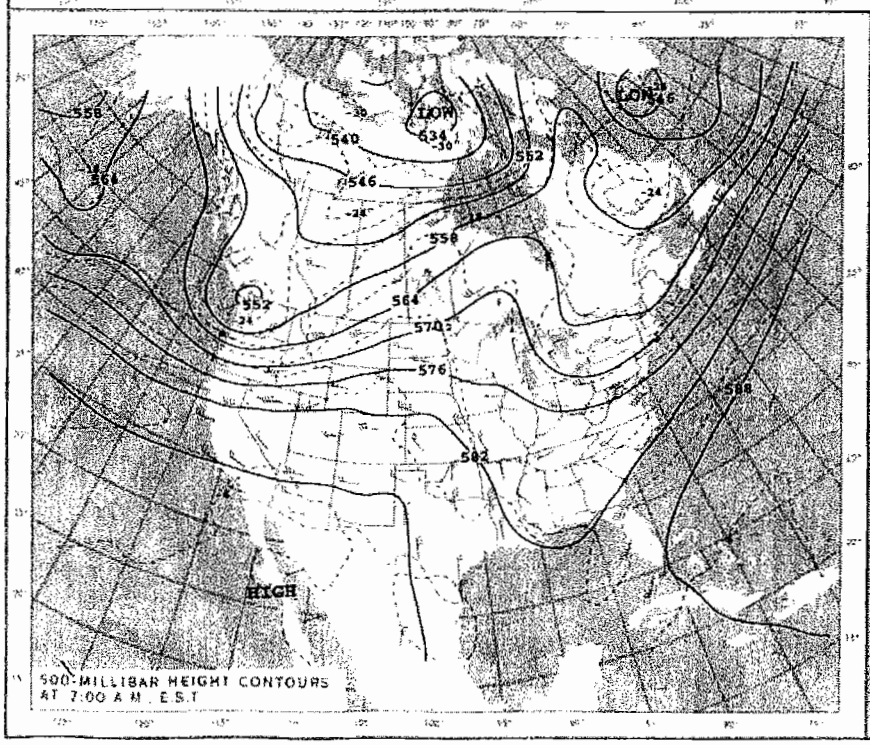


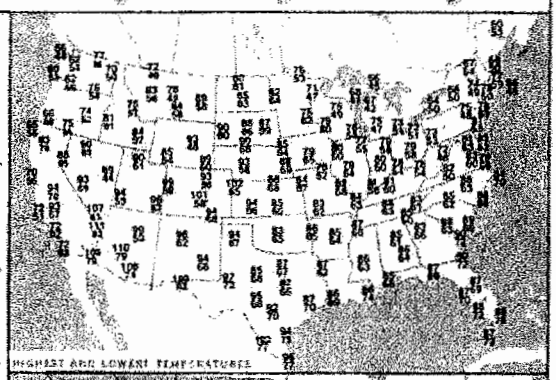


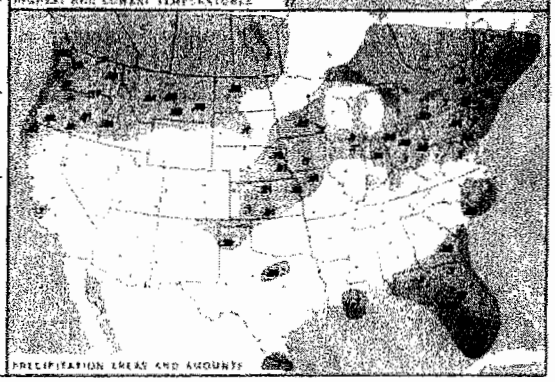




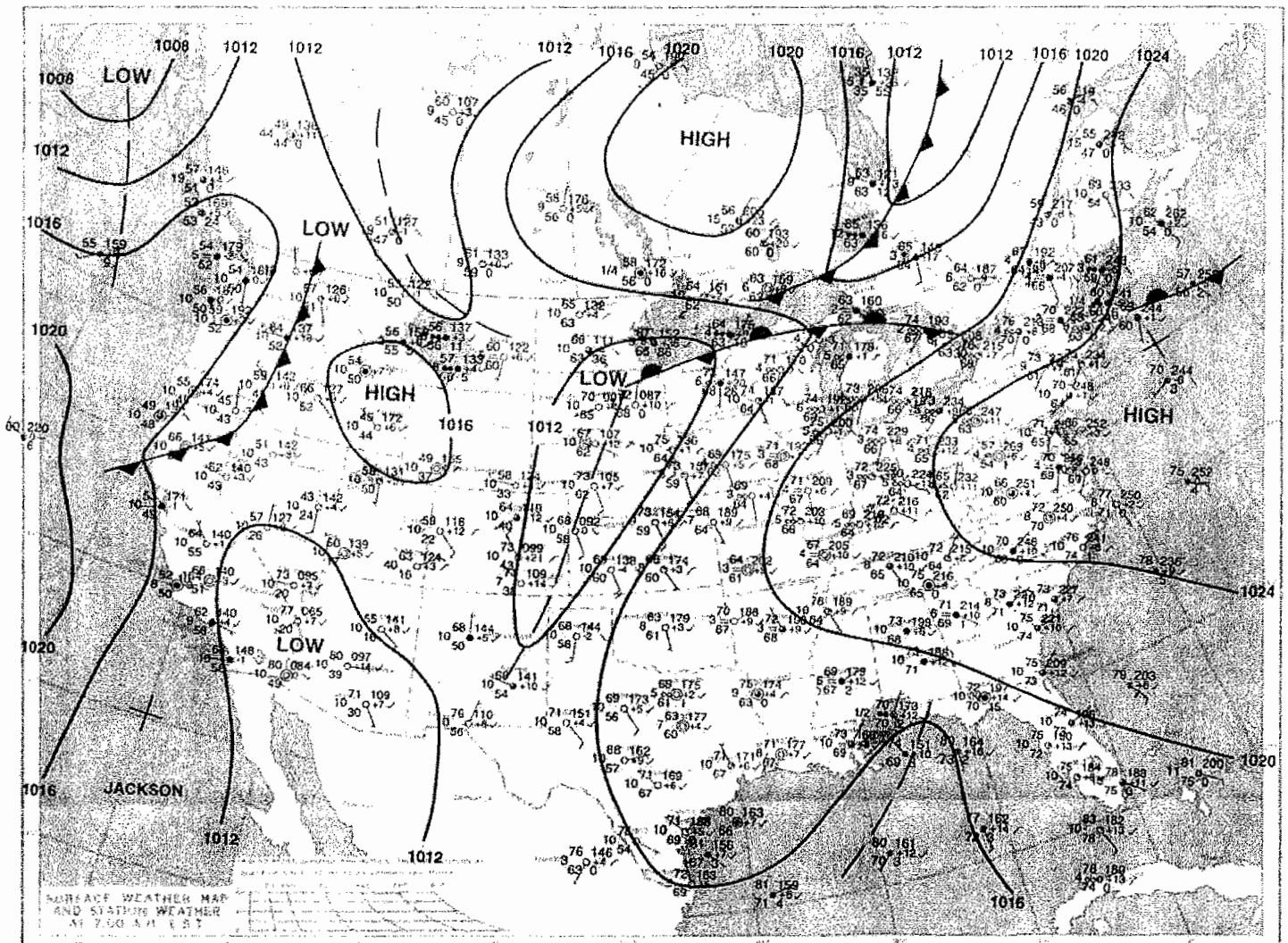

LOW
HIGH
JACKSON
SURFACE WEATHER MAP
AND STATION WEATHER
AT 7:00 A.M. E.S.T


LOW
HIGH
500-MILLIBAR HEIGHT CONTOURS
AT 7:00 A.M. E.S.T

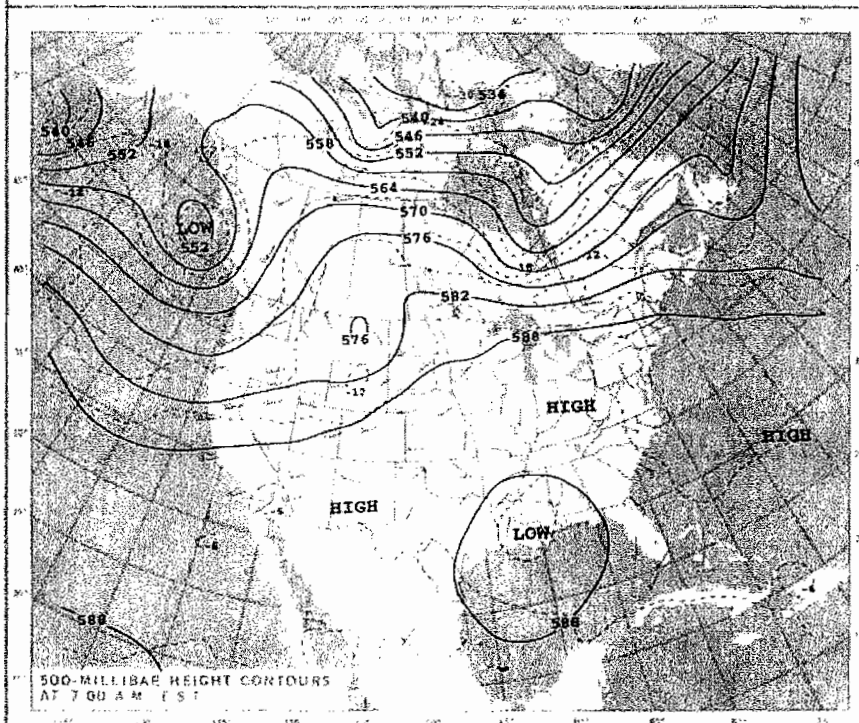

HIGHEST AND LOWEST TEMPERATURES


PRECIPITATION AREAS AND AMOUNTS

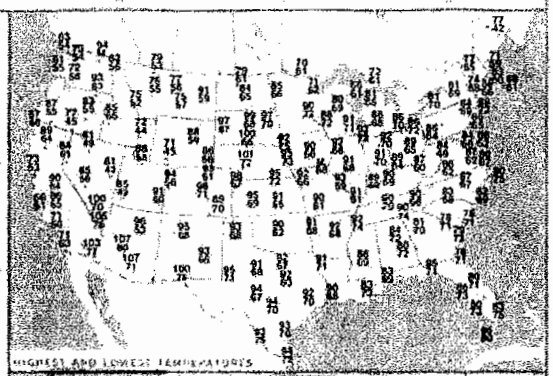
SUNDAY, JUNE 23, 2002



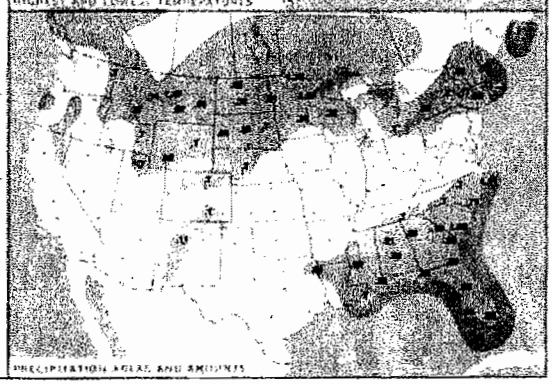
SURFACE WEATHER MAP AND STATION WEATHER AT 7:00 A.M. E.S.T.



500-MILLIBAR HEIGHT CONTOURS AT 7:00 A.M. E.S.T.

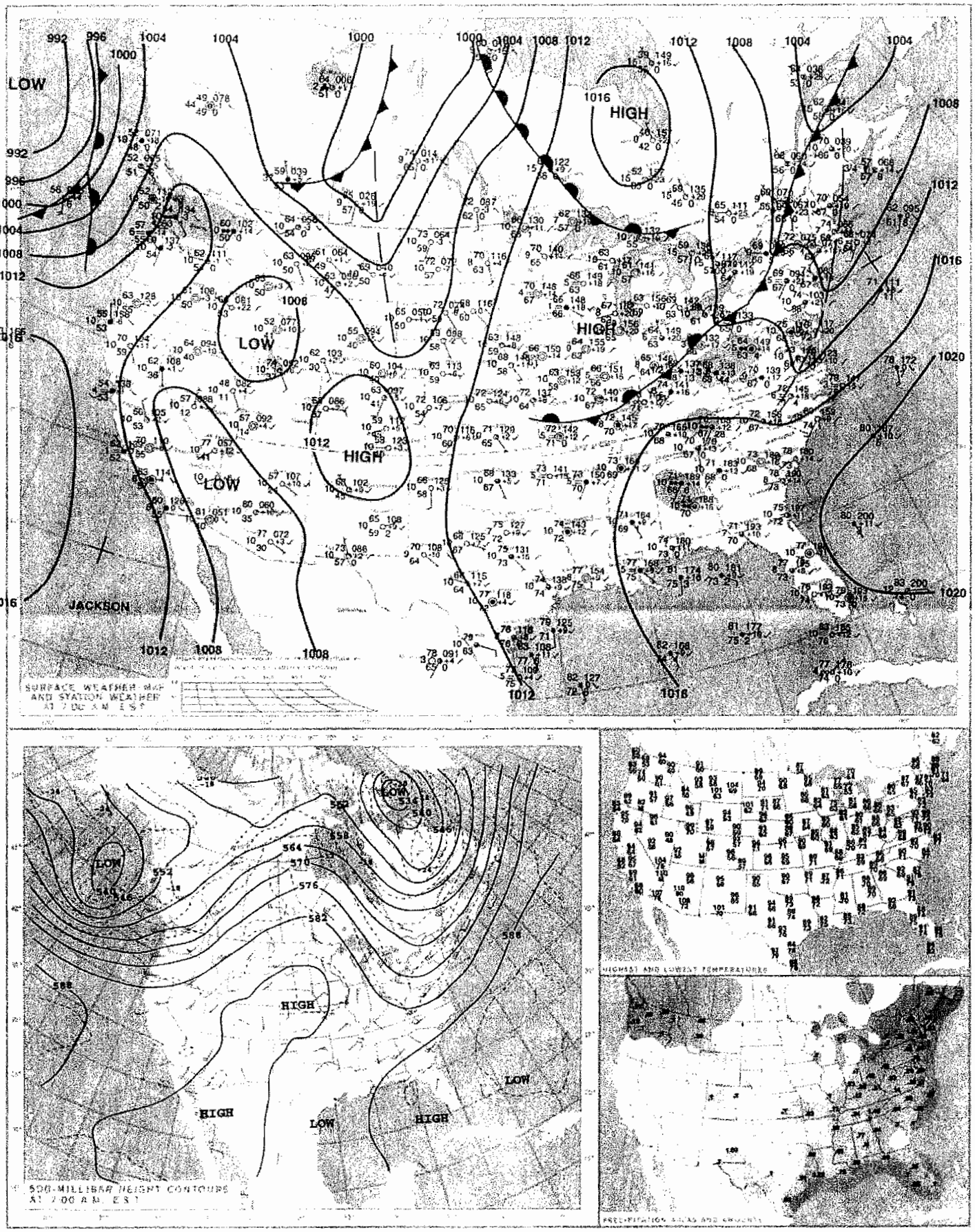


HIGHEST AND LOWEST TEMPERATURES

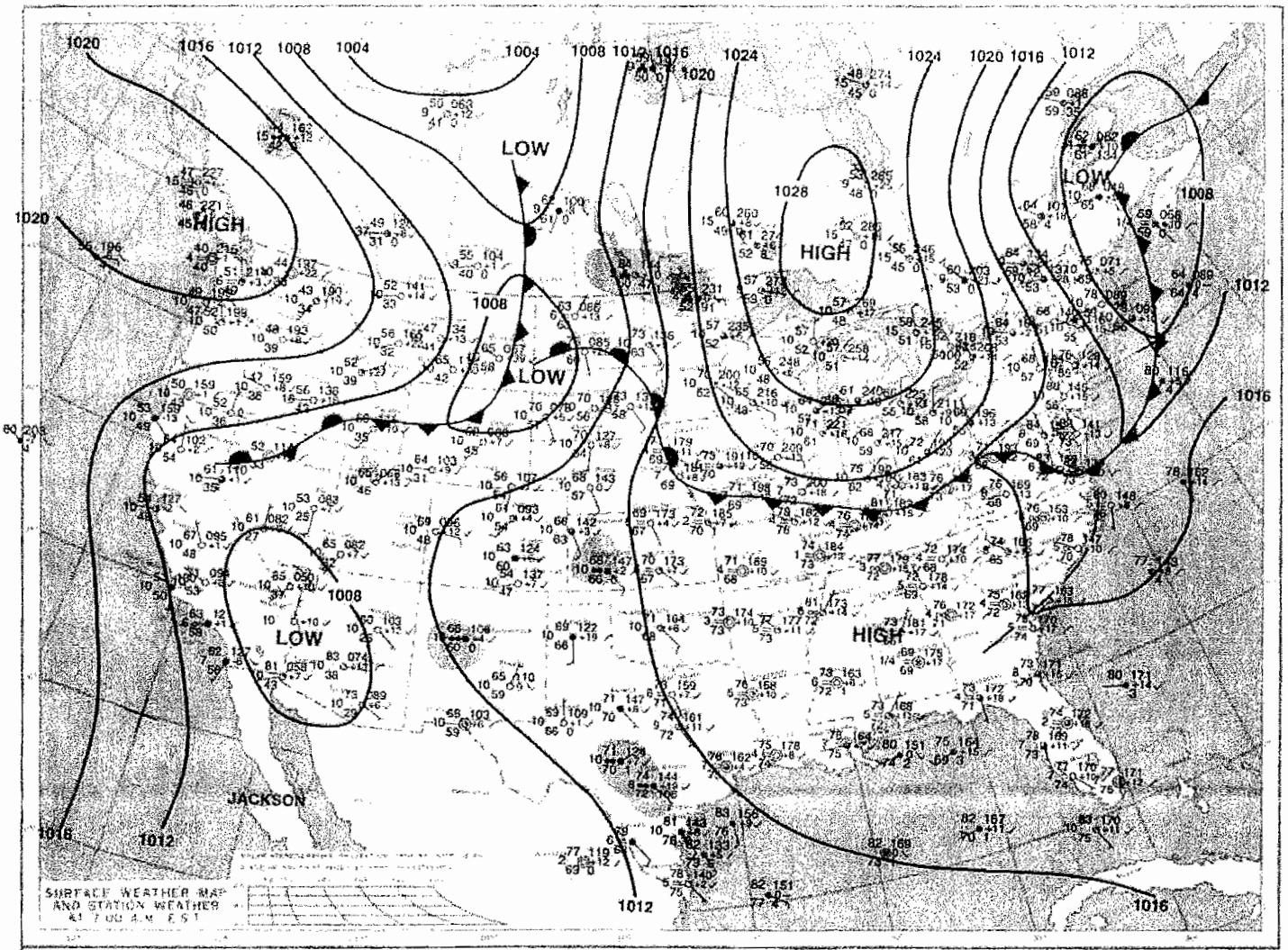


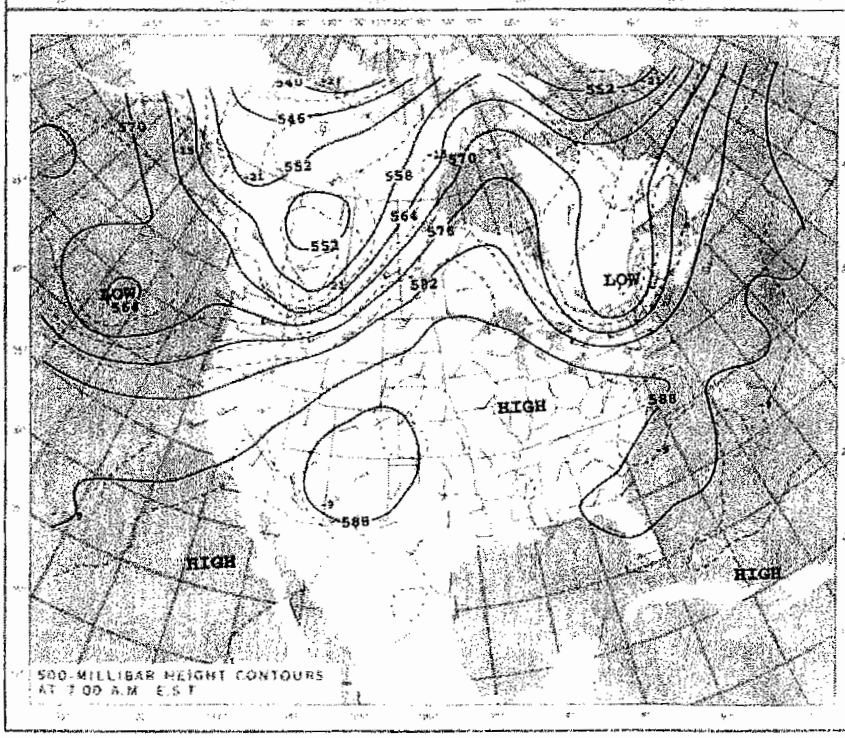
PRECIPITATION AREAS AND AMOUNTS

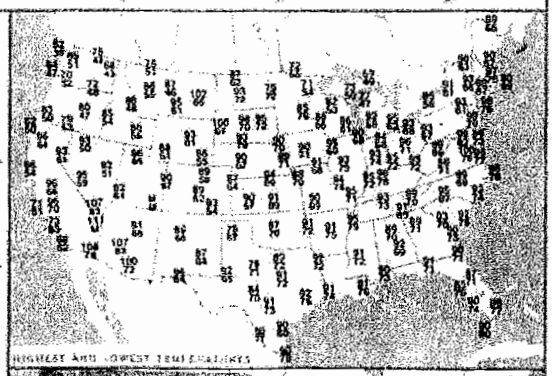
FRIDAY, JUNE 28, 2002



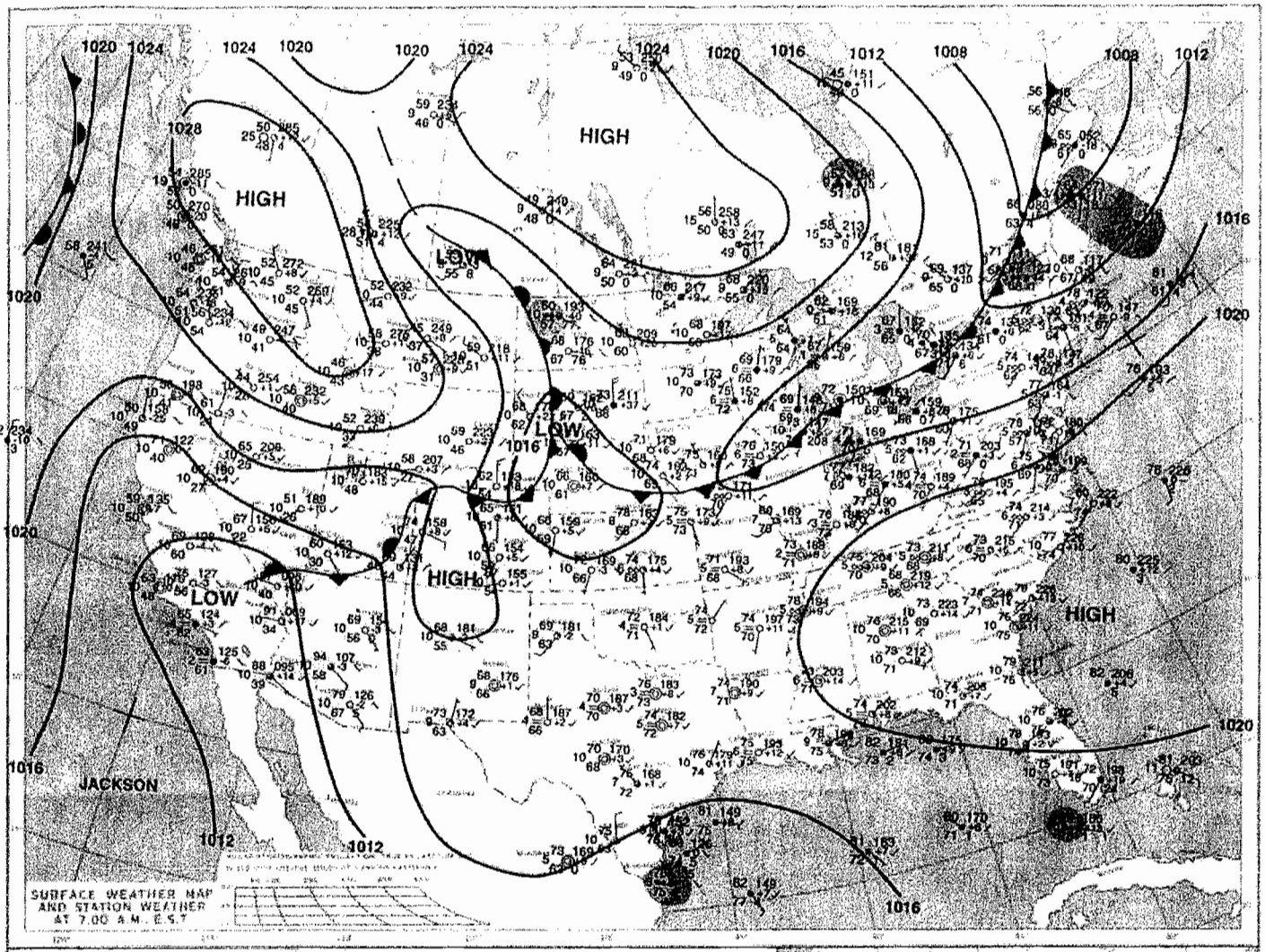
FRIDAY, JULY 5, 2002

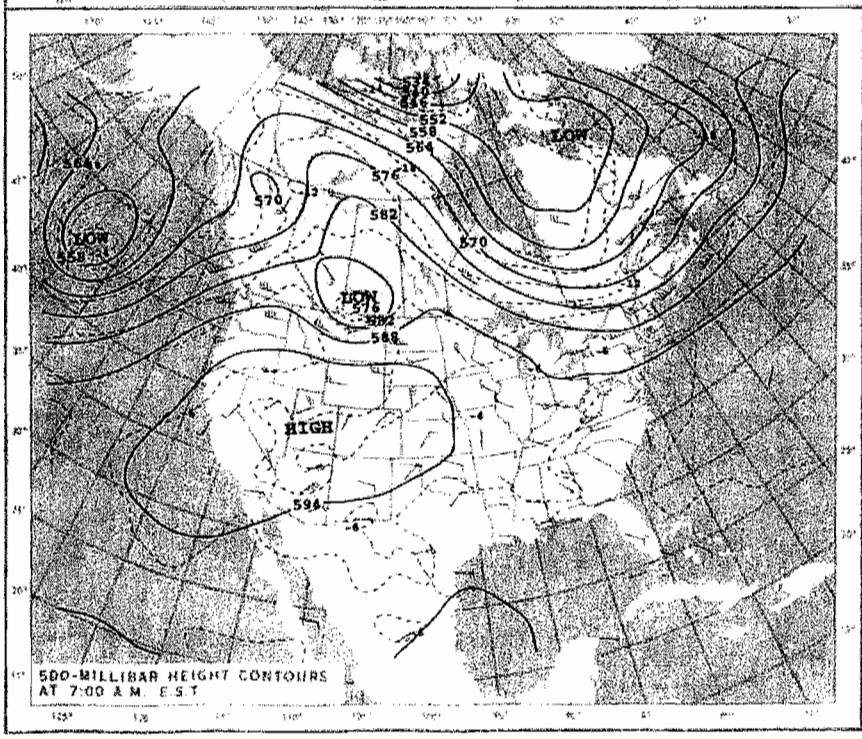


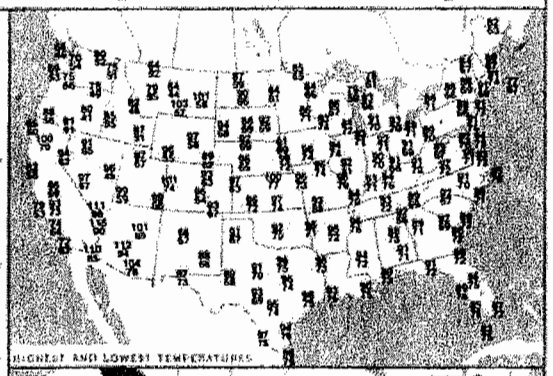


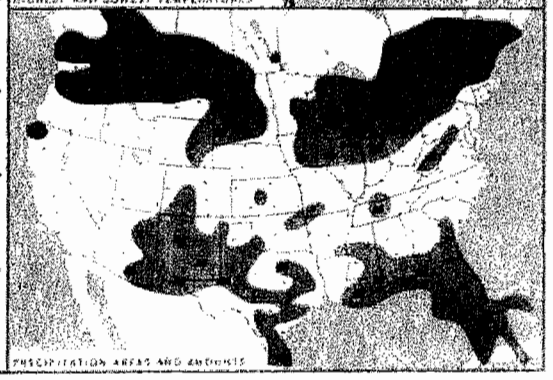


TUESDAY, JULY 9, 2002

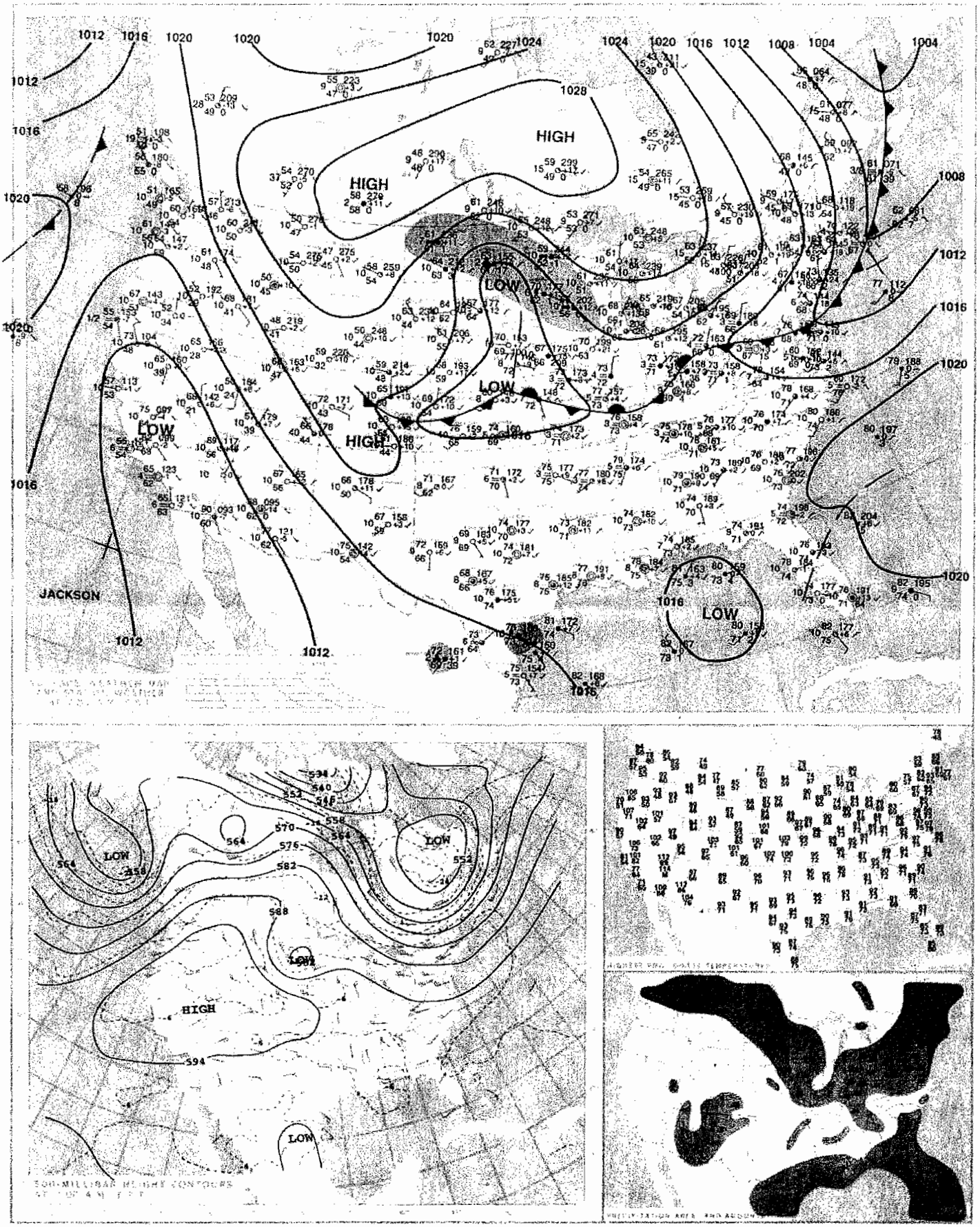


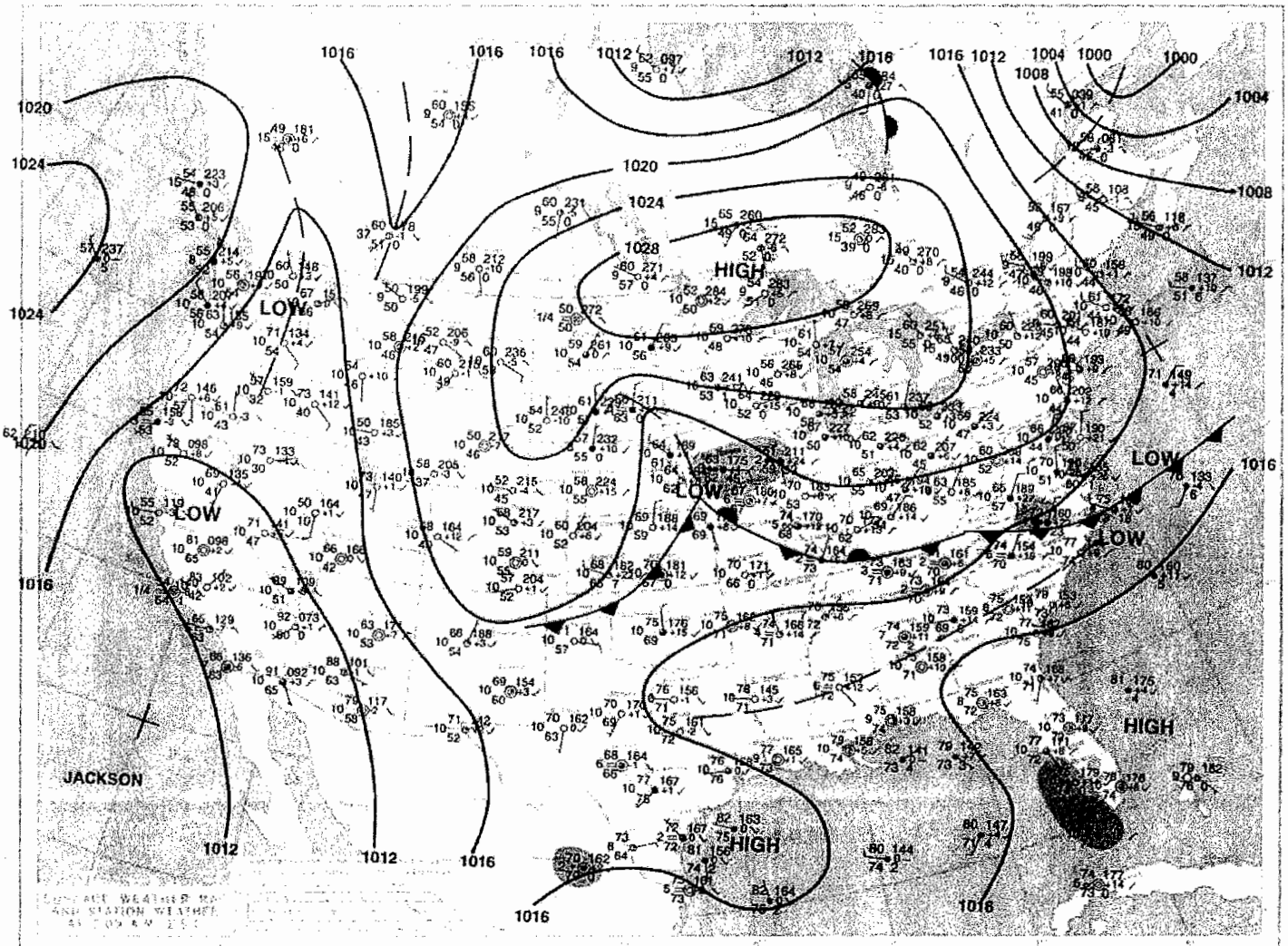






WEDNESDAY, JULY 10, 2002

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1016
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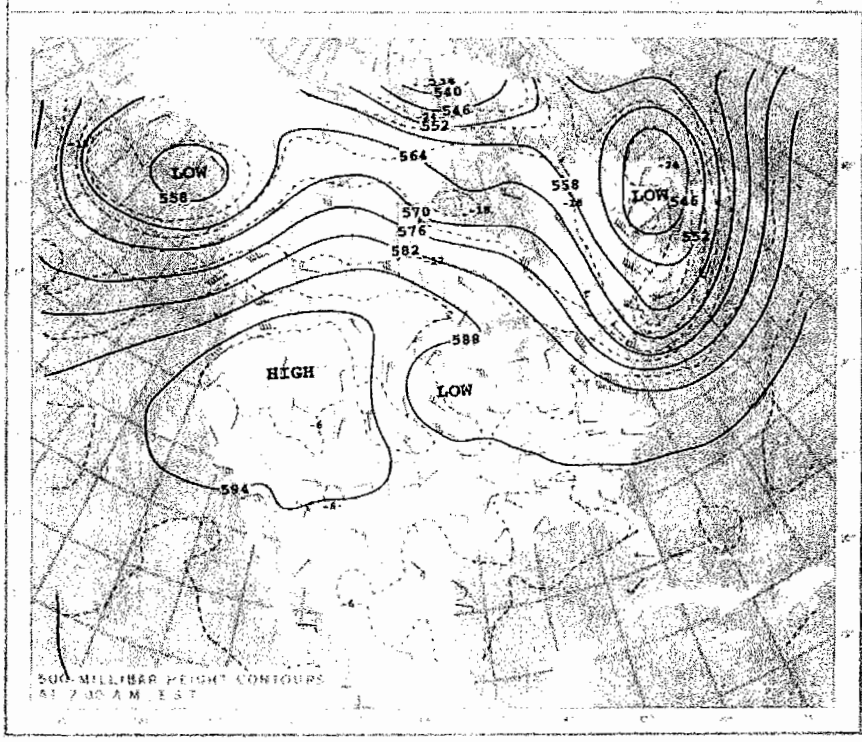
1012
1012
1016
1016
1016


540
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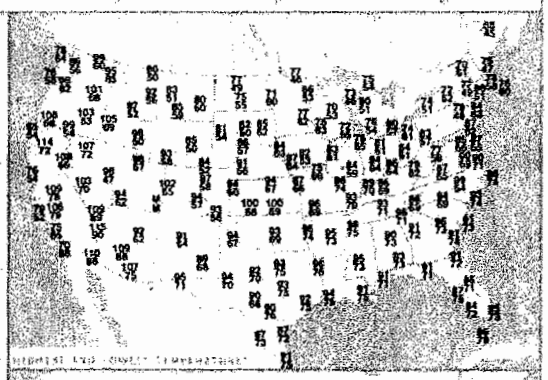
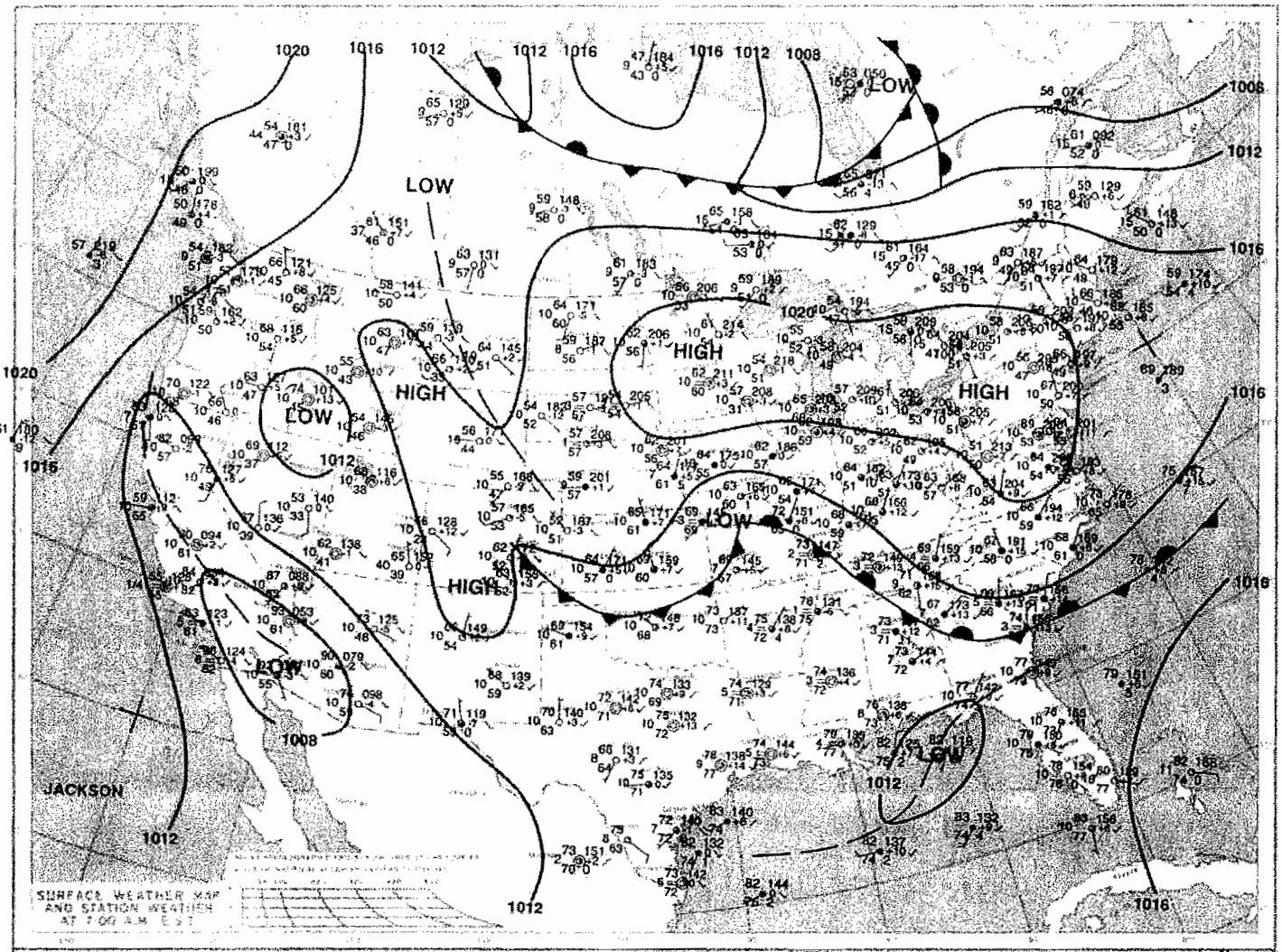
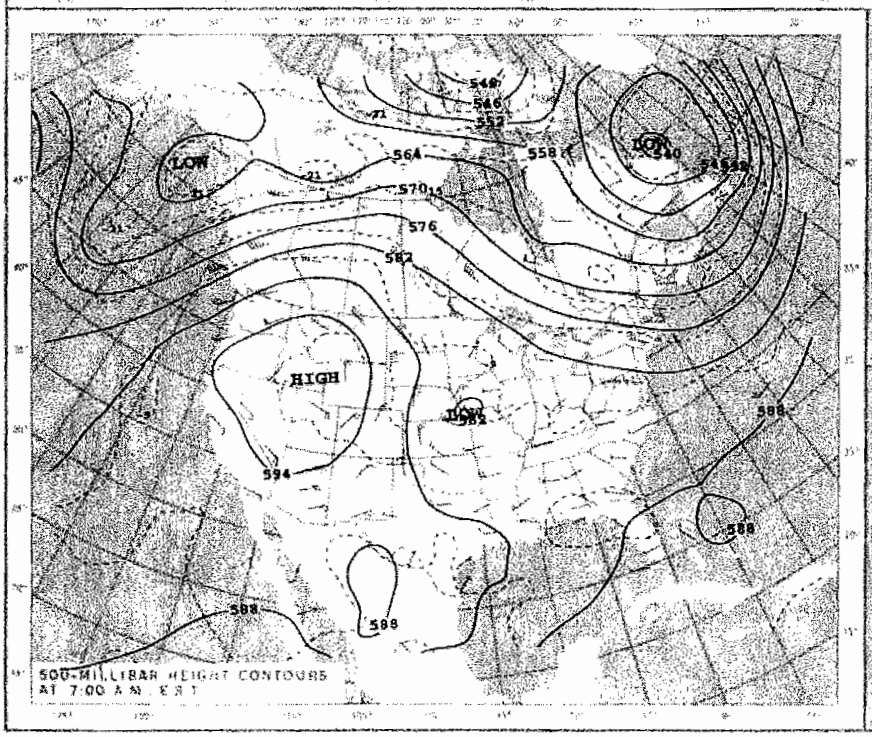
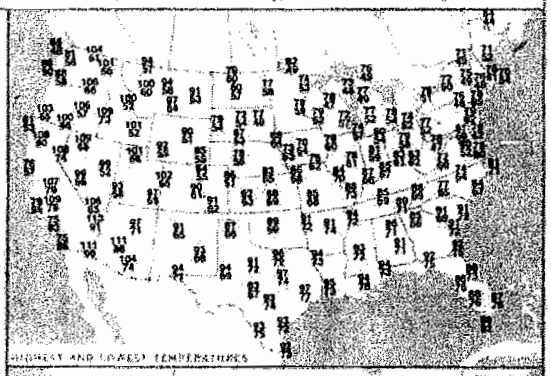
HIGH
LOW
594
500 MILLIBAR HEIGHT CONTOURS

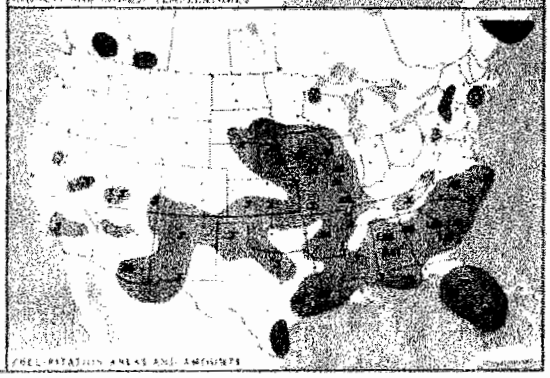


FRIDAY, JULY 12, 2002

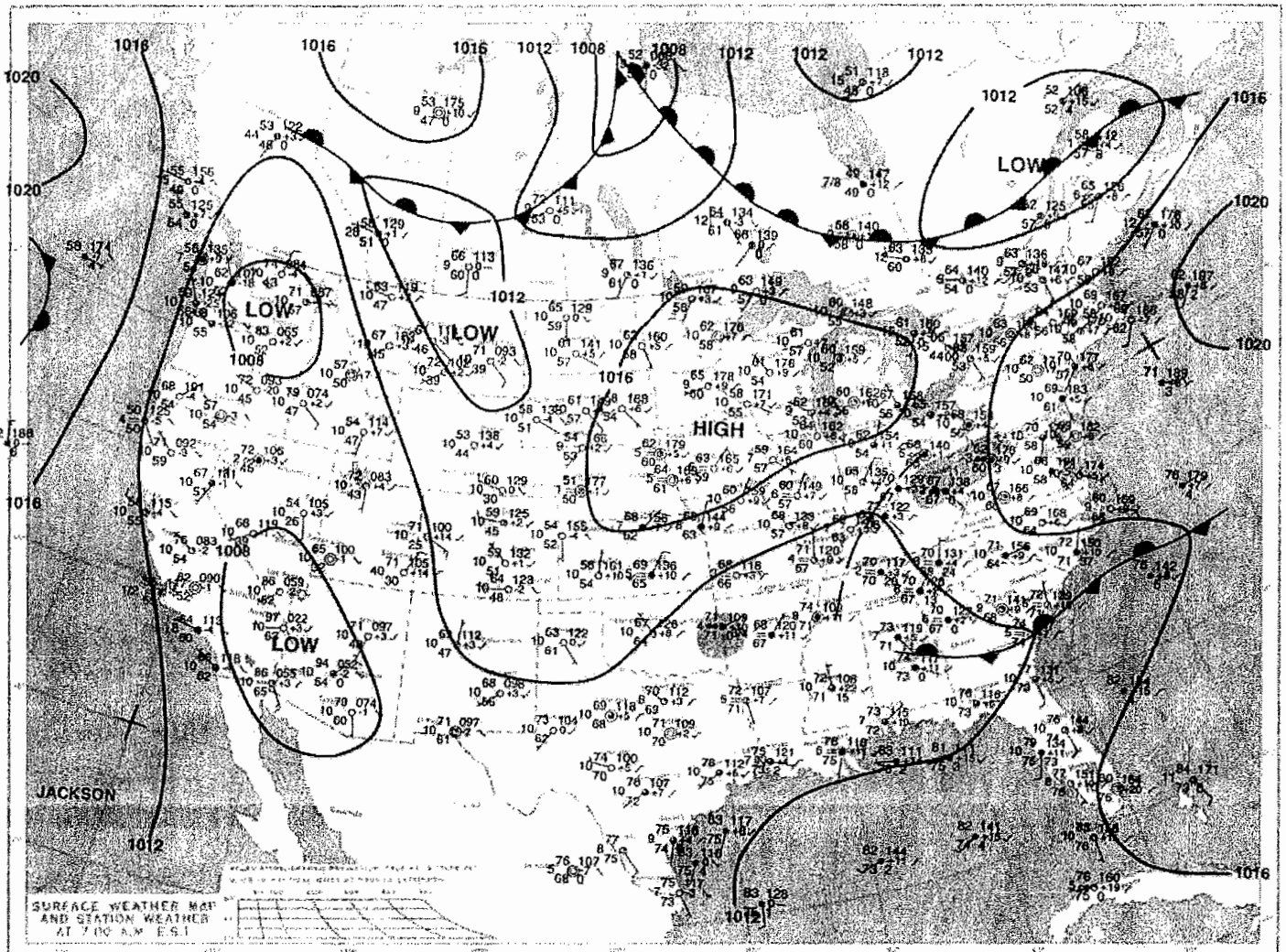


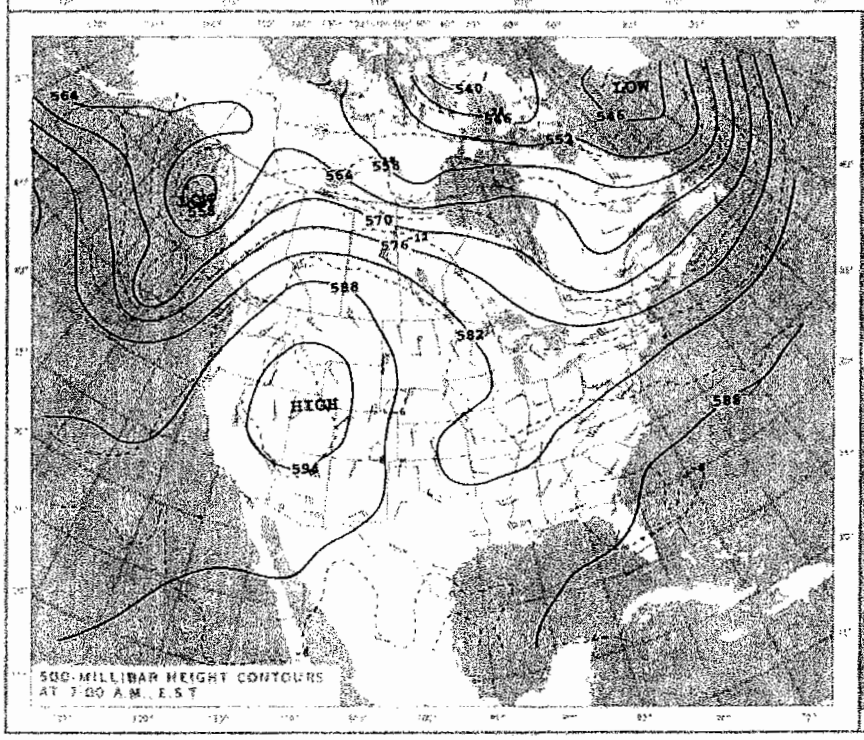


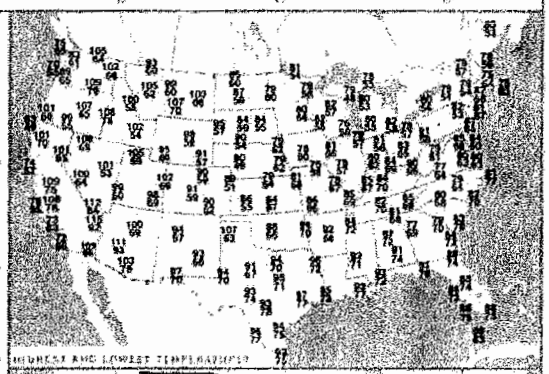




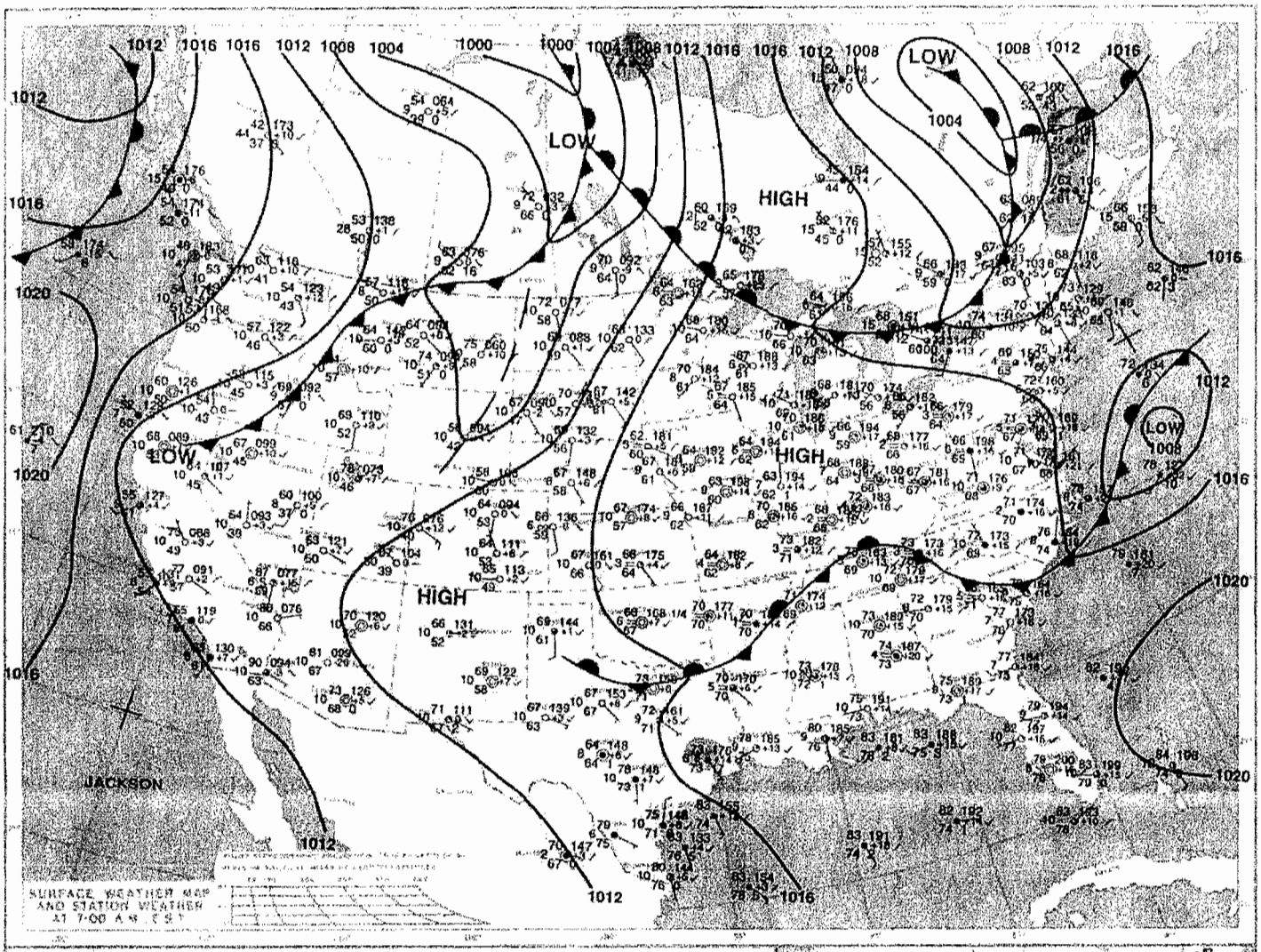
SATURDAY, JULY 13, 2002

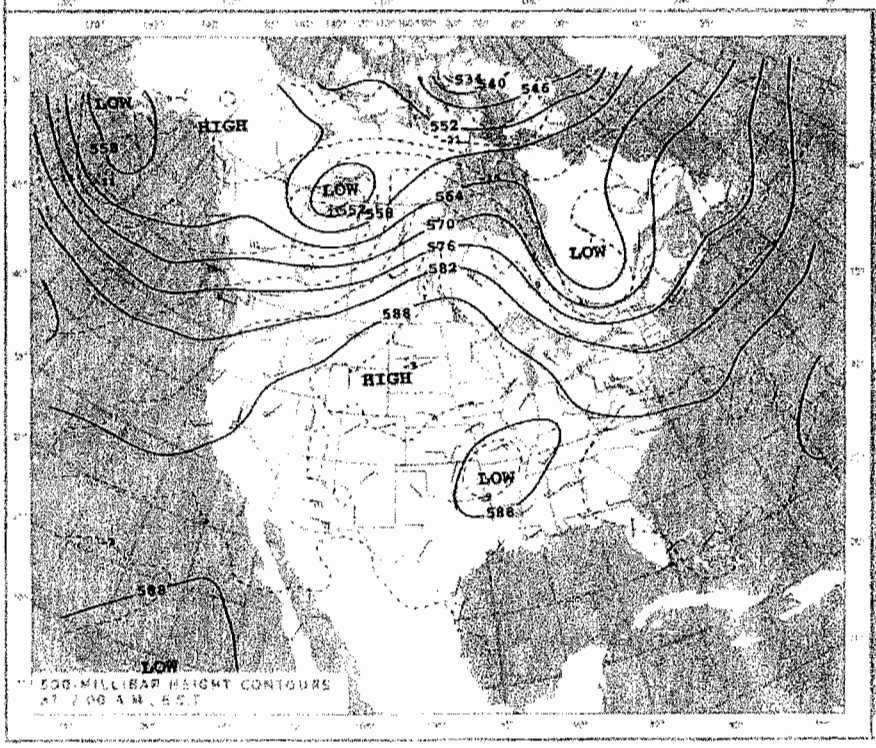


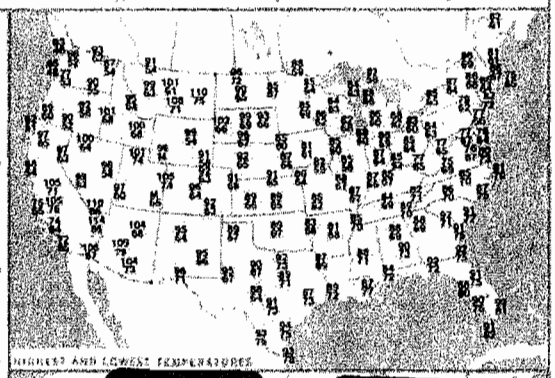


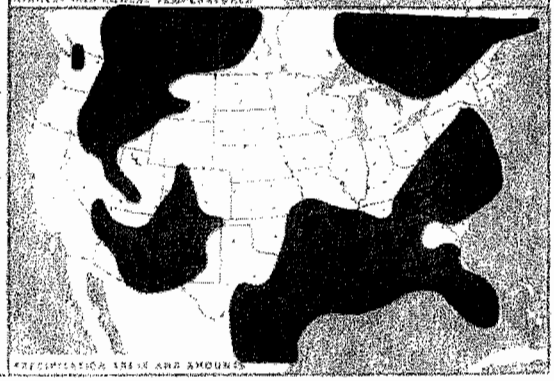


MONDAY, JULY 15, 2002









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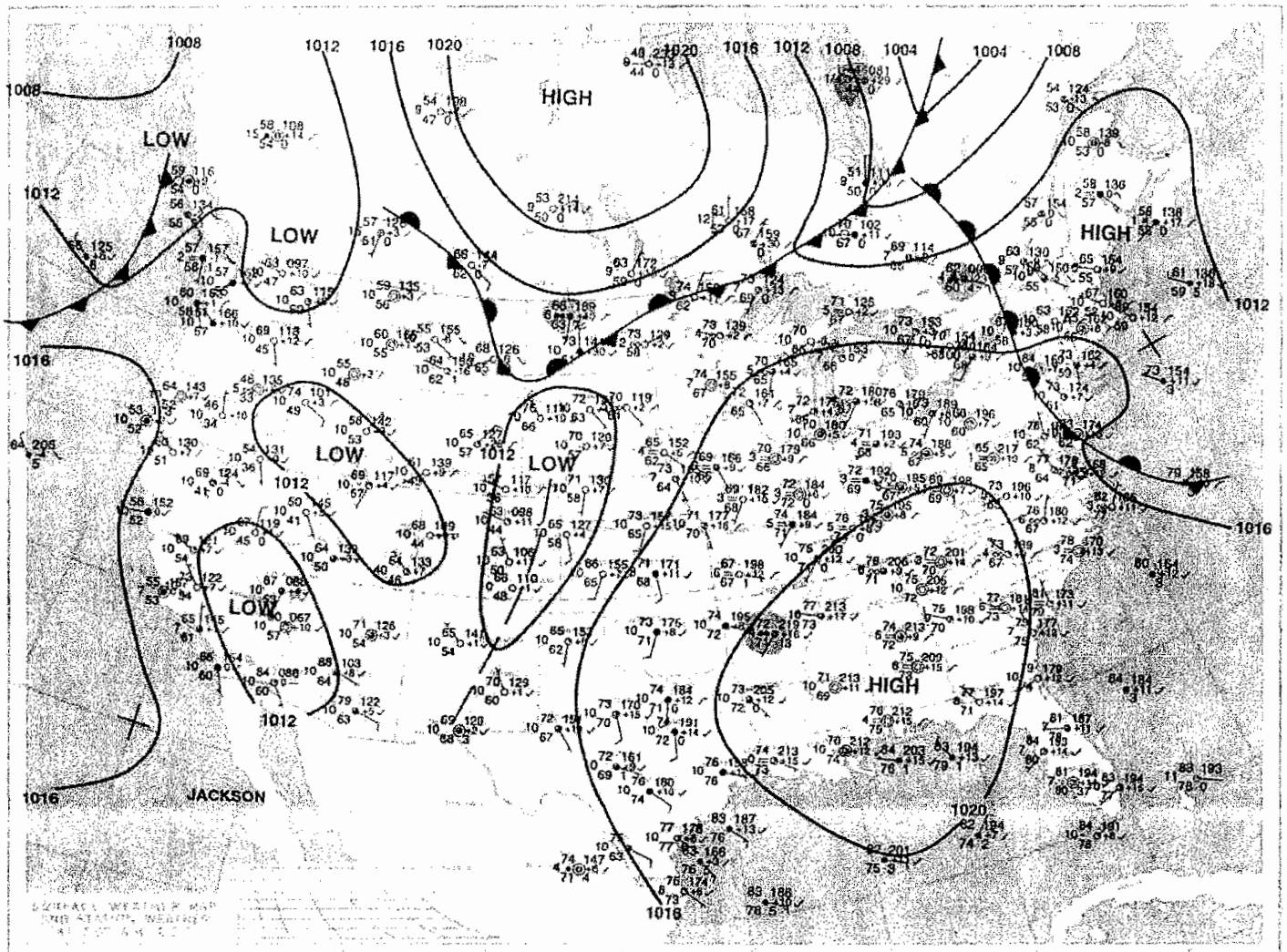

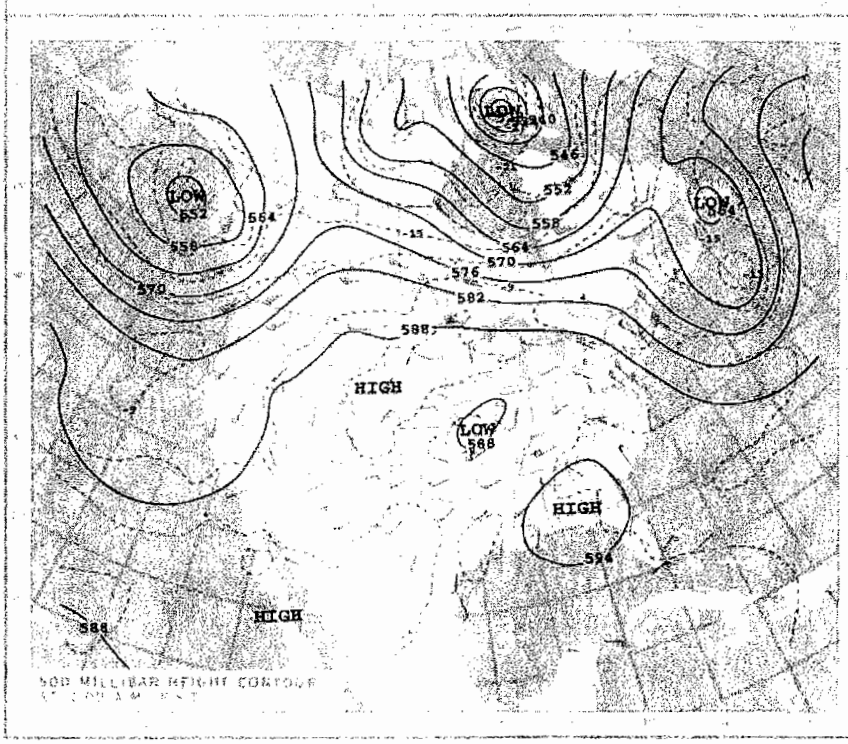

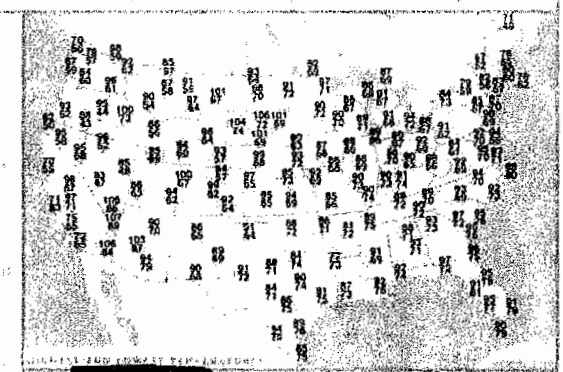

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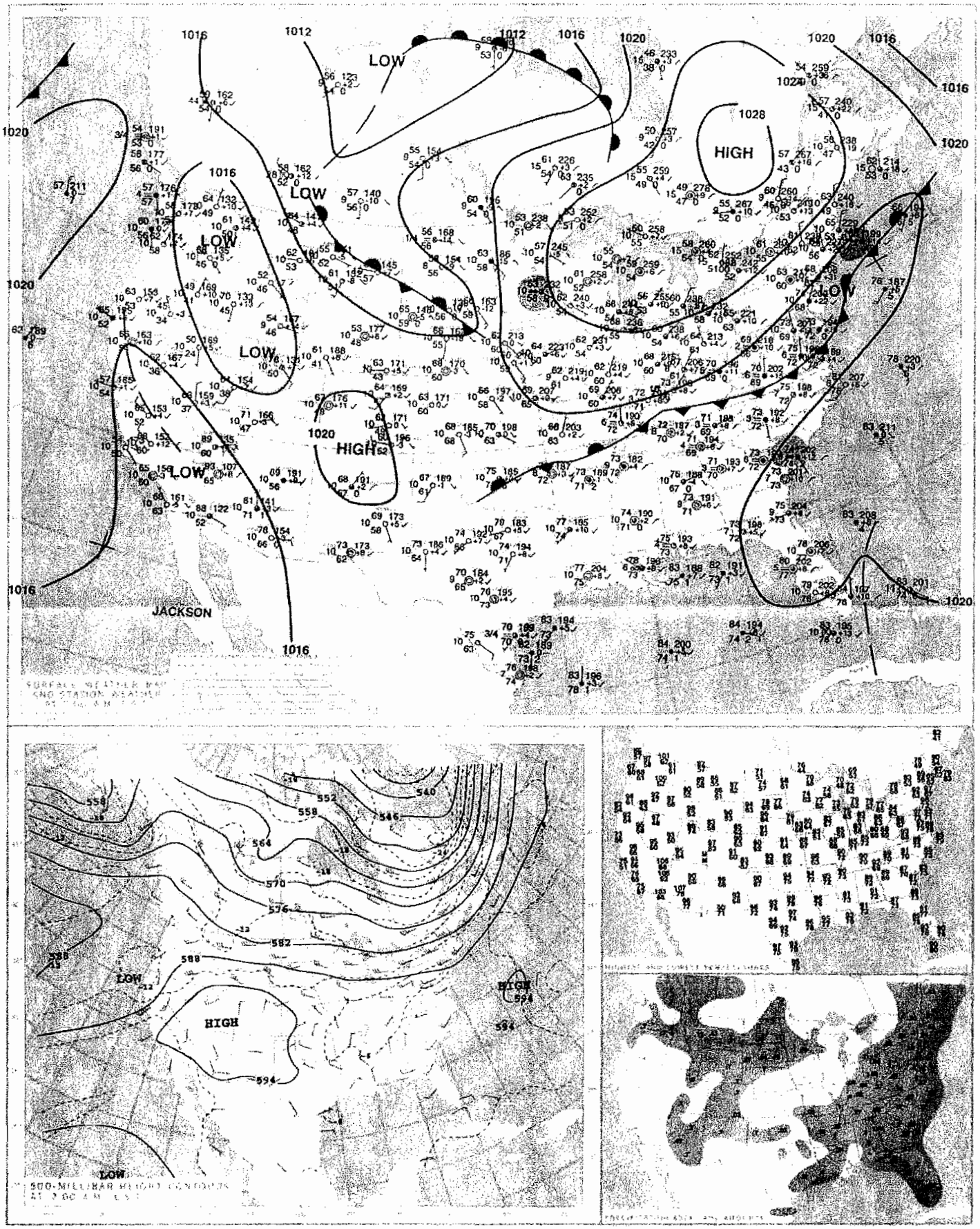
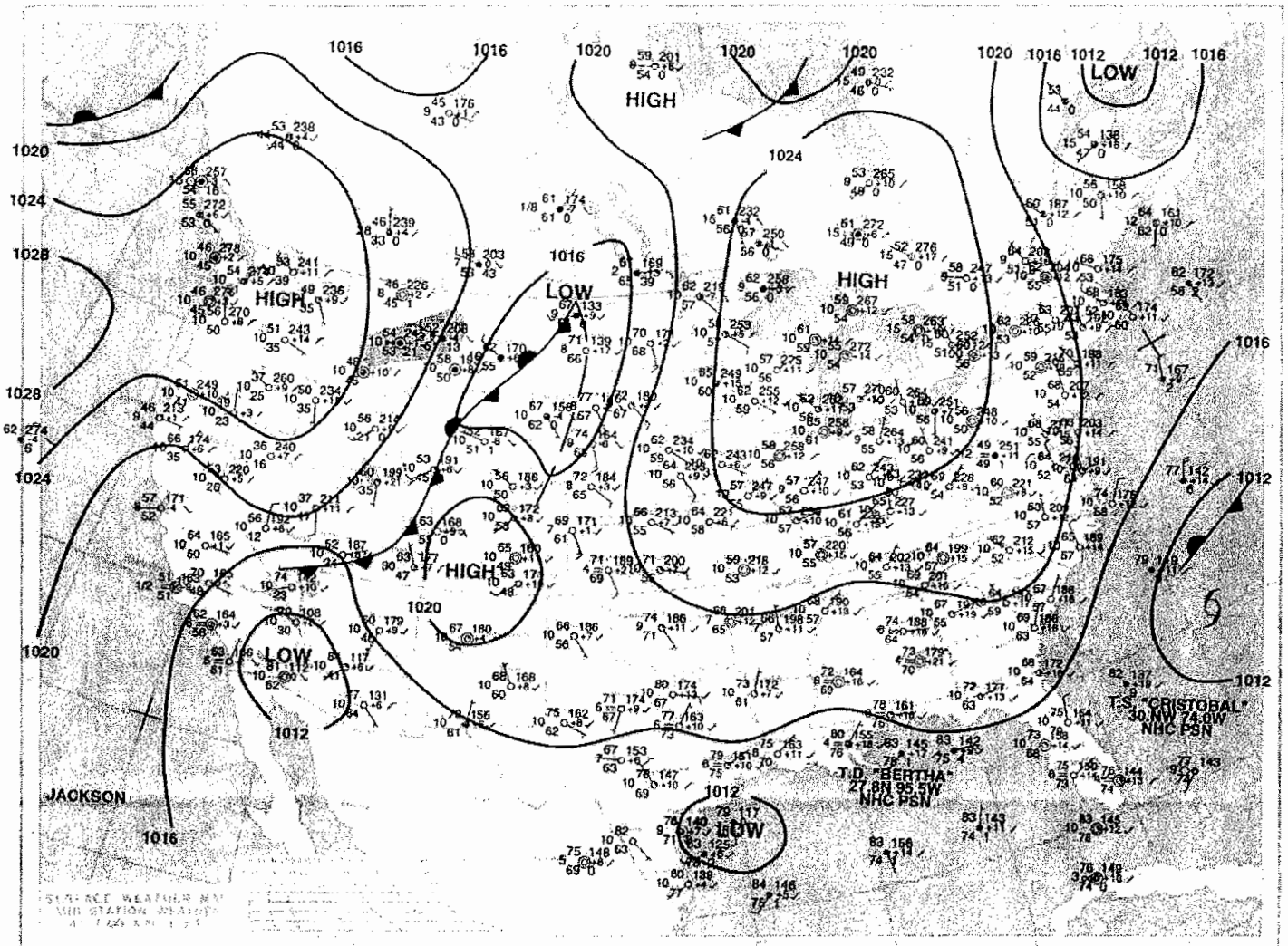
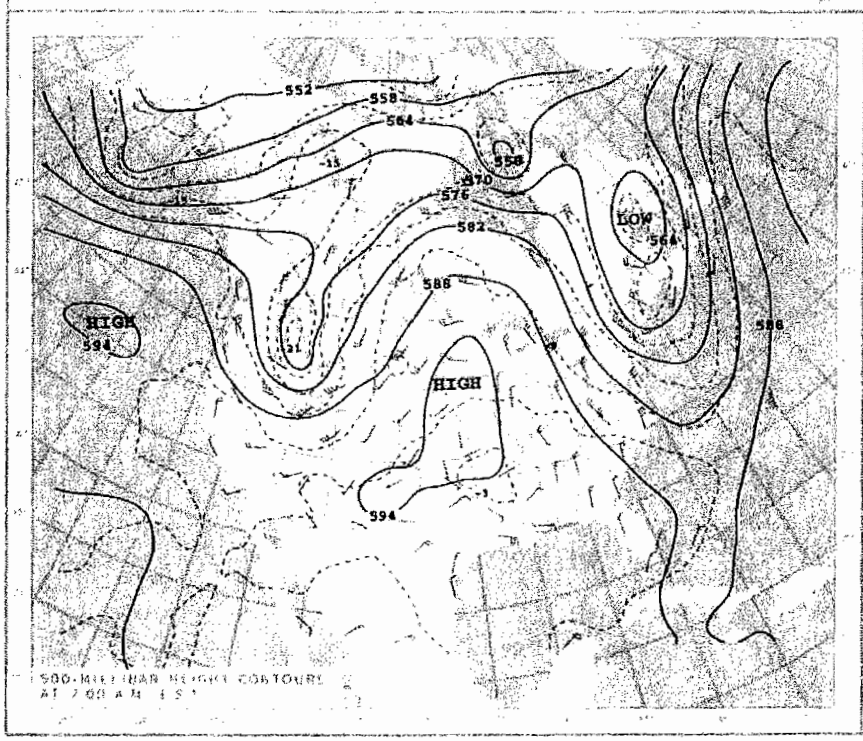
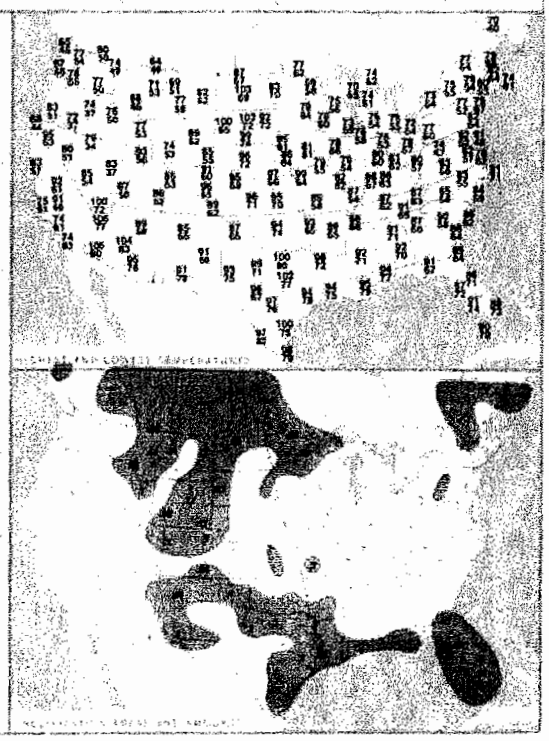
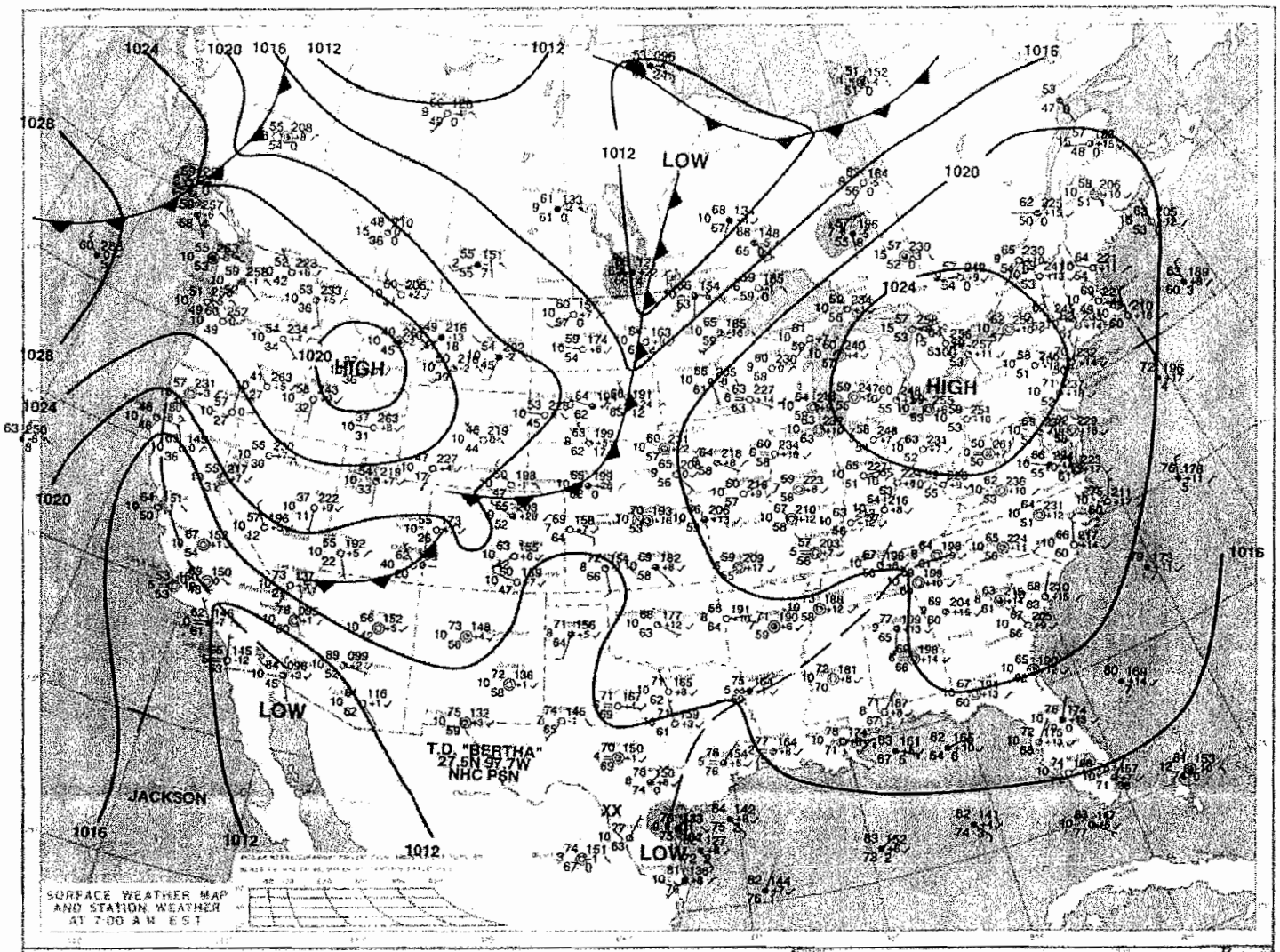


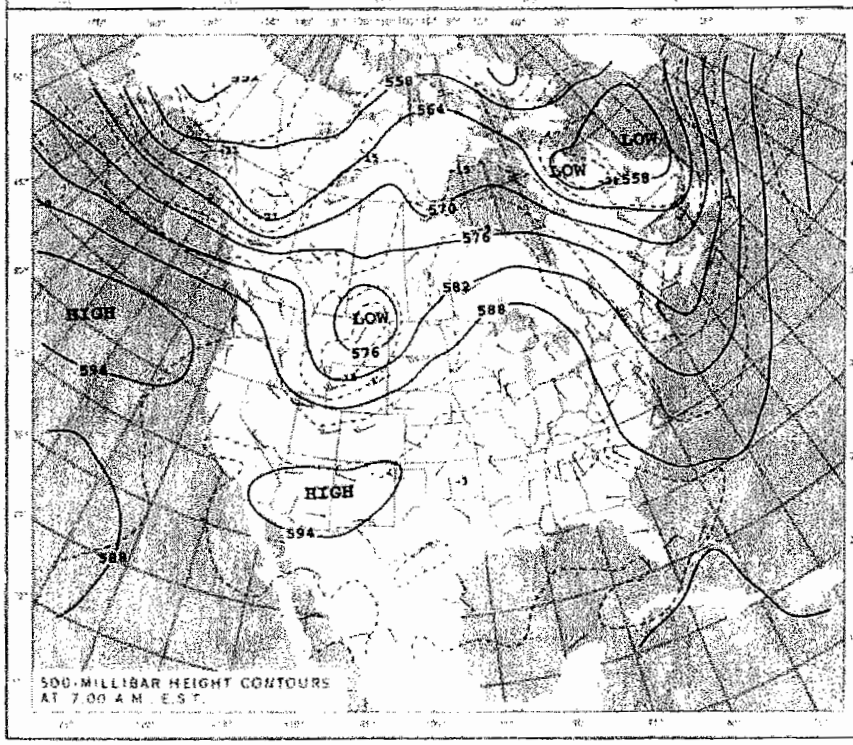

HIGH
LOW
T.S. "CRISTOBAL"
30 NW 74.0W
NHC PSN
T.D. "BERTHA"
27.8N 95.5W
NHC PSN
JACKSON

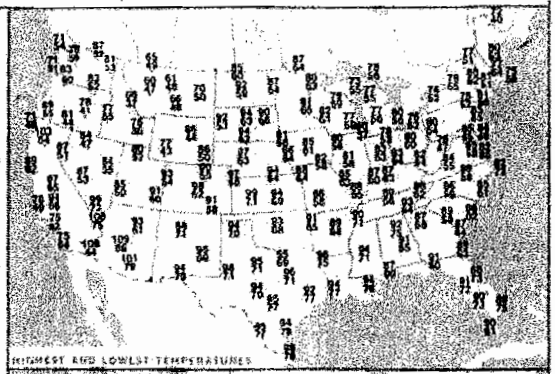

HIGH
LOW
HIGH

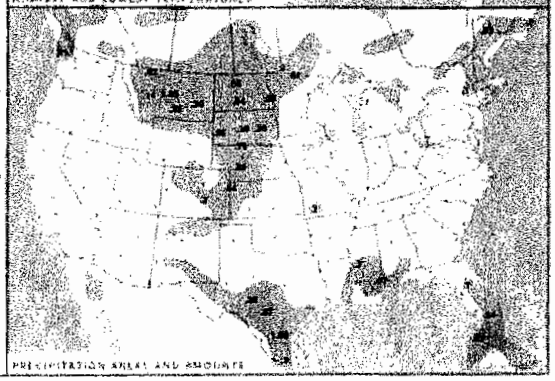


FRIDAY, AUGUST 9, 2002

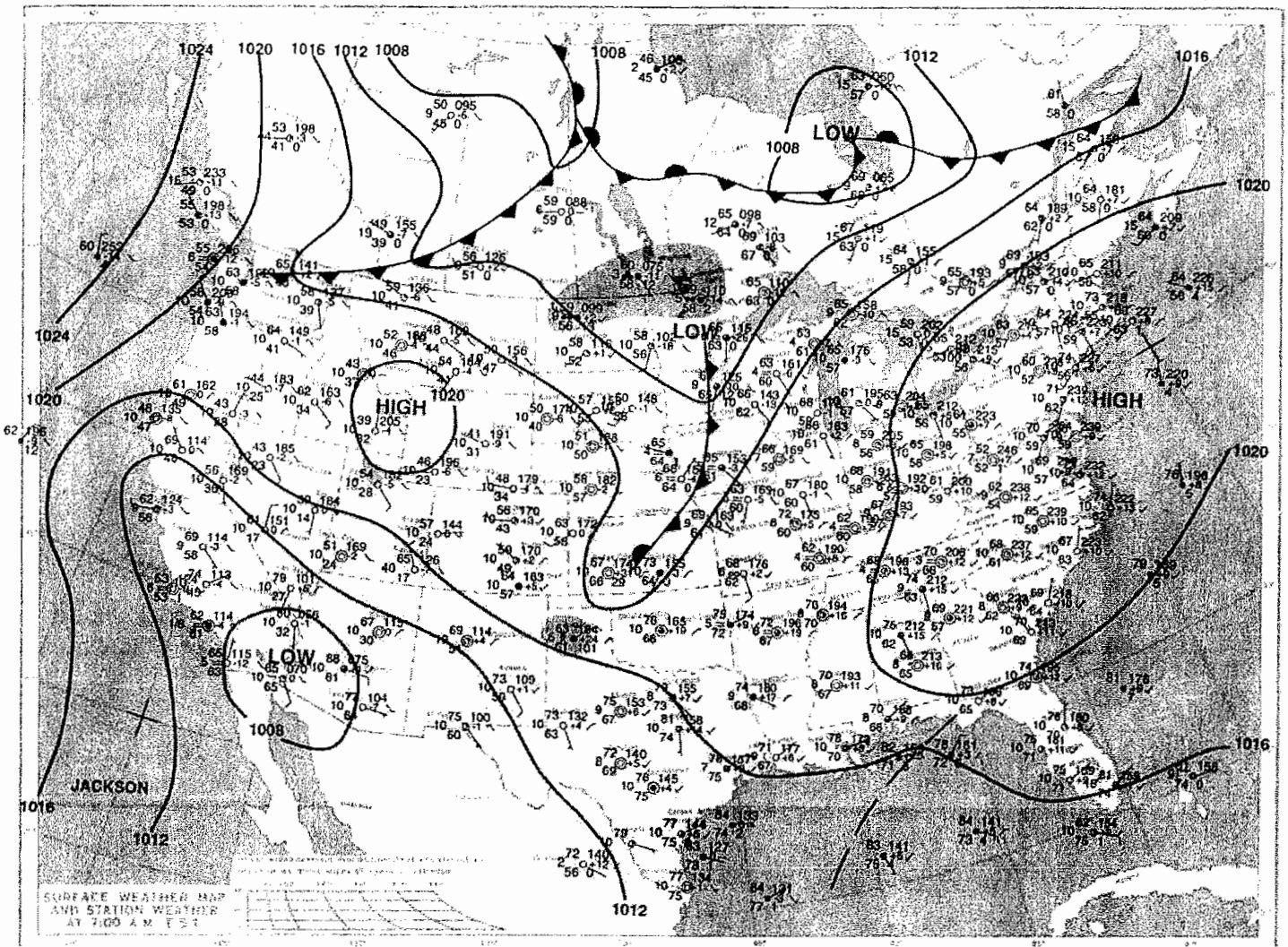


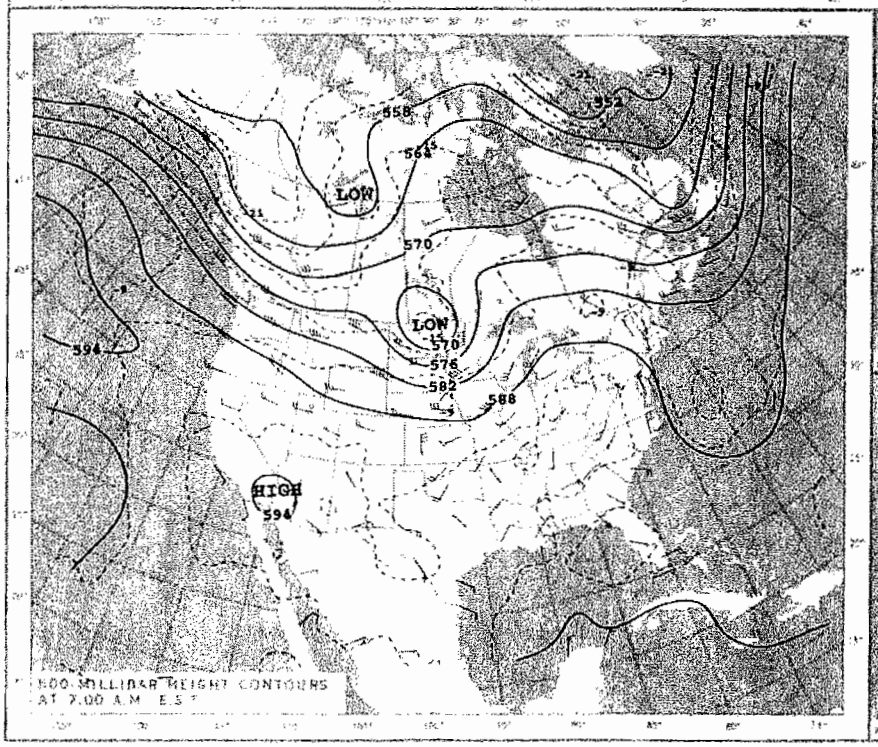


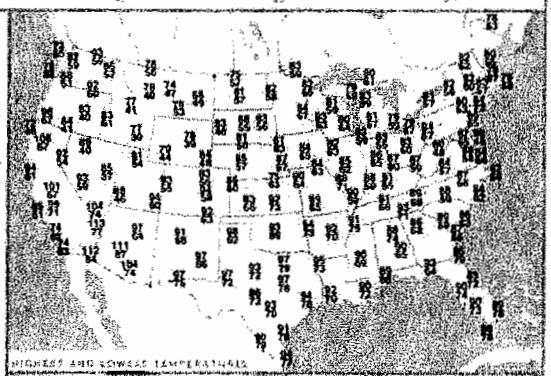


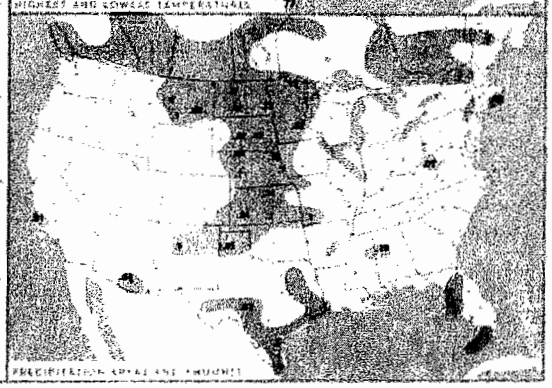


SATURDAY, AUGUST 10, 2002

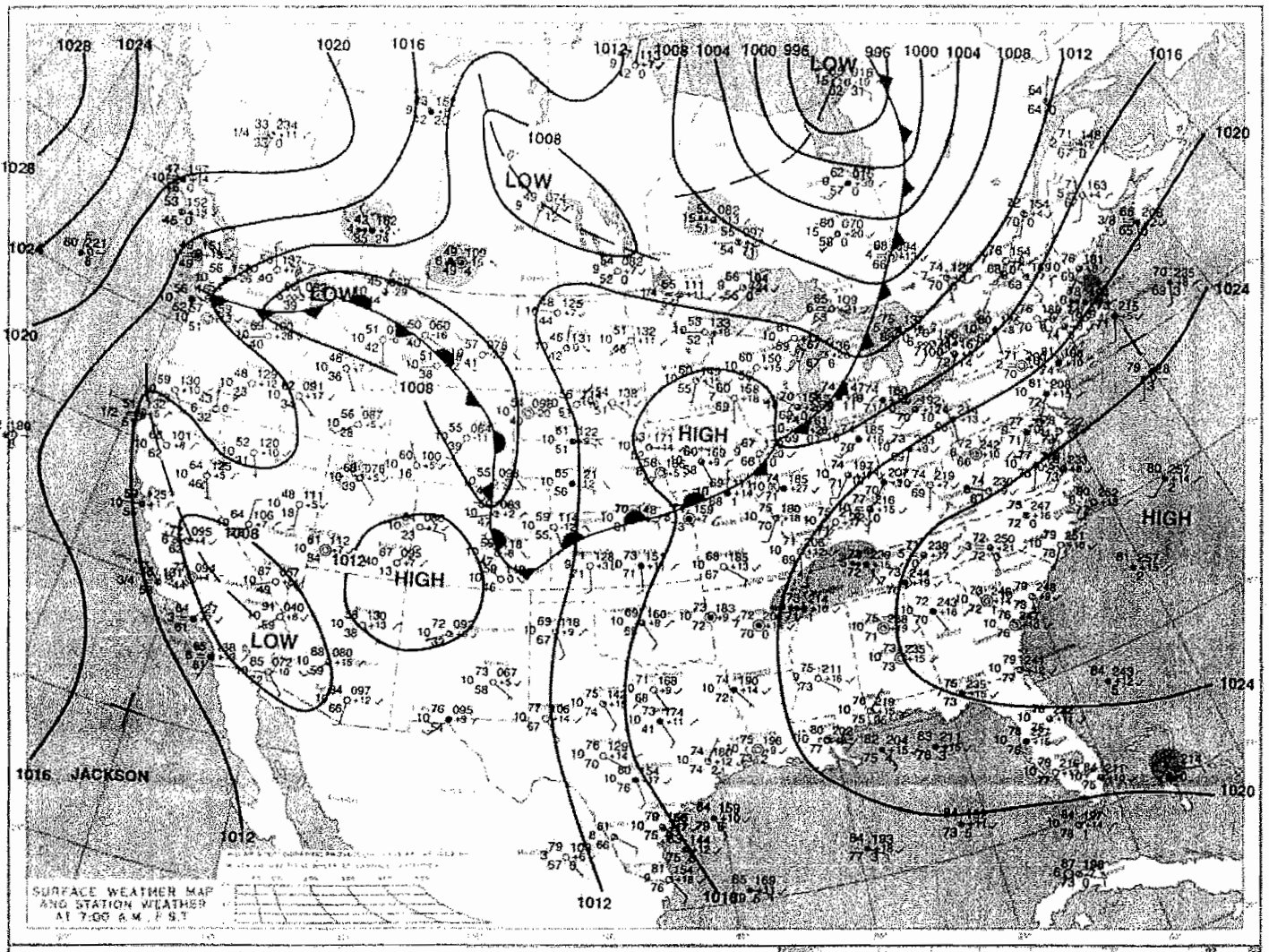


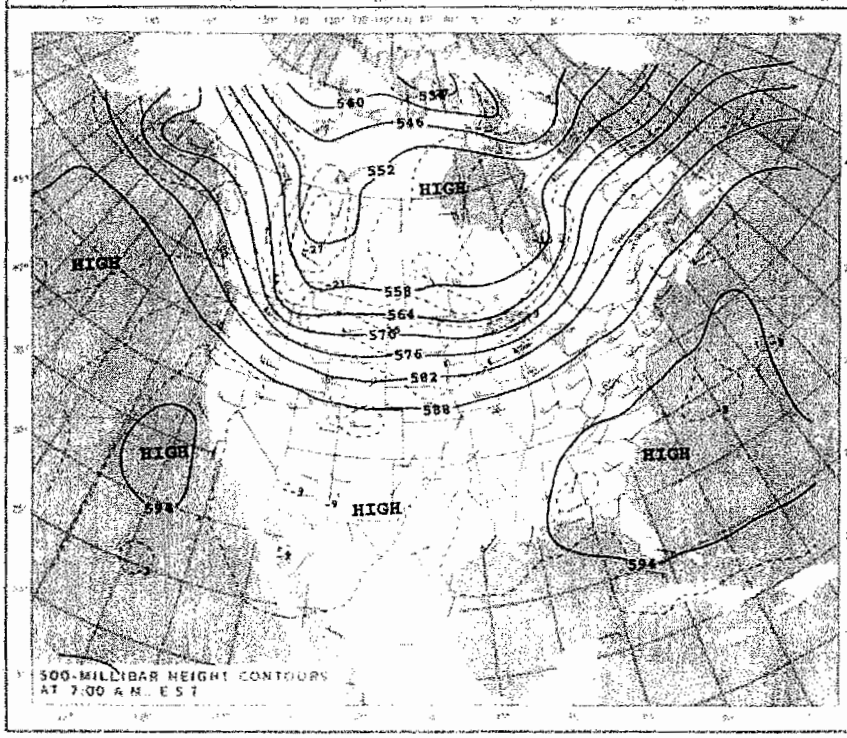


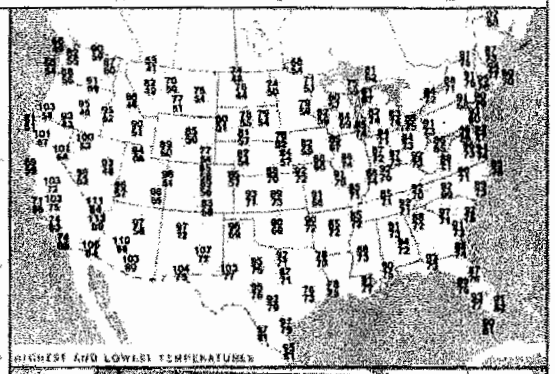


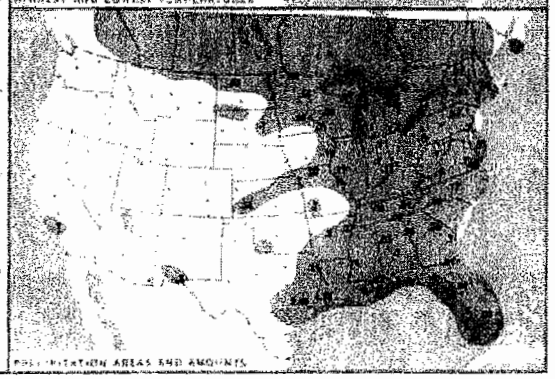


FRIDAY, AUGUST 16, 2002









APPENDIX F

Backward Trajectories for the Selected High Ozone Days in 2000-2004

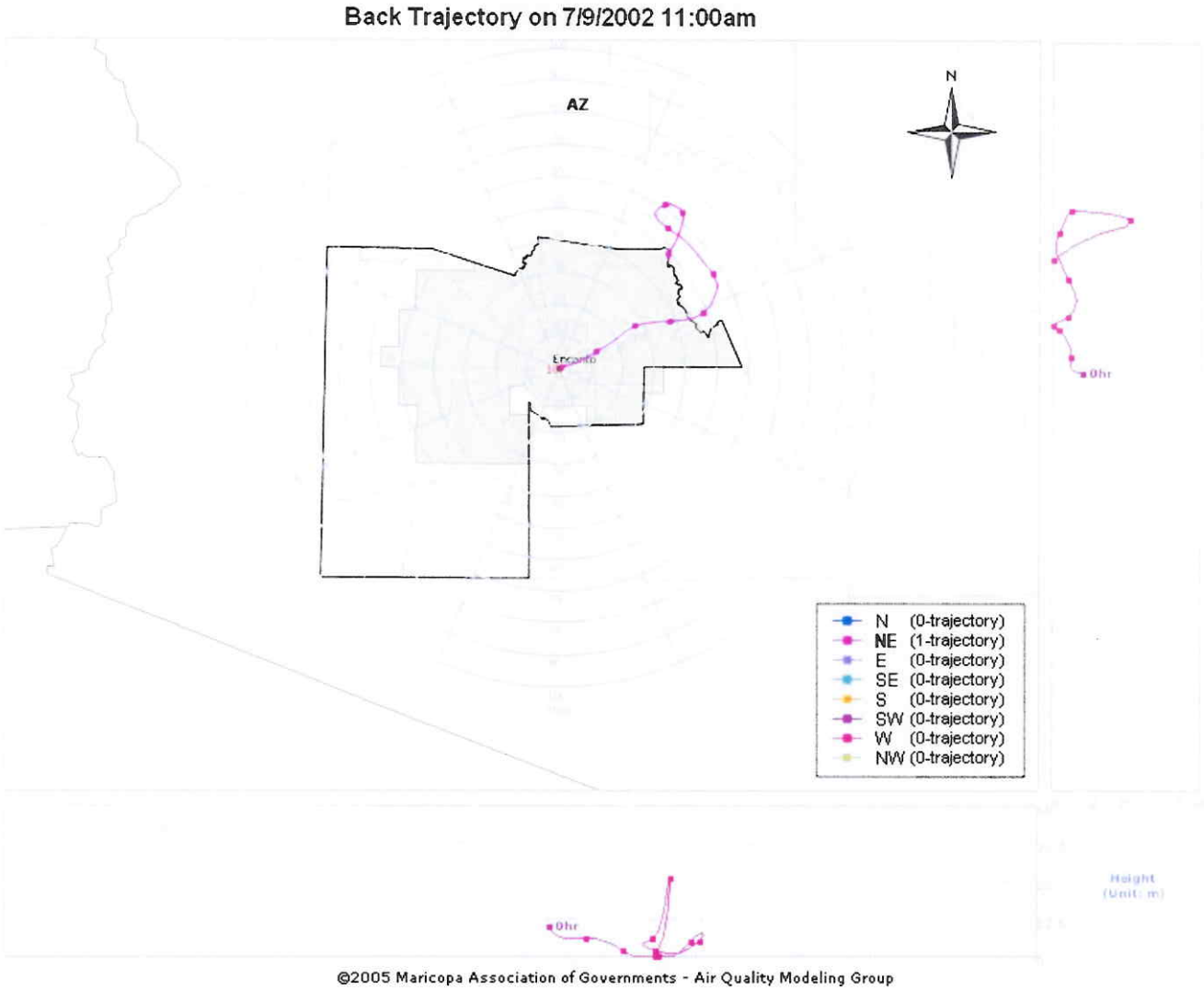


Figure F.1.1 Backward trajectory for the July 8-14, 2002 episode (start time: July 9, 2002 11:00 am, start height: 10 m)

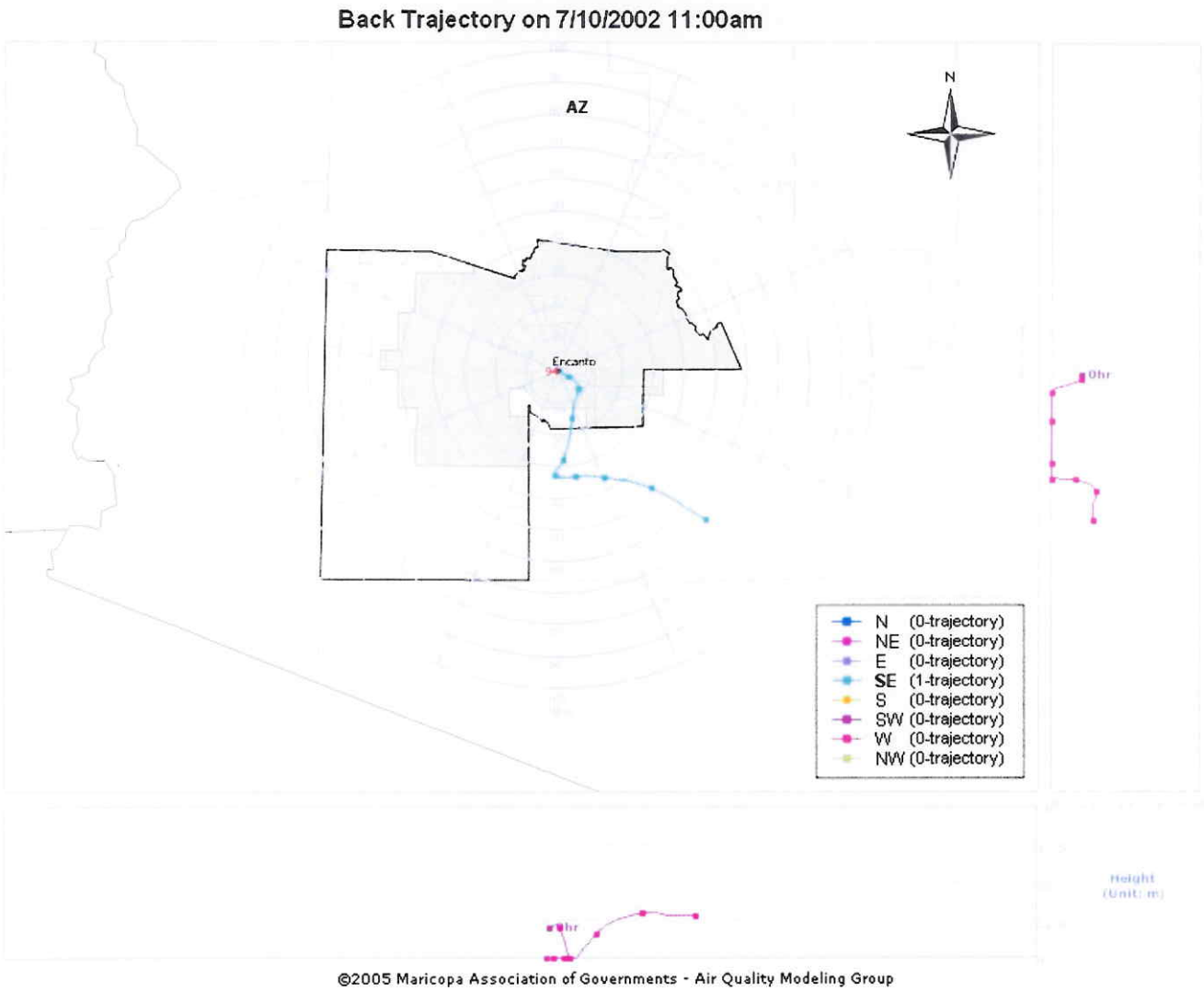


Figure F.1.2 Backward trajectory for the July 8-14, 2002 episode (start time: July 10, 2002 11:00 am, start height: 10 m)

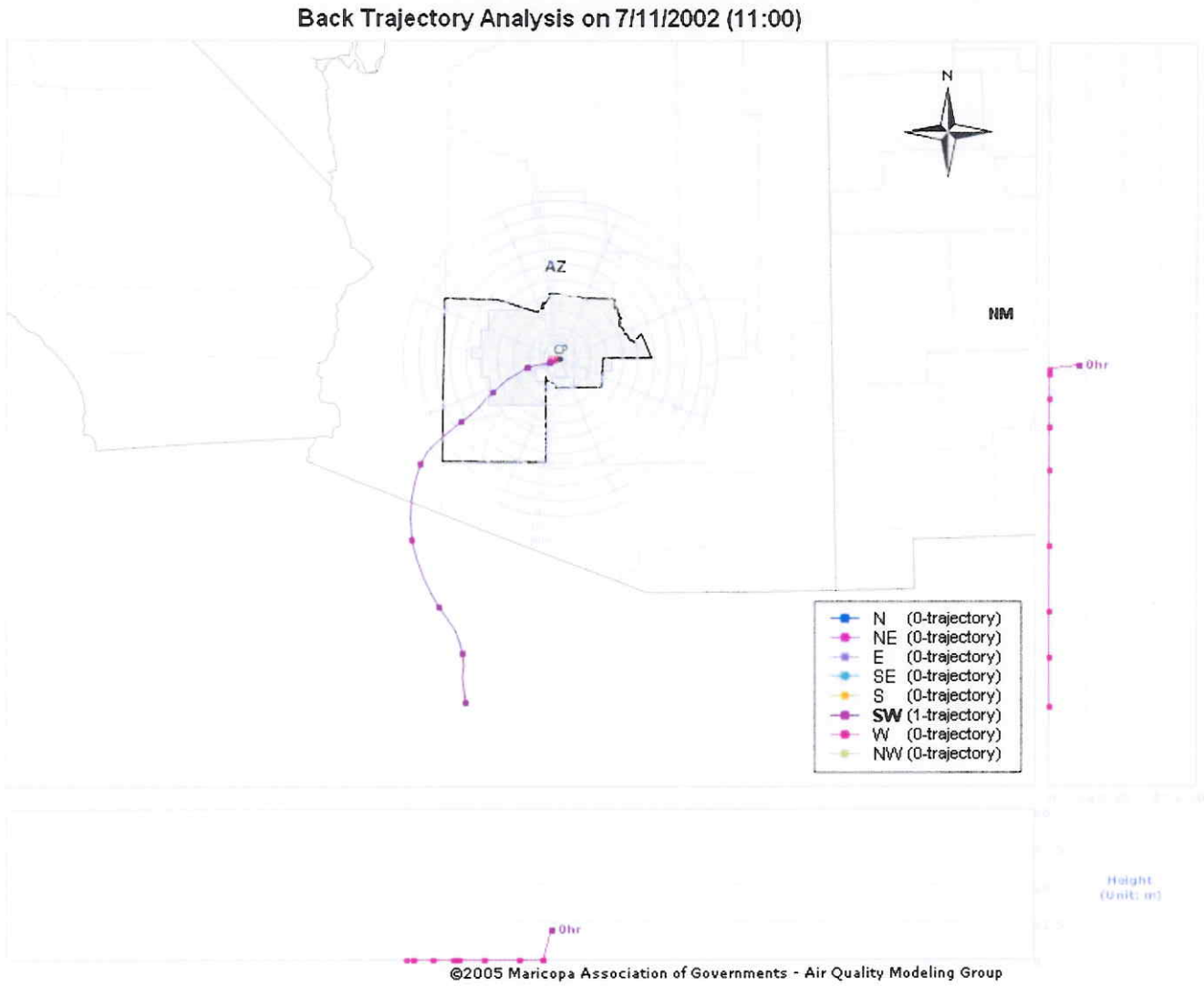


Figure F.1.3 Backward trajectory for the July 8-14, 2002 episode (start time: July 11, 2002 11:00 am, start height: 10 m)

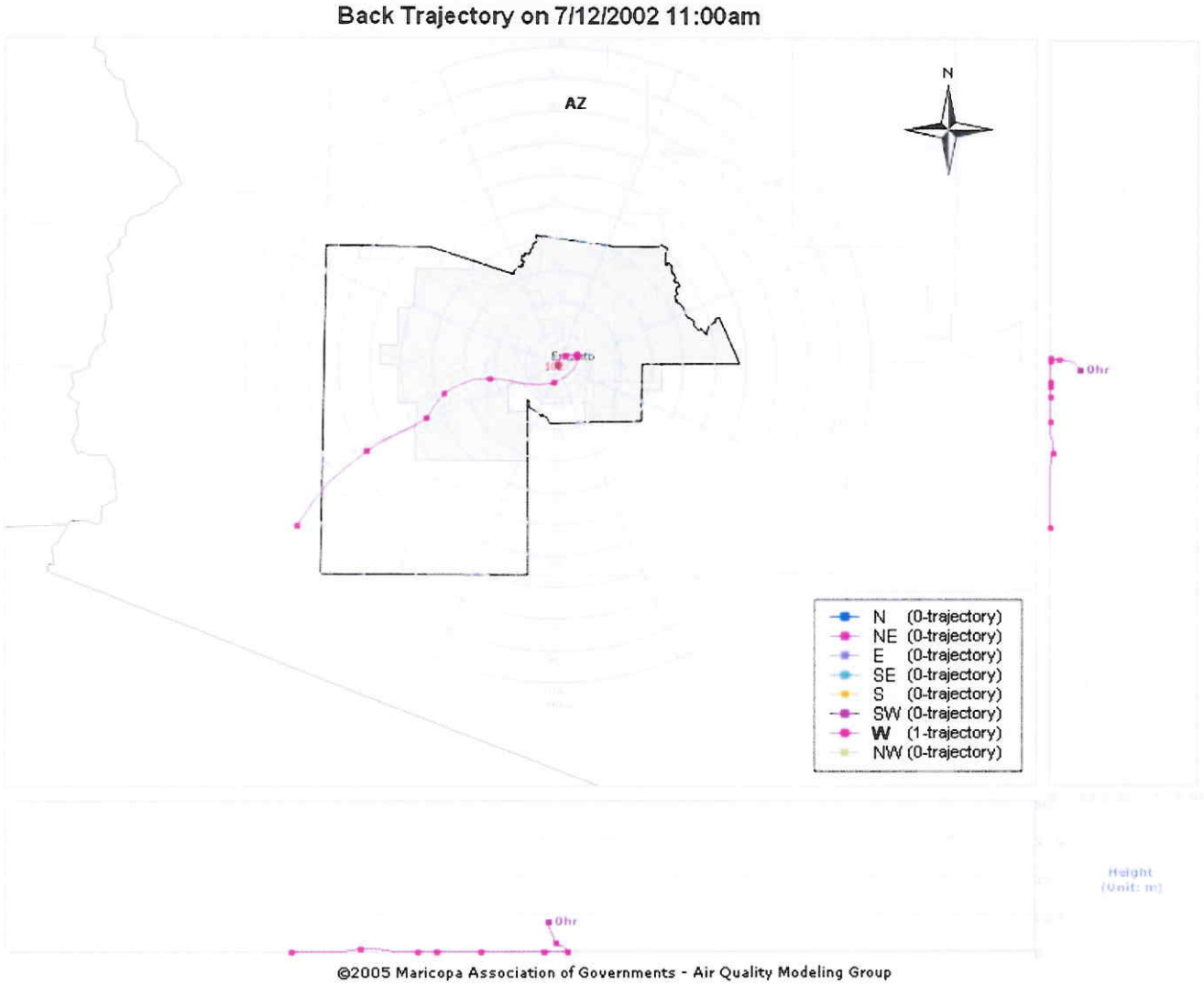


Figure F.1.4 Backward trajectory for the July 8-14, 2002 episode (start time: July 12, 2002 11:00 am, start height: 10 m)

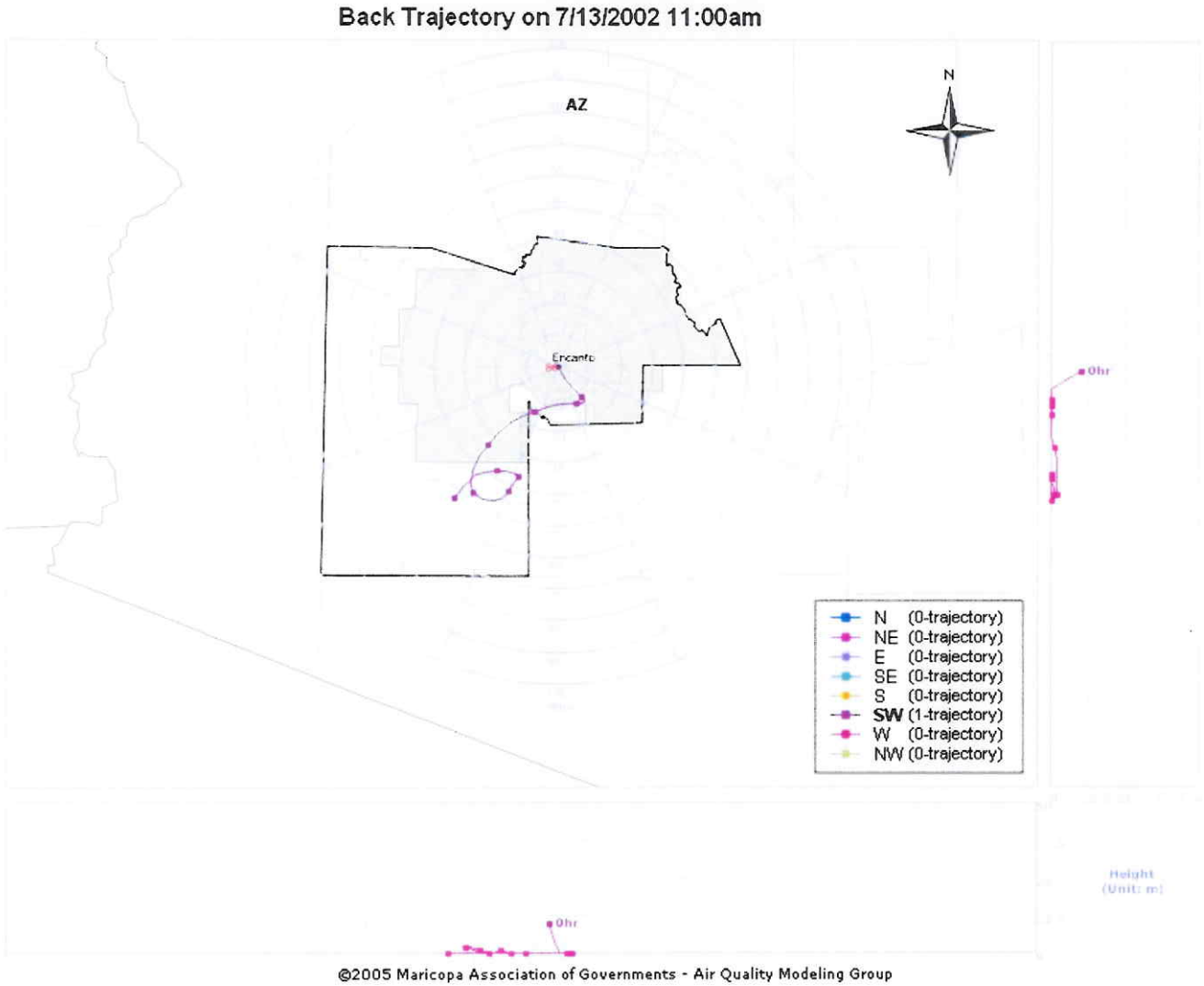


Figure F.1.5 Backward trajectory for the July 8-14, 2002 episode (start time: July 13, 2002 11:00 am, start height: 10 m)

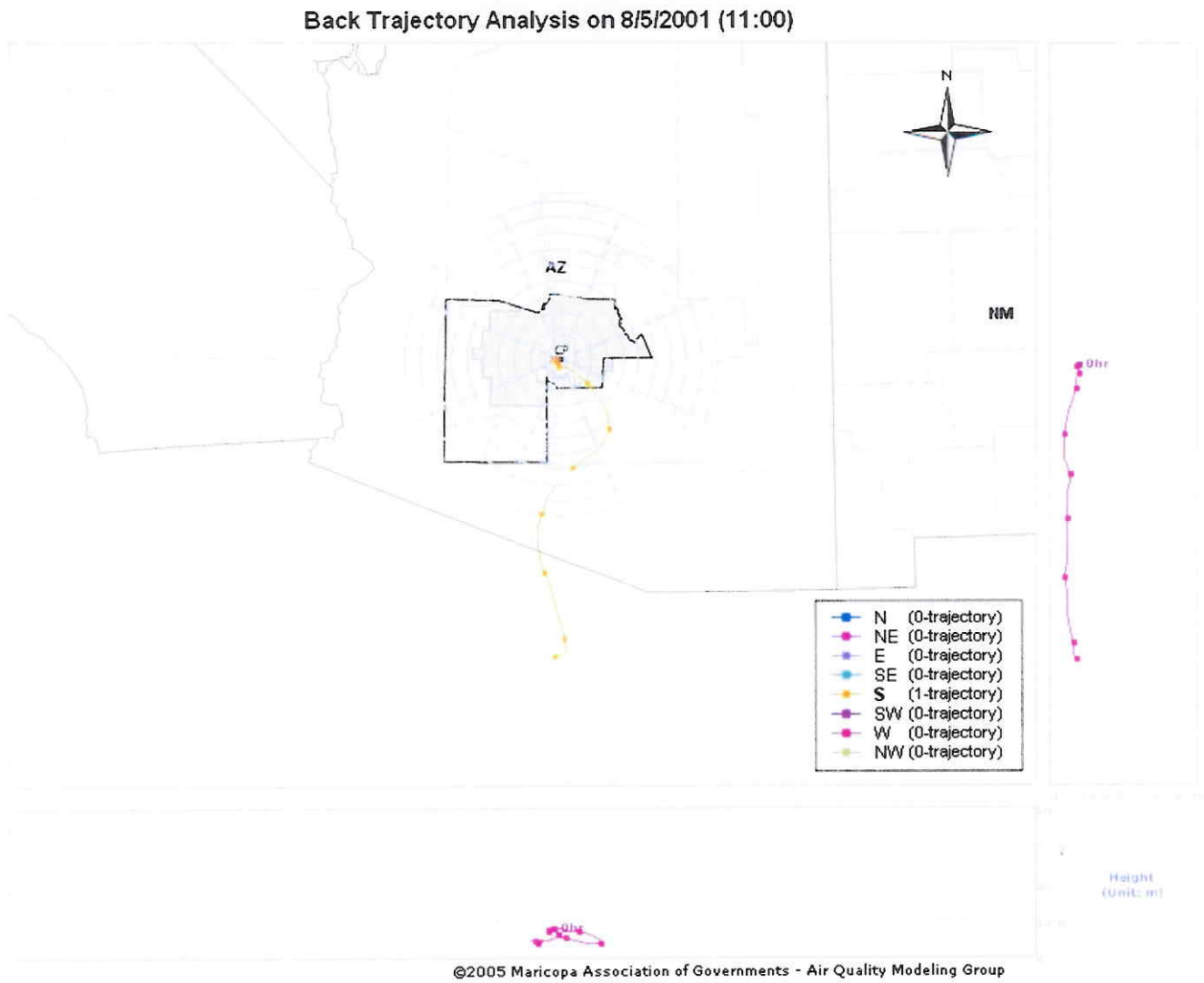


Figure F.2.1 Backward trajectory for the August 5-11, 2001 episode (start time: August 5, 2001 11:00 am, start height: 10 m)

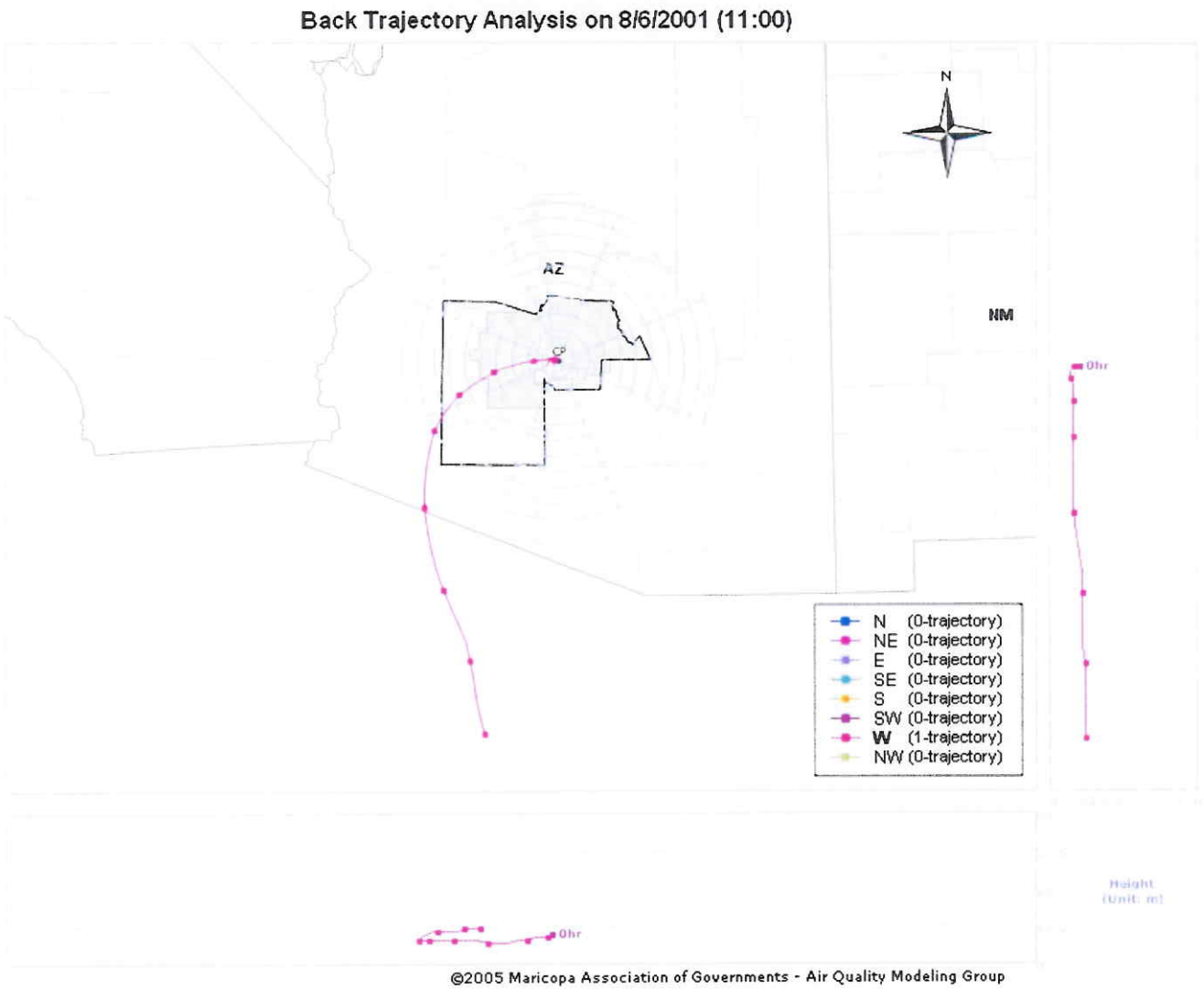


Figure F.2.2 Backward trajectory for the August 5-11, 2001 episode (start time: August 6, 2001 11:00 am, start height: 10 m)

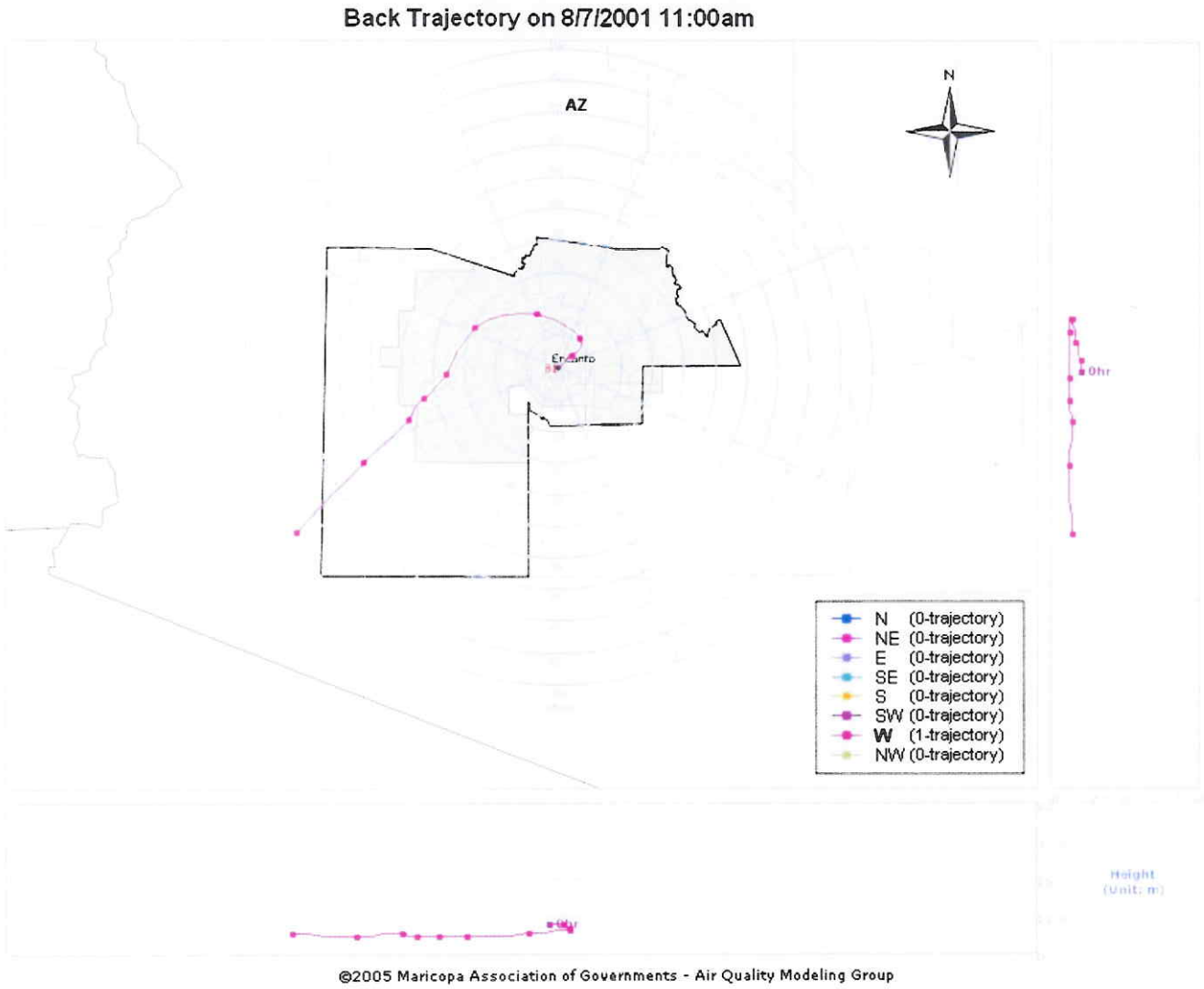


Figure F.2.3 Backward trajectory for the August 5-11, 2001 episode (start time: August 7, 2001 11:00 am, start height: 10 m)

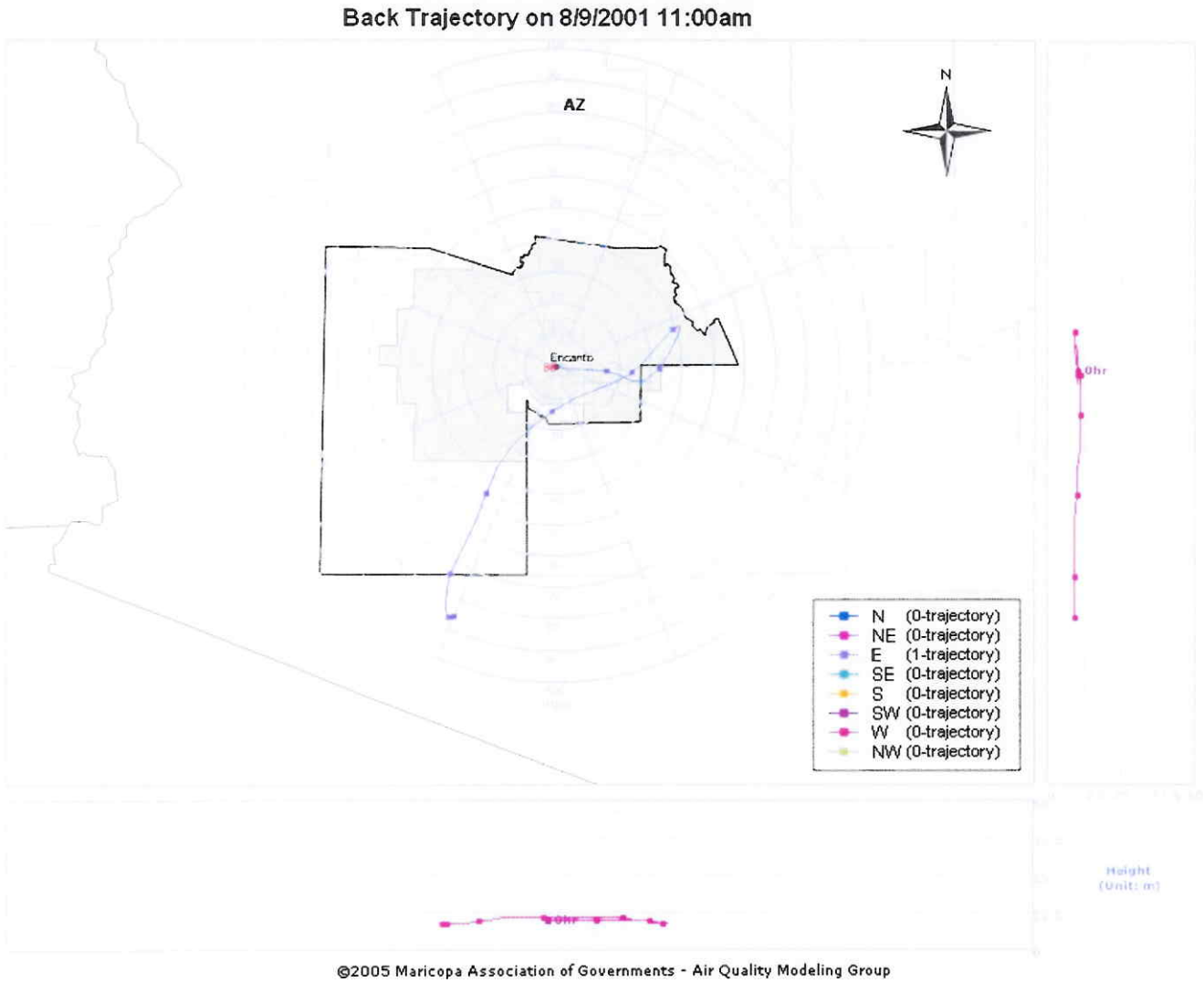


Figure F.2.4 Backward trajectory for the August 5-11, 2001 episode (start time: August 9, 2001 11:00 am, start height: 10 m)

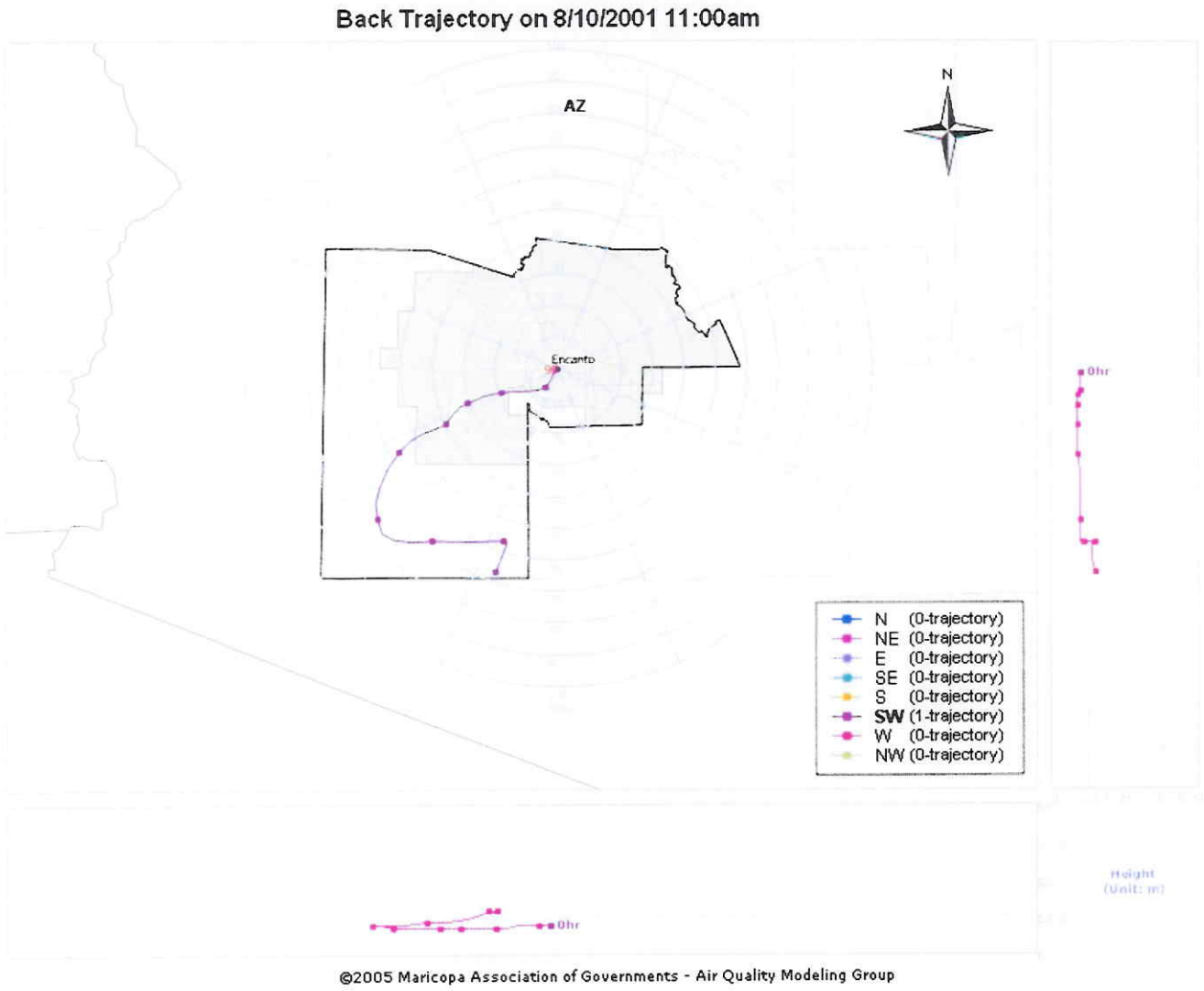


Figure F.2.5 Backward trajectory for the August 5-11, 2001 episode (start time: August 10, 2001 11:00 am, start height: 10 m)

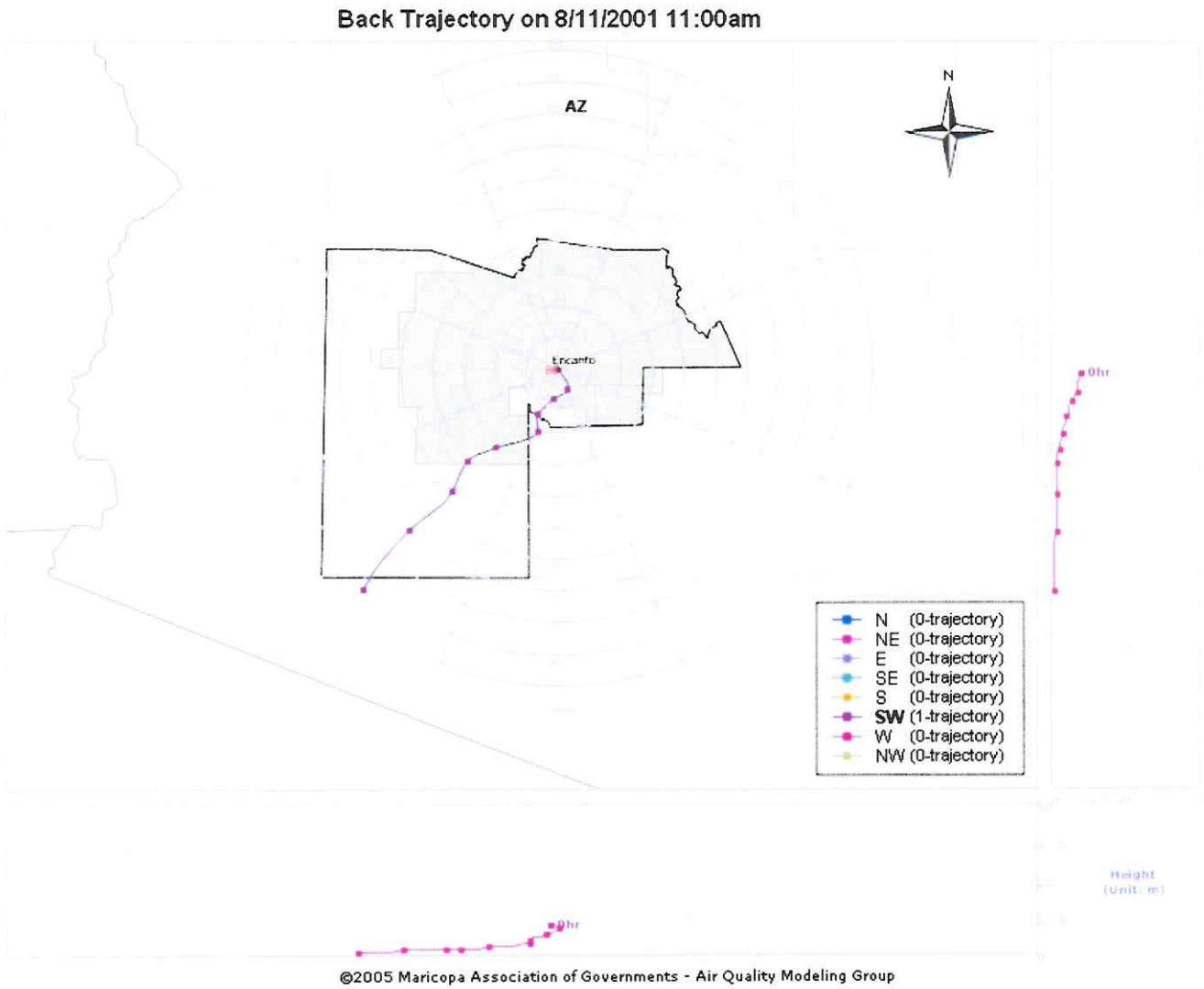


Figure F.2.5 Backward trajectory for the August 5-11, 2001 episode (start time: August 10, 2001 11:00 am, start height: 10 m)

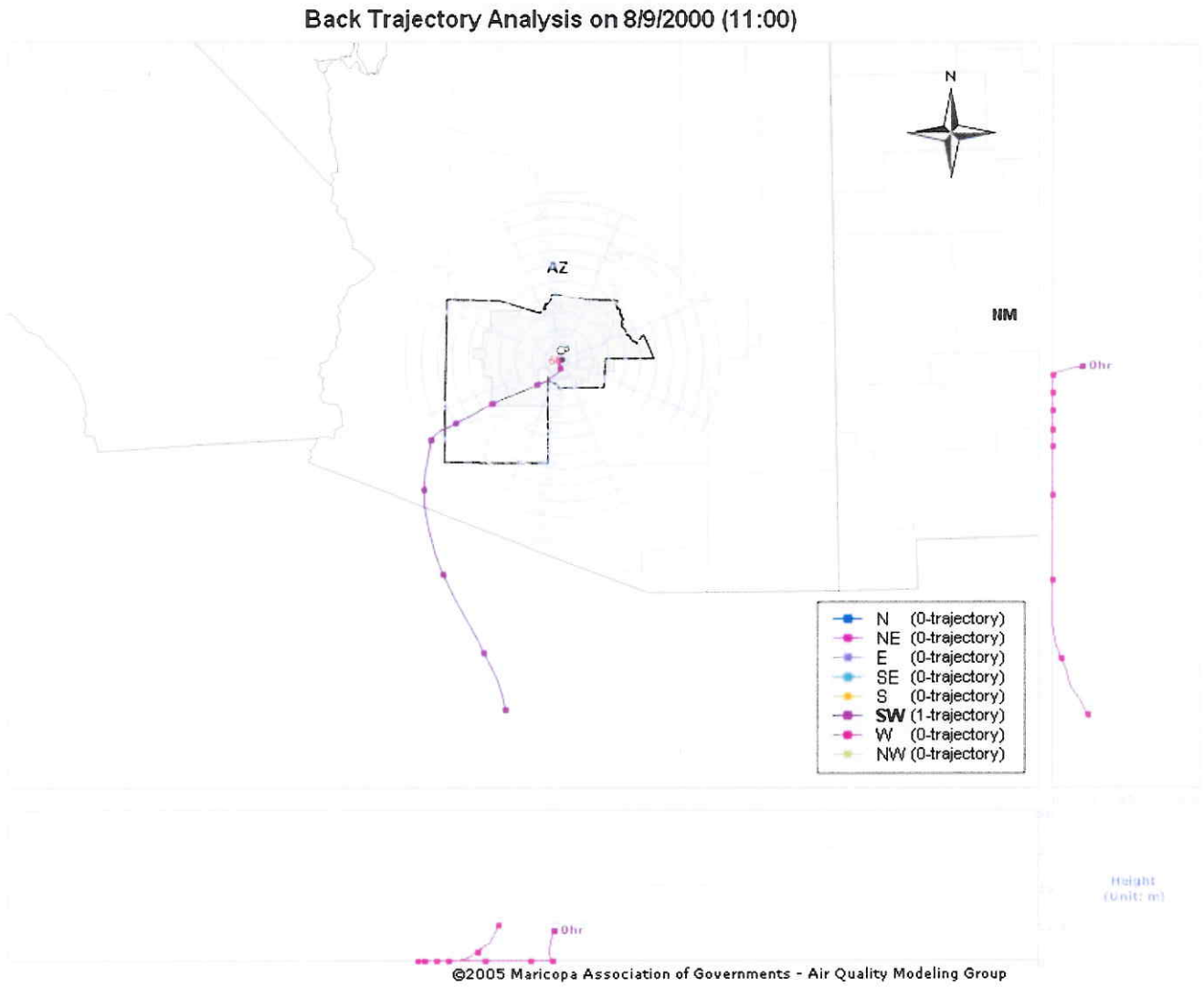


Figure F.3.1 Backward trajectory for the August 9-15, 2000 episode (start time: August 9, 2000 11:00 am, start height: 10 m)

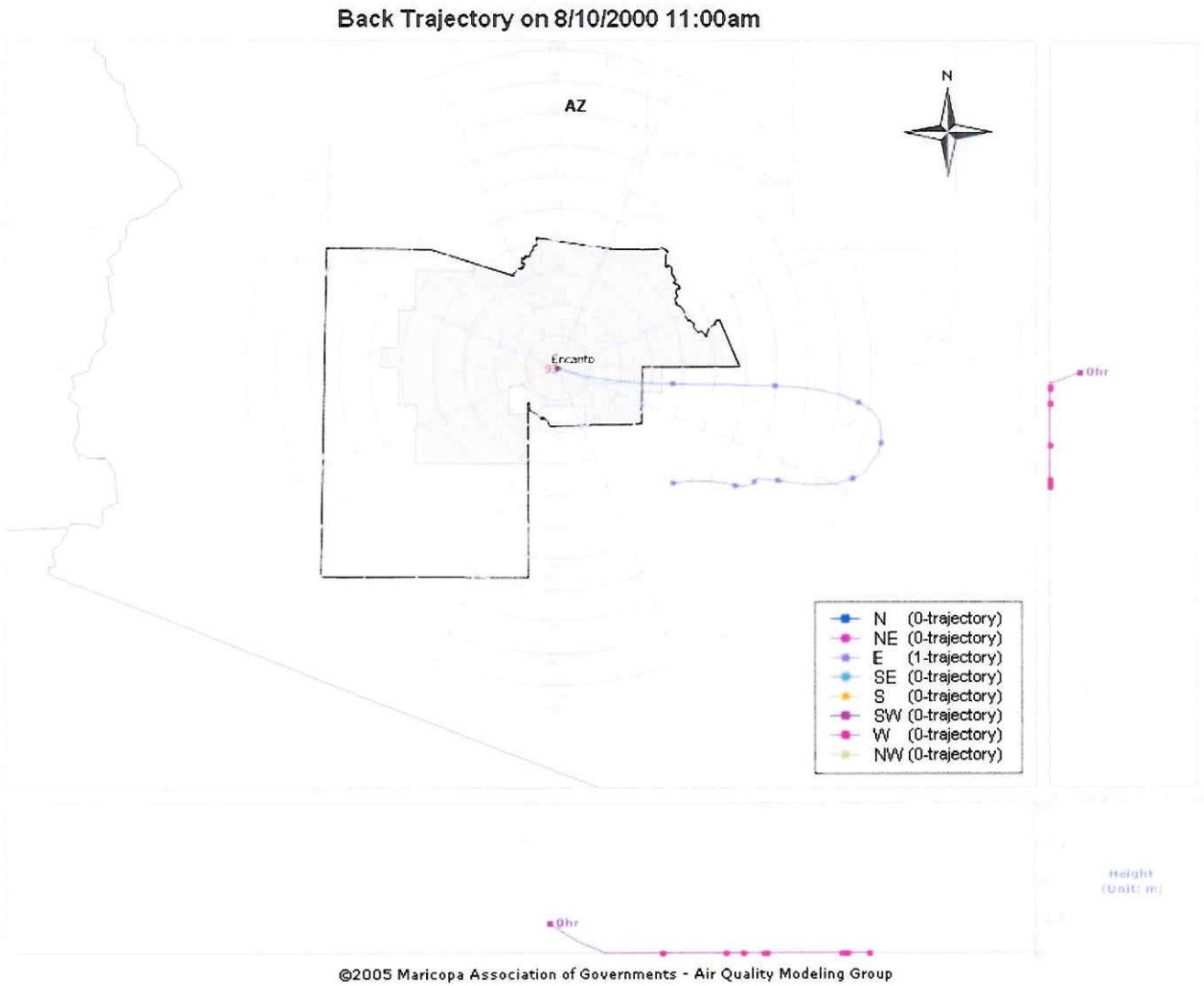


Figure F.3.2 Backward trajectory for the August 9-15, 2000 episode (start time: August 10, 2000 11:00 am, start height: 10 m)

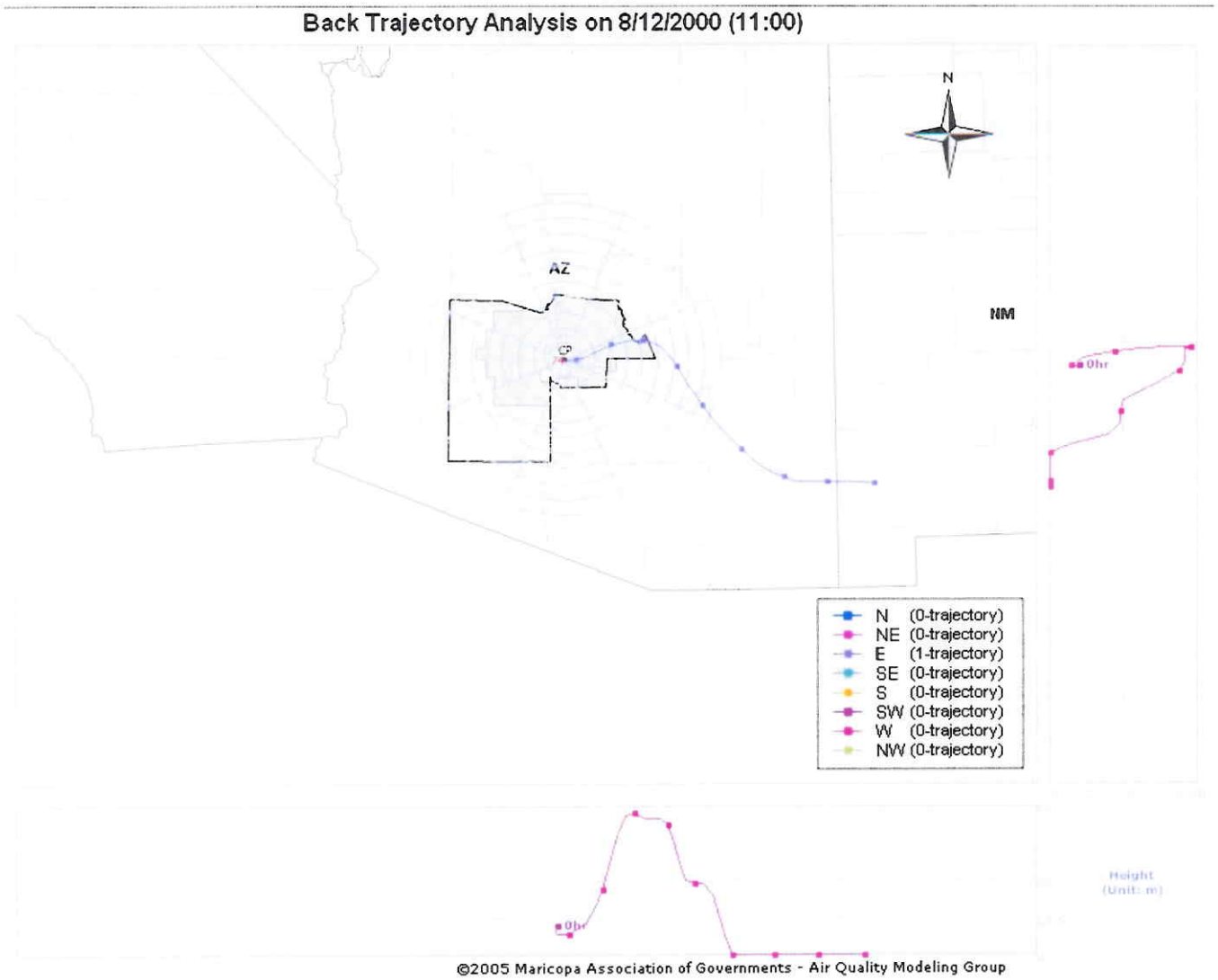


Figure F.3.3 Backward trajectory for the August 9-15, 2000 episode (start time: August 12, 2000 11:00 am, start height: 10 m)

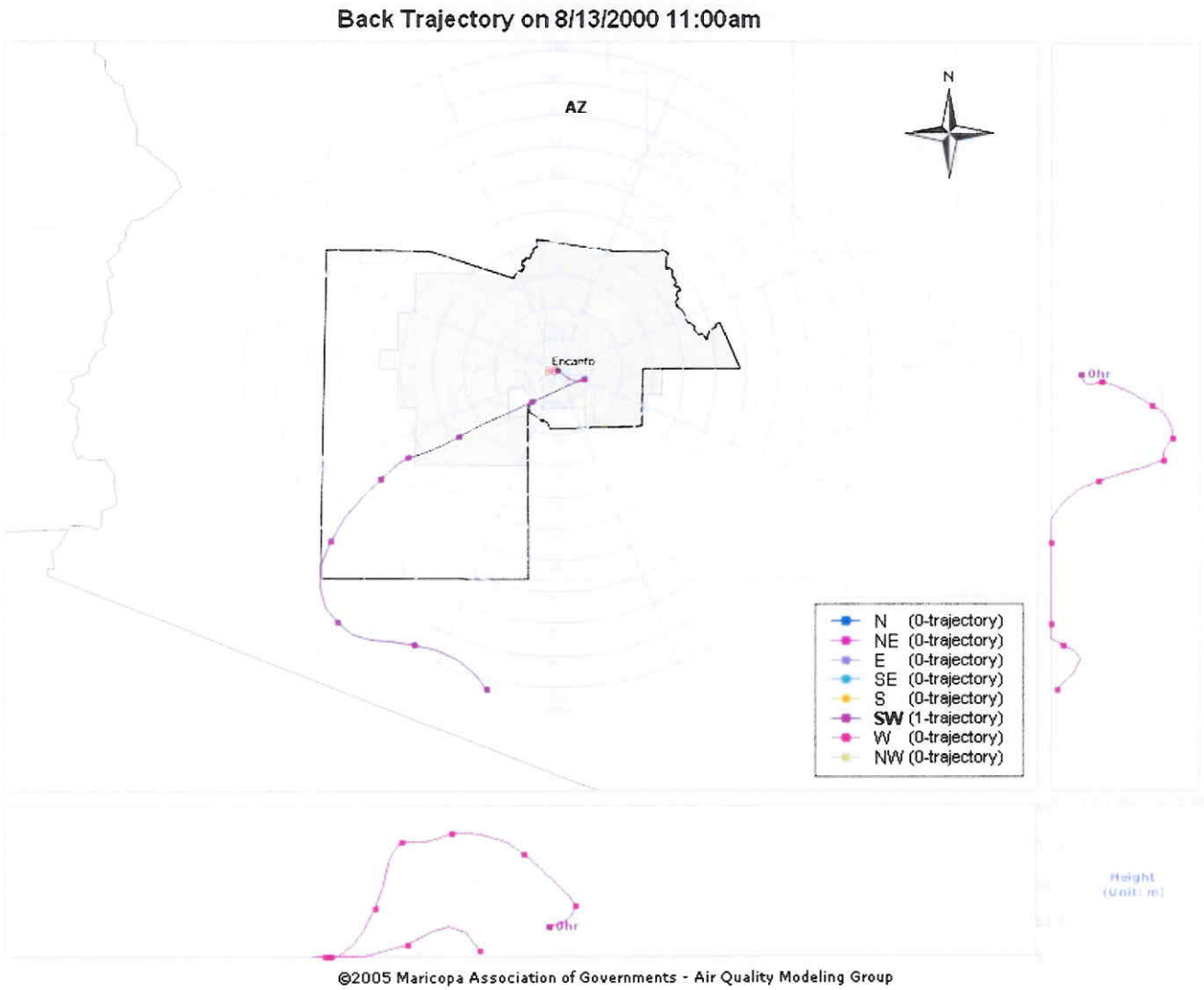


Figure F.3.4 Backward trajectory for the August 9-15, 2000 episode (start time: August 13, 2000 11:00 am, start height: 10 m)

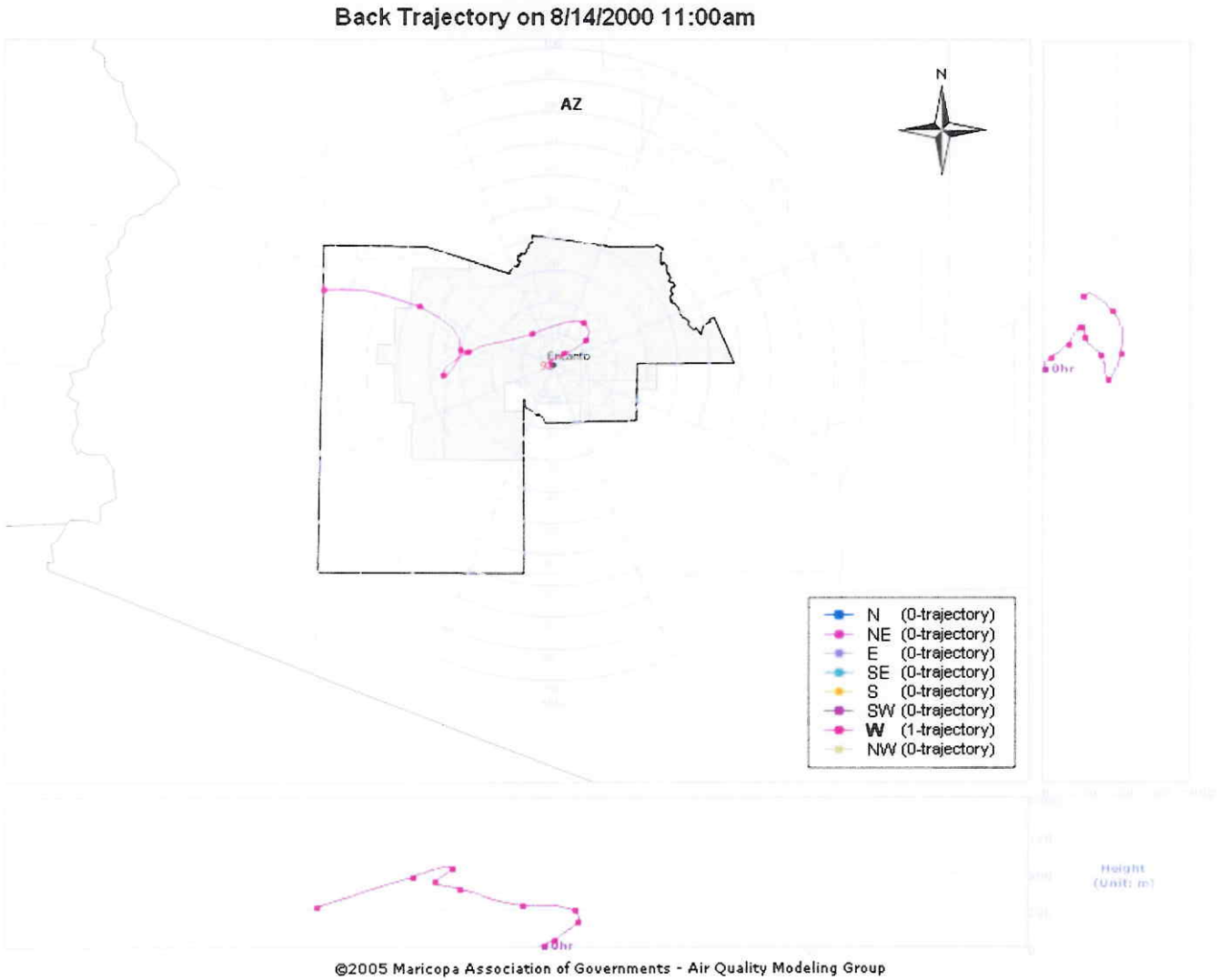


Figure F.3.5 Backward trajectory for the August 9-15, 2000 episode (start time: August 14, 2000 11:00 am, start height: 10 m)

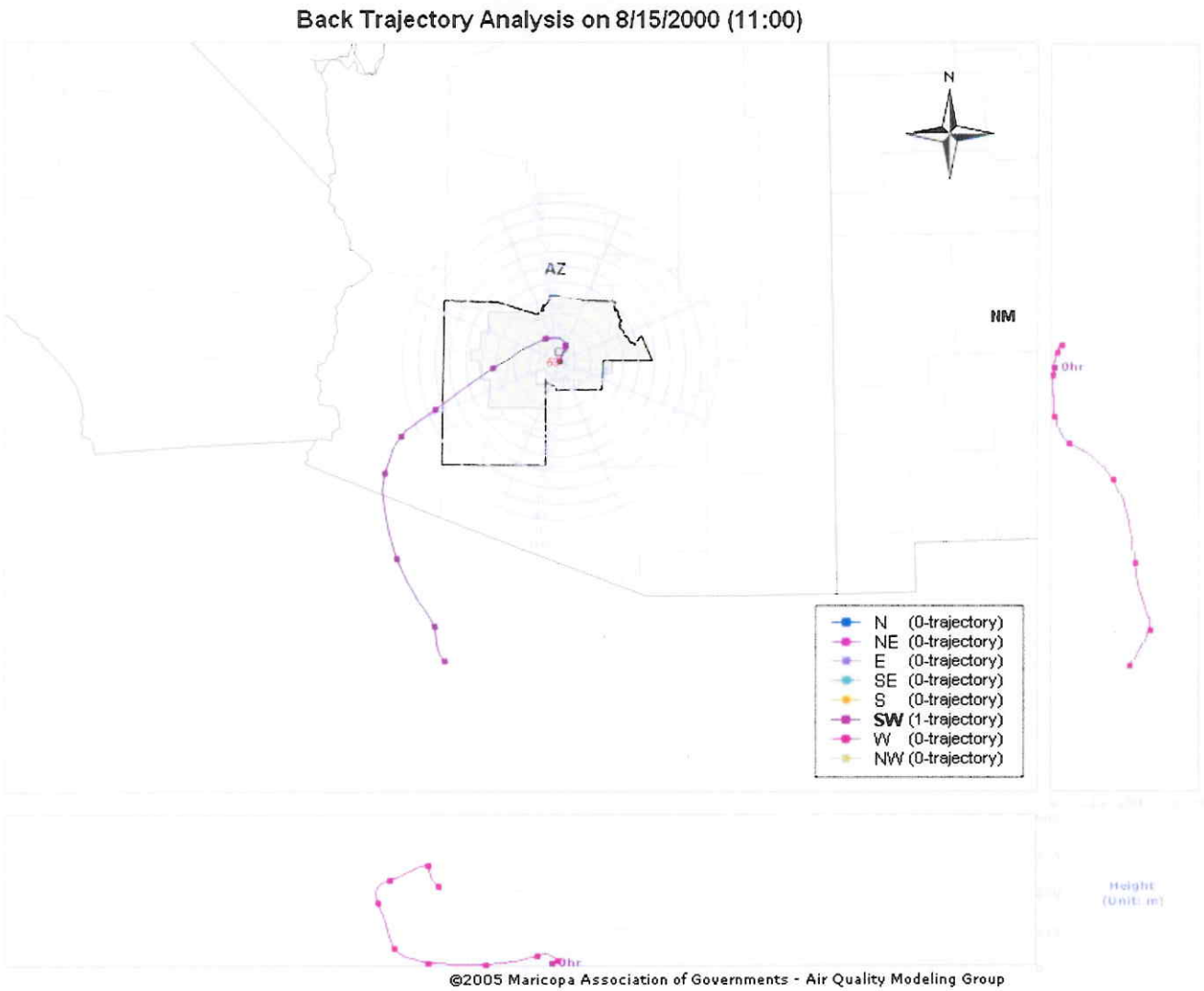


Figure F.3.6 Backward trajectory for the August 9-15, 2000 episode (start time: August 15, 2000 11:00 am, start height: 10 m)

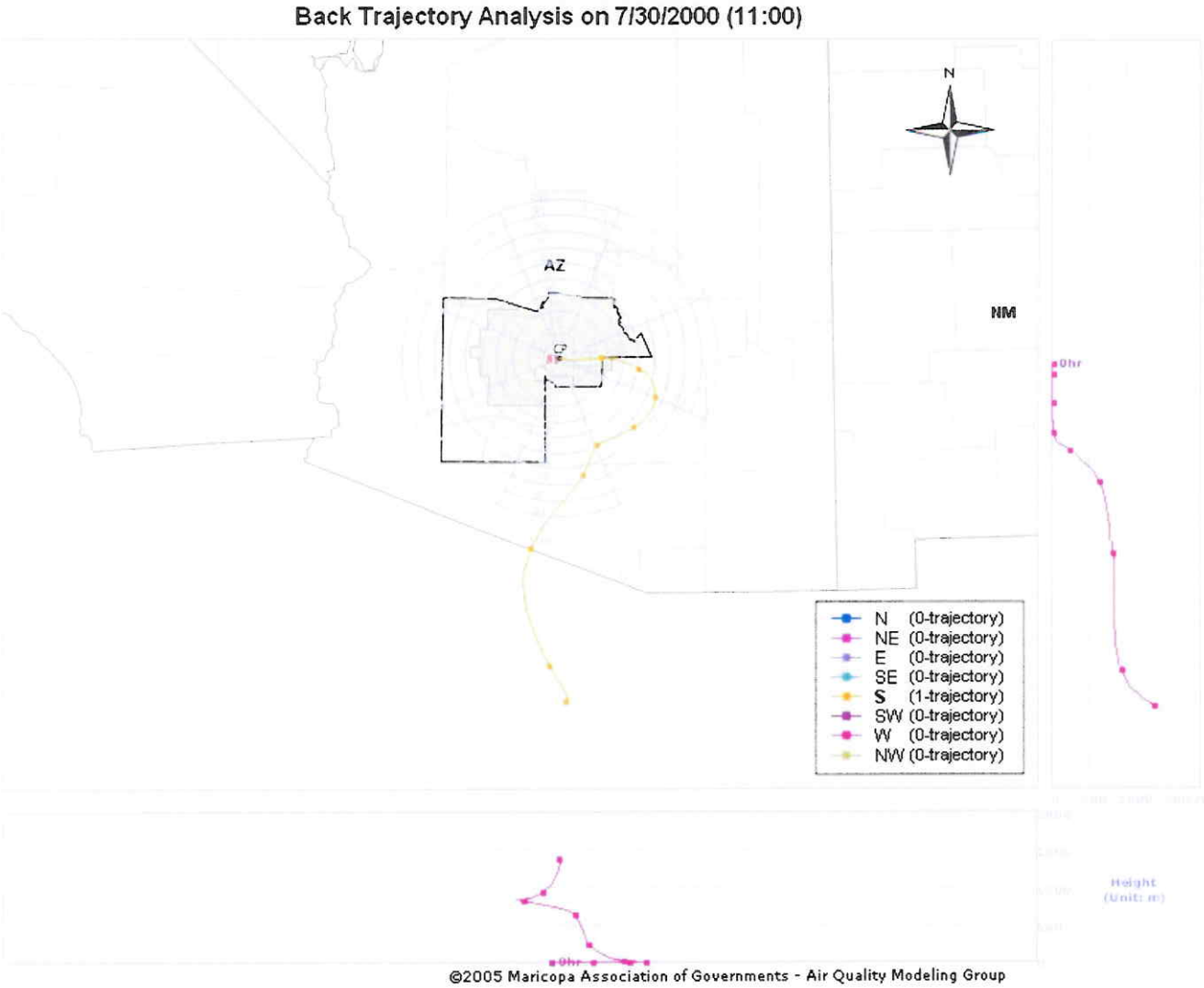


Figure F.4.1 Backward trajectory for the July 30-August 5, 2000 episode (start time: July 30, 2000 11:00 am, start height: 10 m)

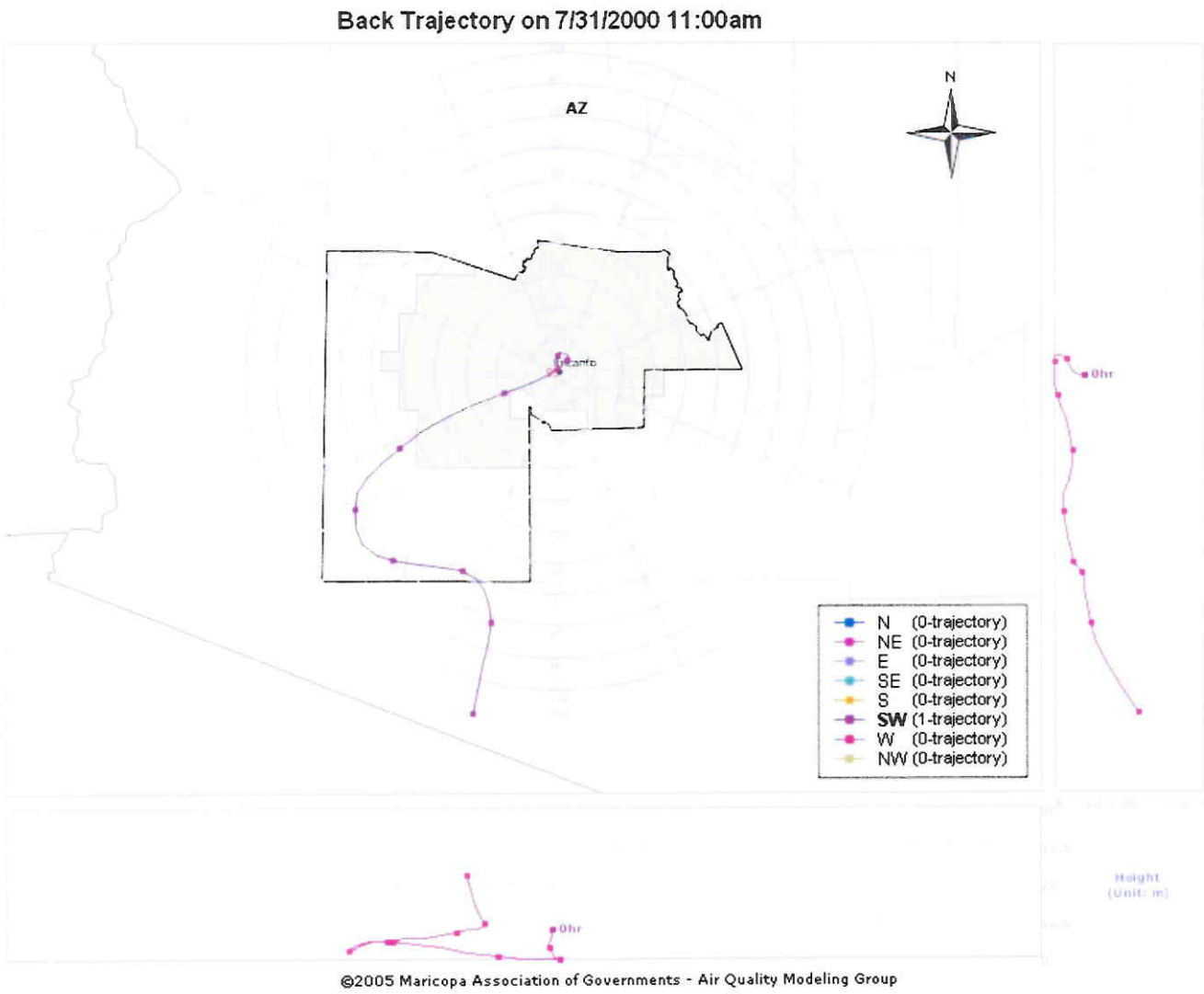


Figure F.4.2 Backward trajectory for the July 30-August 5, 2000 episode (start time: July 31, 2000 11:00 am, start height: 10 m)

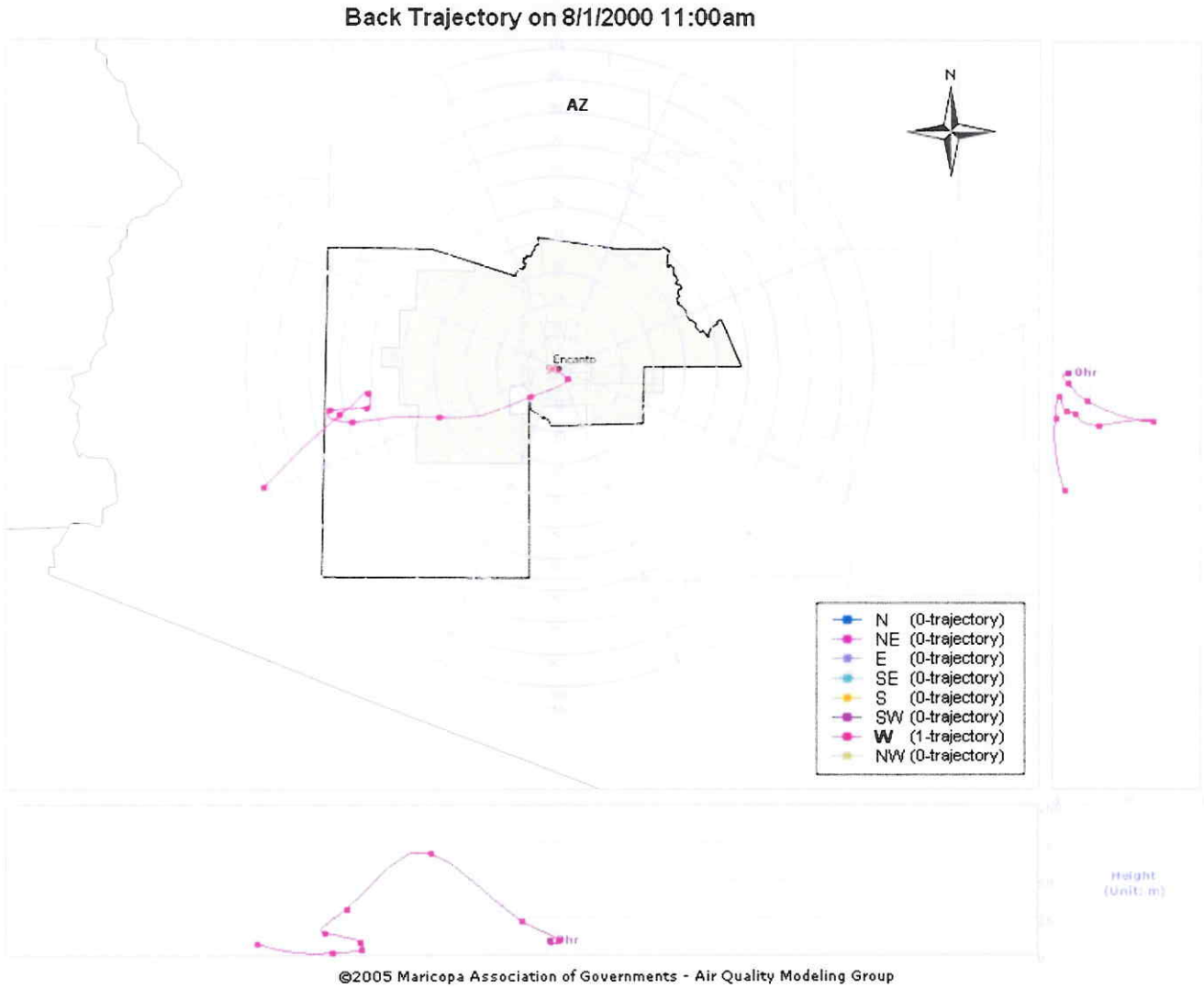


Figure F.4.3 Backward trajectory for the July 30-August 5, 2000 episode (start time: August 1, 2000 11:00 am, start height: 10 m)

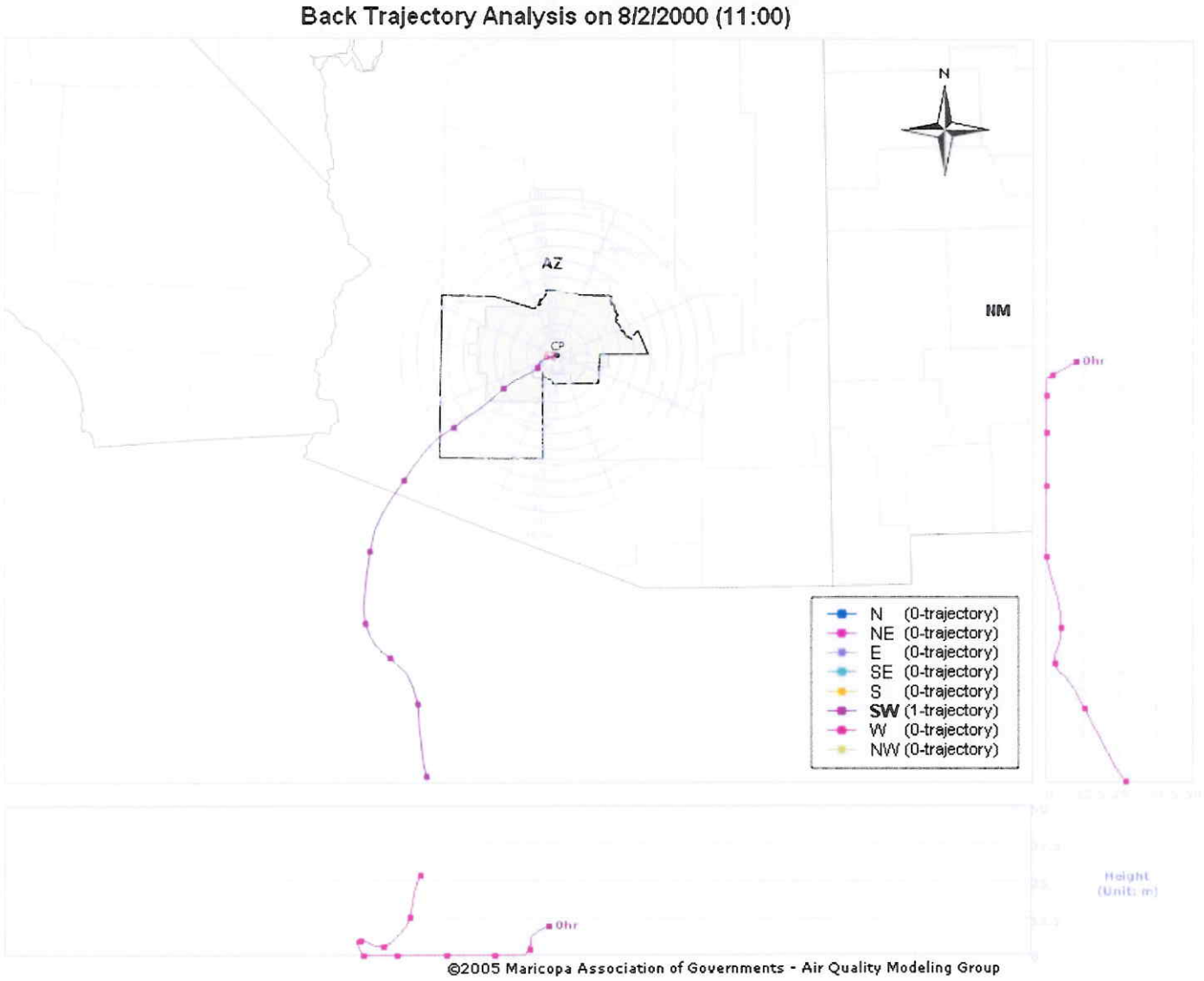


Figure F.4.4 Backward trajectory for the July 30-August 5, 2000 episode (start time: August 2, 2000 11:00 am, start height: 10 m)

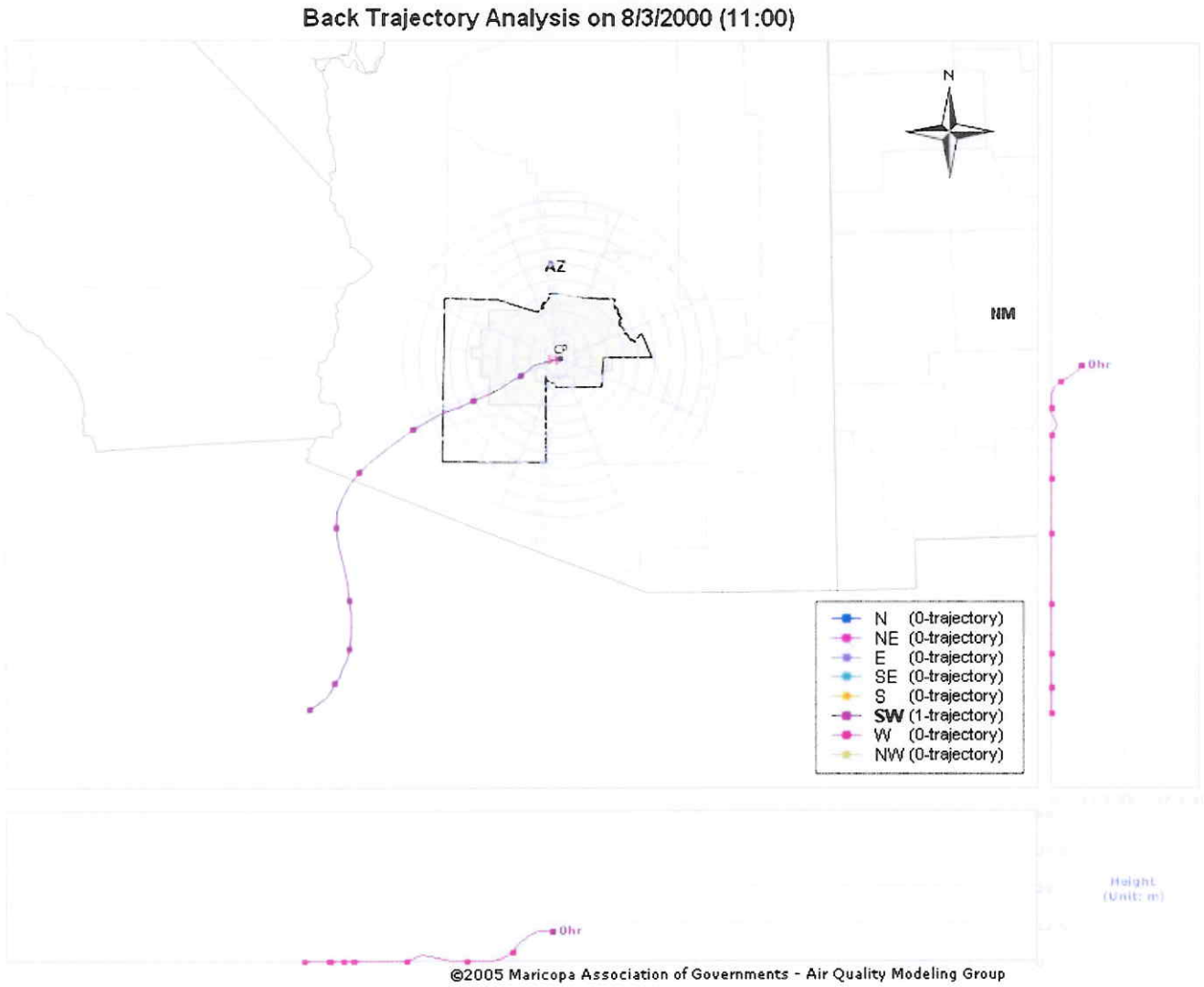


Figure F.4.5 Backward trajectory for the July 30-August 5, 2000 episode (start time: August 3, 2000 11:00 am, start height: 10 m)

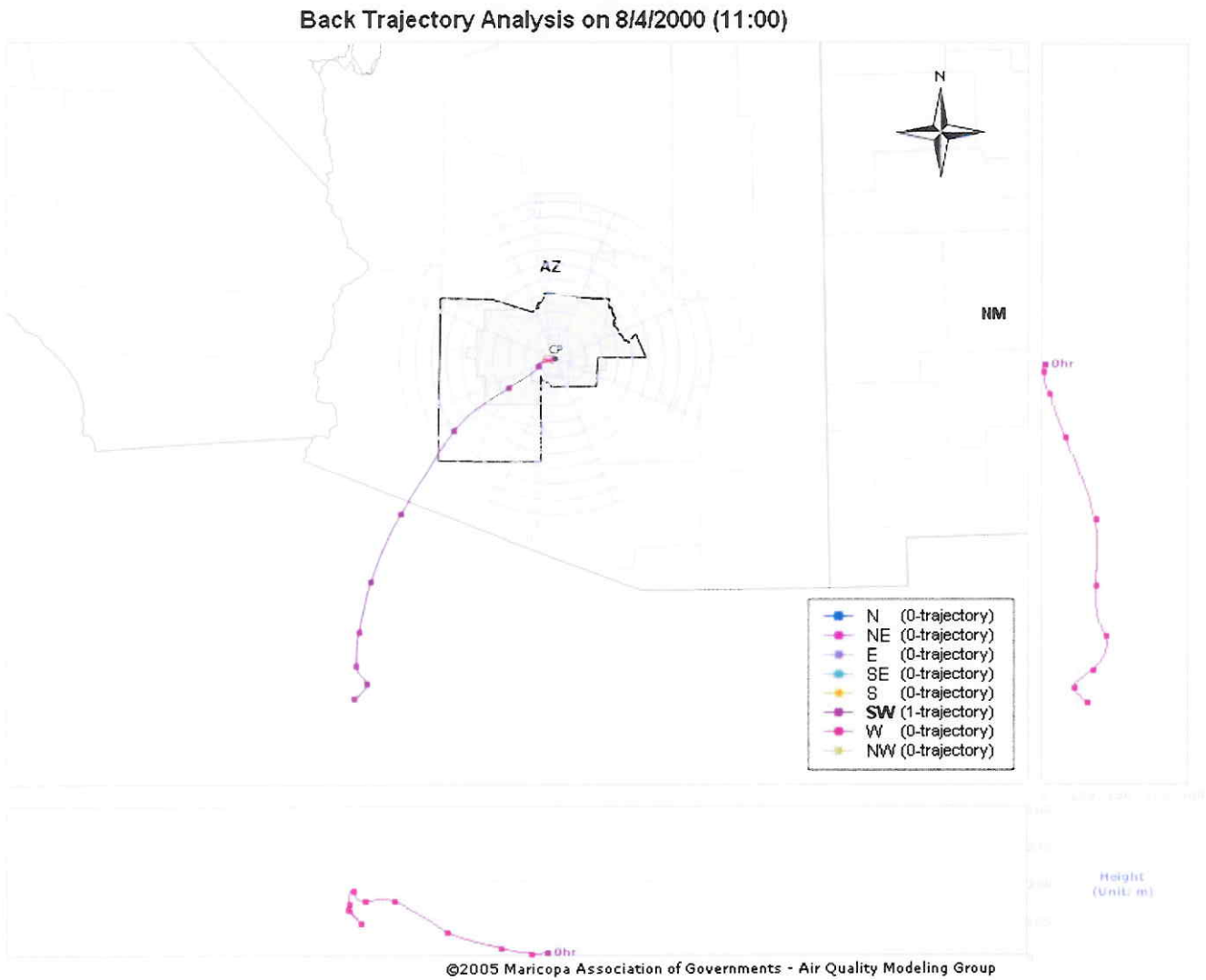


Figure F.4.6 Backward trajectory for the July 30-August 5, 2000 episode (start time: August 4, 2000 11:00 am, start height: 10 m)

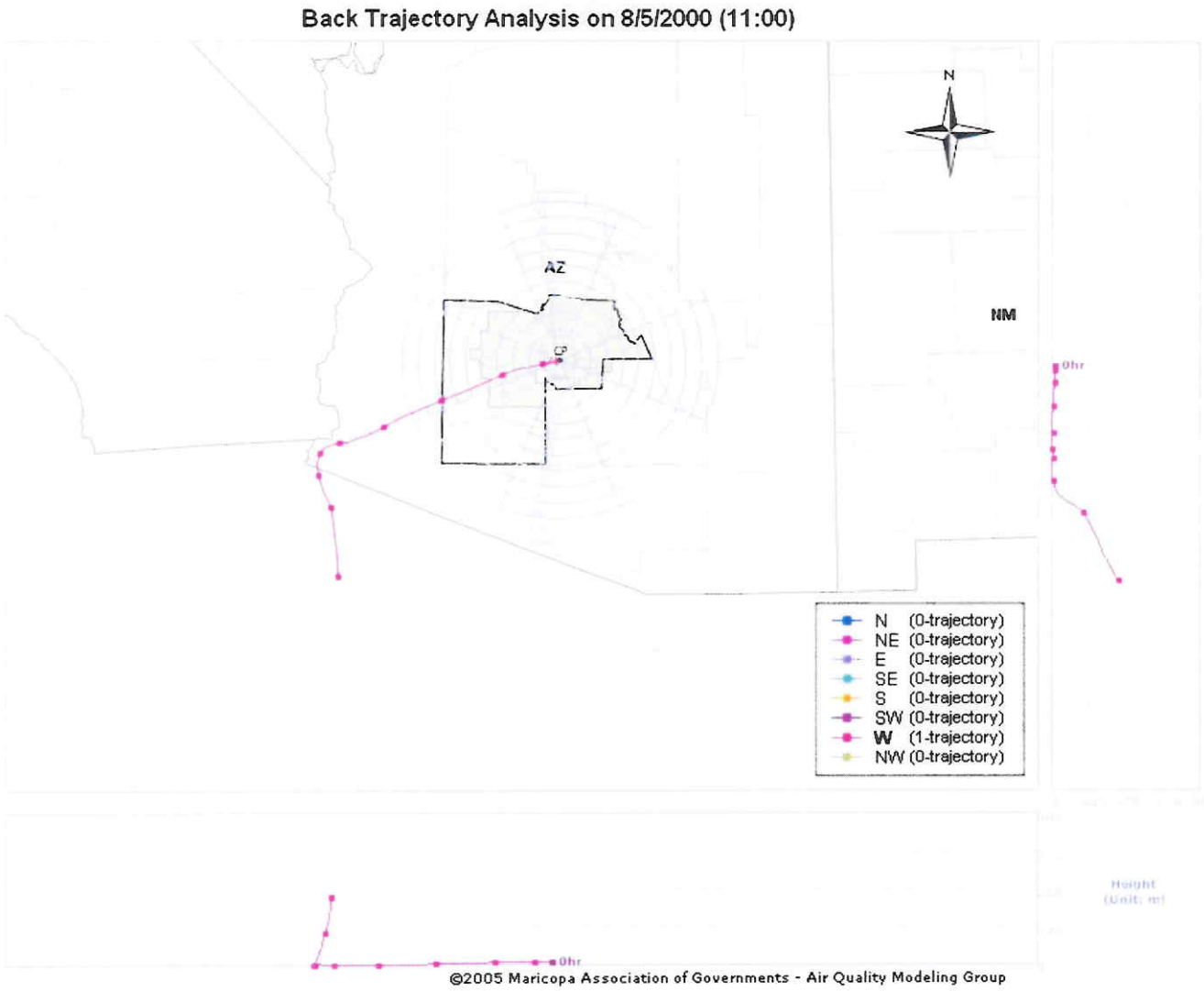


Figure F.4.7 Backward trajectory for the July 30-August 5, 2000 episode (start time: August 5, 2000 11:00 am, start height: 10 m)

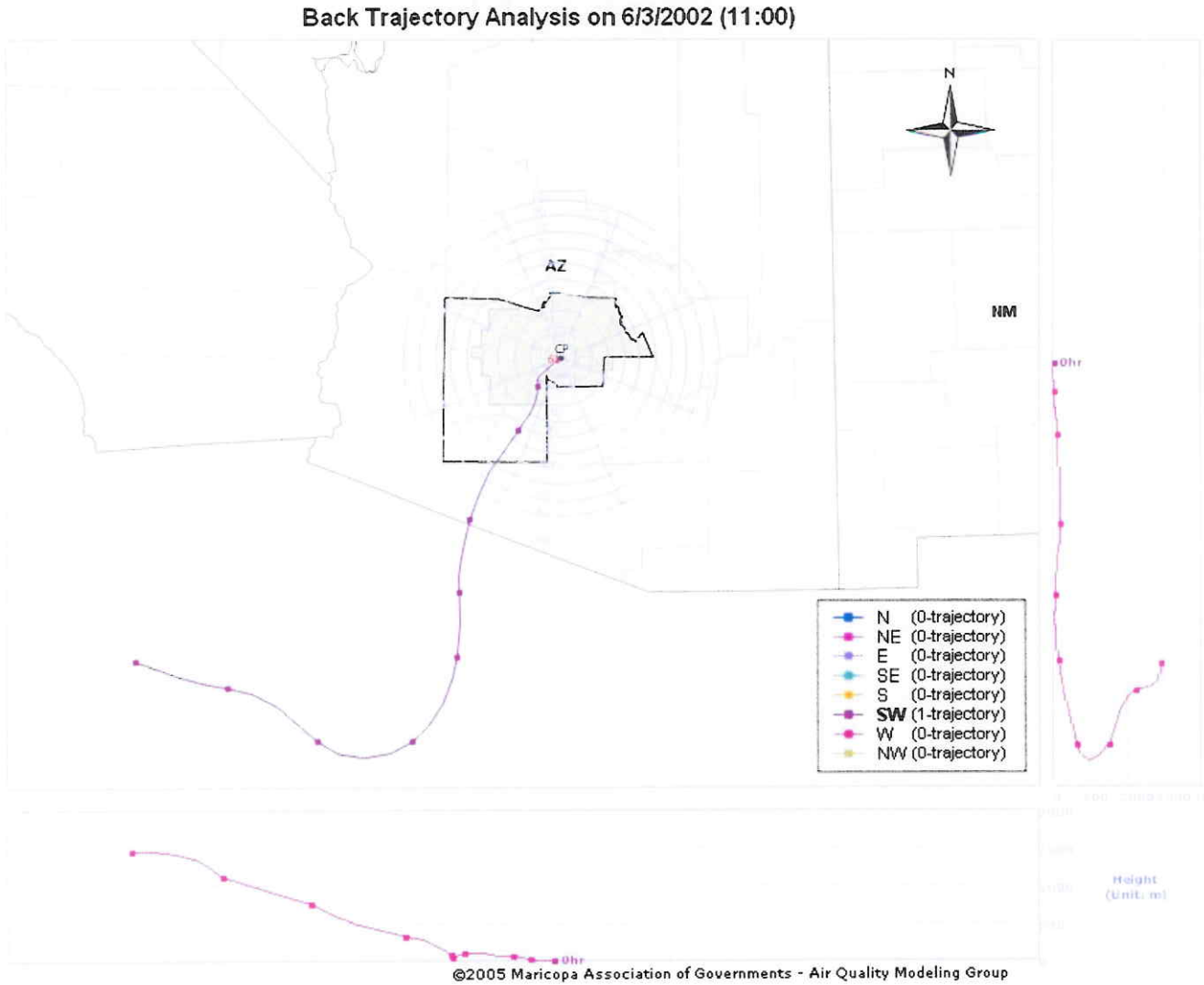


Figure F.5.1 Backward trajectory for the June 3-7, 2002 episode (start time: June 3, 2002 11:00 am, start height: 10 m)

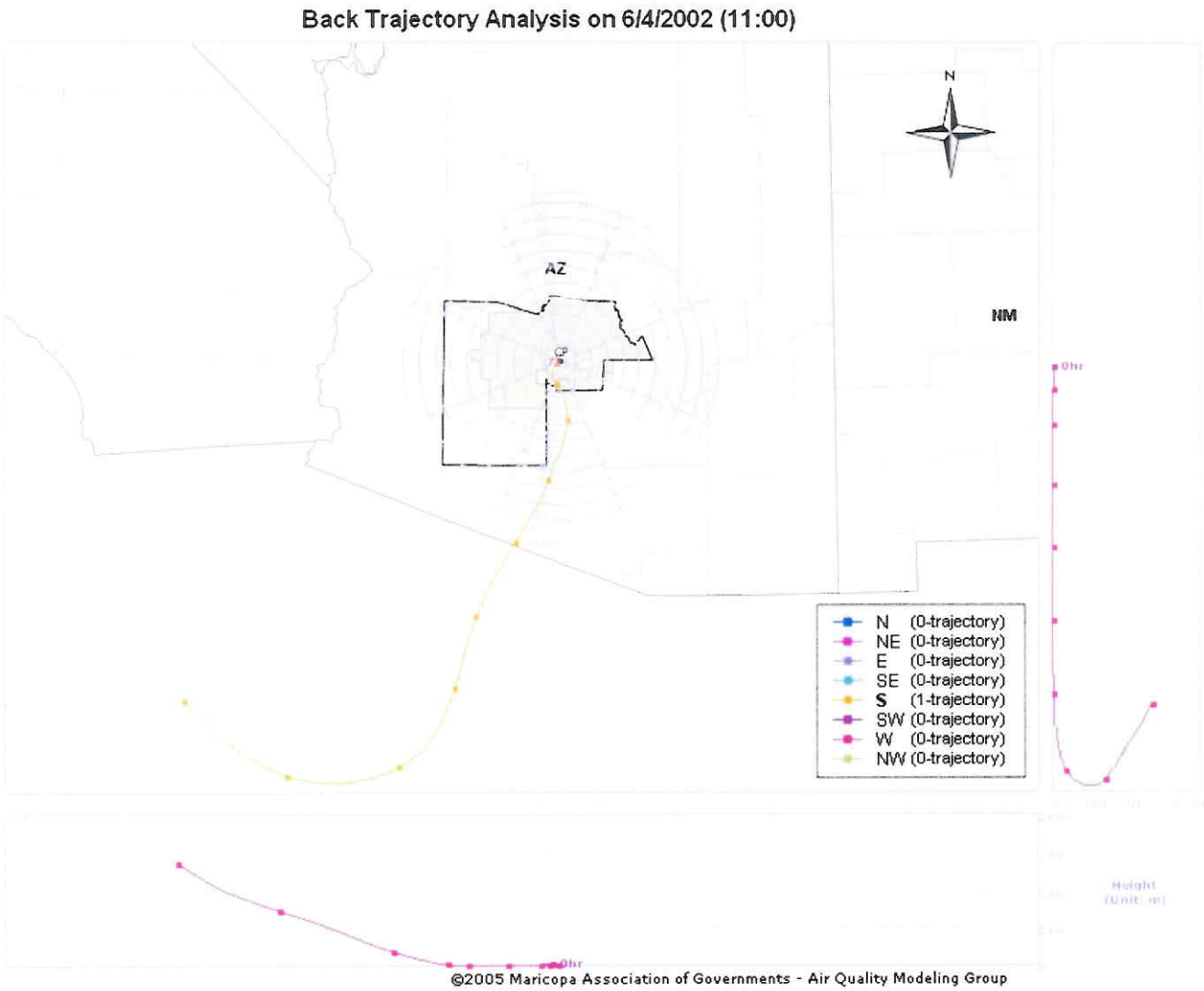


Figure F.5.2 Backward trajectory for the June 3-7, 2002 episode (start time: June 4, 2002 11:00 am, start height: 10 m)

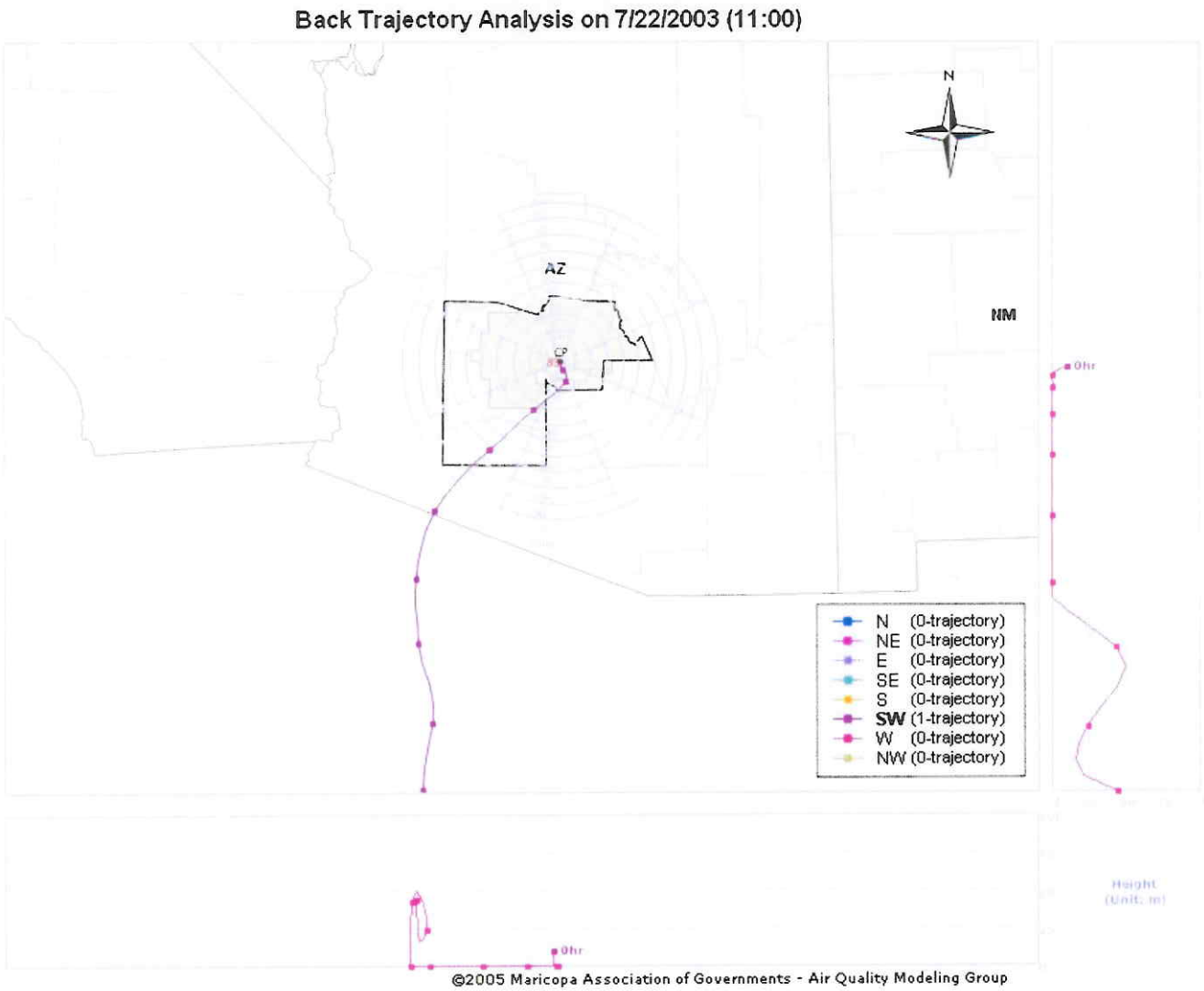


Figure F.6.2 Backward trajectory for the July 21-23, 2003 episode (start time: July 22, 2002 11:00 am, start height: 10 m)

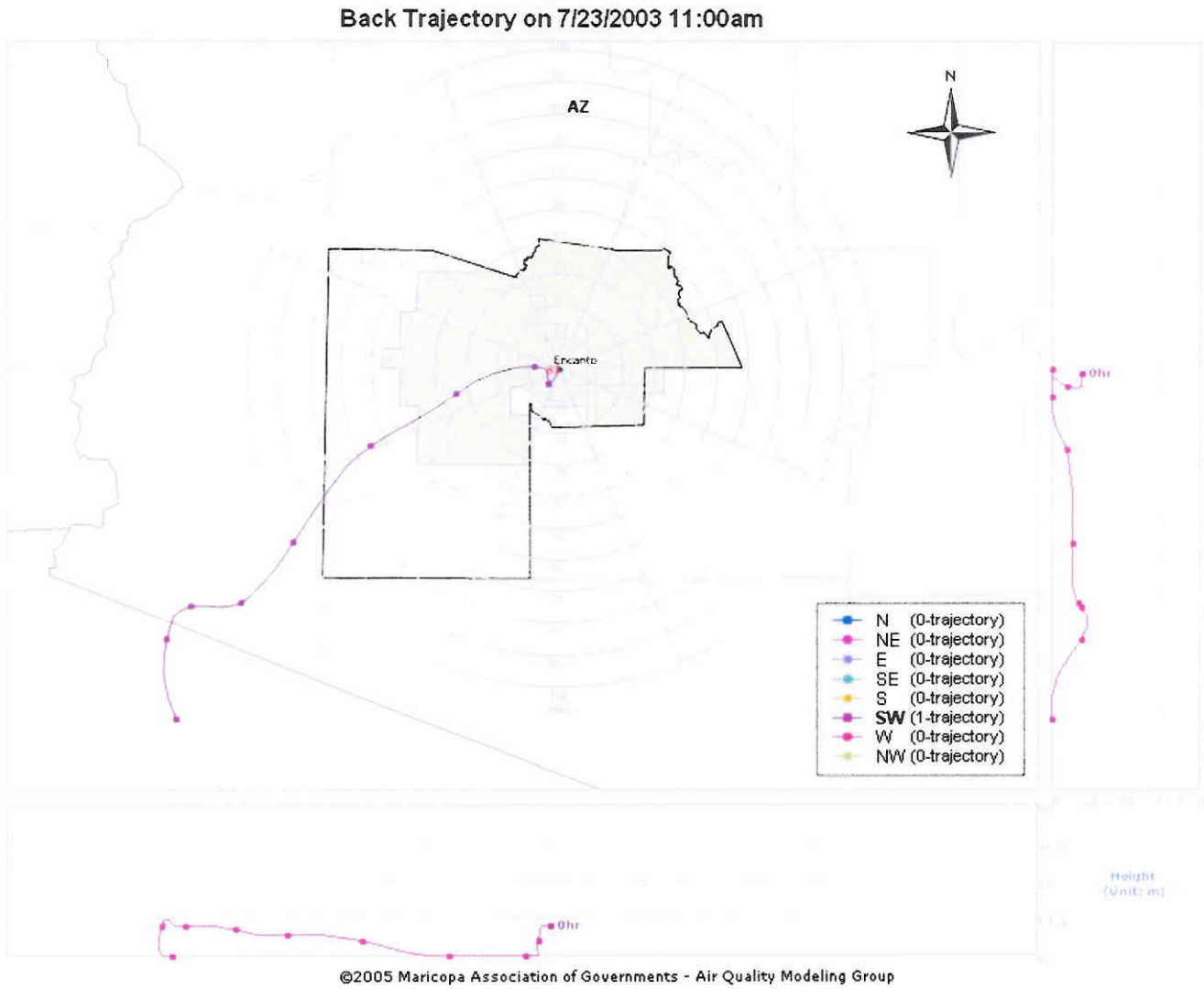


Figure F.6.3 Backward trajectory for the July 21-23, 2003 episode (start time: July 23, 2002 11:00 am, start height: 10 m)

APPENDIX G

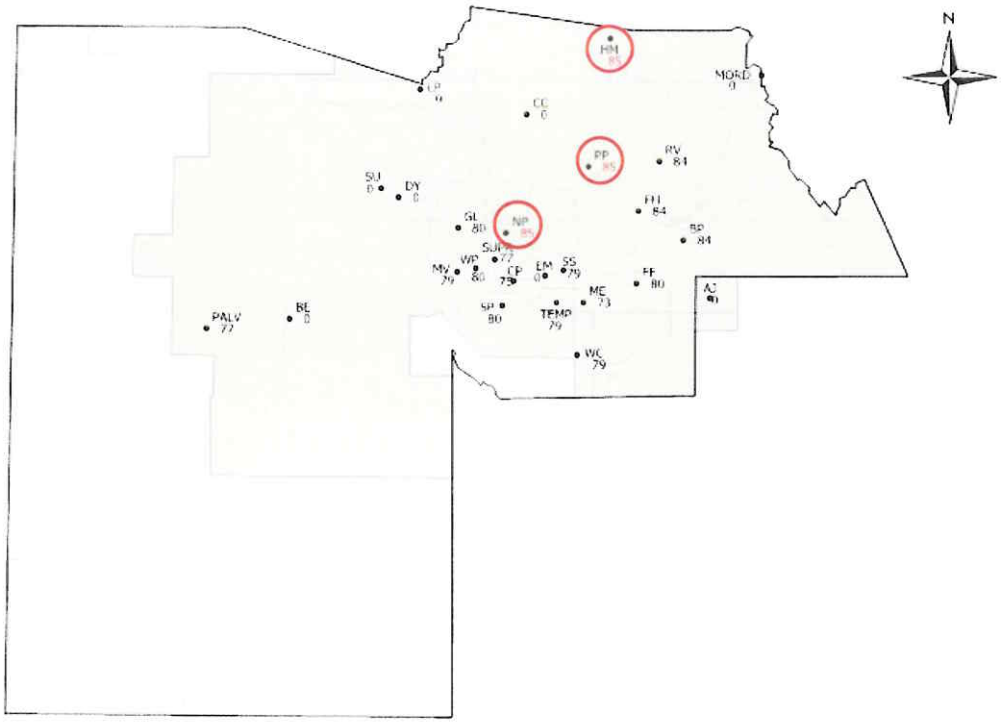
Conceptual Description for the Selected High Ozone Days in 2000-2004

This conceptual description following EPA's *Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS* provides additional information on the MNA's nonattainment problem.

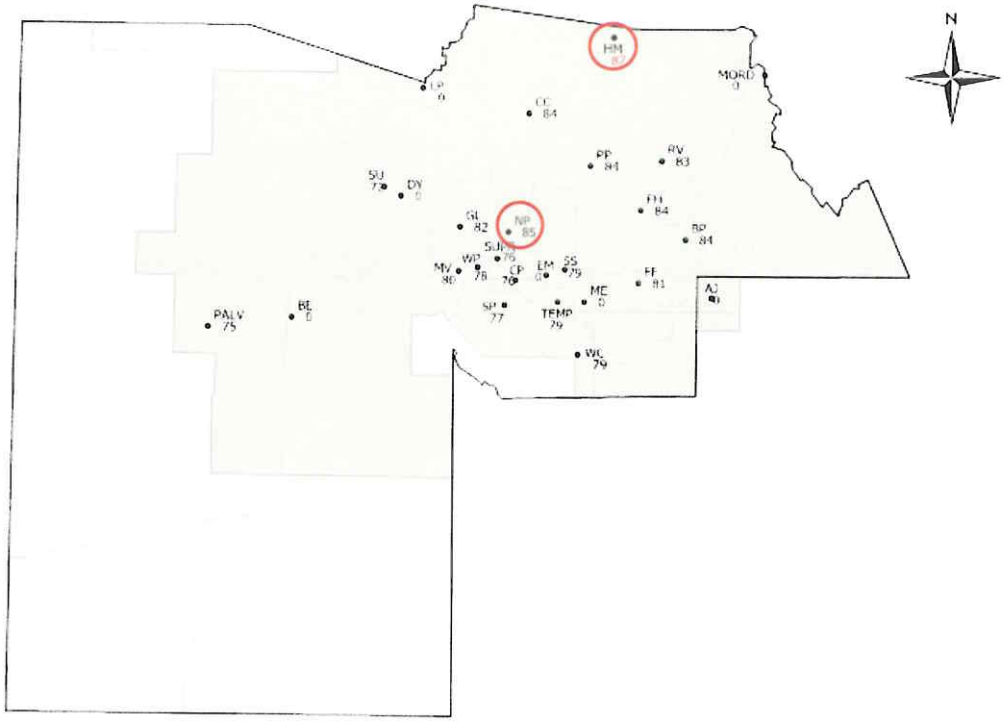
G.1 Do violations of the NAAQS occur at several monitoring sites throughout the nonattainment area, or are they confined to one or a small number of sites in proximity to one another?

As shown in Figures G.1.1~3, violations of the NAAQS occur at a limited number of sites throughout the MNA. The number of sites having a violation reduces from three sites during 2000-2002 to one site during 2002-2004. Humboldt Mountain is the only monitoring site violating the NAAQS for three consecutive periods (2000-2002, 2001-2003, and 2002-2004).

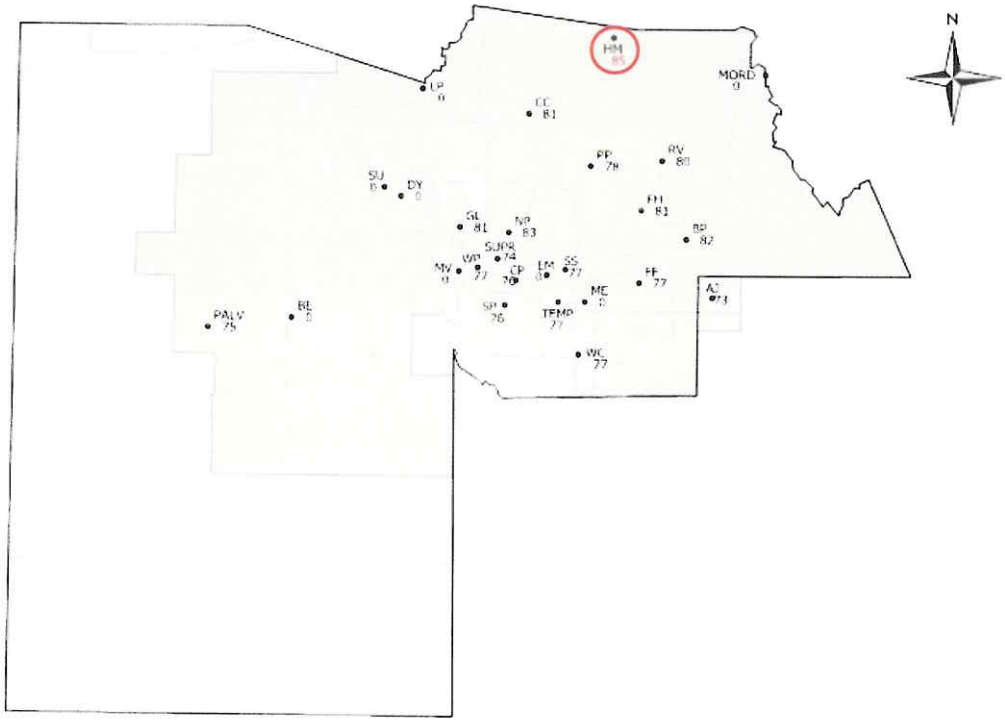
During the study period (2000-2004), high ozone days exceeding 85ppb of the daily maximum 8-hour ozone concentration were observed at least once at most of the monitoring sites except two sites, the Dysart site and the Surprise site.



Figures G.1.1. Spatial distribution of 8-hour ozone design value during 2000-2002



Figures G.1.2. Spatial distribution of 8-hour ozone design value during 2001-2003



Figures G.1.3. Spatial distribution of 8-hour ozone design value during 2002-2004

G.2 Do observed 8-hour daily maximum ozone concentrations exceed 84 ppb frequently or just on a few occasions?

The frequency of 8-hour daily maximum ozone exceedances varies among the monitors up to 10 times per year as shown in Table G.2.1. The Blue Point site has the period record of 8-hour daily maximum ozone exceedances, 10 days, in 2000. Observed 8-hour daily maximum ozone concentrations exceeded 84 ppb frequently in 2000, but gradually decreased to the minimum of only one exceedance in 2004. The average frequency for all monitoring sites within the MNA for 5 years (2000-2004) is 1.56 days per year.

Table G.2.1. Number of days exceeding 84 ppb of 8-hour daily maximum ozone

Site	2000	2001	2002	2003	2004	Max
Apache Junction (AJ: 04-021-3001)	N/A	N/A	0	1	0	1
Blue Point (BP: 04-013-9702)	10	1	5	4	0	10
Buckeye (BE: 04-013-4011)	N/A	N/A	N/A	N/A	0	0
Cave Creek (CC: 04-013-4008)	N/A	2	4	2	0	4
Central Phoenix (CP: 04-013-3002)	1	0	1	0	0	1
Dysart (DY: 04-013-4010)	N/A	N/A	N/A	0	0	0
Emergency Management (EM: 04-013-3004)	0	0	N/A	N/A	N/A	0
Falcon Field (FF: 04-013-1010)	0	2	3	1	0	3
Fountain Hills (FH: 04-013-9704)	4	3	5	1	0	5
Glendale (GL: 04-013-2001)	1	2	2	4	0	4
Humboldt Mountain (HM: 04-013-9508)	2	4	8	5	0	8
Lake Pleasant (LP: 04-013-9805)	2	0	N/A	N/A	N/A	2
Maryvale (MV: 04-013-3006)	1	0	3	2	0	3
Mesa (ME: 04-013-1003)	1	0	0	N/A	N/A	1
Mount Ord (MORD: 04-013-9701)	8	0	N/A	N/A	N/A	8
North Phoenix (NP: 04-013-1004)	4	4	5	4	1	5
Palo Verde (PALV: 04-013-9993)	1	0	1	0	0	1
Pinnacle Peak (PP: 04-013-2005)	5	4	3	3	0	5
Rio Verde (RV: 04-013-9706)	5	0	4	2	0	5
South Phoenix (SP: 04-013-4003)	3	1	2	0	0	3
South Scottsdale (SS: 04-013-3003)	1	1	1	3	0	3
Super Site (SUPR: 04-013-9997)	1	1	2	0	0	2
Surprise (SU: 04-013-4007)	N/A	0	0	0	N/A	0
Tempe (TEMP: 04-013-4005)	1	1	2	1	0	2
West Chandler (old) (WC: 04-013-3009)	0	N/A	N/A	N/A	N/A	0
West Chandler (WC: 04-013-4004)	1	1	2	0	0	2
West Phoenix (WP: 04-013-0019)	1	0	2	0	0	2
Max	**10**	**4**	**8**	**5**	**1**	**10**

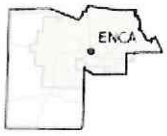
G.3 When 8-hour daily maxima in excess of 84 ppb occur, is there an accompanying characteristic spatial pattern, or is there a variety of spatial patterns?

According to the spatial distribution of 8-hour daily maxima on high ozone days in Appendix D, a variety of spatial patterns is seen when 8-hour daily maxima in excess of 84 ppb occur. These patterns, grouped by the red lines, are summarized in Figure G.3. Most exceedances occur at a small number of sites in proximity to one another in a partial region of the MNA. The exception is July 31, 2000, when two separate groups of regions appear.

Figure G.3. A variety of spatial patterns when 8-hour daily maxima in excess of 84 ppb occur

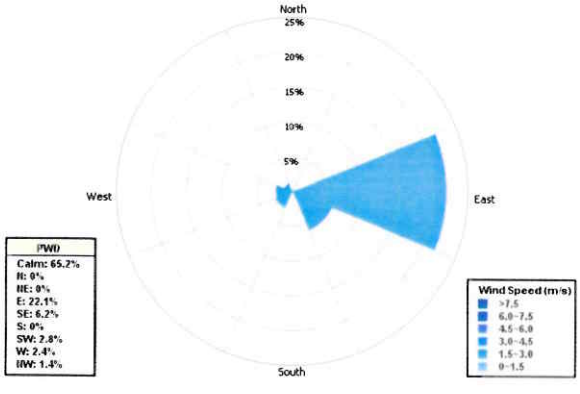
G.4 Do monitored violations occur at locations subject to mesoscale wind patterns which may differ from the general wind flow?

No. Hourly surface wind direction and speed data on high and low ozone days at the Phoenix Encanto site are summarized in Figure G.4.1. Morning winds are predominantly calm (65.2%) and easterly (22.1%) on days with 8-hour daily maximum ozone greater than 84 ppb. This is similar to morning winds on low ozone days less than 40 ppb, except calms (72%) are more frequent and easterly component winds (12.8%) are less common. Afternoon winds are predominantly SW-W (48.8%) on high ozone days. This is in contrast to low ozone days when afternoon winds have more frequent calm periods (44.6%). The MNA has apparent morning (easterly) and afternoon (westerly) wind patterns regardless of days with high or low ozone concentrations.

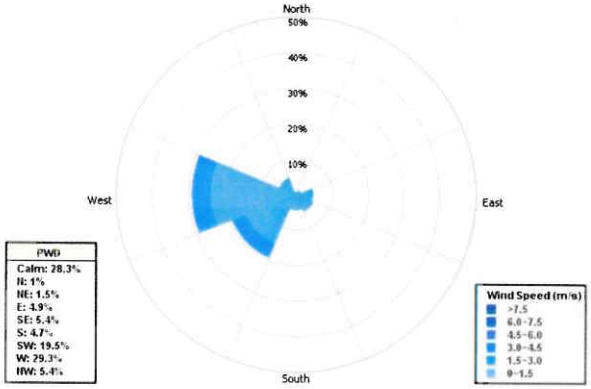


Phoenix Encanto Site
(2000~2004)

Ozone ≥ 85ppb

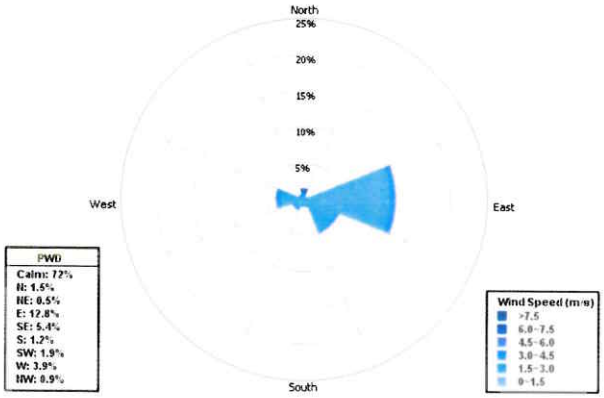


Calm	N	NE	E	SE	S	SW	W	NW
65.2%	0%	0%	22.1%	6.2%	0%	2.8%	2.4%	1.4%

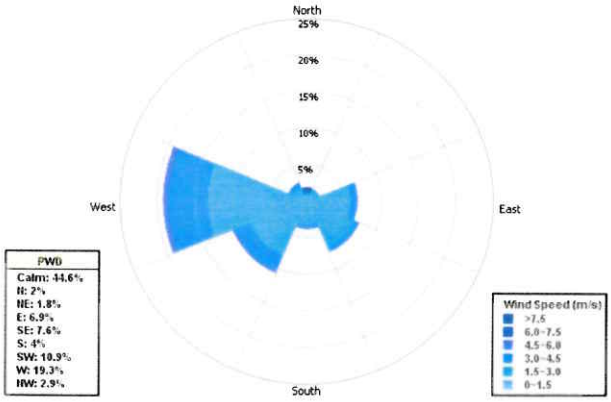


Calm	N	NE	E	SE	S	SW	W	NW
28.3%	1%	1.5%	4.9%	5.4%	4.7%	19.5%	29.3%	5.4%

Ozone < 40ppb



Calm	N	NE	E	SE	S	SW	W	NW
72%	1.5%	0.5%	12.8%	5.4%	1.2%	1.9%	3.9%	0.9%



Calm	N	NE	E	SE	S	SW	W	NW
44.6%	2%	1.8%	6.9%	7.6%	4%	10.9%	19.3%	2.9%

Morning (7:00~11:00) **Afternoon (12:00~18:00)**

Figure G.4.1. Wind roses for morning (7:00-11:00 MST) and afternoon (12:00-18:00 MST) hours on high and low ozone days at the Phoenix Encanto site (2000-2004)

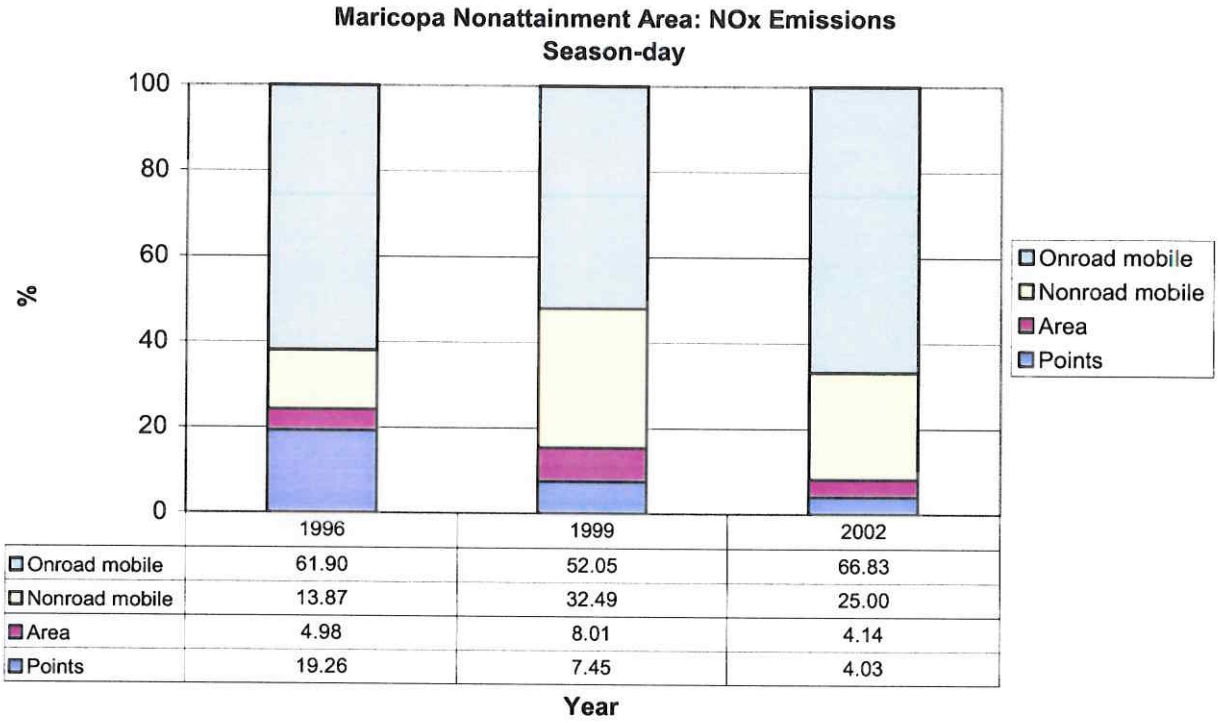
G.5 Have there been any recent major changes in emissions of VOC or NOx in or near the nonattainment area? If so, what changes have occurred?

NOx and VOC emissions for point, area, on-road mobile, and off-road mobile sources in the MNA were provided by the Maricopa County Air Quality Department. (Downing et al., June 2004) Table G.5.1 summarizes total anthropogenic emissions for a typical season day in the MNA in 1996, 1999, and 2002.

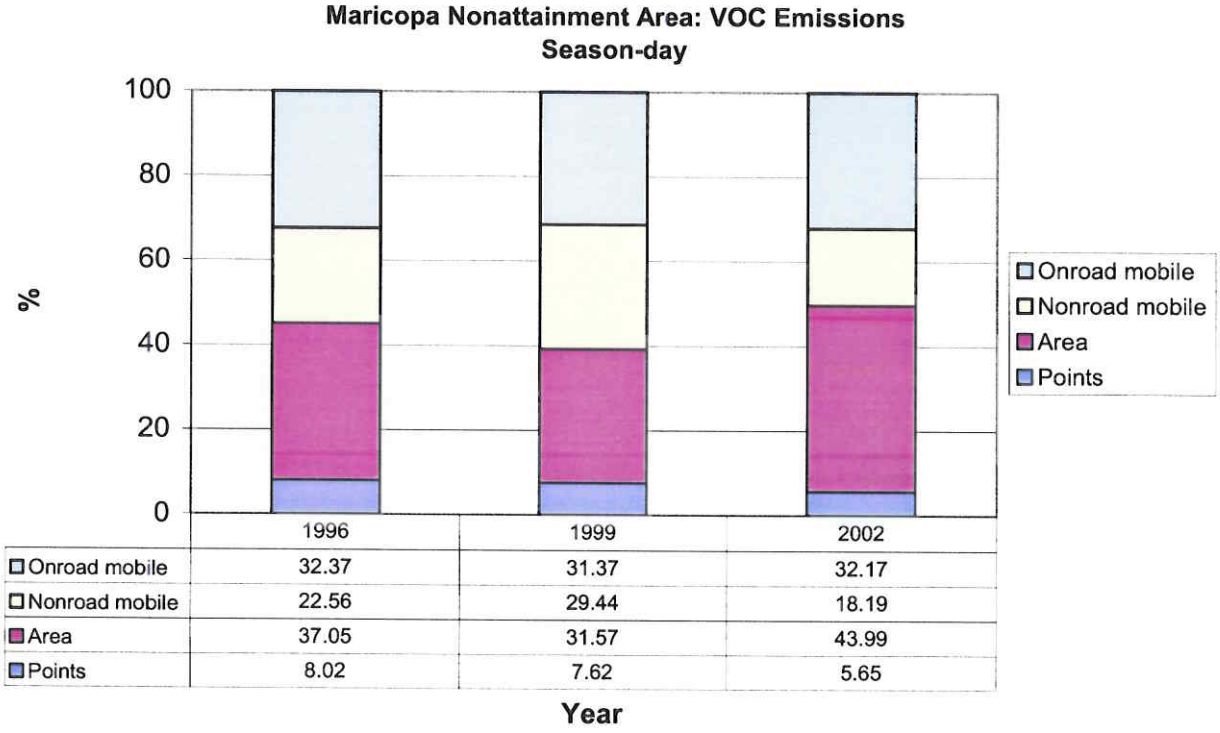
Table G.5.1. Summary of season-day anthropogenic emissions by category in the MNA (tons/day)

Source Category		Inventory Year		
		1996	1999	2002
Points	NOx	44.44	21.06	12.05
	VOC	23.57	21.96	14.56
Area	NOx	11.50	22.63	12.38
	VOC	108.90	91.01	113.44
Nonroad Mobile	NOx	32.00	91.85	74.76
	VOC	66.30	84.86	46.91
Onroad Mobile	NOx	142.85	147.15	199.87
	VOC	95.14	90.45	82.96
Total Anthropogenic	NOx	230.79	282.69	299.06
	VOC	293.91	288.28	257.87

The season-day anthropogenic emissions for the MNA are depicted in Figure G.5.1. The contribution of onroad mobile sources to the anthropogenic NOx is dominant and increased between 1996 and 2002. The NOx emissions from all anthropogenic sources except onroad mobile sources declined between 1999 and 2002. Total anthropogenic NOx emissions increased (4.5%), with the greatest contribution due to a 35.8% increase in onroad mobile source NOx. In contrast, total anthropogenic VOC emissions declined between 1999 and 2002, producing a 9.8% decrease, with the greatest contribution due to a 44.7% reduction in nonroad mobile source VOC. Interestingly, only point sources showed a steady decrease for both NOx and VOC during the period, especially NOx emissions which declined by 50% every 3 years. In the 2002 anthropogenic emissions inventory the major source categories are onroad mobile (66.8% for NOx) and area sources (43.8% for VOC). There have been no recent major changes in emissions that are inconsistent with the trends shown in Figure G.5.1.



	1996	1999	2002
Onroad mobile	61.90	52.05	66.83
Nonroad mobile	13.87	32.49	25.00
Area	4.98	8.01	4.14
Points	19.26	7.45	4.03



	1996	1999	2002
Onroad mobile	32.37	31.37	32.17
Nonroad mobile	22.56	29.44	18.19
Area	37.05	31.57	43.99
Points	8.02	7.62	5.65

Figure G.5.1. Summary of 1996, 1999, and 2002 season-day NOx and VOC emissions by major anthropogenic source categories in the MNA.

G.6 Are there discernible trends in design values or other air quality indicators which have accompanied a change in emissions?

Figure G.6 shows the 1996-2004 trend in the design values (three consecutive years' average of annual fourth highest daily maximum 8-hour average concentration) at monitoring sites in the MNA. In general, trends are similar over all sites, with values gradually decreasing to a minimum in 2004. During 1996-2004, the highest design value occurred primarily at the North Phoenix site (before 2002) and the Humboldt Mountain site (after 2002).

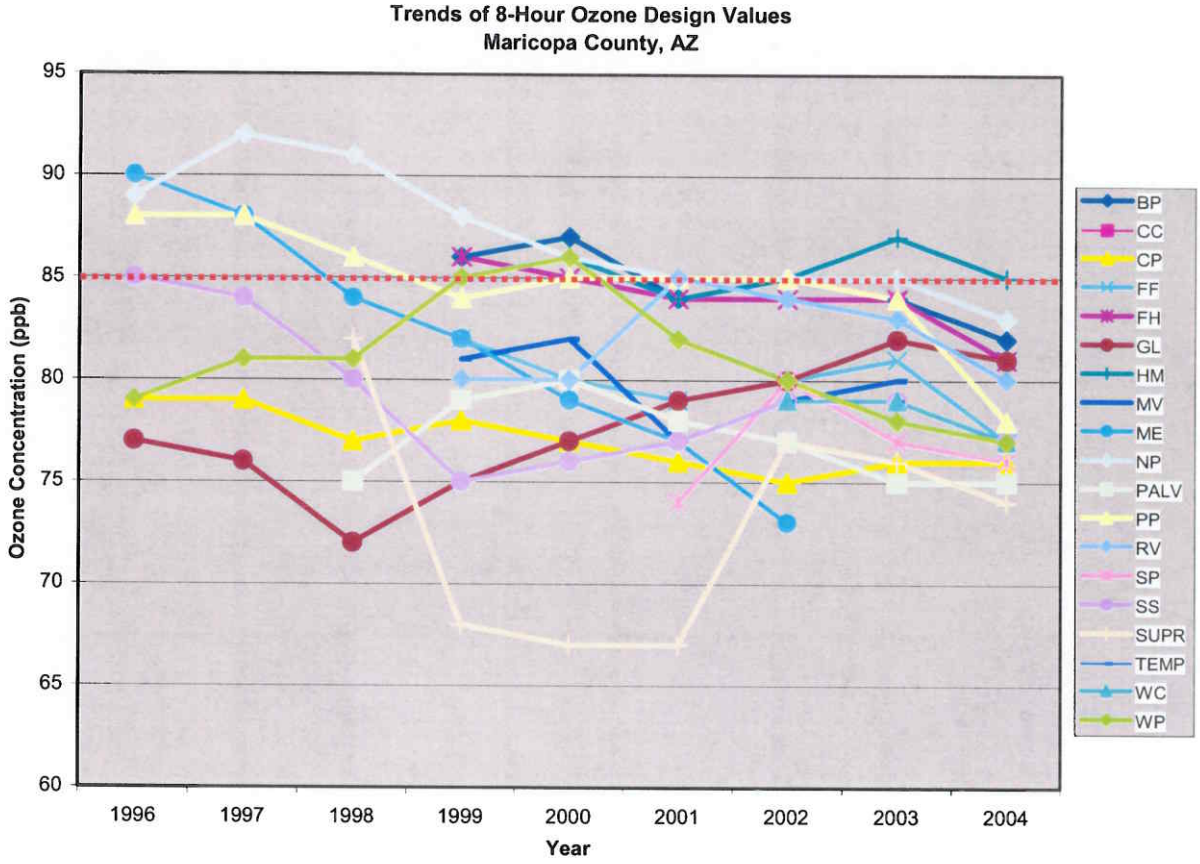


Figure G.6. Trends of 8-hour ozone design values at Maricopa County monitoring sites: 1996-2004

G.7 Is there any apparent spatial pattern to the trends in design values?

There are two apparent spatial patterns to the trends in design values when the area is divided into two different parts (northeast and southwest), as shown in Figure G.7 (the red dotted line). Over all sites in the northeast part violated the 8-hour ozone standard during this period 1996-2004, but none of the sites in the southwest part exceeded the 8-hour ozone standard during this period.

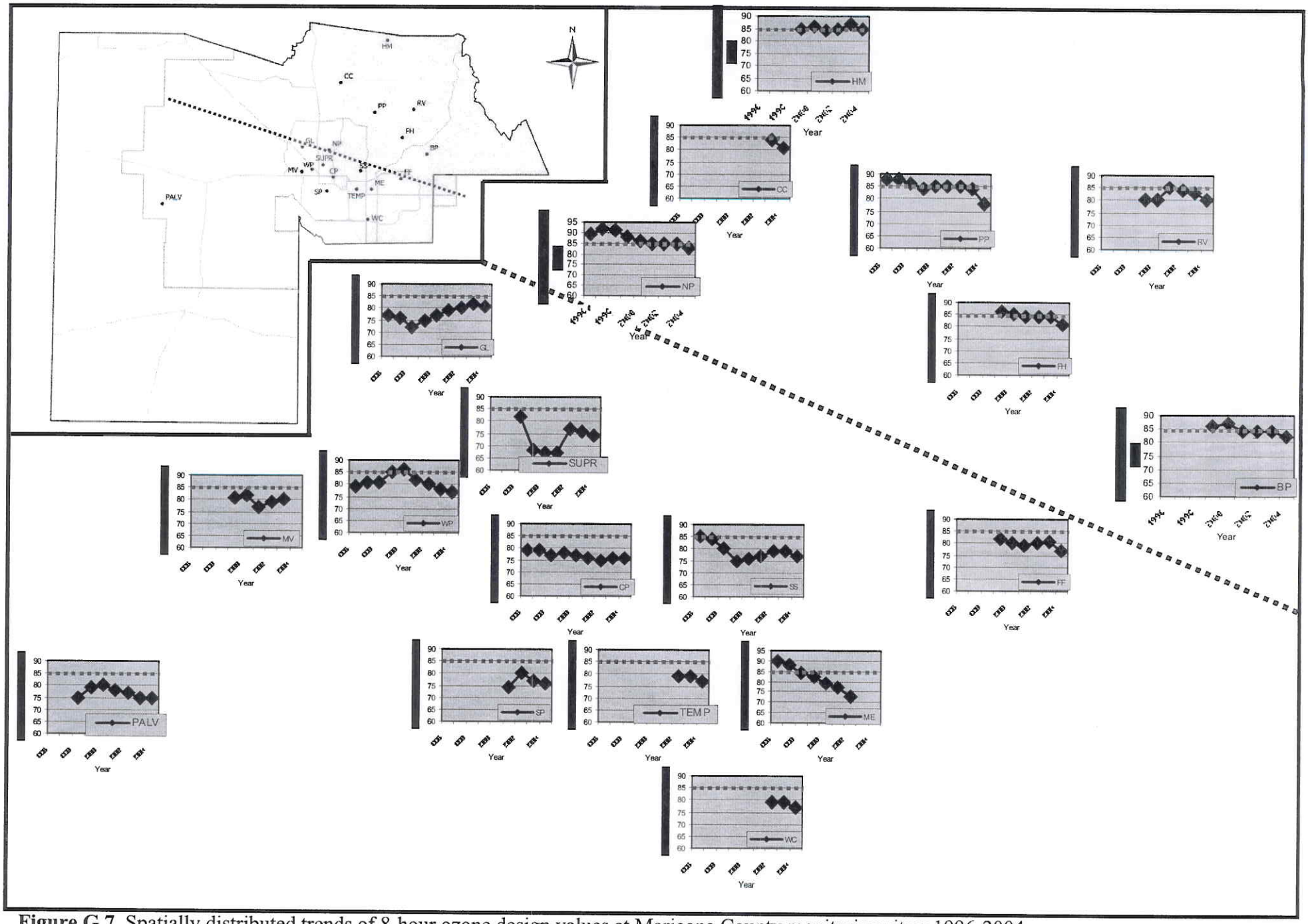


Figure G.7. Spatially distributed trends of 8-hour ozone design values at Maricopa County monitoring sites: 1996-2004.

G.8 Is the nonattainment problem primarily a local one, or are regional factors important?

To figure out the influence of regional factors on the nonattainment problem in the MNA, it is useful to check if there are other nonattainment areas within one day's transport of the MNA. Figure G.8.1 shows 8-hour ozone area counties in the U.S. This figure indicates that the closest nonattainment areas to the MNA reside in southern California. However, the back trajectories on high ozone days shown in Appendix F depict that the nonattainment areas in southern California are more than one day's transport for the MNA. Moreover, most of the 24-hour back trajectories on high ozone days came from south-southwest of the MNA, where the border of Mexico and the Pacific Ocean are located. This provides evidence that the nonattainment problem in the MNA is primarily caused by local factors, not regional transport. The spatial patterns of 8-hour ozone exceedances presented in Figure G.3 also support this conclusion. Further evidence is provided by examining the correlation between observed 8-hour daily maximum ozone concentrations at monitoring sites within the nonattainment area, as shown in Tables G.8.1-2 and Figure G.8.2. Table G.8.1 provides correlation coefficient (R^2) values between observed 8-hour daily maximum ozone concentrations at monitoring sites within the MNA. Table G.8.2 tabulates the distances between the monitoring sites. The relationship between the correlation coefficient and distance of ozone monitoring sites in the MNA is summarized in Figure G.8.2. Since most points have a moderate relationship ($R^2 \geq 0.5$), this Figure reveals 8-hour daily maximum ozone concentrations are strongly influenced by their distance from each other. This supports the premise that the nonattainment problem is primarily caused by local, not regional, factors.

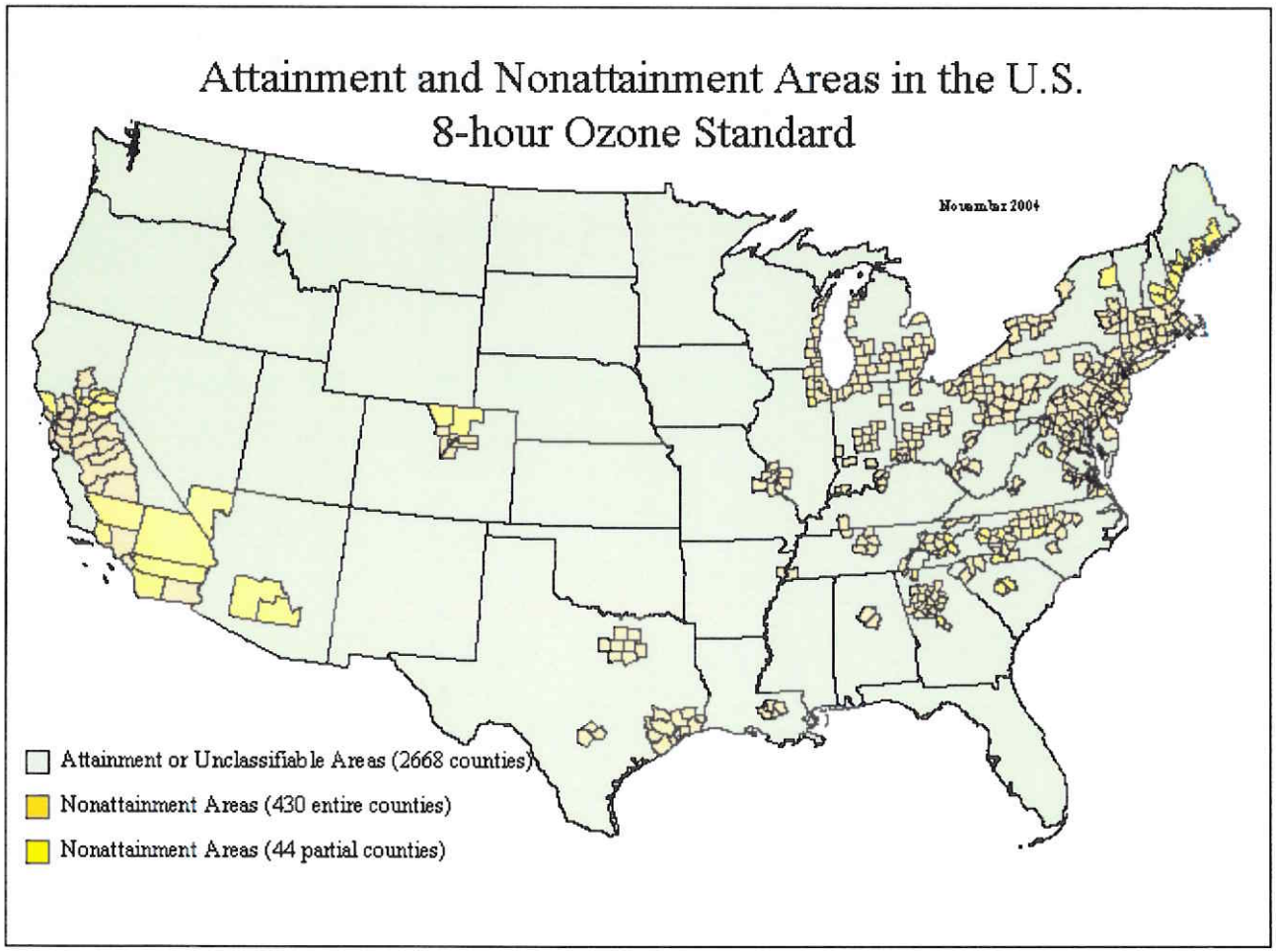


Figure G.8.1. 8-hour ozone area county map (source: U.S.EPA, http://www.epa.gov/air/oaqps/greenbk/naa8hrgreen.html)

Table G.8.1. R^2 values of 8-hour daily maximum ozone concentrations

Site	AJ	BP	BE	CC	CP	DY	EM	FF	FH	GL	HM	LP	MV	ME	MORD	NP	PALV	PP	RV	SP	SS	SUPR	SU	TEMP	WC	WP
AJ	1	0.9007	0.5817	0.6186	0.7587	0.545	N/A	0.8749	0.838	0.3914	0.5695	N/A	0.5679	0.7625	N/A	0.7667	0.348	0.7899	0.8211	0.7485	0.7961	0.7467	0.3619	0.7187	0.6369	0.7123
BP	0.9007	1	0.491	0.6675	0.7745	0.5159	0.4784	0.8051	0.904	0.3685	0.556	0.3019	0.5695	0.7978	0.714	0.7868	0.3469	0.8377	0.7965	0.7856	0.8134	0.7528	0.4557	0.7399	0.6484	0.7172
BE	0.5817	0.491	1	0.6226	0.7627	0.7974	N/A	0.6357	0.5663	0.6415	0.4838	N/A	N/A	N/A	N/A	0.6846	0.7298	0.6226	0.4863	0.7473	0.6533	0.7463	N/A	0.7145	0.6281	0.7652
CC	0.6186	0.6675	0.6226	1	0.6842	0.7166	N/A	0.6828	0.7291	0.6249	0.8231	N/A	0.6795	0.6941	0.7098	0.7653	0.5035	0.803	0.7395	0.7412	0.667	0.7139	0.5773	0.7141	0.5664	0.6948
CP	0.7587	0.7745	0.7627	0.6842	1	0.8074	0.549	0.6785	0.7639	0.6702	0.4846	0.3729	0.814	0.8313	0.5036	0.9061	0.4588	0.7171	0.5615	0.9087	0.9059	0.9217	0.6245	0.8659	0.6354	0.9086
DY	0.545	0.5159	0.7974	0.7166	0.8074	1	N/A	0.6397	0.6017	0.78	0.5506	N/A	0.8488	N/A	N/A	0.7988	0.6527	0.6022	0.5347	0.7316	0.7494	0.8499	N/A	0.7468	0.6721	0.8235
EM	N/A	0.4784	N/A	N/A	0.549	N/A	1	0.7534	0.5956	0.5994	0.5008	0.465	0.7069	0.5878	0.4045	0.6829	0.4457	0.6054	0.4938	0.5319	0.7457	0.718	0.5382	0.8626	0.7673	0.6184
FF	0.8749	0.8051	0.6357	0.6828	0.6785	0.6397	0.7534	1	0.7953	0.5065	0.5681	0.3306	0.639	0.7552	0.5047	0.7155	0.3458	0.7391	0.7166	0.6691	0.7709	0.6976	0.3883	0.8473	0.7177	0.6444
FH	0.838	0.904	0.5663	0.7291	0.7639	0.6017	0.5956	0.7953	1	0.419	0.5647	0.402	0.5435	0.7465	0.7241	0.7953	0.3398	0.8388	0.7572	0.7603	0.8098	0.7556	0.4476	0.7461	0.5961	0.7125
GL	0.3914	0.3685	0.6415	0.6249	0.6702	0.78	0.5994	0.5065	0.419	1	0.4632	0.5215	0.7608	0.6016	0.3738	0.7307	0.5241	0.5384	0.3755	0.6866	0.6412	0.759	0.6262	0.6683	0.4893	0.7729
HM	0.5695	0.556	0.4838	0.8231	0.4846	0.5506	0.5008	0.5681	0.5647	0.4632	1	0.5064	0.5105	0.5075	0.6188	0.5771	0.4683	0.6713	0.5908	0.5563	0.4951	0.517	0.4924	0.5874	0.4806	0.5077
LP	N/A	0.3019	N/A	N/A	0.3729	N/A	0.465	0.3306	0.402	0.5215	0.5064	1	0.5306	0.2926	0.4311	0.4909	0.6717	0.4674	0.2696	0.4356	0.4849	0.5613	0.3952	0.5116	0.4803	0.4663
MV	0.5679	0.5695	N/A	0.6795	0.814	0.8488	0.7069	0.639	0.5435	0.7608	0.5105	0.5306	1	0.691	0.5174	0.7801	0.5584	0.6263	0.5147	0.8141	0.7634	0.8051	0.6166	0.8088	0.5972	0.8993
ME	0.7625	0.7978	N/A	0.6941	0.8313	N/A	0.5878	0.7552	0.7465	0.6016	0.5075	0.2926	0.691	1	0.4991	0.8452	0.4249	0.7729	0.5453	0.8644	0.8818	0.8193	0.5883	0.8992	0.5678	0.7951
MORD	N/A	0.714	N/A	0.7098	0.5036	N/A	0.4045	0.5047	0.7241	0.3738	0.6188	0.4311	0.5174	0.4991	1	0.429	0.3947	0.6626	0.6172	0.5528	0.5217	0.3395	0.3935	0.5097	0.4801	0.4803
NP	0.7667	0.7868	0.6846	0.7653	0.9061	0.7988	0.6829	0.7155	0.7953	0.7307	0.5771	0.4909	0.7801	0.8452	0.429	1	0.469	0.7666	0.5811	0.8951	0.8948	0.9349	0.6509	0.86	0.6339	0.8938
PALV	0.348	0.3469	0.7298	0.5035	0.4588	0.6527	0.4457	0.3458	0.3398	0.5241	0.4683	0.6717	0.5584	0.4249	0.3947	0.469	1	0.3933	0.3626	0.5775	0.4274	0.4996	0.6646	0.4511	0.4047	0.5386
PP	0.7899	0.8377	0.6226	0.803	0.7171	0.6022	0.6054	0.7391	0.8388	0.5384	0.6713	0.4674	0.6263	0.7729	0.6626	0.7666	0.3933	1	0.7426	0.7181	0.7785	0.7373	0.5259	0.7415	0.5922	0.682
RV	0.8211	0.7965	0.4863	0.7395	0.5615	0.5347	0.4938	0.7166	0.7572	0.3755	0.5908	0.2696	0.5147	0.5453	0.6172	0.5811	0.3626	0.7426	1	0.586	0.6026	0.5484	0.3921	0.6413	0.566	0.5302
SP	0.7485	0.7856	0.7473	0.7412	0.9087	0.7316	0.5319	0.6691	0.7603	0.6866	0.5563	0.4356	0.8141	0.8644	0.5528	0.8951	0.5775	0.7181	0.586	1	0.862	0.8821	0.6773	0.8554	0.6696	0.8977
SS	0.7961	0.8134	0.6533	0.667	0.9059	0.7494	0.7457	0.7709	0.8098	0.6412	0.4951	0.4849	0.7634	0.8818	0.5217	0.8948	0.4274	0.7785	0.6026	0.862	1	0.8901	0.6	0.8777	0.659	0.8585
SUPR	0.7467	0.7528	0.7463	0.7139	0.9217	0.8499	0.718	0.6976	0.7556	0.759	0.517	0.5613	0.8051	0.8193	0.3395	0.9349	0.4996	0.7373	0.5484	0.8821	0.8901	1	0.6651	0.8785	0.6479	0.9035
SU	0.3619	0.4557	N/A	0.5773	0.6245	N/A	0.5382	0.3883	0.4476	0.6262	0.4924	0.3952	0.6166	0.5883	0.3935	0.6509	0.6646	0.5259	0.3921	0.6773	0.6	0.6651	1	0.6624	0.3118	0.6158
TEMP	0.7187	0.7399	0.7145	0.7141	0.8659	0.7468	0.8626	0.8473	0.7461	0.6683	0.5874	0.5116	0.8088	0.8992	0.5097	0.86	0.4511	0.7415	0.6413	0.8554	0.8777	0.8785	0.6624	1	0.7582	0.7908
WC	0.6369	0.6484	0.6281	0.5664	0.6354	0.6721	0.7673	0.7177	0.5961	0.4893	0.4806	0.4803	0.5972	0.5678	0.4801	0.6339	0.4047	0.5922	0.566	0.6696	0.659	0.6479	0.3118	0.7582	1	0.6152
WP	0.7123	0.7172	0.7652	0.6948	0.9086	0.8235	0.6184	0.6444	0.7125	0.7729	0.5077	0.4663	0.8993	0.7951	0.4803	0.8938	0.5386	0.682	0.5302	0.8977	0.8585	0.9035	0.6158	0.7908	0.6152	1

Table G.8.2. Distance between monitoring sites (Unit: miles)

Site	AJ	BP	BE	CC	CP	DY	EM	FF	FH	GL	HM	LP	MV	ME	MORD	NP	PALV	PP	RV	SP	SS	SUPR	SU	TEMP	WC	WP
AJ	0	9.4	62.2	38.4	29.1	48.3	24.6	11.1	16.7	38.6	41.3	52.8	37.5	18.5	34.3	31.6	74.4	26.6	21.8	30.7	21.9	32.3	51.1	22.6	21.4	34.7
BP	9.4	0	59.5	29.8	25.9	42.6	21.2	9.6	8	33.5	32	44.9	33.9	17.4	27.4	26.3	71.7	18	12.5	28.6	18.3	28.1	45.3	20.9	23.2	31
BE	62.2	59.5	0	46.7	33.6	24.5	38.3	51.5	54.2	28.3	63.4	39.5	25.7	43.6	78.8	34.5	12.3	49.8	59.7	31.5	41.2	31.6	23.9	39.6	42.8	28.7
CC	38.4	29.8	46.7	0	24.9	22.6	24.2	29.9	21.9	20	16.7	16.2	25.9	29.4	35.1	18.1	57.2	11.8	20.8	28.9	24	22.2	24.2	28.4	36.6	24.3
CP	29.1	25.9	33.6	24.9	0	21	4.7	18	21.3	11.3	38.9	31.6	8.5	11	47.9	7.2	45.9	20.4	28.1	4.1	7.6	4.2	23.8	7.1	14.4	5.8
DY	48.3	42.6	24.5	22.6	21	0	24.5	37.3	35.5	9.9	39.2	16.4	14.1	31.6	56.6	16.7	34.5	28.3	38.9	22.3	26.8	16.9	2.8	28.1	35.2	15.6
EM	24.6	21.2	38.3	24.2	4.7	24.5	0	13.5	17	14.6	36.6	33.2	13	7.1	43.9	8.5	50.5	17.5	24.1	7.8	2.9	7.8	27.3	4.4	12.7	10.2
FF	11.1	9.6	51.5	29.9	18	37.3	13.5	0	10.9	27.6	36.7	42.9	26.5	8.1	36.4	20.6	63.7	18.9	18.7	20	10.7	21.2	40.1	12	13.7	23.7
FH	16.7	8	54.2	21.9	21.3	35.5	17	10.9	0	27	25.9	36.9	28.5	16	27.2	20	66.3	10	8	24.8	14.3	22.6	38.1	18.3	23.4	25.6
GL	38.6	33.5	28.3	20	11.3	9.9	14.6	27.6	27	0	36.3	21.5	6.6	21.7	50.5	7.2	39.9	21.4	31.6	13.3	16.9	7.1	12.7	18.3	25.7	6.6
HM	41.3	32	63.4	16.7	38.9	39.2	36.6	36.7	25.9	36.3	0	29.1	41.7	39.6	22.9	32.9	73.7	19.3	19.6	43	35.3	37.2	40.6	40.1	47.4	39.7
LP	52.8	44.9	39.5	16.2	31.6	16.4	33.2	42.9	36.9	21.5	29.1	0	27.8	40	50.4	24.9	47.7	27.2	36.9	34.5	34.3	27.6	15.9	37.5	45.7	27.9
MV	37.5	33.9	25.7	25.9	8.5	14.1	13	26.5	28.5	6.6	41.7	27.8	0	19.4	53.9	9.4	37.8	25.1	34.4	8.4	15.9	6	16.7	15.4	21.5	3
ME	18.5	17.4	43.6	29.4	11	31.6	7.1	8.1	16	21.7	39.6	40	19.4	0	43	15.5	55.9	20.4	24	12.1	5.6	14.7	34.4	4.1	7.8	16.8
MORD	34.3	27.4	78.8	35.1	47.9	56.6	43.9	36.4	27.2	50.5	22.9	50.4	53.9	43	0	44.6	90.3	29.1	19.8	51.6	41.4	48.2	58.7	45.5	50	51.2
NP	31.6	26.3	34.5	18.1	7.2	16.7	8.5	20.6	20	7.2	32.9	24.9	9.4	15.5	44.6	0	46.4	15.7	25.2	10.9	10.2	4.3	19.5	12.7	20.9	6.9
PALV	74.4	71.7	12.3	57.2	45.9	34.5	50.5	63.7	66.3	39.9	73.7	47.7	37.8	55.9	90.3	46.4	0	61.3	71.5	43.8	53.5	43.7	33.2	51.9	54.8	40.8
PP	26.6	18	49.8	11.8	20.4	28.3	17.5	18.9	10	21.4	19.3	27.2	25.1	20.4	29.1	15.7	61.3	0	10.6	24.5	16.1	19.6	30.7	20.8	28.2	22.5
RV	21.8	12.5	59.7	20.8	28.1	38.9	24.1	18.7	8	31.6	19.6	36.9	34.4	24	19.8	25.2	71.5	10.6	0	31.8	21.7	28.5	41.3	26	31.4	31.6
SP	30.7	28.6	31.5	28.9	4.1	22.3	7.8	20	24.8	13.3	43	34.5	8.4	12.1	51.6	10.9	43.8	24.5	31.8	0	10.5	7	24.9	8.1	13.2	6.8
SS	21.9	18.3	41.2	24	7.6	26.8	2.9	10.7	14.3	16.9	35.3	34.3	15.9	5.6	41.4	10.2	53.5	16.1	21.7	10.5	0	10.4	29.6	4.8	12.6	13
SUPR	32.3	28.1	31.6	22.2	4.2	16.9	7.8	21.2	22.6	7.1	37.2	27.6	6	14.7	48.2	4.3	43.7	19.6	28.5	7	10.4	0	19.7	11.2	18.7	3
SU	51.1	45.3	23.9	24.2	23.8	2.8	27.3	40.1	38.1	12.7	40.6	15.9	16.7	34.4	58.7	19.5	33.2	30.7	41.3	24.9	29.6	19.7	0	30.9	37.9	18.3
TEMP	22.6	20.9	39.6	28.4	7.1	28.1	4.4	12	18.3	18.3	40.1	37.5	15.4	4.1	45.5	12.7	51.9	20.8	26	8.1	4.8	11.2	30.9	0	8.3	12.9
WC	21.4	23.2	42.8	36.6	14.4	35.2	12.7	13.7	23.4	25.7	47.4	45.7	21.5	7.8	50	20.9	54.8	28.2	31.4	13.2	12.6	18.7	37.9	8.3	0	19.6
WP	34.7	31	28.7	24.3	5.8	15.6	10.2	23.7	25.6	6.6	39.7	27.9	3	16.8	51.2	6.9	40.8	22.5	31.6	6.8	13	3	18.3	12.9	19.6	0

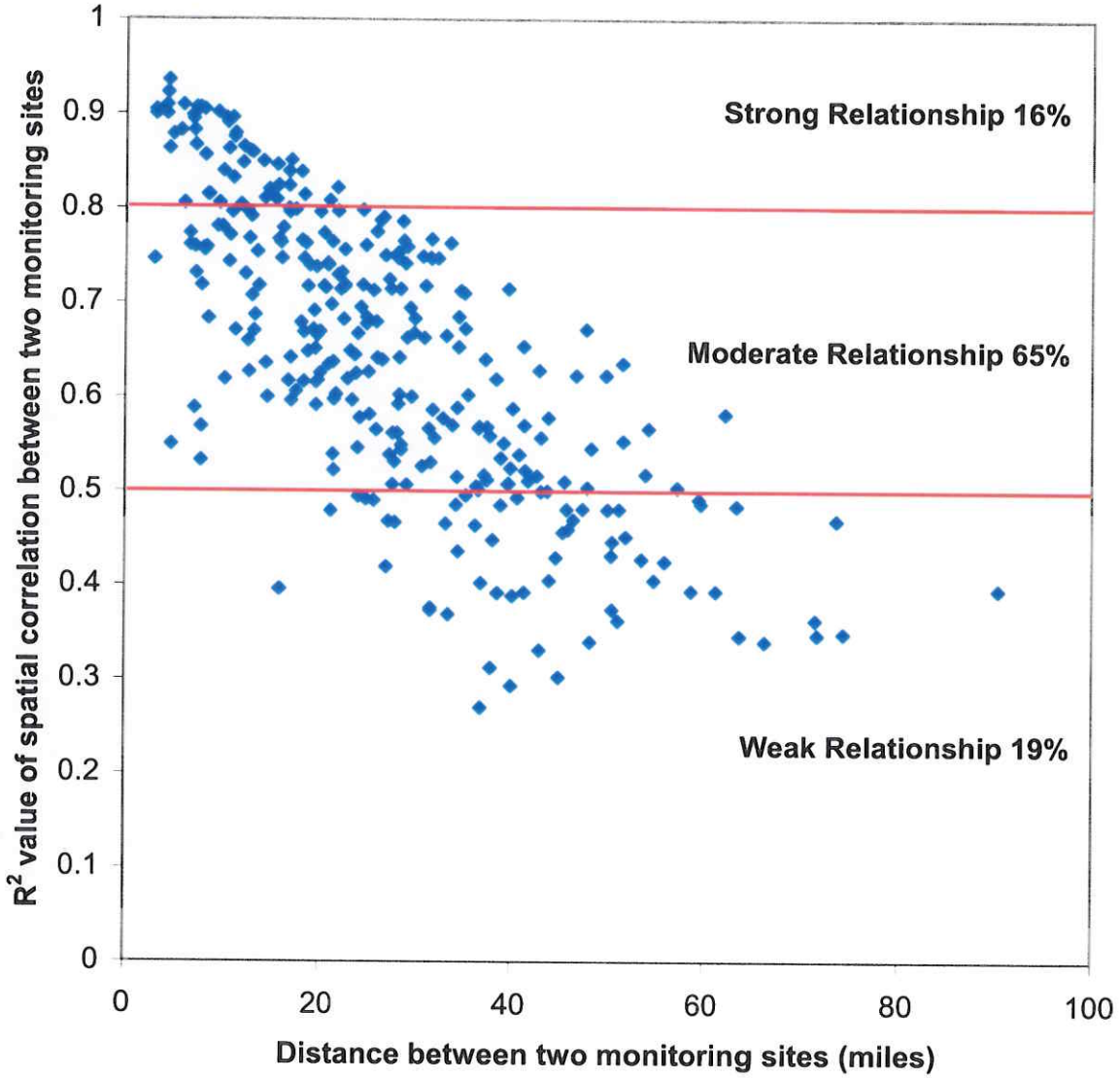
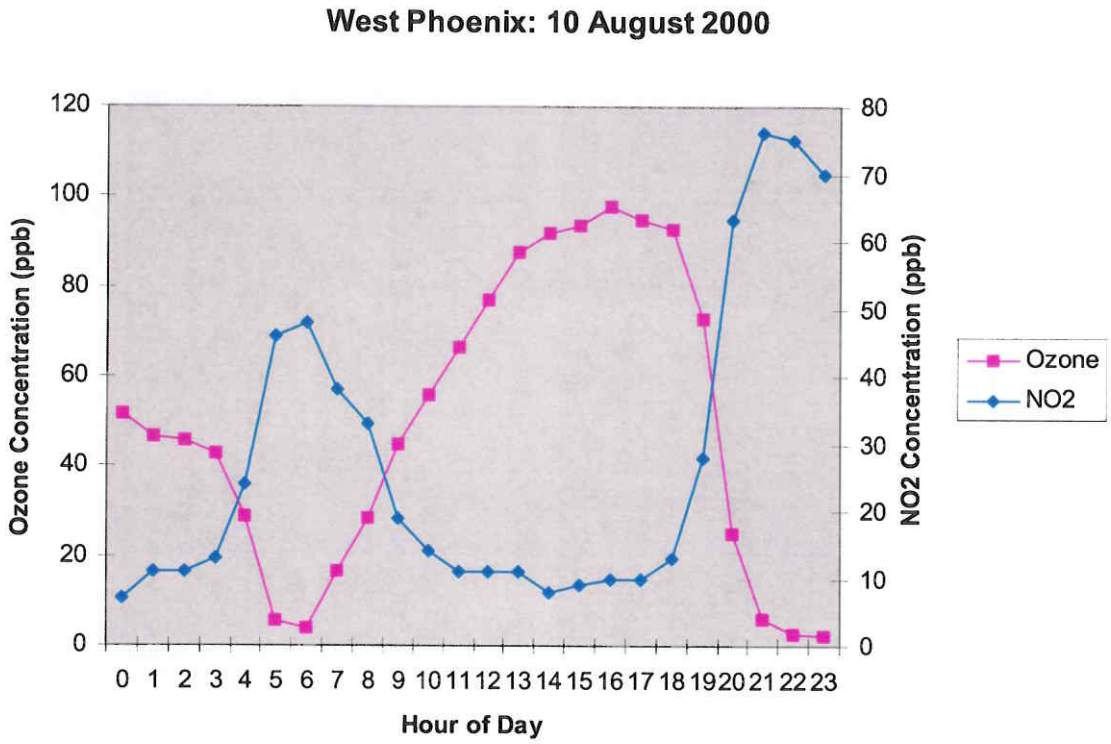


Figure G.8.2. Relationship between distance and R^2 value of ozone monitoring sites in the MNA

G.9 Have ambient precursor concentrations or measured VOC species profiles changed?

NOx monitors (NO and/or NO_2) have been co-located with ozone monitors at nine sites in the MNA. Because of data availability on high ozone days, five sites (Central Phoenix, West Phoenix, Super Site, Palo Verde, and South Scottsdale) have been selected for this analysis. Data from these monitors provide an opportunity to examine the relationship between NOx and ozone during 8-hour ozone exceedance events. Figure G.9 depicts hourly average ozone and NOx for selected days between 2000 and 2002 on which daily maximum 8-hour ozone exceeded 84 ppb. On all such days, ozone and NO_2 are diametrically opposed in their trends, although the hourly average NO_2 concentrations are relatively low. Also, early-morning peaks of NO_2 appear to be associated with ozone production.



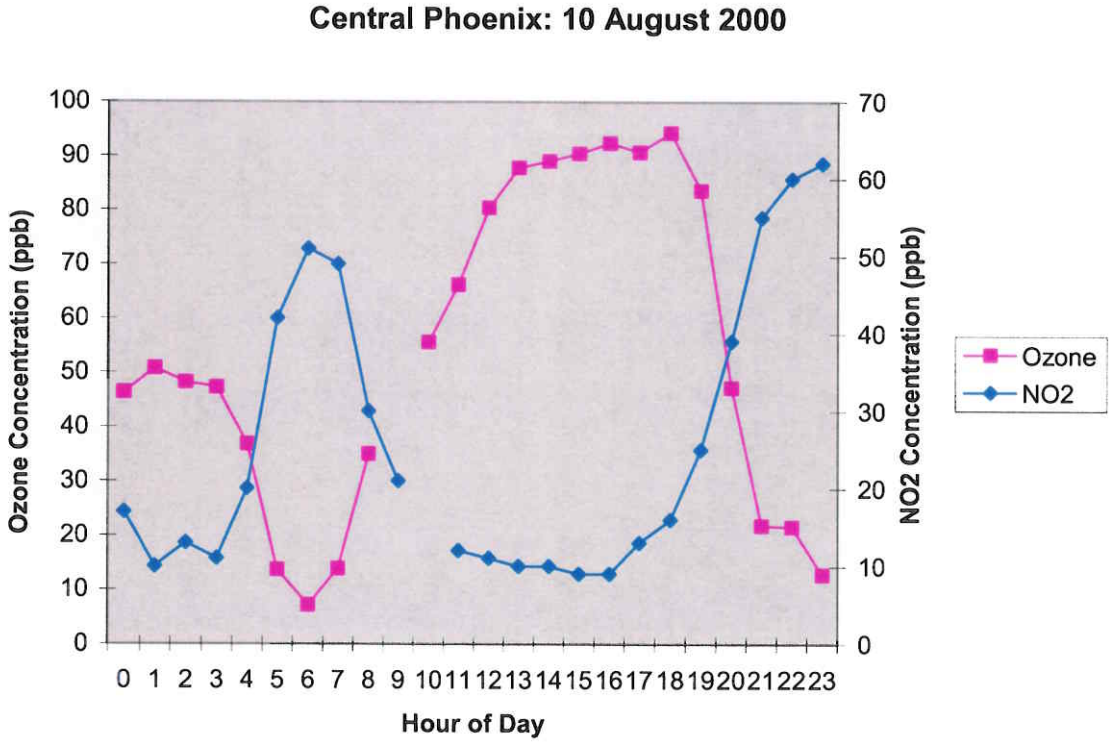
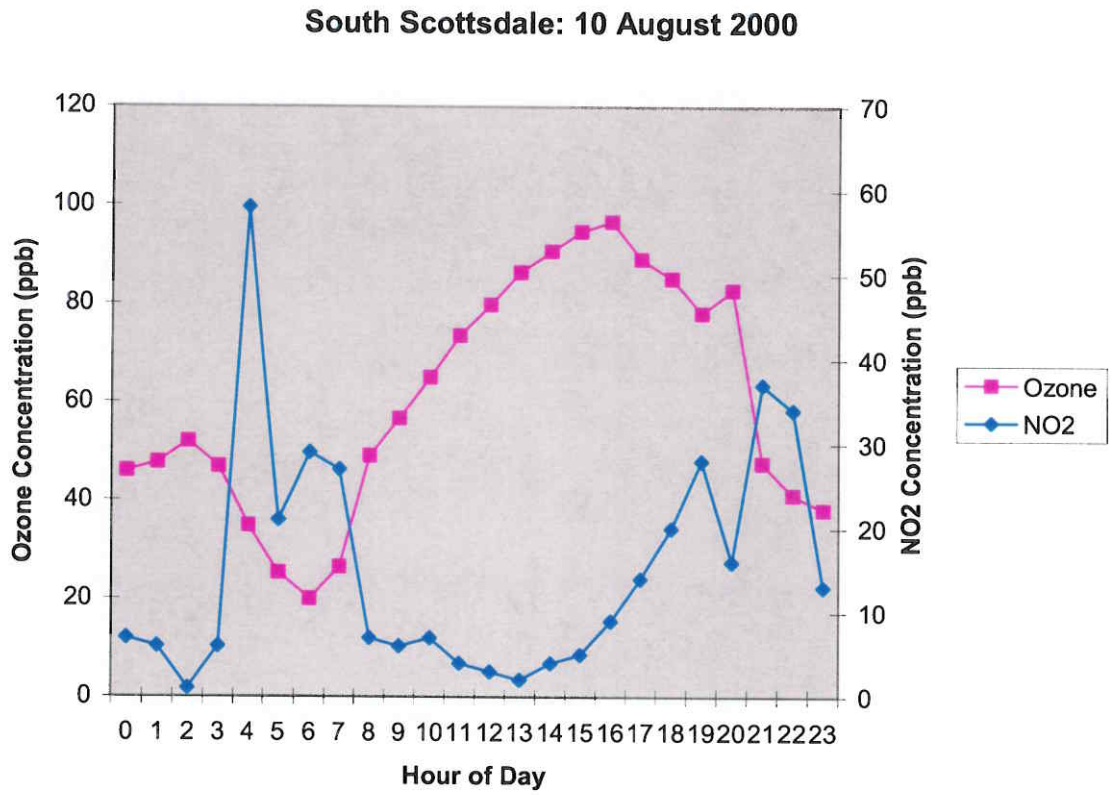


Figure G.9. Hourly 8-hour ozone and NO_2 concentration at selected monitoring sites in the MNA on the selected high ozone days from 2000 to 2004.



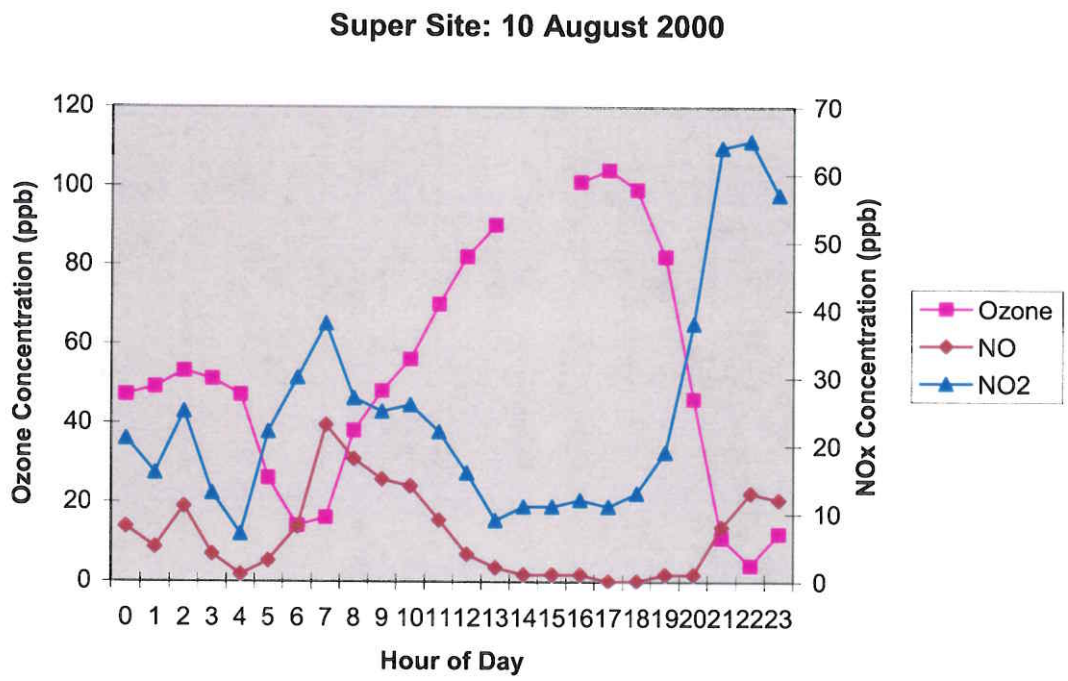
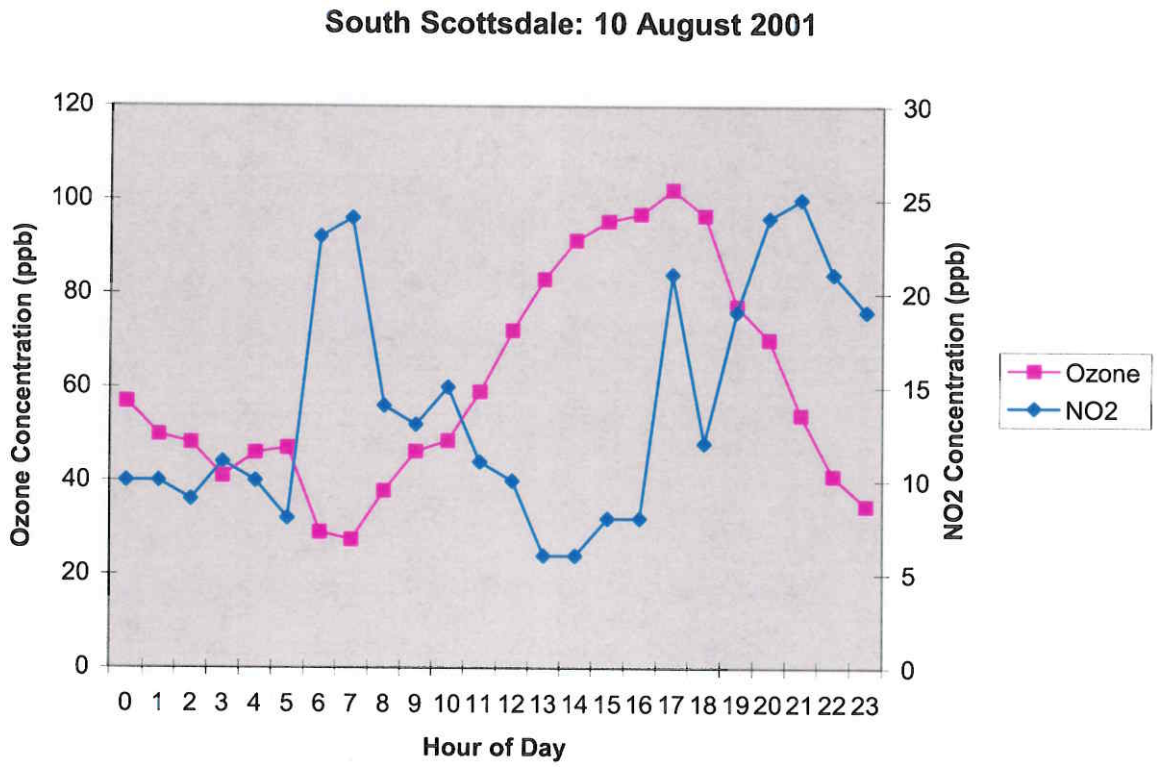


Figure G.9. Continued.



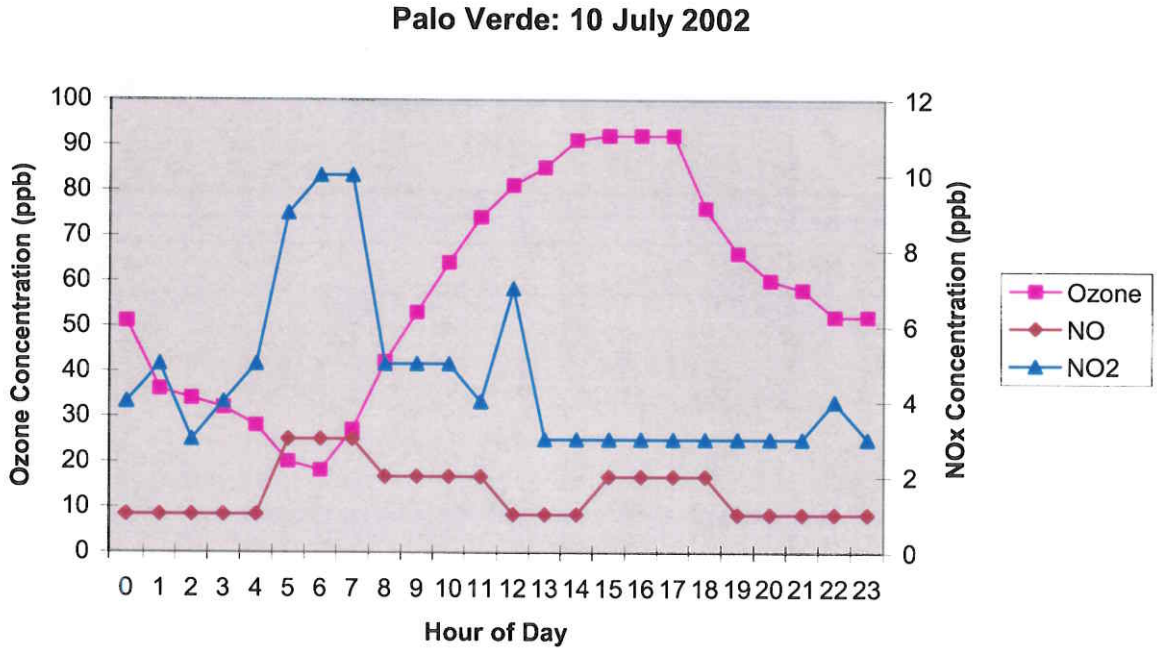
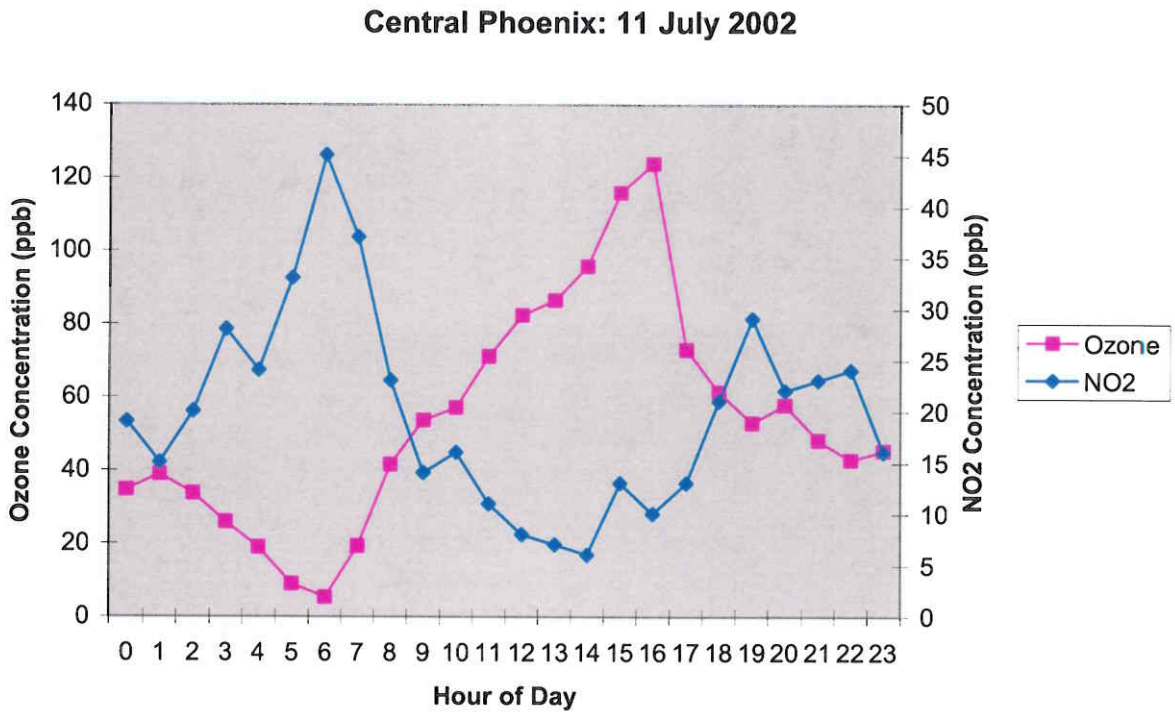


Figure G.9. Continued.



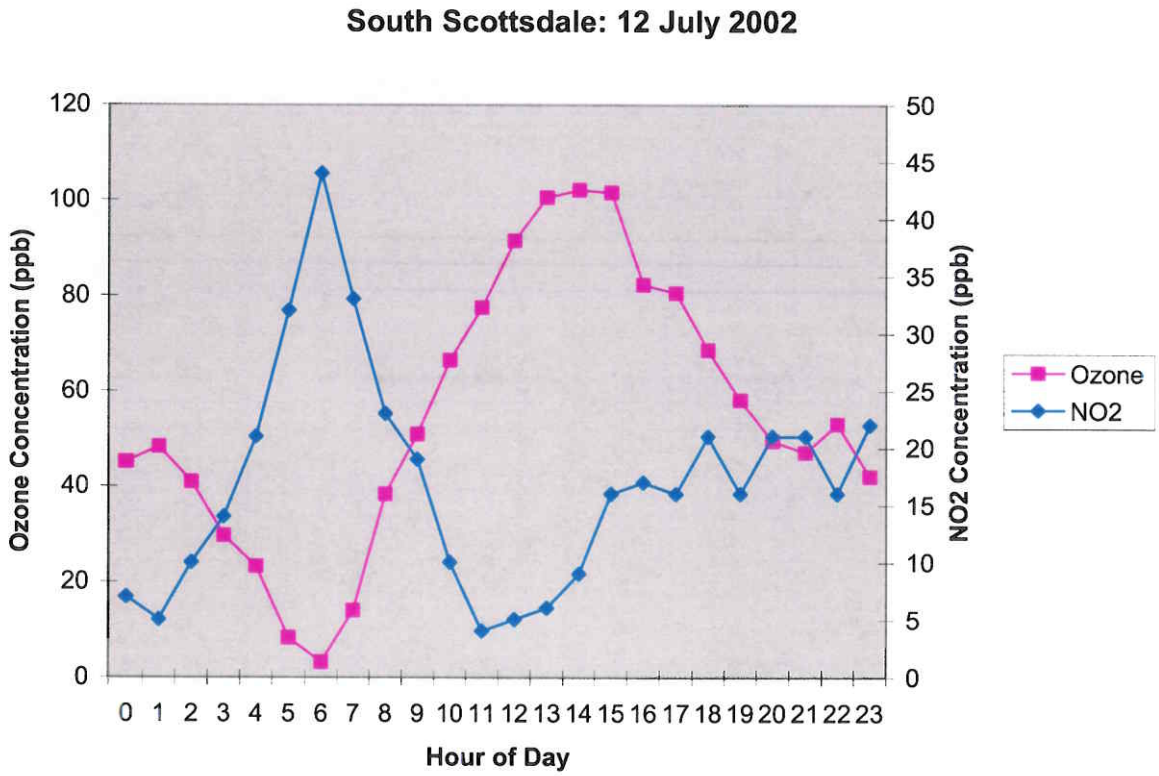


Figure G.9. Concluded.

G.10 Are there any distinctive meteorological measurements at the surface or aloft which appear to coincide with occasions with 8-hour daily maxima greater than 84 ppb?

There are no measurements aloft. There is no obvious correspondence with meteorological measurements other than daily maximum temperatures are always greater or equal to 89 F on these days.

Reference

Downing, B. et al., 2004. "2002 Periodic Emissions Inventory for Ozone Precursors." Maricopa County Air Quality Department, June 2004.

ATTACHMENT III

Addendum to Review of 2000-2004 Ozone Episodes in the Maricopa County Eight-Hour Ozone Nonattainment Area

MARICOPA ASSOCIATION OF GOVERNMENTS

OFFICE MEMO

August 24, 2005

TO: Cathy Arthur, Air Quality Modeling Program Manager

FROM: Ieesuck Jung, Air Quality Engineer II

SUBJECT: ADDENDUM TO REVIEW OF 2000-2004 OZONE EPISODES IN THE MARICOPA COUNTY 8-HOUR OZONE NONATTAINMENT AREA

An additional trajectory analysis has been performed to support ENVIRON's recommendations for the size of the regional grid for 8-hour ozone SIP modeling. This analysis is focused on transportation issue during the three potential ozone modeling periods including July 8-14, 2002 (Episode 1), June 3-7, 2002 (Episode 2), and August 5-11, 2001 (Episode 3). MAG's Air Quality and Meteorological Monitoring Database System archiving trajectory data generated by HYSPLIT has been used to conduct this analysis. Major configurations for trajectories are as follows:

- Type: 36-hour backward trajectory
- Start height: 10, 100, and 800-m
- Start time: 11:00 am (LST)
- Start location: The Phoenix Encanto site (Latitude: 33.47 and Longitude: -112.09)

Figures 1.1-3, 2.1-3, and 3.1-3 show back trajectories and their distances from the origin (36-hour back) for the Episode 1, 2, and 3, respectively. Each figure has trajectories for the whole episode days. Tables 1 through 3 summarize the distances from the origin for the Episode 1, 2, and 3, respectively, by their start height. As the characteristics of transport, "farther than 100 miles", Episode 1 is mostly local, Episode 2 is absolutely transport, and Episode 3 is mixed with local and transport. Although Episodes 2 and 3 have characteristics of transport, trajectories in these episodes are entirely covered by the 12-km domain recommended by ENVIRON. Therefore the 8-hour ozone SIP modeling grid system for the MNA could be simplified to a 12/4-km configuration that covers the immediate vicinity around Arizona.

Table 1. Distances from the origin (36-hour back) for the whole episode days (Episode 1) at 11:00 am (unit: mile)

Date	Start Height: 10-m	Start Height: 100-m	Start Height: 800-m
July 8, 2002	121	32	216
July 9, 2002	49	47	59
July 10, 2002	66	62	262
July 11, 2002	225	183	227
July 12, 2002	96	96	71
July 13, 2002	53	48	61
July 14, 2002	33	55	93

Table 2. Distances from the origin (36-hour back) for the whole episode days (Episode 2) at 11:00 am (unit: mile)

Date	Start Height: 10-m	Start Height: 100-m	Start Height: 800-m
June 3, 2002	331	398	414
June 4, 2002	320	354	553
June 5, 2002	175	177	240
June 6, 2002	176	168	250
June 7, 2002	147	143	171

Table 3. Distances from the origin (36-hour back) for the whole episode days (Episode 3) at 11:00 am (unit: mile)

Date	Start Height: 10-m	Start Height: 100-m	Start Height: 800-m
August 5, 2001	188	144	172
August 6, 2001	239	261	87
August 7, 2001	97	117	122
August 8, 2001	91	99	162
August 9, 2001	85	83	271
August 10, 2001	66	258	148
August 11, 2001	93	106	140

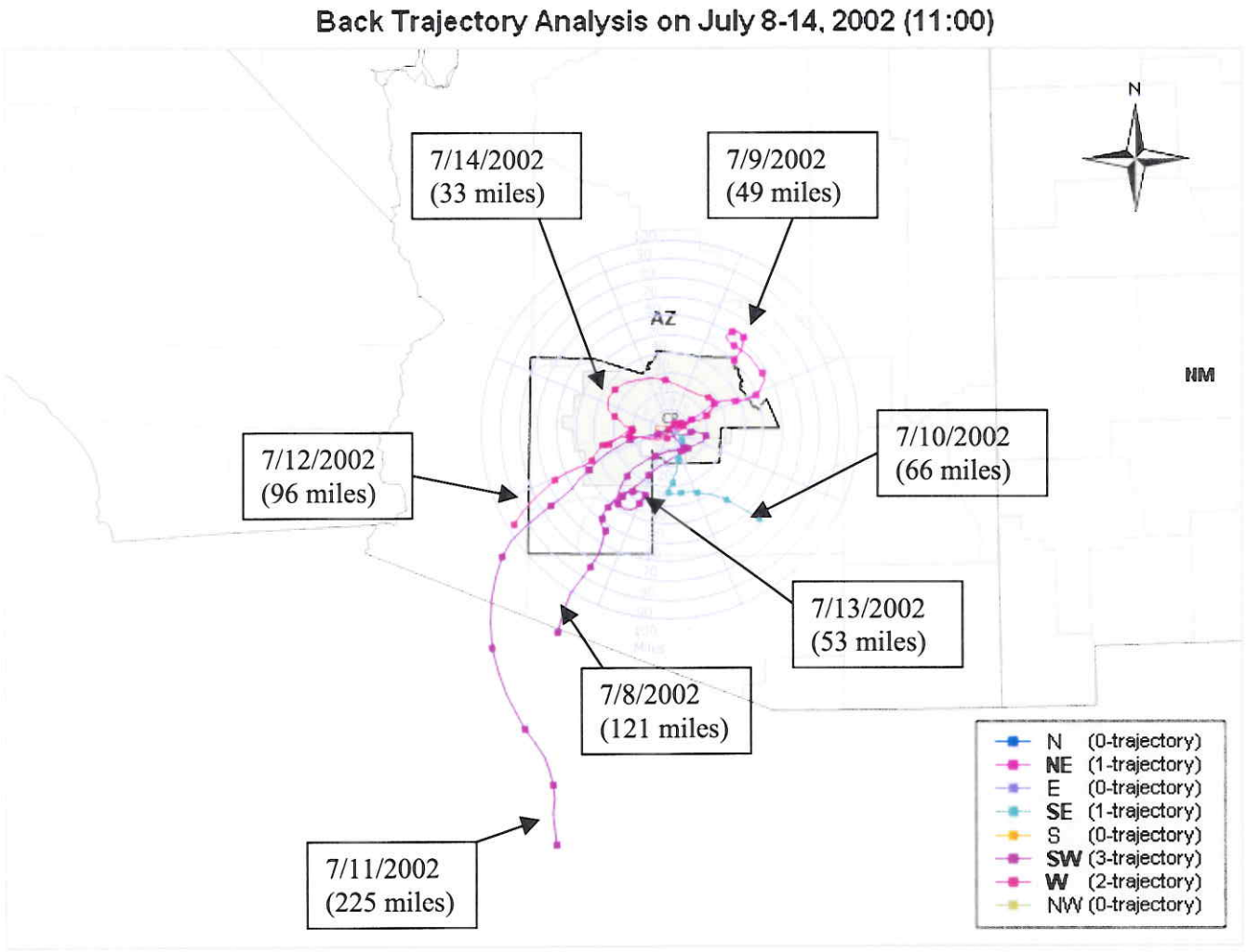


Figure 1.1 Backward trajectory for the July 8-14, 2002 episode (start height: 10-m)

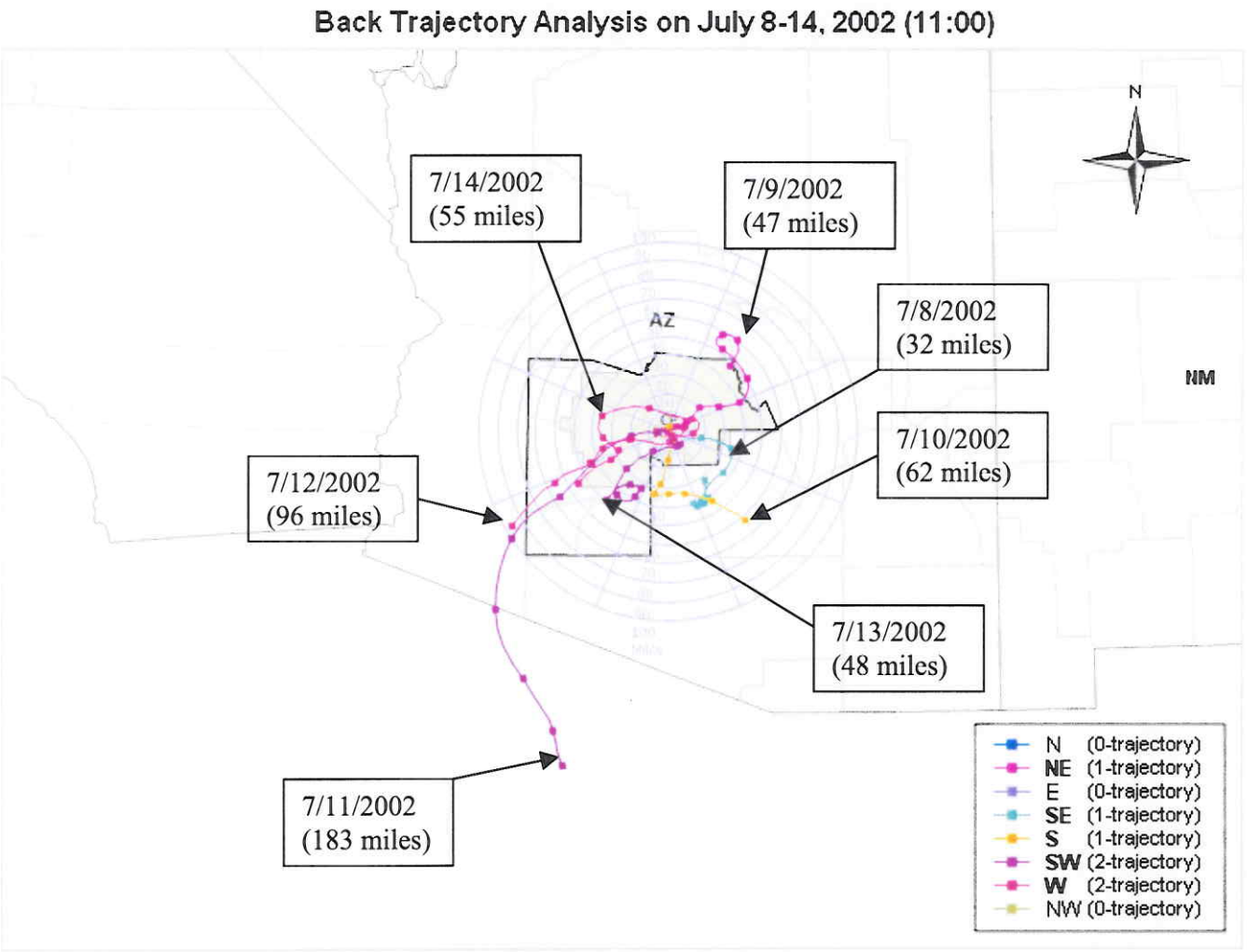


Figure 1.2 Backward trajectory for the July 8-14, 2002 episode (start height: 100-m)

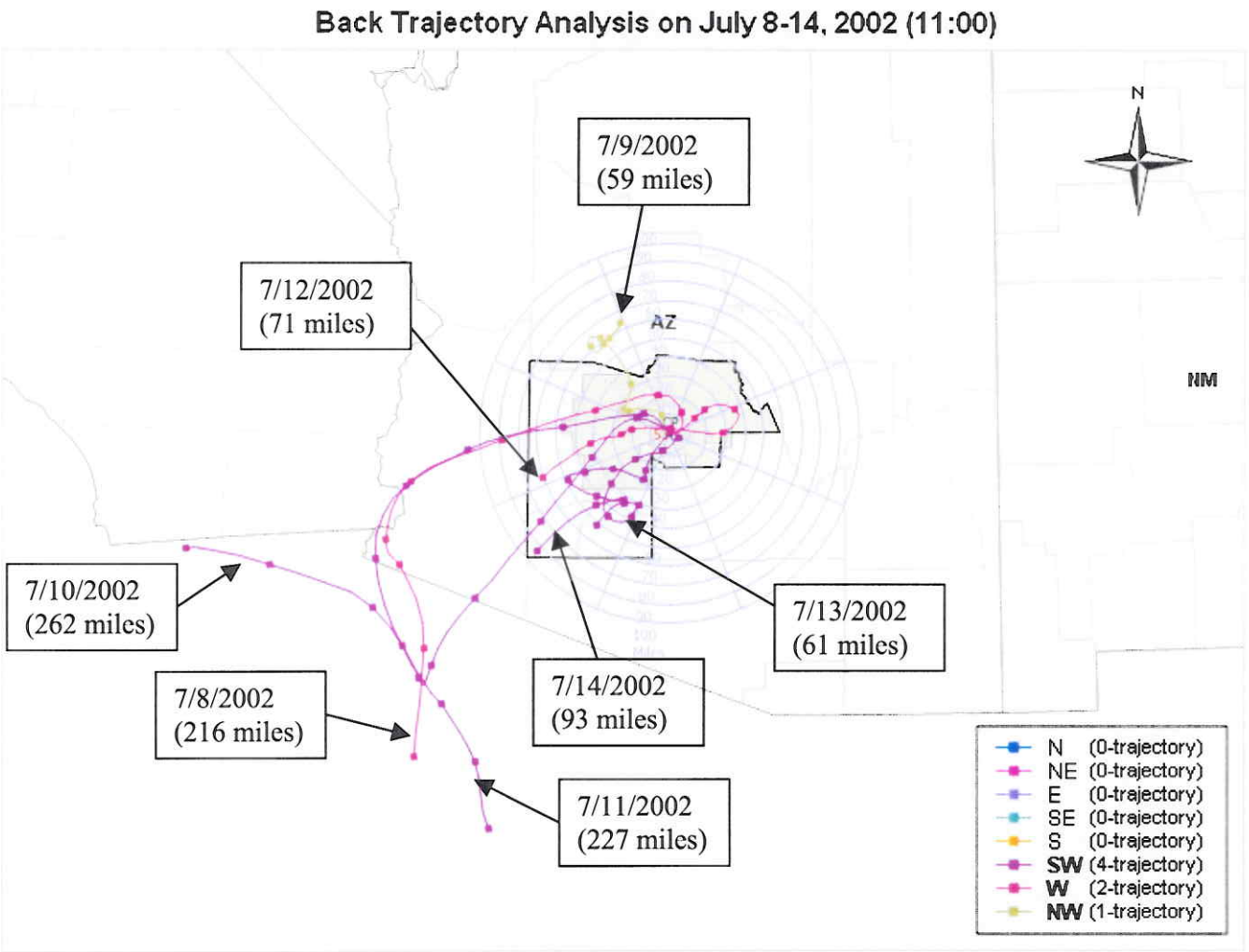


Figure 1.3 Backward trajectory for the July 8-14, 2002 episode (start height: 800-m)

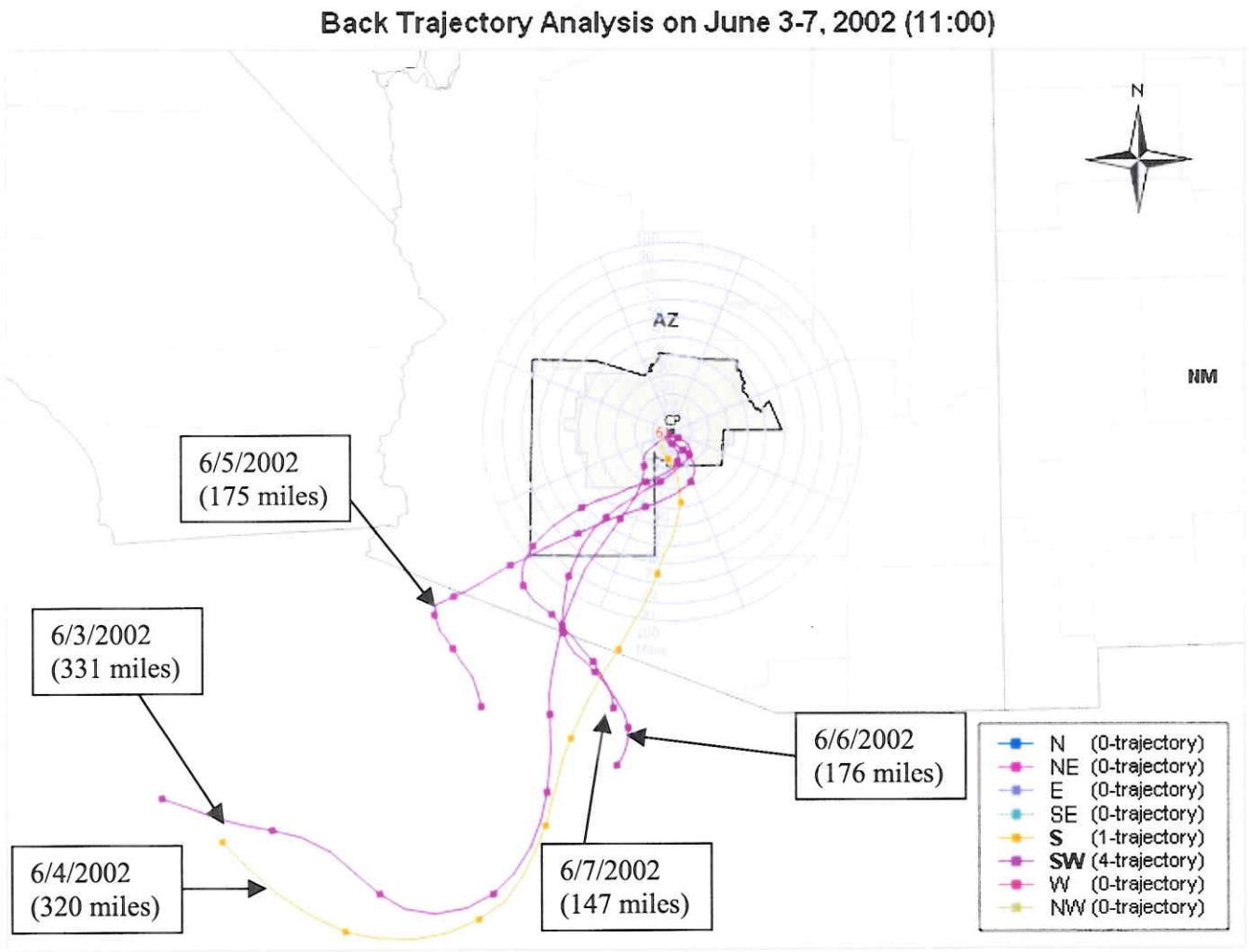


Figure 2.1 Backward trajectory for the June 3-7, 2002 episode (start height: 10-m)

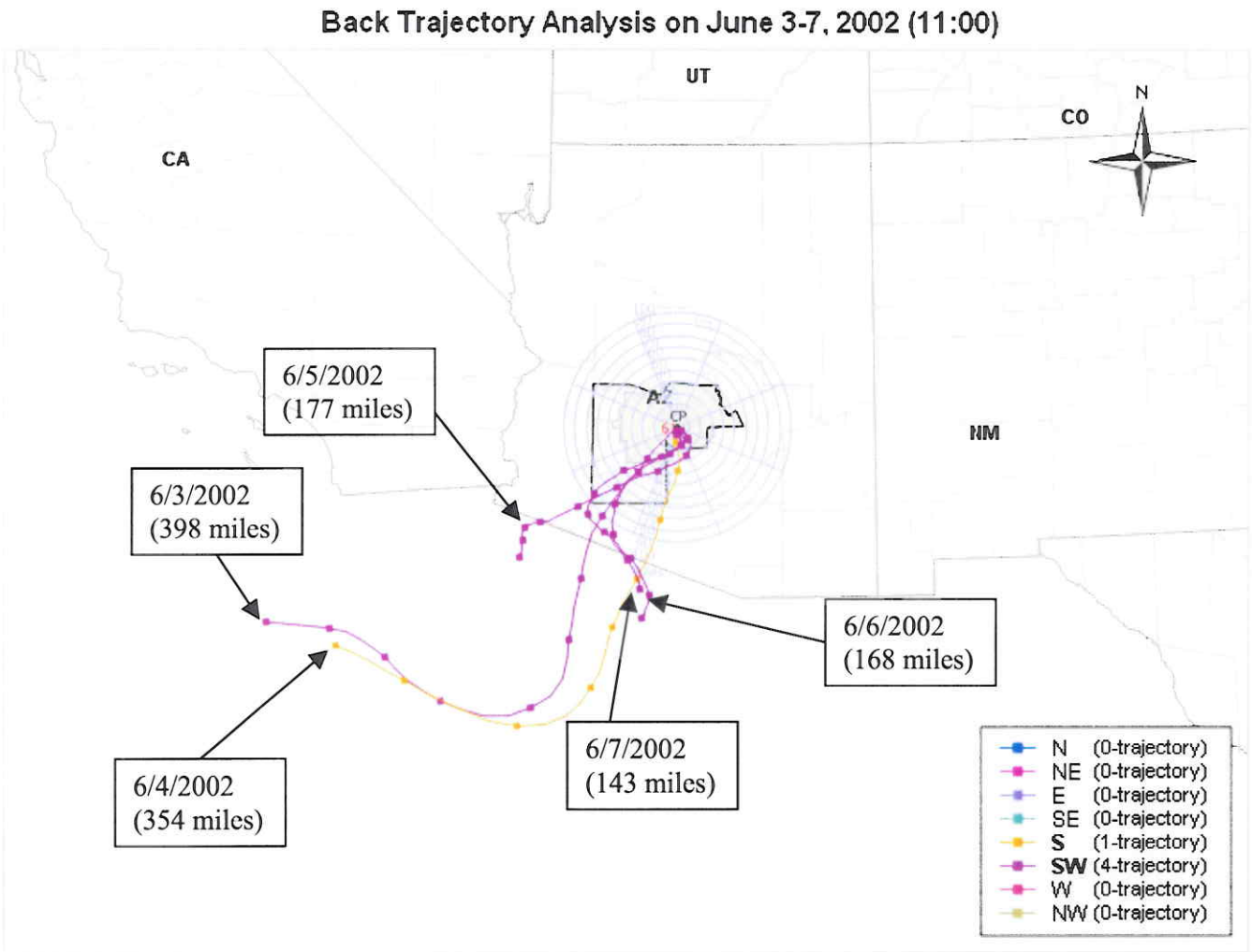


Figure 2.2 Backward trajectory for the June 3-7, 2002 episode (start height: 100-m)

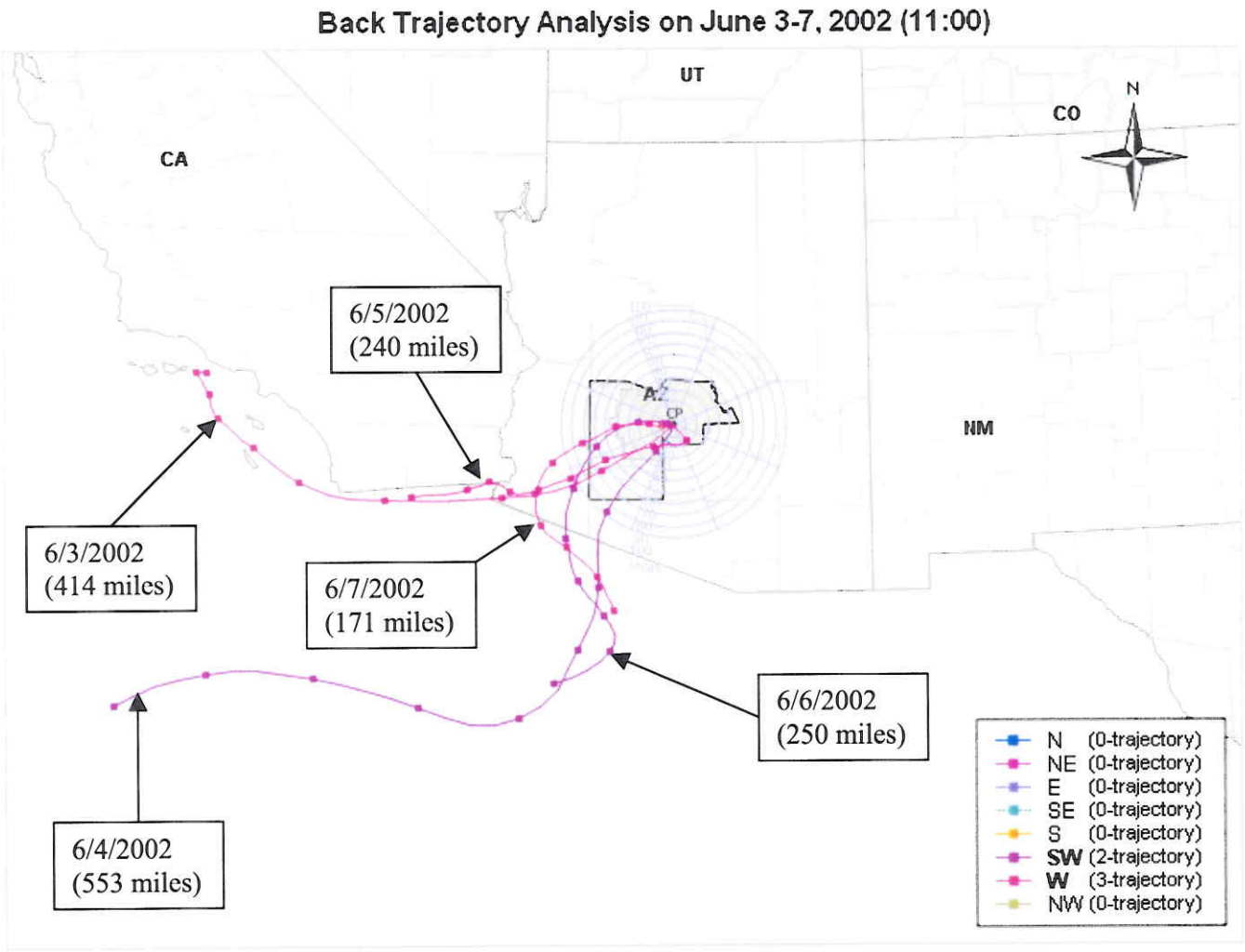


Figure 2.3 Backward trajectory for the June 3-7, 2002 episode (start height: 800-m)

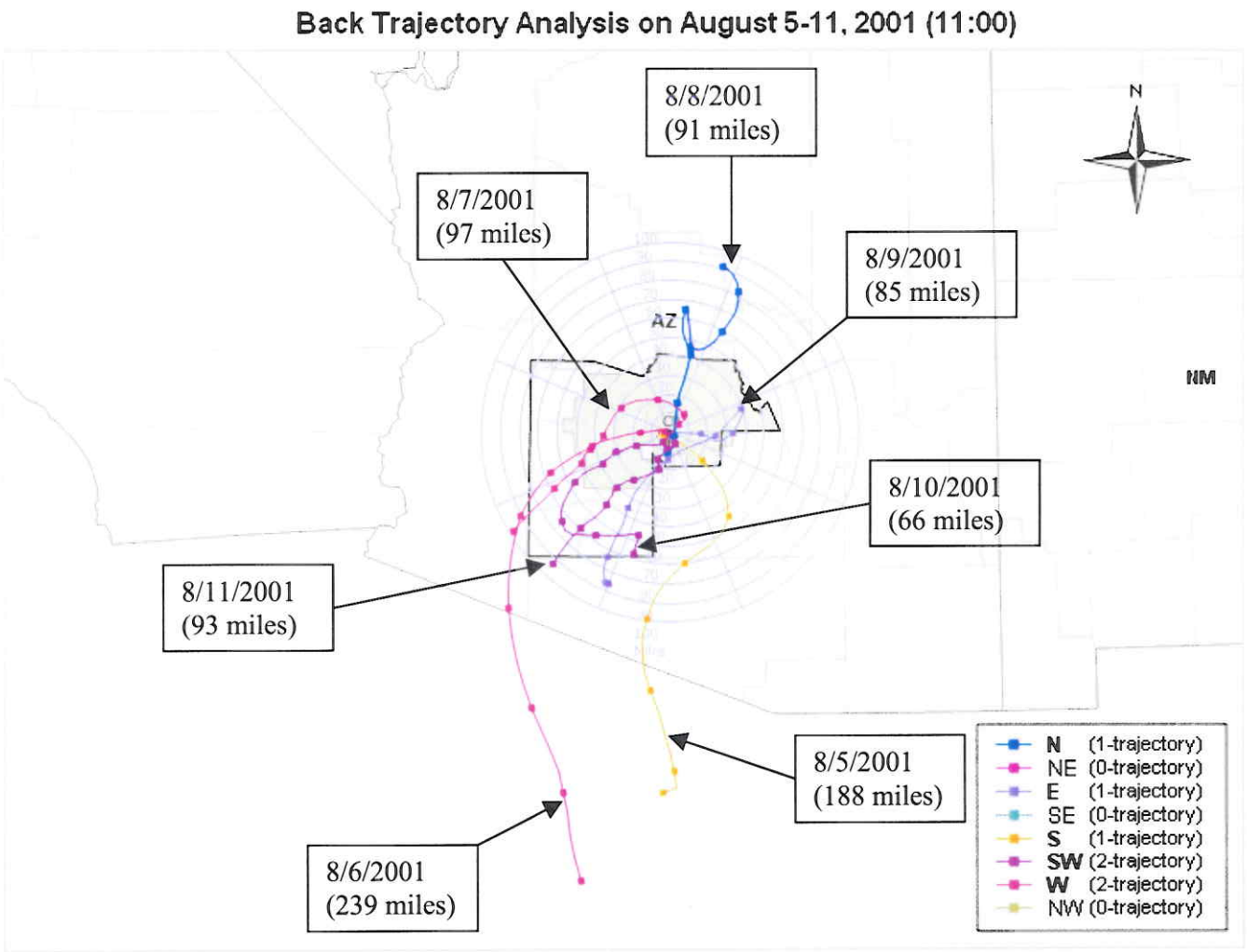


Figure 3.1 Backward trajectory for the August 5-11, 2001 episode (start height: 10-m)

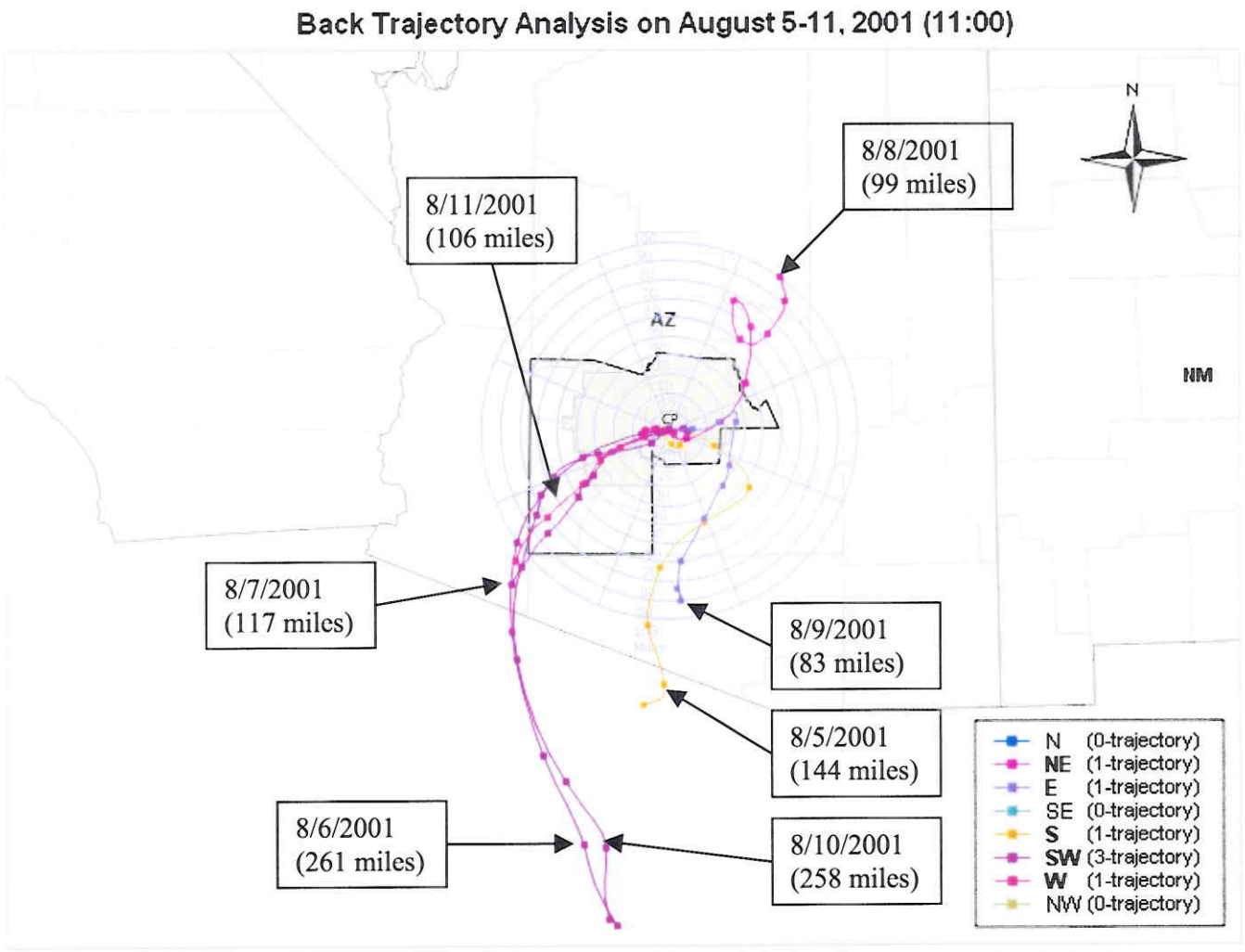


Figure 3.2 Backward trajectory for the August 5-11, 2001 episode (start height: 100-m)

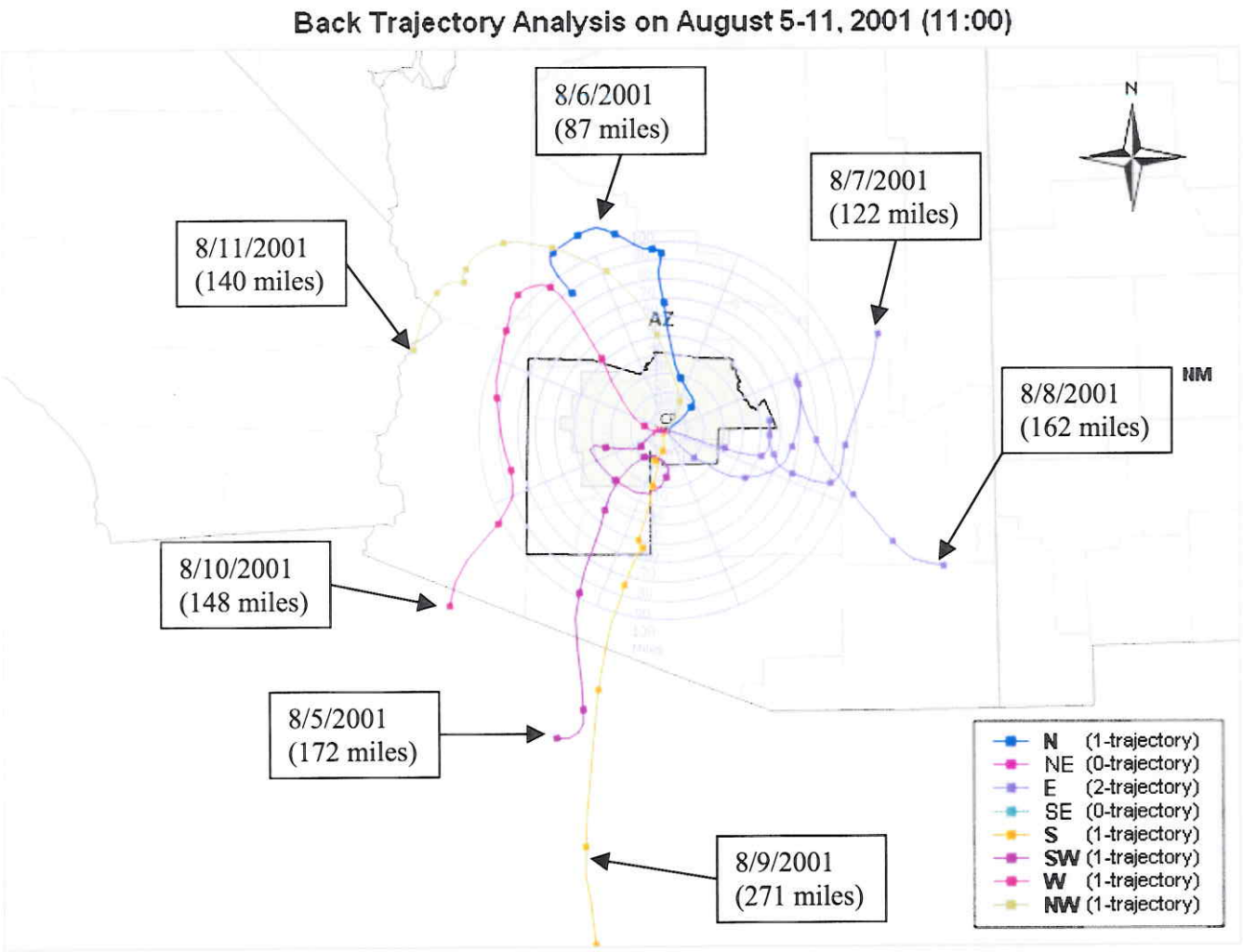


Figure 3.3 Backward trajectory for the August 5-11, 2001 episode (start height: 800-m)

ATTACHMENT IV

One-Hour Ozone Emission Density Plots

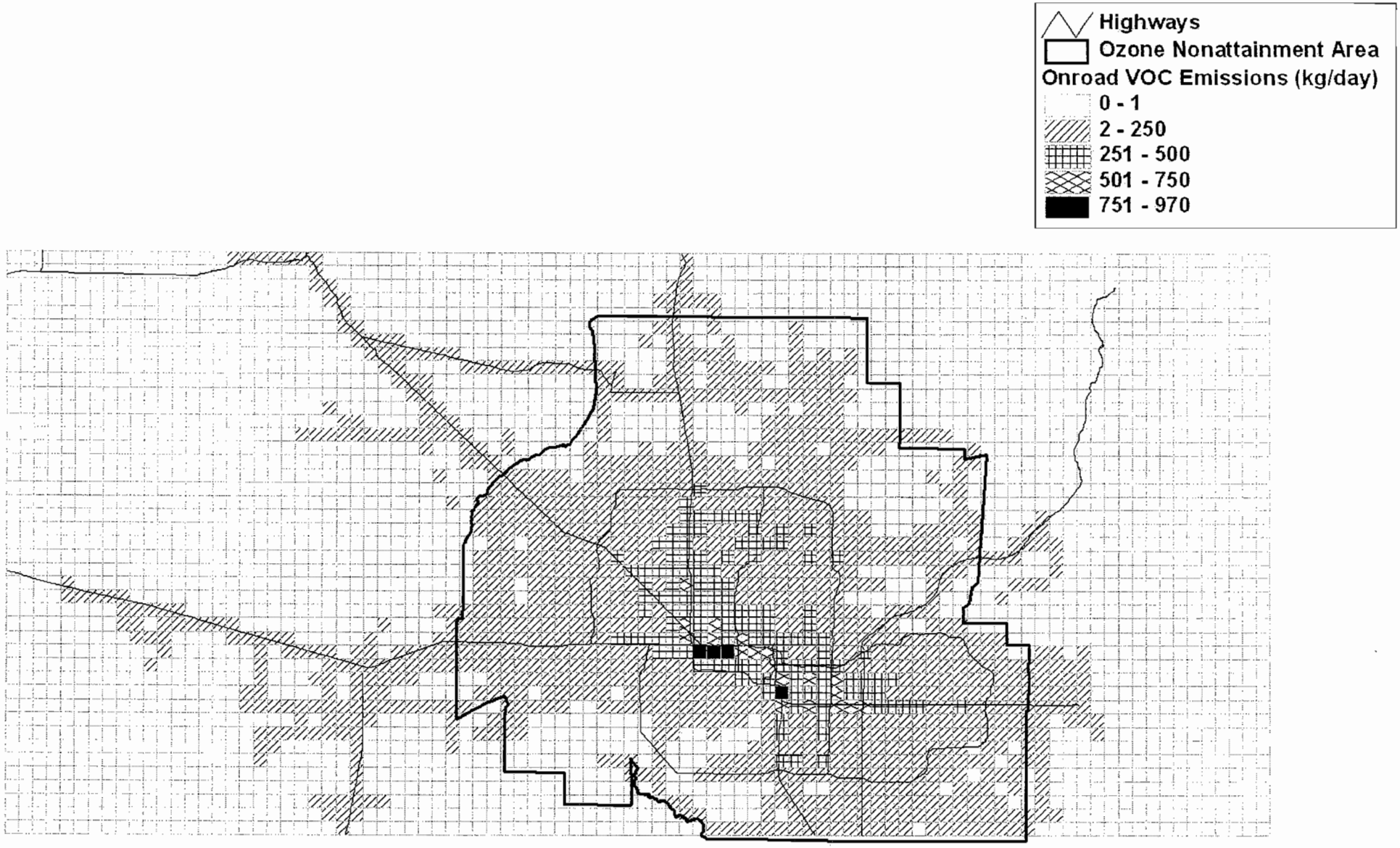


FIGURE III-2D. Onroad VOC Emissions for August 24, 1999 - Base Case
Total emissions = 111,120 kg/day
Total emissions in ozone nonattainment area = 106,900 kg/day
Maximum = 970 kg/day at cell (52,14)

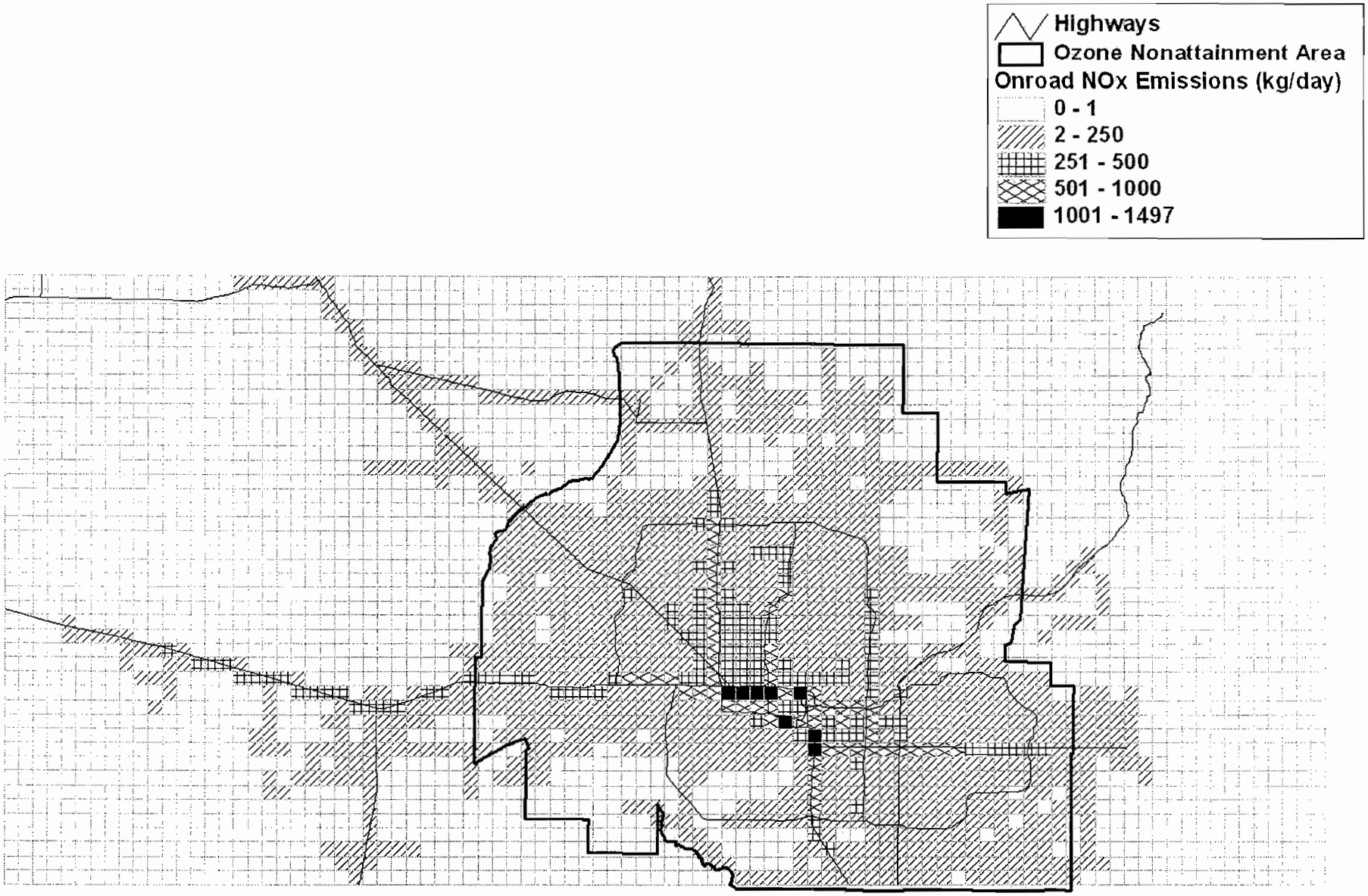


FIGURE III-2C. Onroad NOx Emissions for August 24, 1999 - Base Case
Total emissions = 142,519 kg/day
Total emissions in ozone nonattainment area = 129,800 kg/day
Maximum = 1,497 kg/day at cell (51,14)

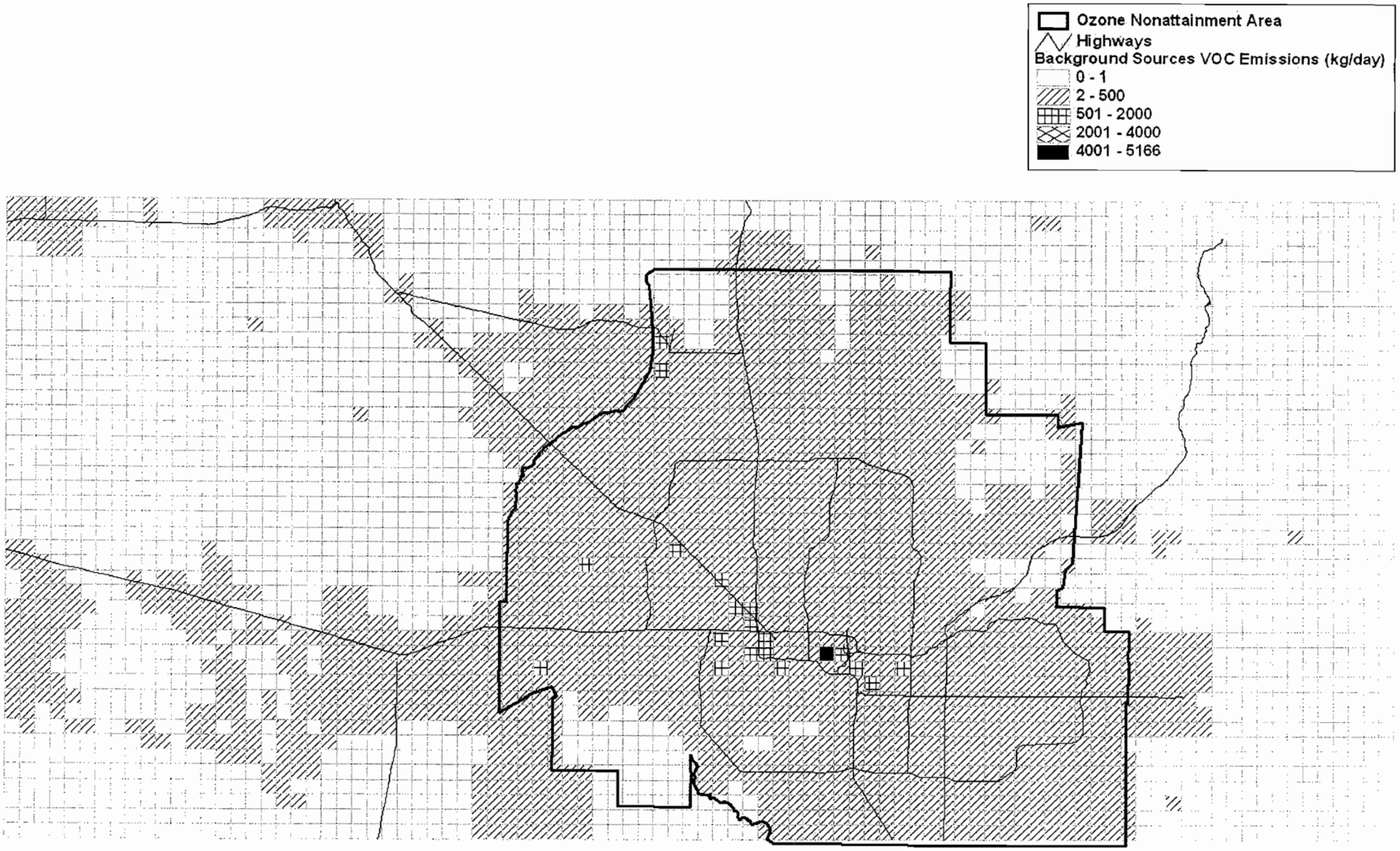


FIGURE III-6. Background Source VOC Emissions for August 24, 1999 - Base Case
Total emissions = 188,596 kg/day
Total emissions in ozone nonattainment area = 176,400 kg/day
Maximum = 5,166 kg/day at cell (55,13)

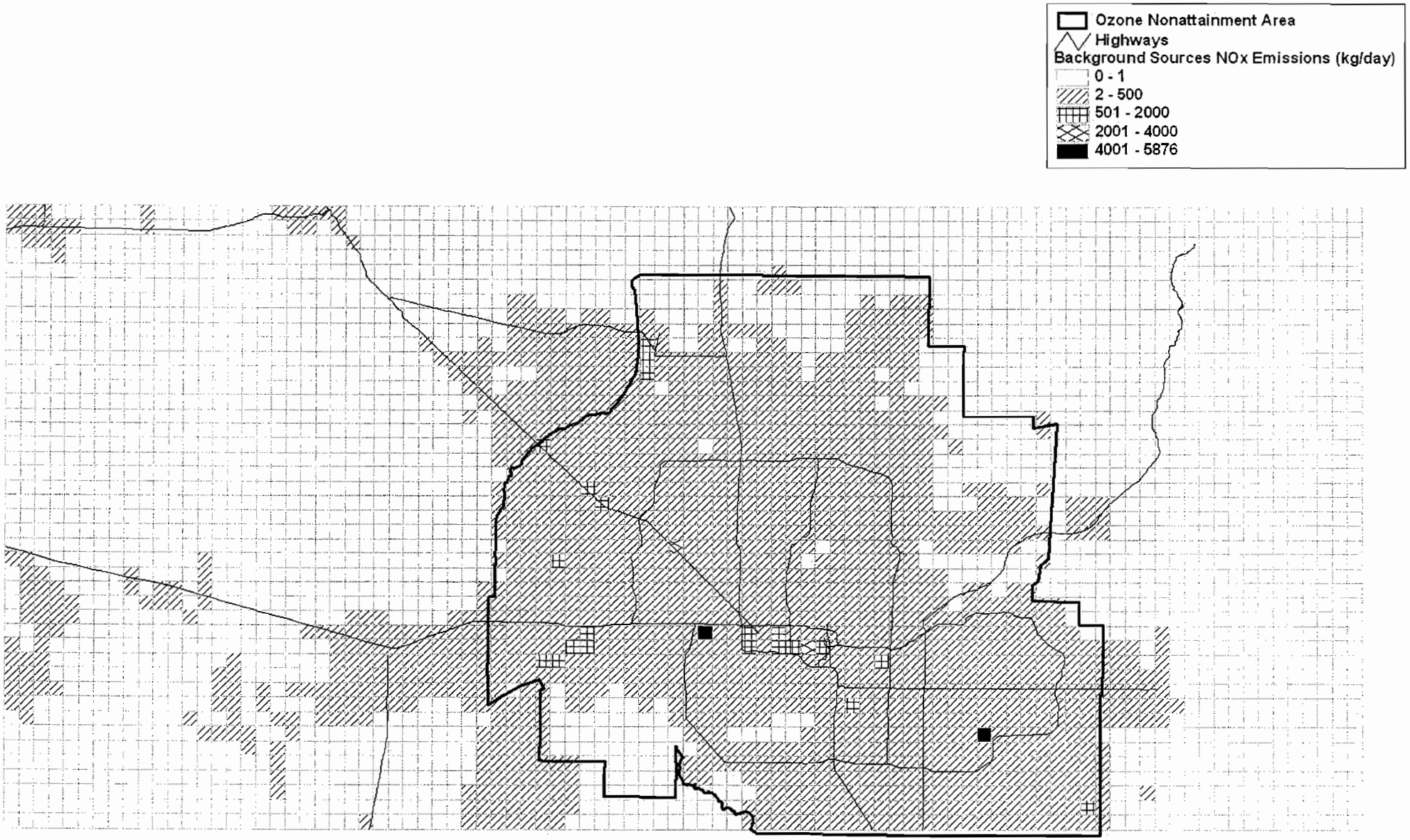


FIGURE III-5. Background Source NOx Emissions for August 24, 1999 - Base Case
Total emissions = 123,415 kg/day
Total emissions in ozone nonattainment area = 118,800 kg/day
Maximum = 5,876 kg/day at cell (66,7)

Appendix I-ii

MODELING DATA FILE LIST

Directory structure for the data files

```
P-ChemModel
    CAMx.v4.40
        src.v4.4
            CAMx
            CF_AERO
            CMC
            CMU_AERO
            DDM
            HG
            Includes
            IO_bin
            IO_hdf
            OSAT
            PA
            PiG
            RTRAC
            SOAP
        runfiles
        inputs
            MAG_CAMx_20L
            met
                200205
                200207
                200108
        postproc
            camxpost
                src
            camxtrct
                src
            mag.test10.200808
            mag.test11.200807
            mag.test32.200108
            mag.test40.200207
            mag.test40.200805
            mag.test92.200205
        preproc
            tuv
                DATAJ1
                    CHLORINE
                    CH3COCHO
                    SAPRC97
                    RONO2
                    CB_2002
                    CH3CHO
                    SAPRC99
                    YLD
                    CH3OOH
                    CHOCHO
                    CH2O
                    C2H5CHO
                    ABS
                    CH3COCH3
                    IUPAC04
                        raw_data
                src
                DATAS1
                DATAJ2
                    KFA
                    IUPAC
                DATAE1
                    NO2
                    SUN
                    SO2
                    ATM
                    GRIDS
                    O3
                    O2
            metpave
            kvpatch
            icbc
            ems_hono
            ahomap
                ozcol_data
                src
            mm5camx
                src
        mm5metdata
            200205
            200207
            200108
    EmissionModels
        EPS3.0
            jobs
            inputs
            outputs
                Emiss_base
                    msg
                    emar
                    embr
                    emiss
                    out
                        msg
                Emiss_08
                    msg
                    emiss
                    embr
                    emar
                    out
                        msg
        Onroad
            MOBILE6
                2706
                2705
                2607
                2606
                2605
                2604
                2603
                2602
                2601
                2531
                1811
                1810
                1809
```

```
│   │   ├──1808
│   │   ├──8811
│   │   ├──8810
│   │   ├──8809
│   │   ├──8808
│   │   ├──8807
│   │   ├──8806
│   │   ├──8805
│   │   ├──8804
│   │   ├──8803
│   │   ├──8802
│   │   ├──8714
│   │   ├──8713
│   │   ├──8712
│   │   ├──8711
│   │   ├──8710
│   │   ├──8709
│   │   ├──8708
│   │   ├──8707
│   │   ├──8706
│   │   ├──8705
│   │   ├──8607
│   │   ├──8606
│   │   ├──8605
│   │   ├──8604
│   │   ├──8603
│   │   ├──8602
│   │   ├──8601
│   │   ├──8531
│   │   ├──5606
│   │   ├──2714
│   │   ├──2713
│   │   ├──2712
│   │   ├──2711
│   │   ├──2710
│   │   ├──2709
│   │   ├──2708
│   │   ├──2707
│   │   ├──1807
│   │   ├──1806
│   │   ├──1805
│   │   ├──1804
│   │   ├──1803
│   │   └──1802
│   ├──M6LinkPart1
│   │   ├──2001
│   │   │   └──shape
│   │   │       ├──p1018W
│   │   │       ├──p1018T
│   │   │       ├──p1018S
│   │   │       ├──p1018R
│   │   │       ├──p1018M
│   │   │       ├──p1018F
│   │   │       ├──p1018A
│   │   │       └──info
│   │   ├──2002
│   │   │   ├──p1027W
```

```
│   │   │   ├──p1027T
│   │   │   ├──p1027S
│   │   │   ├──p1027R
│   │   │   ├──p1027M
│   │   │   ├──p1027F
│   │   │   ├──p1027A
│   │   │   ├──p1026W
│   │   │   ├──p1026T
│   │   │   ├──p1026S
│   │   │   ├──p1026R
│   │   │   ├──p1026M
│   │   │   ├──p1026F
│   │   │   ├──p1026A
│   │   │   ├──p1025F
│   │   │   └──info
│   │   └──2008
│   │       └──shape
│   │           ├──p1088W
│   │           ├──p1088T
│   │           ├──p1088S
│   │           ├──p1088R
│   │           ├──p1088M
│   │           ├──p1088F
│   │           ├──p1088A
│   │           ├──p1087W
│   │           ├──p1087T
│   │           ├──p1087S
│   │           ├──p1087R
│   │           ├──p1087M
│   │           ├──p1087F
│   │           ├──p1087A
│   │           ├──p1086W
│   │           ├──p1086T
│   │           ├──p1086S
│   │           ├──p1086R
│   │           ├──p1086M
│   │           ├──p1086F
│   │           ├──p1086A
│   │           ├──p1085F
│   │           └──info
│   ├──M6LinkPart2
│   │   ├──oz1805
│   │   ├──oz1804
│   │   ├──oz1803
│   │   ├──oz1802
│   │   ├──oz2714
│   │   ├──oz2713
│   │   ├──oz2712
│   │   ├──oz2711
│   │   ├──oz2710
│   │   ├──oz2709
│   │   ├──oz2708
│   │   ├──oz2707
│   │   ├──oz2706
│   │   ├──oz2705
│   │   ├──oz2607
│   │   ├──oz2606
```

```
│   │   ├──oz2605
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│   │   ├──oz2603
│   │   ├──oz2602
│   │   ├──oz2601
│   │   ├──oz2531
│   │   ├──oz1811
│   │   ├──oz1810
│   │   ├──oz1809
│   │   ├──oz1808
│   │   ├──oz1807
│   │   └──oz1806
│   └──MV_4km_Emis
├──Nonroad
│   ├──2001
│   ├──2008
│   │   └──Control
│   │       ├──Trial1
│   │       └──May_2002
│   ├──DATA
│   │   ├──TECH
│   │   ├──SEASON
│   │   ├──RETROFIT
│   │   ├──POP
│   │   ├──GROWTH
│   │   ├──EMSFAC
│   │   ├──DETFAC
│   │   ├──DAILY
│   │   ├──ALLOCATE
│   │   └──ACTIVITY
│   └──2002
│       └──May_2002
├──Aviation
│   └──INPUT_FILES
└──Biogenics
    ├──MEGAN_out
    │   └──em_run5
    ├──Bio_4km_Emis
    └──MEGAN_input
```

Complete File List

```
./P-ChemModel
./EmissionModels

./P-ChemModel/CAMx.v4.40

./P-ChemModel/CAMx.v4.40/src.v4.4
./P-ChemModel/CAMx.v4.40/runfiles
./P-ChemModel/CAMx.v4.40/inputs
./P-ChemModel/CAMx.v4.40/postproc
./P-ChemModel/CAMx.v4.40/preproc
./P-ChemModel/CAMx.v4.40/mm5metdata

./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx.mag.pg_linuxomp
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx.namelist.template
./P-ChemModel/CAMx.v4.40/src.v4.4/chktracer
./P-ChemModel/CAMx.v4.40/src.v4.4/LICENSE
./P-ChemModel/CAMx.v4.40/src.v4.4/Makefile
./P-ChemModel/CAMx.v4.40/src.v4.4/README
./P-ChemModel/CAMx.v4.40/src.v4.4/Release_notes_4.40
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx
./P-ChemModel/CAMx.v4.40/src.v4.4/CF_AERO
./P-ChemModel/CAMx.v4.40/src.v4.4/CMC
./P-ChemModel/CAMx.v4.40/src.v4.4/CMU_AERO
./P-ChemModel/CAMx.v4.40/src.v4.4/DDM
./P-ChemModel/CAMx.v4.40/src.v4.4/HG
./P-ChemModel/CAMx.v4.40/src.v4.4/Includes
./P-ChemModel/CAMx.v4.40/src.v4.4/IO_bin
./P-ChemModel/CAMx.v4.40/src.v4.4/IO_hdf
./P-ChemModel/CAMx.v4.40/src.v4.4/OSAT
./P-ChemModel/CAMx.v4.40/src.v4.4/PA
./P-ChemModel/CAMx.v4.40/src.v4.4/PiG
./P-ChemModel/CAMx.v4.40/src.v4.4/RTRAC
./P-ChemModel/CAMx.v4.40/src.v4.4/SOAP

./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/uptime.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/readchm.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/scavrat.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/luassgn.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/timestep.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/dlsode.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/plumeris.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/intrpdat.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/emassign.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/issgn2d.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/getunit.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/expndlay.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/exptbl.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/aggr00.f
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./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/aggdep.f
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./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/istrln.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/rassgn4d.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/iehsolv.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/chem10.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/aerochem_cf.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/aggreg.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/finwind.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/vd_aer.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/ahoprep.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/parntchd.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/chrtime.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/massum.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/wtmass.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/cvtwind.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/CAMx.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/intrpcnc.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/aerochem_aq.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/nstprep.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/ktberm.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/getdelt.f
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./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/zadvec.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/caldate.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/timrates.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/readpht.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/hadvppm.f
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./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/linpac.f
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./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/vdifflmp.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/updtmet.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/getinth.f
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./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/iniptr.f
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./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/startup.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/setbc.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/interpv.f
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./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/micromet.f
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./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/vd_gas.f
./P-ChemModel/CAMx.v4.40/src.v4.4/CAMx/henryfnc.f
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./P-ChemModel/CAMx.v4.40/src.v4.4/Includes/deposit.com
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./P-ChemModel/CAMx.v4.40/src.v4.4/IO_bin/rdpthdr.f
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./P-ChemModel/CAMx.v4.40/src.v4.4/PA/cparad.f
./P-ChemModel/CAMx.v4.40/src.v4.4/PA/cpamech4.f
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./P-ChemModel/CAMx.v4.40/src.v4.4/PiG/ironchem.f
./P-ChemModel/CAMx.v4.40/src.v4.4/PiG/ironwet.f
./P-ChemModel/CAMx.v4.40/src.v4.4/PiG/pigdiag.f
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./P-ChemModel/CAMx.v4.40/postproc/mag.test92.200205/surf.predmax.020605.8hr.o3
./P-ChemModel/CAMx.v4.40/postproc/mag.test92.200205/surf.predmax.020606.1hr.o3
./P-ChemModel/CAMx.v4.40/postproc/mag.test92.200205/surf.predmax.020606.8hr.o3
./P-ChemModel/CAMx.v4.40/postproc/mag.test92.200205/surf.predmax.020607.1hr.o3
./P-ChemModel/CAMx.v4.40/postproc/mag.test92.200205/surf.predmax.020607.8hr.o3

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./P-ChemModel/CAMx.v4.40/preproc/metpave
./P-ChemModel/CAMx.v4.40/preproc/kvpatch
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./P-ChemModel/CAMx.v4.40/preproc/mm_hono
./P-ChemModel/CAMx.v4.40/preproc/ahomap
./P-ChemModel/CAMx.v4.40/preproc/mm5camx

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./P-ChemModel/CAMx.v4.40/preproc/tuv/src
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAS1
./P-ChemModel/CAMx.v4.40/preproc/tuv/tuv.jun02.out
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2
./P-ChemModel/CAMx.v4.40/preproc/tuv/tuv4.0_1.mag.jul02.job
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1

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./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/CH3COCHO
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/SAPRC97
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/RONO2
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/CB_2002
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ3/CH3CHO
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/SAPRC99
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ3/YLD
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/CH3OOH
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/CHOCHO
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./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/RONO2/PAN_senum.abs
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./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/CB_2002/Hchos.cqy
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/CB_2002/Acro.cqy
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/CB_2002/Ccho.cqy
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./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/CB_2002/Hono_no2.cqy
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/CB_2002/No1no.cqy
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./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/ABS/Halon-1202_jp197.abs
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./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/CH3COCH3/CH3COCH3_iup.yld
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/HNO3.phf
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/PAN.phf
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/HCHO_H.phf
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/raw_data
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/HONO.phf
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/O3_O1P.phf
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/MGLY.0
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/NTR.phf
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/MGLY.phf
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/O3_O1D.phf
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/N2O5.phf
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/HCHO_H2.phf
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/HO2NO2.phf
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/MGLY.760
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/raw_data/HCHO_H2.phi
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/raw_data/O3_O1D.phi
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/raw_data/HCHO.sig
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/raw_data/O3.sig2
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/raw_data/O3.sig1
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/raw_data/HCHO_H.phi
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ1/IUPAC04/raw_data/O3_O3P.phi

./P-ChemModel/CAMx.v4.40/preproc/tuv/src/pchem.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/rdso2xs.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/params
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/rn.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/sphers.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/zenith.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/readl.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/psndo.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/futr.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/rtlink.psndo.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/orc/ps2str.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/fchap.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/inter3.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/Makefile
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/settmp.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/zerol.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/fsum.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/setno2.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/rdetfl.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/tuv.lnx
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/rdo3xs.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/setair.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/zero2.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/pbio11.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/seto2.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/fery.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/gridz.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/inter1.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/setalb.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/dlmach.netlib.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/inter2.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/sundis.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/setno2.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/schu.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/rtlink.ps2str.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/lymana.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/sjo2.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/setcld.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/rdo2xs.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/tuv.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/addpnt.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/setaer.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/erc/gridck.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/erc/gridw.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/rdno2xs.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/inter4.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/setozo.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/src/read2.f

./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAS1/dna.setlow.new
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAS1/phaeo.bio
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAS1/rhm.501
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAS1/ery.anders
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAS1/proro.bio
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAS1/SCUP-h
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAS1/acgih.1992
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/KFA
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/IUPAC
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/KFA/ch3cocho.003
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/KFA/ch3cho.001
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/KFA/ch3cho.005
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/KFA/ch3cocho.001
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/KFA/ch3cocho.004
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/KFA/ch3cocho.002
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/KFA/c2h5cho.001
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/KFA/ch3cho.002
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/KFA/ch3cho.003
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/KFA/ch3cho.006
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/KFA/chocho.001
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/KFA/ch3cho.004
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/IUPAC/ch3o2no2.abs
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/IUPAC/c2h5ono2.abs
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/IUPAC/i_c3h7ono2.abs
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/IUPAC/ch3co3no2.abs
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/IUPAC/ch3ono2.abs
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/IUPAC/ch3ooh.abs
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAJ2/IUPAC/n_c3h7ono2.abs

./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/NO2
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SO2
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/wmo85
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/ATM
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/GRIDS
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/O3
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/O2
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/NO2/NO2_ncar_00.abs
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/NO2/NO2_jp194.abs
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/fort.20
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/atlas3_1994_317_a.dat
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/t.f
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/zodtranl.flx
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/susim_lo.flx
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/sunlean.flx
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/nicolarv.flx
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/demerj.flx
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/susim_hi.flx
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/lowsun3.flx
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/solstice.flx
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/extsol.flx
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/a.out
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/atlas3.old
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/neckel.flx
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SUN/wmo85.flx
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SO2/SO2.abs
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/SO2/SO2xs.all
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/ATM/ussa.temp
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/ATM/atmmod.afglmw.100
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/ATM/ussa.orone
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/ATM/ussa.dens
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/GRIDS/kockartz.grid
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/GRIDS/isaksen.grid
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/O3/O3_molina.abs
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/O3/O3_bass.abs
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/O3/o3abcqs.dat
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/O2/O2_src.abs
./P-ChemModel/CAMx.v4.40/preproc/tuv/DATAE1/O2/O2_jp194.abs

./P-ChemModel/CAMx.v4.40/preproc/kvpatch/pbl_limit.jul02.MM5run9.1yr23.job
./P-ChemModel/CAMx.v4.40/preproc/kvpatch/pbl_limit.f
./P-ChemModel/CAMx.v4.40/preproc/kvpatch/pbl_limit.o
./P-ChemModel/CAMx.v4.40/preproc/kvpatch/pbl_limit
./P-ChemModel/CAMx.v4.40/preproc/kvpatch/makefile

./P-ChemModel/CAMx.v4.40/preproc/ems_hono/ems_hono
./P-ChemModel/CAMx.v4.40/preproc/ems_hono/ems_hono.v8.200807.job
./P-ChemModel/CAMx.v4.40/preproc/ems_hono/ems_hono.v20.200205.job
./P-ChemModel/CAMx.v4.40/preproc/ems_hono/ems_hono.f
./P-ChemModel/CAMx.v4.40/preproc/ems_hono/ems_hono.v12.200207.job
./P-ChemModel/CAMx.v4.40/preproc/ems_hono/ems_hono.v13.200108.job
./P-ChemModel/CAMx.v4.40/preproc/ems_hono/ems_hono.v30.200805.job
./P-ChemModel/CAMx.v4.40/preproc/ems_hono/ems_hono.v8.200808.job
./P-ChemModel/CAMx.v4.40/preproc/ems_hono/makefile

./P-ChemModel/CAMx.v4.40/preproc/ahomap/ahomap.mag.aug01.job
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ahomap.mag.jun02.job
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ahomap.mag.out
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ahomap.mag.jul02.job
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data
./P-ChemModel/CAMx.v4.40/preproc/ahomap/README
./P-ChemModel/CAMx.v4.40/preproc/ahomap/arc
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020605.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020709.txt
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./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020705.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20010801.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20010810.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020603.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20010808.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020712.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020606.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20010811.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20010806.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20010809.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020531.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20010805.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20010802.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020706.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020707.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020708.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20010804.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020713.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020711.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20010807.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020602.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020710.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020604.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020601.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020607.txt
./P-ChemModel/CAMx.v4.40/preproc/ahomap/ozcol_data/L3_ozone_ept_20020714.txt

./P-ChemModel/CAMx.v4.40/preproc/ahomap/src/strlen.f
./P-ChemModel/CAMx.v4.40/preproc/ahomap/src/ahomap.lnx
./P-ChemModel/CAMx.v4.40/preproc/ahomap/src/juldate.f
./P-ChemModel/CAMx.v4.40/preproc/ahomap/src/ahomap.f
./P-ChemModel/CAMx.v4.40/preproc/ahomap/src/lcpgeo.f
./P-ChemModel/CAMx.v4.40/preproc/ahomap/src/TOMSprep.f
./P-ChemModel/CAMx.v4.40/preproc/ahomap/src/utmgeo.f
./P-ChemModel/CAMx.v4.40/preproc/ahomap/src/makefile
./P-ChemModel/CAMx.v4.40/preproc/ahomap/src/psgeo.f

./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.mag.jun02.run5.cmaq.job
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.mag.jun02.run5.ob70.lyr23.job
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010811.4k.run9.ob70.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010811.12k.run9.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010810.4k.run9.ob70.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010810.12k.run9.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010809.4k.run9.ob70.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010809.12k.run9.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010808.4k.run9.ob70.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010808.12k.run9.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010807.4k.run9.ob70.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010807.12k.run9.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/src
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010806.4k.run9.ob70.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010806.12k.run9.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010805.4k.run9.ob70.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010805.12k.run9.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010804.4k.run9.ob70.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010804.12k.run9.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010803.4k.run9.ob70.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010803.12k.run9.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010802.4k.run9.ob70.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20010802.12k.run9.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.mag.jul02.run9.cmaq.job
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.mag.aug01.run9.cmaq.job
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.mag.aug01.run9.ob70.lyr23.job
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20020714.4k.run9.cmaq.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20020713.4k.run9.cmaq.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20020712.4k.run9.cmaq.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20020711.4k.run9.cmaq.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20020710.4k.run9.cmaq.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20020709.4k.run9.cmaq.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20020708.4k.run9.cmaq.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20020707.4k.run9.cmaq.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20020706.4k.run9.cmaq.lyr23.out
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/mm5camx.20020705.4k.run9.cmaq.lyr23.out
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./P-ChemModel/CAMx.v4.40/preproc/mm5camx/src/interp_geo.f
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/src/vertmap.f
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/src/kvcalc_tke.f
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/src/readmm5.f
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./P-ChemModel/CAMx.v4.40/preproc/mm5camx/src/cldiag.f
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/src/mm5camx.linux
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/src/lcpgeo.f
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/src/README
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/src/utmgeo.f
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/src/mm5camx.f
./P-ChemModel/CAMx.v4.40/preproc/mm5camx/src/makefile
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./P-ChemModel/CAMx.v4.40/mm5metdata/200108

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./EmissionModels/Nonroad
./EmissionModels/Aviation
./EmissionModels/Biogenics

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./EmissionModels/EPS3.0/outputs

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./EmissionModels/EPS3.0/outputs/Emiss_base/msg/msg.grdem.offr.4km.020607
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./EmissionModels/EPS3.0/outputs/Emiss_base/msg/msg.chmspl.avi.4km.020531.hr
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./EmissionModels/EPS3.0/outputs/Emiss_base/msg/msg.tmprl.ar.4km.020602.mari
./EmissionModels/EPS3.0/outputs/Emiss_base/msg/msg.grdem.ar.4km.020602.mari
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./EmissionModels/EPS3.0/outputs/Emiss_base/emar/emar.grdem.offr.vl.4km.020531
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./EmissionModels/EPS3.0/outputs/Emiss_base/emar/emar.tmprl.offr.vl.4km.020602
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./EmissionModels/EPS3.0/outputs/Emiss_base/emar/emar.grdem.avi.4km.010810.hr
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./EmissionModels/EPS3.0/outputs/Emiss_base/emar/emar.tmprl.avi.4km.010810.day
./EmissionModels/EPS3.0/outputs/Emiss_base/emar/emar.grdem.avi.4km.010810.day
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./EmissionModels/EPS3.0/outputs/Emiss_base/emar/emar.grdem.avi.4km.020604.hr
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./EmissionModels/EPS3.0/outputs/Emiss_base/emar/emar.grdem.avi.4km.020604.day
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./EmissionModels/EPS3.0/outputs/Emiss_base/emiss/emiss.offr.vl.4km.020601
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./EmissionModels/EPS3.0/outputs/Emiss_base/emiss/emiss.avi.4km.010802.day
./EmissionModels/EPS3.0/outputs/Emiss_base/emiss/emiss.avi.4km.010803.hr
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./EmissionModels/EPS3.0/outputs/Emiss_08/msg/msg.chmspl.avi.4km.080603.hr
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./EmissionModels/EPS3.0/outputs/Emiss_08/msg/msg.tmprl.avi.4km.080603.hr
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./EmissionModels/EPS3.0/outputs/Emiss_08/emiss/stkhdr.pt.4km.080707.mari
./EmissionModels/EPS3.0/outputs/Emiss_08/emiss/emiss.pt.4km.080708.mari
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./EmissionModels/EPS3.0/outputs/Emiss_08/embr/embr.chmspl.pt.4km.080802.mari
./EmissionModels/EPS3.0/outputs/Emiss_08/embr/embr.tmprl.pt.4km.080802.mari
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./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088T/summary_networkO.txt

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./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088S/088S1O.txt
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088S/088S2A.txt
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088S/088S2O.txt
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088S/088S3A.txt
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088S/088S3O.txt
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./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088S/088S4O.txt
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088S/088S5A.txt
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088S/088S5O.txt
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088S/L088SA
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088S/L088SO
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088S/summary_domainA.txr
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088S/summary_domainO.txt
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088S/summary_networkA.txt
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088S/summary_networkO.txt

./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088R/088R1A.txt
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088R/088R1O.txt
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088R/088R2A.txt
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088R/088R2O.txt
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./EmissionModels/Onroad/M6LinkPart1/2008/shape/p1088R/088R3O.txt
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./EmissionModels/Onroad/M6LinkPart1/2008/shape/p088R/088R5O.txt
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./EmissionModels/Onroad/M6LinkPart1/2008/shape/p088R/summary_domainO.txt
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p088R/summary_networkA.txt
./EmissionModels/Onroad/M6LinkPart1/2008/shape/p088R/summary_networkO.txt

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./EmissionModels/Onroad/M6LinkPart1/2008/shape/p088M/088M1O.txt
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./EmissionModels/Onroad/M6LinkPart1/2008/shape/p088M/summary_networkO.txt

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./EmissionModels/Onroad/M6LinkPart1/2008/shape/p088F/summary_networkO.txt

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APPENDIX II

BASE YEARS EMISSION INVENTORY DEVELOPMENT
(2001 and 2002)

Appendix II-i

Onroad Vehicle Emission Factor Estimation Procedure for 2001 and 2002

Appendix II-i is followed by an attachment containing a sample of the MOBILE6.2 input files for 2001.

ONROAD VEHICLE EMISSION FACTOR ESTIMATION PROCEDURE FOR 2001 AND 2002

Emission Factor Model

Hydrocarbons in the form of volatile organic compounds (VOCs), carbon monoxide (CO), and oxides of nitrogen (NOx) vehicle exhaust emission factors were calculated using MOBILE6.2, a model developed by the Environmental Protection Agency (EPA) for the purpose of estimating motor vehicle emission factors. The MOBILE6.2 runs were executed by the Maricopa Association of Governments (MAG). The contact person for the MOBILE6.2emission estimates is Taejoo Shin (602-254-6300). More information about the MOBILE6.2model may be found in the EPA User's Guide to MOBILE6.1 and MOBILE6.2: Mobile Source Emission Factor Model, August 2003, EPA420-R-02-026, which may be found at the web site http://www.epa.gov/otaq/models.htm.

A series of MOBILE6.2 runs were performed to create a complete set of emission factors for input to the M6Link model.

Two Inspection/maintenance (I/M) scenarios were modeled:

1. With an I/M program in place.
2. No I/M program in place.

Five area types were modeled:

1. Central Business District
2. Urban Area
3. Urban Fringe
4. Suburban
5. Rural

Ten days for 2001 and eighteen days for 2002 were modeled:

1. August 2 (Thursday) - 11 (Saturday), 2001
2. May 31 (Friday) - 7 (Friday), 2002 and July 5 (Friday) - 14 (Sunday), 2002

Two sets of control measures were applied to the MOBILE6.2 inputs, depending upon the location:

1. Area A

2. Outside Area A

Combinations of the above scenarios were processed through the MOBILE6.2 model for the creation of detailed MOBILE6.2 output files for each base year (2 I/M status conditions X 5 area types X 28 days X 2 control measure subareas).

The results of the I/M and non-I/M runs for each of the five area types were combined to reflect the proportions of I/M and non I/M vehicles by the M6Link program. The term I/M vehicles means vehicles which are required to undergo an emission test and inspection under the Arizona Vehicle Inspection/Maintenance Program. It is important to note that the I/M program is assumed to be required for all vehicles of the appropriate age *registered* in the Area A. In addition, it is assumed that 89.6 percent of the vehicles *operating* within the Area A will participate in the I/M program, and that 10.4 percent will not participate in the program during the 2001 and 2002 time period. Refer to ATTACHMENT ONE for the actual input files for the 2001 runs.

Development of Model Inputs

The inputs to MOBILE6.2 are grouped into three categories: Header inputs, Run inputs, and Scenario inputs. The input values used in the above described MOBILE6.2 runs are specified and explained below.

Header Section

1. **MOBILE6 INPUT FILE** identifies a MOBILE6.2 input file as a regular command input file rather than a batch file.

2. **DATABASE OUTPUT** instructs MOBILE6.2 to report output in database format.

3. **WITH FIELDNAMES** specifies that a header record of field names is to be generated for the database output file.

4. **DATABASE EMISSIONS : 2222 2222** indicates that all emissions types are reported in database output format if appropriate. The eight emission types are exhaust running emissions, exhaust start emissions, evaporative hot soak emissions, evaporative diurnal emissions, evaporative resting loss emissions, evaporative running loss emissions, evaporative crankcase emissions, and evaporative refueling emissions. For carbon monoxide and NOx, only exhaust running emissions and exhaust start emissions are relevant. For HC, all eight emission types were included in the MOBILE6.2 runs, although the evaporative refueling emissions were omitted from subsequent analyses because refueling emissions are included in the area source emission class.

5. **DATABASE FACILITIES : Arterial Freeway Local Ramp None** instructs MOBILE6.2 to output emissions in the database output table specific to each of the four roadway types modeled by MOBILE6.2. Also, emissions that are independent of roadway type are output separately by MOBILE6.2.

6. **DATABASE VEHICLES : 22222 22222222 2 222 22222222 222** instructs MOBILE6.2 to output emission factors for all 28 vehicle classes considered by MOBILE6.

Run Data Section

The run data section includes information about stage II vapor recovery system, the local inspection and maintenance programs, the anti-tampering program, and local vehicle registration data. For the data lines STAGE II REFUELING, I/M PROGRAM, I/M MODEL YEARS, I/M VEHICLES, I/M STRINGENCY, I/M COMPLIANCE, and I/M WAIVER RATE the first "1" indicates that the data to follow reflects component number one of the I/M program where an I/M program may have many components. For the runs described in this report, there are five components to the I/M program in 2001, 2002, and 2008.

1. **NO 2007 HDDV RULE:** instructs overriding the default settings for the 2007 Heavy Duty Vehicle emissions standards.

2. **STAGE II REFUELING:94 1 80.77 80.77** instructs MOBILE6.2 to model a Stage II program that started in 1994, was phased in over one year, and was 80.77 percent efficient for LDGVs and LDGTs and 80.77 percent efficient for HDGVs.

3. **I/M PROGRAM :1 1977 2050 1 T/O LOADED/IDLE** instructs MOBILE6.2 to model an I/M program with an I/M program start year of 1977 and 2050 end year. The program is an annual program "1". The program is a Test only rather than test and repair program "T/O". Finally, the program is a loaded/idle program.

4. **I/M MODEL YEARS : 1 1967 2050** instructs MOBILE6.2 that the portion of the I/M program defined in the "I/M PROGRAM" line is applied to model year 1967 through 2050 model year vehicles.

5. **I/M VEHICLES : 1 11111 22222222 2** this instructs MOBILE6.2 which vehicle classes are subject to this component of the I/M program where the number two indicates that a particular vehicle class is subject to the program and the number one indicates that a particular vehicle class is not subject to the program.

6. **I/M STRINGENCY : 1 28.0** defines that the expected exhaust inspection failure rate for pre-1981 model year vehicles covered by the I/M program is 28.0 percent.

7. **I/M COMPLIANCE : 1 97.0** describes the expected compliance rate within this portion of the I/M program where the compliance rate is the percentage of vehicles in the fleet that complete the I/M program and receive either a certificate of compliance or a waiver.

8. **I/M WAIVER RATES: 1 1.3 1.0** specifies the percentage of vehicles that fail an initial I/M test and do not pass a retest but receive a certificate of compliance. This input instructs MOBILE6.2to set the waiver rate at 1.3 percent for pre-1981 model years and 1.0 percent for 1981 and later model years for this portion of the I/M program during the 2001 time period.

9. **ANTI-TAMP PROG : 87 75 80 22222 22222222 2 11 097. 22111222** indicates information for the local anti-tampering program. Note that there may be more than one component of an anti-tampering program, requiring multiple inputs of this data.

   "**87**" indicates that the program began in 1987.
   "**75**" indicates that the earliest model year covered by the program is 1975.
   "**80**" indicates that the last model year covered by the program is 1980.
   "**22222**" indicates that the five light duty gasoline vehicle classes considered by MOBILE6.2are all subject to this portion of the anti-tampering program.
   "**22222222**" indicates that the eight heavy duty gasoline vehicle classes considered by MOBILE6.2are all subject to this portion of the anti-tampering program.
   "**2**" indicates that the gasoline powered buses are subject to this portion of the anti-tampering program.
   "**11**" indicates that credit is to be taken for the anti-tampering program and that the test is performed annually.
   "**097.**" indicates that the program compliance rate is 97 percent.
   "**22111222**" indicates that the ATP program consists of an air pump system disablement test, catalyst removal test, PCV system disablement test, evaporative system disablement test, and gas cap test. Omitted from the program are an EGR disablement test, fuel inlet restrictor disablement test, and tailpipe lead deposit test.

10. **REG DIST: 02reg01.d** indicates that local registration distribution data is provided for MOBILE6.2 use, rather than national default data, and that these data may be found in the external data file 02reg01.d. The data input to the runs performed for this analysis reflect ADOT registration data developed in 2002.

11. **DIESEL FRACTIONS :** indicates that the user is inputting data to reflect the fraction of vehicles by vehicle class that are diesel powered, where appropriate. In the case of MAG analysis, local data is used for the vehicle classes light duty gasoline vehicles, light duty trucks 1, and light duty trucks 2. For the remaining vehicle classes, MOBILE6.2 default data was input. Please note that the 42 lines of registration data following the DIESEL FRACTIONS: command have not been reproduced here, but may be seen in the sample MOBILE6.2 input file provided with this document.

Scenario Data Section

1. **SCENARIO RECORD : I/M Scenario** is a required field that provides a unique identifier to each scenario analyzed. The individual MOBILE6.2 runs performed by MAG for this analysis each have only one scenario.

2. **CALENDAR YEAR : 2001** indicates that the year analyzed is 2001 (or 2002 for the case of 2002).

3. **EVALUATION MONTH : 7** indicates that the month analyzed was July (where January and July are the only months available for analysis by MOBILE6.2). Since the periods subject to analysis were June, July and August, the closest month available to model was July.

4. **ALTITUDE : 1** indicates that the runs are being performed for a low-altitude region. The low altitude flag represents approximately 500 feet above sea level and the high altitude flag represents approximately 5,500 feet above sea level.

5. **HOURLY TEMPERATURES:** indicates the 24 hourly temperatures for the day being modeled, starting at 6 a.m. and ending at 5 a.m. the next morning in degrees Fahrenheit.

6. **RELATIVE HUMIDITY:** indicates the 24 hourly humidity values for the day being modeled, starting at 6 a.m. and ending at 5 a.m. the next morning in percent.

7. **BAROMETRIC PRESSURE: 28.8** indicates the average daily barometric pressure expressed in inches of mercury.

8. **SPEED VMT: 018F1A.txt** indicates that the user has chosen to provide an external data file, 018R1A.txt, that contains hourly speed distributions for both freeway and arterial roadway types. In this case, the file reflects area type 1 "1A" in the Area A for the Friday design day "F", August "8" in 2001 "01".

9. **FUEL RVP : 6.5** indicates that the fuel volatility Reid Vapor Pressure was measured at 6.5 pounds per square inch during the period modeled.

10. **FUEL PROGRAM : 4** instructs MOBILE6.2 that the user will supply the gasoline sulfur levels, expressed as parts per million. The first 16 values are the average fuel sulfur content for gasoline in calendar years 2000 through 2015. The next 16 values are the maximum sulfur levels to which the model years 2000 through 2015 are exposed.

Model Outputs

MOBILE6.2 was executed with the inputs described above to obtain a database of emission factors in grams per mile (g/mi) for CO, NOx, and VOC emissions. The database of emission factors represented emission factors split out by the vehicle classes, vehicle ages, hour of the day, roadway (facility) type on which the vehicle is driving. These outputs, in the units of grams per mile were input to the M6Link system for further processing.

ATTACHMENT ONE

MOBILE6.2 INPUT FILES

Attachment One contains a portion of the MOBILE6.2 input files for the I/M and no I/M runs inside Area A and no I/M run outside Area A for for the modeling years 2001 and 2002. The sample inputs reflects Area Type number 1 (central business district) and the Friday 2001, and Thursday and Tuesday 2002 modeling days. The I/M input is first followed by the no I/M input for Area A, and then lastly followed by no I/M input for outside Area A.

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222


RUN DATA
NO 2007 HDDV RULE  :
STAGE II REFUELING :
94 1 80.77 80.77
I/M PROGRAM        : 1 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 1 1967 2050
I/M VEHICLES       : 1 11111 22222222 2
I/M STRINGENCY     : 1 28.0
I/M COMPLIANCE     : 1 97.0
I/M WAIVER RATES   : 1 1.3 1.0
I/M GRACE PERIOD   : 1 5
I/M PROGRAM        : 2 1977 2050 2 T/O IM240
I/M MODEL YEARS    : 2 1981 1995
I/M VEHICLES       : 2 22222 11111111 1
I/M STRINGENCY     : 2 28.0
I/M COMPLIANCE     : 2 97.0
I/M WAIVER RATES   : 2 1.3 1.0
I/M GRACE PERIOD   : 2 5
I/M CUTPOINTS      : 2 CUTPNT01.d
I/M PROGRAM        : 3 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 3 1967 1980
I/M VEHICLES       : 3 22222 11111111 1
I/M STRINGENCY     : 3 28.0
I/M COMPLIANCE     : 3 97.0
I/M WAIVER RATES   : 3 1.3 1.0
I/M PROGRAM        : 4 2001 2050 2 T/O OBD I/M
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M STRINGENCY     : 4 28.0
I/M COMPLIANCE     : 4 97.0
I/M WAIVER RATES   : 4 1.3 1.0
I/M GRACE PERIOD   : 4 5
I/M PROGRAM        : 5 2001 2050 2 T/O EVAP OBD & GC
I/M MODEL YEARS    : 5 1996 2050
I/M VEHICLES       : 5 22222 11111111 1
I/M STRINGENCY     : 5 28.0
I/M COMPLIANCE     : 5 97.0
I/M WAIVER RATES   : 5 1.3 1.0
I/M GRACE PERIOD   : 5 5
ANTI-TAMP PROG     :
87 75 80 22222 22222222 2 11 097. 22111222
ANTI-TAMP PROG     :
87 81 95 11111 22222222 2 11 097. 22111222

REG DIST           : 02reg01.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0006 0.0001 0.0003 0.0006
0.0013 0.0004 0.0004 0.0001 0.0027 0.0032 0.0097 0.0162 0.0241 0.0510
0.0706 0.0390 0.0269 0.0114 0.0093
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223 0.0656
0.0616 0.0439 0.0316 0.0259 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223 0.0656
0.0616 0.0439 0.0316 0.0259 0.0000
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115
0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209 0.0256
```

```
0.0013 0.0006 0.0011 0.0001 0.0000
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115
0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209 0.0256
0.0013 0.0006 0.0011 0.0001 0.0000
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.2578 0.2515 0.3263 0.2784
0.2963 0.2384 0.2058 0.1756 0.1958 0.2726 0.2743 0.3004 0.2918 0.2859
0.0138 0.0000 0.0000 0.0000 0.0000
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.7715 0.7910 0.8105 0.8068
0.8280 0.8477 0.7940 0.7488 0.7789 0.7842 0.6145 0.5139 0.5032 0.4277
0.0079 0.0000 0.0000 0.0001 0.0003
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8473 0.8048 0.8331 0.7901
0.7316 0.7275 0.7158 0.5647 0.3178 0.2207 0.1968 0.1570 0.0738 0.0341
0.0414 0.0003 0.0000 0.0000 0.0000
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4384 0.3670 0.4125 0.3462
0.2771 0.2730 0.2616 0.1543 0.0615 0.0383 0.0333 0.0255 0.0111 0.0049
0.0060 0.0000 0.0000 0.0000 0.0000
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6078 0.5246 0.5767 0.5289
0.5788 0.5617 0.4537 0.4216 0.4734 0.4705 0.4525 0.4310 0.3569 0.3690
0.4413 0.3094 0.1679 0.1390 0.0808
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8443 0.7943 0.8266 0.7972
0.8279 0.8177 0.7440 0.7184 0.7588 0.7567 0.7431 0.7261 0.6602 0.6717
0.7344 0.6107 0.4140 0.3610 0.2353
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9989 0.9987 0.9989 0.9977
0.9984 0.9982 0.9979 0.9969 0.9978 0.9980 0.9979 0.9976 0.9969 0.9978
0.9982 0.9974 0.9965 0.9964 0.9949
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.8857 0.8525 0.8795 0.9900
0.9105 0.8760 0.7710 0.7502 0.7345 0.6733 0.5155 0.3845 0.3238 0.3260
0.2639 0.0594 0.0460 0.0291 0.0240

SCENARIO RECORD     : I/M Scenario
CALENDAR YEAR       : 2001
EVALUATION MONTH    : 7
ALTITUDE            : 1
HOURLY TEMPERATURES: 82.0 83.0 81.0 85.0 88.0 89.0 92.0 95.0 97.0 98.0 97.0 96.0
                     97.0 96.0 96.0 95.0 94.0 93.0 91.0 87.0 87.0 86.0 86.0 87.0
RELATIVE HUMIDITY   : 74.0 67.0 77.0 65.0 57.0 59.0 52.0 46.0 43.0 43.0 45.0 46.0
                     46.0 49.0 42.0 43.0 44.0 47.0 54.0 51.0 50.0 55.0 55.0 55.0
BAROMETRIC PRES     : 28.7
SPEED VMT           : 018F1A.txt
FUEL RVP            : 6.5
FUEL PROGRAM        : 4
FUEL PROGRAM        : 4
147.6  94.9  71.5  89.2  52.4  40.0  33.0  33.0
 30.0  30.0  30.0  30.0  30.0  30.0  30.0  30.0
348.0  224.0  338.0  380.0  164.0   93.0   87.0   87.0
 80.0   80.0   80.0   80.0   80.0   80.0   80.0   80.0

END OF RUN
```

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222


RUN DATA
NO 2007 HDDV RULE  :
STAGE II REFUELING :
94 1 80.77 80.77

REG DIST           : 02reg01.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0006 0.0001 0.0003 0.0006
0.0013 0.0004 0.0004 0.0001 0.0027 0.0032 0.0097 0.0162 0.0241 0.0510
0.0706 0.0390 0.0269 0.0114 0.0093
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223 0.0656
0.0616 0.0439 0.0316 0.0259 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223 0.0656
0.0616 0.0439 0.0316 0.0259 0.0000
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115
0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209 0.0256
0.0013 0.0006 0.0011 0.0001 0.0000
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115
0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209 0.0256
0.0013 0.0006 0.0011 0.0001 0.0000
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.2578 0.2515 0.3263 0.2784
0.2963 0.2384 0.2058 0.1756 0.1958 0.2726 0.2743 0.3004 0.2918 0.2859
0.0138 0.0000 0.0000 0.0000 0.0000
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.7715 0.7910 0.8105 0.8068
0.8280 0.8477 0.7940 0.7488 0.7789 0.7842 0.6145 0.5139 0.5032 0.4277
0.0079 0.0000 0.0000 0.0001 0.0003
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8473 0.8048 0.8331 0.7901
0.7316 0.7275 0.7158 0.5647 0.3178 0.2207 0.1968 0.1570 0.0738 0.0341
0.0414 0.0003 0.0000 0.0000 0.0000
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4384 0.3670 0.4125 0.3462
0.2771 0.2730 0.2616 0.1543 0.0615 0.0383 0.0333 0.0255 0.0111 0.0049
0.0060 0.0000 0.0000 0.0000 0.0000
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6078 0.5246 0.5767 0.5289
0.5788 0.5617 0.4537 0.4216 0.4734 0.4705 0.4525 0.4310 0.3569 0.3690
0.4413 0.3094 0.1679 0.1390 0.0808
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8443 0.7943 0.8266 0.7972
0.8279 0.8177 0.7440 0.7184 0.7588 0.7567 0.7431 0.7261 0.6602 0.6717
0.7344 0.6107 0.4140 0.3610 0.2353
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9989 0.9987 0.9989 0.9977
0.9984 0.9982 0.9979 0.9969 0.9978 0.9980 0.9979 0.9976 0.9969 0.9978
0.9982 0.9974 0.9965 0.9964 0.9949
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.8857 0.8525 0.8795 0.9900
0.9105 0.8760 0.7710 0.7502 0.7345 0.6733 0.5155 0.3845 0.3238 0.3260
0.2639 0.0594 0.0460 0.0291 0.0240

SCENARIO RECORD    : Non-I/M Scenario
CALENDAR YEAR      : 2001
EVALUATION MONTH   : 7
ALTITUDE           : 1
HOURLY TEMPERATURES: 82.0 83.0 81.0 85.0 88.0 89.0 92.0 95.0 97.0 98.0 97.0 96.0
                     97.0 96.0 96.0 95.0 94.0 93.0 91.0 87.0 87.0 86.0 86.0 87.0
RELATIVE HUMIDITY  : 74.0 67.0 77.0 65.0 57.0 59.0 52.0 46.0 43.0 43.0 45.0 46.0
                     46.0 49.0 42.0 43.0 44.0 47.0 54.0 51.0 50.0 55.0 55.0 55.0
```

```
BAROMETRIC PRES     : 28.7
SPEED VMT           : 018F1A.txt
FUEL RVP            : 6.5
FUEL PROGRAM        : 4
147.6  94.9  71.5  89.2  52.4  40.0  33.0  33.0
 30.0  30.0  30.0  30.0  30.0  30.0  30.0  30.0
348.0  224.0  338.0  380.0  164.0   93.0   87.0   87.0
 80.0   80.0   80.0   80.0   80.0   80.0   80.0   80.0

END OF RUN
```

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222

RUN DATA
NO 2007 HDDV RULE  :
REG DIST           : 02reg01.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0006 0.0001 0.0003 0.0006
0.0013 0.0004 0.0004 0.0001 0.0027 0.0032 0.0097 0.0162 0.0241 0.0510
0.0706 0.0390 0.0269 0.0114 0.0093
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223 0.0656
0.0616 0.0439 0.0316 0.0259 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223 0.0656
0.0616 0.0439 0.0316 0.0259 0.0000
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115
0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209 0.0256
0.0013 0.0006 0.0011 0.0001 0.0000
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115
0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209 0.0256
0.0013 0.0006 0.0011 0.0001 0.0000
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.2578 0.2515 0.3263 0.2784
0.2963 0.2384 0.2058 0.1756 0.1958 0.2726 0.2743 0.3004 0.2918 0.2859
0.0138 0.0000 0.0000 0.0000 0.0000
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.7715 0.7910 0.8105 0.8068
0.8280 0.8477 0.7940 0.7488 0.7789 0.7842 0.6145 0.5139 0.5032 0.4277
0.0079 0.0000 0.0000 0.0001 0.0003
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8473 0.8048 0.8331 0.7901
0.7316 0.7275 0.7158 0.5647 0.3178 0.2207 0.1968 0.1570 0.0738 0.0341
0.0414 0.0003 0.0000 0.0000 0.0000
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4384 0.3670 0.4125 0.3462
0.2771 0.2730 0.2616 0.1543 0.0615 0.0383 0.0333 0.0255 0.0111 0.0049
0.0060 0.0000 0.0000 0.0000 0.0000
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6078 0.5246 0.5767 0.5289
0.5788 0.5617 0.4537 0.4216 0.4734 0.4705 0.4525 0.4310 0.3569 0.3690
0.4413 0.3094 0.1679 0.1390 0.0808
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8443 0.7943 0.8266 0.7972
0.8279 0.8177 0.7440 0.7184 0.7588 0.7567 0.7431 0.7261 0.6602 0.6717
0.7344 0.6107 0.4140 0.3610 0.2353
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9989 0.9987 0.9989 0.9977
0.9984 0.9982 0.9979 0.9969 0.9978 0.9980 0.9979 0.9976 0.9969 0.9978
0.9982 0.9974 0.9965 0.9964 0.9949
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.8857 0.8525 0.8795 0.9900
0.9105 0.8760 0.7710 0.7502 0.7345 0.6733 0.5155 0.3845 0.3238 0.3260
0.2639 0.0594 0.0460 0.0291 0.0240

SCENARIO RECORD    : I/M Scenario
CALENDAR YEAR      : 2001
EVALUATION MONTH   : 7
ALTITUDE           : 1
HOURLY TEMPERATURES: 82.0 83.0 81.0 85.0 88.0 89.0 92.0 95.0 97.0 98.0 97.0 96.0
                     97.0 96.0 96.0 95.0 94.0 93.0 91.0 87.0 87.0 86.0 86.0 87.0
RELATIVE HUMIDITY  : 74.0 67.0 77.0 65.0 57.0 59.0 52.0 46.0 43.0 43.0 45.0 46.0
                     46.0 49.0 42.0 43.0 44.0 47.0 54.0 51.0 50.0 55.0 55.0 55.0
BAROMETRIC PRES    : 28.7
SPEED VMT          : 018F1O.txt
FUEL RVP           : 6.5
END OF RUN
```

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222


RUN DATA
NO 2007 HDDV RULE  :
STAGE II REFUELING :
94 1 80.77 80.77

I/M PROGRAM        : 1 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 1 1967 2050
I/M VEHICLES       : 1 11111 22222222 2
I/M STRINGENCY     : 1 28.0
I/M COMPLIANCE     : 1 97.0
I/M WAIVER RATES   : 1 1.3 1.0
I/M GRACE PERIOD   : 1 5
I/M PROGRAM        : 2 1977 2050 2 T/O IM240
I/M MODEL YEARS    : 2 1981 1995
I/M VEHICLES       : 2 22222 11111111 1
I/M STRINGENCY     : 2 28.0
I/M COMPLIANCE     : 2 97.0
I/M WAIVER RATES   : 2 1.3 1.0
I/M GRACE PERIOD   : 2 5
I/M CUTPOINTS      : 2 CUTPNT02.d
I/M PROGRAM        : 3 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 3 1967 1980
I/M VEHICLES       : 3 22222 11111111 1
I/M STRINGENCY     : 3 28.0
I/M COMPLIANCE     : 3 97.0
I/M WAIVER RATES   : 3 1.3 1.0
I/M PROGRAM        : 4 2001 2050 2 T/O OBD I/M
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M STRINGENCY     : 4 28.0
I/M COMPLIANCE     : 4 97.0
I/M WAIVER RATES   : 4 1.3 1.0
I/M GRACE PERIOD   : 4 5
I/M PROGRAM        : 5 2001 2050 2 T/O EVAP OBD & GC
I/M MODEL YEARS    : 5 1996 2050
I/M VEHICLES       : 5 22222 11111111 1
I/M STRINGENCY     : 5 28.0
I/M COMPLIANCE     : 5 97.0
I/M WAIVER RATES   : 5 1.3 1.0
I/M GRACE PERIOD   : 5 5
ANTI-TAMP PROG     :
87 75 80 22222 22222222 2 11 097. 22111222
ANTI-TAMP PROG     :
87 81 95 11111 22222222 2 11 097. 22111222

REG DIST           : 02reg02.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0006 0.0001 0.0003
0.0006 0.0013 0.0004 0.0004 0.0001 0.0027 0.0032 0.0097 0.0162 0.0241
0.0510 0.0706 0.0390 0.0269 0.0114
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223
0.0656 0.0616 0.0439 0.0316 0.0259
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223
0.0656 0.0616 0.0439 0.0316 0.0259
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
```

```
0.0256 0.0013 0.0006 0.0011 0.0001
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.2578 0.2515 0.3263
0.2784 0.2963 0.2384 0.2058 0.1756 0.1958 0.2726 0.2743 0.3004 0.2918
0.2859 0.0138 0.0000 0.0000 0.0000
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.7715 0.7910 0.8105
0.8068 0.8280 0.8477 0.7940 0.7488 0.7789 0.7842 0.6145 0.5139 0.5032
0.4277 0.0079 0.0000 0.0000 0.0001
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8473 0.8048 0.8331
0.7901 0.7316 0.7275 0.7158 0.5647 0.3178 0.2207 0.1968 0.1570 0.0738
0.0341 0.0414 0.0003 0.0000 0.0000
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4384 0.3670 0.4125
0.3462 0.2771 0.2730 0.2616 0.1543 0.0615 0.0383 0.0333 0.0255 0.0111
0.0049 0.0060 0.0000 0.0000 0.0000
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6078 0.5246 0.5767
0.5289 0.5788 0.5617 0.4537 0.4216 0.4734 0.4705 0.4525 0.4310 0.3569
0.3690 0.4413 0.3094 0.1679 0.1390
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8443 0.7943 0.8266
0.7972 0.8279 0.8177 0.7440 0.7184 0.7588 0.7567 0.7431 0.7261 0.6602
0.6717 0.7344 0.6107 0.4140 0.3610
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9989 0.9987 0.9989
0.9977 0.9984 0.9982 0.9979 0.9969 0.9978 0.9980 0.9979 0.9976 0.9969
0.9978 0.9982 0.9974 0.9965 0.9964
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.8857 0.8525 0.8795
0.9900 0.9105 0.8760 0.7710 0.7502 0.7345 0.6733 0.5155 0.3845 0.3238
0.3260 0.2639 0.0594 0.0460 0.0291

SCENARIO RECORD     : I/M Scenario
CALENDAR YEAR       : 2002
EVALUATION MONTH    : 7
ALTITUDE            : 1
HOURLY TEMPERATURES: 78.0 82.0 88.0 92.0 97.0 102.0 102.0 107.0 109.0 107.0 109.0
108.0
                      107.0 106.0 105.0 99.0 98.0 98.0 93.0 91.0 89.0 85.0 87.0 82.0
RELATIVE HUMIDITY   : 22.0 18.0 14.0 12.0 11.0 9.0 8.0 6.0 6.0 6.0 5.0 4.0
                       5.0 6.0 6.0 9.0 9.0 9.0 11.0 14.0 14.0 19.0 14.0 22.0
BAROMETRIC PRES     : 28.6
SPEED VMT           : 026R1A.txt
FUEL RVP            : 6.6
FUEL PROGRAM        : 4
 94.0  91.5  69.1  71.5  44.7  45.3  33.0  33.0
 30.0  30.0  30.0  30.0  30.0  30.0  30.0  30.0
348.0  224.0  338.0  380.0  164.0   93.0   87.0   87.0
 80.0   80.0   80.0   80.0   80.0   80.0   80.0   80.0
OXYGENATED FUELS    : 1.000 0.000 0.018 0.000 1

END OF RUN
```

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222

RUN DATA
NO 2007 HDDV RULE  :
STAGE II REFUELING :
94 1 80.77 80.77

REG DIST           : 02reg02.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0006 0.0001 0.0003
0.0006 0.0013 0.0004 0.0004 0.0001 0.0027 0.0032 0.0097 0.0162 0.0241
0.0510 0.0706 0.0390 0.0269 0.0114
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223
0.0656 0.0616 0.0439 0.0316 0.0259
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223
0.0656 0.0616 0.0439 0.0316 0.0259
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.2578 0.2515 0.3263
0.2784 0.2963 0.2384 0.2058 0.1756 0.1958 0.2726 0.2743 0.3004 0.2918
0.2859 0.0138 0.0000 0.0000 0.0000
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.7715 0.7910 0.8105
0.8068 0.8280 0.8477 0.7940 0.7488 0.7789 0.7842 0.6145 0.5139 0.5032
0.4277 0.0079 0.0000 0.0000 0.0001
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8473 0.8048 0.8331
0.7901 0.7316 0.7275 0.7158 0.5647 0.3178 0.2207 0.1968 0.1570 0.0738
0.0341 0.0414 0.0003 0.0000 0.0000
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4384 0.3670 0.4125
0.3462 0.2771 0.2730 0.2616 0.1543 0.0615 0.0383 0.0333 0.0255 0.0111
0.0049 0.0060 0.0000 0.0000 0.0000
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6078 0.5246 0.5767
0.5289 0.5788 0.5617 0.4537 0.4216 0.4734 0.4705 0.4525 0.4310 0.3569
0.3690 0.4413 0.3094 0.1679 0.1390
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8443 0.7943 0.8266
0.7972 0.8279 0.8177 0.7440 0.7184 0.7588 0.7567 0.7431 0.7261 0.6602
0.6717 0.7344 0.6107 0.4140 0.3610
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9989 0.9987 0.9989
0.9977 0.9984 0.9982 0.9979 0.9969 0.9978 0.9980 0.9979 0.9976 0.9969
0.9978 0.9982 0.9974 0.9965 0.9964
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.8857 0.8525 0.8795
0.9900 0.9105 0.8760 0.7710 0.7502 0.7345 0.6733 0.5155 0.3845 0.3238
0.3260 0.2639 0.0594 0.0460 0.0291

SCENARIO RECORD    : I/M Scenario
CALENDAR YEAR      : 2002
EVALUATION MONTH   : 7
ALTITUDE           : 1
HOURLY TEMPERATURES: 78.0 82.0 88.0 92.0 97.0 102.0 102.0 107.0 109.0 107.0 109. 108.
                     107.0 106.0 105.0 99.0 98.0 98.0 93.0 91.0 89.0 85.0 87.0 82.0
RELATIVE HUMIDITY  : 22.0 18.0 14.0 12.0 11.0 9.0 8.0 6.0 6.0 6.0 5.0 4.0
                      5.0 6.0 6.0 9.0 9.0 9.0 11.0 14.0 14.0 19.0 14.0 22.0
BAROMETRIC PRES    : 28.6
```

```
SPEED VMT           : 026R1A.txt
FUEL RVP            : 6.6
FUEL PROGRAM        : 4
 94.0  91.5  69.1  71.5  44.7  45.3  33.0  33.0
 30.0  30.0  30.0  30.0  30.0  30.0  30.0  30.0
348.0  224.0  338.0  380.0  164.0   93.0   87.0   87.0
 80.0   80.0   80.0   80.0   80.0   80.0   80.0   80.0
OXYGENATED FUELS    : 1.000 0.000 0.018 0.000 1

END OF RUN
```

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222


RUN DATA
NO 2007 HDDV RULE  :

*the tech12.d file must be located with Mobile6 execution file
*the user tech file tech12.1me should be renamed as tech12.d
*Two more I/M programs should not have overlapped motor vehicles.

REG DIST           : 02reg02.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0006 0.0001 0.0003
0.0006 0.0013 0.0004 0.0004 0.0001 0.0027 0.0032 0.0097 0.0162 0.0241
0.0510 0.0706 0.0390 0.0269 0.0114
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223
0.0656 0.0616 0.0439 0.0316 0.0259
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223
0.0656 0.0616 0.0439 0.0316 0.0259
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.2578 0.2515 0.3263
0.2784 0.2963 0.2384 0.2058 0.1756 0.1958 0.2726 0.2743 0.3004 0.2918
0.2859 0.0138 0.0000 0.0000 0.0000
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.7715 0.7910 0.8105
0.8068 0.8280 0.8477 0.7940 0.7488 0.7789 0.7842 0.6145 0.5139 0.5032
0.4277 0.0079 0.0000 0.0000 0.0001
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8473 0.8048 0.8331
0.7901 0.7316 0.7275 0.7158 0.5647 0.3178 0.2207 0.1968 0.1570 0.0738
0.0341 0.0414 0.0003 0.0000 0.0000
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4384 0.3670 0.4125
0.3462 0.2771 0.2730 0.2616 0.1543 0.0615 0.0383 0.0333 0.0255 0.0111
0.0049 0.0060 0.0000 0.0000 0.0000
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6078 0.5246 0.5767
0.5289 0.5788 0.5617 0.4537 0.4216 0.4734 0.4705 0.4525 0.4310 0.3569
0.3690 0.4413 0.3094 0.1679 0.1390
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8443 0.7943 0.8266
0.7972 0.8279 0.8177 0.7440 0.7184 0.7588 0.7567 0.7431 0.7261 0.6602
0.6717 0.7344 0.6107 0.4140 0.3610
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9989 0.9987 0.9989
0.9977 0.9984 0.9982 0.9979 0.9969 0.9978 0.9980 0.9979 0.9976 0.9969
0.9978 0.9982 0.9974 0.9965 0.9964
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.8857 0.8525 0.8795
0.9900 0.9105 0.8760 0.7710 0.7502 0.7345 0.6733 0.5155 0.3845 0.3238
0.3260 0.2639 0.0594 0.0460 0.0291

SCENARIO RECORD    : I/M Scenario
CALENDAR YEAR      : 2002
EVALUATION MONTH   : 7
ALTITUDE           : 1
HOURLY TEMPERATURES: 78.0 82.0 88.0 92.0 97.0 102.0 102.0 107.0 109.0 107.0 109. 108.
                     107.0 106.0 105.0 99.0 98.0 98.0 93.0 91.0 89.0 85.0 87.0 82.0
```

```
RELATIVE HUMIDITY  : 22.0 18.0 14.0 12.0 11.0 9.0 8.0 6.0 6.0 6.0 5.0 4.0
                       5.0 6.0 6.0 9.0 9.0 9.0 11.0 14.0 14.0 19.0 14.0 22.0
BAROMETRIC PRES    : 28.6
SPEED VMT          : 026R1O.txt
FUEL RVP           : 6.6
END OF RUN
```

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222


RUN DATA
NO 2007 HDDV RULE  :

STAGE II REFUELING :
94 1 80.77 80.77
I/M PROGRAM        : 1 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 1 1967 2050
I/M VEHICLES       : 1 11111 22222222 2
I/M STRINGENCY     : 1 28.0
I/M COMPLIANCE     : 1 97.0
I/M WAIVER RATES   : 1 1.3 1.0
I/M GRACE PERIOD   : 1 5
I/M PROGRAM        : 2 1977 2050 2 T/O IM240
I/M MODEL YEARS    : 2 1981 1995
I/M VEHICLES       : 2 22222 11111111 1
I/M STRINGENCY     : 2 28.0
I/M COMPLIANCE     : 2 97.0
I/M WAIVER RATES   : 2 1.3 1.0
I/M GRACE PERIOD   : 2 5
I/M CUTPOINTS      : 2 CUTPNT02.d
I/M PROGRAM        : 3 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 3 1967 1980
I/M VEHICLES       : 3 22222 11111111 1
I/M STRINGENCY     : 3 28.0
I/M COMPLIANCE     : 3 97.0
I/M WAIVER RATES   : 3 1.3 1.0
I/M PROGRAM        : 4 2001 2050 2 T/O OBD I/M
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M STRINGENCY     : 4 28.0
I/M COMPLIANCE     : 4 97.0
I/M WAIVER RATES   : 4 1.3 1.0
I/M GRACE PERIOD   : 4 5
I/M PROGRAM        : 5 2001 2050 2 T/O EVAP OBD & GC
I/M MODEL YEARS    : 5 1996 2050
I/M VEHICLES       : 5 22222 11111111 1
I/M STRINGENCY     : 5 28.0
I/M COMPLIANCE     : 5 97.0
I/M WAIVER RATES   : 5 1.3 1.0
I/M GRACE PERIOD   : 5 5
ANTI-TAMP PROG     :
87 75 80 22222 22222222 2 11 097. 22111222
ANTI-TAMP PROG     :
87 81 95 11111 22222222 2 11 097. 22111222

REG DIST           : 02reg02.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0006 0.0001 0.0003
0.0006 0.0013 0.0004 0.0004 0.0001 0.0027 0.0032 0.0097 0.0162 0.0241
0.0510 0.0706 0.0390 0.0269 0.0114
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223
0.0656 0.0616 0.0439 0.0316 0.0259
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223
0.0656 0.0616 0.0439 0.0316 0.0259
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
```

```
0.0256 0.0013 0.0006 0.0011 0.0001
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.2578 0.2515 0.3263
0.2784 0.2963 0.2384 0.2058 0.1756 0.1958 0.2726 0.2743 0.3004 0.2918
0.2859 0.0138 0.0000 0.0000 0.0000
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.7715 0.7910 0.8105
0.8068 0.8280 0.8477 0.7940 0.7488 0.7789 0.7842 0.6145 0.5139 0.5032
0.4277 0.0079 0.0000 0.0000 0.0001
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8473 0.8048 0.8331
0.7901 0.7316 0.7275 0.7158 0.5647 0.3178 0.2207 0.1968 0.1570 0.0738
0.0341 0.0414 0.0003 0.0000 0.0000
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4384 0.3670 0.4125
0.3462 0.2771 0.2730 0.2616 0.1543 0.0615 0.0383 0.0333 0.0255 0.0111
0.0049 0.0060 0.0000 0.0000 0.0000
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6078 0.5246 0.5767
0.5289 0.5788 0.5617 0.4537 0.4216 0.4734 0.4705 0.4525 0.4310 0.3569
0.3690 0.4413 0.3094 0.1679 0.1390
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8443 0.7943 0.8266
0.7972 0.8279 0.8177 0.7440 0.7184 0.7588 0.7567 0.7431 0.7261 0.6602
0.6717 0.7344 0.6107 0.4140 0.3610
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9989 0.9987 0.9989
0.9977 0.9984 0.9982 0.9979 0.9969 0.9978 0.9980 0.9979 0.9976 0.9969
0.9978 0.9982 0.9974 0.9965 0.9964
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.8857 0.8525 0.8795
0.9900 0.9105 0.8760 0.7710 0.7502 0.7345 0.6733 0.5155 0.3845 0.3238
0.3260 0.2639 0.0594 0.0460 0.0291

SCENARIO RECORD     : I/M Scenario
CALENDAR YEAR       : 2002
EVALUATION MONTH    : 7
ALTITUDE            : 1
HOURLY TEMPERATURES: 93.0 93.0 94.0 97.0 101.0 103.0 106.0 108.0 107.0 108.0 109.0
111.0
                     111.0 109.0 91.0 89.0 90.0 91.0 87.0 89.0 89.0 88.0 88.0 88.0
RELATIVE HUMIDITY   : 32.0 33.0 33.0 30.0 25.0 22.0 19.0 17.0 17.0 17.0 16.0 15.0
                      15.0 17.0 41.0 50.0 47.0 41.0 45.0 38.0 39.0 42.0 43.0 42.0
BAROMETRIC PRES     : 28.7
SPEED VMT           : 027T1A.txt
FUEL RVP            : 6.6
FUEL PROGRAM        : 4
131.8 106.7  88.9  79.5  52.8  45.1  33.0  33.0
 30.0  30.0  30.0  30.0  30.0  30.0  30.0  30.0
348.0  224.0  338.0  380.0  164.0   93.0   87.0   87.0
 80.0   80.0   80.0   80.0   80.0   80.0   80.0   80.0
OXYGENATED FUELS    : 1.000 0.000 0.018 0.000 1

END OF RUN
```

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222

RUN DATA
NO 2007 HDDV RULE  :
STAGE II REFUELING :
94 1 80.77 80.77

REG DIST           : 02reg02.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0006 0.0001 0.0003
0.0006 0.0013 0.0004 0.0004 0.0001 0.0027 0.0032 0.0097 0.0162 0.0241
0.0510 0.0706 0.0390 0.0269 0.0114
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223
0.0656 0.0616 0.0439 0.0316 0.0259
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223
0.0656 0.0616 0.0439 0.0316 0.0259
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.2578 0.2515 0.3263
0.2784 0.2963 0.2384 0.2058 0.1756 0.1958 0.2726 0.2743 0.3004 0.2918
0.2859 0.0138 0.0000 0.0000 0.0000
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.7715 0.7910 0.8105
0.8068 0.8280 0.8477 0.7940 0.7488 0.7789 0.7842 0.6145 0.5139 0.5032
0.4277 0.0079 0.0000 0.0000 0.0001
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8473 0.8048 0.8331
0.7901 0.7316 0.7275 0.7158 0.5647 0.3178 0.2207 0.1968 0.1570 0.0738
0.0341 0.0414 0.0003 0.0000 0.0000
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4384 0.3670 0.4125
0.3462 0.2771 0.2730 0.2616 0.1543 0.0615 0.0383 0.0333 0.0255 0.0111
0.0049 0.0060 0.0000 0.0000 0.0000
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6078 0.5246 0.5767
0.5289 0.5788 0.5617 0.4537 0.4216 0.4734 0.4705 0.4525 0.4310 0.3569
0.3690 0.4413 0.3094 0.1679 0.1390
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8443 0.7943 0.8266
0.7972 0.8279 0.8177 0.7440 0.7184 0.7588 0.7567 0.7431 0.7261 0.6602
0.6717 0.7344 0.6107 0.4140 0.3610
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9989 0.9987 0.9989
0.9977 0.9984 0.9982 0.9979 0.9969 0.9978 0.9980 0.9979 0.9976 0.9969
0.9978 0.9982 0.9974 0.9965 0.9964
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.8857 0.8525 0.8795
0.9900 0.9105 0.8760 0.7710 0.7502 0.7345 0.6733 0.5155 0.3845 0.3238
0.3260 0.2639 0.0594 0.0460 0.0291

SCENARIO RECORD    : I/M Scenario
CALENDAR YEAR      : 2002
EVALUATION MONTH   : 7
ALTITUDE           : 1
HOURLY TEMPERATURES: 93.0 93.0 94.0 97.0 101.0 103.0 106.0 108.0 107.0 108.0 109. 111.
                     111.0 109.0 91.0 89.0 90.0 91.0 87.0 89.0 89.0 88.0 88.0 88.0
RELATIVE HUMIDITY  : 32.0 33.0 33.0 30.0 25.0 22.0 19.0 17.0 17.0 17.0 16.0 15.0
                     15.0 17.0 41.0 50.0 47.0 41.0 45.0 38.0 39.0 42.0 43.0 42.0
BAROMETRIC PRES    : 28.7
```

```
SPEED VMT          : 027T1A.txt
FUEL RVP           : 6.6
FUEL PROGRAM       : 4
131.8 106.7  88.9  79.5  52.8  45.1  33.0  33.0
 30.0  30.0  30.0  30.0  30.0  30.0  30.0  30.0
348.0  224.0  338.0  380.0  164.0   93.0   87.0   87.0
 80.0   80.0   80.0   80.0   80.0   80.0   80.0   80.0
OXYGENATED FUELS   : 1.000 0.000 0.018 0.000 1

END OF RUN
```

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222

RUN DATA
NO 2007 HDDV RULE  :
REG DIST           : 02reg02.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0006 0.0001 0.0003
0.0006 0.0013 0.0004 0.0004 0.0001 0.0027 0.0032 0.0097 0.0162 0.0241
0.0510 0.0706 0.0390 0.0269 0.0114
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223
0.0656 0.0616 0.0439 0.0316 0.0259
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033 0.0048 0.0120 0.0223
0.0656 0.0616 0.0439 0.0316 0.0259
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.2578 0.2515 0.3263
0.2784 0.2963 0.2384 0.2058 0.1756 0.1958 0.2726 0.2743 0.3004 0.2918
0.2859 0.0138 0.0000 0.0000 0.0000
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.7715 0.7910 0.8105
0.8068 0.8280 0.8477 0.7940 0.7488 0.7789 0.7842 0.6145 0.5139 0.5032
0.4277 0.0079 0.0000 0.0000 0.0001
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8473 0.8048 0.8331
0.7901 0.7316 0.7275 0.7158 0.5647 0.3178 0.2207 0.1968 0.1570 0.0738
0.0341 0.0414 0.0003 0.0000 0.0000
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4384 0.3670 0.4125
0.3462 0.2771 0.2730 0.2616 0.1543 0.0615 0.0383 0.0333 0.0255 0.0111
0.0049 0.0060 0.0000 0.0000 0.0000
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6078 0.5246 0.5767
0.5289 0.5788 0.5617 0.4537 0.4216 0.4734 0.4705 0.4525 0.4310 0.3569
0.3690 0.4413 0.3094 0.1679 0.1390
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8443 0.7943 0.8266
0.7972 0.8279 0.8177 0.7440 0.7184 0.7588 0.7567 0.7431 0.7261 0.6602
0.6717 0.7344 0.6107 0.4140 0.3610
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9989 0.9987 0.9989
0.9977 0.9984 0.9982 0.9979 0.9969 0.9978 0.9980 0.9979 0.9976 0.9969
0.9978 0.9982 0.9974 0.9965 0.9964
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.8857 0.8525 0.8795
0.9900 0.9105 0.8760 0.7710 0.7502 0.7345 0.6733 0.5155 0.3845 0.3238
0.3260 0.2639 0.0594 0.0460 0.0291

SCENARIO RECORD    : I/M Scenario
CALENDAR YEAR      : 2002
EVALUATION MONTH   : 7
ALTITUDE           : 1
HOURLY TEMPERATURES: 93.0 93.0 94.0 97.0 101.0 103.0 106.0 108.0 107.0 108.0 109. 111.
                     111.0 109.0 91.0 89.0 90.0 91.0 87.0 89.0 89.0 88.0 88.0 88.0
RELATIVE HUMIDITY  : 32.0 33.0 33.0 30.0 25.0 22.0 19.0 17.0 17.0 17.0 16.0 15.0
                     15.0 17.0 41.0 50.0 47.0 41.0 45.0 38.0 39.0 42.0 43.0 42.0
BAROMETRIC PRES    : 28.7
SPEED VMT          : 027T1O.txt
FUEL RVP           : 6.6
END OF RUN
```

Appendix II-ii

The M6Link System

Appendix II-ii contains a description of the M6Link system which is a tool that combines onroad vehicle traffic data with onroad vehicle emission factors to create an onroad vehicle emissions inventory.

The M6Link System

The M6Link system is a series of two FORTRAN-based programs that integrates travel demand modeling output from the EMME/2 and emission factors from MOBILE6.2 to produce estimates of total onroad vehicle emissions. The vehicle travel component of M6Link reads in the output from the travel demand models that are processed through GIS software. The output from the travel demand models reflect four times of day; a.m. peak, midday, p.m. peak, and nighttime. The outputs also reflect four vehicle classes; light duty commercial vehicles, medium duty commercial vehicles, heavy duty commercial vehicles, and all other vehicles. Other components of the data produced by the travel demand models are the coordinates of each modeled roadway link and individualized traffic estimates for that link, the facility type of the link, the area type, and more.

The vehicle travel component of M6Link reads in data produced from the travel demand models and produces vehicle miles traveled (VMT) estimates that have been changed from being link-specific to grid cell specific. The estimates have also been converted from reflecting a total for the four time periods of the day to hourly estimates.

The EMME/2 model produces estimates of vehicle trips and vehicle speeds for each modeled transportation link (roadway segment) for each of the four time periods of the day of a.m. peak (6 a.m. to 9 a.m.), midday (9 a.m. to 3 p.m.), p.m. peak (3 p.m. to 6 p.m.) and nighttime (6 p.m. to 6 a.m.). The traffic volumes for each of these time periods was split to produce hourly traffic volumes. The volumes by time period are split into hourly volumes by M6Link using hourly VMT splits from the MAG document 1998 MAG Regional Congestion Study, September 2000.

In this component of M6Link, actual VMT reported by Highway Performance Monitoring System (HPMS) factors were compared with VMT generated by the EMME/2 travel demand models. HPMS data for the State is submitted annually to the Federal Highway Administration by the Arizona Department of Transportation. VMT modeled by EMME/2 agreed pretty well with actual HPMS VMTs. Therefore, reconciliation of travel demand modeled VMT with HPMS was not needed.

All VMT estimates contained in the travel demand model are generated for an average weekday. To take into account traffic volumes for a specific episode day, adjustment factors are calculated and used to convert the "typical" weekday traffic volumes into volumes for the ozone season days considered in this plan. The month-specific adjustment factors are 0.8870 for June, 0.8436 for July and 0.8638 for August. The factors that reflect the specific day of the week are 1.1080 for Monday (August) and 1.1223 for Tuesday (August), 1.1307 for Wednesday (July),1.1407 for Thursday (July), and 1.1474 for Friday (June) and 0.7840 for Saturday. The resulting combined factors are 0.96 for the Monday in August, 0.97 for Tuesday in August, 0.95 for Wednesday in July, and 0.96 for Thursday in July, 0.02 for Friday and 0.70 for Saturday. These factors and the factors for all day of the week and month combinations are documented in the August 7, 1996 MAG

memo from Cathy Arthur to Roger Herzog titled Conversion of Modeled Traffic Volumes to a Specific Month and Day of the Year (Appendix III-v).

The highway network VMT data, created with the EMME/2 transportation model, that is read in by M6Link reemerges from M6Link in the form of a VMT table. The VMT table that is output by M6Link includes the estimated VMT for each grid cell, for each hour, and for each combination of area type, facility type, and vehicle class. This file includes individual VMT estimates for approximately two million area type/hour/vehicle class/grid cell/facility type combinations. Each of these VMT estimates is combined with an emissions factor (in grams per VMT) in the second portion of M6Link.

There are several inputs required by the emissions portion of M6Link. In addition to the very detailed outputs of the vehicle travel component of M6Link, other inputs include the emission factor outputs from MOBILE6.2 in the database format, a job file that includes information such as the year that is being modeled and the names of the MOBILE6.2 files to use, and a file that assists in converting the 28 vehicle classes considered by the MOBILE6.2 model into the four classes included in the travel demand models. The MOBILE6.2 outputs that reflect the I/M scenario and the outputs that reflect the non-I/M scenario reside in different electronic files. The program reads in the I/M and non-I/M emission factor for each scenario and weights them internally to produce a single emission factor for each area type/vehicle type/facility type/hour combination.

The aforementioned conversion between vehicle classes is needed because the MOBILE6.2 model outputs emission factors as one of 28 vehicle classes as described on page 13 in the User's Guide to MOBILE6.1 and MOBILE6.2 Mobile Source Emission Factor Model, EPA420-R-02-001, January 2002 which may be found at the web site http://www.epa.gov/otaq/models/mobile6/r02001.pdf. Conversely, the EMME/2 transportation model produces estimates of vehicle trips in four categories; commercial light duty vehicles, commercial medium duty vehicles, commercial heavy duty vehicles, and all other vehicles. Using data developed in the February 1992 Arizona Department of Transportation report FHWA-AZ92-314 Development of an Urban Truck Travel Model for the Phoenix Metropolitan Area, a series of factors were developed that are used to appropriately weight the VMT ratios from the 28 vehicle classes into the four vehicle classes described above.

Additionally, while the MOBILE6 model produces estimates of cold starts emission factors independent of facility type, cold start emissions are generally more likely to occur on smaller roadways such as arterials and local roadways. It is unlikely that vehicles would produce cold start emissions while on a freeway since it would generally take several minutes to reach a freeway from where the vehicle had been at rest (such as a home or workplace). As such, cold start emissions have been applied to all roadway types except for freeways and freeway ramps to improve the spatial allocation of these emissions.

Using the emission factors output by MOBILE6, M6Link calculates and spatially allocate the onroad mobile emissions in the modeling domain. The emissions are spatially

allocated into sixteen square kilometer cells, and the modeling domain consists of 50 grid cells in the east-west direction and 29 grid cells in the north-south direction. The hourly emissions output from M6Link are processed through MEDEXPLORA, which is a component of the EXPLORA modeling system used in the Serious Area CO Plan analysis, to provide CAMx-ready input files. Control measures that result in across-the-board adjustments are applied to the CAMx-ready input files through the EMSCOR utility.

The M6Link program is run using a control file to provide needed inputs. The inputs to a M6Link run performed for this analysis, in particular the 2001 analysis for Thursday, are described below. The inputs to a M6Link run for the 2001, 2002, or 2008 scenarios would follow the same pattern.

1. **/VERSION/**
   1.1 ozone

   identifies the M6Link control file as being appropriate for use with a particular version of the model. This run was performed with the M6Link executable version 1.1 ozone.

2. **/XCELLS/**
   50

   instructs the M6Link model to include 50 grid cells of emissions in the east-west direction in the active modeling domain.

3. **/YCELLS/**
   29

   instructs the M6Link model to include 29 grid cells of emissions in the north-south direction in the active modeling domain.

4. **/YEAR/**
   2001

   instructs the M6Link model to condense the 28 MOBILE6 vehicle class emission factors to four vehicle classes using weighting factors appropriate for the 2001 time period. For modeling the 2002 episode, 2001 was replaced by 2002. The weighting factors differ over time due to changes in overall fleet characteristics.

5. **/MOBILEIN/**
   I18021A.TB1
   I18022A.TB1
   I18023A.TB1
   I18024A.TB1

I18025A.TB1
N18021A.TB1
N18022A.TB1
N18023A.TB1
N18024A.TB1
N18025A.TB1

instructs the M6Link model which ten MOBILE6 output files to access to derive emission factors appropriate for the particular analysis where the first five MOBILE6 files reflect an I/M program present and area types one through five and the second five MOBILE6 files reflect no I/M program.

6. **/MESSAGES/**
   YES
   YES
   YES
   YES

   instructs the M6Link model to include all four optional message output files available.

7. **/LINK FILE/**
   L18RA

   instructs the M6Link model to access the file named L18RA as containing the transportation modeling data appropriate for use in developing emission totals.

8. **/WEIGHTS/**
   91.6
   8.4

   instructs the M6Link model to weight the MOBILE6 factors as 91.6 percent of vehicles of the appropriate age and class participate in the I/M program and the remaining 8.4 percent do not.

9. **/FACTORS/**
   1.0000
   1.0000
   1.0000
   etc...

   instructs the M6Link model to apply an adjustment factor to hourly vehicle miles of travel estimates.

10. **/MC IM /**
YES

instructs the M6Link model to apply credit for the motorcycle component of the inspection and maintenance program.

Appendix II-iii

Development of the Spatial Surrogates

DEVELOPMENT OF SPATIAL ALLOCATION SURROGATES FOR EIGHT-HOUR OZONE ATTAINMENT CAMx MODELING

1. Background

Since the Comprehensive Air Quality Model With Extensions (CAMx) predicts carbon monoxide and ozone concentrations at grid level the modeler defined, it must be supplied with the same resolution of the grid-level emissions. The amount of effort needed to derive grid-level emissions varies depending on the type of emission source. Two methods are generally used to allocate emissions to grid cells: One method is to directly obtain emissions for each grid cell and the other is to use spatial surrogates of emission levels (e.g., the number of houses or acres of land use). The former is the most accurate method to obtain grid-level emissions, but it is absolutely dependent upon available resources such as time, money, and data. It has been applied to point or onroad mobile source emissions since existing databases of point and onroad mobile source emissions contain location data for each source or each link, allowing direct assignment to the appropriate grid cells. The latter assumes that emissions from each source behave spatially in the same manner as the spatial surrogate. It has been used for the spatial allocation of area and nonroad mobile source emissions because specific location data for each area or nonroad mobile source are not available. Fourteen categories of spatial surrogates shown in Table 1 were developed for area and nonroad mobile source emissions in conjunction with eight-hour ozone attainment demonstration modeling. A typical spatial surrogate is defined as the ratio of a grid-level to the Maricopa County land use area. This document describes the development of spatial surrogates to spatially allocate area and nonroad mobile source emissions of the Maricopa County to the eight-hour ozone modeling domain. The result of this effort is gridded spatial surrogate files for use with the GRDEM module of EPS3.0.

2. Development Procedures

2.1 Gridded Domain

Gridded domain was developed using the GENERATE ARC command of ARC/INFO. The origin of the gridded domain is located at 277,000 meters and 3,596,000 meters in UTM zone 12. Gridded domain has 55 grid cells in x direction (easting) and 44 grid cells in y direction (northing) and each grid cell size is 4000 meters by 4000 meters. The gridded domain designed to include the entire area of Maricopa and Pinal Counties. The gridded domain is used to grid the land use data of Maricopa County or Pinal County portion of the 8-hour ozone modeling domain by overlaying the grid domain over the land use data.

2.2 Spatial Surrogates

Fifteen spatial surrogates were developed for the whole Maricopa County area and Pinal County portion of the 8-hour ozone modeling area for calendar years 2001, 2002 and 2008 since area and nonroad mobile source emissions inventories were developed for the entire Maricopa County and Pinal County portion of the 8-hour ozone modeling domain,

respectively. The latest land use data were obtained for these areas. Categories and data sources used to develop spatial surrogates are shown in Table 1.

To develop housing spatial surrogate, individual 2001, 2002, and 2008 socio-economic data were linked to the Traffic Analysis Zone (TAZ) shape file based on TAZ Identification numbers. The shape file linked with socio-economic data for each calendar year was intersected by a gridded domain shape file which includes Maricopa and Pinal counties, using INTERSECT command in PC ArcView "xtools" extension. Since socio-economic data provide total number of houses by TAZ, houses per unit area for each TAZ were calculated, and then multiplied by TAZ areas for a grid cell. Total house number in a grid cell was extracted to calculate the ratio of the number of houses in a grid cell to the number of houses in Maricopa or Pinal county portion of 8-hour ozone modeling area.

Industrial and non-industrial spatial surrogates were based on the MAG 2004 land use data. Industrial and non-industrial areas for grid cells were extracted by intersecting the MAG 2004 land use data with the gridded domain. Industrial land use category in the MAG 2004 land use data was used for the industrial spatial surrogate while land use categories such as business parks, commercial retail centers, warehouse/distribution centers, hotels, motels, resorts, retail centers, large assembly areas, offices and public facilities were included in developing the non-industrial spatial surrogate.

The spatial surrogates for undeveloped total and developed total were developed based on the MAG 2004 land use data and the gridded domain. The undeveloped total spatial surrogate was based on vacant category of the MAG 2004 land use data. The developed total surrogate was based on residential, commercial, industrial, office, other public, other space, and multiple use categories. The MAG 2004 land use was intersected with the gridded domain. Acres of land use categories by grid cell were extracted to calculate the ratio of grid area to Maricopa County or Pinal County portion of 8-hour ozone modeling domain . Airport, golf course, and water spatial surrogates were developed based on the MAG 2004 land use intersected with the gridded domain.

More detailed spatial surrogates for agriculture are needed to develop with MAG2004 land use data for a better representation of agricultural emissions: agriculture-stockyard and agriculture-other crops. However, MAG 2004 land use data contain only one category of agricultural land. In an effort to maintain the spatial distinction among agricultural land uses, MAG GIS staff developed more distinctive land use data for agricultural stockyard and agricultural-other crop. Total acres of agricultural land within each grid cell were extracted, being divided by total agricultural acres of Maricopa County or Pinal County portion of 8-hour ozone modeling damain.

Construction spatial surrogates such as residential, commercial and total construction were developed using residential construction, commercial construction and all construction categories of MAG 2004 land use. The shape files for the land use categories were intersected with gridded domain, and then spatial surrogate ratios were calculated.

The MAG 2004 land use coverage was used to develop the remaining spatial surrogates including non-developable forest, landfill, water, and airport. However, railroad shape file was provided by MAG GIS staff and pipeline shape file was provided by TRC since railroad and pipeline categories of land use are not available from the MAG 2004 land use data. The 2004 land use was intersected with gridded ozone modeling domain and the acres of land use categories by each grid cell were extracted from the intersected coverage. The pipeline spatial surrogate is utilized for gridding only 2008 pipeline emissions since emissions from new pipeline is expected in 2008. Thus, pipeline surrogate is not available from the 2001 and 2002 spatial surrogate sets.

The separately generated 15 spatial surrogates for Maricopa County and Pinal County portion of 8-hour ozone modeling area were combined into one file and formatted by a FORTRAN program to use in the GRDEM module of EPS3.0. Using the GRDEM module with the developed two sets of spatial surrogates, emissions from Maricopa County and Pinal County portion of 8-hour ozone modeling domain were separately allocated to grid cells and then the separately gridded emissions were merged with the MRGUAM module of EPS3.0.

Table 1. Spatial Surrogate Codes and Categories

Code	Categories	Data Source
1	Housing	2001, 2002, 2008 SocioEconomic Data
2	Industrial	MAG 2004 Land Use
3	Non-industrial	MAG 2004 Land Use
4	Undeveloped Total	MAG 2004 Land Use
5	Developed Total	MAG 2004 Land Use
6	Construction	MAG 2004 Land Use
7	Agriculture - Stockyards	MAG GIS Data
8	Agriculture - Other Crops	MAG GIS Data
9	Non-developable Forest	MAG 2004 Land Use
10	Railroad	MAG GIS Data
11	Landfill	MAG 2004 Land Use
12	Water	MAG 2004 Land Use
13	Golf Course	MAG 2004 Land Use
14	Airport	MAG 2004 Land Use
15	Pipeline	TRC

Table 2. Spatial Surrogate Assignments

Area Source Category	Spatial Surrogate Code	Secondary Surrogate Code	Source Category Description
2102004000	2	1	Industrial; External Combustion
2102006000	2	1	Industrial; Natural Gas; External Combustion
2102010000	2	1	Industrial; Process Gas; All Boiler Types
2102011000	2	1	Industrial; Kerosene; Total: All Boiler Types
2103004000	2	1	Commercial/Institutional Distillate Oil; Boilers and IC Engines
2103006000	2	1	Com/Inst; Nat Gas; External Combustion
2103007000	2	1	Commercial/Institutional Liquified Petroleum Gas (LPG); All Combustor Types
2103011000	2	1	Commercial/Institutional Kerosene; All Combustor Types
2104004000	1	5	Residential;Distillate Oil; All Combustor Types
2104006000	1	5	Residential; Nat Gas; External Combustion
2104007000	1	5	Residential; Liquified Petroleum Gas (LPG); All Combustor Types
2104008000	1	5	Residential; Barbecues/Firepits
2104011000	1	5	Residential; Fireplaces ?
2260001010	4	9	Off-Road Motorcycles, Gasoline, 2-stroke, Mobile
2260001030	4	9	All Terrain Vehicles (ATVs), Gasoline, 2-stroke, Mobile
2260001060	4	9	Specialty Vehicles Carts, Gasoline, 2-stroke, Mobile
2260002006	6	1	Tampers/Rammers, Gasoline, 2-stroke, Mobile
2260002009	6	1	Plate Compactors, Gasoline, 2-stroke, Mobile
2260002012	6	1	Concrete Pavers, Gasoline, 2-stroke, Mobile
2260002027	6	1	Signal Boards, Gasoline, 2-stroke, Mobile
2260002039	6	1	Concrete/Industrial Saws, Gasoline, 2-stroke, Mobile
2260003030	2	5	Sweepers/Scrubbers, Gasoline, 2-stroke, Mobile
2260003040	2	5	Other General Industrial Equipment, Gasoline, 2-stroke, Mobile
2260004015	5	1	Tillers <5 HP, Gasoline, 2-stroke, Mobile
2260004016	5	1	Chainsaws <4 HP, Gasoline, 2-stroke, Mobile
2260004020	5	1	Lawn and Garden Equipment; Chain Saws < 6 HP (Residential)
2260004021	5	1	Lawn and Garden Equipment; Chain Saws < 6 HP (Commercial)
2260004025	5	1	Trimmers/Edgers/Brush Cutters, Gasoline, 2-stroke, Mobile
2260004026	5	1	Lawn and Garden Equipment;Trimmers/Edgers/Brush Cutters (Commercial)
2260004030	5	1	Leaf Blowers/Vacuums, Gasoline, 2-stroke, Mobile
2260004031	5	1	Lawn and Garden Equipment; Leafblowers/Vacuums (Commercial)
2260004071	5	1	Lawn and Garden Equipment; Turf Equipment (Commercial)

2260005035	8	7	Other Lawn & Garden Equipment, Gasoline, 2-stroke, Mobile
2260005050	8	7	Hydro Power Units, Gasoline, 2-stroke, Mobile
2260006005	3	5	Generator Sets <50 HP, Gasoline, 2-stroke, Mobile
2260006010	3	5	Pumps <50 HP, Gasoline, 2-stroke, Mobile
2260006015	3	5	Air Compressors <50 HP, Gasoline, 2-stroke, Mobile
2260007005	9	4	Chainsaws >4 HP, Gasoline, 2-stroke, Mobile
2265001010	4	9	Off-Road Motorcycles, Gasoline, 4-stroke, Mobile
2265001030	4	9	All Terrain Vehicles (ATVs), Gasoline, 4-stroke, Mobile
2265001050	4	9	Golf Carts, Gasoline, 4-stroke, Mobile
2265001060	4	9	Specialty Vehicles Carts, Gasoline, 4-stroke, Mobile
2265002003	6	1	Asphalt Pavers, Gasoline, 4-stroke, Mobile
2265002006	6	1	Tampers/Rammers, Gasoline, 4-stroke, Mobile
2265002009	6	1	Plate Compactors, Gasoline, 4-stroke, Mobile
2265002015	6	1	Rollers, Gasoline, 4-stroke, Mobile
2265002021	6	1	Paving Equipment, Gasoline, 4-stroke, Mobile
2265002024	6	1	Surfacing Equipment, Gasoline, 4-stroke, Mobile
2265002027	6	1	Signal Boards, Gasoline, 4-stroke, Mobile
2265002030	6	1	Trenchers, Gasoline, 4-stroke, Mobile
2265002033	6	1	Bore/Drill Rigs, Gasoline, 4-stroke, Mobile
2265002039	6	1	Concrete/Industrial Saws, Gasoline, 4-stroke, Mobile
2265002042	6	1	Cement and Mortar Mixers, Gasoline, 4-stroke, Mobile
2265002045	6	1	Cranes, Gasoline, 4-stroke, Mobile
2265002054	6	1	Crushing/Proc. Equipment, Gasoline, 4-stroke, Mobile
2265002057	6	1	Rough Terrain Forklifts, Gasoline, 4-stroke, Mobile
2265002060	6	1	Rubber Tired Loaders, Gasoline, 4-stroke, Mobile
2265002066	6	1	Tractors/Loaders/Backhoes, Gasoline, 4-stroke, Mobile
2265002072	6	1	Skid Steer Loaders, Gasoline, 4-stroke, Mobile
2265002078	6	1	Dumpers/Tenders, Gasoline, 4-stroke, Mobile
2265002081	6	1	Other Construction Equipment, Gasoline, 4-stroke, Mobile
2265003010	2	5	Aerial Lifts, Gasoline, 4-stroke, Mobile
2265003020	2	5	Forklifts, Gasoline, 4-stroke, Mobile
2265003030	2	5	Sweepers/Scrubbers, Gasoline, 4-stroke, Mobile
2265003040	2	5	Other General Industrial Equipment, Gasoline, 4-stroke, Mobile
2265003050	2	5	Other Material Handling Equipment, Gasoline, 4-stroke, Mobile
2265003060	2	5	Industrial Equipment; AC\Refrigeration
2265003070	2	5	Industrial Equipment;Terminal Tractors
2265004010	5	1	Lawn Mowers, Gasoline, 4-stroke, Mobile
2265004011	5	1	Lawn and Garden Equipment;Lawn Mowers (Commercial)
2265004015	5	1	Tillers <5 HP, Gasoline, 4-stroke, Mobile
2265004016	5	1	Lawn and Garden Equipment;Rotary Tillers < 6 HP (Commercial)
2265004025	5	1	Trimmers/Edgers/Brush Cutters, Gasoline, 4-stroke, Mobile

2265004026	5	1	Lawn and Garden Equipment:Trimmers/Edgers/Brush Cutters (Commercial)
2265004030	5	1	Leaf Blowers/Vacuums, Gasoline, 4-stroke, Mobile
2265004031	5	1	Lawn and Garden Equipment: Leafblowers/Vacuums (Commercial)
2265004040	5	1	Rear Engine Riding Mowers, Gasoline, 4-stroke, Mobile
2265004041	5	1	Lawn and Garden Equipment; Rear Engine Riding Mowers (Commercial)
2265004046	5	1	Lawn and Garden Equipment;Front Mowers (Commercial)
2265004051	5	1	Lawn and Garden Equipment;Shredders < 6 HP (Commercial)
2265004055	5	1	Lawn & Garden Tractors, Gasoline, 4-stroke, Mobile
2265004056	5	1	Lawn and Garden Equipment;Lawn and Garden Tractors (Commercial)
2265004066	5	1	Lawn and Garden Equipment Chippers/Stump Grinders (Commercial)
2265004071	5	1	Lawn and Garden Equipment;Turf Equipment (Commercial)
2265004075	5	1	Other Lawn & Garden Equipment, Gasoline, 4-stroke, Mobile
2265004076	5	1	Lawn and Garden Equipment; Other Lawn and Garden Equipment (Commercial)
2265005010	8	7	2-Wheel Tractors, Gasoline, 4-stroke, Mobile
2265005015	8	7	Agricultural Tractors, Gasoline, 4-stroke, Mobile
2265005025	8	7	Combines, Gasoline, 4-stroke, Mobile
2265005030	8	7	Agricultural Mowers, Gasoline, 4-stroke, Mobile
2265005035	8	7	Sprayers, Gasoline, 4-stroke, Mobile
2265005040	8	7	Tillers >5 HP, Gasoline, 4-stroke, Mobile
2265005045	8	7	Swathers, Gasoline, 4-stroke, Mobile
2265005050	8	7	Hydro Power Units, Gasoline, 4-stroke, Mobile
2265005055	8	7	Other Agricultural Equipment, Gasoline, 4-stroke, Mobile
2265005060	8	7	Agricultural Equipment;Irrigation Sets
2265006005	3	5	Generator Sets <50 HP, Gasoline, 4-stroke, Mobile
2265006010	3	5	Pumps <50 HP, Gasoline, 4-stroke, Mobile
2265006015	3	5	Air Compressors <50 HP, Gasoline, 4-stroke, Mobile
2265006025	3	5	Welders <50 HP, Gasoline, 4-stroke, Mobile
2265006030	3	5	Pressure Washers <50 HP, Gasoline, 4-stroke, Mobile
2265007010	9	4	Shredders >5 HP, Gasoline, 4-stroke, Mobile
2265007015	9	4	Skidders, Gasoline, 4-stroke, Mobile
2265008005	14	4	Aircraft Support Equipment, Gasoline, 4-stroke, Mobile
2267001060	4	9	Recreational Equipment;Specialty Vehicles/Carts
2267002003	6	1	Construction and Mining Equipment;Pavers
2267002015	6	1	Construction and Mining Equipment;Rollers
2267002021	6	1	Construction and Mining Equipment;Paving Equipment
2267002024	6	1	Construction and Mining Equipment;Surfacing Equipment
2267002030	6	1	Construction and Mining Equipment;Trenchers
2267002033	6	1	Construction and Mining Equipment;Bore/Drill Rigs

2267002039	6	1	Construction and Mining Equipment;Concrete/Industrial Saws
2267002045	6	1	Construction and Mining Equipment;Cranes
2267002054	6	1	Construction and Mining Equipment;Crushing/Processing Equipment
2267002057	6	1	Construction and Mining Equipment;Rough Terrain Forklifts
2267002060	6	1	Construction and Mining Equipment;Rubber Tire Loaders
2267002066	6	1	Construction and Mining Equipment; Tractors/ Loaders/ Backhoes
2267002072	6	1	Construction and Mining Equipment;Skid Steer Loaders
2267002081	6	1	Construction and Mining Equipment;Other Construction Equipment
2267003010	2	5	Industrial Equipment;Aerial Lifts
2267003020	2	5	Industrial Equipment;Forklifts
2267003030	2	5	Industrial Equipment;Sweepers/Scrubbers
2267003040	2	5	Industrial Equipment;Other General Industrial Equipment
2267003050	2	5	Industrial Equipment;Other Material Handling Equipment
2267003070	2	5	Industrial Equipment;Terminal Tractors
2267004066	5	1	Lawn and Garden Equipment;Chippers/Stump Grinders (Commercial)
2267005050	8	4	Agricultural Equipment;Hydro-power Units
2267005055	8	4	Agricultural Equipment;Other Agricultural Equipment
2267005060	8	4	Agricultural Equipment;Irrigation Sets
2267006005	3	5	Commercial Equipment Generator Sets
2267006010	3	5	Commercial Equipment Pumps
2267006015	3	5	Commercial Equipment Air Compressors
2267006025	3	5	Commercial Equipment Welders
2267006030	3	5	Commercial Equipment Pressure Washers
2267008005	14	4	Airport Ground Support Equipment; Airport Ground Support Equipment
2268002081	6	1	Construction and Mining Equipment;Other Construction Equipment
2268003020	2	5	Industrial Equipment;Forklifts
2268003030	2	5	Industrial Equipment;Sweepers/Scrubbers
2268003040	2	5	Industrial Equipment;Other General Industrial Equipment
2268003060	2	5	Industrial Equipment;AC\Refrigeration
2268003070	2	5	Industrial Equipment;Terminal Tractors
2268005055	8	7	Agricultural Equipment;Other Agricultural Equipment
2268005060	8	7	Agricultural Equipment;Irrigation Sets
2268006005	3	5	Commercial Equipment;Generator Sets
2268006010	3	5	Commercial Equipment Pumps
2268006015	3	5	Commercial Equipment Air Compressors
2268006020	3	5	Commercial Equipment Gas Compressors
2270001060	4	9	Specialty Vehicles Carts, Diesel, Mobile
2270002003	6	1	Asphalt Pavers, Diesel, Mobile

2270002009	6	1	Plate Compactors, Diesel, Mobile
2270002015	6	1	Rollers, Diesel, Mobile
2270002018	6	1	Scrapers, Diesel, Mobile
2270002021	6	1	Paving Equipment, Diesel, Mobile
2270002024	6	1	Surfacing Equipment, Diesel, Mobile
2270002027	6	1	Signal Boards, Diesel, Mobile
2270002030	6	1	Trenchers, Diesel, Mobile
2270002033	6	1	Bore/Drill Rigs, Diesel, Mobile
2270002036	6	1	Excavators, Diesel, Mobile
2270002039	6	1	Concrete/Industrial Saws, Diesel, Mobile
2270002042	6	1	Cement and Mortar Mixers, Diesel, Mobile
2270002045	6	1	Cranes, Diesel, Mobile
2270002048	6	1	Graders, Diesel, Mobile
2270002051	6	1	Off-Highway Trucks, Diesel, Mobile
2270002054	6	1	Crushing/Proc. Equipment, Diesel, Mobile
2270002057	6	1	Rough Terrain Forklifts, Diesel, Mobile
2270002060	6	1	Rubber Tired Loaders, Diesel, Mobile
2270002066	6	1	Tractors/Loaders/Backhoes, Diesel, Mobile
2270002069	6	1	Crawler Tractors, Diesel, Mobile
2270002072	6	1	Skid Steer Loaders, Diesel, Mobile
2270002075	6	1	Off-Highway Tractors, Diesel, Mobile
2270002078	6	1	Dumpers/Tenders, Diesel, Mobile
2270002081	6	1	Other Construction Equipment, Diesel, Mobile
2270003010	2	5	Aerial Lifts, Diesel, Mobile
2270003020	2	5	Forklifts, Diesel, Mobile
2270003030	2	5	Sweepers/Scrubbers, Diesel, Mobile
2270003040	2	5	Other General Industrial Equipment, Diesel, Mobile
2270003050	2	5	Other Material Handling Equipment, Diesel, Mobile
2270003060	2	5	Industrial Equipment;AC\Refrigeration
2270003070	2	5	Industrial Equipment;Terminal Tractors
2270004031	5	1	Leaf Blowers/Vacuums, Diesel, Mobile
2270004046	5	1	Front Mowers, Diesel, Mobile
2270004056	5	1	Lawn & Garden Tractors, Diesel, Mobile
2270004066	5	1	Chippers/Stump Grinders, Diesel, Mobile
2270004071	5	1	Commercial Turf Equipment, Diesel, Mobile
2270004076	5	1	Other Lawn & Garden Equipment, Diesel, Mobile
2270005010	8	7	2-Wheel Tractors, Diesel, Mobile
2270005015	8	7	Agricultural Tractors, Diesel, Mobile
2270005020	8	7	Combines, Diesel, Mobile
2270005025	8	7	Balers, Diesel, Mobile
2270005030	8	7	Agricultural Mowers, Diesel, Mobile
2270005035	8	7	Sprayers, Diesel, Mobile

2270005040	8	7	Tillers >5 HP, Diesel, Mobile
2270005045	8	7	Swathers, Diesel, Mobile
2270005050	8	7	Hydro Power Units, Diesel, Mobile
2270005055	8	7	Other Agricultural Equipment, Diesel, Mobile
2270005060	8	7	Agricultural Equipment;Irrigation Sets
2270006005	3	5	Generator Sets <50 HP, Diesel, Mobile
2270006010	3	5	Pumps <50 HP, Diesel, Mobile
2270006015	3	5	Air Compressors <50 HP, Diesel, Mobile
2270006025	3	5	Welders <50 HP, Diesel, Mobile
2270006030	3	5	Pressure Washers <50 HP, Diesel, Mobile
2270007015	9	4	Skidders, Diesel, Mobile
2270008005	9	4	Aircraft Support Equipment, Diesel, Mobile
2275001000	14	4	Military Aircraft Total
2275020000	14	4	Commercial Aircraft; All Types
2275050000	14	4	General Aviation;Total
2275060000	14	4	Air Taxi;Total
2282005010	12	4	Pleasure Craft; Gasoline, 2-stroke Outboard
2282005015	12	4	Pleasure Craft; Gasoline, 2-stroke Sterndrive
2282010005	12	4	Pleasure Craft; Gasoline, 4-stroke Inboard
2282020005	12	4	Pleasure Craft; Diesel Inboard
2282020010	12	4	Pleasure Craft; Diesel Outboard
2285002000	12	4	Diesel;Total
2285002006	12	4	Railroads Locomotives
2285002010	12	4	Railroads Yard
2285002015	12	4	Diesel;Railway Maintenance
2285004015	10	5	Gasoline, 4-Stroke;Railway Maintenance
2285006015	10	5	LPG;Railway Maintenance
2301010000	2	5	Industrial Inorganic Chemical Manufacturing;Total
2301030000	2	5	Process Emissions from Pharmaceutical Manuf (NAPAP cat. 106);Total
2302002100	2	5	Commercial Cooking - Charbroiling;Conveyorized Charbroiling
2302002200	2	5	Commercial Cooking - Charbroiling;Under-fired Charbroiling
2302003000	2	5	Commercial Cooking - Frying;Deep Fat Fying
2302003100	2	5	Commercial Cooking - Frying;Flat Griddle Frying
2302003200	2	5	Commercial Cooking - Frying;Clamshell Griddle Frying
2302050000	2	5	Bakery Products;Total
2304000000	2	5	All Processes;Total
2305000000	2	5	All Processes;Total
2308000000	2	5	All Processes;Total
2309000000	2	5	All Processes;Total
2312000000	2	5	All Processes;Total
2399000000	2	5	Industrial Processes: NEC;Total

2401001000	5	1	Surface Coating -Architectural Coatings
2401005000	2	5	Surface Coating-Auto Refinishing
2401008000	6	5	Surface Coating-Traffic Markings
2401015000	2	5	Surface Coating-Factory Finished Wood
2401020000	2	5	Surface Coating-Wood Furniture
2401025000	2	5	Surface Coating-Metal Furniture
2401030000	2	5	Surface Coating-Papers
2401045000	2	5	Surface Coating- Metal Coils
2401055000	2	5	Surface Coating-Machinery and Equipment
2401060000	2	5	Surface Coating-Large Appliances
2401065000	2	5	Electronic and Other Electrical: SIC 36 - 363; All Solvent Types
2401070000	2	5	Motor Vehicles: SIC 371 Total: All Solvent Types
2401075000	2	5	Surface Coating-Aircraft Solvent Utilization
2401080000	2	5	Surface Coating-Marines
2401090000	2	5	Surface Coating-Misc. Manufacturing
2401100000	2	5	Surface Coating-Industrial Maintenance Coating
2401200000	2	5	Surface Coating-Other Specific Purpose Coating
2415000000	2	5	Degreasing -Solvent Utilization
2415105000	2	5	Motor Vehicles: SIC 371 Total: All Solvent Types
2415110000	2	5	Primary Metal Industries (SIC 33): Open Top Degreasing Total: All Solvent Types
2415120000	2	5	Fabricated Metal Products (SIC 34): Open Top Degreasing Total: All Solvent Types
2415125000	2	5	Industrial Machinery and Equipment (SIC 35): Open Top Degreasing;Total: All Solvent Types
2415130000	2	5	Electronic and Other Elec. (SIC 36): Open Top Degreasing Total: All Solvent Types
2415135000	2	5	Transportation Equipment (SIC 37): Open Top Degreasing Total: All Solvent Types
2415140000	2	5	Instruments and Related Products (SIC 38): Open Top Degreasing;Total: All Solvent Types
2415145000	2	5	Miscellaneous Manufacturing (SIC 39): Open Top Degreasing Total: All Solvent Types
2415305000	2	5	Furniture and Fixtures (SIC 25): Cold Cleaning Total: All Solvent Types
2415310000	2	5	Primary Metal Industries (SIC 33): Cold Cleaning Total: All Solvent Types
2415320000	2	5	Fabricated Metal Products (SIC 34): Cold Cleaning Total: All Solvent Types
2415325000	2	5	Industrial Machinery and Equipment (SIC 35): Cold Cleaning;Total: All Solvent Types
2415330000	2	5	Electronic and Other Elec. (SIC 36): Cold Cleaning Total: All Solvent Types

2415335000	2	5	Transportation Equipment (SIC 37): Cold Cleaning Total: All Solvent Types
2415340000	2	5	Instruments and Related Products (SIC 38): Cold Cleaning;Total: All Solvent Types
2415345000	2	5	Miscellaneous Manufacturing (SIC 39): Cold Cleaning Total: All Solvent Types
2415355000	2	5	Automotive Dealers (SIC 55): Cold Cleaning;Total: All Solvent Types
2415360000	2	5	Auto Repair Services (SIC 75): Cold Cleaning;Total: All Solvent Types
2415365000	2	5	Miscellaneous Repair Services (SIC 76): Cold Cleaning Total: All Solvent Types
2420000000	5	2	All Processes;Total: All Solvent Types
2420010055	5	2	Commercial/Industrial Cleaners Perchloroethylene
2420000370	5	2	All Processes-Drying Cleaning
2420020055	5	2	Coin-operated Cleaners Perchloroethylene
2425000000	2	5	All Processes;Total: All Solvent Types
2430000000	2	5	All Processes;Total: All Solvent Types
2440000000	2	5	Solvent Utilization - Misc. Industrial
2440020000	2	5	Adhesive (Industrial) Application Total: All Solvent Types
2460100000	1	5	All Personal Care Products;Total: All Solvent Types
2460200000	1	5	All Household Products;Total: All Solvent Types
2460500000	1	5	All Coatings and Related Products;Total: All Solvent Types
2460600000	1	5	All Adhesives and Sealants;Total: All Solvent Types
2460800000	1	5	All FIFRA Related Products;Total: All Solvent Types
2460900000	1	5	Miscellaneous Products (Not Otherwise Covered) Total: All Solvent Types
2461021000	1	5	Misc. Non-Industrial: Cutback Asphalt
2461022000	1	5	Misc. Non-Industrial: Emulsified Asphalt
2461023000	1	5	Misc. Non-Industrial-Asphalt Roofing
2461800000	2	5	Misc. Non-Industrial-Pestcide Application
2461850000	8	7	Pesticide Application: Agricultural;All Processes
2465100000	1	5	Personal Care Products Total: All Solvent Types
2465200000	1	5	Household Products;Total: All Solvent Types
2465400000	1	5	Automotive Aftermarket Products;Total: All Solvent Types
2465600000	1	5	Adhesives and Sealants Total: All Solvent Types
2501050120	5	1	Bulk Stations Terminals-Breathing Loss Gasoline
2501060050	5	1	Gasoline Service Stations- Tank Truck Unloading
2501060052	5	1	Gasoline Service Stations-Tank Truck Unloading
2501060053	5	1	Gasoline Service Stations; Stage 1: Balanced Submerged Filling
2501060100	5	1	Gasoline Service Stations-Vehicle Refueling
2501060201	5	1	Gasoline Service Stations-Underground Tank Breathing Losses
2505030120	1	5	Tank Truck in Transit

2505040120	15	5	Pipeline Gasoline
2510000000	2	5	Organic Chemical Storage and Transport
2601000000	2	5	On-Site Incineration Waste Disposal
2601010000	2	5	Industrial;Total
2601020000	2	5	Commercial/Institutional Total
2610000500	1	5	All Categories;Land Clearing Debris (use 28-10-005-000 for Logging Debris Burning)
2610030000	1	5	Residential;Household Waste (use 26-10-000-xxx for Yard Wastes)
2620000000	1	5	All Categories;Total
2630000000	2	5	All Categories;Total Processed
2630020000	2	5	Public Owned;Total Processed
2640000000	1	5	All TSDF Types;Total: All Processes
2650000000	2	5	Scrap and Waste Materials;Total: All Processes
2660000000	2	5	Leaking -Underground Storage Tanks
2810001000	9	1	Forest Wildfires
2810030000	5	1	Cigarette Smoke;Total
2810040000	2	5	Aircraft/Rocket Engine Firing and Testing;Total
2810050000	1	5	Motor Vehicle Fires;Total
2810060100	1	5	Cremation;Humans
2830000000	2	5	All Catastrophic/Accidental Releases;Total
2850000000	2	5	Hospitals;Total: All Operations

Appendix IV-i

On-Road Vehicle Emission Factor Estimation Procedure for 2008

Appendix IV-i is followed by an attachment containing a sample of the MOBILE6.2 input files for 2008.

APPENDIX III

MODELING ANALYSES

Appendix III-i

MM5 Meteorological Simulations in Support of Eight-Hour Ozone Modeling for the Maricopa Nonattainment Area

This section presents detailed information for MM5 model preparation, configuration, and sensitivity tests provided by ENVIRON.

Final Report

MM5 METEOROLOGICAL SIMULATIONS IN SUPPORT OF 8-HOUR OZONE MODELING FOR THE MARICOPA NONATTAINMENT AREA

Prepared for

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1. INTRODUCTION

1.1 BACKGROUND

The Maricopa Nonattainment Area (MNA) is currently designated by the U.S. Environmental Protection Agency (EPA) as a "Basic" 8-hour ozone nonattainment area, according to ozone monitoring conducted throughout the basin since 2000. Basic nonattainment areas must submit a State Implementation Plan (SIP) by June 15, 2007 that demonstrates attainment of the new, more restrictive 8-hour ozone standard by 2009. Since 2000 the number and severity of 8-hour ozone exceedances in the MNA has decreased to just a single violating monitor in 2004[1]. If the 2005 fourth-highest maximum 8-hour ozone at this monitor remains below 90 ppb, the MNA may attain the 8-hour standard this year (MAG, 2006). Nevertheless, MAG has begun modeling work for the MNA in support of their 8-hour ozone SIP submittal.

Following EPA modeling guidance to support 8-hour ozone SIP submissions (EPA, 2005), MAG has developed a modeling protocol document, which includes a conceptual model of 8-hour ozone episodes between 2000-2004 (MAG, 2006). From this review, MAG has identified three potential ozone modeling periods (in the following order of significance):

1. July 8-14, 2002 (Regime 1)
2. June 3-7, 2002 (Regime 2)
3. August 5-11, 2001 (Regimes 2 and 3)

The 8-hour ozone episodes listed above do not include any model "spin-up" days as a way to reduce air quality model sensitivity to initial conditions. ENVIRON has recommended adding at least three spin-up days to each episode (Emery et al., 2005). The three periods identified by MAG include a total of 19 days; adding 3 additional days to each episode increases the total number of modeling days to 28:

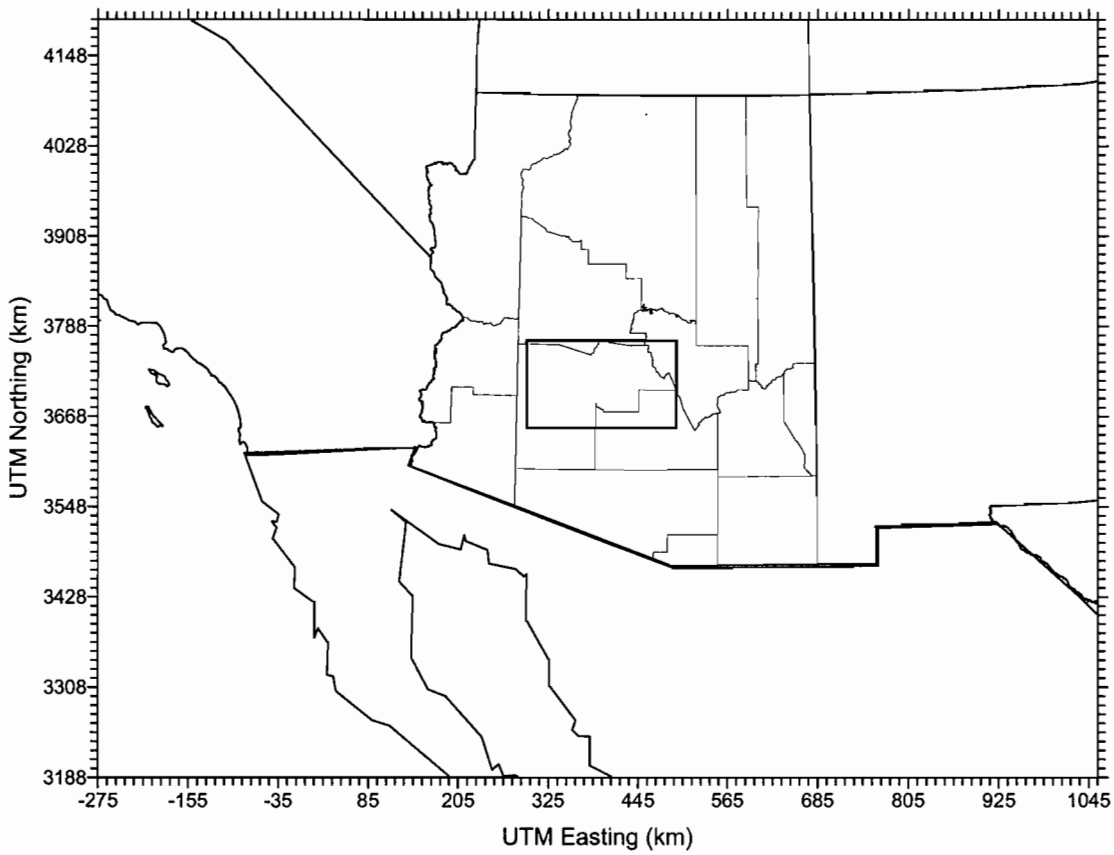
1. July 5-14, 2002
2. May 31 – June 7, 2002
3. August 2-11, 2001

MAG had previously specified the horizontal coverage, grid resolution (4 km), and projection (Universal Transverse Mercator, or UTM) of the MNA modeling domain, and had anticipated that this domain would be nested within a larger regional grid. This nesting approach follows from EPA modeling guidance, which suggests the use of multiple grids to accommodate the analysis of transport, both into the domain of interest to account for contributions from upwind source areas, and outward from the domain of interest to assess downwind impacts. MAG plans to continue to develop MNA modeling emission inventories for ozone on their current UTM projection grid, at least for the foreseeable future. Hence, MAG's primary choice of photochemical model was the Comprehensive Air quality Model with extensions (CAMx), which can directly run on a UTM grid. MAG also intends to use the EPA Community Multiscale Air Quality (CMAQ) model as well for corroborative analyses. MAG anticipated using the Pennsylvania State University/National Center for Atmosphere Research (PSU/NCAR)

1 The area's current 2002-2004 design value is 85 ppb, just above the 84 ppb 8-hour standard, based on the three-year average of the fourth highest 8-hour ozone at each monitoring site (MAG, 2006).

Fifth Generation Mesoscale Model (MM5) as the prognostic meteorological model of choice to develop meteorological input fields for the photochemical air quality models.

Based upon the episode review and conceptual model developed by MAG (2006), ENVIRON formulated recommendations for the size of the overlying regional grid for photochemical modeling (Emery et al., 2005). The conceptual model indicates that most episodes selected for analysis include periods associated with stagnation and therefore local ozone production would be dominant. Since stagnation is a consistent theme among all three episodes, and multi-day back trajectories do not extend far upwind (southern California and northern Mexico), ENVIRON recommended a 12/4-km nested grid configuration that covers the immediate vicinity around Arizona. Figure 1-1 displays the final nested UTM air quality modeling grid system.



12-km Grid: 111 x 84, (-275,3188) to (1057,4196)
4-km Grid: 50 x 29, (297,3652) to (497,3768) -- Includes Buffer

Figure 1-1. Regional coverage of the 12/4-km nested grids to be used for air quality modeling of three ozone episodes in 2001 and 2002. The 4-km nest is indicated by the red inset.

1.2 PURPOSE AND OBJECTIVES

The purpose of the work described in this report was to develop hourly, three-dimensional, multi-scale meteorological fields using the PSU/NCAR MM5 prognostic meteorological model to support photochemical modeling of the three 8-hour ozone episodes identified by MAG (2006). Many simulations were undertaken in order to settle upon a model configuration that resulted in acceptable meteorological model performance in replicating observed patterns of winds, temperature, humidity, and rainfall.

This report describes the work performed by ENVIRON in meeting these objectives, summarizes the various MM5 configurations and their results, and raises issues concerning the ambient observational data as a means for gauging model performance. Section 1 has briefly described the background for this work. Section 2 presents the modeling methodology, including data sources, MM5 input requirements, grid and physics configurations, and discussion of sensitivity tests. Section 3 summarizes the MM5 simulation results, and justifies the selection of the final MM5 configurations for each episode.

2. TECHNICAL APPROACH

2.1 OVERVIEW

We planned to exploit the substantial work and knowledge gained from ENVIRON's involvement in regional/annual modeling for the Western Regional Air Partnership (WRAP) by using the WRAP MM5 configuration as a starting point. WRAP has invested significant time and resources to obtain acceptable MM5 performance in replicating observed meteorological patterns over the western U.S. for the entire year of 2002. The primary performance problems encountered in the WRAP modeling centered around poor temperature, humidity, and rainfall simulations in the desert southwest (Arizona and New Mexico) during the warm seasons. In this study, we needed to maximize the performance of MM5 on the high resolution MNA grid, which required additional sensitivity tests. This specifically included the need to tone down the tendency for MM5 to over predict the coverage and intensity of convective rainfall over Maricopa County during the June 2002 and August 2001 episodes. Furthermore, "nudging" the MM5 model toward observational analyses and local measurement networks was imperative to control model "drift" from conditions that actually occurred, so we procured all available observation and analysis datasets. However, as discussed later, there are some consistency issues among the observational data that must be considered in order to effectively use these datasets and to properly interpret performance results.

MAG has assembled a comprehensive database of meteorological observations from various monitoring networks in the Maricopa area and throughout Arizona, including surface sites from the Arizona mesonet (AZMET) and the National Weather Service (NWS), as well as a few upper air profiler sites operated by the National Oceanic and Atmospheric Administration's Forecast Systems Laboratory (FSL) (Jung, 2005). Note, however, that there continues to be a dearth of upper air data in the region. Hourly measurements of surface-level winds, temperature, and humidity are available from over 50 sites in the dataset, and these provided a crucial input element to the MM5 modeling. Use of these data ranged from direct ingestion by MM5 in its Four Dimensional Data Assimilation (FDDA) system; to qualitative and statistical model performance evaluation. MAG provided these data to ENVIRON, and we used existing processing tools to generate the data formats needed for MM5 and its post-processors. Jung (2005) provided technical documentation that describes each of the networks populating the database. ENVIRON reviewed the specifications in the MAG database as a quality assurance step.

Other datasets needed for MM5 include terrain elevation, landuse/landcover, hourly observational datasets from regional and national networks, and large-scale meteorological analysis fields. The large-scale analyses are used for prescribing initial/boundary conditions and for nudging MM5 during integration as part of its FDDA system. The analyses we commonly utilize for MM5 were extracted from the Eta Data Assimilation System (EDAS), which provides high temporal and spatial resolution North American analyses. ENVIRON also obtained the standard NCAR/NWS hourly surface observation dataset (referred to as "DS472") to augment the MAG databases and to cover the entire region encompassed by the MM5 domain. The DS472 data were also used to improve the large-scale EDAS analyses by incorporating local observational influences into the input fields for initial/boundary conditions and FDDA analysis nudging. ENVIRON procured all of the needed datasets listed above directly from NCAR.

All observational datasets described above were utilized to gauge MM5 model performance. The performance evaluation included graphical and statistical analyses of predictions against observations. The simulation of convective rainfall was a particular challenge in this project, which prompted the need for an observational rainfall dataset as well. Gridded rainfall fields analyzed and distributed by the Climatological Prediction Center (CPC) were obtained for the summer of 2002; gridded electronic data for 2001 were not available, so we relied on hard-copy analyses of daily rainfall from CPC's "Daily Weather Maps". Qualitative comparisons between the CPC and MM5 rainfall patterns were performed to enhance the model performance assessment.

2.2 MM5 GRID SPECIFICATIONS

MM5 does not support UTM map projections. The most appropriate projection to use for the latitude of Maricopa County is the Lambert Conformal Projection (LCP). The use of multiple grid nests in MM5 is necessary to provide superior boundary conditions to the finer grid(s) over the area of interest. Grid nests allow for resolution to telescope down from a large regional area (e.g., entire western U.S.) to an intermediate area (e.g., the southwestern U.S.), to the specific grid of interest (e.g., the non-attainment area). Particular care is needed to set up the MM5 grid nesting arrangement because: (1) there are certain rules and restrictions within MM5 for grid nesting; and (2) it is necessary to ensure that the MM5 12/4-km LCP grids provide adequate coverage of the CAMx 12/4-km UTM grids with a minimum of distortion between the two projections. The LCP mapping definition was therefore selected to align the LCP central longitude along the central longitude of UTM zone 12 (111°W). A central latitude of 34°N was specified; the choice of the central latitude is not crucial in relation to UTM projections. Default conic true latitudes were used (45°N and 33°N), which minimizes mapping distortion relative to UTM in the area of Maricopa County.

Figure 2-1 shows the layout of the MM5 36/12/4-km nested grid system. Grid parameters are given below:

Grid Resolution	Cell Size	LCP Range
36-km grid	64 by 49	(-1134, -864) to (1134, 864)
12-km grid	91 by 118	(-810, -612) to (594, 468)
4-km grid	40 by 61	(-222, -132) to (18,24)

Table 2-1 presents the MM5 vertical layer structure for MAG 8-hour ozone modeling, which is based on the WRAP CMAQ/CAMx regional modeling configuration. Basing layers on WRAP will facilitate the development of regional boundary conditions. MM5 is defined in terms of a normalized terrain-following pressure coordinate ("sigma-p"), which has a value 1 at the ground and 0 at the top of the model. CAMx layers are allowed to span several MM5 layers, and thus are defined as a subset of the MM5 layers, expressed in altitude (m) above ground level (AGL). In the table below, pressure is shown for CAMx layer midpoints, while height is given for the layer interfaces. Layer thickness is given in the last column.

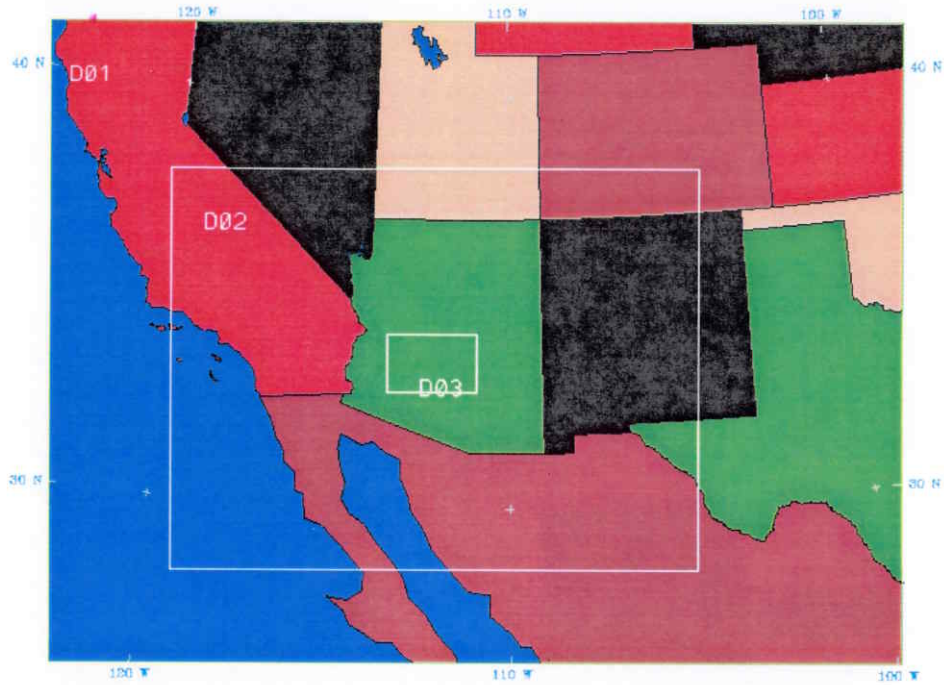


Figure 2-1. Configuration of the MM5 36/12/4-km nested grid system.

2.3 MM5 SIMULATION DESIGN

The MM5 model physics options and parameterizations are outlined in this section. The initial configuration (Run 1) for all three episodes was taken directly from the final WRAP setup that produced the best overall performance in the desert southwest. This configuration is presented in Table 2-2.

Reisner 2 (or Reisner Graupel in formal terms) is a multi-phase microphysics scheme that includes six classes of hydrometeors (water vapor, cloud water, rain, cloud ice, snow and graupel) and explicitly resolves water vapor, cloud and precipitation processes. The Pleim-Xiu Land Surface Model (P-X LSM) coupled to its Asymmetric Convective Model (ACM) planetary boundary layer scheme can explicitly simulate soil moisture and temperature in two layers (surface - 1 cm; and root zone - 1 m), as well as canopy moisture. The Rapid Radiative Transfer Model (RRTM) is a highly accurate and efficient method to calculate short-wave (solar) and long-wave (terrestrial) radiation.

All of the treatments listed in Table 2-2, except for the Betts-Miller (BM) sub-grid convection scheme, are currently the most commonly used algorithms for treating cloud physics, radiation, soil thermodynamics, and boundary layer mixing in the context of air quality modeling. As such, they also comprise the EPA-recommended configuration for use with CMAQ and CAMx. Our use of BM in WRAP was a result of the much improved performance in reducing the over-stated sub-grid convective rainfall that was prevalent in earlier MM5 simulations during the warm season. The BM approach is rather dated, and considered much more simplistic than the newer options available in MM5; however, it makes a clear difference in precipitation performance.

Table 2-1. MM5 and CAMx layer configurations from WRAP CMAQ/CAMx modeling.

	CMAQ/CAMx Layer Structure			
MM5 Sigma-p	Layer Index	Pressure (mb)	Height (m)	Thickness (m)
0.000	19	258	14662	6536
0.050				
0.100				
0.150				
0.200				
0.250	18	462	8127	2966
0.300				
0.350				
0.400				
0.450	17	615	5160	1712
0.500				
0.550				
0.600	16	721	3448	986
0.650				
0.700	15	794	2462	634
0.740				
0.770	14	846	1829	428
0.800				
0.820	13	885	1401	329
0.840				
0.860	12	911	1071	160
0.880	11	928	911	158
0.900	10	946	753	155
0.910				
0.920	9	963	598	153
0.930				
0.940	8	976	445	76
0.950	7	985	369	75
0.960	6	994	294	74
0.970	5	1002	220	74
0.980	4	1009	146	37
0.985	3	1013	109	37
0.990	2	1018	73	36
0.995	1	1022	36	36
1.000	Surface		0	

Table 2-2. Configuration of MM5 Physics and FDDA options in the initial runs for all three photochemical modeling episodes (referred to as Run 1).

Process	36-km and 12-km Domains	4-km Domain
Sub-Grid Cumulus	Betts-Miller	None
Explicit Moisture	Reisner2	
Boundary Layer	Pleim-Chang (ACM)	
Land Surface Model	Pleim-Xiu	
Radiation	RRTM	
Data Assimilation	3-D analysis nudging of wind, temperature, humidity above the boundary layer	
Data Assimilation	2-D surface analysis nudging of wind	

This is particularly key in the Maricopa area since overstated convective rainfall will result in washing out ozone and precursors.

A series of sensitivity runs were conducted to find the optimal configuration for the Southwest, especially the designated modeling area of Arizona. Table 2-3 summarizes the differences in physics options and FDDA configuration among these sensitivity tests. Runs 2 and 3 introduced observational nudging toward surface wind observations from various networks. The "MAG" network consists of NWS and AZMET data compiled by MAG as described by Jung (2005). The "DS472" network consists of NWS sites only as archived by NCAR (primarily airports). The Run 2 configuration was applied on all three episodes. To be cost-efficient, the configurations for Runs 4 through 9 were first tested on the July 2002 episode, in which gross over predictions in convective precipitation were found to result in the worst model performance results in Runs 1 through 3. Runs 4 and 5 were designed specifically to find a solution for the overestimated convective rainfall on the modeling area. Run 4 applied the Betts-Miller cumulus parameterization scheme on the 4-km domain in addition to the 36-km and 12-km domains, while no convective scheme was employed on either the 12 or 4-km domains in Run5. Run 6 increased the strength of FDDA, and included surface analysis nudging of temperature and humidity.

Table 2-3. Major differences in MM5 Physics and FDDA options between each sensitivity run.

	Cumulus			Surface Analysis FDDA		Observational FDDA
Run	36km	12km	04km	36km and 12km	04km	12km and 4km
1	BM	BM		Wind	Wind	
2	BM	BM		Wind	Wind	W/MAG
3	BM	BM		Wind	Wind	W/DS472
4	BM	BM	BM	Wind	Wind	W/MAG
5	BM			Wind	Wind	W/MAG
6	BM	BM		W/T/RH	W/T/RH	W/MAG
7	KF	KF		Wind	Wind	W/MAG
8	KF	KF		Wind	Wind	W/MAG
9	KF	KF		Wind		W/MAG

W/T/RH: Nudging to Wind/Temperature/Moisture analyses
W/MAG: Nudging wind to the MAG observation data set
W/DS472: Nudging wind to the DS472 observation data set

After the first six runs, the model performance was improved to a certain degree. However, the early onset of daily convection and over estimated rainfall remained a problem, affecting model performance for wind, temperature and humidity. Though the Betts-Miller cumulus scheme had proven to be a better approach in the WRAP application, it is a relatively simplified and out-dated scheme. Therefore, to further investigate the performance of other approaches, the more sophisticated and current Kain-Fritsch (KF) cumulus scheme was used in Run 7. The temperature and moisture performance improved noticeably in this run and the overestimated rainfall was lowered.

All of the sensitivity runs up to this point had produced similar results during the dry period before July 9, 2002, but quite different results during the wet period on July 9 and afterward. In order to remove a possible bias in convective potential that may have built up through July 8, Run 8 was started on 00 UTC July 9 using initial conditions and soil parameters developed from

EDAS on that day (as opposed to relying on MM5 fields as in a re-start). The model was configured in all other respects exactly as in Run 7. The results from Run 8 were comparable to those of Run 7, indicating little difference in the use of MM5 or EDAS as initial conditions.

However, if the initial conditions from EDAS data were too wet and we were strongly nudging to these conditions (as in all previous runs), the model would erroneously respond by producing too much strong convective activity. Therefore, in Run 9 the soil moisture was initialized using default climatological soil moisture tables instead of the EDAS fields. Additionally, the 2-D surface analysis nudging was turned off in the 4-km domain and the nudging coefficients for wind observational FDDA were lowed. Run 9 produced the best performance for the July 2002 episode. Based on these results, the August 2001 episode was run with the Run 7 and 9 configurations since it also exhibited performance problems associated with convective activity.

2.4 PERFORMANCE EVALUATION METHODOLOGY

The goal of the MM5 model evaluation should be to (a) assess whether and to what extent confidence may be placed in the modeling system to provide three-dimensional wind, temperature, moisture, and turbulent mixing rates to air quality models, and (b) compare and contrast performance against results obtained from previous meteorological model applications across the country. The basis for the assessment is a comparison of the predicted meteorological fields to available surface and aloft data collected by the National Weather Service and other reporting agencies. This is carried out both graphically and statistically. A specific set of statistics has been identified for use in establishing benchmarks for acceptable model performance, with the idea that these benchmarks, similar to current EPA guidance criteria for air quality model performance, allow for a consistent comparison of various meteorological simulations for important variables at the surface and in the boundary layer.

This performance evaluation centers on performance in the 4-km grid. However, a regional qualitative analysis is also carried out in the 36- and 12-km MM5 domains. The first step in the operational evaluation is the preparation of graphics to display the predicted meteorological fields at the surface and for selected levels aloft. This allows for a qualitative assessment of model performance by comparing results to commonly available analysis maps of wind, temperature, pressure, and precipitation patterns available from several entities, including the NWS and others (e.g., http://weather.unisys.com). The purpose of these evaluations is to establish a first-order acceptance/rejection of the simulation in adequately replicating the gross weather phenomena in the region of interest. Thus, this approach screens for obvious model flaws and errors.

2.4.1 Statistical Evaluation

Several statistical measures are calculated as part of the meteorological model evaluation. Additional plots and graphs are used to present these statistics on both hourly and daily time frames. These measures are calculated for wind speed, wind direction, temperature, and humidity at the surface. We do not evaluate upper air performance quantitatively because usually there is a dearth of upper air data available within small local domains (such as MNA), and because MM5 replicates the free atmosphere (above 850 mb, ~1500 m MSL) rather well since three-dimensional analysis nudging is applied to control model drift on the large meso-

scale to synoptic scale.

ENVIRON has derived a set of daily performance "benchmarks" for typical meteorological model performance (Emery et al., 2001), and since then these benchmarks have been widely adopted in many local and regional air quality modeling studies throughout the U.S. These standards were based upon the evaluation of a variety of about 30 MM5 and RAMS air quality applications over the past decade, as reported by Tesche et al. (2001). The purposes of these benchmarks are not necessarily to give a passing or failing grade to any one particular meteorological model application, but rather to put its results into the proper context. The key to the benchmarks is to understand how good or poor the results are relative to the universe of other model applications run throughout the U.S. Certainly, an important criticism of the past EPA guidance statistics for acceptable photochemical model performance is that they have been relied upon much too heavily to establish an "acceptable" model simulation for a given area and episode. Often lost in the statistical evaluation is the need to critically evaluate all aspects of the model via diagnostic and process-oriented approaches. The same must be stressed for the meteorological performance evaluation.

Emery et al. (2001) carefully considered the appropriateness and adequacy of the benchmarks based upon the results of MM5 simulations performed and reported in that study. Benchmarks were developed for root-mean-square error (RMSE), bias, gross (absolute) error, and index of agreement (IOA – a normalized metric ranging from 0 [no skill] to 1 [perfect]). The daily benchmarks are given below:

Wind Speed	RMSE:	$\leq$ 2 m/s
	Bias:	$\leq \pm$0.5 m/s
	IOA:	$\geq$ 0.6
Wind Direction	Gross Error:	$\leq$ 30 deg
	Bias:	$\leq \pm$10 deg
Temperature	Gross Error:	$\leq$ 2 K
	Bias:	$\leq \pm$0.5 K
	IOA	$\geq$ 0.8
Humidity	Gross Error:	$\leq$ 2 g/kg
	Bias:	$\leq \pm$1 g/kg
	IOA:	$\geq$ 0.6

2.4.2 The METSTAT Program

A statistical analysis software package has been developed to calculate and graphically present the statistics described above. The package is comprised of a single Fortran program (METSTAT) to generate observation-prediction pairings and to calculate the statistics, and a Microsoft Excel macro (METSTAT.XLS) that plots the results.

The program spatially and temporally pairs MM5 predictions with observations for a user-defined time and space window. Only surface-level data are used for the statistical calculations.

Since the surface layer in MM5 is usually rather thick relative to the standard heights at which the observational data were recorded, the METSTAT program includes a micro-meteorological module that scales mid-layer predicted winds to 10 m heights, and mid-layer predicted temperatures to 2 m heights, using common stability-dependent similarity relationships[1]. The program then proceeds to calculate the statistics described above for each hour and for each day of the time window. The following parameters are determined:

- Wind Speed, Temperature, Humidity:
  - Mean Observed
  - Mean Predicted
  - Bias
  - Gross Error
  - RMSE
  - $RMSE_S$ (systematic error component)
  - $RMSE_U$ (unsystematic/random error component)
  - IOA

- Wind Direction
  - Mean Observed
  - Mean Predicted
  - Bias
  - Gross Error

The RMSE and IOA have not been typically used to quantify error for wind direction, and thus are not calculated by the program.

2.4.3 Observation Datasets for Model Evaluation and Observation Nudging

Before undertaking the MM5 simulations and subsequent performance evaluation, we need to inspect and evaluate the datasets that will be used for both FDDA and model assessment in terms of the physical configuration of the probes and their data quality.

As described earlier, the DS472 dataset includes standard automated NWS weather stations at airports (Table 2-4), while the MAG dataset has compiled AZMET, NWS and FSL sites (see Table 1 and Figure 1 in Jung [2005]). Standard meteorological monitoring networks utilize wind sensors on 10 m masts, with temperature and humidity sensors located at 2 m. MM5 is usually configured with layer structures that result in a surface layer that ranges from 20 to 100 m. Predicted winds and thermodynamic variables are all carried as volume averages through each layer, meaning that they are characteristic of heights much higher and deeper than the 10 and 2 m measurement probe heights. The METSTAT program was written to extrapolate the MM5 predictions within the surface layer to the standard probe heights. Since then, MM5 has been modified by NCAR to directly write optional wind and temperature fields at those same heights using similar techniques as incorporated into METSTAT.

[1] Probe heights of 10 m (winds) and 2 m (temperature) are standard configurations for NWS sites. Networks operated by other agencies may differ significantly from these, depending upon their intended focus.

Table 2-4. List of NWS sites in the NCAR DS472 dataset.

Site Name	Abbr.	LAT	LON
Casa Grande Municipal Airport	KCGZ	32.90	-111.70
Chandler Municipal Airport	KCHD	33.27	-111.82
Phoenix Deer Valley Municipal Airport	KDVT	33.69	-112.07
Glendale Municipal Airport	KGEU	33.53	-112.30
Goodyear Municipal Airport	KGYR	33.42	-112.38
Phoenix Sky Harbor International Airport	KPHX	33.43	-112.02
Phoenix Scd	KPSR	33.44	-112.02
Scottsdale Airport	KSDL	33.62	-111.92
Mesa/Falcon Field	KFFZ	33.47	-111.73
Mesa Williams Gateway Airport	KIWA	33.30	-111.67
Luke AFB	KLUF	33.55	-112.37
Gila Bend Army Airfield	KGBN	32.93	-112.70

Review of the very good AZMET data documentation from Jung (2005) states that wind probe heights for that array are located at 3 m, and temperature is located at 1.5 m above the ground. While the temperature probe difference from NWS standards should be inconsequential, the 7 m (23 ft) difference in wind probe height can lead to substantial differences in horizontal winds due to strong vertical shear that is very common near the ground, especially at night. Deviations in siting criteria (exposure to buildings, trees, and the underlying surface type) from NWS standards can also lead to significant differences in wind and temperature measurements.

To illustrate this point, Figure 2-2 shows hourly wind, temperature, and humidity time series for the June 2002 episode. The top panel in each plot shows the mean observations in the 4-km domain for the NCAR/DS472 sites (12 sites), MAG-compiled NWS sites (10 sites, all of which should correspond to the DS472 sites), and AZMET sites (11 sites). The bottom panels show the model bias gauged against each of the three observational datasets. Wind speed is clearly different for the AZMET sites than for the DS472 and MAG/NWS sites, showing a definite low wind bias by as much as 50%. As a reality check, the DS472 and MAG/NWS means follow each other quite closely. Differences in wind direction are less clear, although the AZMET mean deviates from the two NWS means.

Temperature and humidity are also surprisingly more different than expected. AZMET is usually much cooler (especially at night) and wetter than NWS. This may not be associated with probe height so much as siting criteria. Jung (2005) states: "AZMET operated by the University of Arizona provides meteorological data for agricultural and horticultural interests in southern and central Arizona." This suggests that AZMET purposely sites their instruments in or very near agricultural fields: besides providing for a different surface condition from NWS sites (live, green, dense vegetation vs. relatively bare or thinly covered soil used for NWS sites), it is likely that these fields are fully irrigated during the ozone season. These represent real differences that MM5 might be able to reproduce if irrigated fields with dense, active vegetation could be introduced accurately into the MM5 soil surface inputs.

In summary, we need to carefully consider the biases associated with the AZMET observations when they are used in the meteorological modeling for FDDA, and in the statistical performance assessments. Nevertheless, we elected to use the AZMET data in the model performance

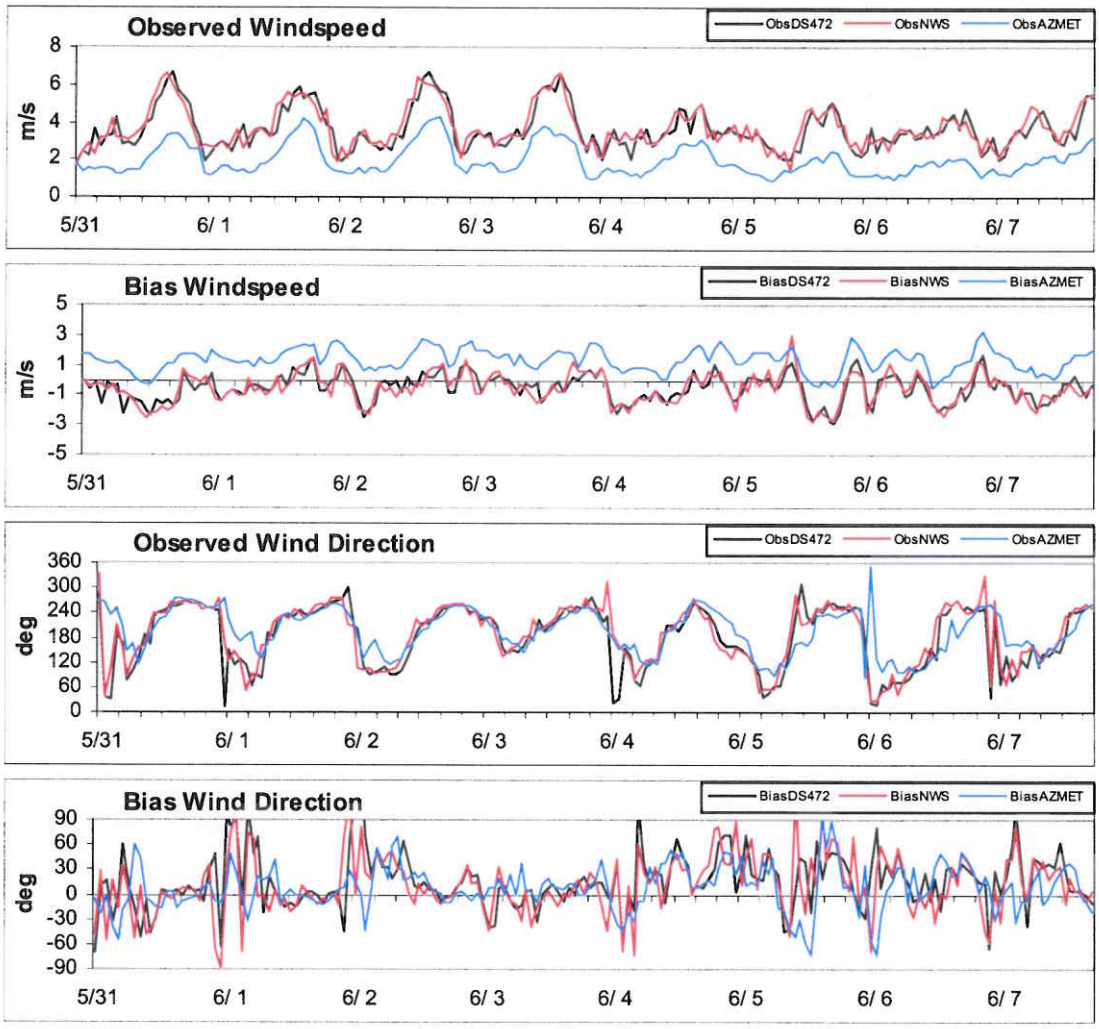


Figure 2-2. Hourly time series statistics comparing mean DS472 (black), MAG/NWS (red), and AZMET (blue) wind observations (top) and MM5 wind bias (bottom) from Run 1, in the 4-km MNA domain over the June 2002 episode.

evaluation as temperature and humidity biases associated with those measurements are potentially due to real local surface conditions throughout the domain. We introduced the DS472 dataset to provide an objective comparison for model simulations and evaluation.

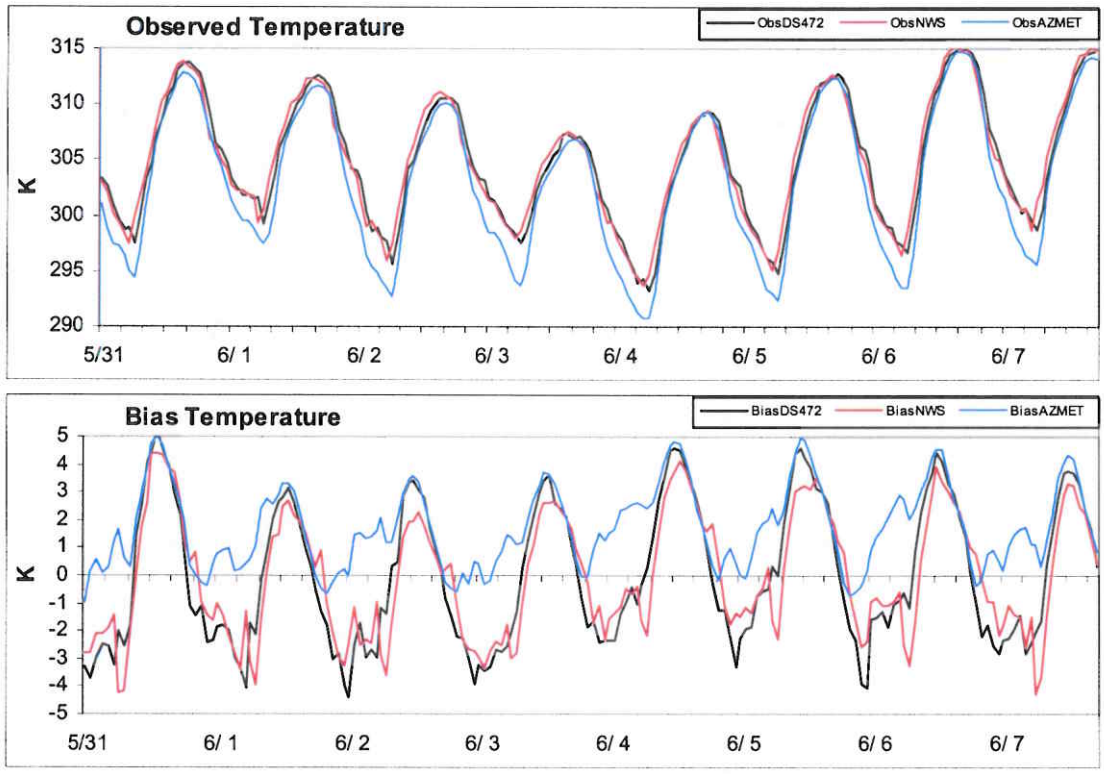


Figure 2-2 (continued). Hourly time series statistics comparing mean DS472 (black), MAG/NWS (red), and AZMET (blue) temperature observations (top) and MM5 wind bias (bottom) from Run 1, in the 4-km MNA domain over the June 2002 episode.

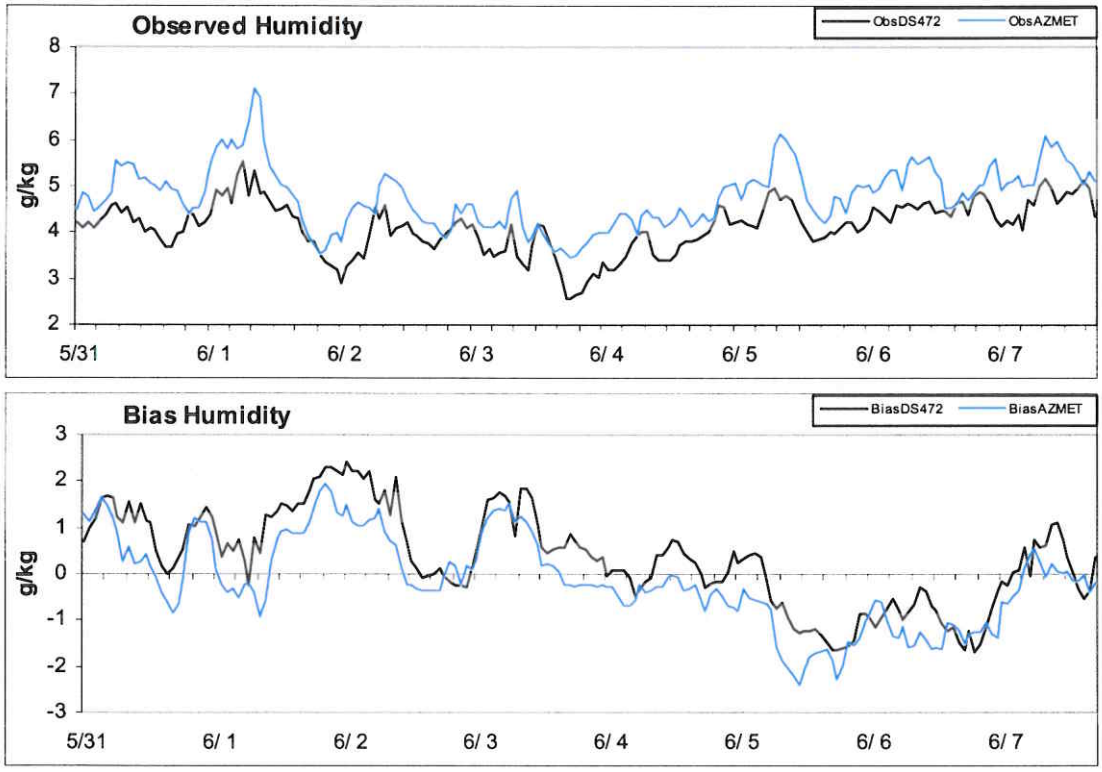


Figure 2-2 (concluded). Hourly time series statistics comparing mean DS472 (black) and AZMET (blue) humidity observations (top) and MM5 humidity bias (bottom) from Run 1, in the 4-km MNA domain over the June 2002 episode. MAG/NWS humidity measurements in g/kg are not available.

3. DISCUSSION OF RESULTS

3.1 JUNE 2002 EPISODE

MM5 performance in replicating surface observations of winds, temperature, and humidity were evaluated statistically on both hourly and daily time scales, on all three simulation grids. Typically we use all available surface data to maximize the observation-prediction pairings for statistics.

Figure 3-1 displays hourly statistical performance for surface winds, temperature, and humidity for the June 2002 episode. Observations were taken from all NWS sites from the NCAR archive (referred to as DS472) located within the 4-km MM5 modeling domain. The predictions are taken from MM5 Run 1, as described in Table 2-2. The top plot on each page shows the mean observations and predictions across all sites. This episode was our best performing of the three; wind and temperature performance for the July 2002 and August 2001 were slightly worse (as explained later).

Performance for wind speed and direction is considered to be rather good, considering the influences of local topography and the relatively small number of observation-prediction pairings in the 4-km MNA domain (usually statistics look better with larger numbers of pairings, while results from just a few pairings look much more disorganized). Midday maximum wind speeds are captured well, except on June 6. MM5 captures the regular wind direction shifts associated with the diurnal tides, with perhaps the exception of the total directional range. For temperature, MM5 has no problems simulating the wide range of the diurnal minimum and maximum, which has been a major limitation of the model in the past. We attribute this improved performance with the use of the RRTM radiation scheme in combination with the Pleim-Xu land surface and PBL model. However, the daily temperature range is now perhaps a bit too large. For humidity, the atmosphere is simulated to be appropriately dry, and close to observations. However, there is no apparent skill in matching the intra- and inter-daily variations except perhaps on June 4. Overall, this is a very promising result for an initial MM5 simulation.

Figure 3-2 displays an example of daily statistical performance for the same period and modeling grid. The format of the plots is similar to the hourly time-series in Figure 3-1, but the daily averages are presented as bar charts. Again, from our experience, performance on daily time scales is quite good. The only major problem is the large temperature error caused by an over prediction in the daily temperature range.

Run 2 introduced observational nudging toward surface wind observations from the MAG network, which includes AZMET and NWS data compiled by MAG. Table 3-1 displays the comparison of the episode-average daily statistics over the 4-km grid for Run 1 and 2 of the June 2002 episode relative to the DS472 and AZMET datasets. Performance benchmarks for acceptable performance are also provided to put these results in context. The wind performance in Run 2 shows noticeable improvement compared to Run 1. The episode-average daily wind

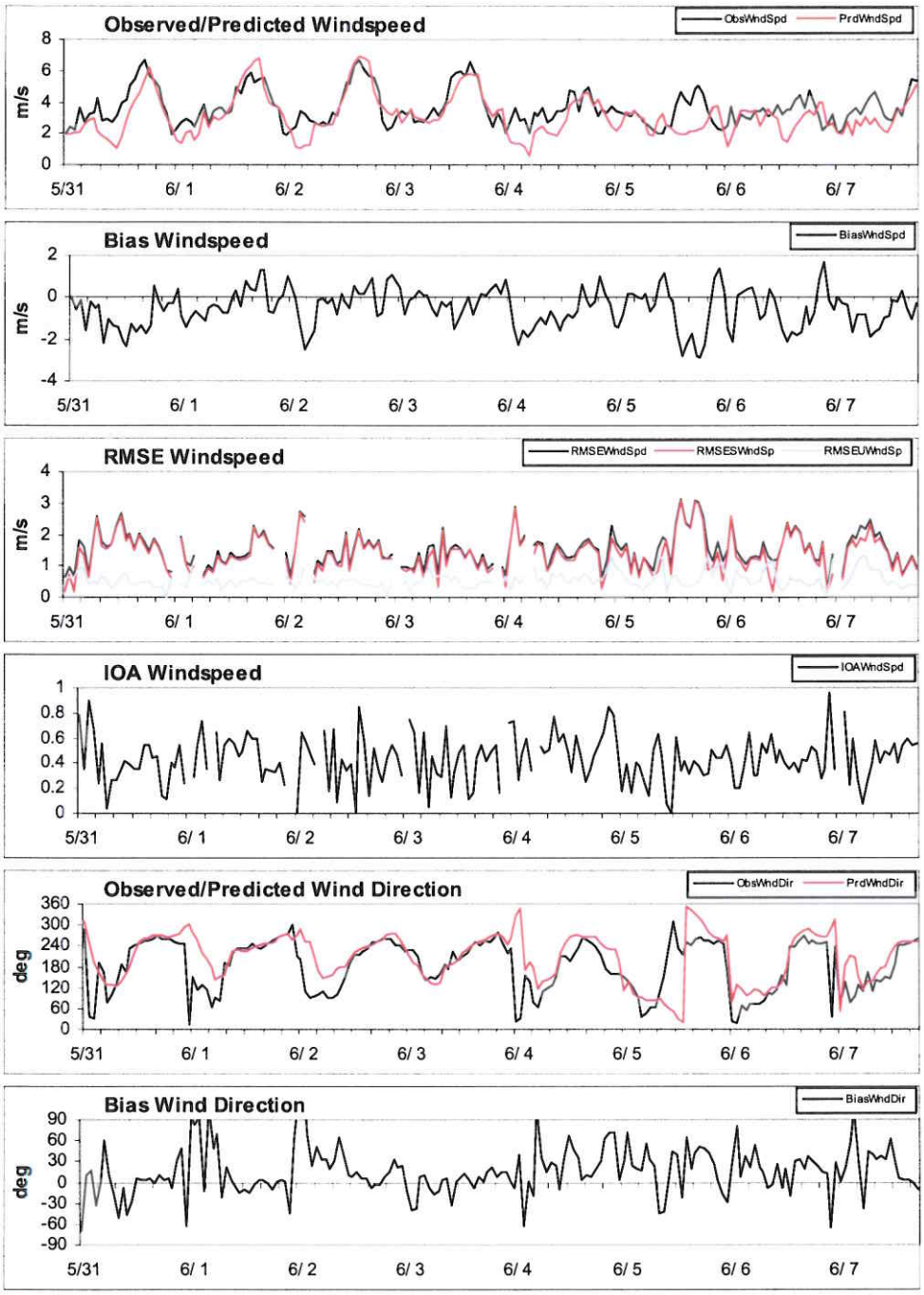


Figure 3-1. Hourly time series statistics comparing DS472 wind observations to paired MM5 wind predictions from Run 1, in the 4-km MNA domain over the June 2002 episode.

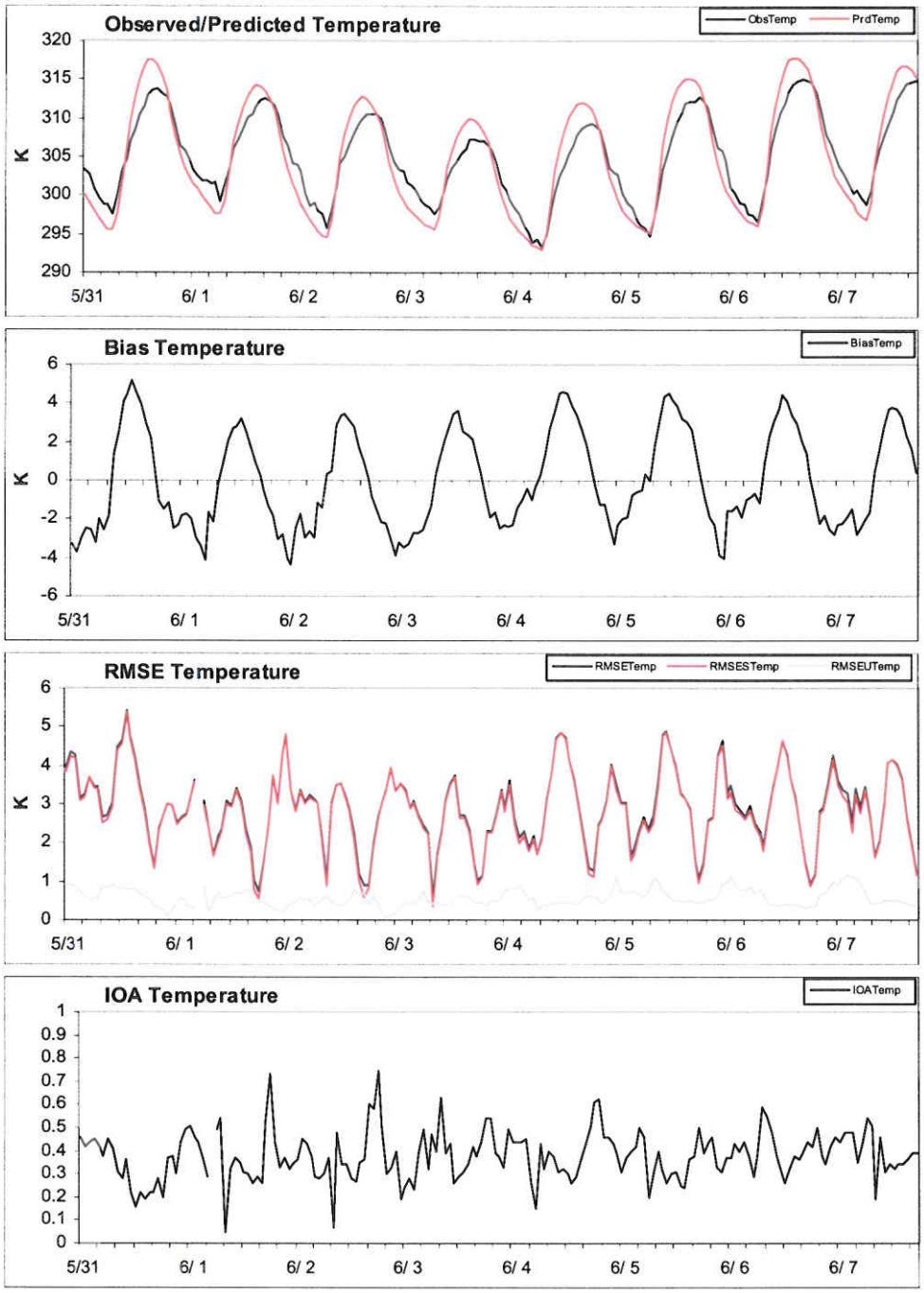


Figure 3-1 (continued). Hourly time series statistics comparing DS472 temperature observations to paired MM5 temperature predictions from Run 1, in the 4-km MNA domain over the June 2002 episode.

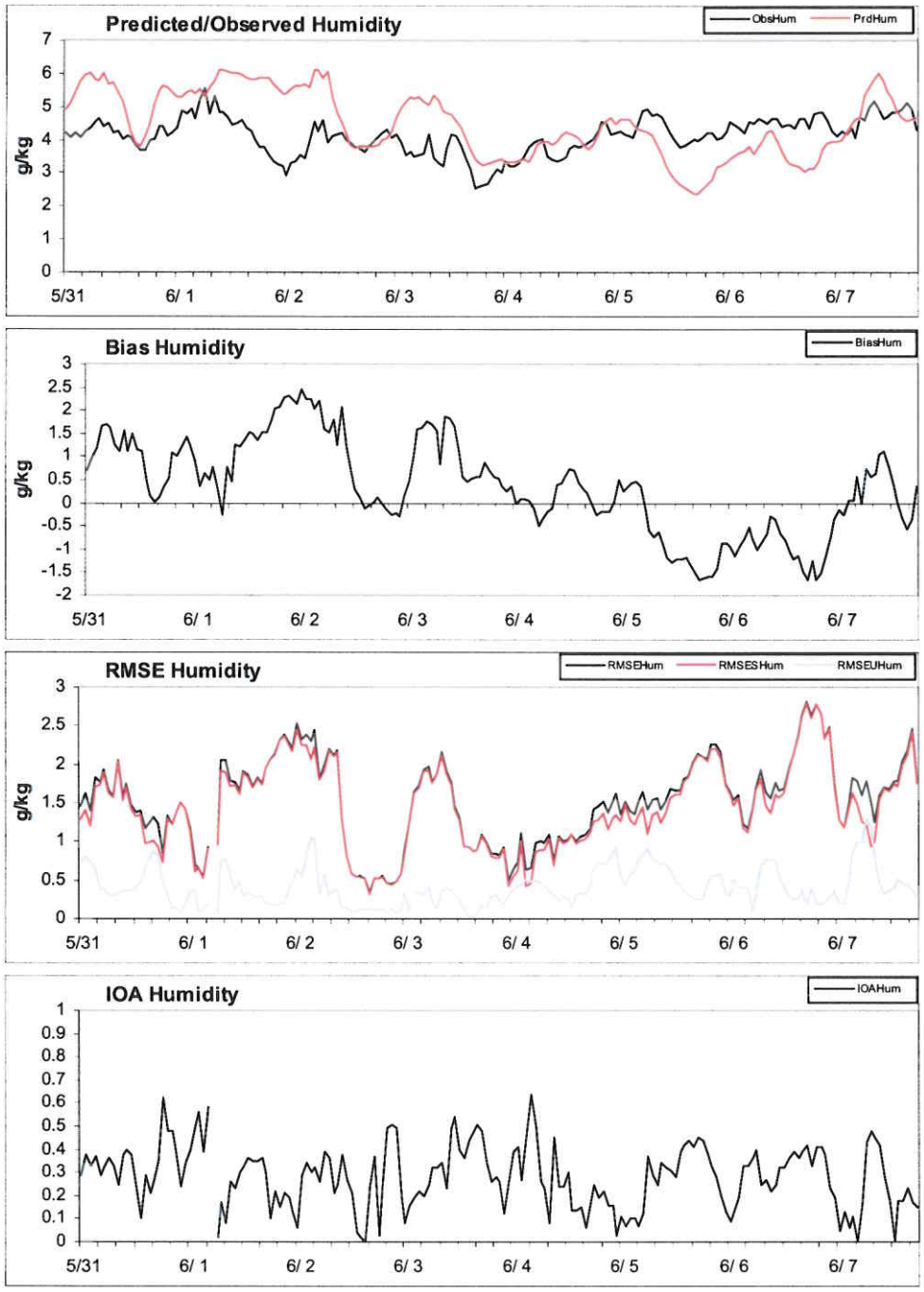


Figure 3-1 (concluded). Hourly time series statistics comparing DS472 humidity observations to paired MM5 humidity predictions from Run 1, in the 4-km MNA domain over the June 2002 episode.

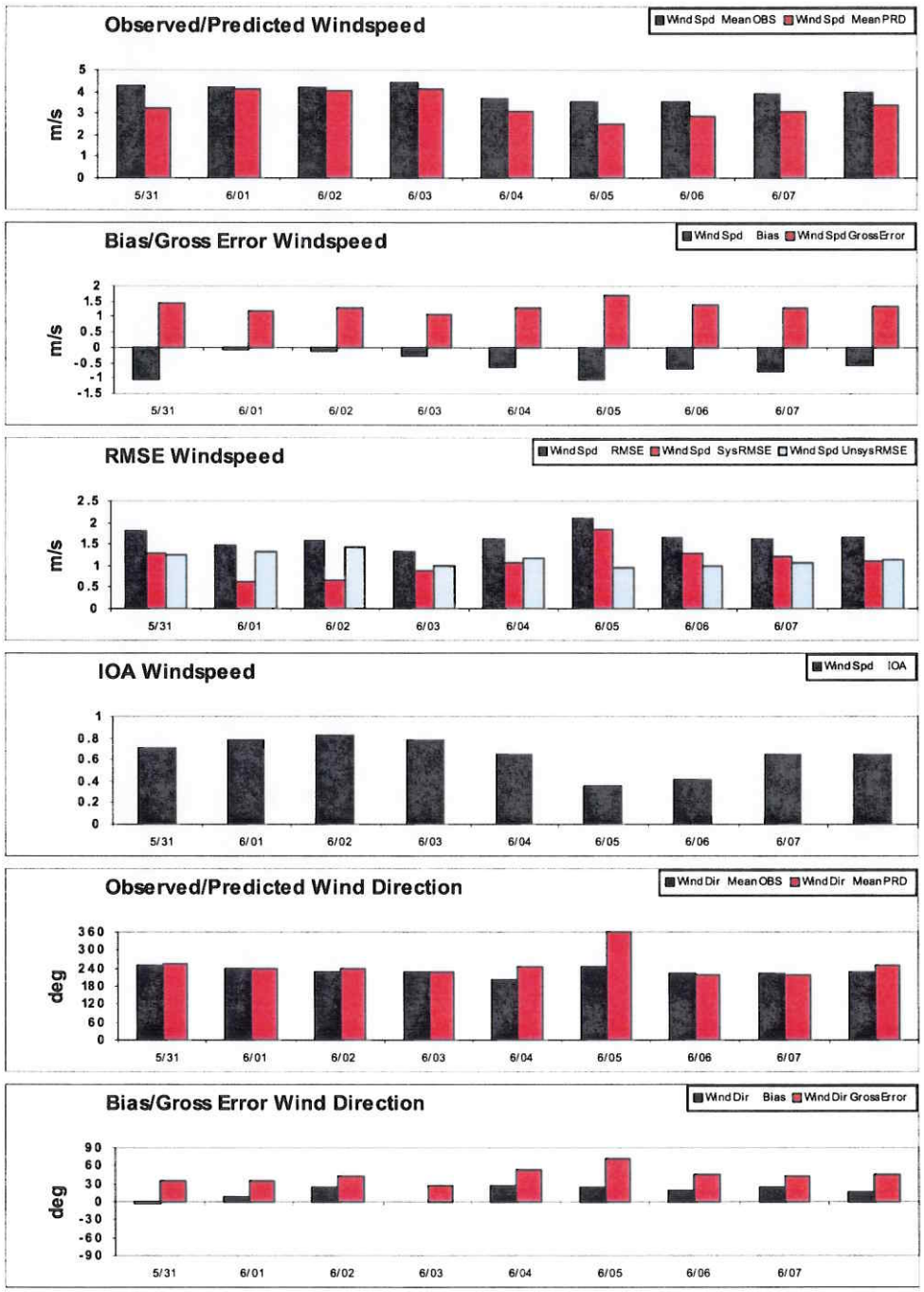


Figure 3-2. Daily statistics comparing DS472 wind observations to paired MM5 wind predictions from Run 1, in the 4-km MNA domain over the June 2002 episode.

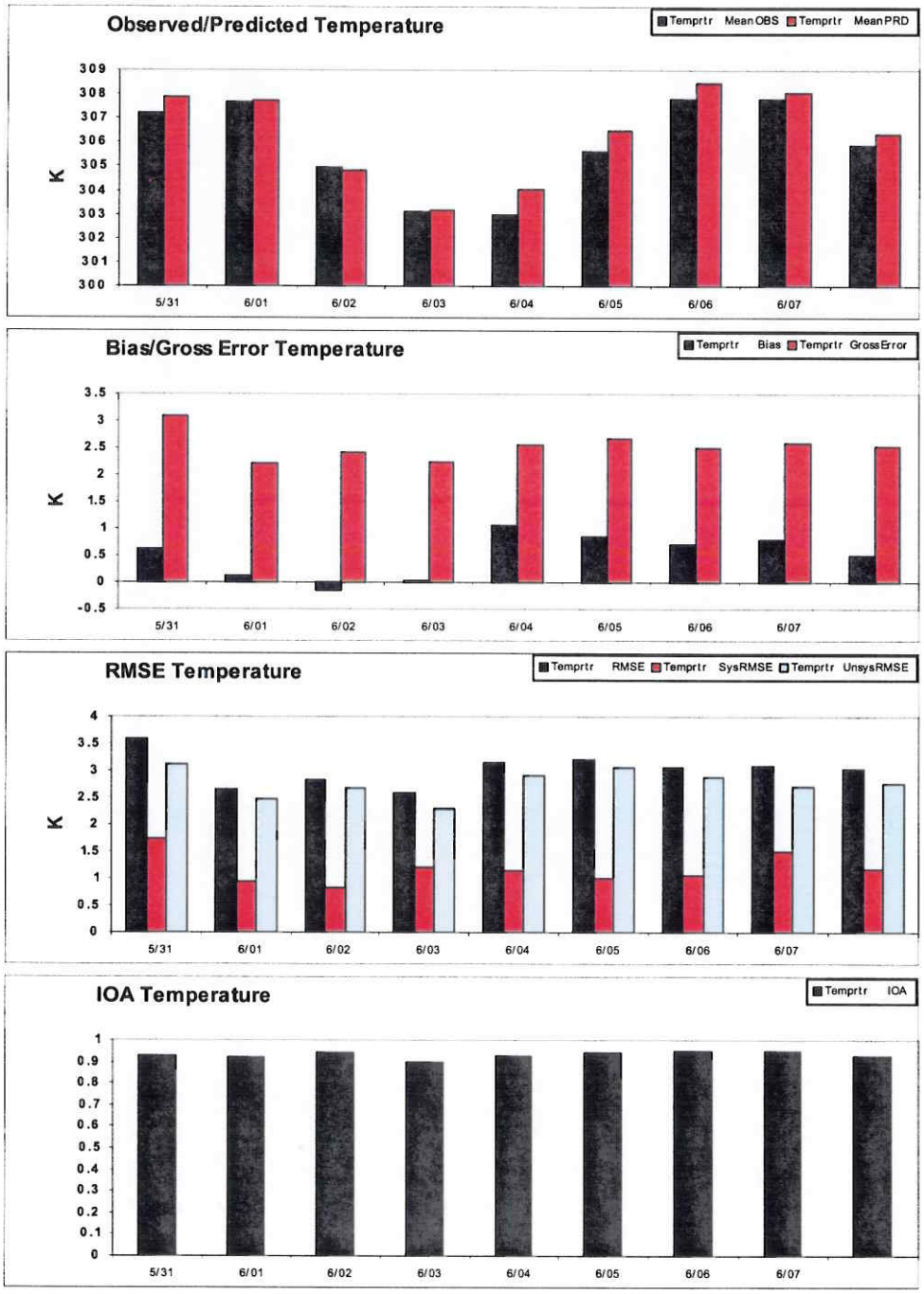


Figure 3-2 (continued). Daily statistics comparing DS472 temperature observations to paired MM5 temperature predictions from Run 1, in the 4-km MNA domain over the June 2002 episode.

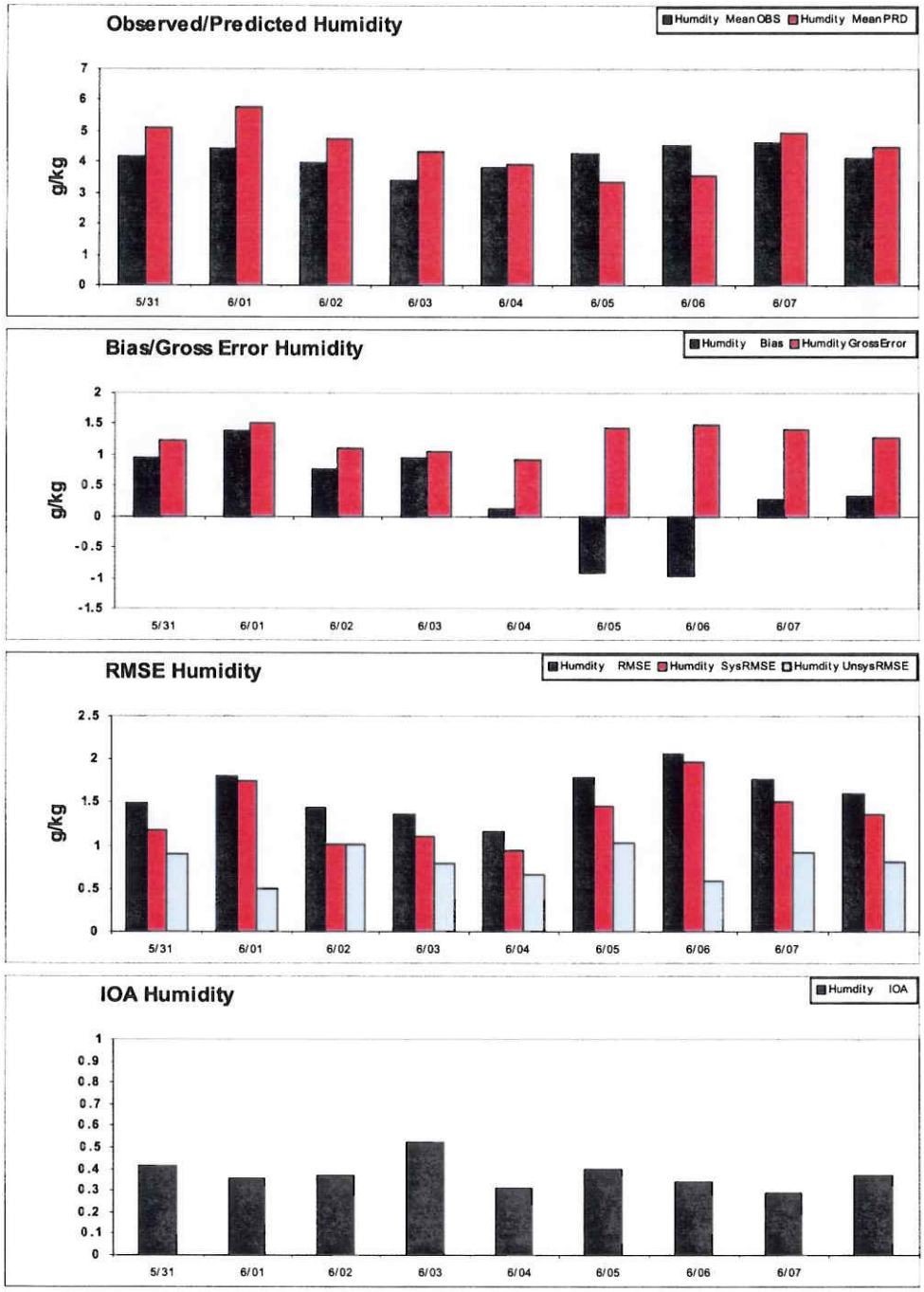


Figure 3-2 (concluded). Daily statistics comparing DS472 humidity observations to paired MM5 humidity predictions from Run 1, in the 4-km MNA domain over the June 2002 episode.

Table 3-1. Average daily MM5 performance statistics for Runs 1 and 2 over the June 2002 episode; values exceeding benchmarks are highlighted in red.

		DS472		AZMET	
Metric	**Benchmark**	**Run1**	**Run2**	**Run1**	**Run2**
Wind Speed Bias (m/s)	≤ ±0.5	-0.57	-0.91	1.31	0.77
Wind Speed RMSE (m/s)	≤ 2.0	1.64	1.66	1.80	1.35
Wind Speed IOA	≥ 0.6	0.64	0.68	0.56	0.68
Wind Dir Bias (deg)	≤ ±10	14.94	10.67	7.80	8.58
Wind Dir Gross Error (deg)	≤ 30	43.98	36.56	51.46	43.45
Temp Bias (K)	≤ ±0.5	0.5	0.45	1.73	1.69
Temp Gross Error (K)	≤ 2.0	2.54	2.75	2.43	2.51
Temp IOA	≥ 0.8	0.93	0.93	0.95	0.95
Humidity Bias (g/kg)	≤ ±1.0	0.32	0.13	-0.17	-0.33
Humidity Gross Error (g/kg)	< 2.0	1.27	1.17	1.31	1.26
Humidity IOA	≥ 0.6	0.37	0.39	0.56	0.56

statistics against the AZMET dataset exhibit marked improvement. For example, the wind speed IOA increased from 0.56 in Run 1 to 0.68 in Run 2 to exceed the benchmark. This was expected since Run 2 was explicitly nudged toward the AZMET wind field. Also note the differences in wind, temperature, and humidity performance between the DS472 and AZMET statistics. Wind speed bias is higher (AZMET is slower) due to the lower probe heights; temperature bias is higher (AZMET is cooler) and humidity bias is lower (AZMET is wetter) due to siting criteria relative to the DS472 results. These results are consistent with the analysis described in Section 2.4.3.

This episode was characterized by warm dry conditions typical of early June climatology for the Maricopa region, which precedes the more humid mid- to late-summer monsoon flow regime. The performance for MM5 during this period is considered quite good relative to the benchmarks shown in Table 3-1. Those measures that are outside the benchmarks are actually quite close, depending upon the dataset used to develop the statistics. Therefore, Run 2 for this episode was deemed to be adequate for use in the photochemical models.

3.2 JULY 2002 AND AUGUST 2001 EPISODES

3.2.1 Initial Runs

Table 3-2 displays the episode-average daily statistics over the 4-km grids for all three episodes using the DS472 dataset. Performance benchmarks for acceptable performance are also provided to put these results in context.

The July 2002 and August 2001 results are showing particularly poor performance for wind speed/direction error and temperature. These may be related to each other. The hourly statistical performance for July 2002 shows that after July 9, when convective activity begins, the simulated episode is consistently too cool, or cools too rapidly, in the afternoon (Figure 3-3). There are

Table 3-2. Average daily MM5 performance statistics for Run 1 over three MAG 8-hour ozone episodes; values exceeding benchmarks are highlighted in red.

Metric	Benchmark	June 2002	July 2002	August 2001
Wind Speed Bias (m/s)	≤ ±0.5	-0.57	-0.57	-0.45
Wind Speed RMSE (m/s)	≤ 2.0	1.64	2.26	2.75
Wind Speed IOA	≥ 0.6	0.64	0.53	0.42
Wind Dir Bias (deg)	≤ ±10	15	5	10
Wind Dir Gross Error (deg)	≤ 30	44	56	70
Temp Bias (K)	≤ ±0.5	0.50	-0.61	-1.24
Temp Gross Error (K)	≤ 2.0	2.54	3.2	3.67
Temp IOA	≥ 0.8	0.93	0.85	0.74
Humidity Bias (g/kg)	≤ ±1.0	0.32	0.36	-0.06
Humidity Gross Error (g/kg)	< 2.0	1.27	1.88	2.5
Humidity IOA	≥ 0.6	0.37	0.45	0.46

large corresponding increases in humidity during these times (Figure 3-4). The wind speeds show uncorrelated short-lived afternoon spikes up to 10 m/s, and large directional errors occur during similar times (Figure 3-5). Review of weather maps and blended radar/rain gauge precipitation imagery indicate that both of these two episodes were influenced by daily convective activity throughout the Sonoran Desert and surrounding mountains associated with the Mexican monsoon (no such activity was present during June 2002). Figure 3-6 presents the observed and MM5 simulated precipitation for the July 2002 episode. Plots on the left of Figure 3-6 are CPC-observed precipitation, while plots on the right are MM5-simulated rainfall from Run 1 on the 12-km domain. Though MM5 replicated convective activity throughout the area, it is clearly overstated, leading to the cooler temperatures, higher humidity, and rapid wind changes associated with rain-induced downdrafts.

These events are highly stochastic in nature, and MM5 cannot be expected to replicate their number, location, intensity, and timing. The only control we have over convection is to attempt to reduce its intensity (i.e., systematic error) through the use of alternative model configurations such as soil characteristics (wetness), boundary layer schemes, or convective algorithms. If convective activity cannot be adequately simulated, it will have undesirable influences on the ozone modeling. Most nonattainment areas drop episodes with wide-spread convection due to this very problem. Nevertheless, we continued to attempt to improve MM5 performance for these episodes through a series of sensitivity tests, as described in Section 2.

3.2.2 Sensitivity Tests

As described in detail in Section 2 (Table 2-3), a series of sensitivity tests were run to address the convective activity issue for the July 2002 episode in terms of the storm intensity, location and coverage. Table 3-3 gives a summary of the episode-average daily statistics on the 4-km grid from all sensitivity runs against the benchmark standard, using DS472 and AZMET as evaluation datasets separately.

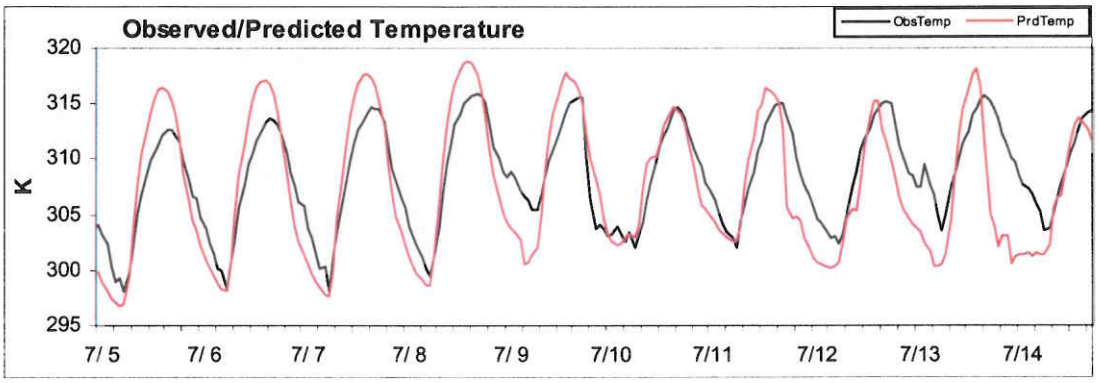


Figure 3-3. Hourly time series comparing mean DS472 temperature observations to paired MM5 temperature predictions from Run 1, in the 4-km MNA domain over the July 2002 episode.

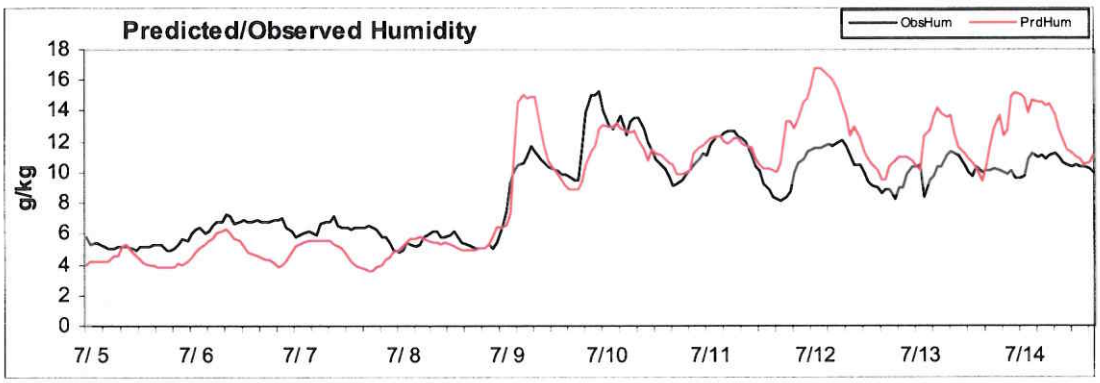


Figure 3-4. Hourly time series comparing mean DS472 humidity observations to paired MM5 humidity predictions from Run 1, in the 4-km MNA domain over the July 2002 episode.

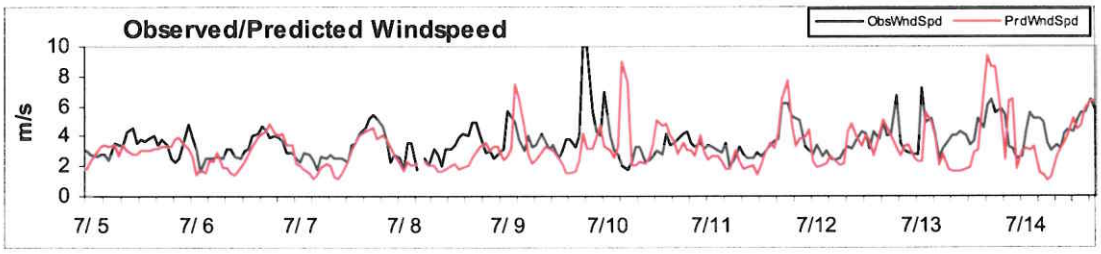


Figure 3-5. Hourly time series comparing mean DS472 wind observations to paired MM5 wind predictions from Run 1, in the 4-km MNA domain over the July 2002 episode.

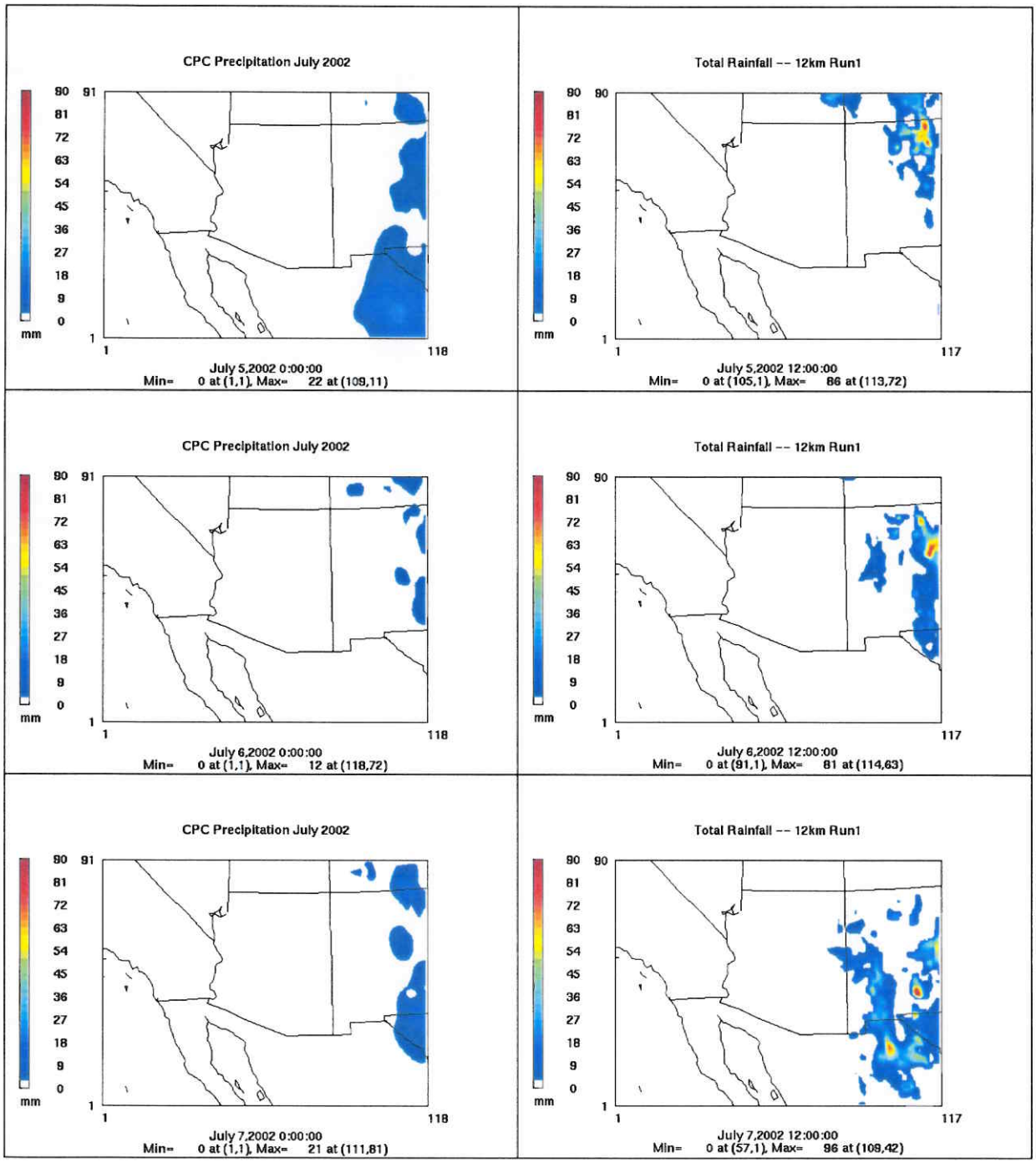


Figure 3-6. Comparison of daily MM5 12-km rainfall from Run 1 (right) against daily CPC observed precipitation (left) during the July 2002 episode. Times given in each plot are inconsequential.

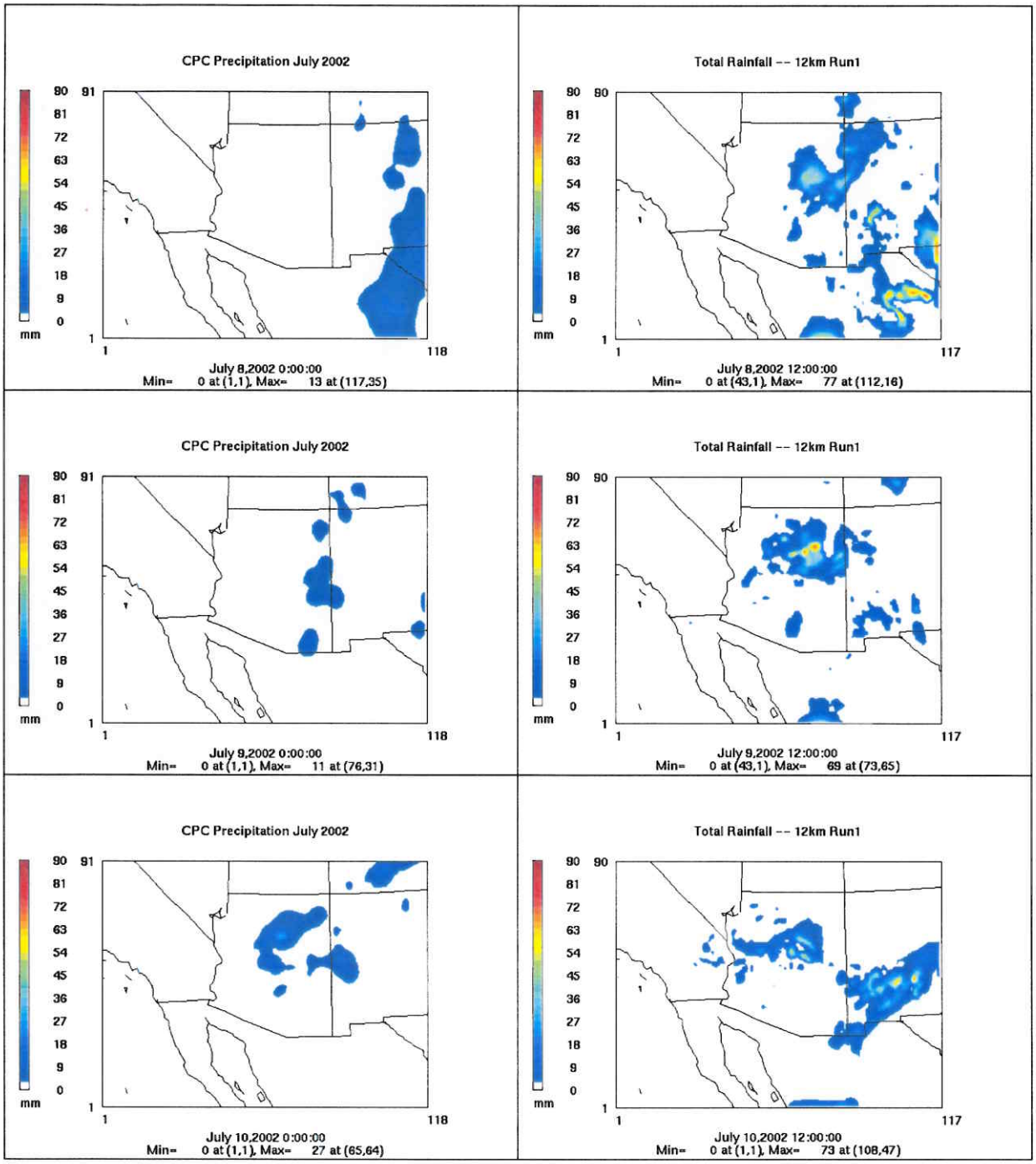


Figure 3-6 (continued). Comparison of MM5 12-km rainfall from Run 1 (right) against CPC observed precipitation (left) during the July 2002 episode. Times given in each plot are inconsequential.

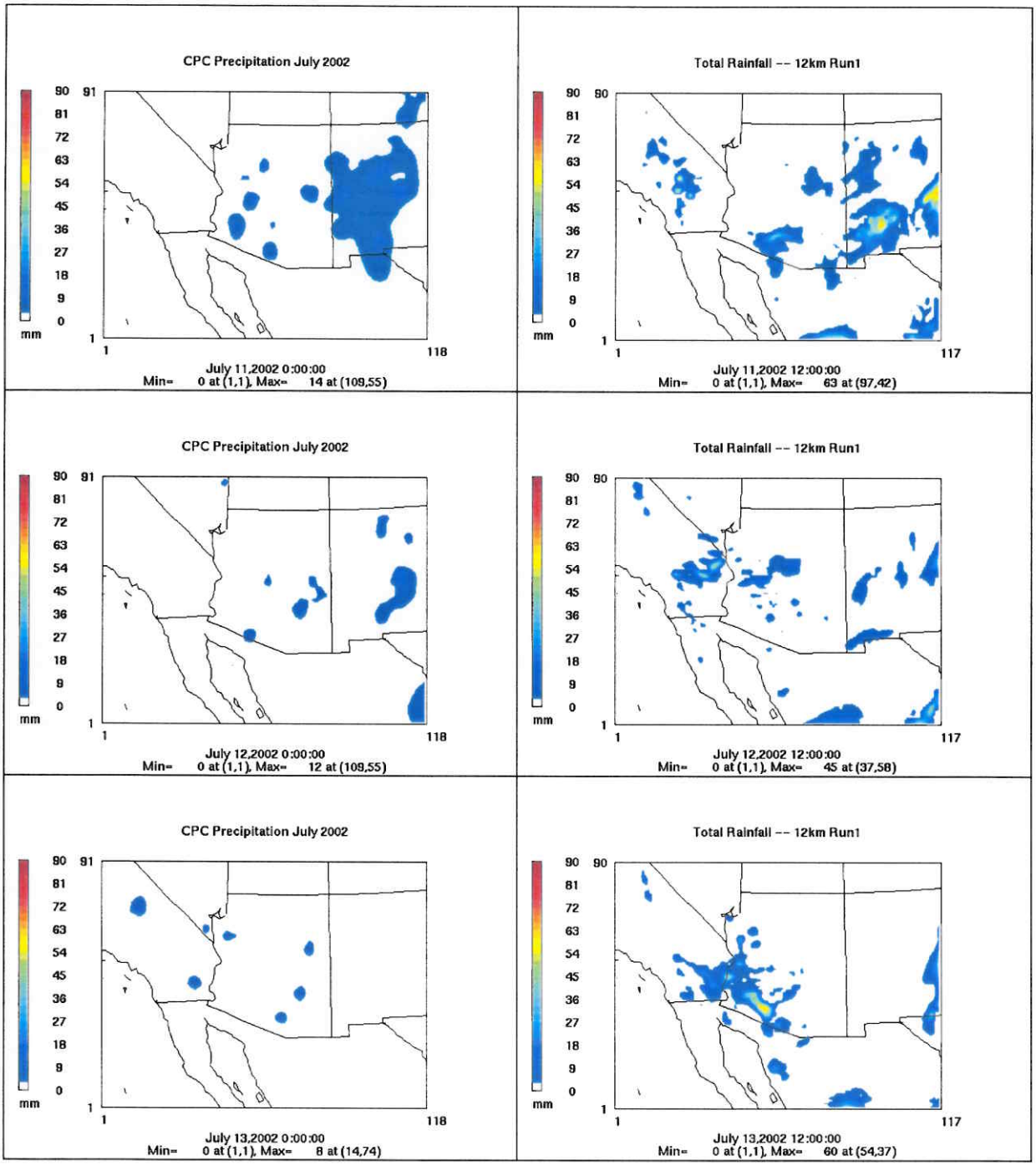


Figure 3-6 (concluded). Comparison of MM5 12-km rainfall from Run 1 (right) against CPC observed precipitation (left) during the July 2002 episode. Times given in each plot are inconsequential.

Table 3-3. Average daily MM5 performance statistics for all sensitivity runs over the July 2002 episode, using DS472 and AZMET data as evaluation datasets; values with great improvement are highlighted in green.

DS472	Benchmar	Run1	Run2	Run3	Run4	Run5	Run6	Run7	Run8	Run9
Wind Speed Bias	$\leq \pm 0.5$	-0.57	-0.49	-0.57	-0.56	-0.45	-0.63	-0.84	-1.03	-0.89
Wind Speed RMSE	≤ 2.0	2.26	2.34	2.17	2.42	2.48	2.38	2	2.59	2.08
Wind Speed IOA	≥ 0.6	0.53	0.57	0.59	0.56	0.55	0.55	0.6	0.48	0.55
Wind Dir Bias	$\leq \pm 10$	4.92	1.31	4.08	0.3	7.26	5.43	-0.51	-7.38	-0.95
Wind Dir Gross Err	≤ 30	56.01	45.79	41.53	49.76	51.73	50.71	46.24	55.32	49.72
Temp Bias	$\leq \pm 0.5$	-0.61	-0.98	-0.7	-1.15	-1.55	-1.12	-0.25	-1.09	-1.04
Temp Gross Error	≤ 2.0	3.2	3.52	3.53	3.75	3.82	3.4	3.21	3.24	2.78
Temp IOA	≥ 0.8	0.85	0.82	0.83	0.81	0.8	0.85	0.86	0.82	0.88
Humidity Bias	$\leq \pm 1.0$	0.36	0.65	0.57	0.79	0.56	1.31	0.47	2.05	1.13
Humidity Gross Error	< 2.0	1.88	1.95	1.97	2.16	2.5	2.45	1.96	2.83	2.23
Humidity IOA	≥ 0.6	0.45	0.43	0.46	0.44	0.41	0.42	0.47	0.46	0.43
AZMET										
Wind Speed Bias	$\leq \pm 0.5$	1.29	1.25	1.44	1.12	1.28	1.09	0.88	0.75	0.87
Wind Speed RMSE	≤ 2.0	2.37	2.35	2.5	2.2	2.36	2.21	1.81	2.08	1.79
Wind Speed IOA	≥ 0.6	0.45	0.51	0.45	0.54	0.5	0.5	0.59	0.5	0.54
Wind Dir Bias	$\leq \pm 10$	9.52	7.95	12.37	8.27	12.35	8.99	10.48	6.99	8.65
Wind Dir Gross Err	≤ 30	61.95	51.62	57.64	52.47	53.94	53.76	50.04	53.35	51.71
Temp Bias	$\leq \pm 0.5$	0.25	0	0.33	-0.08	-0.05	0.15	0.89	-0.16	0.26
Temp Gross Error	≤ 2.0	3.04	3.15	3.12	3.35	3.2	2.94	2.82	2.78	2.52
Temp IOA	≥ 0.8	0.88	0.86	0.87	0.85	0.85	0.89	0.9	0.88	0.91
Humidity Bias	$\leq \pm 1.0$	-0.23	0.11	-0.1	0.21	-0.23	0.56	-0.24	1.04	0.28
Humidity Gross Error	< 2.0	2.18	2.04	2.05	2.24	2.39	2.27	2.01	2.35	2.05
Humidity IOA	≥ 0.6	0.45	0.49	0.5	0.47	0.48	0.51	0.54	0.57	0.52

In Run 2, the MM5 simulation was nudged toward the surface observations from the AZMET dataset. The performance for wind speed, and especially direction, improved noticeably. For example, the Index of Agreement (IOA) for wind speed increased 7.5% relative to DS472 and 13% relative to AZMET. As mentioned before, the AZMET dataset exhibits low wind speeds; therefore, MM5 was nudged toward the DS472 surface wind observations in Run 3. Results show that only the wind performance metrics associated with DS472 are slightly improved. Since nudging to AZMET observations netted relatively larger statistical improvements, we elected to use the MAG dataset for observational FDDA in the subsequent sensitivity tests. However, keep in mind that we would expect to see a continual high wind speed bias in these tests when comparing model predictions to AZMET observations.

Since Run 2 and 3 were only nudging toward the observed surface winds, only the wind performance metrics showed improvement, and there was little improvement in temperature and humidity performance. In Run 6, we augmented the surface FDDA by introducing 2-D surface analysis nudging of temperature and humidity. The impact of strong nudging was not obvious, however. The overall model performance metrics improved slightly for wind, temperature, and humidity against the AZMET dataset.

To clearly illustrate the FDDA impacts on the MM5 simulations, the hourly statistics from Run 1, 2, 3, and 6 using DS472 dataset were overlaid and are compared in Figure 3-7 (similar plots for the AZMET dataset are very similar and are not shown). In this analysis, the observation

nudging of surface wind did not show a big advantage in improving model performance. Although wind performance was slightly better in Run 2 and 3, the temperature and humidity performance of Run1, which had no observation nudging at all, was the best among these four runs. These features also appear in the DS472 and AZMET statistics. One possible explanation for this situation is that the 2-D surface analysis nudging files (i.e., those processed by the LITTLE_R preprocessor, which ingested all surface and upper observations archived at NCAR) already include duplicative information that appears within the observation nudging file. Thus, Run 3 with observation nudging toward DS472 surface winds has similar performance as Run 1. The MAG network provides more detail and intense local coverage. But the dense network only covers Maricopa County, and does not impact the regional pattern significantly. Meanwhile, surface analysis nudging of temperature and humidity (Run 6) did not help improve model performance for those two parameters. Too much moisture was introduced into the system and a high wet bias resulted coincidently with the initiation of convective activity. It is even possible that the moisture signature might induce a "positive feedback"; that is, more simulated moisture resulting from the surface analysis nudging could generate more rainfall as it feeds more moisture into the system.

The FDDA tests proved to be relatively ineffective ways of improving model performance. As a result, we turned our attention to the physics options. In Figure 3-7, we noticed that all sensitivity runs are quite similar until July 9 when the convective activity moved into Arizona (Figure 3-6). The MM5 simulated storm moved into Arizona on July 8 instead of July 9, and rainfall was generally too intense. As pointed out earlier, the timing, location, pattern and intensity of convective activity pose a great challenge for models such as MM5. Recent studies show that MM5 tends to develop artificial "grid storms" on finer resolution (< 5 km) domains because of an inappropriate accumulation of latent heat from the surface, which in turn is due to the fact that cumulus schemes that can efficiently vent this energy are not routinely applied at such fine resolution.

In Run 4 we introduced the Betts-Miller cumulus scheme on the 4-km domain in addition to the larger grids. However, Run 4 did not dramatically change the results. Following the WRAP simulations, we then removed the cumulus schemes from both the 4- and 12-km domains in Run 5. Run 5 crashed a day before the end of the episode because of a lateral boundary problem; unlike WRAP, which employed a much more expansive 12-km domain, a numerical anomaly accumulated on the lateral boundary of the MAG 12-km domain, which was most likely due to the lack of energy dissipation with the cumulus parameterization removed.

In Run 7 we turned our attention to a modern and much more sophisticated cumulus parameterization – the Kain-Fritsch scheme. Results from Run 7 showed some promising changes for overall model performance, especially for temperature and humidity. In the metrics using the DS472 data (Table 3-3), both the wind speed RMSE and IOA, and the humidity gross error, all met the benchmarks for the first time. The same improvements were also shown in the metrics against the AZMET data, especially the humidity IOA, which increased from 0.45 in Run

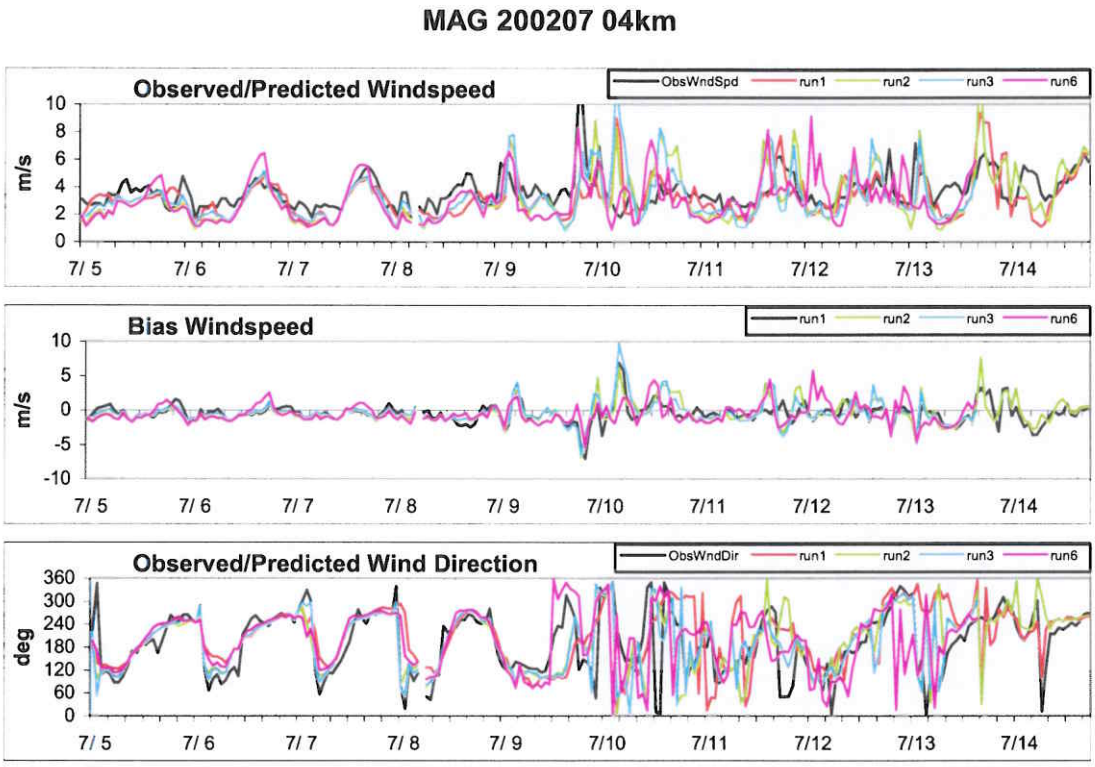


Figure 3-7. Hourly time series comparing mean DS472 wind observations (black) to paired MM5 wind predictions from Runs 1 (red), 2 (green), 3 (cyan) and 6 (magenta), in the 4-km MNA domain over the July 2002 episode.

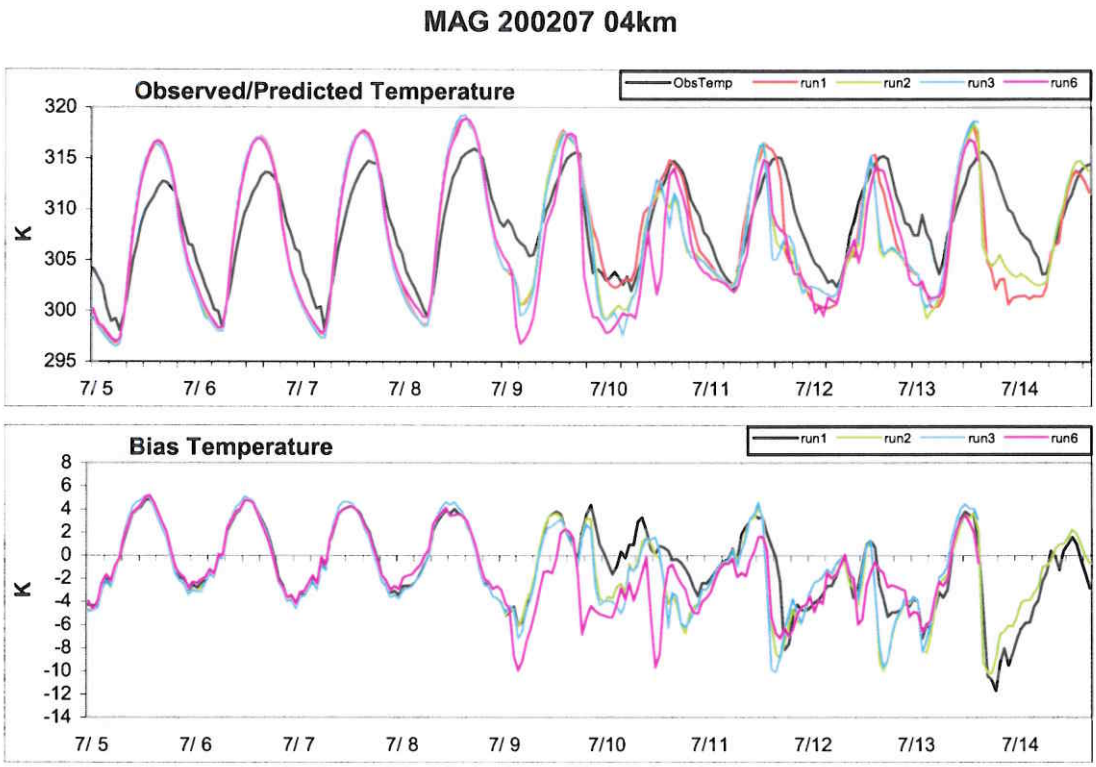


Figure 3-7 (continued). Hourly time series comparing mean DS472 temperature observations (black) to paired MM5 wind predictions from Runs 1 (red), 2 (green), 3 (cyan) and 6 (magenta), in the 4-km MNA domain over the July 2002 episode.

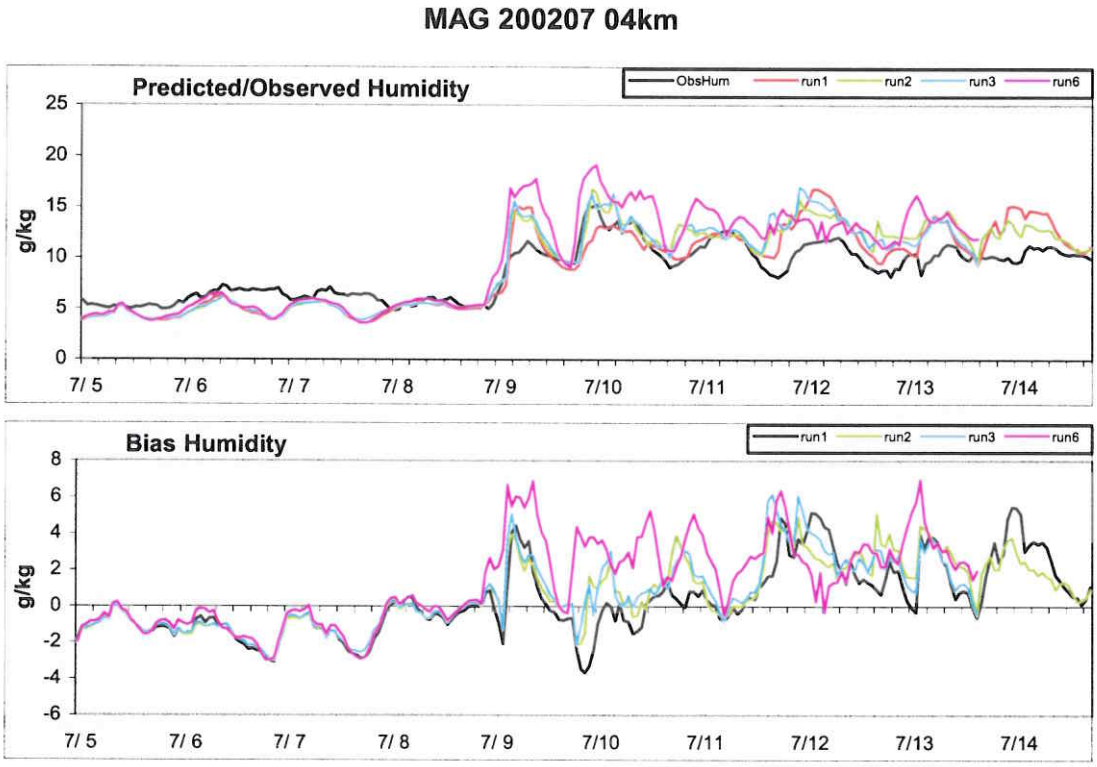


Figure 3-7 (concluded). Hourly time series comparing mean DS472 Humidity observations (black) to paired MM5 wind predictions from Runs 1 (red), 2 (green), 3 (cyan) and 6 (magenta), in the 4-km MNA domain over the July 2002 episode.

1 to 0.54 in Run 7, and the temperature gross error, which decreased to 2.82 from over 3. Figure 3-8 summarizes the hourly statistics from Runs 2, 4, 5, and 7 to show the progress in model performance due to physics adjustments. This figure clearly shows the improvements associated with Run 7.

During the course of these sensitivity runs, we began to suspect that the soil moisture initialization from EDAS, as provided to the P-X LSM, might be too wet. In Run 9, we chose to use the default and static MM5 soil moisture values, which are provided within an internal landuse lookup table. Run 9 showed great improvement for temperature performance, but wind performance was slightly worse than that of Run 7. Figure 3-9 provides a comparison of hourly AZMET statistics for wind, temperature and humidity from Runs 7 and 9. The figure clearly shows the temperature performance improvement: the overestimate of daytime temperature was systematically lowered for the whole episode.

Finally, we applied the configurations from both Runs 7 and 9 to the August 2001 episode. Table 3-4 provides a summary of the episode-average daily statistics on the 4-km grid from Runs 1, 2, 7 and 9 against the benchmark standard, using DS472 and AZMET as evaluation datasets. Table 3-4 shows that the configurations of Runs 7 and 9 also help to greatly improve the model performance for the August 2001 episode. Metrics against AZMET data display greater improvement. Figure 3-10 shows a comparison of the hourly statistics from Runs 2, 7 and 9 against AZMET data. A clear improvement is seen from Run 2 to 9.

3.3 SUMMARY

The MM5 model with four-dimensional data assimilation (FDDA) has been applied to the region surrounding the Maricopa County on three nested-grid domains having grid resolutions of 36-, 12-, and 4-km. All grids were configured with 34 layers in the vertical direction, having greater resolution near the surface and in the boundary layers, with deeper layers aloft. The configurations of physics and FDDA options from the WRAP study were first adopted for all three episodes. Data were assimilated into model runs using analysis nudging on all grids and observation nudging on the 12-km and 4-km domains. Observations from DS472 and MAG (including AZMET, NWS and FSL) datasets were used for observation nudging and model evaluation. Due to the lack of convective activity in the June 2002 episode, MM5 performed quite well in the Maricopa area without the need for additional work. MM5 output fields from Run 2 were provided to MAG.

A series of sensitivity tests over the July 2002 episode was designed to address the overestimate of convective activity and related model performance problems. Results from these runs showed that various FDDA configurations had limited impacts on improving the model performance. By changing the cumulus scheme to a more updated and sophisticated algorithm, and making other adjustments to soil moisture, the wind, temperature and humidity fields over the July 2002 episode finally closed to near the benchmarks suitable for air quality modeling. Similar configurations were applied for the August 2001 episode as well. MM5 output fields from Runs 7 and 9 for both July 2002 and August 2001 episodes were provided to MAG.

Table 3-4. Average daily MM5 performance statistics for all runs over the August 2001 episode, using DS472 and AZMET data as evaluation datasets; values with great improvement are highlighted in green.

DS472	Benchmar	Run1	Run2	Run7	Run9
Wind Speed Bias	$\leq \pm 0.5$	-0.45	-0.31	-0.93	-1.02
Wind Speed RMSE	≤ 2.0	2.75	2.83	2.5	2.38
Wind Speed IOA	≥ 0.6	0.42	0.46	0.45	0.47
Wind Dir Bias	$\leq \pm 10$	10.37	9.17	10.97	13.83
Wind Dir Gross Err	≤ 30	70.48	72.84	64.14	63.54
Temp Bias	$\leq \pm 0.5$	-1.24	-1.47	-0.7	-0.73
Temp Gross Error	≤ 2.0	3.67	3.91	3.47	3.18
Temp IOA	≥ 0.8	0.74	0.69	0.77	0.8
Humidity Bias	$\leq \pm 1.0$	-0.06	-0.06	-0.41	-0.18
Humidity Gross Error	< 2.0	2.5	2.5	2.65	2.48
Humidity IOA	≥ 0.6	0.46	0.45	0.46	0.5
AZMET					
Wind Speed Bias	$\leq \pm 0.5$	1.11	1.23	0.75	0.71
Wind Speed RMSE	≤ 2.0	2.36	2.64	1.94	1.89
Wind Speed IOA	≥ 0.6	0.39	0.38	0.44	0.44
Wind Dir Bias	$\leq \pm 10$	10.87	9.74	16.47	14.78
Wind Dir Gross Err	≤ 30	72.7	73.76	68.5	68.48
Temp Bias	$\leq \pm 0.5$	0.09	0.2	0.62	0.66
Temp Gross Error	≤ 2.0	3.15	3.31	2.87	2.54
Temp IOA	≥ 0.8	0.79	0.75	0.83	0.86
Humidity Bias	$\leq \pm 1.0$	-0.62	-0.68	-0.86	-0.81
Humidity Gross Error	< 2.0	2.23	2.2	2.16	2.04
Humidity IOA	≥ 0.6	0.48	0.46	0.54	0.58

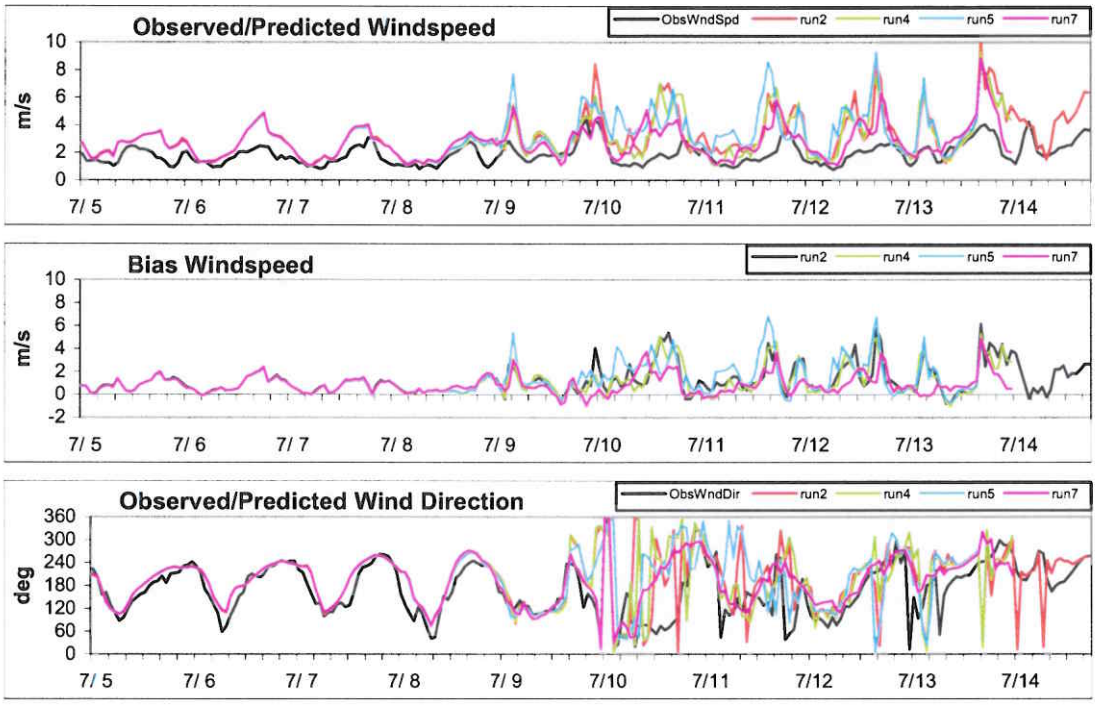


Figure 3-8. Hourly time series comparing mean AZMET wind observations (black) to paired MM5 wind predictions from Runs 2 (red), 4 (green), 5 (cyan) and 7 (magenta), in the 4-km MNA domain over the July 2002 episode.

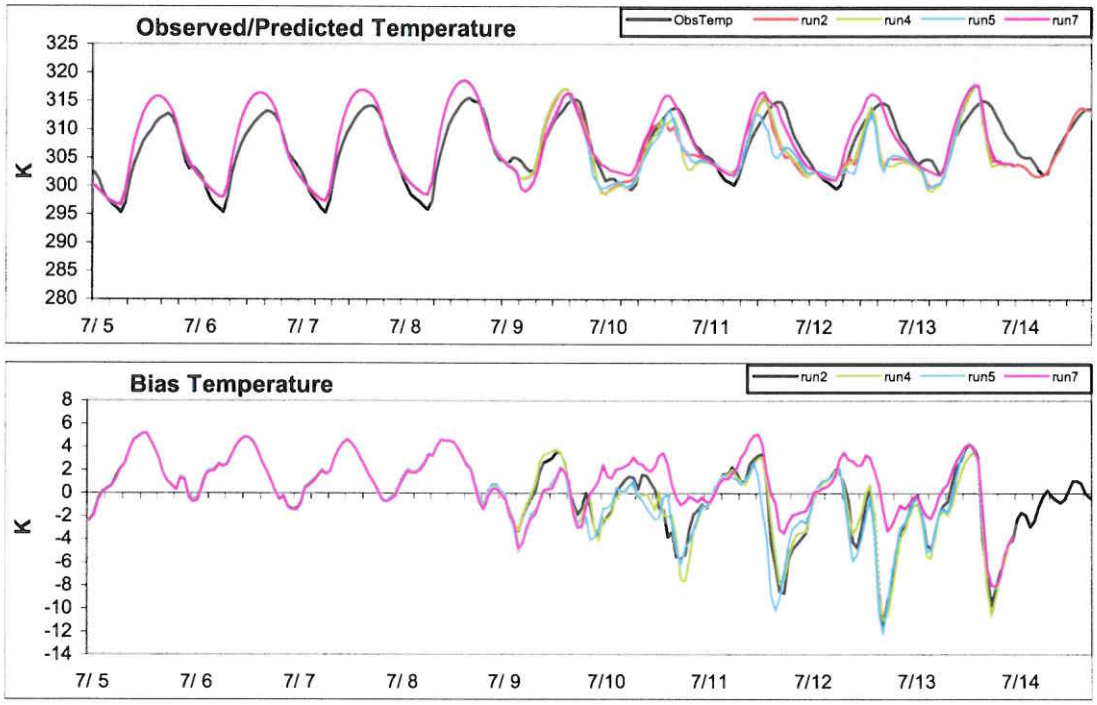


Figure 3-8 (continued). Hourly time series comparing mean AZMET temperature observations (black) to paired MM5 wind predictions from Runs 2 (red), 4 (green), 5 (cyan) and 7 (magenta), in the 4-km MNA domain over the July 2002 episode.

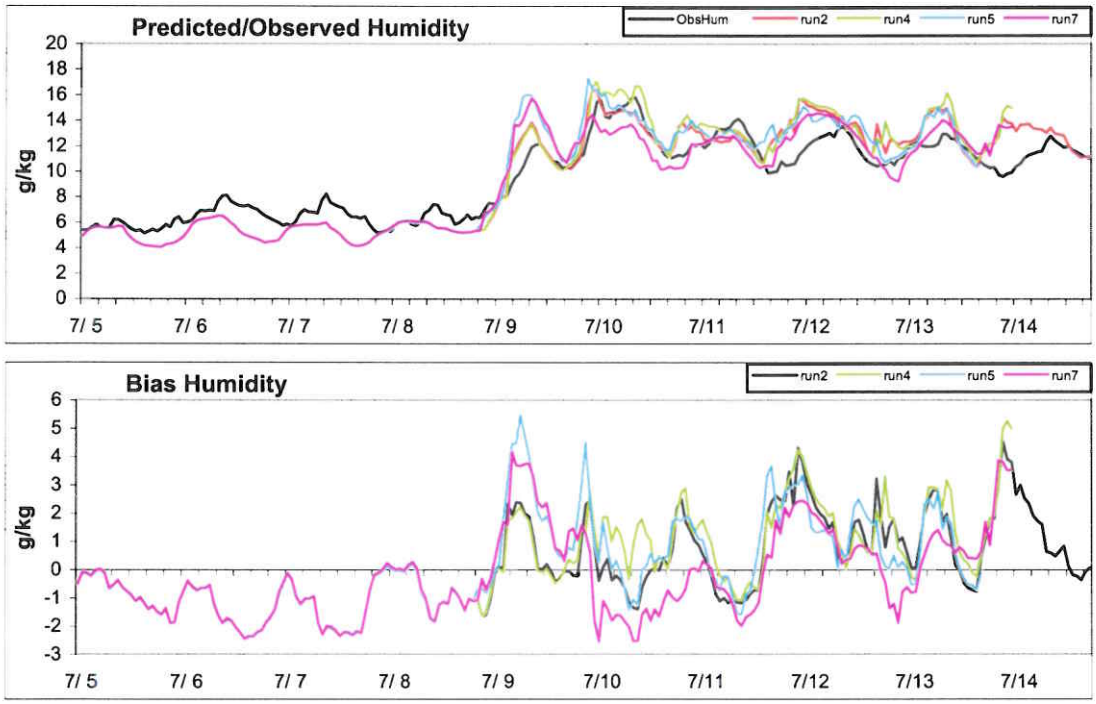


Figure 3-8 (concluded). . Hourly time series comparing mean AZMET humidity observations (black) to paired MM5 wind predictions from Runs 2 (red), 4 (green), 5 (cyan) and 7 (magenta), in the 4-km MNA domain over the July 2002 episode.

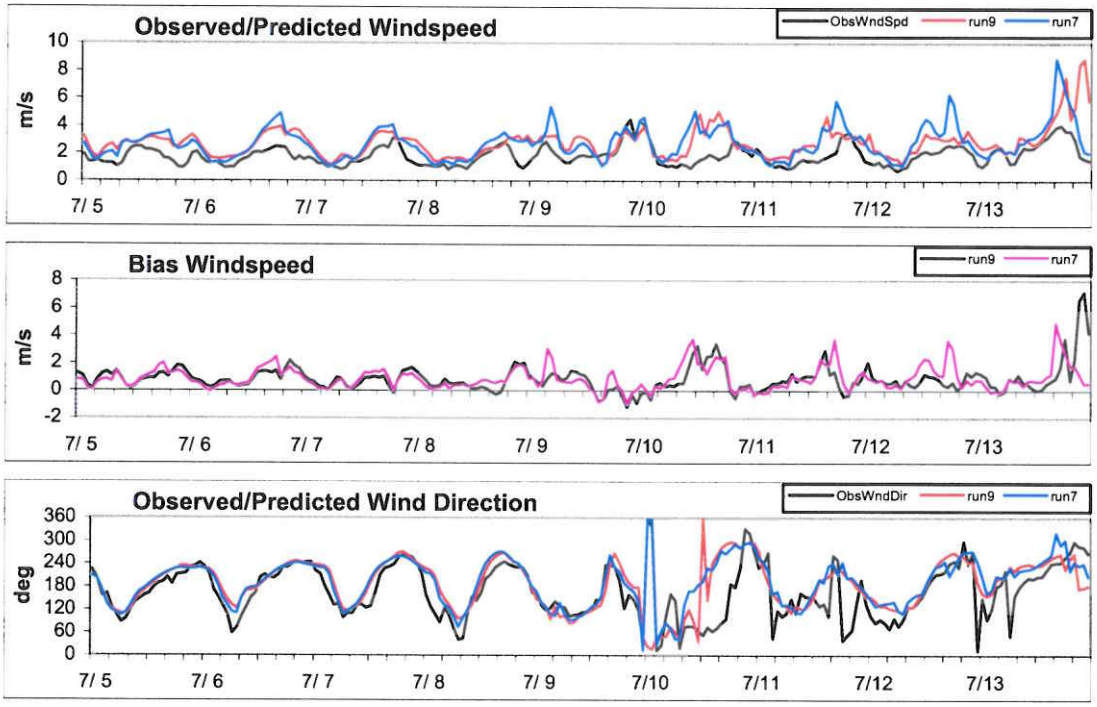


Figure 3-9. Hourly time series comparing mean AZMET wind observations (black) to paired MM5 wind predictions from Runs 9 (red) and 7 (blue), in the 4-km MNA domain over the July 2002 episode.

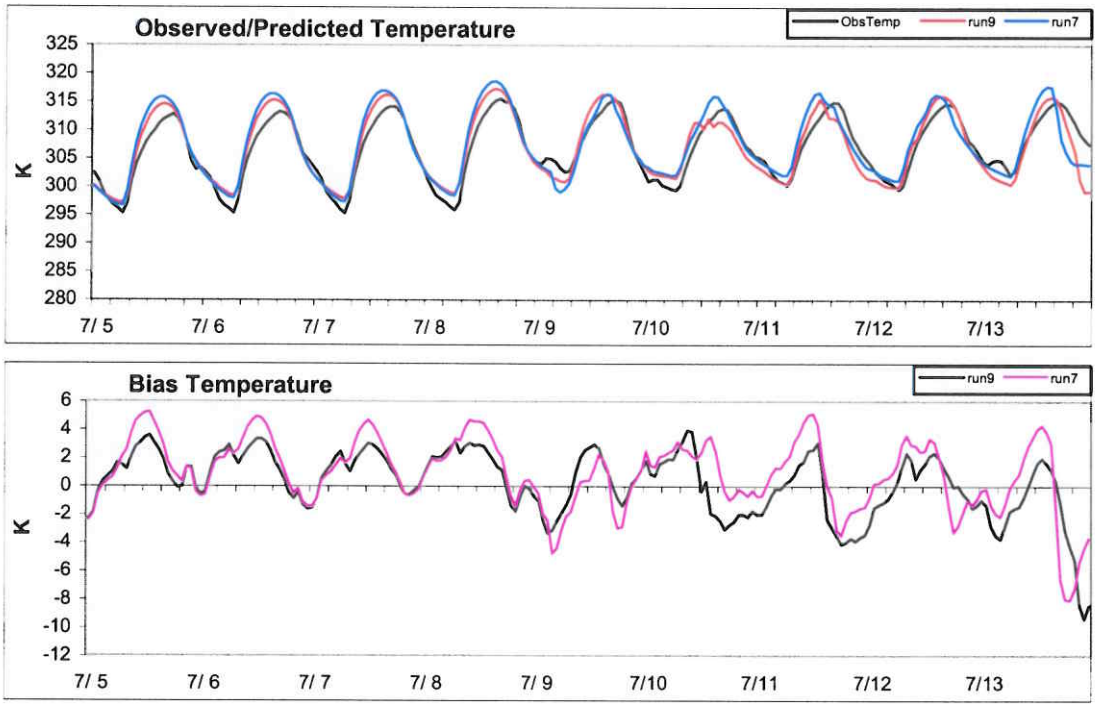


Figure 3-9 (continued). Hourly time series comparing mean AZMET temperature observations (black) to paired MM5 wind predictions from Runs 9 (red) and 7 (blue), in the 4-km MNA domain over the July 2002 episode.

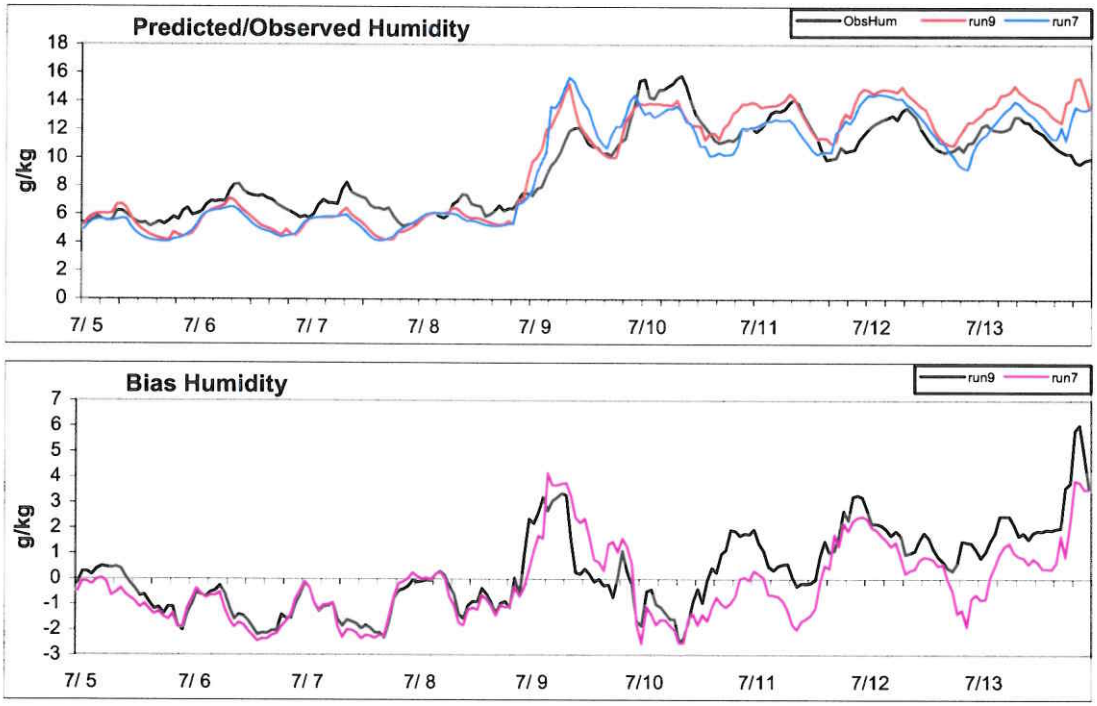


Figure 3-9 (concluded). Hourly time series comparing mean AZMET humidity observations (black) to paired MM5 wind predictions from Runs 9 (red) and 7 (blue), in the 4-km MNA domain over the July 2002 episode.

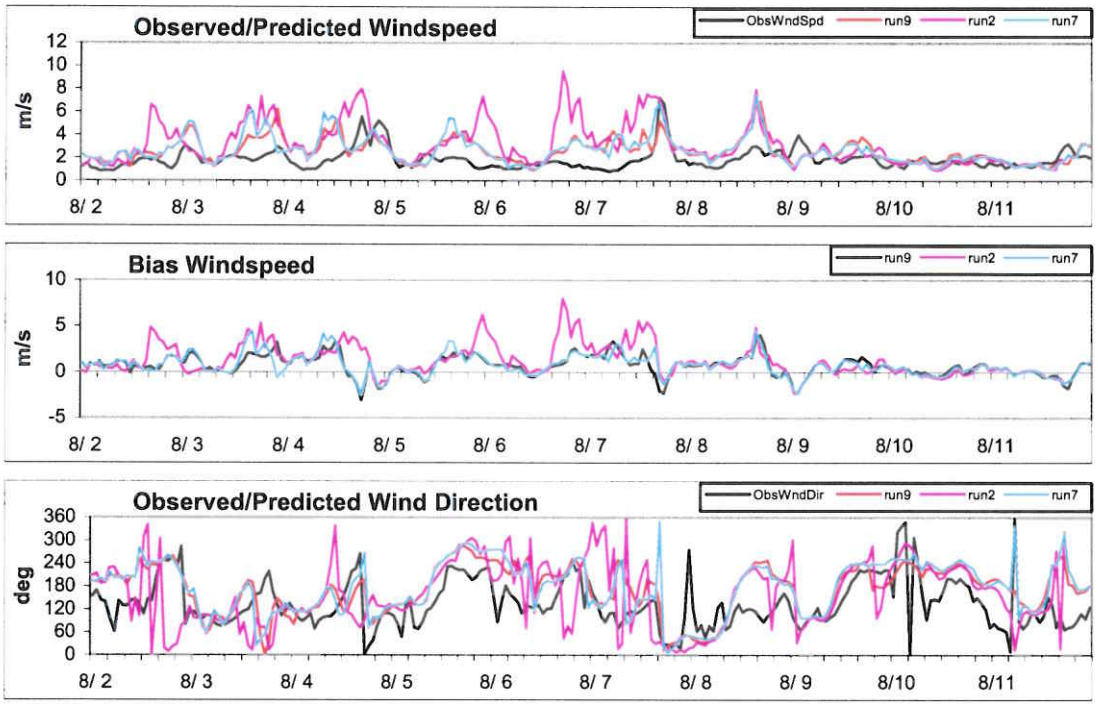


Figure 3-10. Hourly time series comparing mean AZMET wind observations (black) to paired MM5 wind predictions from Runs 9 (red), 2 (magenta) and 7 (cyan), in the 4-km MNA domain over the August 2001 episode.

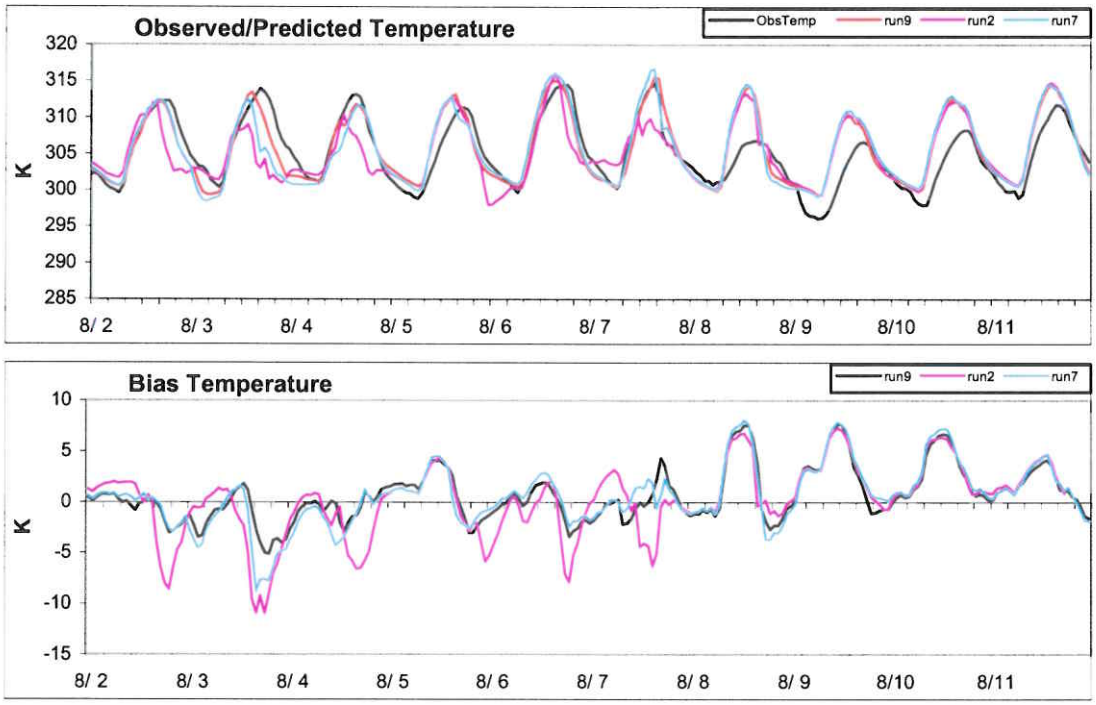


Figure 3-10 (continued). Hourly time series comparing mean AZMET temperature observations (black) to paired MM5 wind predictions from Runs 9 (red), 2 (magenta) and 7 (cyan), in the 4-km MNA domain over the August 2001 episode.

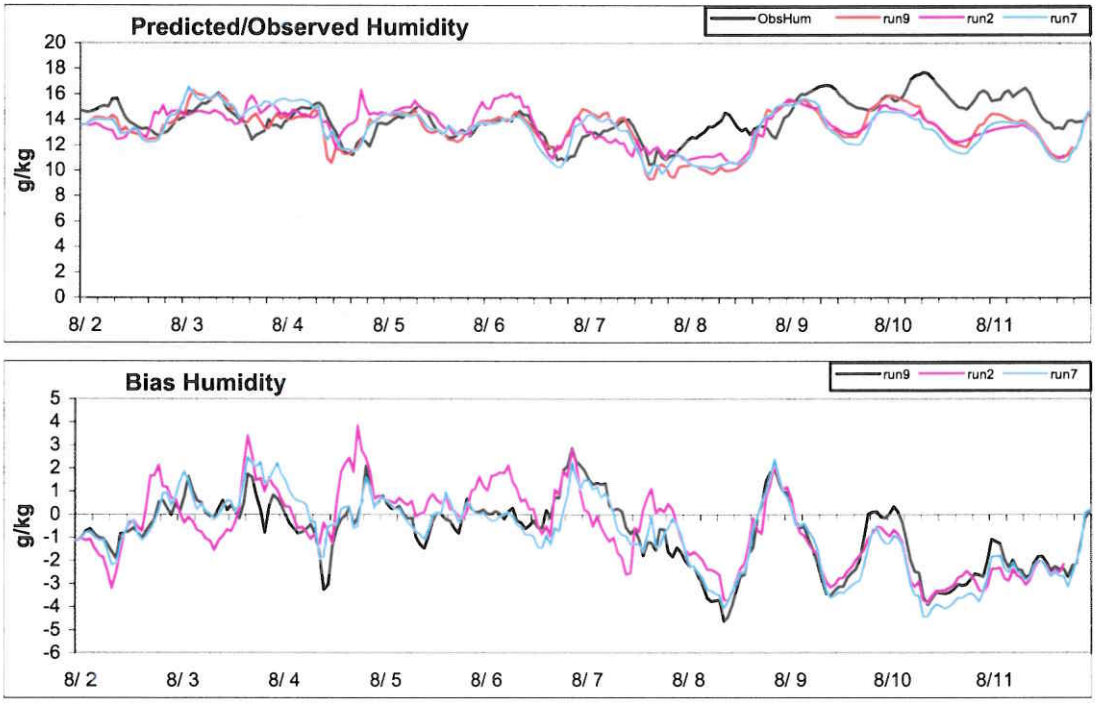


Figure 3-10 (concluded). Hourly time series comparing mean AZMET humidity observations (black) to paired MM5 wind predictions from Runs 9 (red), 2 (magenta) and 7 (cyan), in the 4-km MNA domain over the August 2001 episode.

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Appendix III-ii

Addendum to ENVRON's Report to MAG: MM5 Meteorological Simulation in Support of Eight-Hour Ozone Modeling for the Maricopa Nonattainment Area

This section presents additional MM5 sensitivity runs in an attempt to understand the causes of poor wind direction performance.

ENVIRON

MEMORANDUM

To: Cathy Arthur, MAG Air Quality Modeling Program Manager

From: Chris Emery, Yiqin Jia

Date: May 19, 2006

Subject: MAG Contract No. 245, Task Order #2:
Addendum to ENVIRON's Report to MAG: MM5 METEOROLOGICAL SIMULATIONS IN SUPPORT OF 8-HOUR OZONE MODELING FOR THE MARICOPA NONATTAINMENT AREA

This technical memorandum provides an addendum to the subject report. Since delivering the MM5 databases to MAG for three episodes in 2001 and 2002, CAMx simulations performed by MAG staff for the June 2002 episode have revealed wind direction problems on particularly June 5. This addendum presents the problem and briefly documents several additional MM5 sensitivity runs in an attempt to understand the causes of poor wind direction performance.

Wind Direction Problems During the June 2002 Episode

The subject report shows that overall MM5 statistical performance in the 4-km Maricopa Nonattainment Area (MNA) modeling grid was quite good for the entirety of the June 2002 episode. ENVIRON provided the MM5 output files from June 2002 "Run 2" to MAG for their CAMx photochemical modeling. CAMx was shown to suffer from some rather significant ozone under predictions for this episode. After conducting several sensitivity tests in which MAG staff altered emissions, reduced PBL depths, and disabled dry deposition, it was determined that the ozone under predictions on most days could be improved through various improvements in biogenic emissions, lower PBL depths (and possibly mixing rates), and use of drought stress that limits the rate of surface deposition. However, these tests consistently showed that the largest under prediction bias on June 5, 2002 was not sensitive to these changes. The problem was subsequently tracked back to the simulated wind performance on that day.

Observations show that surface winds in the 4-km MNA follow a very consistent diurnal pattern that is most likely influenced by the topography of the basin. Early morning winds are easterly, then rotate through south during midday, and end as southwesterly to westerly in the late afternoon (Figure 1). MM5 replicates this pattern well on most days, indicating that large (or "synoptic") scale forcings are weak, and that the surface air is vertically decoupled from flow aloft. Simulated winds on June 5 are very different, however. On this day, MM5 properly simulates a weak easterly wind over the MNA, but the winds turn to northerly, and eventually northwesterly by day's end. This is completely opposite from the observations. In CAMx, this results in sending the urban ozone plume to the south of Phoenix, instead of to the northwest of

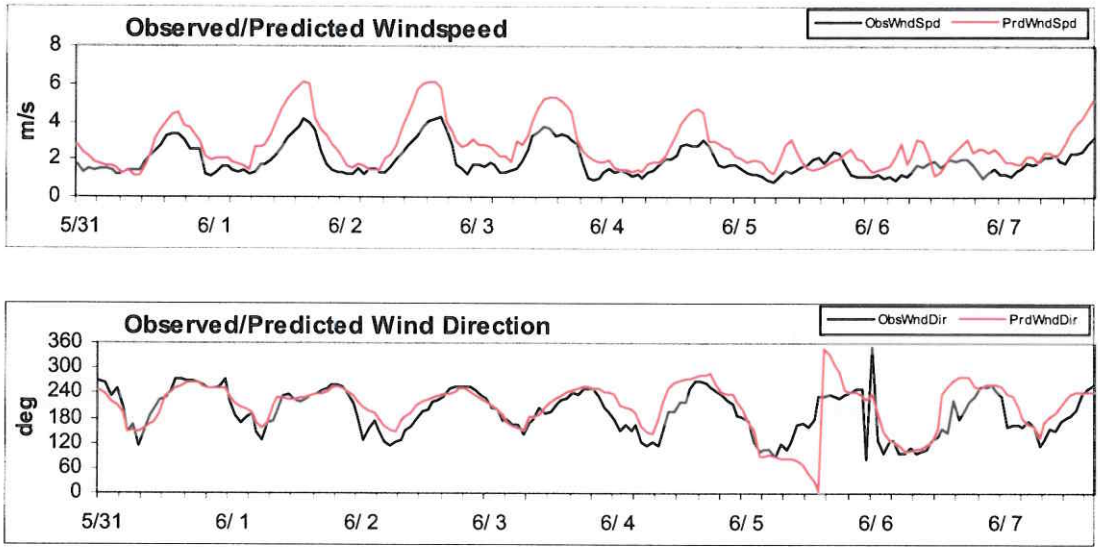

Figure 1. Hourly time series statistics comparing AZMET wind observations to paired MM5 wind predictions from Run 2, in the 4-km MNA domain over the June 2002 episode.

Phoenix where the high ozone was measured. In fact, peak simulated ozone concentrations in the misplaced urban plume agree rather well with peak measured ozone. If winds could be re-aligned to better agree with observations, the poor CAMx performance on this day would be largely mitigated.

After reviewing many graphical products developed by the MAG staff from the CAMx runs, we noticed that the synoptic-scale winds (i.e., those winds above the surface that are influenced by larger-scale weather systems) on June 5 are rather strong and northerly, due to the passage of an upper-level (850 mb, ~1500 m MSL) trough and associated weak front. From this we identified the following potential reasons for the incorrect northerly turning of the local surface winds in MM5:

1) The incredibly deep (and likely over-predicted) boundary layer depths (4000-5000 m) and associated rapid mixing rates simulated by the Pleim-Xiu (P-X) PBL scheme is likely mixing northerly momentum from aloft (1000 – 1500 m) to the surface at very efficient rates.

2) The slight surface temperature over-prediction caused by the land surface model that is coupled to the P-X PBL scheme is likely contributing to the over predicted boundary layer depths, thereby contributing to the northerly wind bias.

3) The three-dimensional observation analyses (EDAS) to which the MM5 is being nudged is incorrectly characterizing the speed and direction of the lower atmospheric flow behind the weak trough that passed through the region on June 5.

These issues were addressed by running some MM5 sensitivity tests.

Additional MM5 Simulations

The first MM5 test for June 2002 was called "Run 3", and we changed the model configuration in two ways:

1) P-X PBL scheme was changed to the Eta PBL scheme. The latter is a totally different approach than the bulk method of the former, in that it diagnoses turbulent kinentic energy (TKE) – the Eta approach is known to generate lower PBL depths and much weaker mixing rates;
2) NOAH/OSU land surface model was employed (P-X has its own land surface model, so using Eta requires selection of a different land surface model). NOAH/OSU is very similar to the P-X approach.

This configuration was to check the first hypothesis, that changing the PBL scheme might decouple the surface from conditions aloft, allowing MM5 to develop surface winds that respond to local basin forcings as seen on other days of the episode.

The resulting PBL depths were much lower (closer to 2500 m), and the mixing rates were smaller as well, confirming our expectations. However, the surface northerly wind patterns on June 5 persisted in the Phoenix area, and the performance statistics for wind direction were nearly identical to Run 2. Interestingly, the resulting surface wind fields were more "noisy" (they were rather smooth in Run 2); the cause of this was not obvious and not investigated further.

Furthermore, use of a different land surface model caused much worse over predictions in surface temperature; the over predictions of ~2 C generated by the P-X method increased to ~5 C with the Eta PBL + NOAH/OSU method. This rendered Run 3 as un-useable. We realized that if surface temperatures were cooler and closer to observations, the PBL would be even weaker and (probably) shallower.

The second MM5 test for June 2002 was called "Run 4", and we changed the model configuration in one more way relative to Run 3:

1) NOAH/OSU land surface model was changed to a simple 5-layer soil model using "canned" soil characteristics imbedded in the MM5 itself – the 5-layer method is known to result in surface temperature under predictions in the western U.S. due to it's high soil moisture setting.

This configuration was to test the second hypothesis, that a cooler surface would further reduce mixing depths and rates, and further decouple surface meteorology from conditions aloft.

The resulting surface temperatures were MUCH cooler than in Runs 2 and 3, and were actually too low to be considered an acceptable simulation. This had lowered the PBL height quite a bit, but the northerly wind shift on June 5 still existed. At this point, MM5 had generated the least

amount of vertical mixing that we could possibly achieve, yet northerly winds aloft were still influencing the surface winds. This indicated that the problem wasn't so much a mixing problem (although the original mixing depths in Run 2 are still considered too deep). Instead, it would appear that the large-scale analyses were the problem.

Hence, the third MM5 test for June 2002 was called "Run 5", and we changed the model configuration in one more way relative to Run 4:

1) MM5 was run for just a 48-hour period covering June 5, but without any 3-D analysis nudging to the EDAS fields, in order to let the model run its own course.

This configuration was to test the third hypothesis, that the input large-scale analyses to which the model is nudged may be in error and are causing a negative impact on model performance after the upper-level trough moved through the area.

Interestingly, this run actually resulted in some directional response. While still not agreeing well with observed direction trends on June 5, the model did not show a rotation through north, but kept the winds from the east quite a while until late in the day. This tends to verify that nudging to the analyses seems to be controlling the northerly wind signal.

Results from all three of these tests were placed on MAG's external hard drive for transfer. We do not recommend using any of these MM5 results for actual production runs of CAMx, although sensitivity tests with each may yield informative results in some other ways. MAG is amending the current contract to free up unused task budgets to carry on the work to improve MM5 performance for the June 2002 8-hour ozone episode.

Appendix III-iii

Development of Regional Grid Initial and Boundary Conditions for CAMx

This section presents information on the approach to develop initial and boundary conditions for CAMx modeling of three episodes in 2001 and 2002.

ENVIRON

MEMORANDUM

To: Cathy Arthur, MAG Air Quality Modeling Program Manager

From: Chris Emery, Bonyoug Koo

Date: May 19, 2006

Subject: MAG Contract No. 245, Task Order #4:
Development of regional grid initial and boundary conditions for CAMx

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This technical memorandum provides information on the approach to develop initial and boundary conditions for MAG's CAMx photochemical modeling of three episodes in 2001 and 2002.

Introduction

MAG has developed a modeling protocol that includes a review and conceptual model of 8-hour ozone episodes between 2000-2004 (MAG, 2006). From this review, MAG has identified three potential ozone modeling periods. ENVIRON has recommended adding at least three spin-up days to each episode as a way to reduce air quality model sensitivity to initial conditions (Emery et al., 2005). The three periods identified by MAG include a total of 19 days; adding 3 additional days to each episode increases the total number of modeling days to 28:

1. July 5-14, 2002
2. May 31 – June 7, 2002
3. August 2-11, 2001

MAG had previously specified the horizontal coverage, grid resolution (4 km), and projection (UTM) of the MNA modeling domain, and had anticipated that this domain would be nested within a larger regional grid. This approach follows from EPA modeling guidance (EPA, 2005a), which suggests the use of nested grids to accommodate the analysis of transport, both into the domain of interest to account for contributions from upwind source areas, and outward from the domain of interest to assess downwind impacts. MAG plans to continue to develop MNA modeling emission inventories for ozone on their current UTM projection grid, at least for the foreseeable future.

Based upon the episode review and conceptual model developed by MAG (2006), ENVIRON formulated recommendations for the size of the overlying regional grid. The conceptual model indicates that most episodes selected for analysis include periods associated with stagnation and therefore local ozone production would be dominant. Since the stagnation theme is consistent among all three episodes, and multi-day back trajectories do not extend far upwind (southern California and northern Mexico), we recommended a 12/4-km nested grid configuration that covers the immediate vicinity around Arizona. Figure 1 displays the final nested UTM grid

system to be used for CAMx.

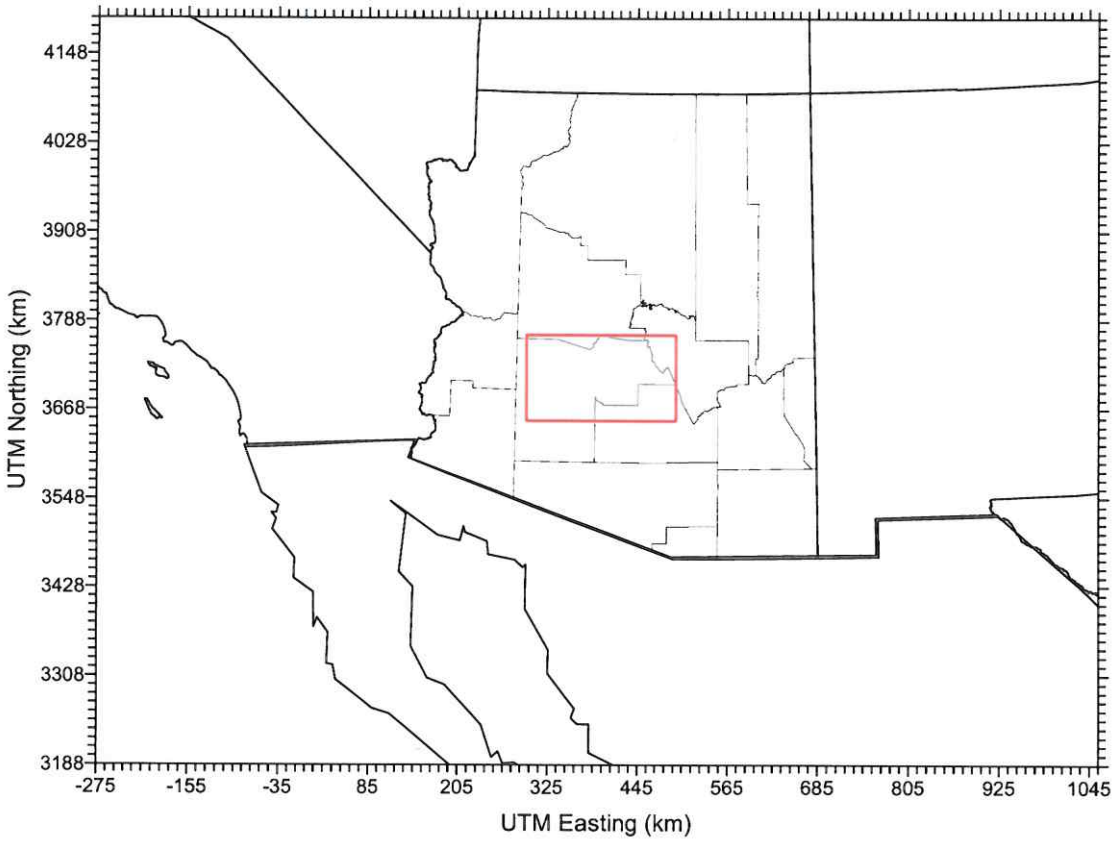

Figure 1. Regional coverage of the CAMx 12/4-km nested grids. The 4-km nest is indicated by the red inset.

ENVIRON has previously assisted MAG in developing CAMx-ready inputs for the three episodes listed above and the regional nested modeling domain shown in Figure 1, including nested grid meteorological fields using MM5 (Jia and Emery, 2006), and regional (12-km grid) emissions from the WRAP modeling of 2002 using EPS3 (Mansell and Hoats, 2005).

Other episode-specific model inputs that are important to carefully consider are the initial and boundary conditions for the air quality modeling. As mentioned earlier, the purpose of adding extra "spin-up" days to the episode is to reduce the influence of the initial conditions, thus letting the model develop its own initial pollutant fields well in advance of the first episode day. This is especially important for regional grids where air mass residency can extend to three or four days. In a similar way, using expansive regional grids can reduce model sensitivity to boundary conditions in the focus area since the contribution from regional sources that would otherwise

need to be characterized by boundary conditions are explicitly carried in the model. Nevertheless, we often see that model sensitivity to boundary conditions is much more discernable than initial conditions over the entire episode, even with the most expansive continental grids. It is important, therefore, to properly characterize boundary conditions to the extent that data are available.

Emery et al. (2005) recommend that MAG consider utilizing air quality fields from other national/regional modeling projects to help develop initial and boundary conditions for their 2001/2002 8-hour ozone episodes. WRAP can provide hourly fields of all photochemical pollutants for 2002, while the EPA/CAIR modeling can provide similar fields for 2001. Specialized extraction/processing programs were used to generate CAMx episodic boundary condition inputs from CMAQ outputs.

Development of CAMx Initial/Boundary Conditions

CMAQ Applications

August 2-11, 2001 Episode

The EPA Models-3 CMAQ modeling system, version 4.5, was used to support the promulgation of the Clean Air Interstate Rule. Information on model configuration and performance is provided by EPA (2005b) and at http://www.epa.gov/interstateairquality/technical.html#final. This CMAQ simulation was originally performed for the entire year of 2001 on the North American 36-km unified-RPO modeling grid (148×112) with 14 vertical layers. For this application, CMAQ was rerun with the same input databases by initializing the model 15 days prior to August 2 (July 18) and running through August 11. It was necessary to rerun CMAQ in order to generate the massive 3-D output files needed to extract hourly concentration fields for the initial/boundary conditions.

May 31-June 7, 2002 and July 5-14, 2002 Episodes

CMAQ v4.5 is also being used by the WRAP RPO to address regional PM and visibility regulations throughout the western U.S. The latest CMAQ simulation for WRAP has just completed, and was performed for the entire year of 2002 on the same unified-RPO modeling grid (148×112), but with 19 vertical layers. Descriptions of this run and some reports are available at www.cert.ucr.edu/aqm/308. The University of California at Riverside (UCR), Center for Environmental Research and Technology, is established as the WRAP modeling center. UCR made available the CMAQ 3-D output fields for the summer of 2002 for this project.

CMAQ ICON/BCON Extraction

The CMAQ ICON/BCON processors (v4.5) were used to extract initial and boundary condition files for the MAG 12-km grid. The ICON files were extracted at 07:00 GMT to get initial conditions at local (MST) midnight for each of the three initial days of the MAG modeling episodes. The daily BCON files were extracted in GMT (midnight-to-midnight), then cut and stitched together to provide hourly 07:00-07:00 GMT (midnight to midnight MST) boundary condition files. The MAG modeling domain follows the WRAP vertical layer structure through its full 19 layers (although the MAG domain includes an additional 20th layer at the model top), thus no vertical layer interpolation was needed. The 20th CAMx layer was added by simply copying data from the 19th layer. The CAIR modeling domain was configured with 14 vertical layers. The BCON processor performed the necessary interpolation to the MAG layer structure using a linear scheme. The ICON processor, however, currently does not allow vertical layer interpolation. Therefore, we developed a vertical layer interpolation tool that performs linear interpolation similar to that of the BCON processor.

CMAQ-to-CAMx Conversion

The CMAQ ICON/BCON files described above were then converted to CAMx IC/BC/TC input files using the CMAQ2CAMx v2 interface utility, which converts CMAQ input file format (I/O-API) to CAMx format (UAM-IV). Additionally, this utility converts CMAQ species to the appropriate naming conventions used by CAMx. Finally, the CMAQ2CAMx processor also shifts the time-span of the ICON/BCON files from GMT to local time (MST).

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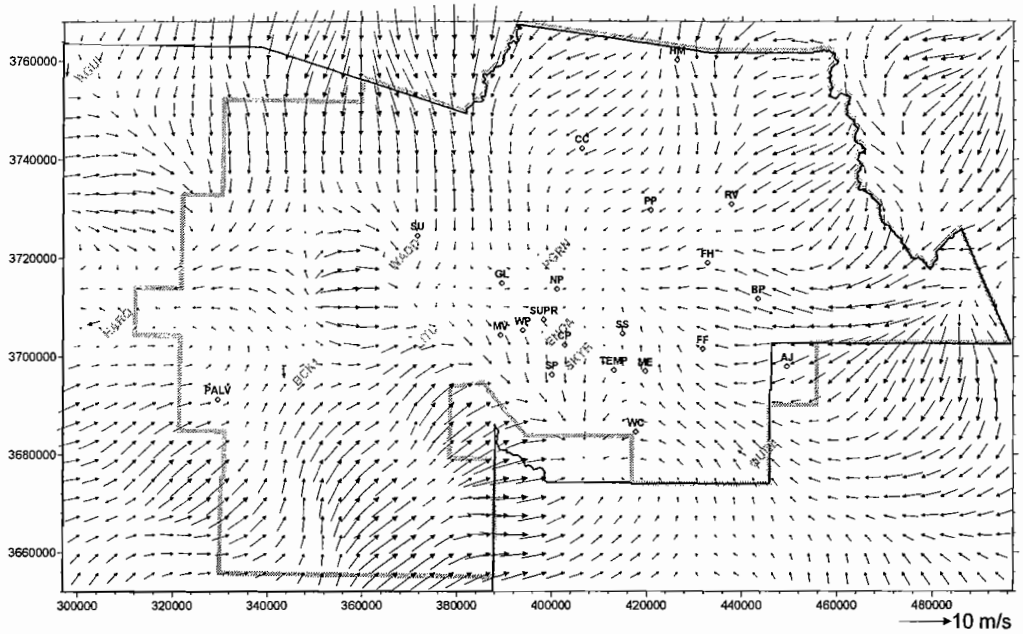
Appendix III-iv

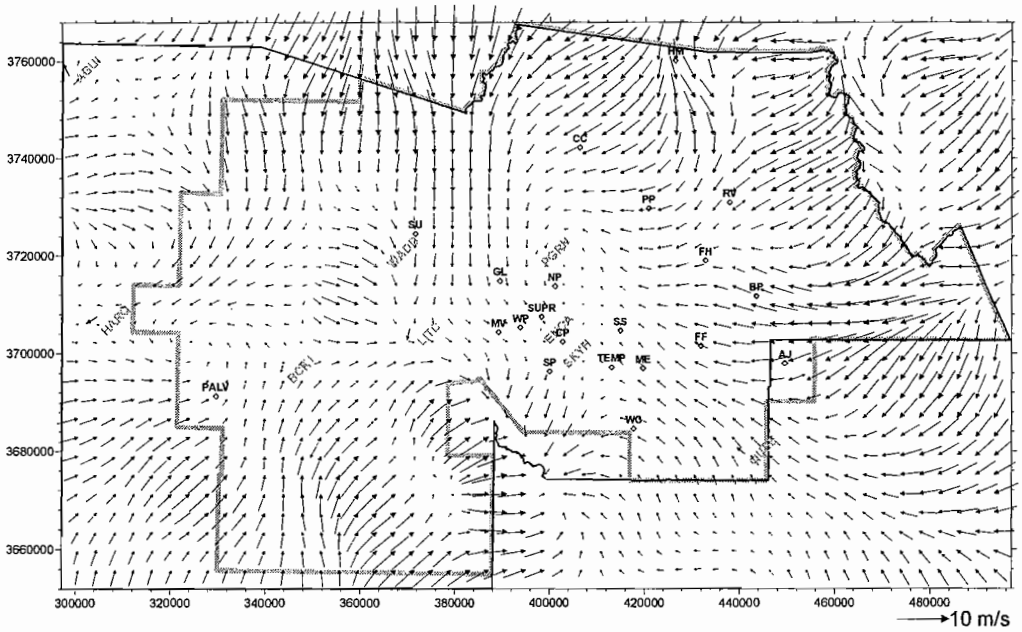
MODELED WIND FIELDS FOR THE JUNE 2002 EPISODE

The plots shown here are the simulated MM5 wind fields. These hourly wind fields are from 0:00 to 24:00 LST on June 6, 2002.

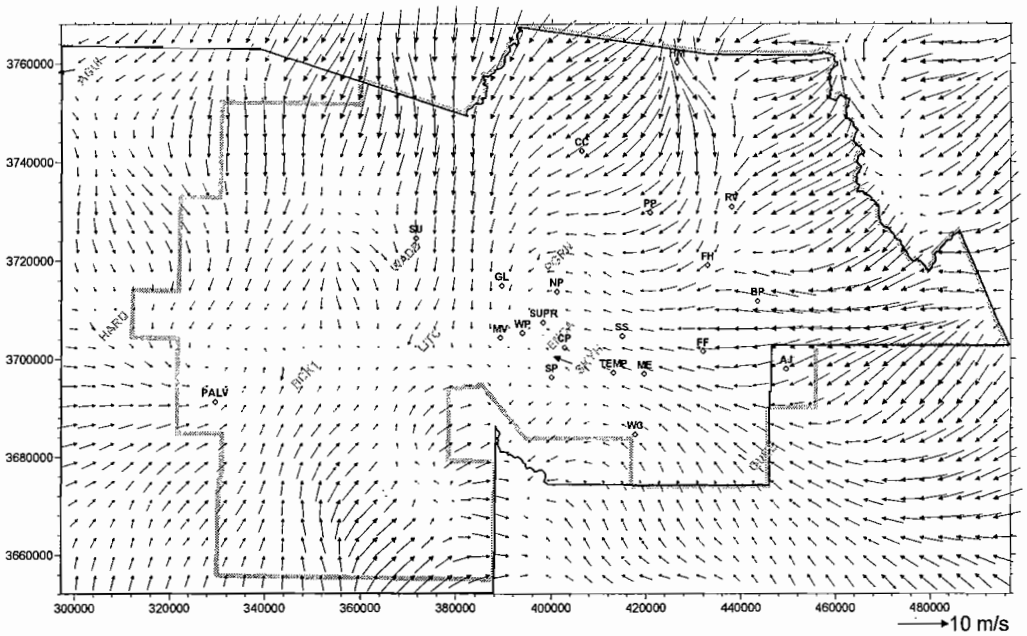
Surface MM5 Wind Field (m/s) on June 6, 2002 0:00-1:00 LST



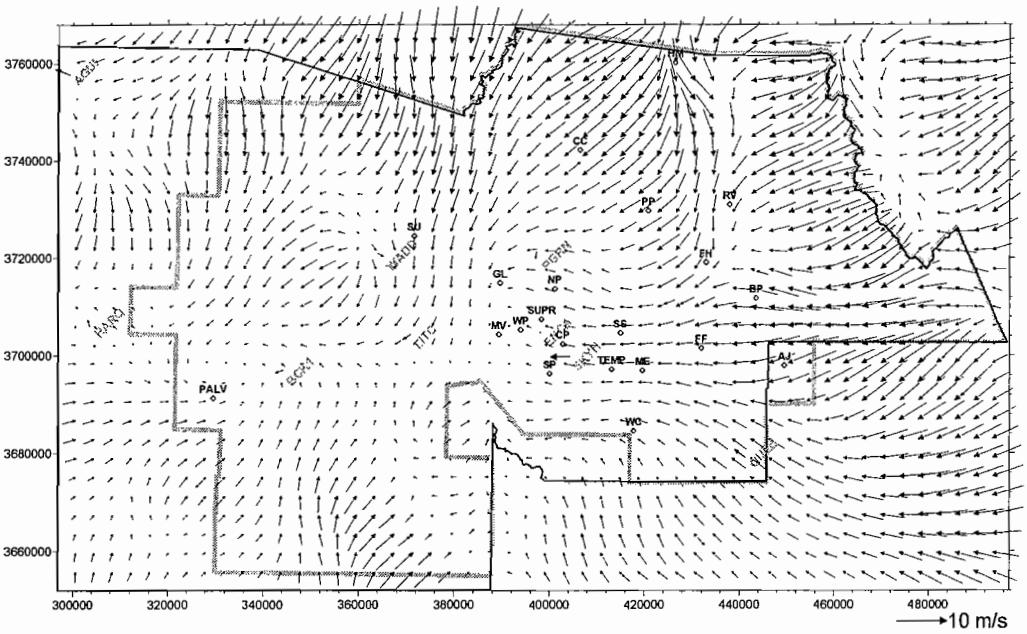
Surface MM5 Wind Field (m/s) on June 6, 2002 1:00-2:00 LST



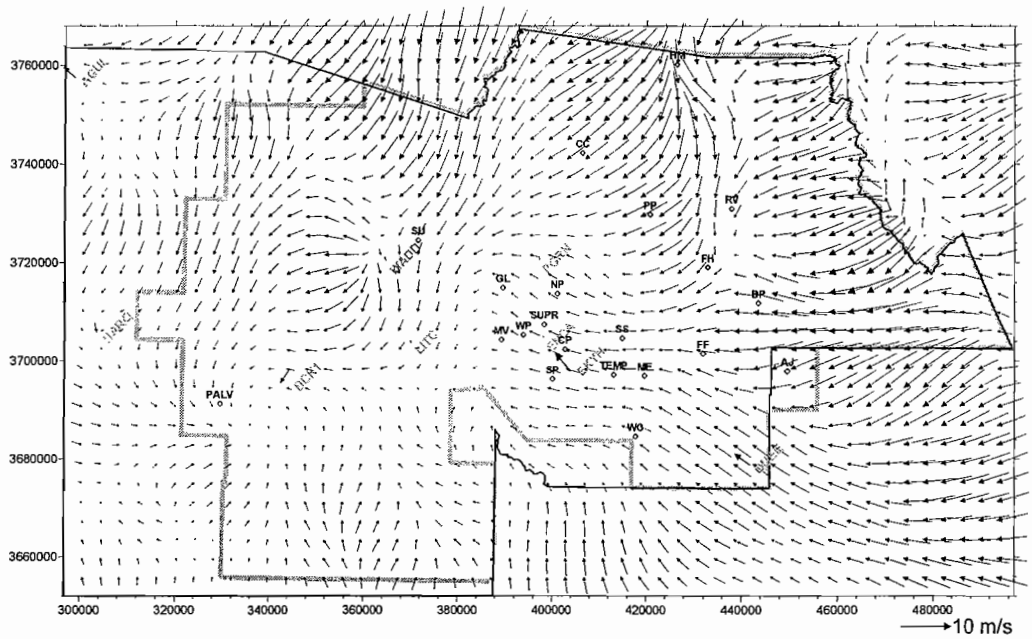
Surface MM5 Wind Field (m/s) on June 6, 2002 2:00-300 LST



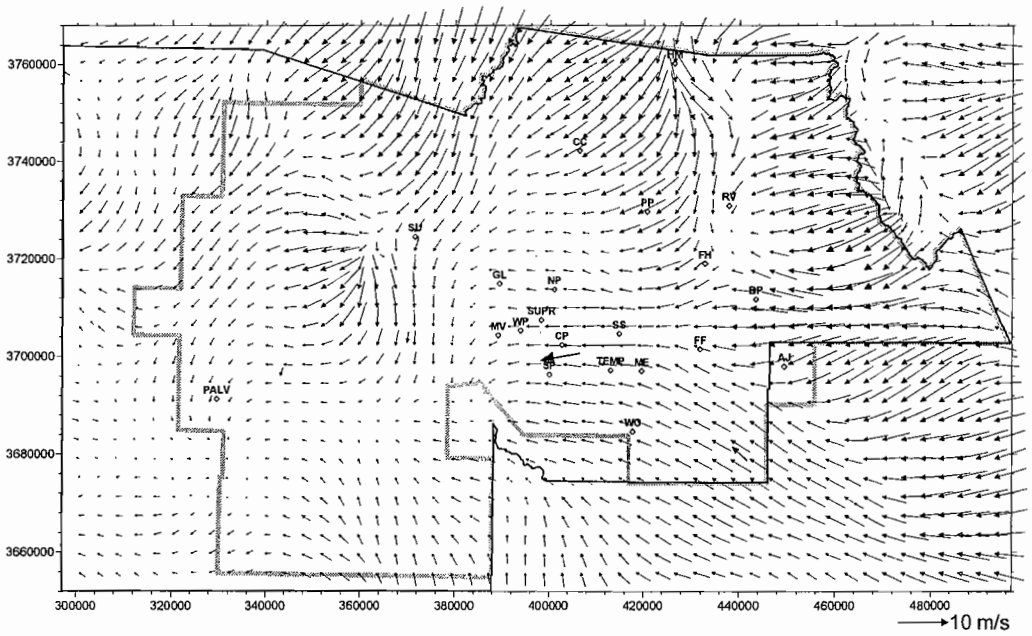
Surface MM5 Wind Field (m/s) on June 6, 2002 3:00-4:00 LST



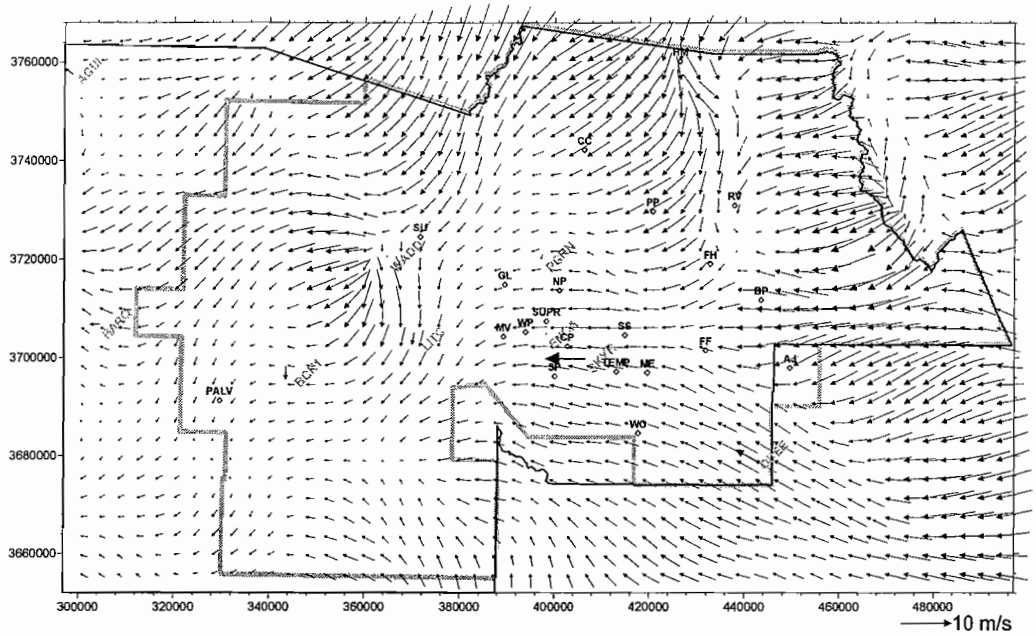
Surface MM5 Wind Field (m/s) on June 6, 2002 4:00-5:00 LST



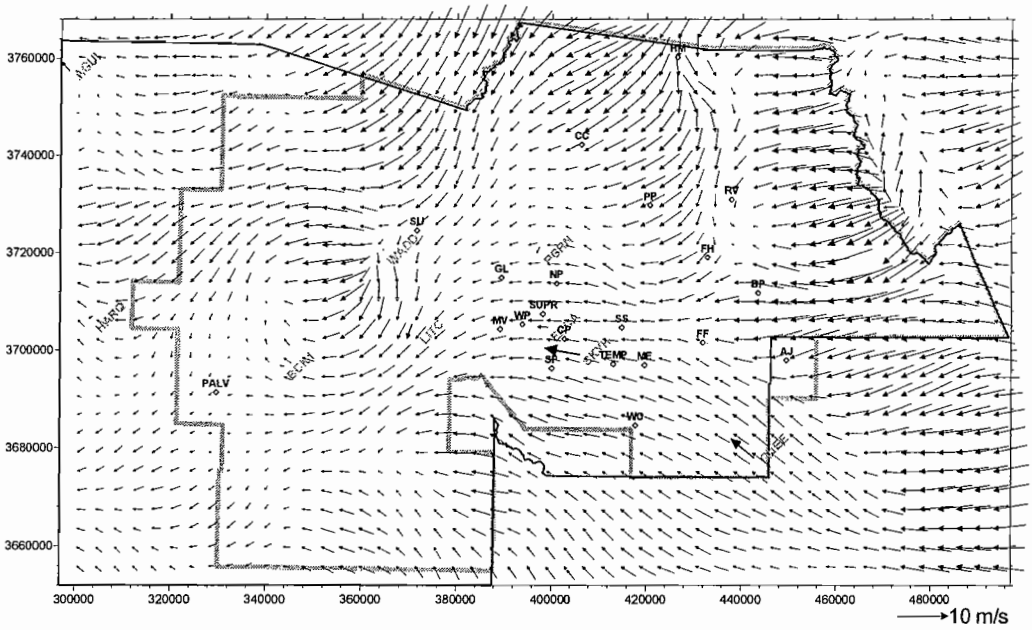
Surface MM5 Wind Field (m/s) on June 6, 2002 5:00-6:00 LST



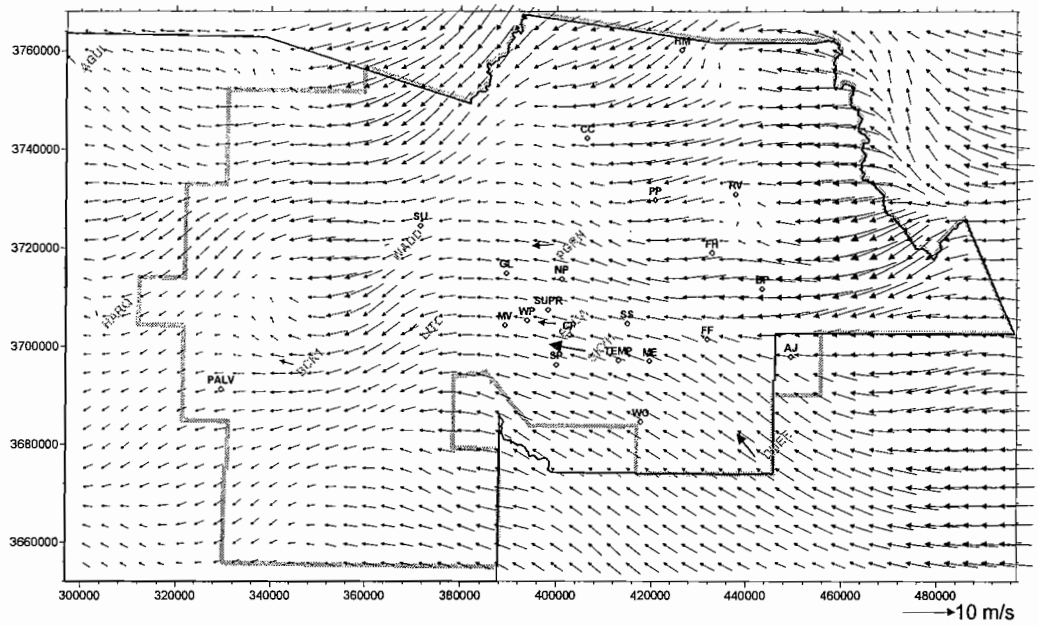
Surface MM5 Wind Field (m/s) on June 6, 2002 6:00-7:00 LST



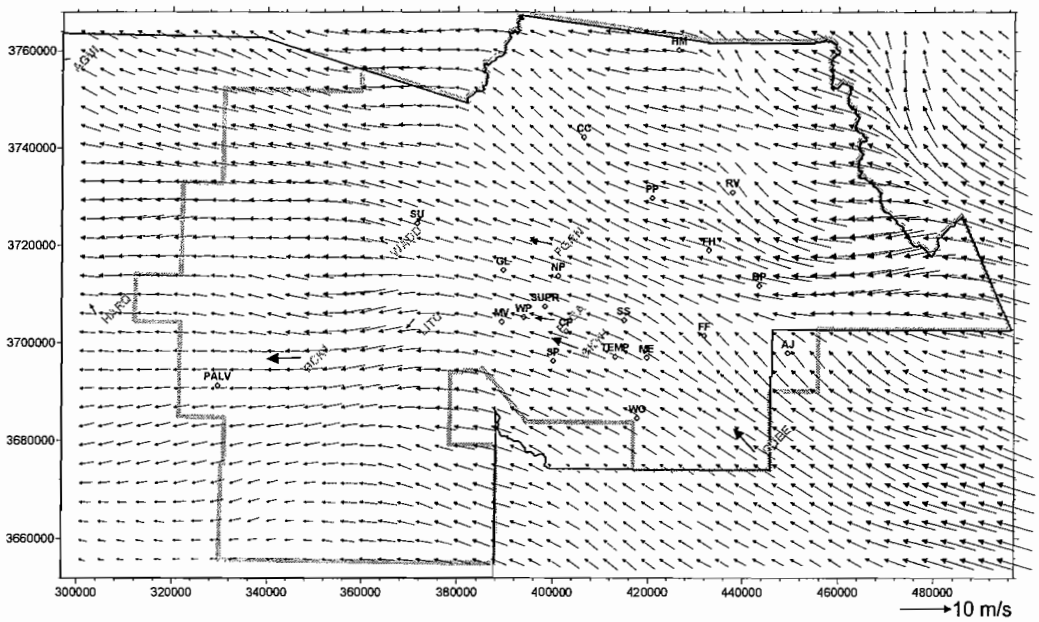
Surface MM5 Wind Field (m/s) on June 6, 2002 7:00-8:00 LST



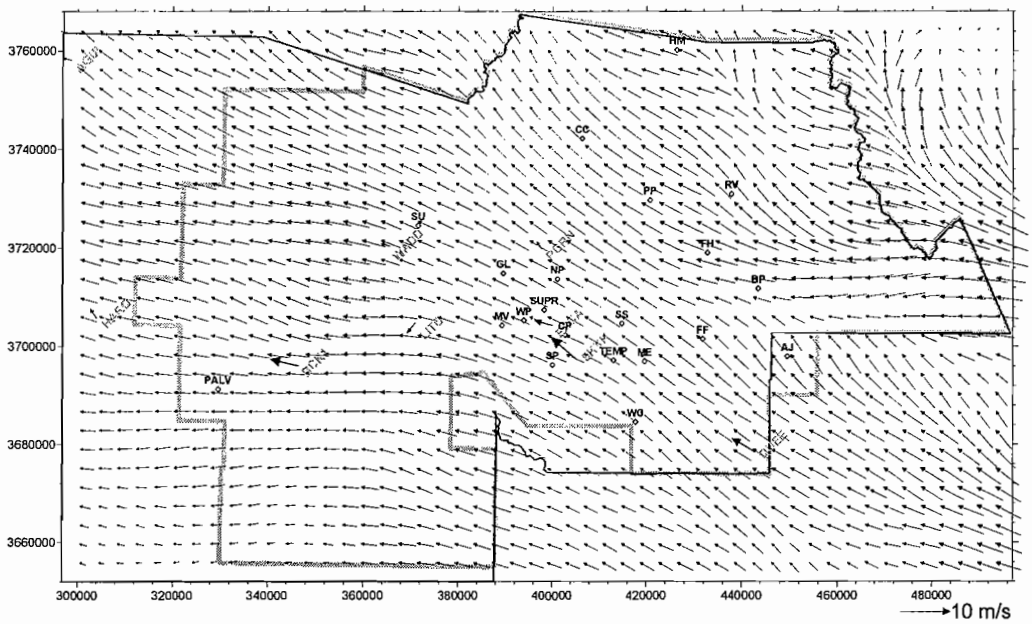
Surface MM5 Wind Field (m/s) on June 6, 2002 8:00-9:00 LST



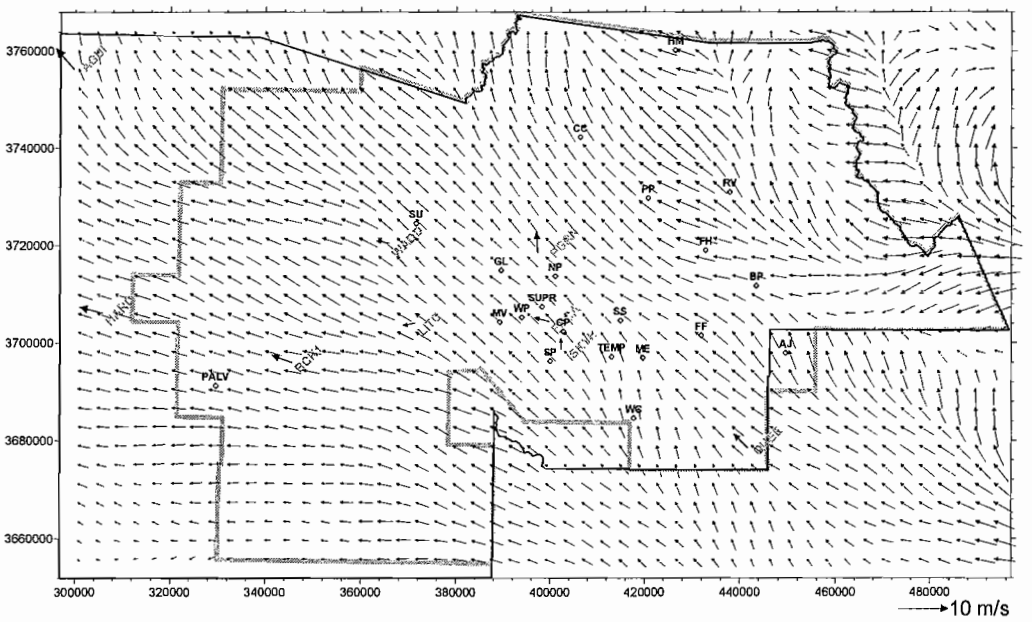
Surface MM5 Wind Field (m/s) on June 6, 2002 9:00-10:00 LST



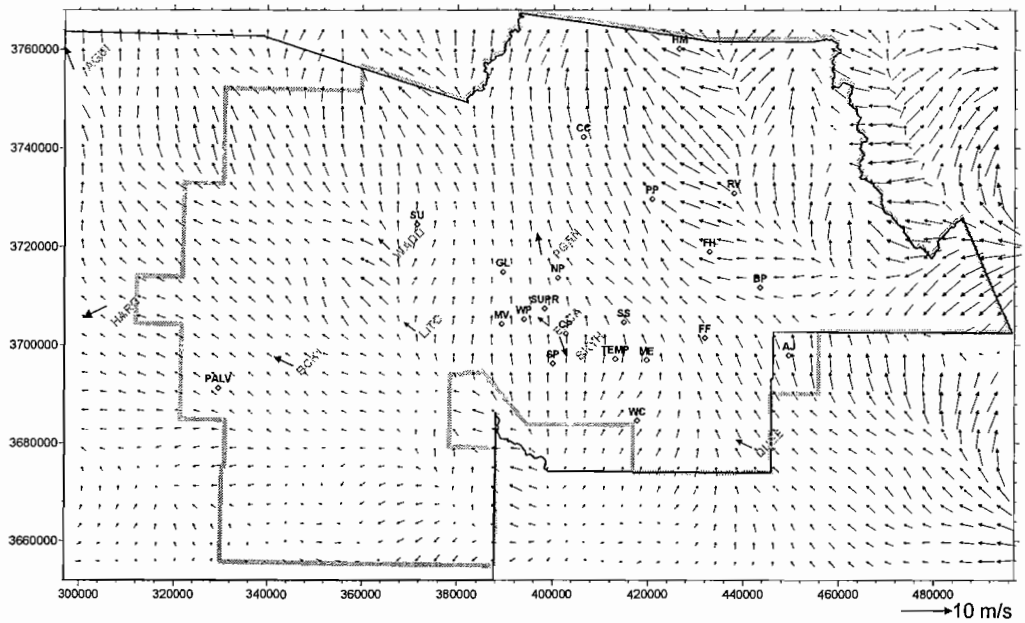
Surface MM5 Wind Field (m/s) on June 6, 2002 10:00-11:00 LST



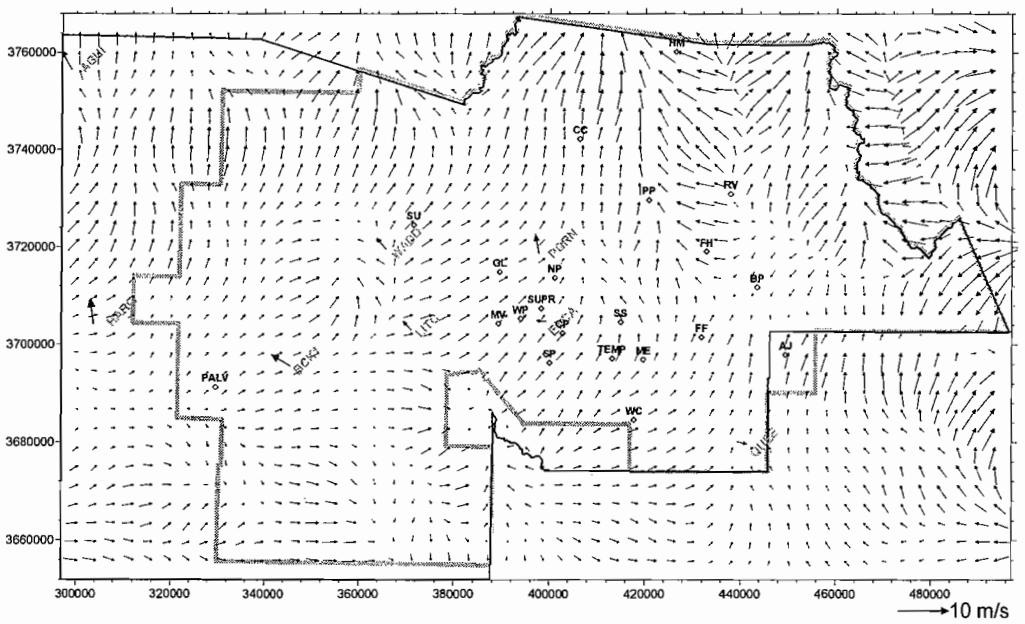
Surface MM5 Wind Field (m/s) on June 6, 2002 11:00-12:00 LST



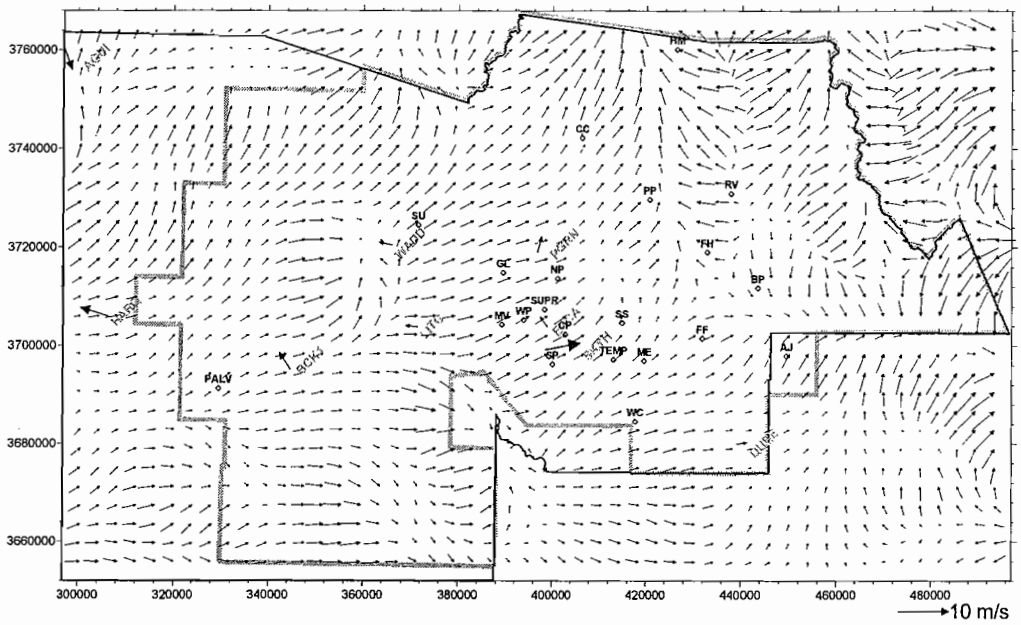
Surface MM5 Wind Field (m/s) on June 6, 2002 12:00-13:00 LST



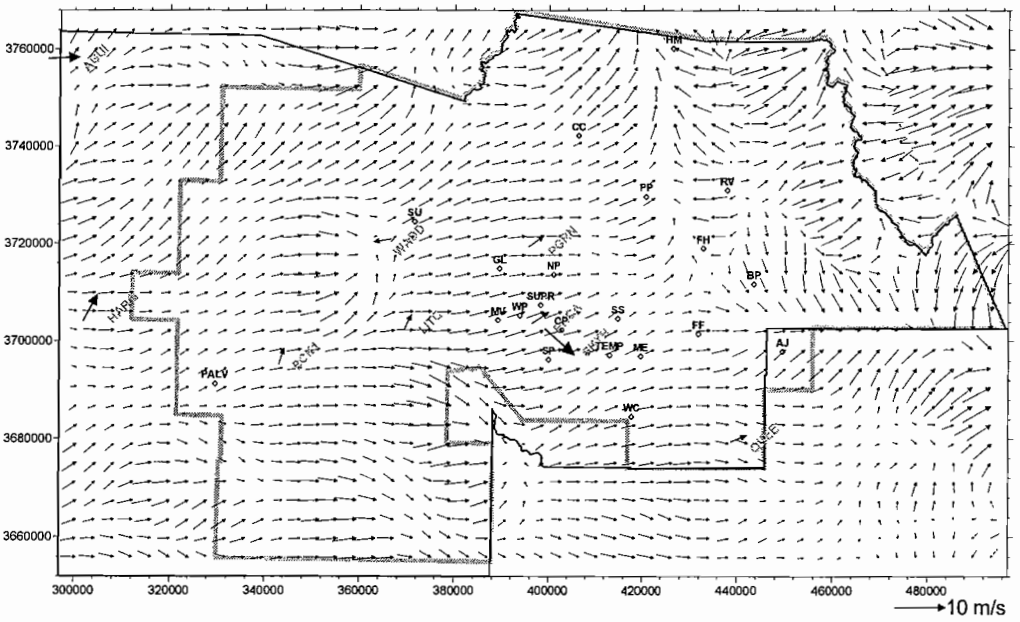
Surface MM5 Wind Field (m/s) on June 6, 2002 13:00-14:00 LST



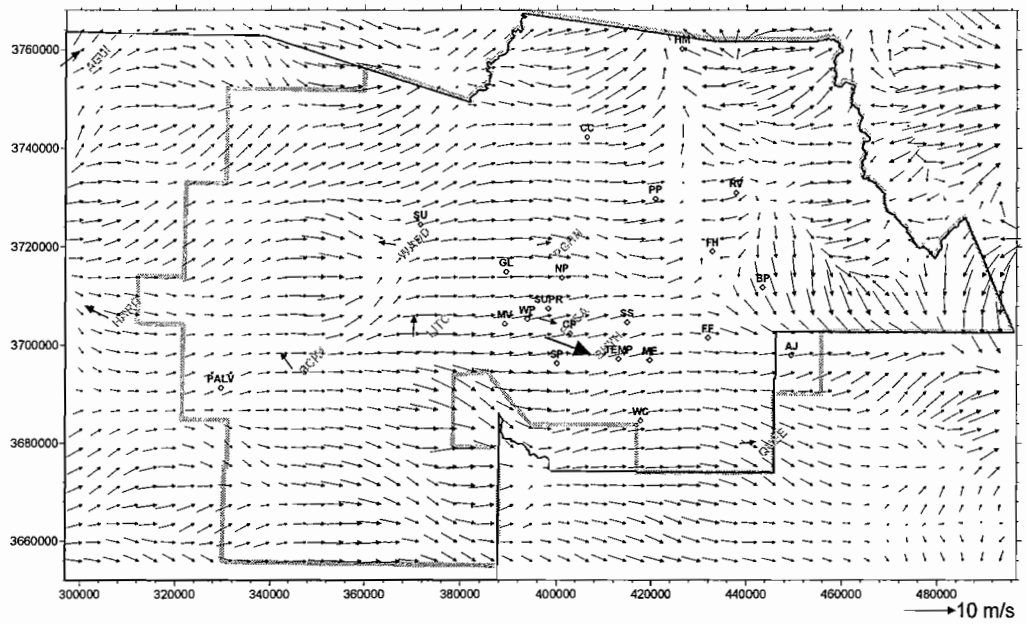
Surface MM5 Wind Field (m/s) on June 6, 2002 14:00-15:00 LST



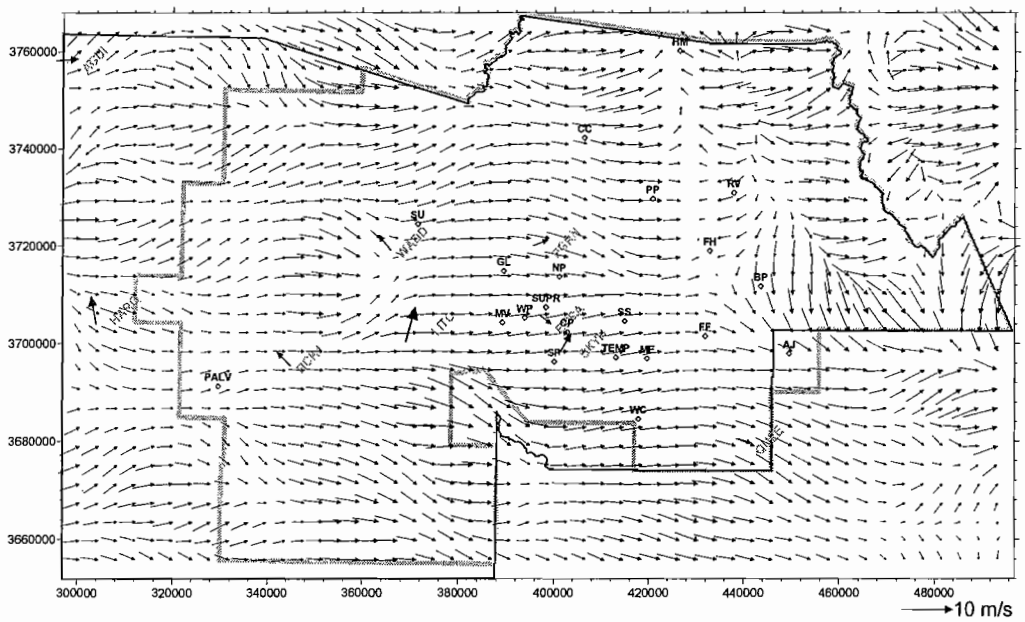
Surface MM5 Wind Field (m/s) on June 6, 2002 15:00-16:00 LST



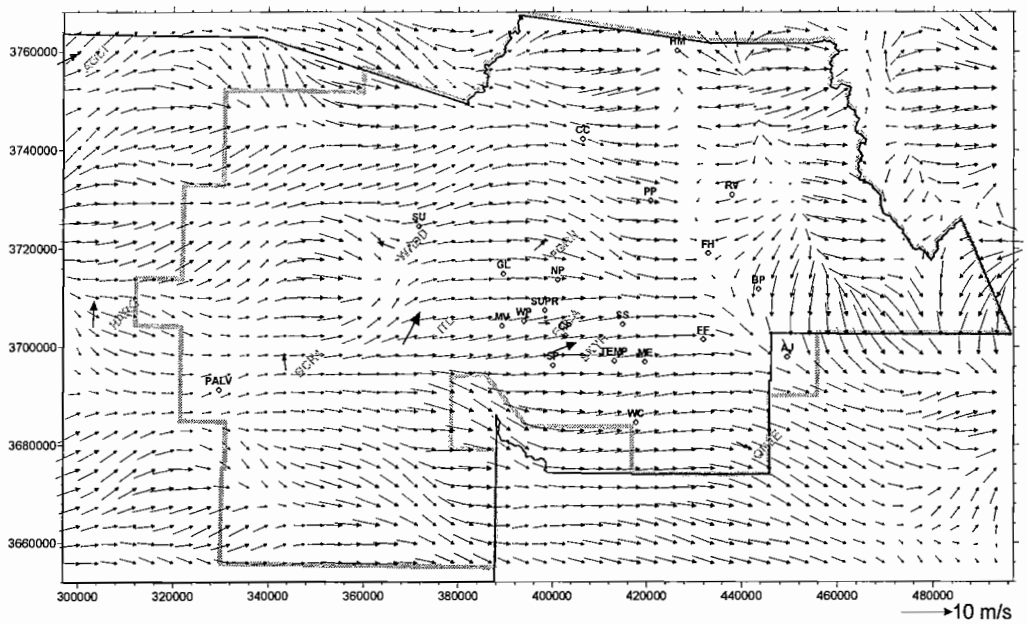
Surface MM5 Wind Field (m/s) on June 6, 2002 16:00-17:00 LST



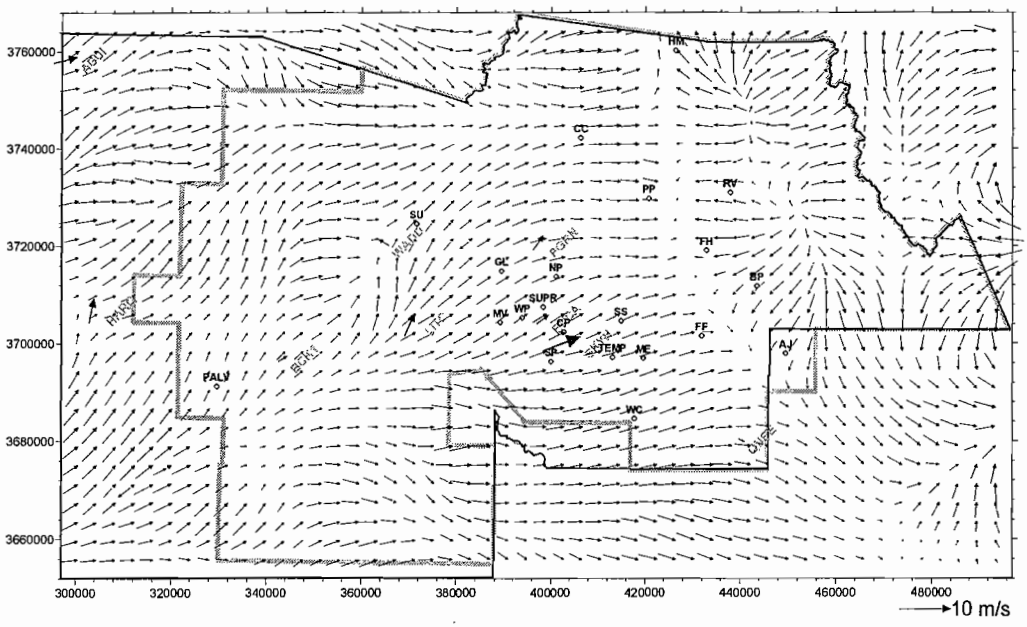
Surface MM5 Wind Field (m/s) on June 6, 2002 17:00-18:00 LST



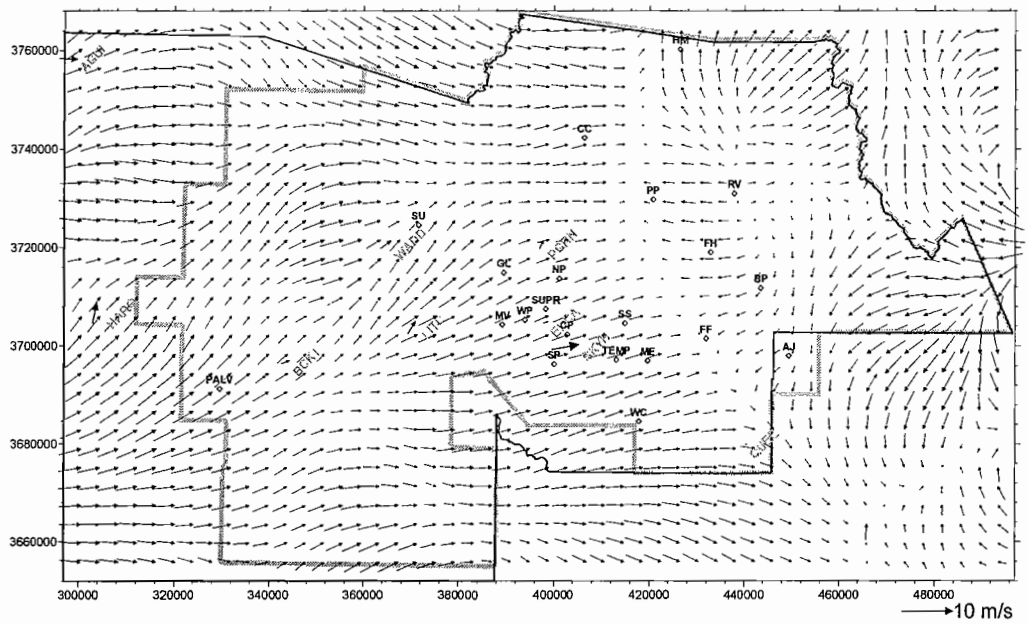
Surface MM5 Wind Field (m/s) on June 6, 2002 18:00-19:00 LST



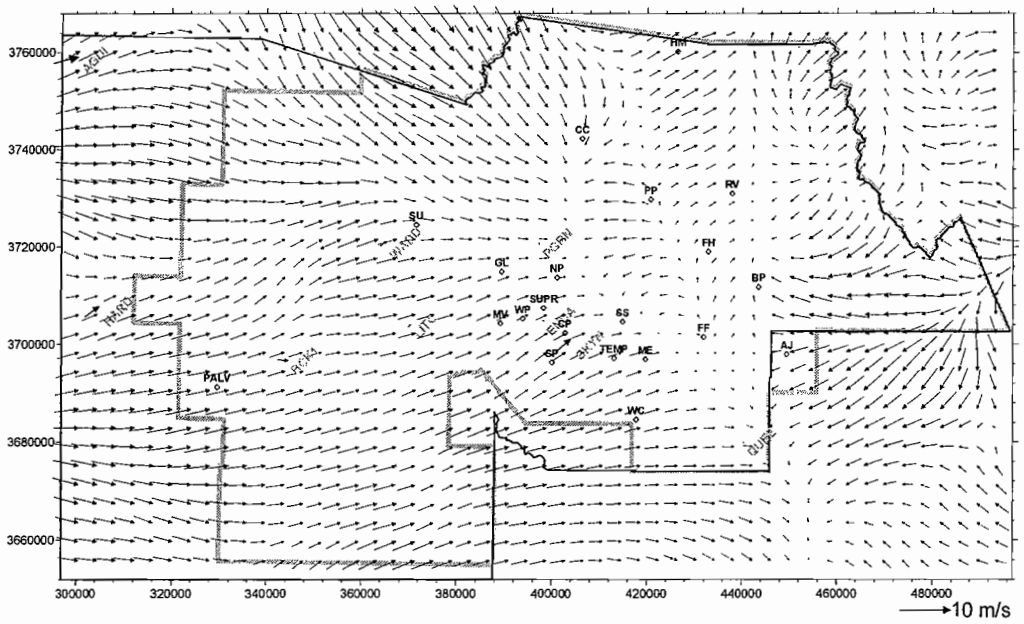
Surface MM5 Wind Field (m/s) on June 6, 2002 19:00-20:00 LST



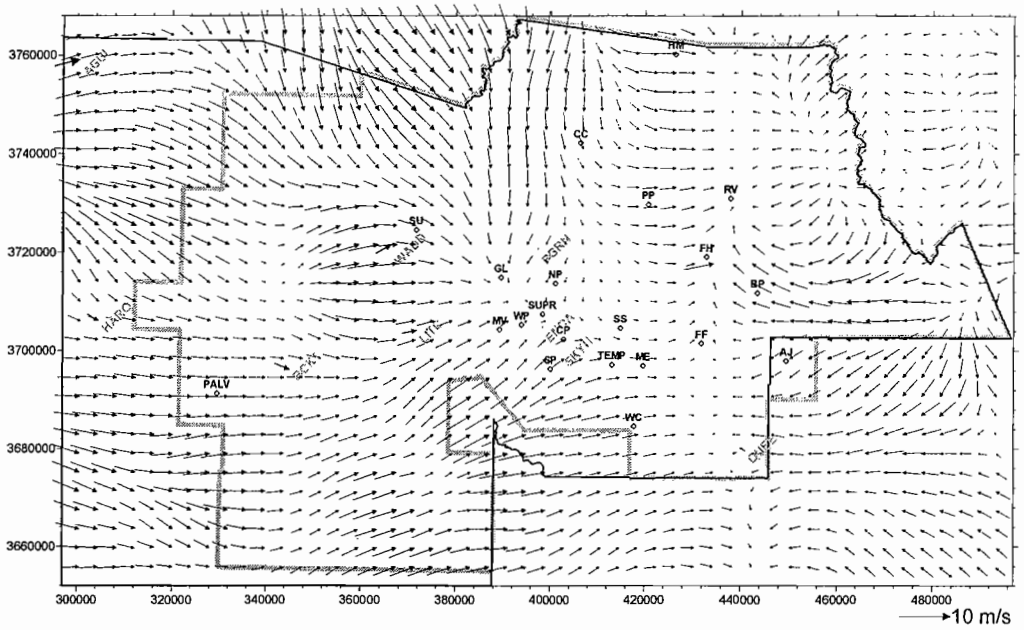
Surface MM5 Wind Field (m/s) on June 6, 2002 20:00-21:00 LST



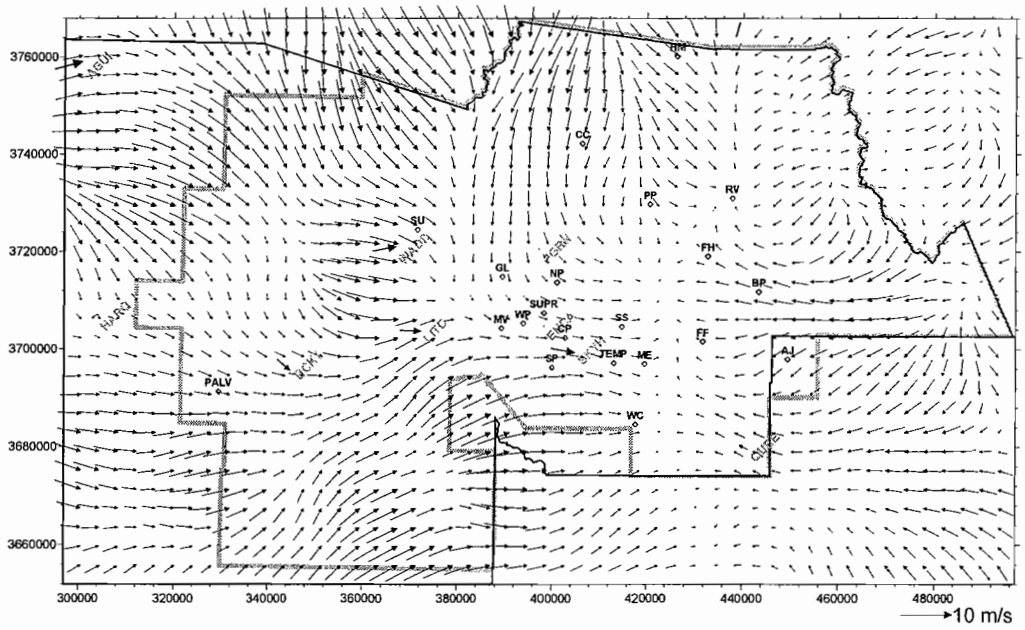
Surface MM5 Wind Field (m/s) on June 6, 2002 21:00-22:00 LST



Surface MM5 Wind Field (m/s) on June 6, 2002 22:00-23:00 LST



Surface MM5 Wind Field (m/s) on June 6, 2002 23:00-24:00 LST

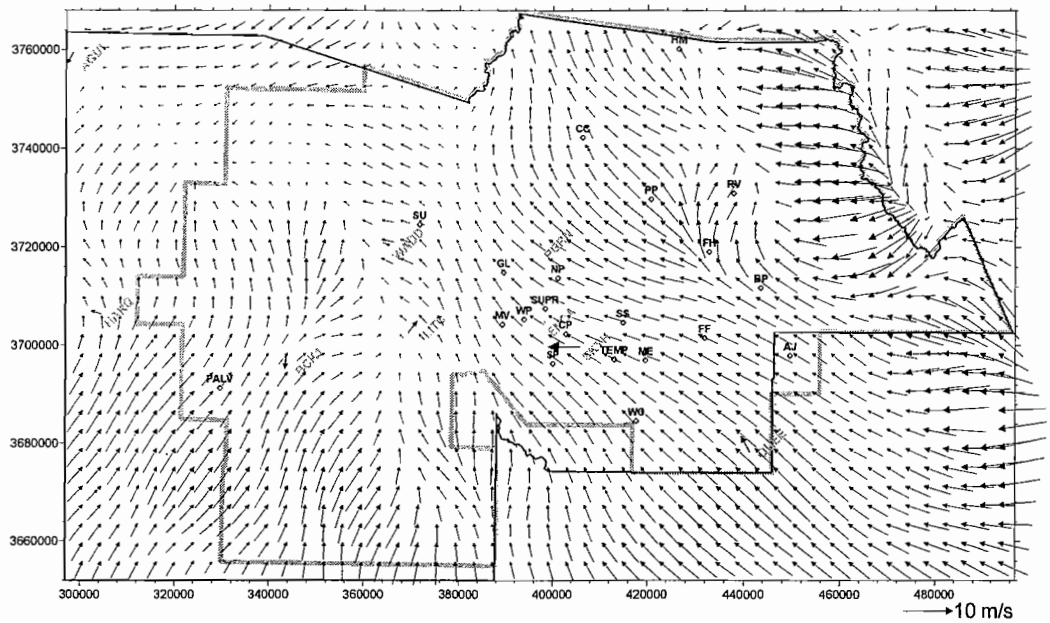


Appendix III-v

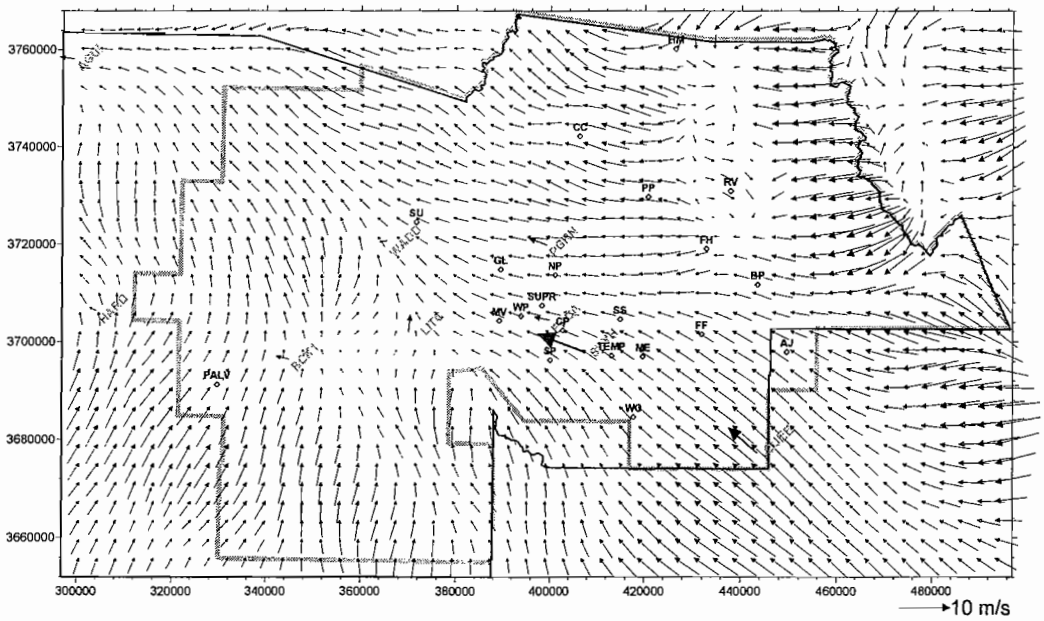
MODELED WIND FIELDS FOR THE JULY 2002 EPISODE

The plots shown here are the simulated MM5 wind fields. These hourly wind fields are from 0:00 to 24:00 LST on July 9, 2002.

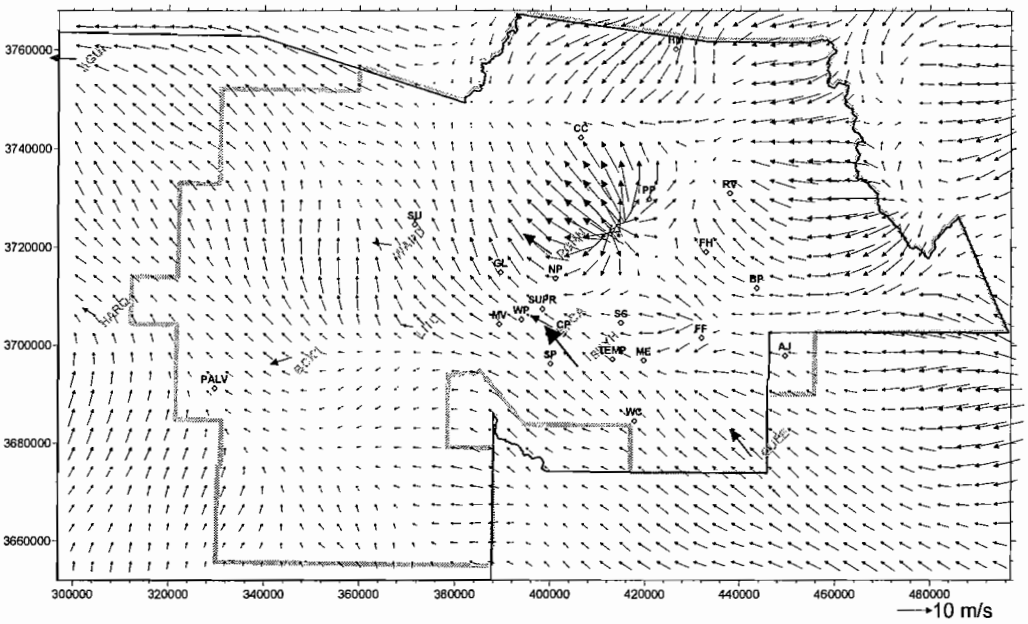
Surface MM5 Wind Field (m/s) on July 9, 2002 0:00-1:00 LST



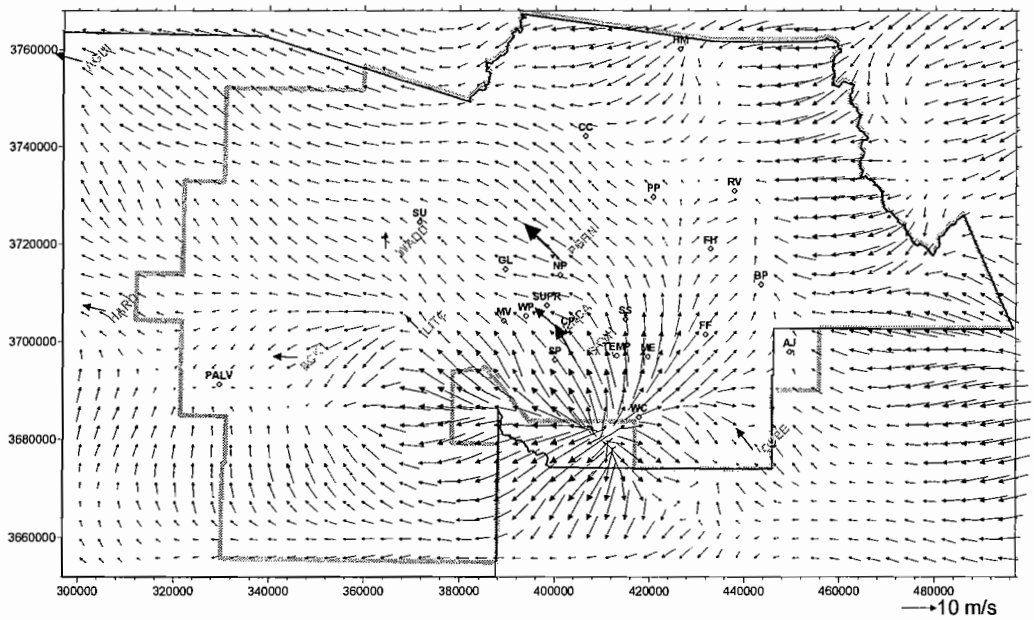
Surface MM5 Wind Field (m/s) on July 9, 2002 1:00-2:00 LST



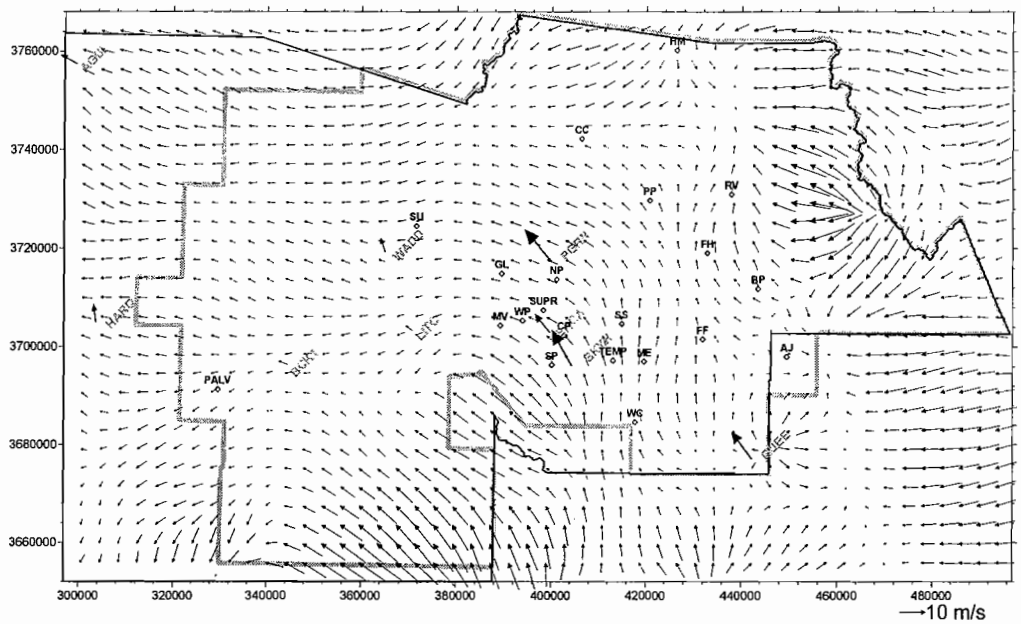
Surface MM5 Wind Field (m/s) on July 9, 2002 2:00-300 LST



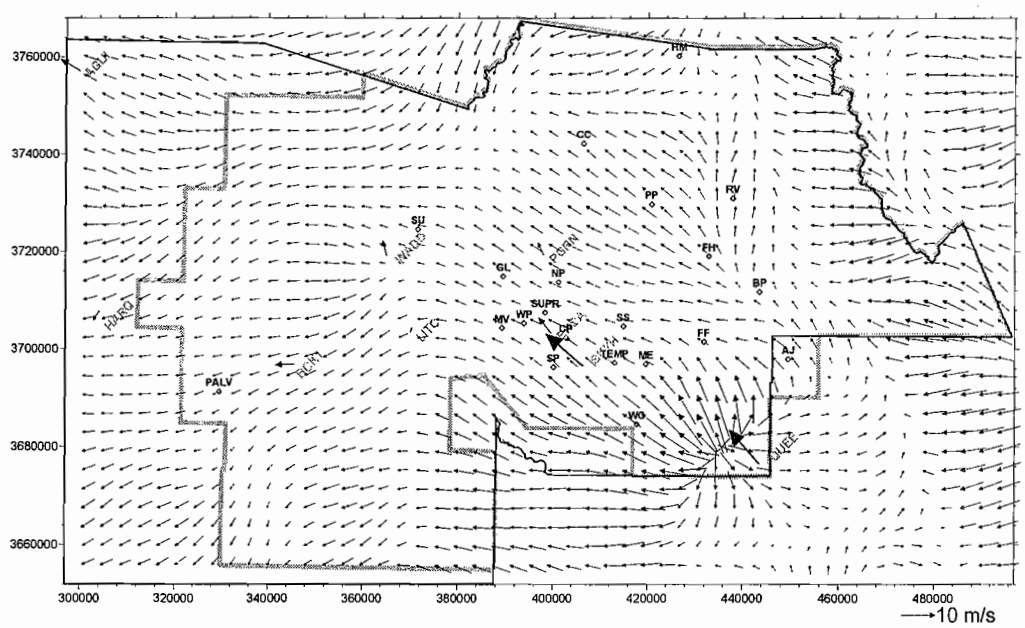
Surface MM5 Wind Field (m/s) on July 9, 2002 3:00-4:00 LST



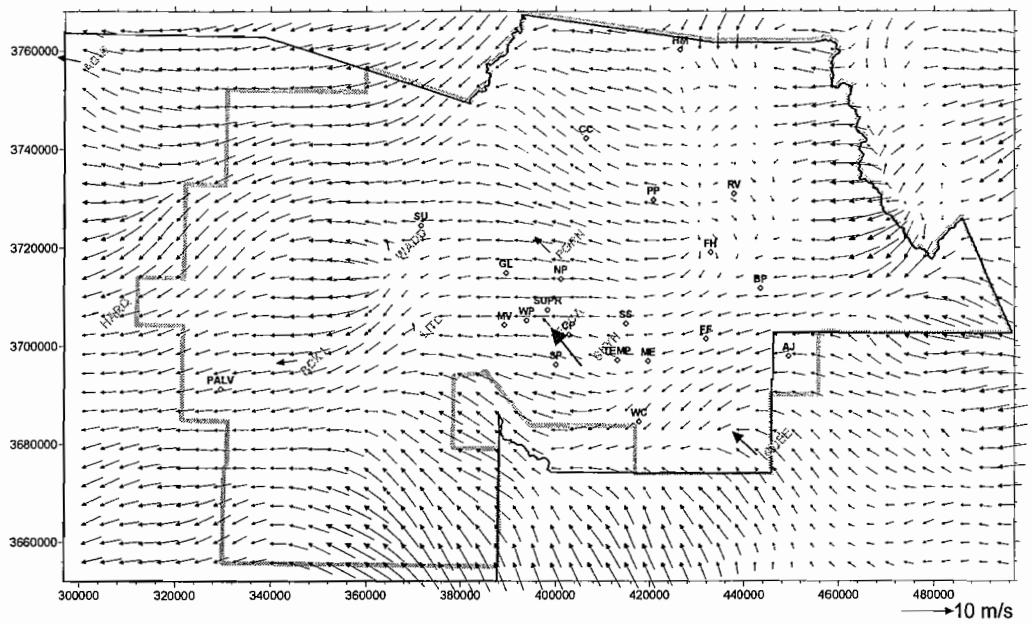
Surface MM5 Wind Field (m/s) on July 9, 2002 4:00-5:00 LST



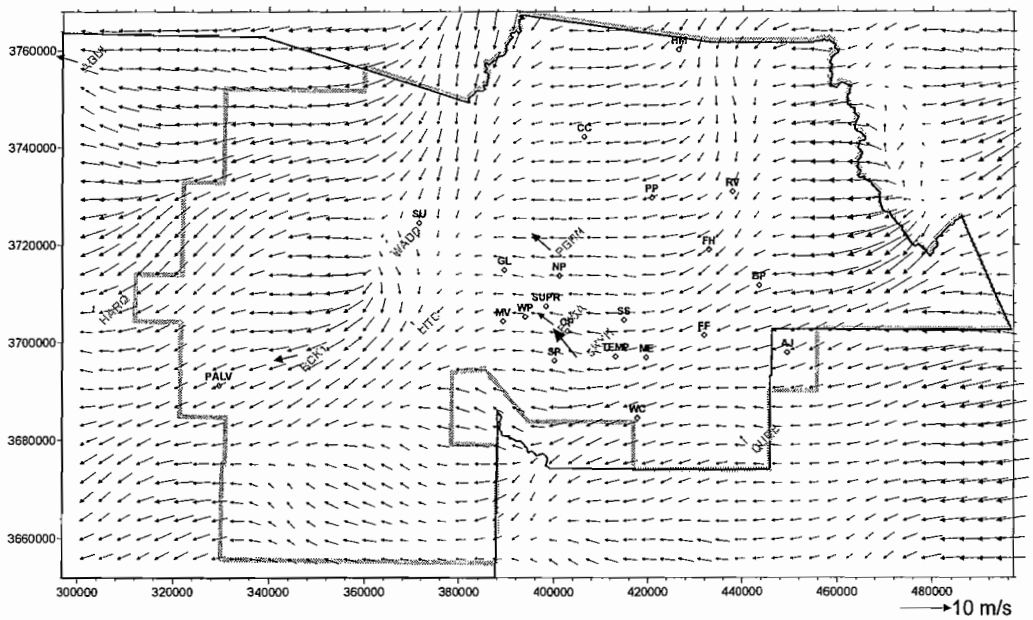
Surface MM5 Wind Field (m/s) on July 9, 2002 5:00-6:00 LST



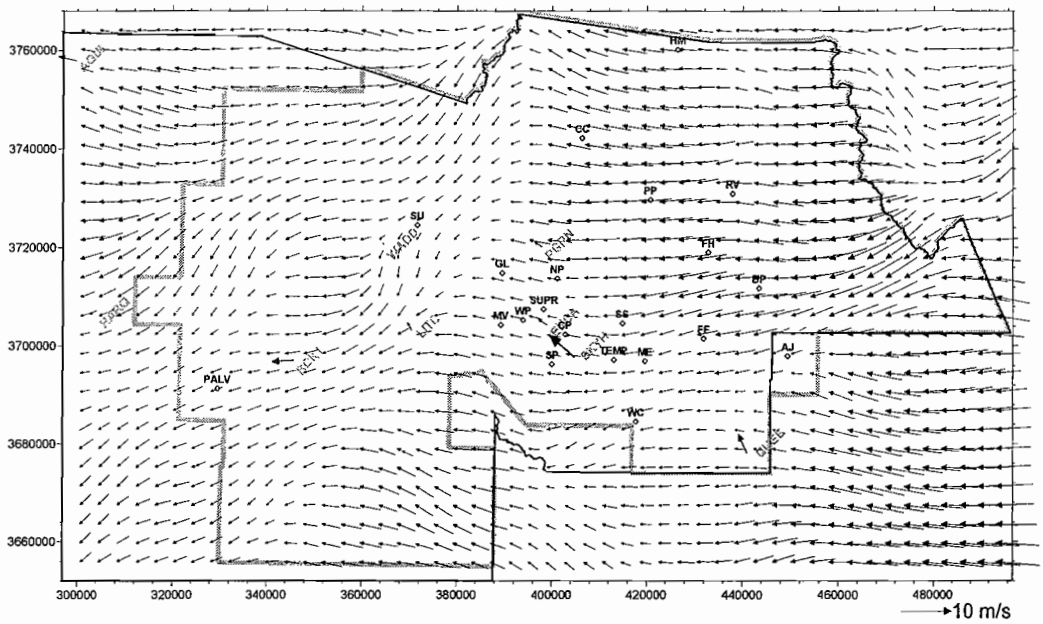
Surface MM5 Wind Field (m/s) on July 9, 2002 6:00-7:00 LST



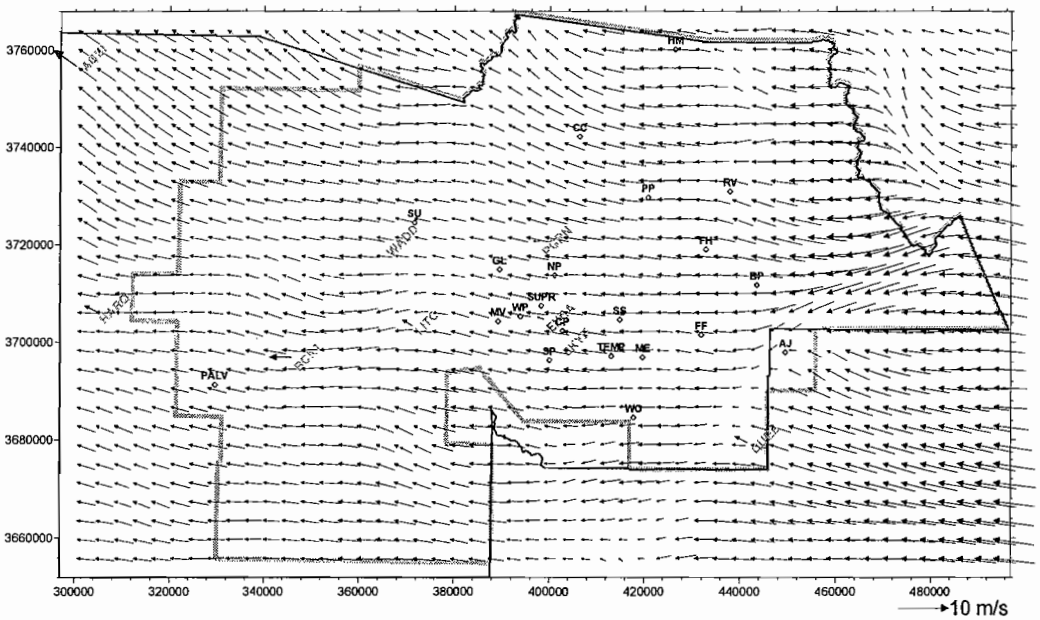
Surface MM5 Wind Field (m/s) on July 9, 2002 7:00-8:00 LST



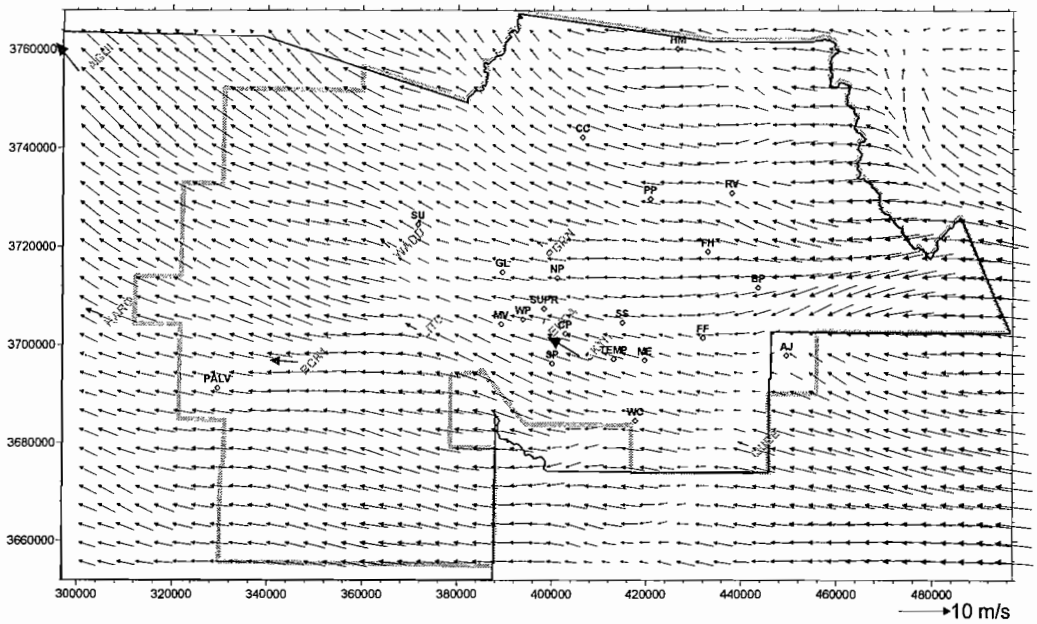
Surface MM5 Wind Field (m/s) on July 9, 2002 8:00-9:00 LST



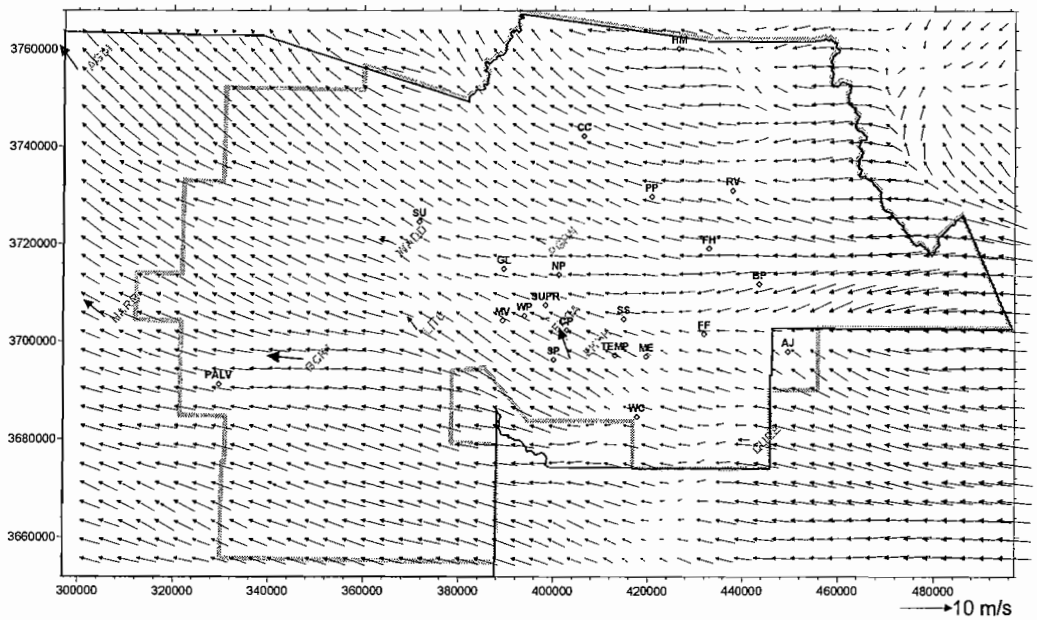
Surface MM5 Wind Field (m/s) on July 9, 2002 9:00-10:00 LST



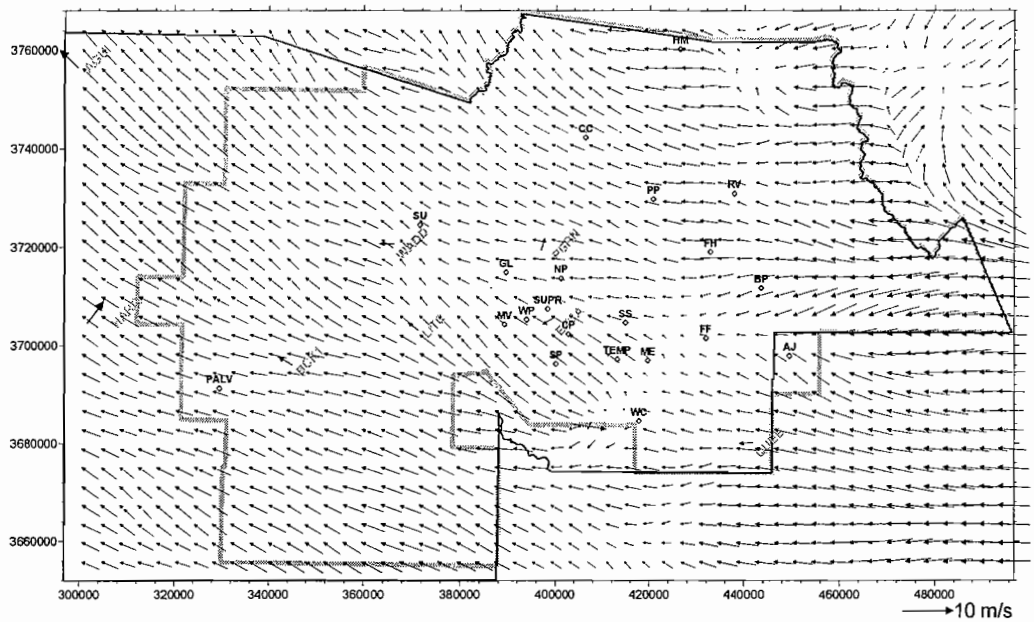
Surface MM5 Wind Field (m/s) on July 9, 2002 10:00-11:00 LST



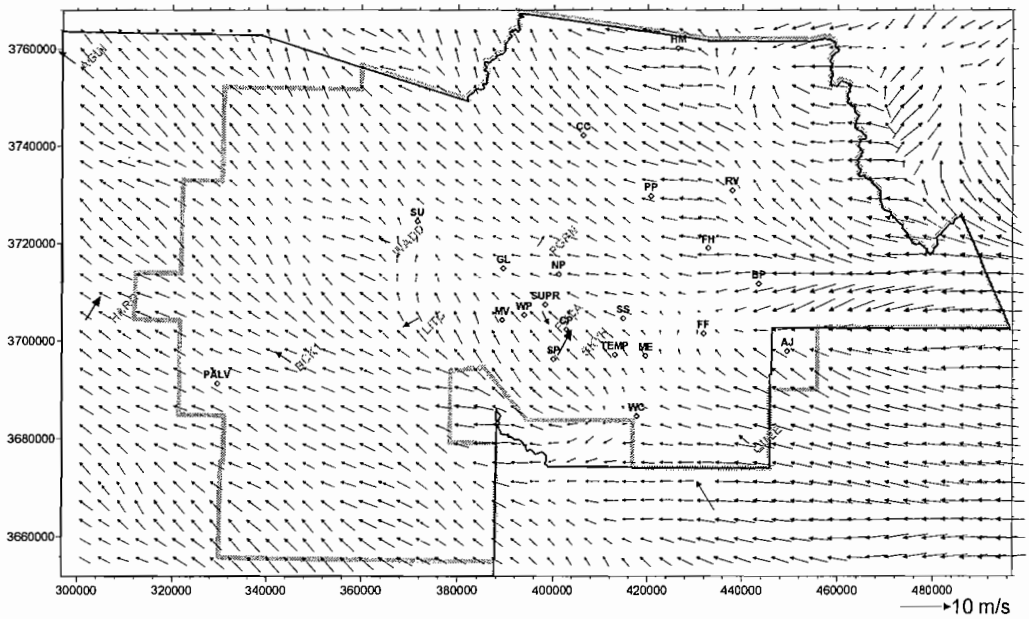
Surface MM5 Wind Field (m/s) on July 9, 2002 11:00-12:00 LST



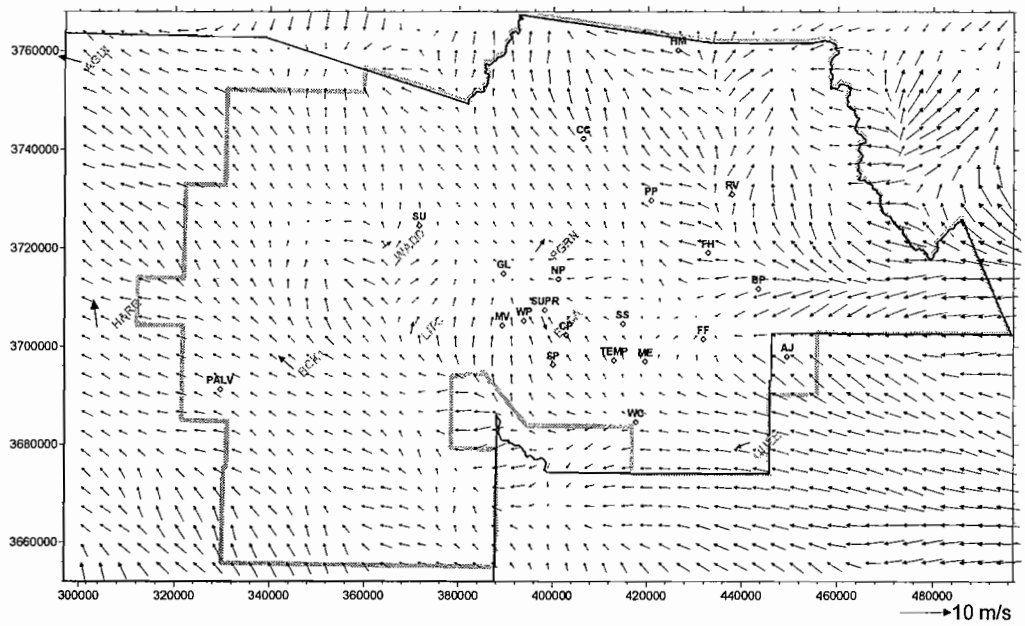
Surface MM5 Wind Field (m/s) on July 9, 2002 12:00-13:00 LST



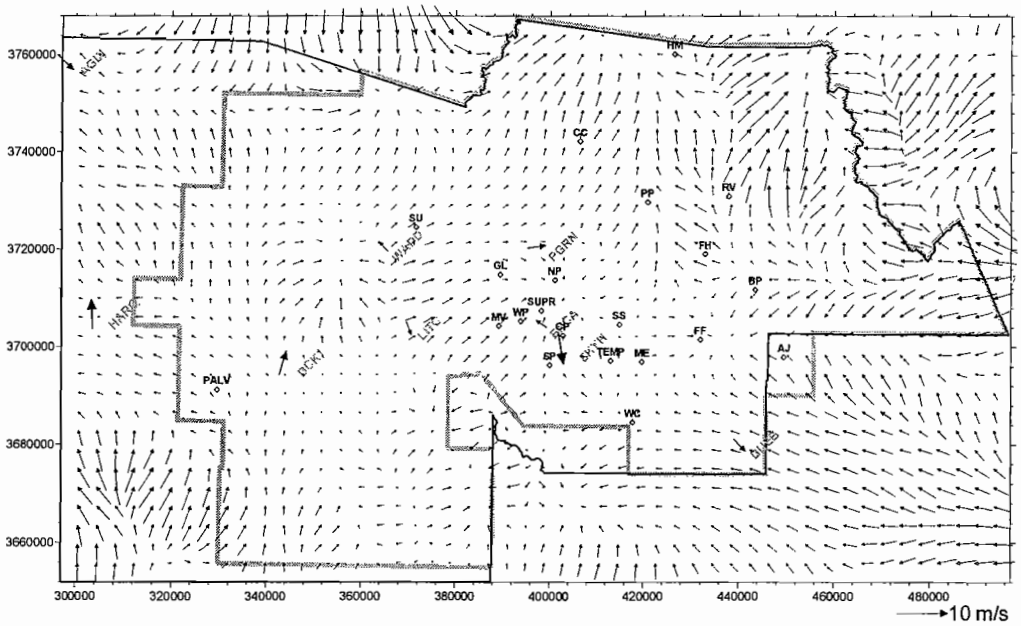
Surface MM5 Wind Field (m/s) on July 9, 2002 13:00-14:00 LST



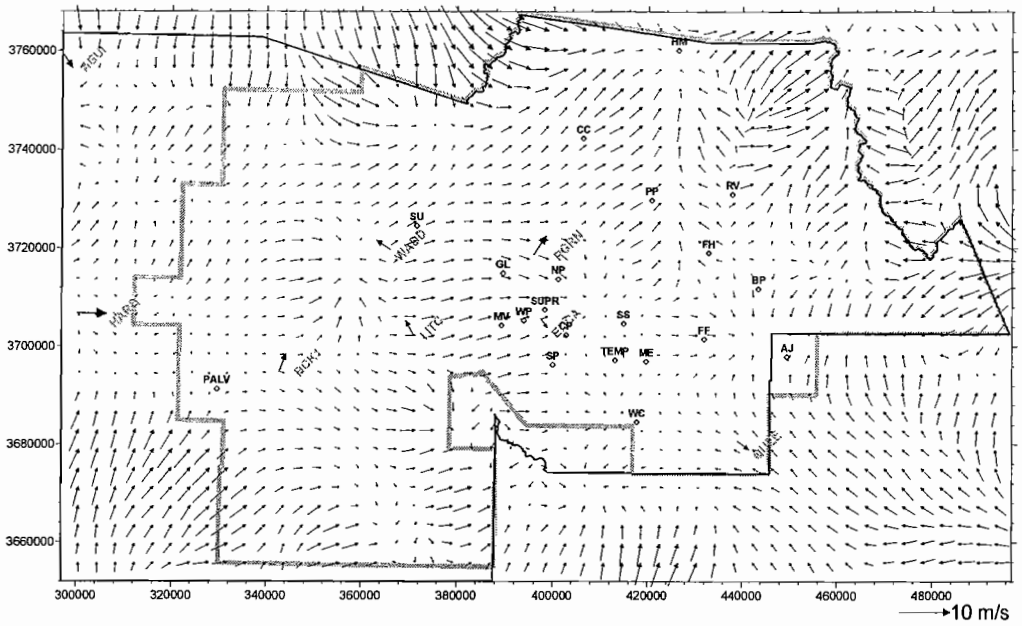
Surface MM5 Wind Field (m/s) on July 9, 2002 14:00-15:00 LST



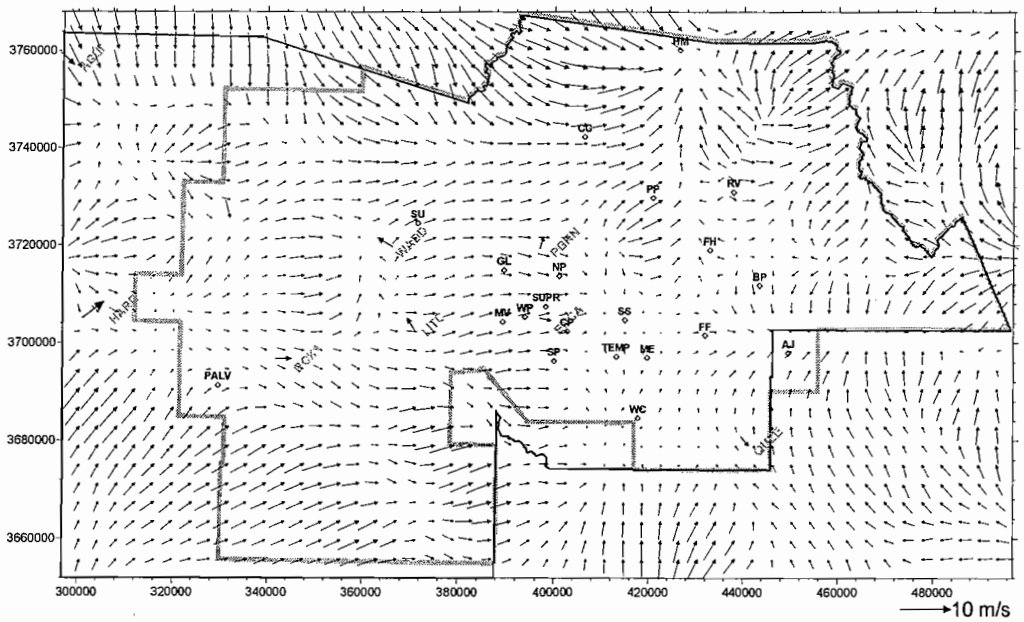
Surface MM5 Wind Field (m/s) on July 9, 2002 15:00-16:00 LST



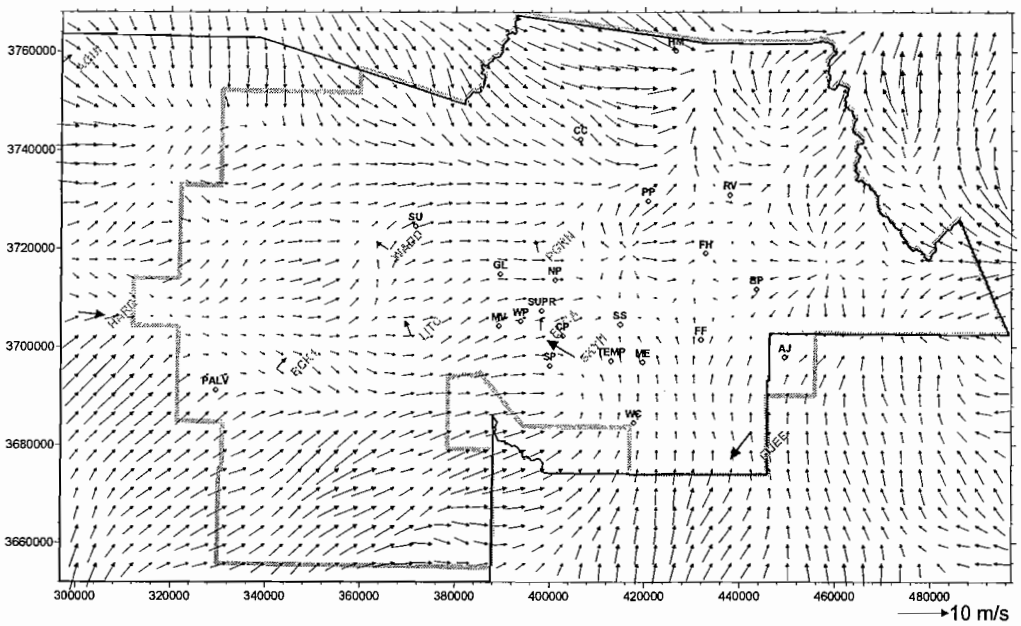
Surface MM5 Wind Field (m/s) on July 9, 2002 16:00-17:00 LST



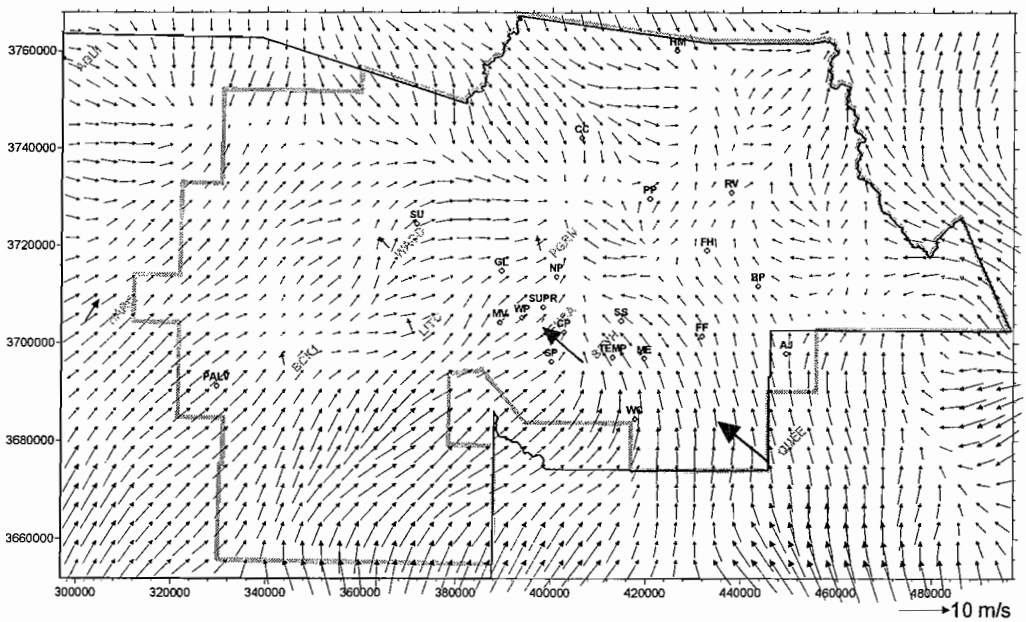
Surface MM5 Wind Field (m/s) on July 9, 2002 17:00-18:00 LST



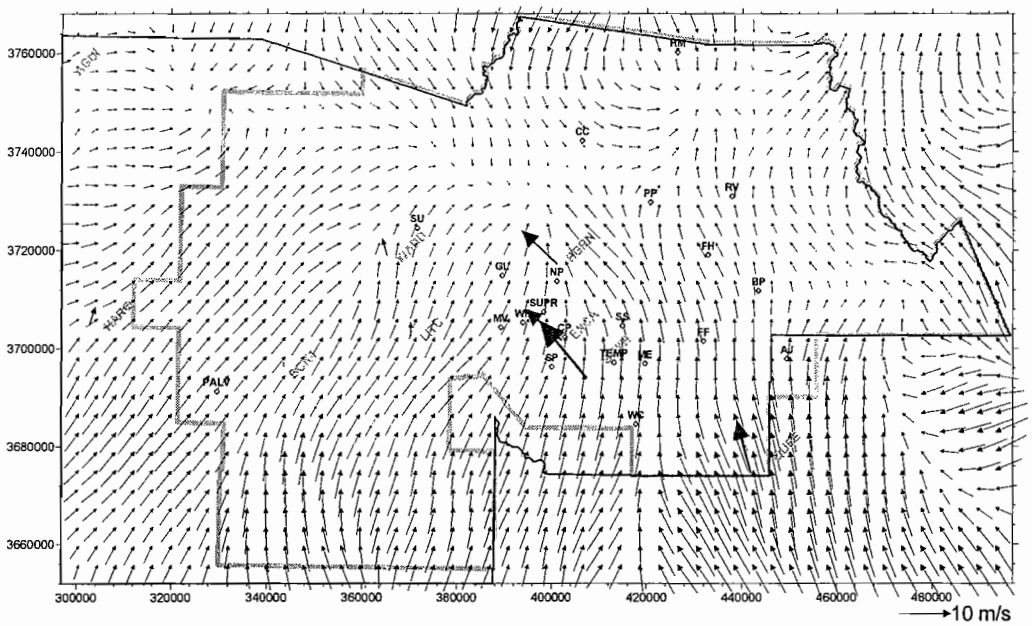
Surface MM5 Wind Field (m/s) on July 9, 2002 18:00-19:00 LST



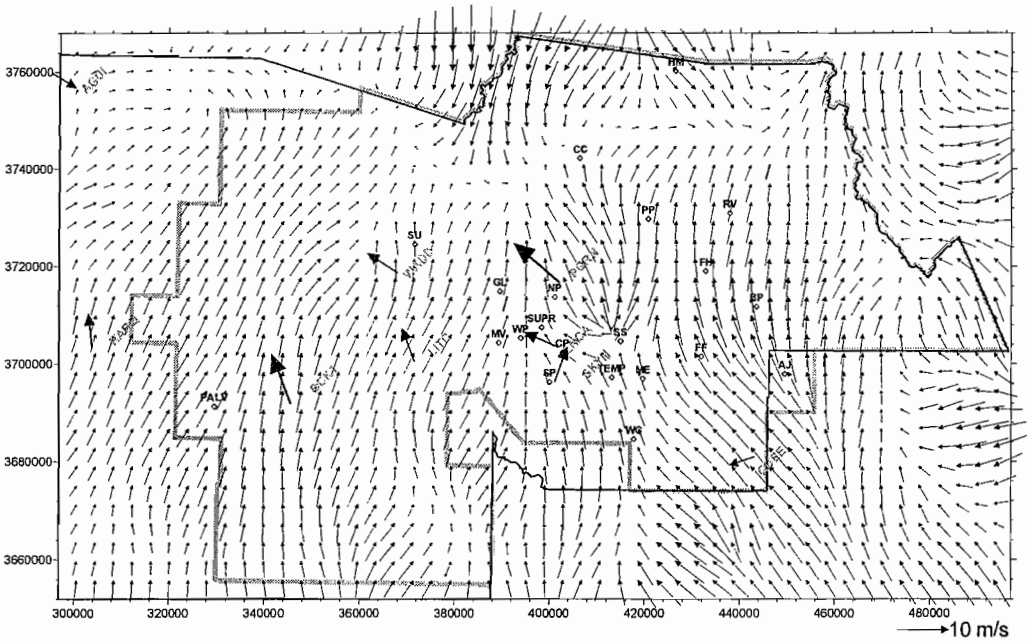
Surface MM5 Wind Field (m/s) on July 9, 2002 19:00-20:00 LST



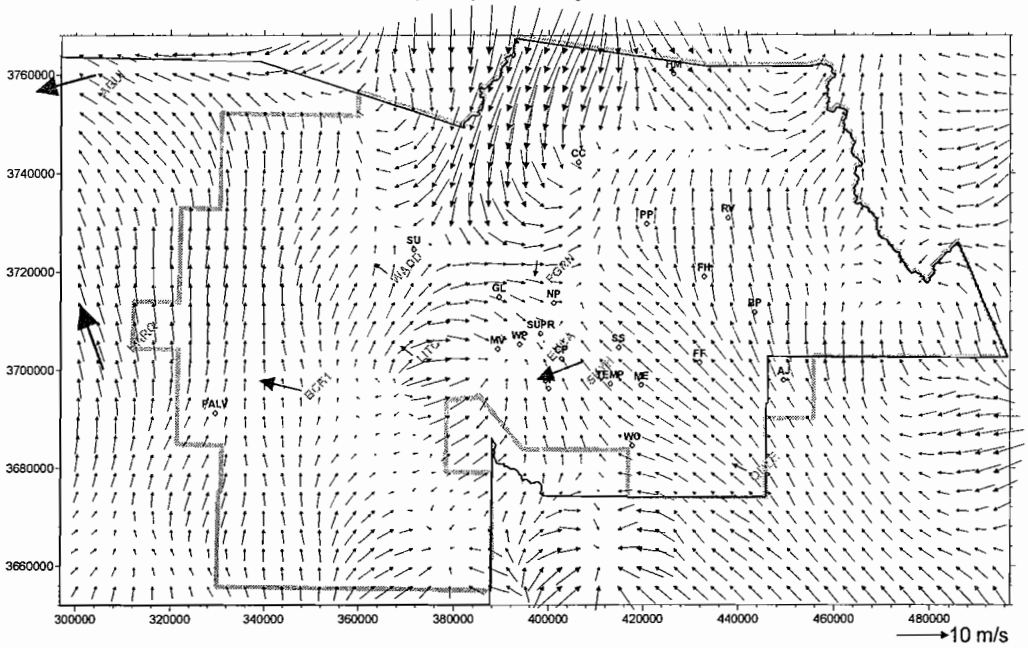
Surface MM5 Wind Field (m/s) on July 9, 2002 20:00-21:00 LST



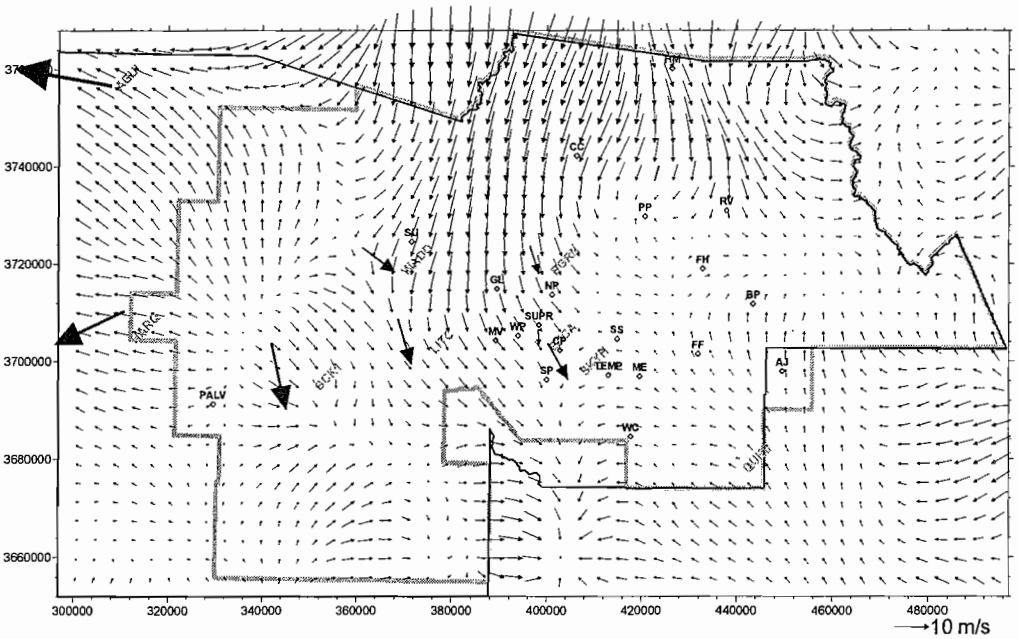
Surface MM5 Wind Field (m/s) on July 9, 2002 21:00-22:00 LST



Surface MM5 Wind Field (m/s) on July 9, 2002 22:00-23:00 LST



Surface MM5 Wind Field (m/s) on July 9, 2002 23:00-24:00 LST

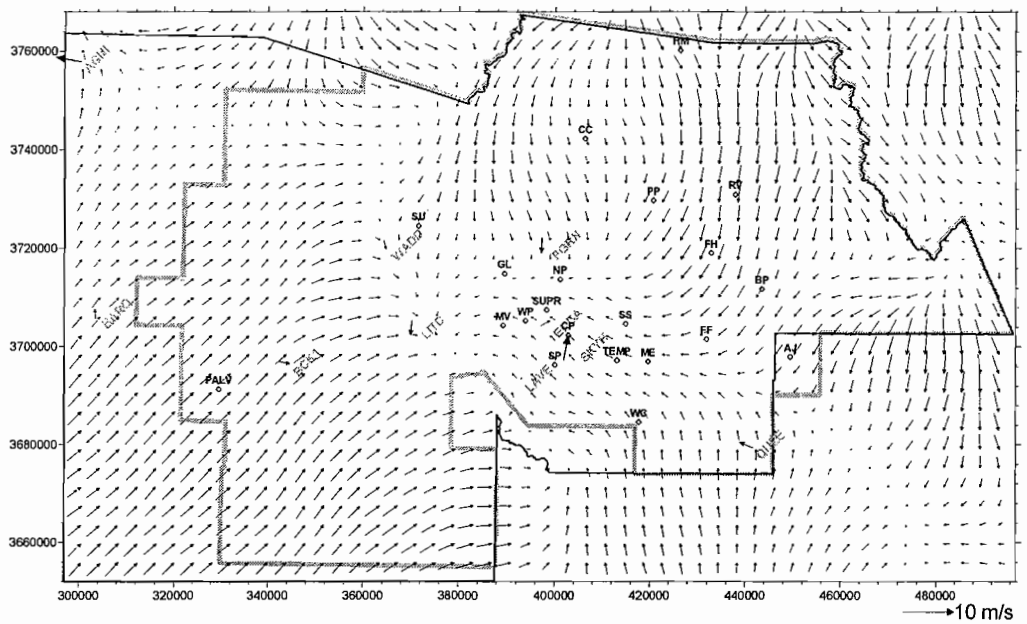


Appendix III-vi

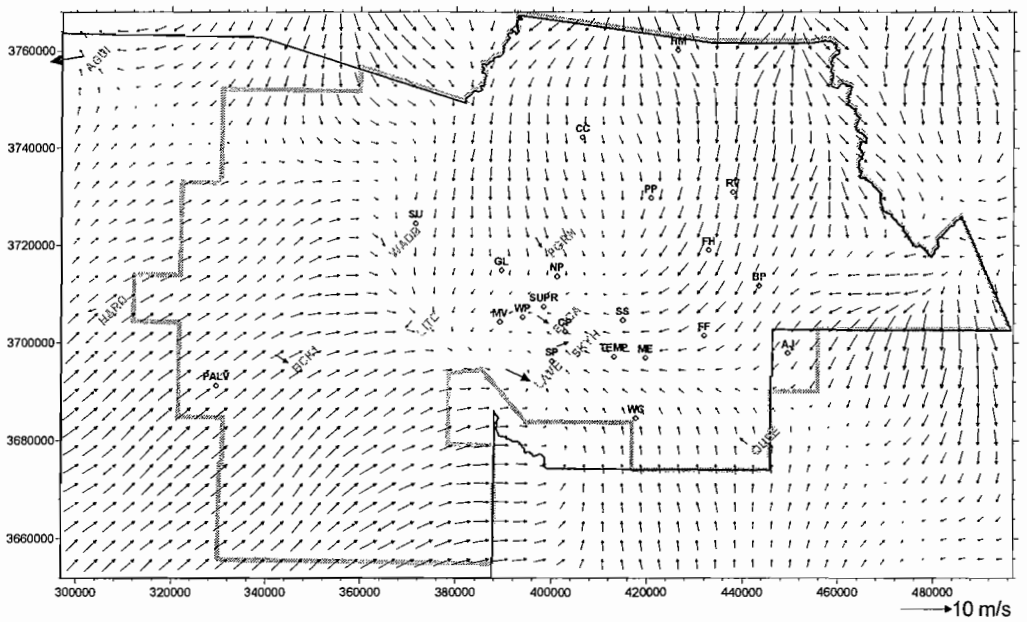
MODELED WIND FIELDS FOR THE August 2001 EPISODE

The plots shown here are the simulated MM5 wind fields. These hourly wind fields are from 0:00 to 24:00 LST on August 10, 2001.

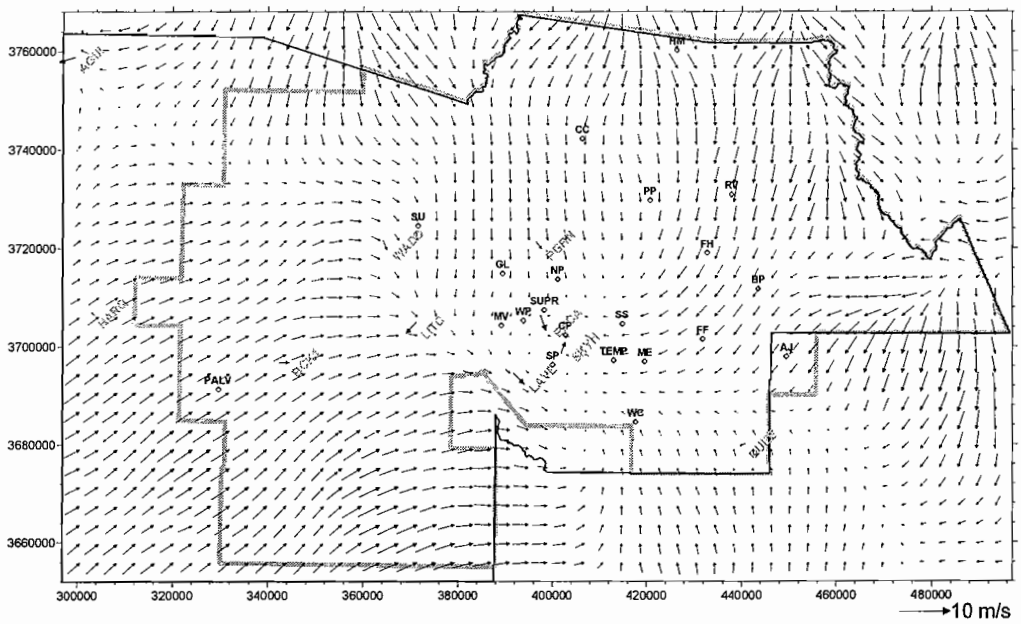
Surface MM5 Wind Field (m/s) on August 10, 2001 0:00-1:00 LST



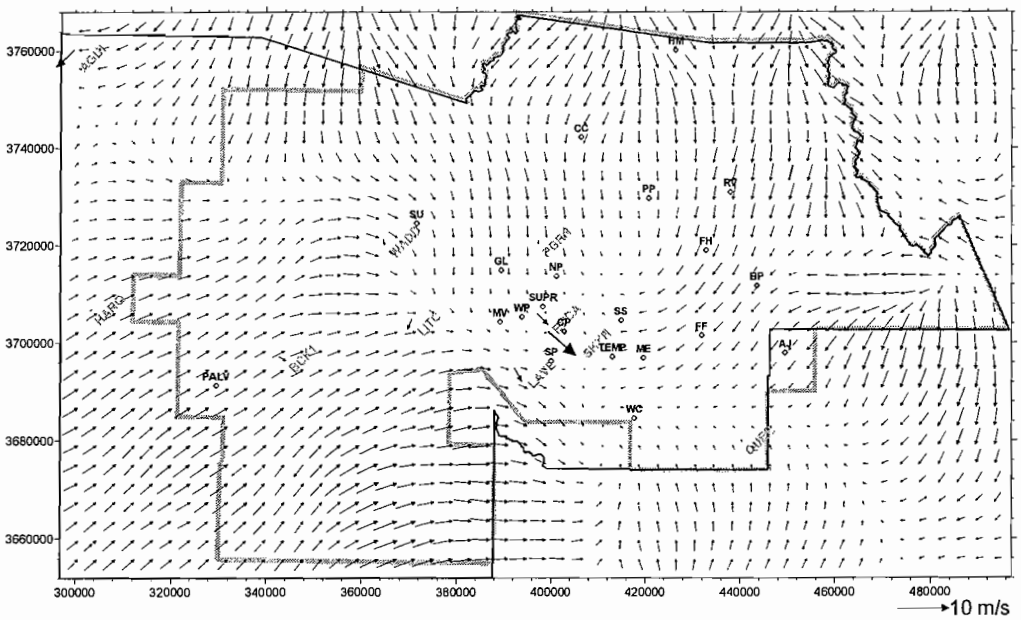
Surface MM5 Wind Field (m/s) on August 10, 2001 1:00-2:00 LST



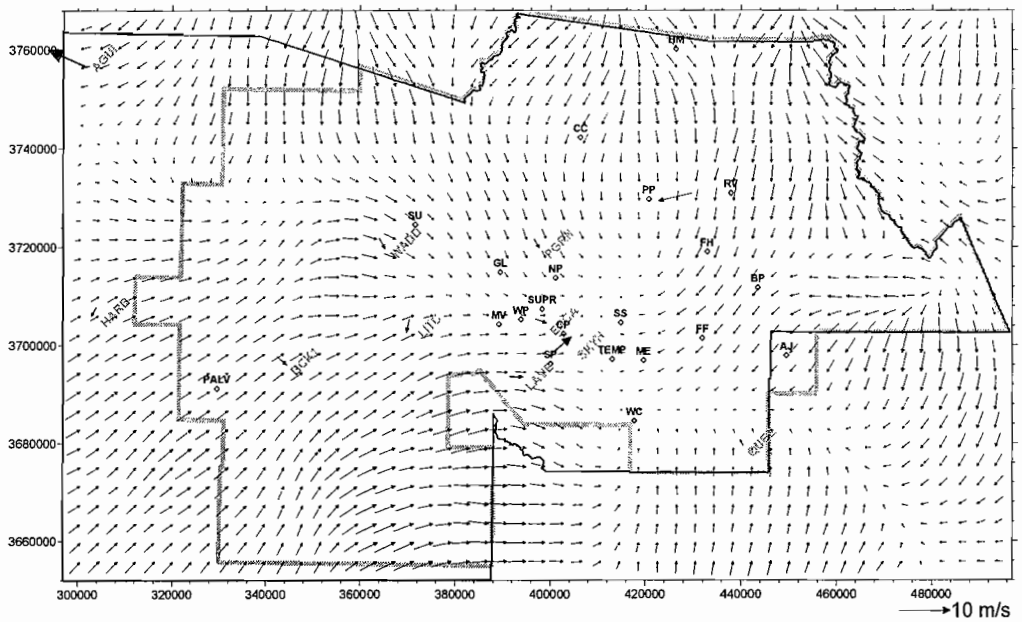
Surface MM5 Wind Field (m/s) on August 10, 2001 2:00-300 LST



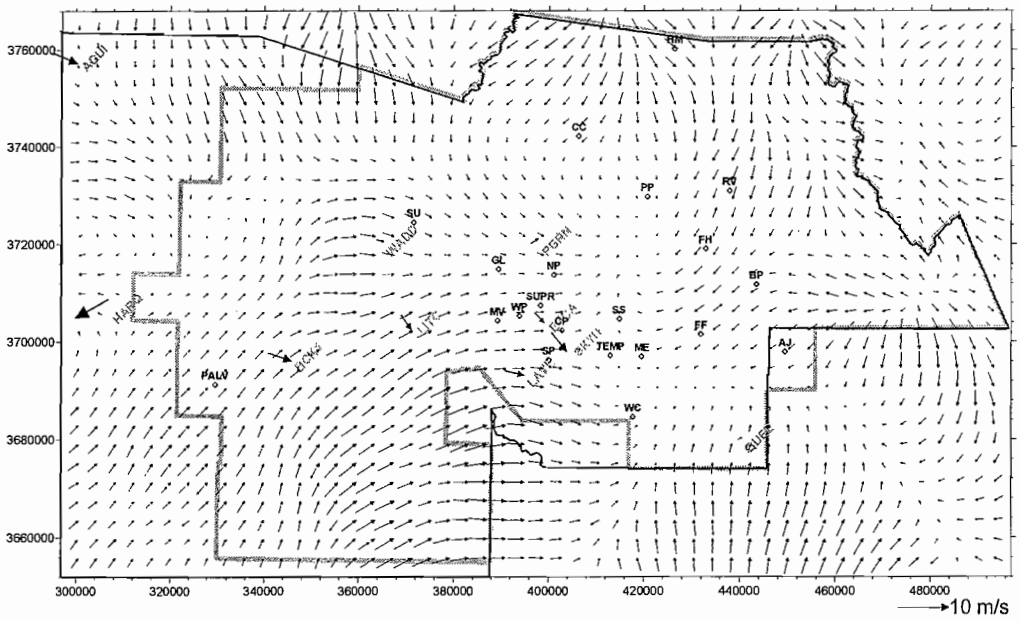
Surface MM5 Wind Field (m/s) on August 10, 2001 3:00-4:00 LST



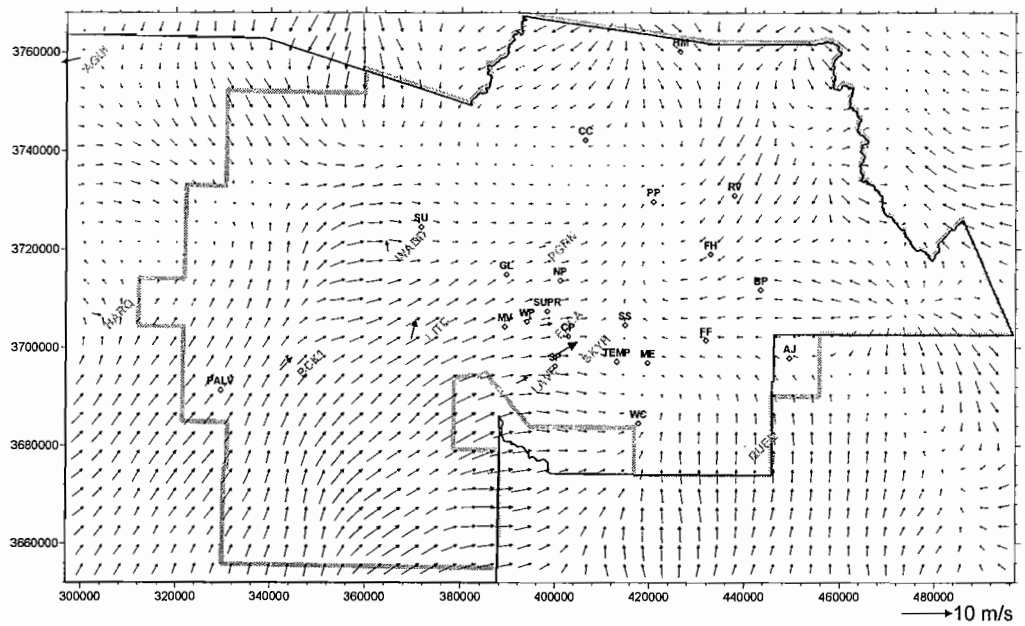
Surface MM5 Wind Field (m/s) on August 10, 2001 4:00-5:00 LST



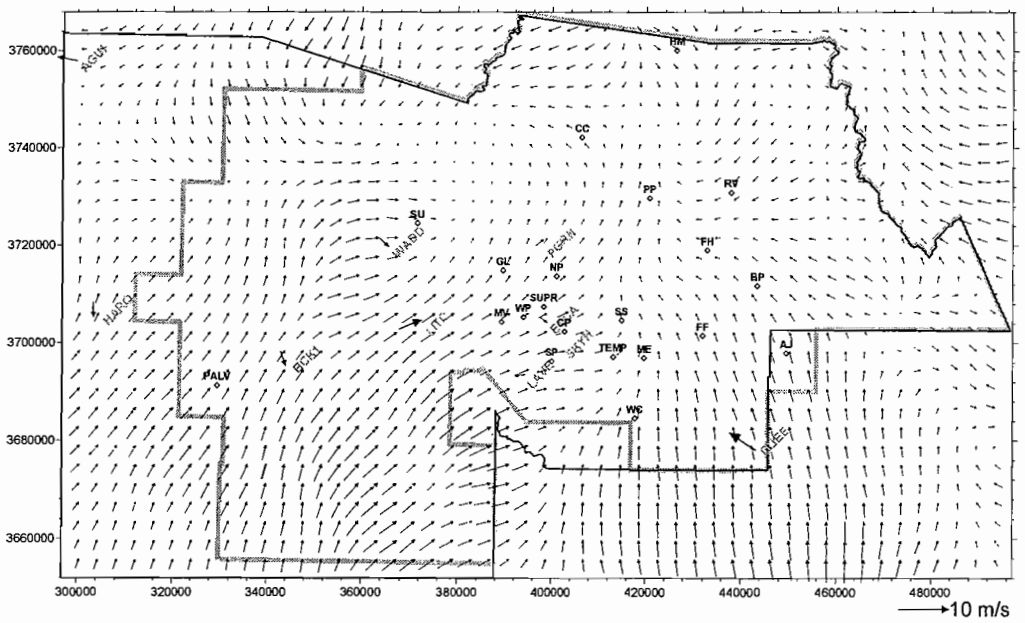
Surface MM5 Wind Field (m/s) on August 10, 2001 5:00-6:00 LST



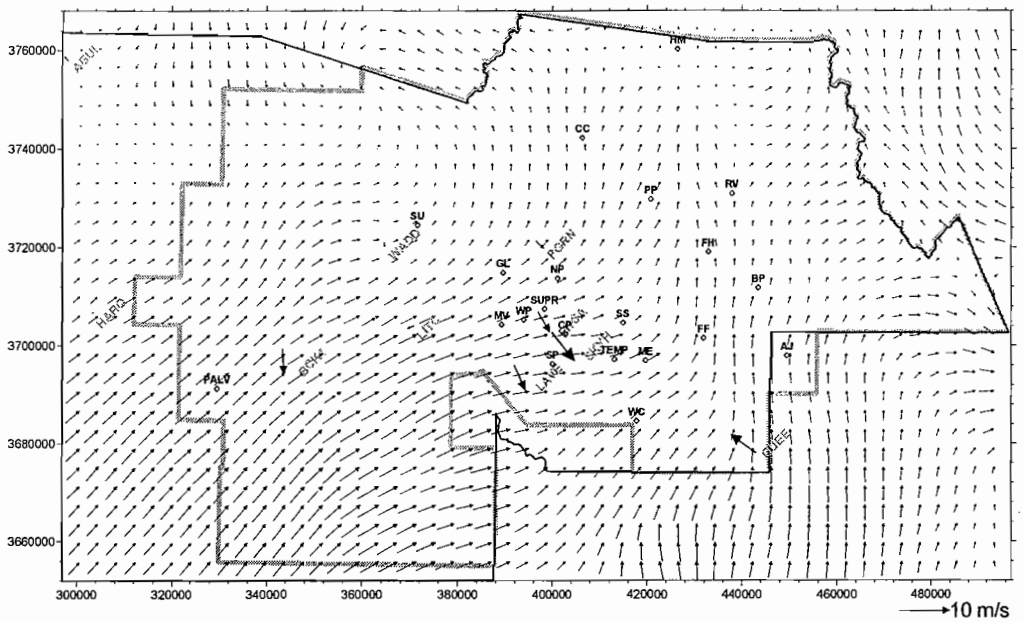
Surface MM5 Wind Field (m/s) on August 10, 2001 6:00-7:00 LST



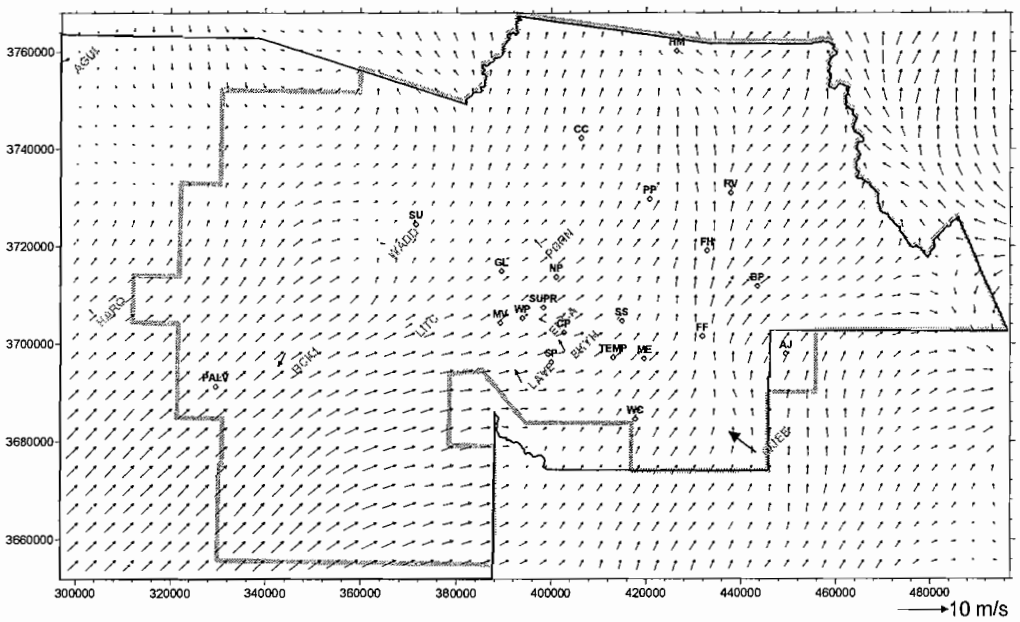
Surface MM5 Wind Field (m/s) on August 10, 2001 7:00-8:00 LST



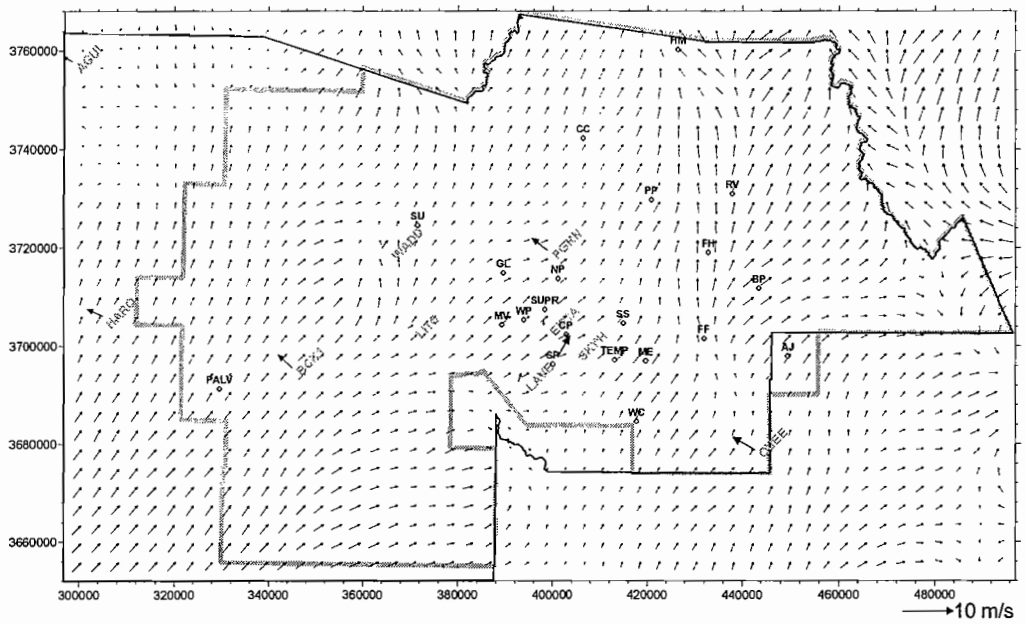
Surface MM5 Wind Field (m/s) on August 10, 2001 8:00-9:00 LST



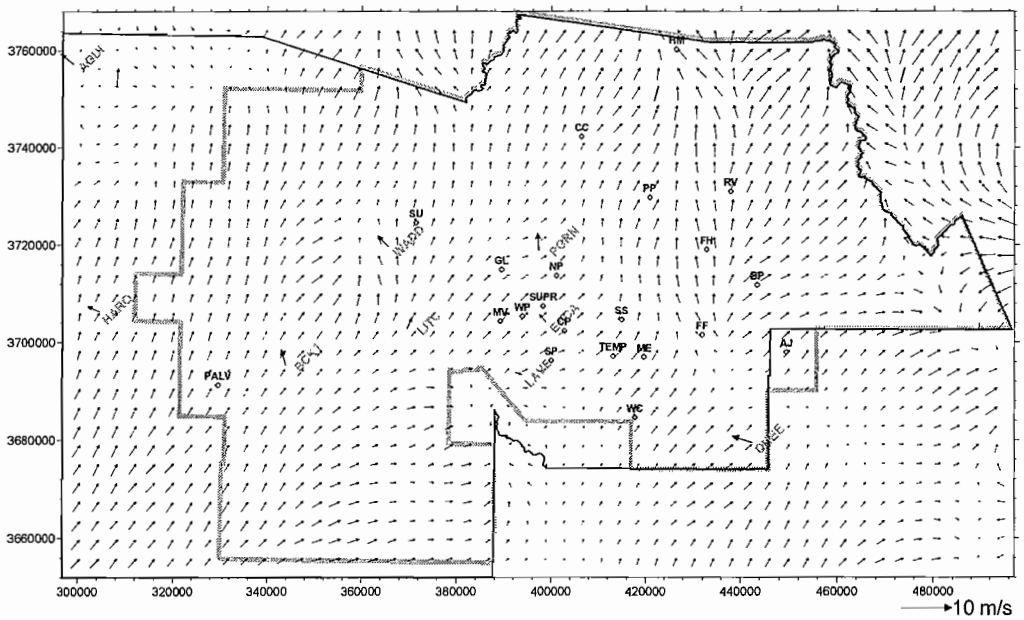
Surface MM5 Wind Field (m/s) on August 10, 2001 9:00-10:00 LST



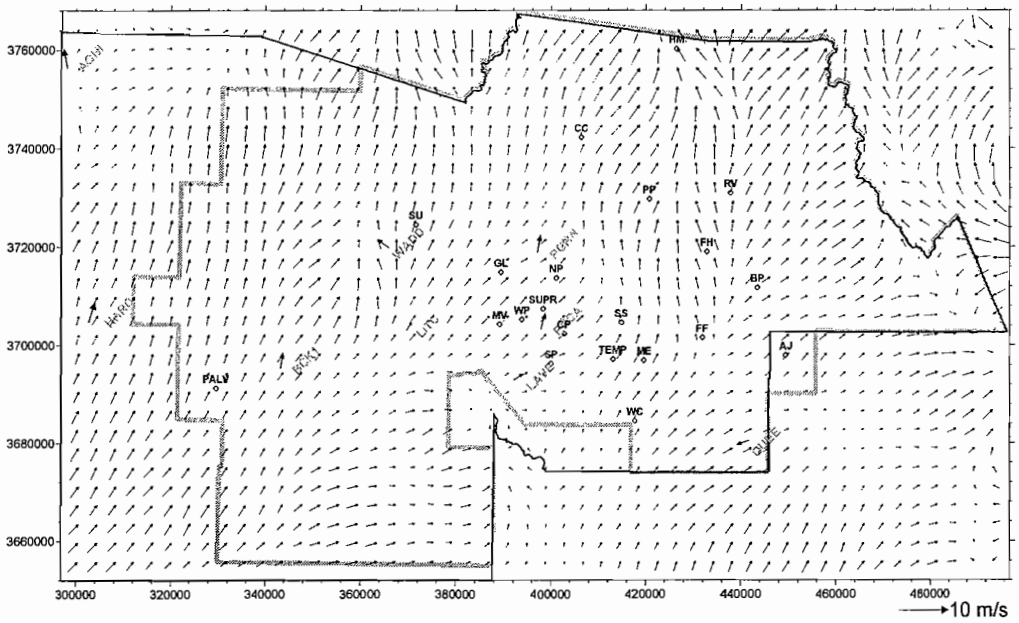
Surface MM5 Wind Field (m/s) on August 10, 2001 10:00-11:00 LST



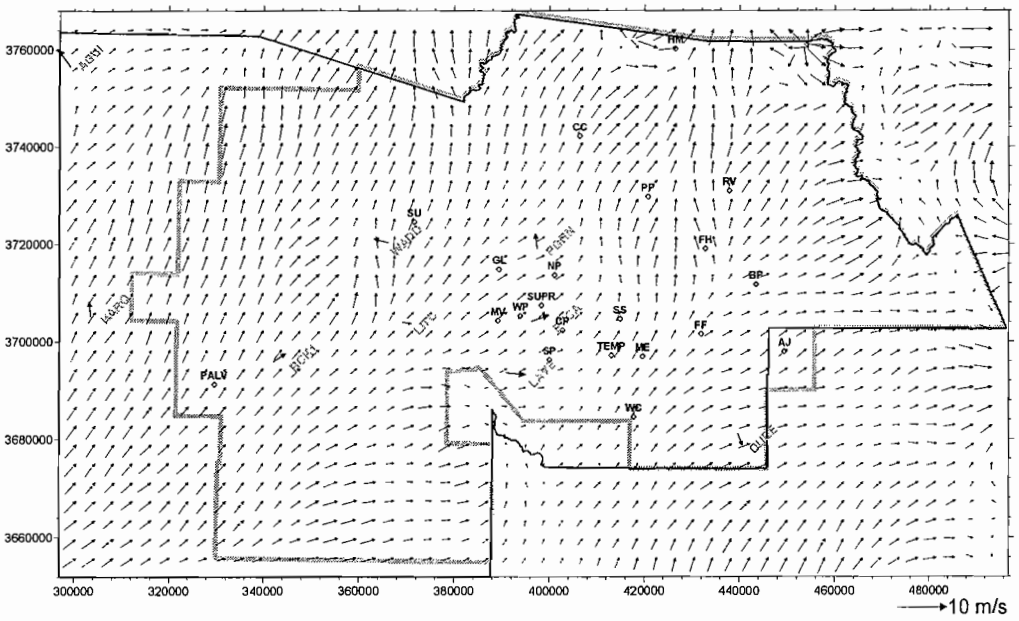
Surface MM5 Wind Field (m/s) on August 10, 2001 11:00-12:00 LST



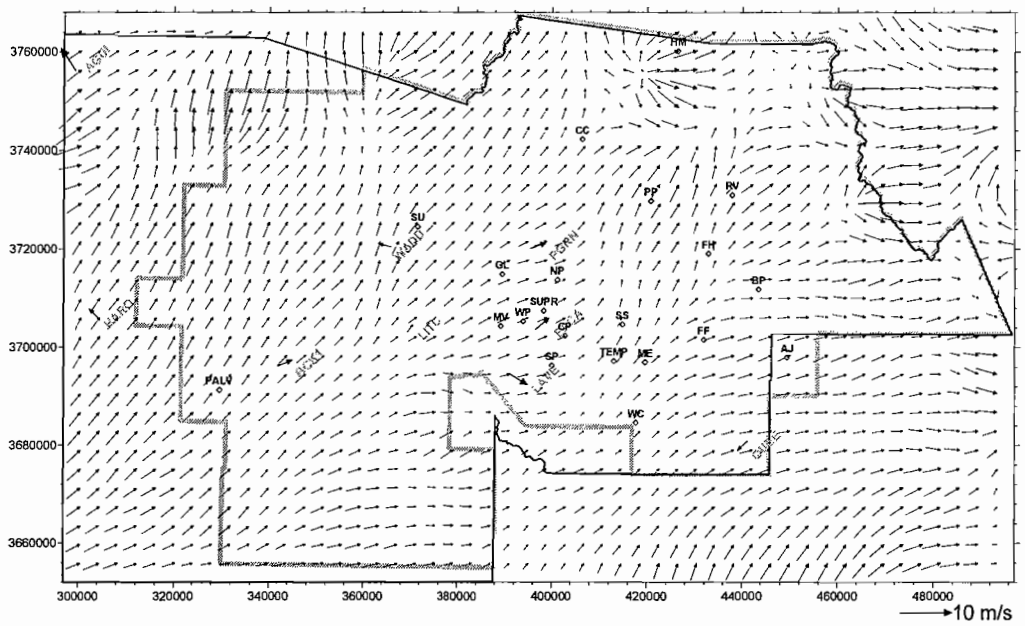
Surface MM5 Wind Field (m/s) on August 10, 2001 12:00-13:00 LST



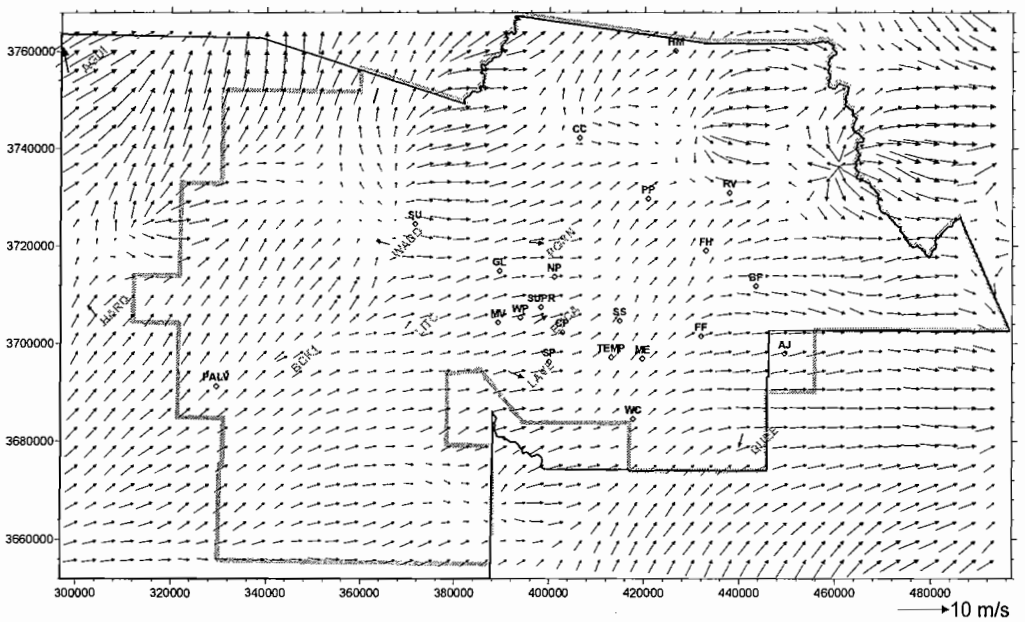
Surface MM5 Wind Field (m/s) on August 10, 2001 13:00-14:00 LST



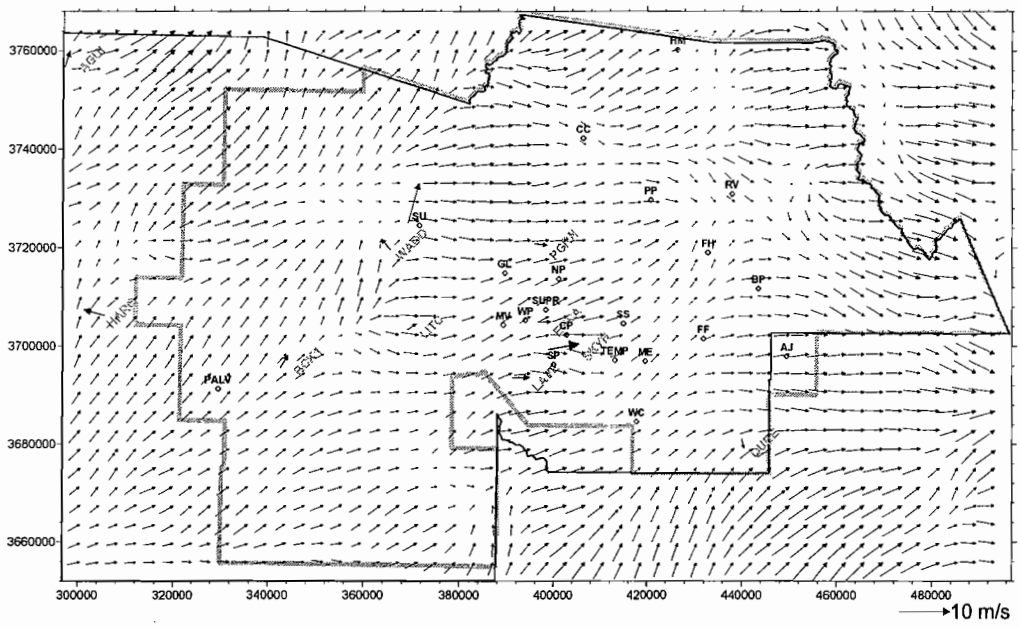
Surface MM5 Wind Field (m/s) on August 10, 2001 14:00-15:00 LST



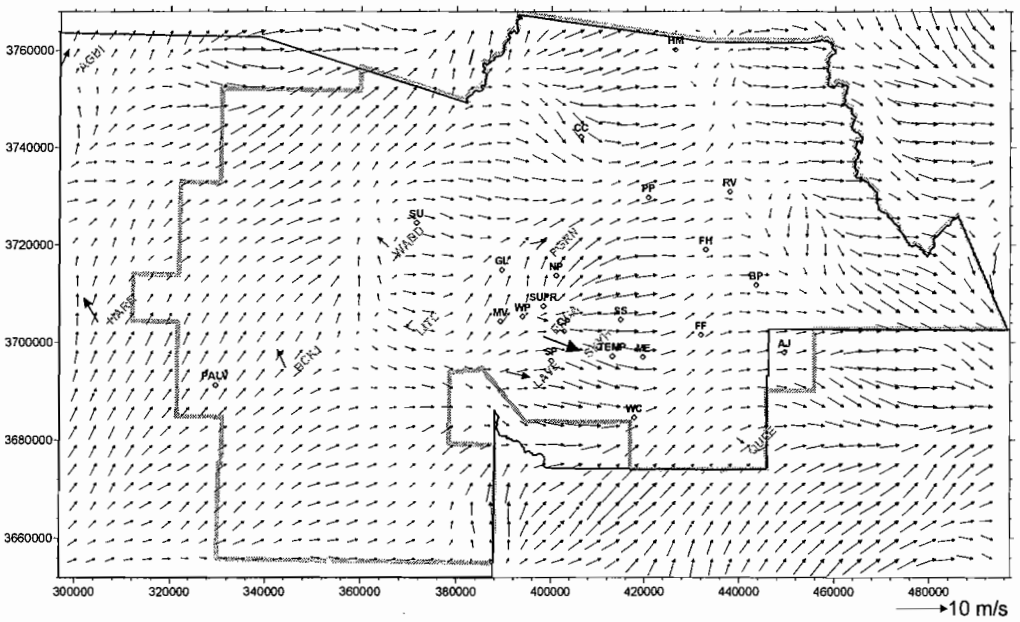
Surface MM5 Wind Field (m/s) on August 10, 2001 15:00-16:00 LST



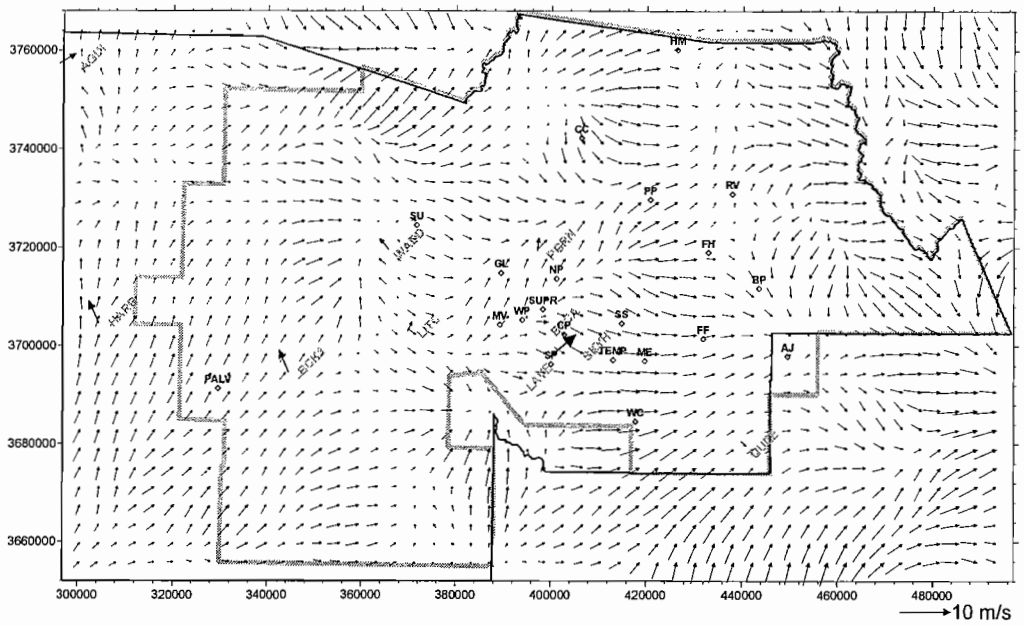
Surface MM5 Wind Field (m/s) on August 10, 2001 16:00-17:00 LST



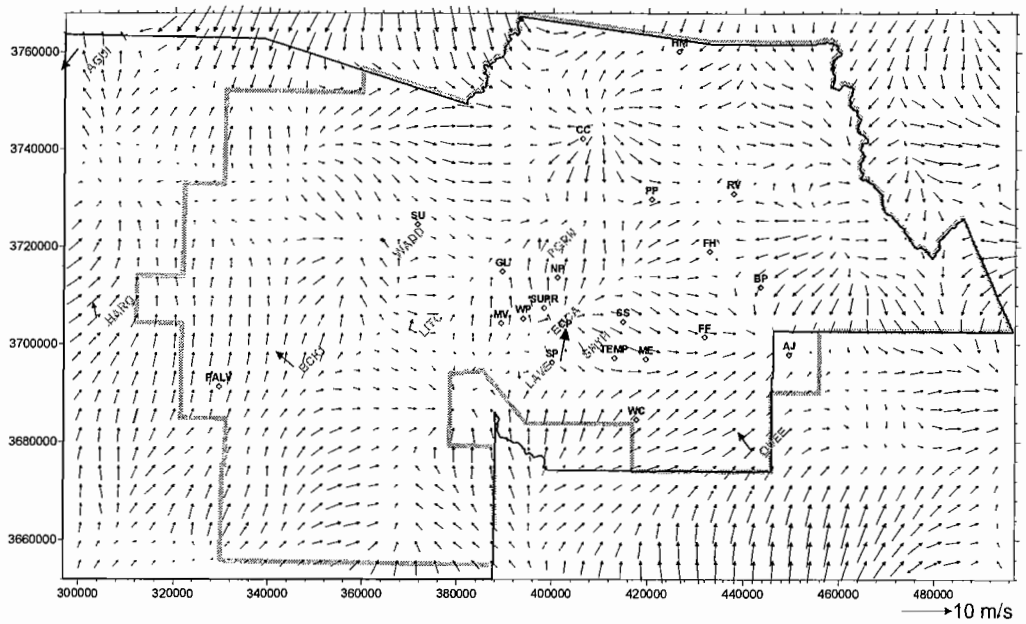
Surface MM5 Wind Field (m/s) on August 10, 2001 17:00-18:00 LST



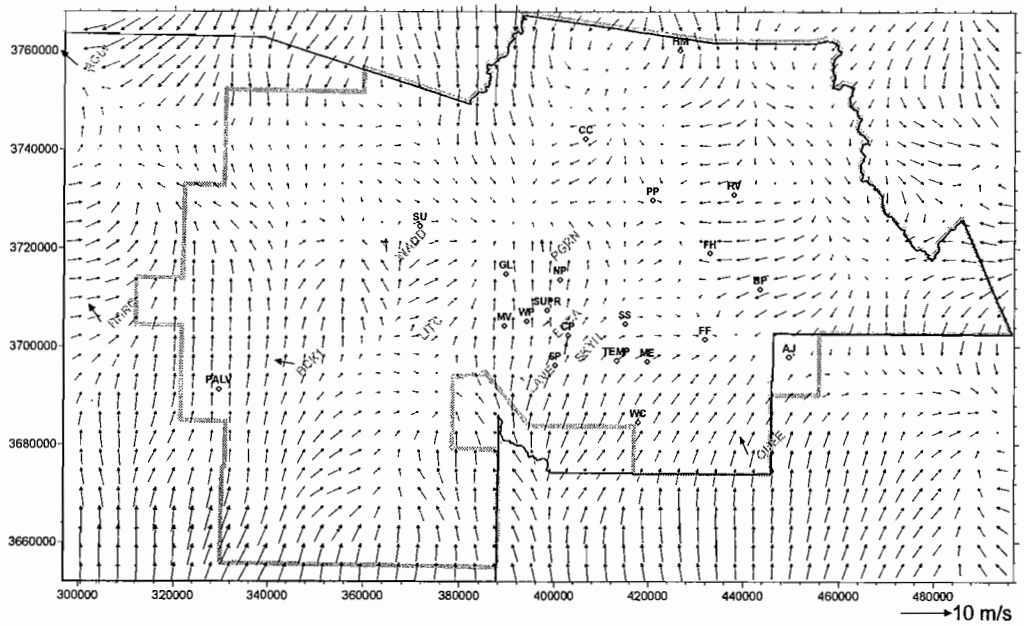
Surface MM5 Wind Field (m/s) on August 10, 2001 18:00-19:00 LST



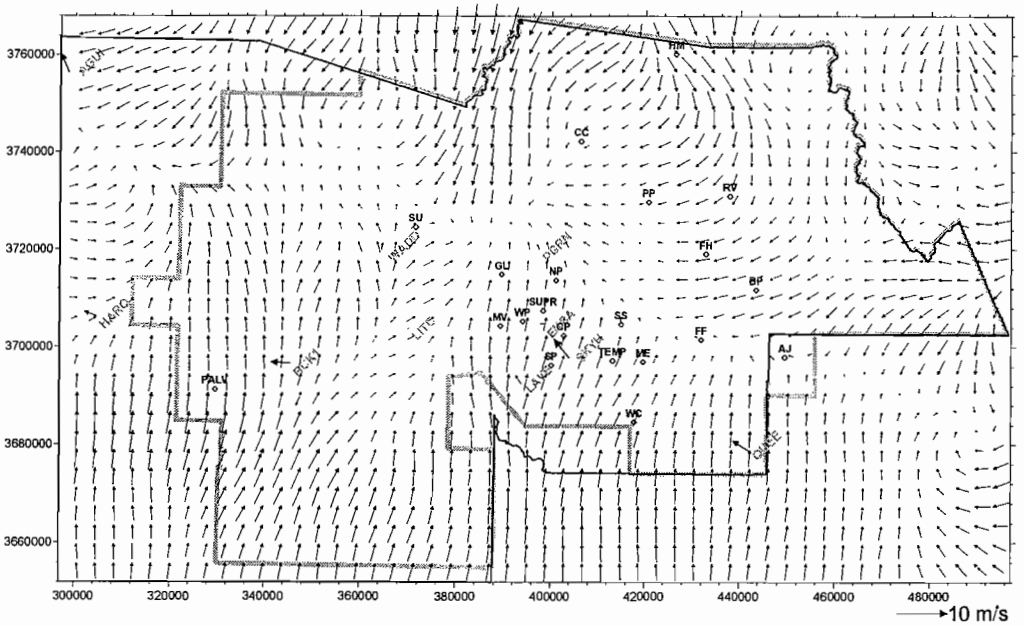
Surface MM5 Wind Field (m/s) on August 10, 2001 19:00-20:00 LST



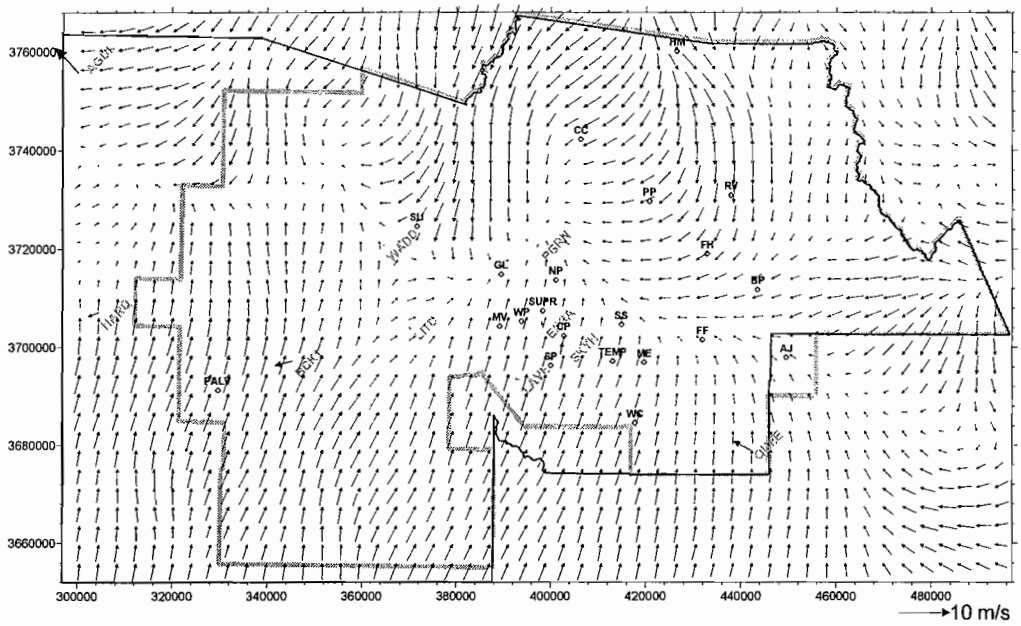
Surface MM5 Wind Field (m/s) on August 10, 2001 20:00-21:00 LST



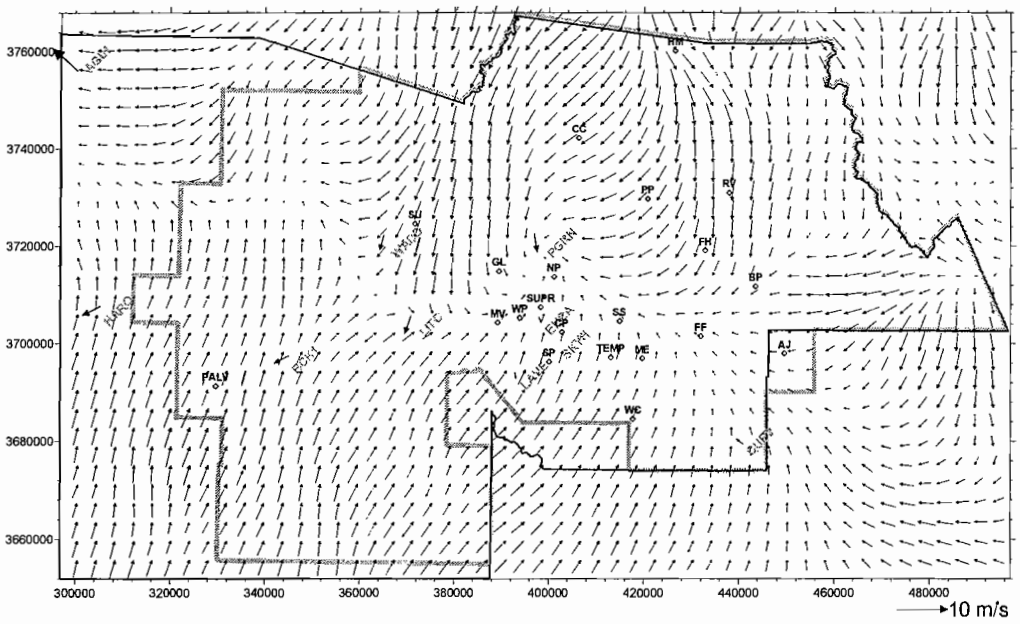
Surface MM5 Wind Field (m/s) on August 10, 2001 21:00-22:00 LST



Surface MM5 Wind Field (m/s) on August 10, 2001 22:00-23:00 LST



Surface MM5 Wind Field (m/s) on August 10, 2001 23:00-24:00 LST

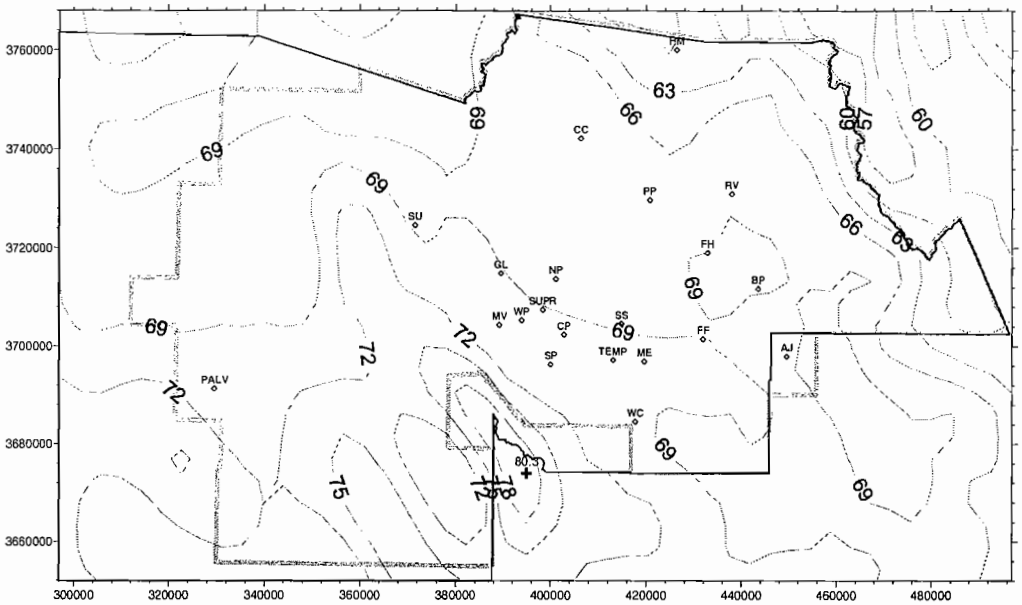


Appendix III-vii

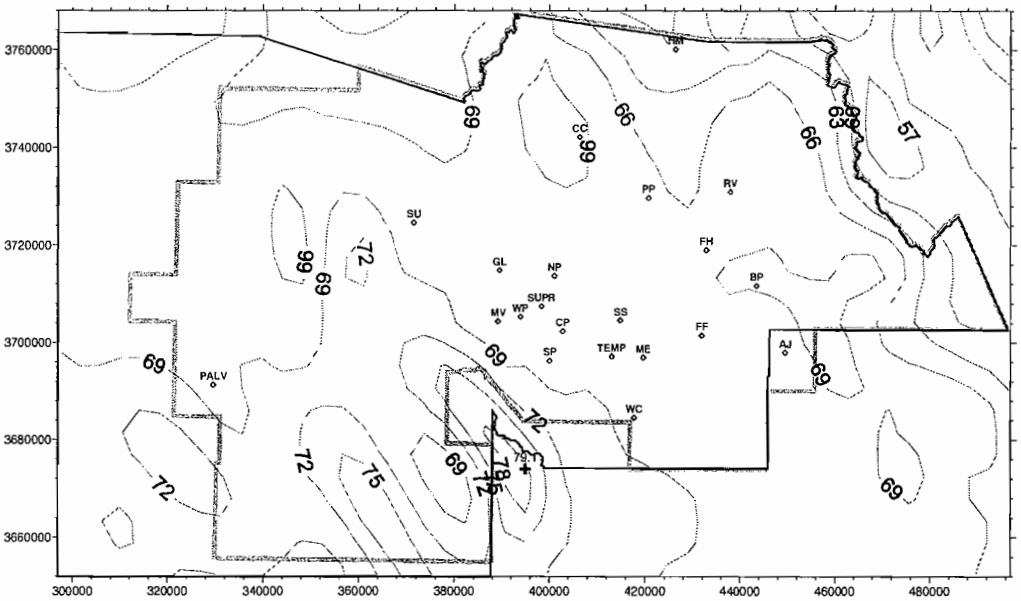
MODELED TEMPERATURE FOR THE JUNE 2002 EPISODE

The plots shown here are the simulated MM5 temperatures. These hourly temperatures are from 0:00 to 24:00 LST on June 6, 2002.

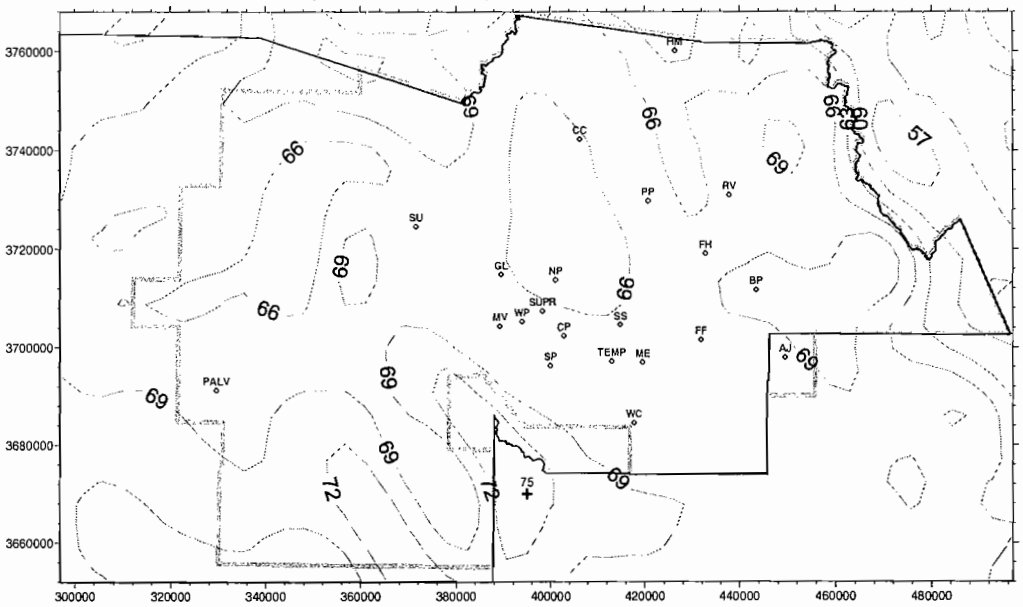
Surface MM5 Temperature (°F) on June 6, 2002 0:00-1:00 LST



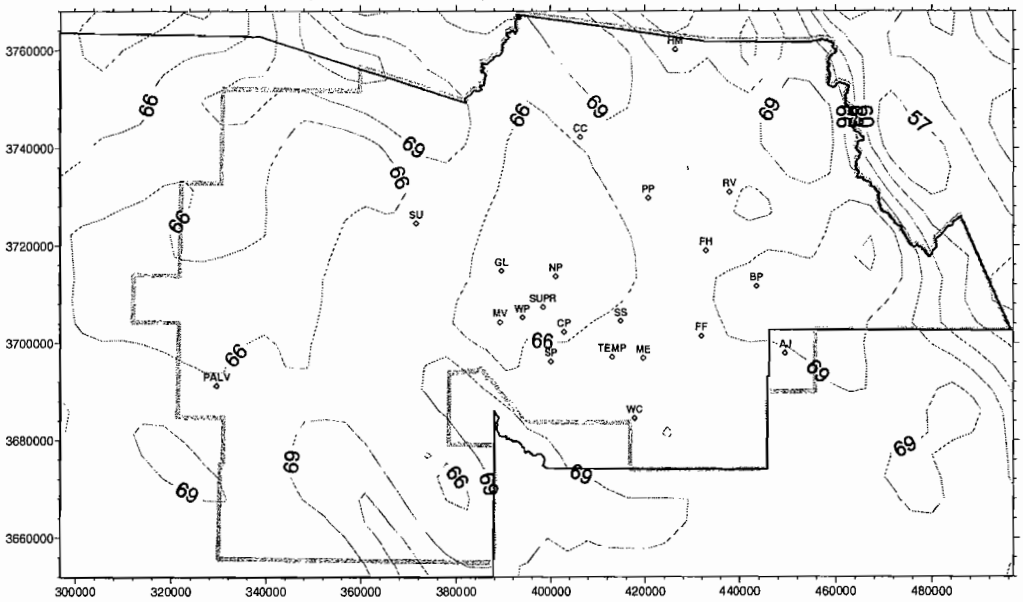
Surface MM5 Temperature (°F) on June 6, 2002 1:00-2:00 LST



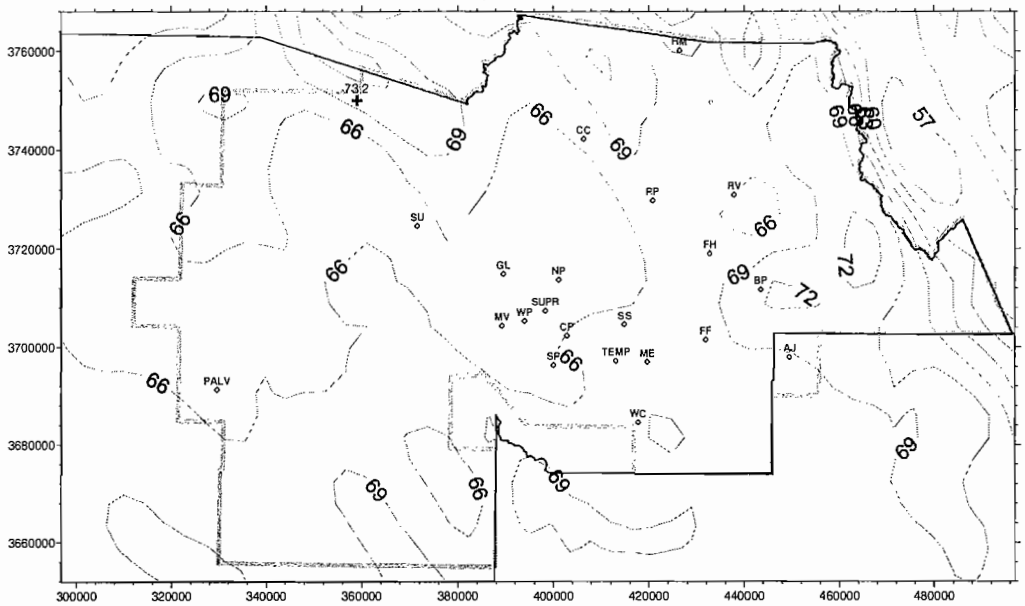
Surface MM5 Temperature (°F) on June 6, 2002 2:00-300 LST



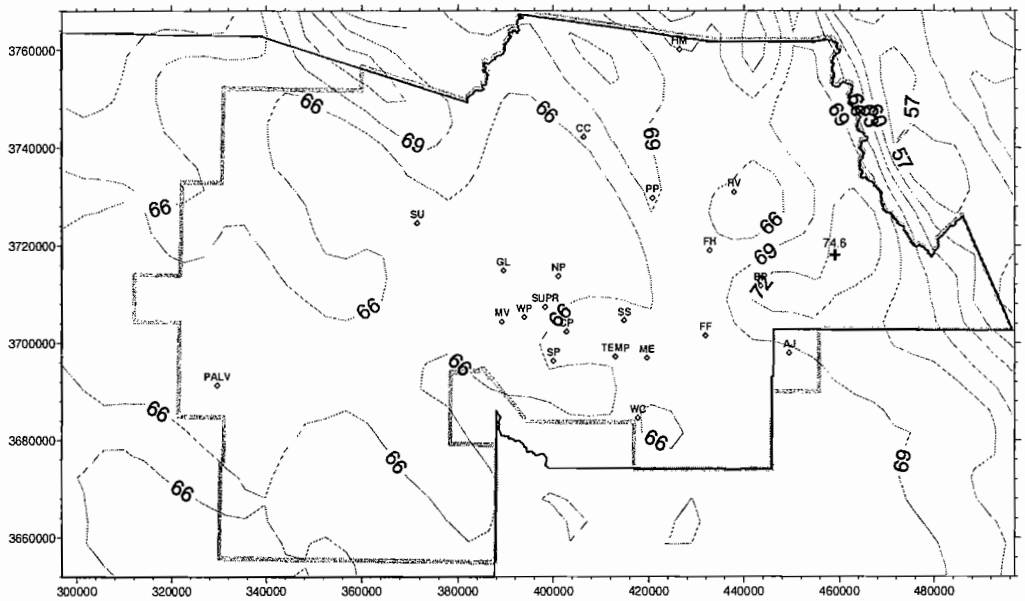
Surface MM5 Temperature (°F) on June 6, 2002 3:00-4:00 LST



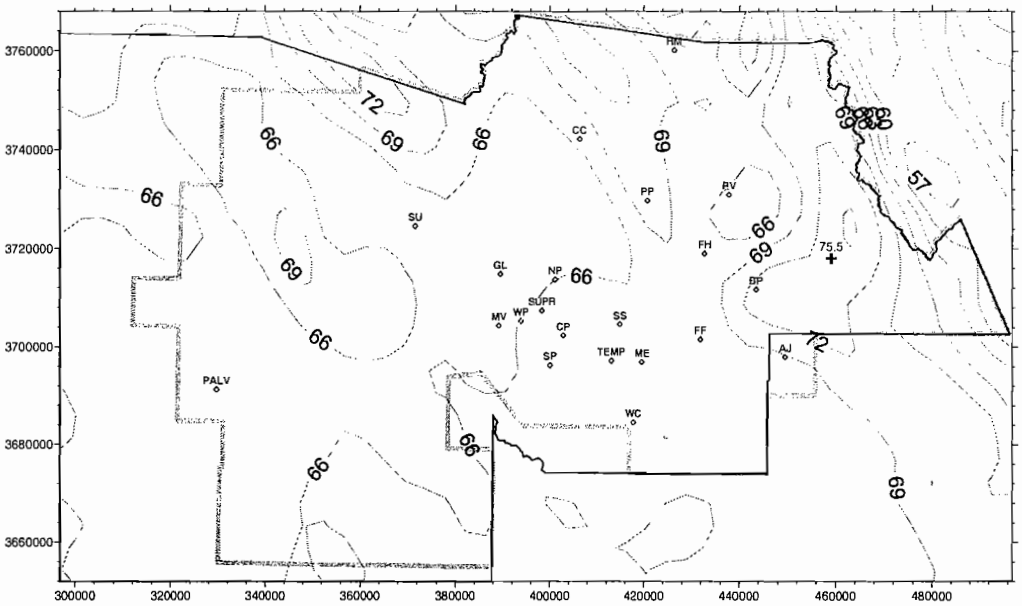
Surface MM5 Temperature (°F) on June 6, 2002 4:00-5:00 LST



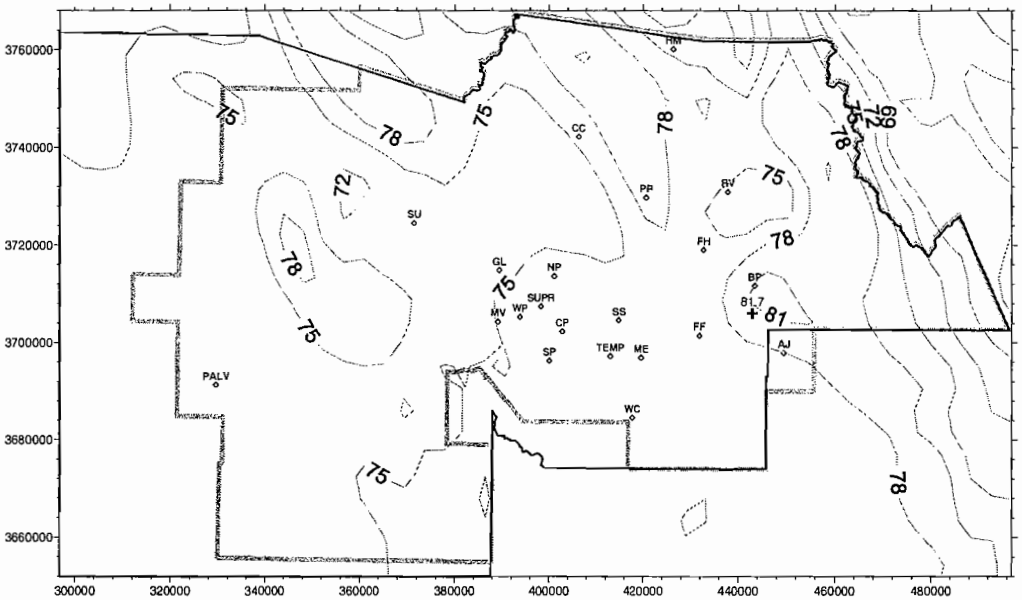
Surface MM5 Temperature (°F) on June 6, 2002 5:00-6:00 LST



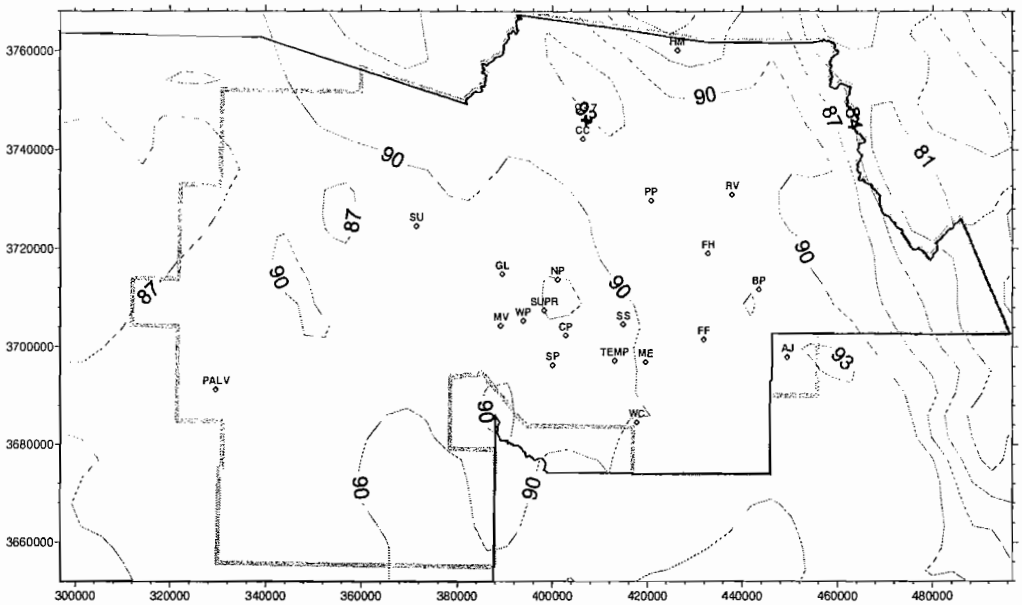
Surface MM5 Temperature (°F) on June 6, 2002 6:00-7:00 LST



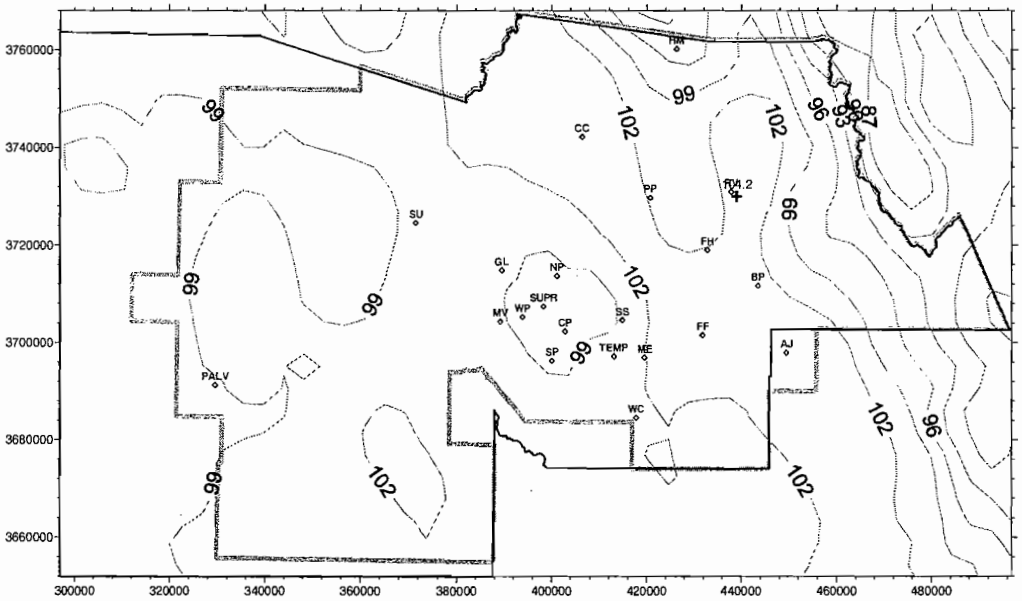
Surface MM5 Temperature (°F) on June 6, 2002 7:00-8:00 LST



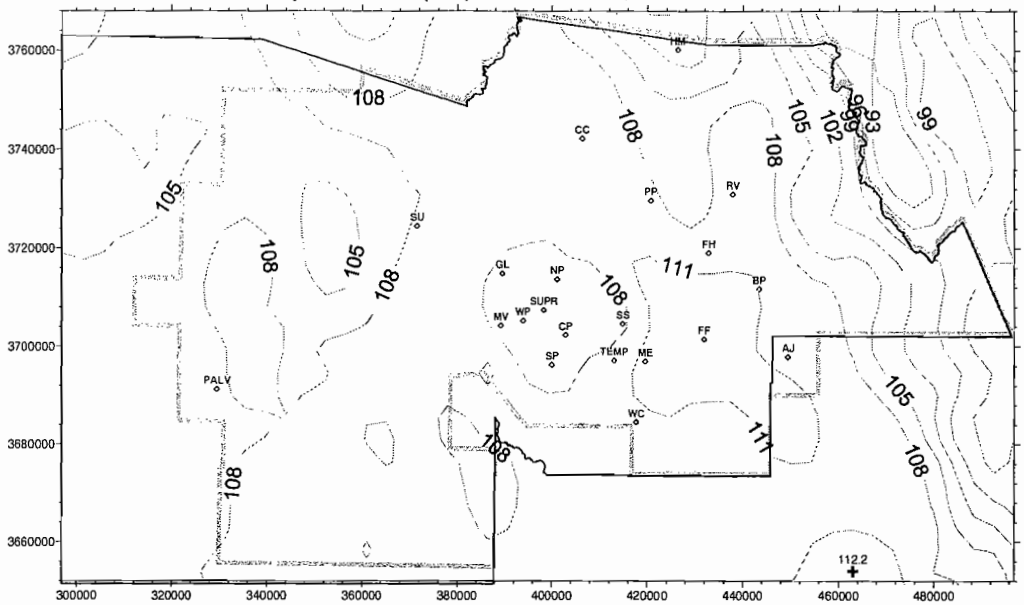
Surface MM5 Temperature (°F) on June 6, 2002 8:00-9:00 LST



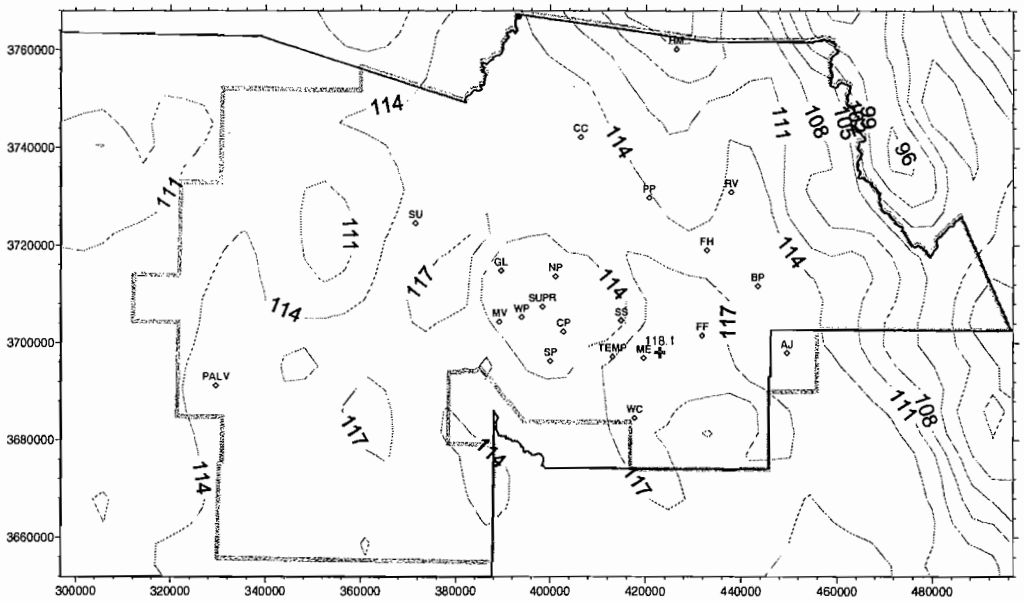
Surface MM5 Temperature (°F) on June 6, 2002 9:00-10:00 LST



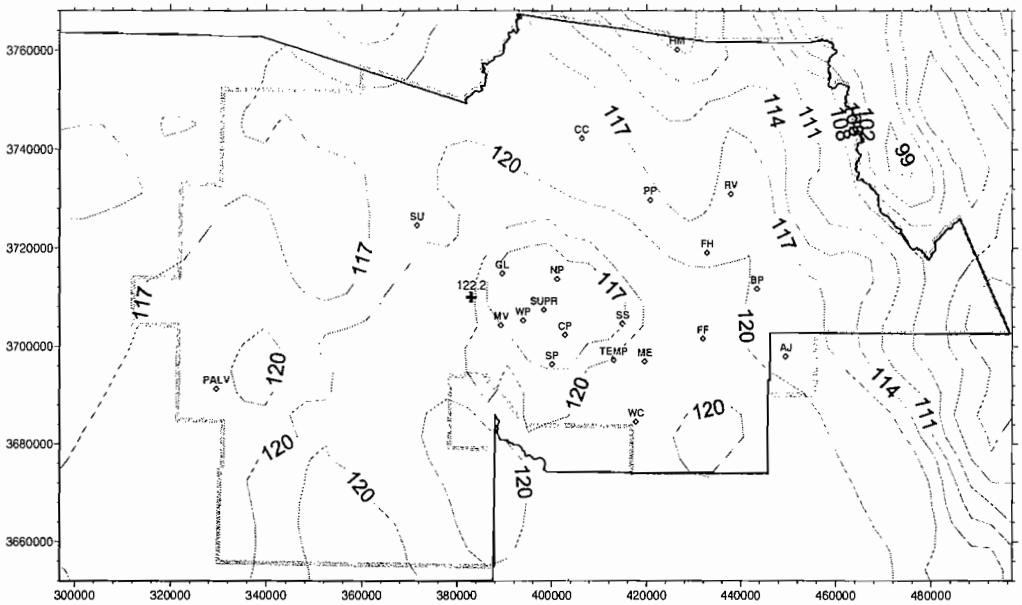
Surface MM5 Temperature (°F) on June 6, 2002 10:00-11:00 LST



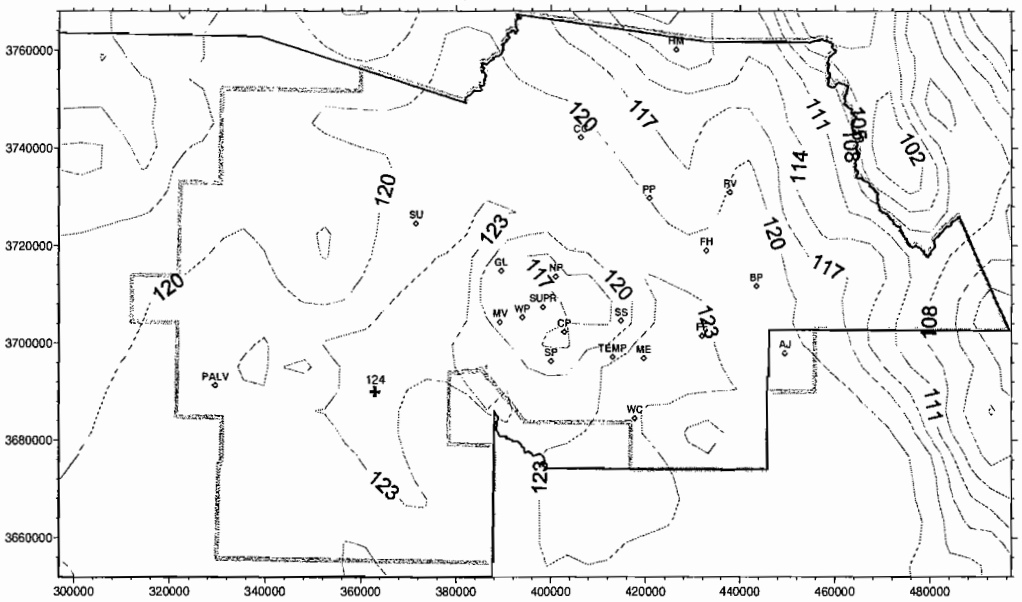
Surface MM5 Temperature (°F) on June 6, 2002 11:00-12:00 LST



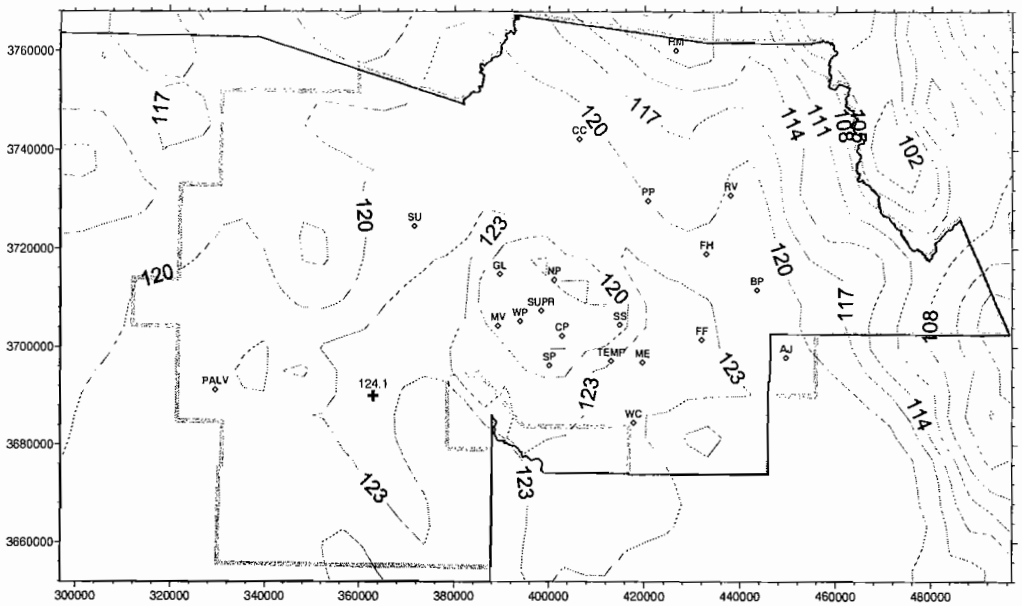
Surface MM5 Temperature (°F) on June 6, 2002 12:00-13:00 LST



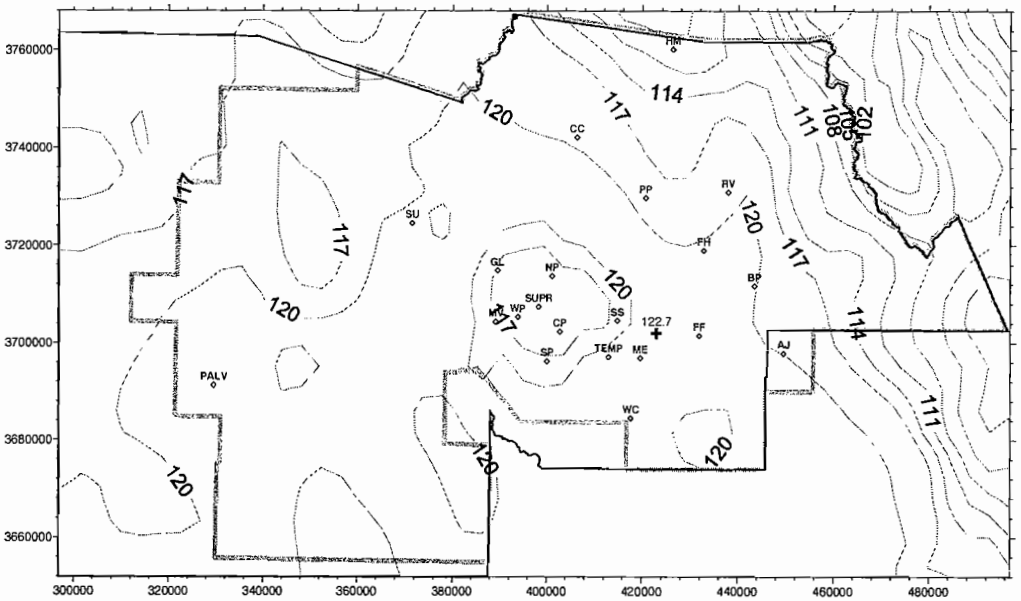
Surface MM5 Temperature (°F) on June 6, 2002 13:00-14:00 LST



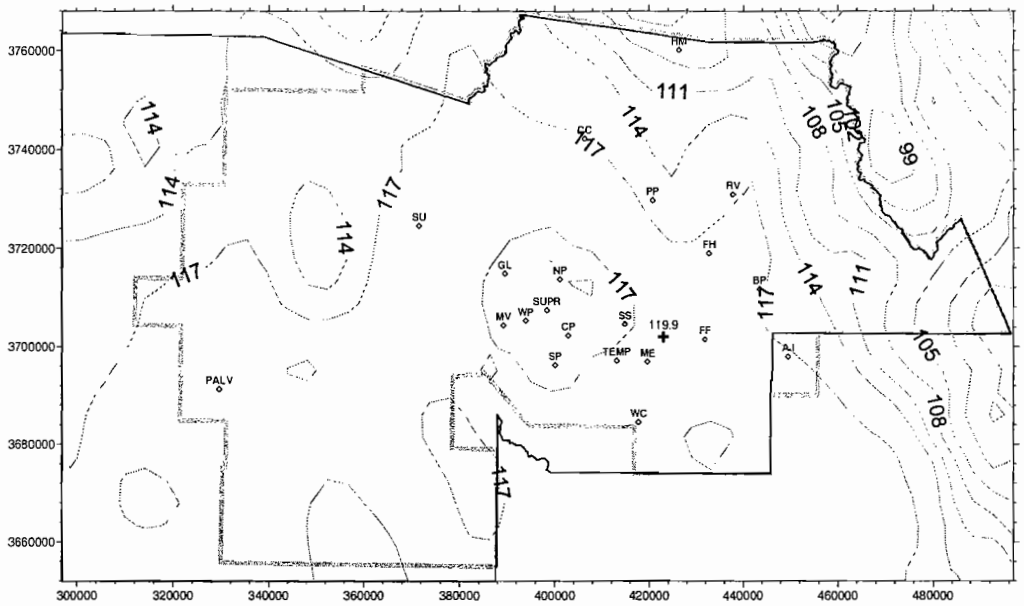
Surface MM5 Temperature (°F) on June 6, 2002 14:00-15:00 LST



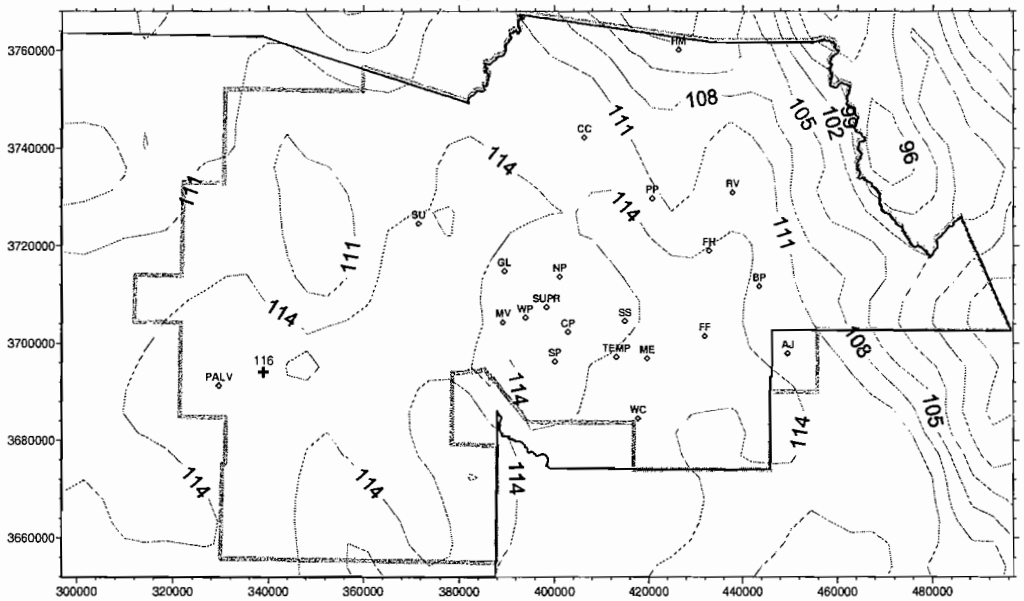
Surface MM5 Temperature (°F) on June 6, 2002 15:00-16:00 LST



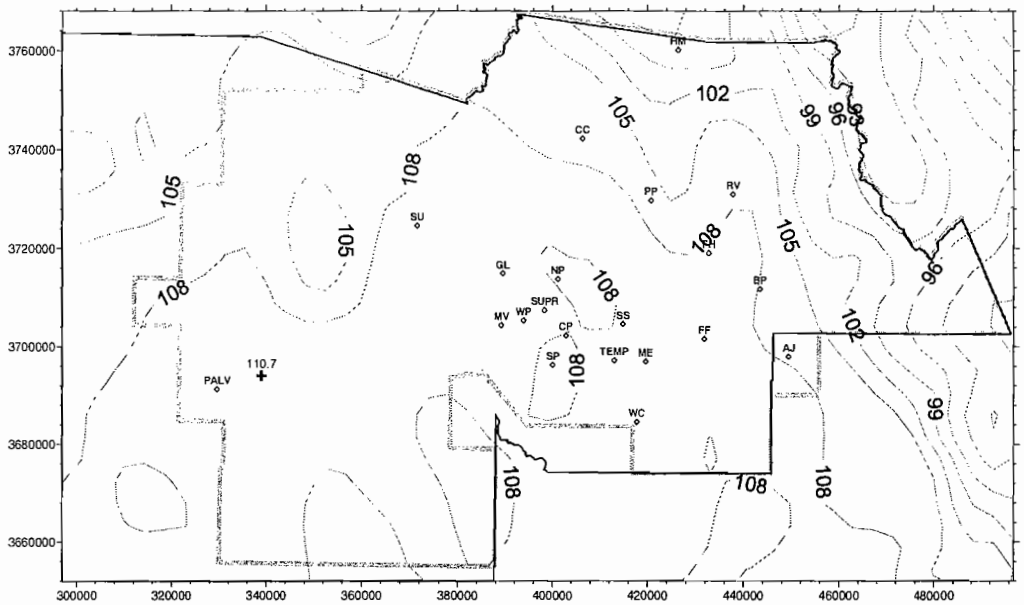
Surface MM5 Temperature (°F) on June 6, 2002 16:00-17:00 LST



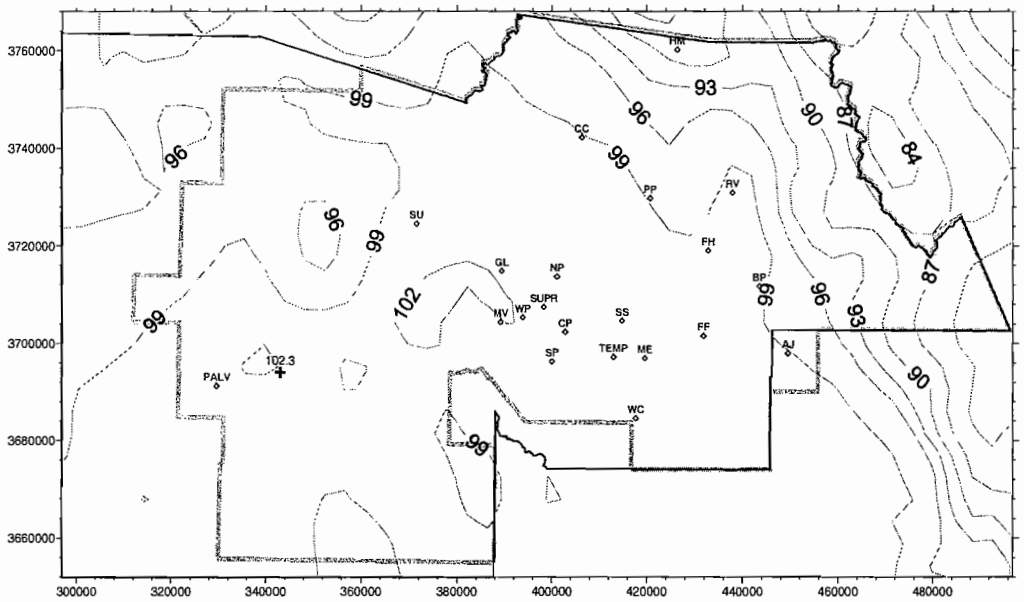
Surface MM5 Temperature (°F) on June 6, 2002 17:00-18:00 LST



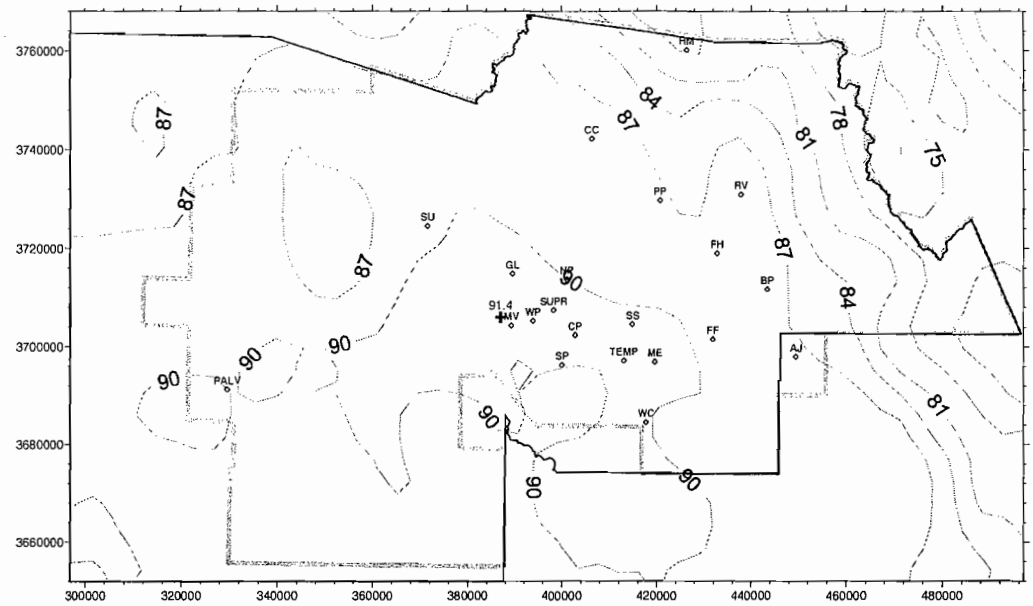
Surface MM5 Temperature (°F) on June 6, 2002 18:00-19:00 LST



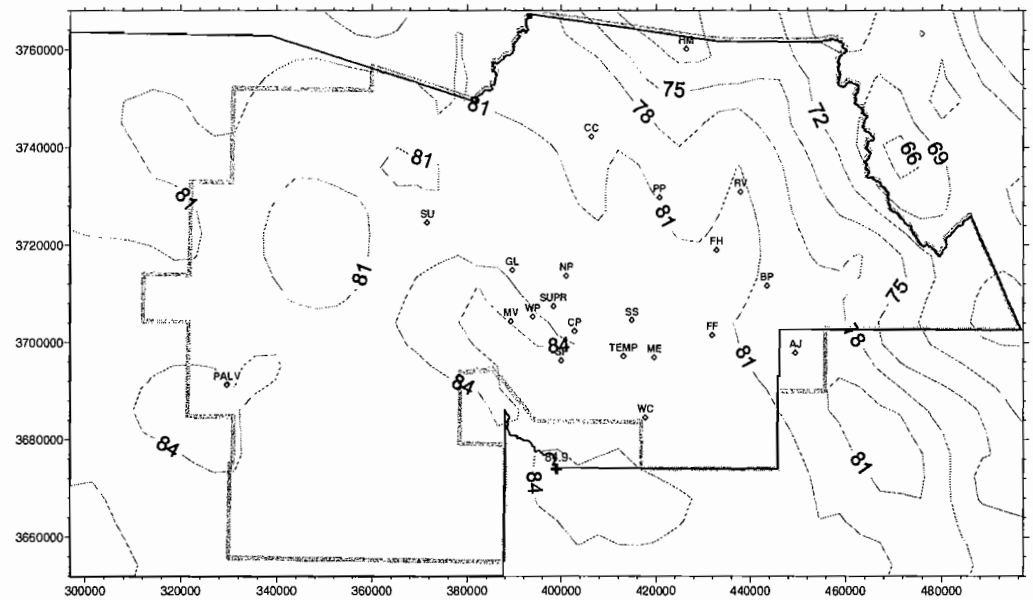
Surface MM5 Temperature (°F) on June 6, 2002 19:00-20:00 LST



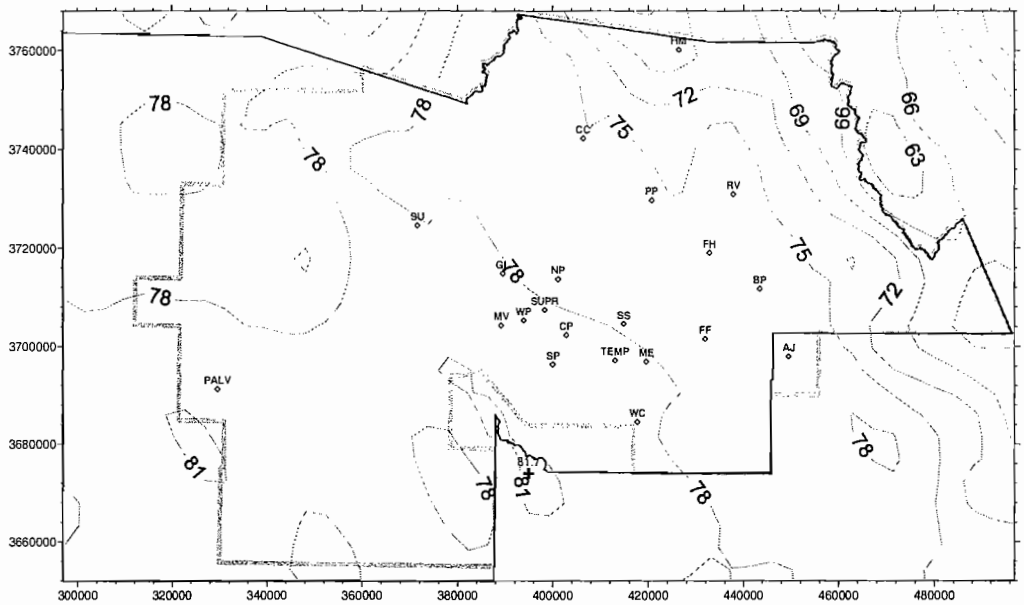
Surface MM5 Temperature (°F) on June 6, 2002 20:00-21:00 LST



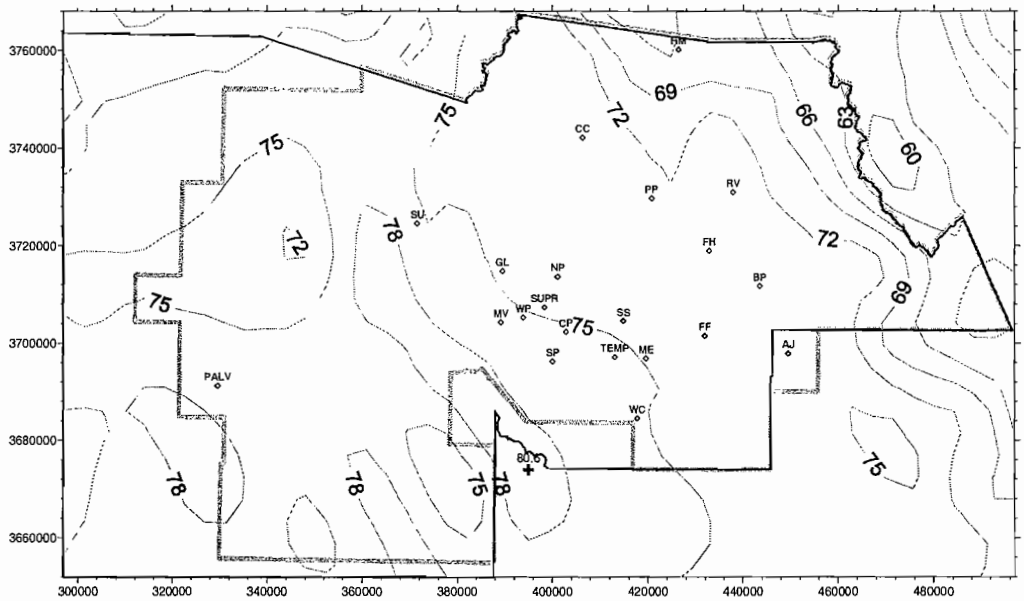
Surface MM5 Temperature (°F) on June 6, 2002 21:00-22:00 LST



Surface MM5 Temperature (°F) on June 6, 2002 22:00-23:00 LST



Surface MM5 Temperature (°F) on June 6, 2002 23:00-24:00 LST

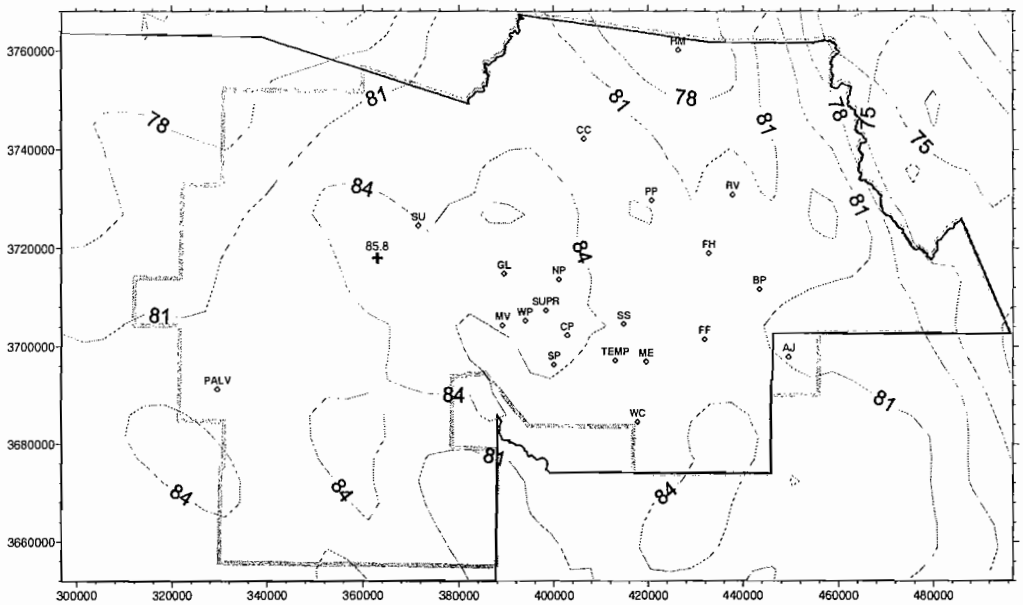


Appendix III-viii

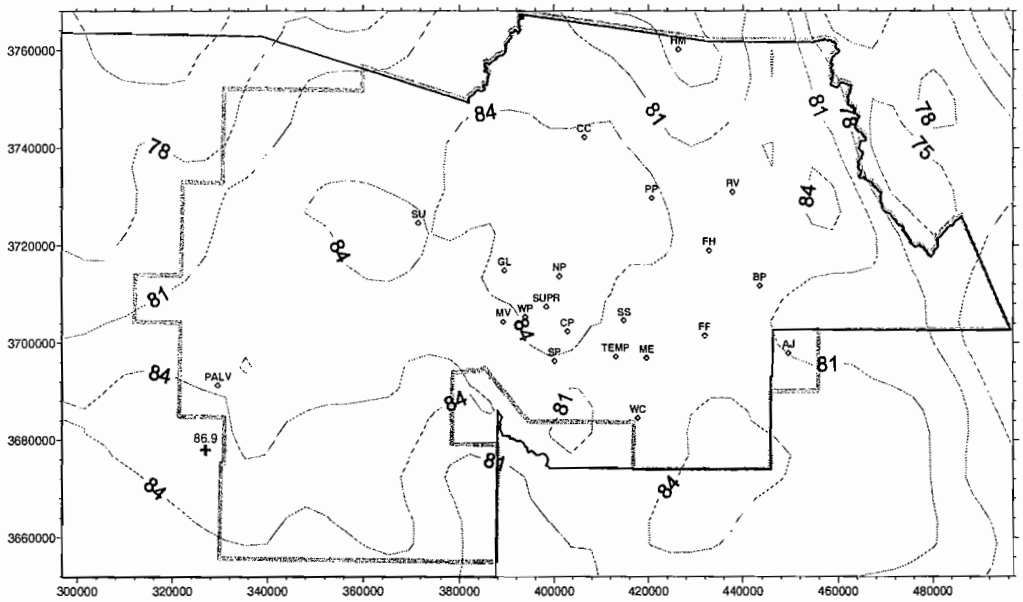
MODELED TEMPERATURE FOR THE JULY 2002 EPISODE

The plots shown here are the simulated MM5 temperatures. These hourly temperatures are from 0:00 to 24:00 LST on July 9, 2002.

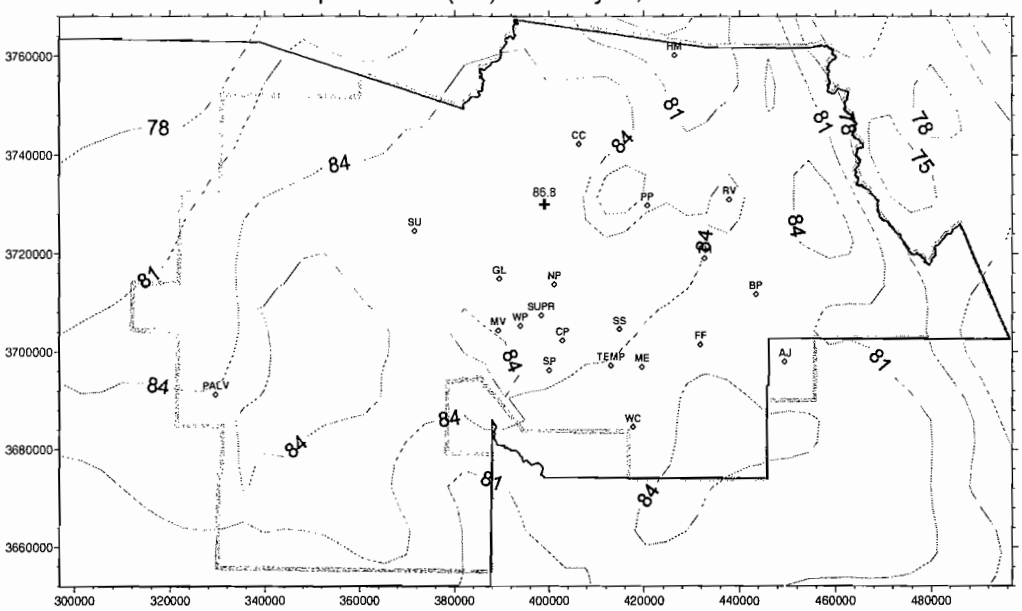
Surface MM5 Temperature (°F) on July 9, 2002 0:00-1:00 LST



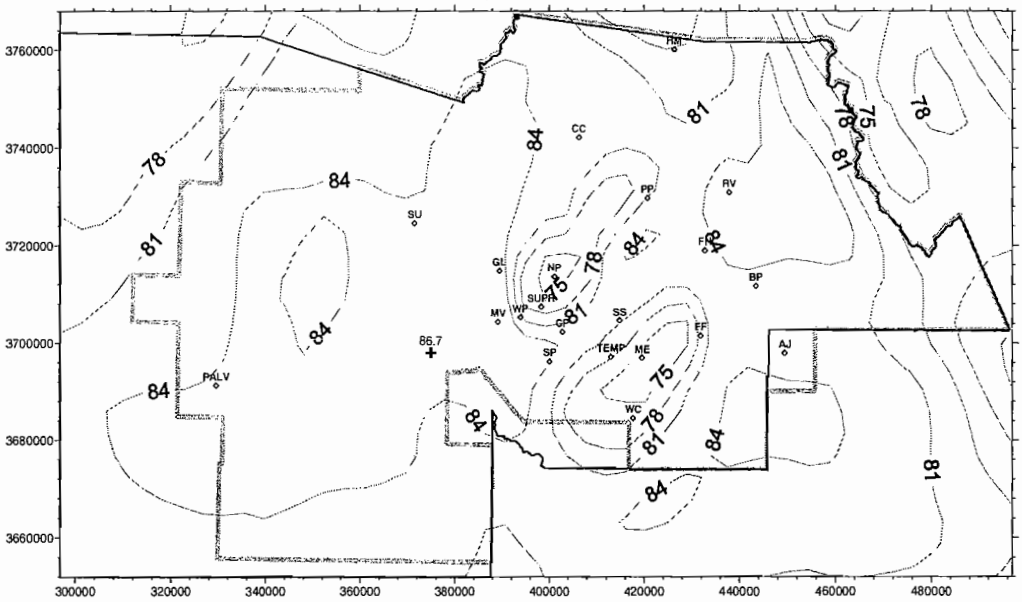
Surface MM5 Temperature (°F) on July 9, 2002 1:00-2:00 LST



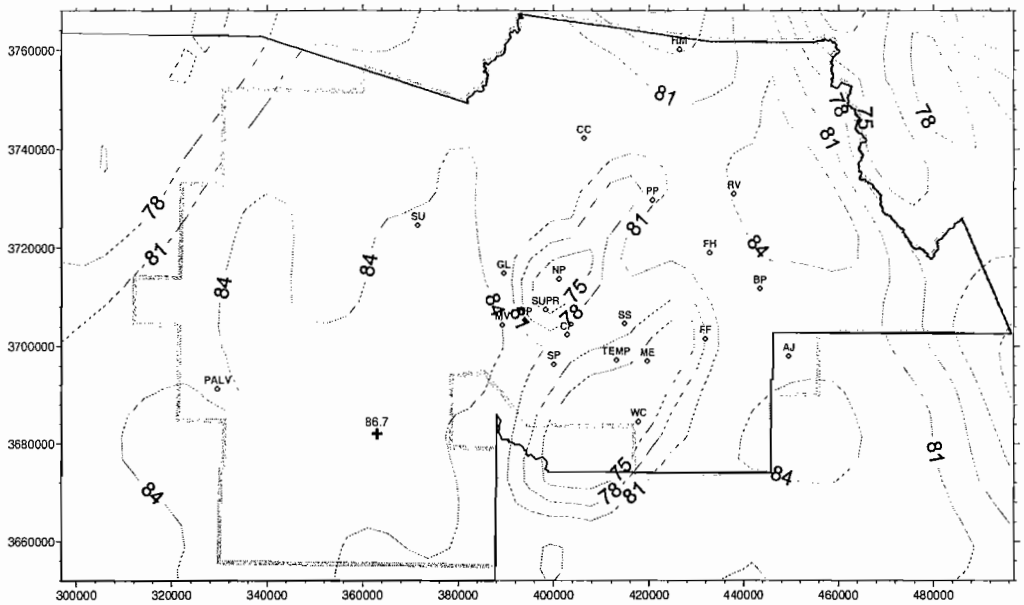
Surface MM5 Temperature (°F) on July 9, 2002 2:00-300 LST



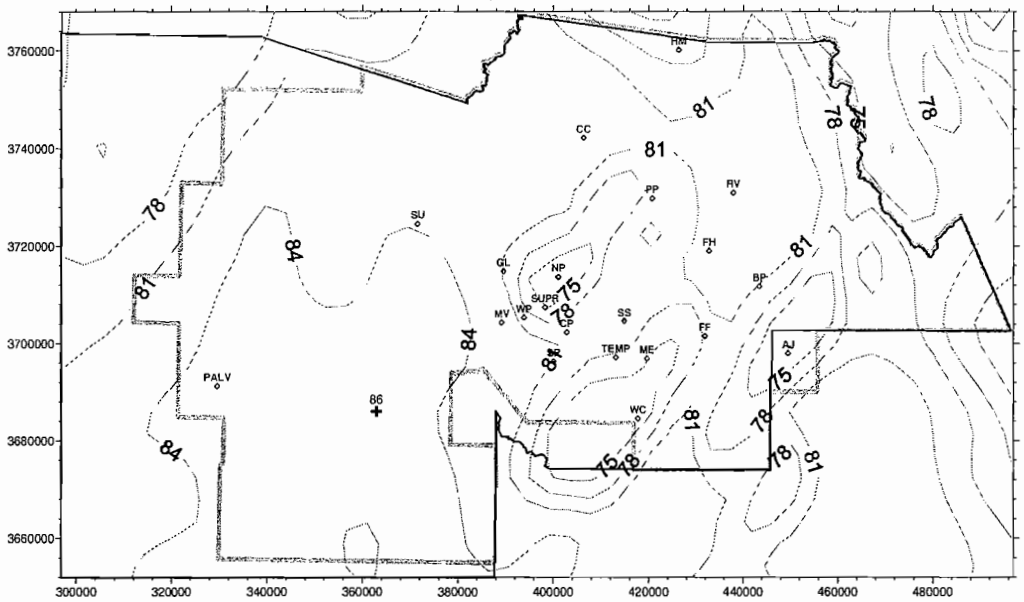
Surface MM5 Temperature (°F) on July 9, 2002 3:00-4:00 LST



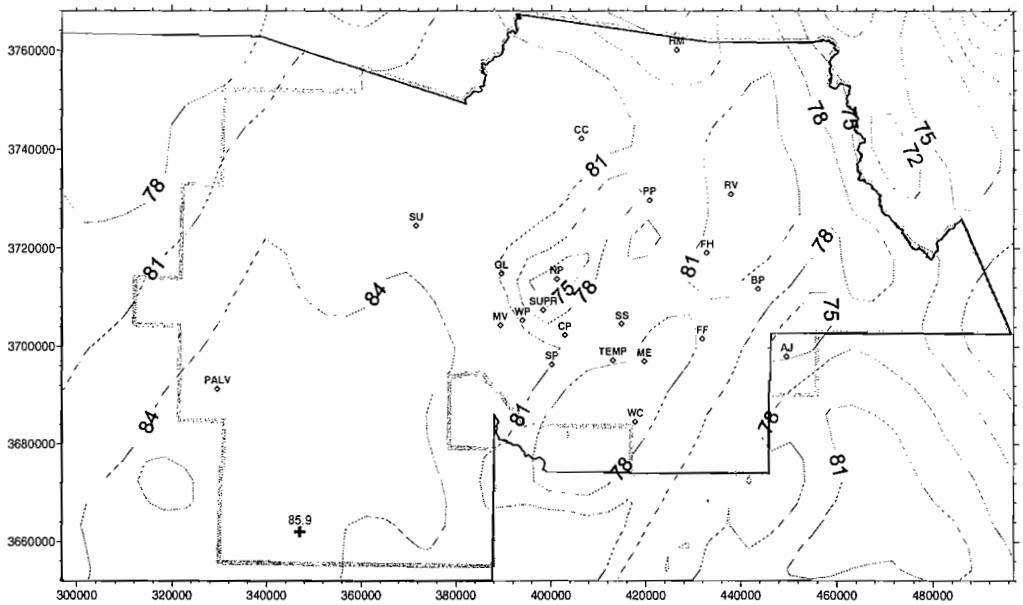
Surface MM5 Temperature (°F) on July 9, 2002 4:00-5:00 LST



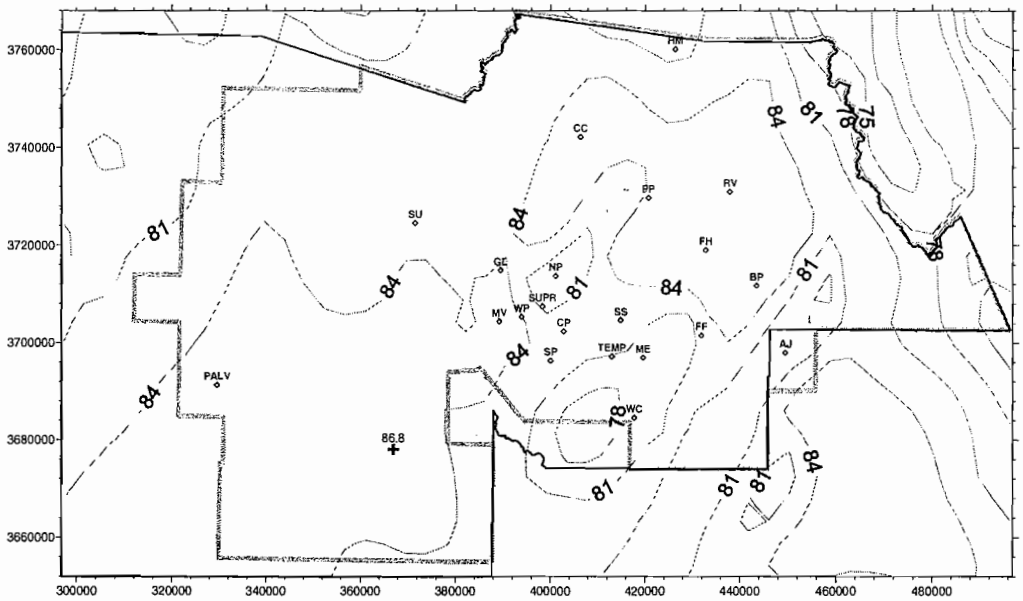
Surface MM5 Temperature (°F) on July 9, 2002 5:00-6:00 LST



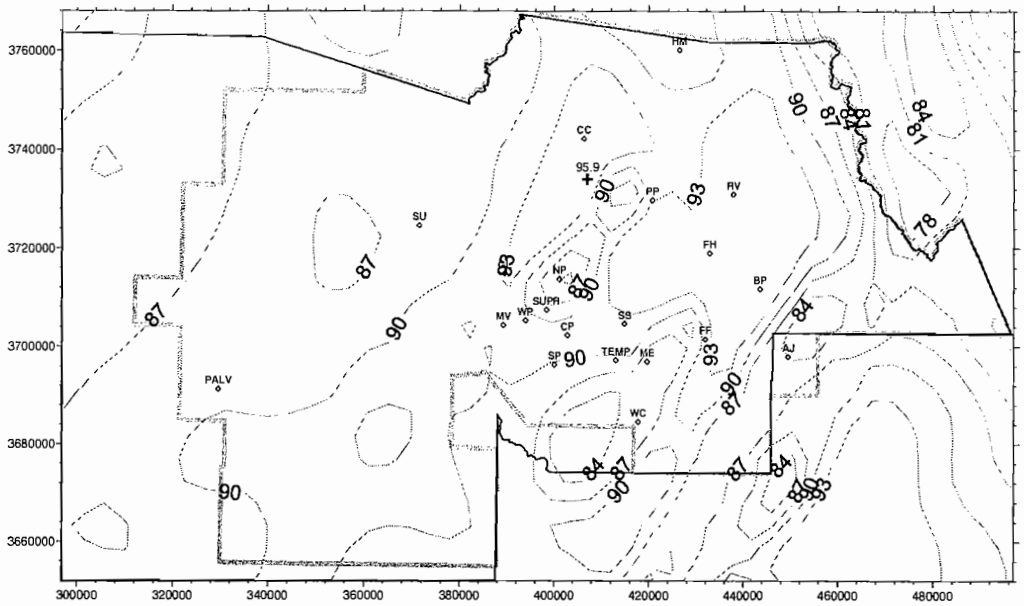
Surface MM5 Temperature (°F) on July 9, 2002 6:00-7:00 LST



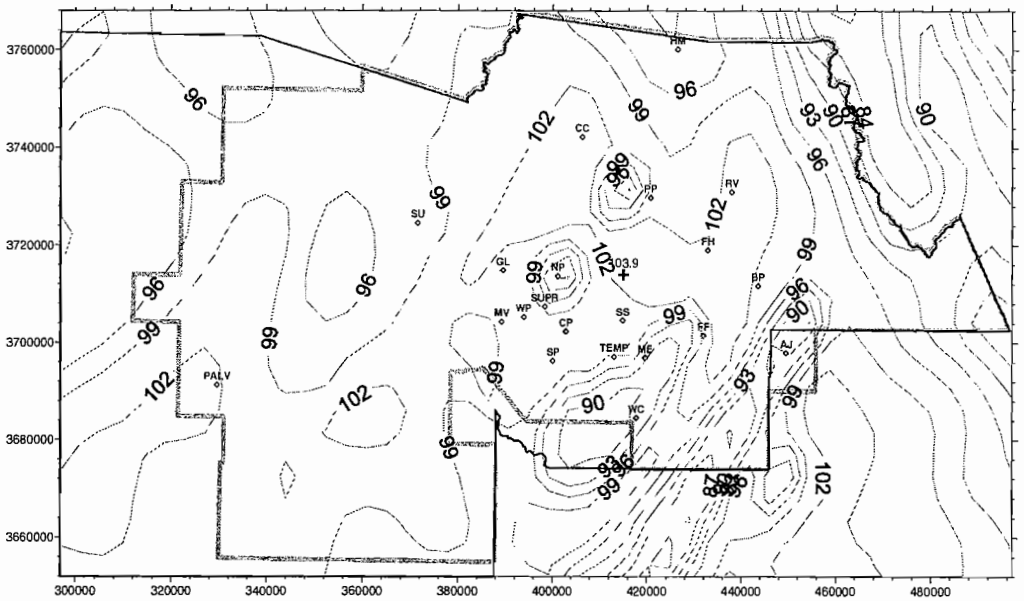
Surface MM5 Temperature (°F) on July 9, 2002 7:00-8:00 LST



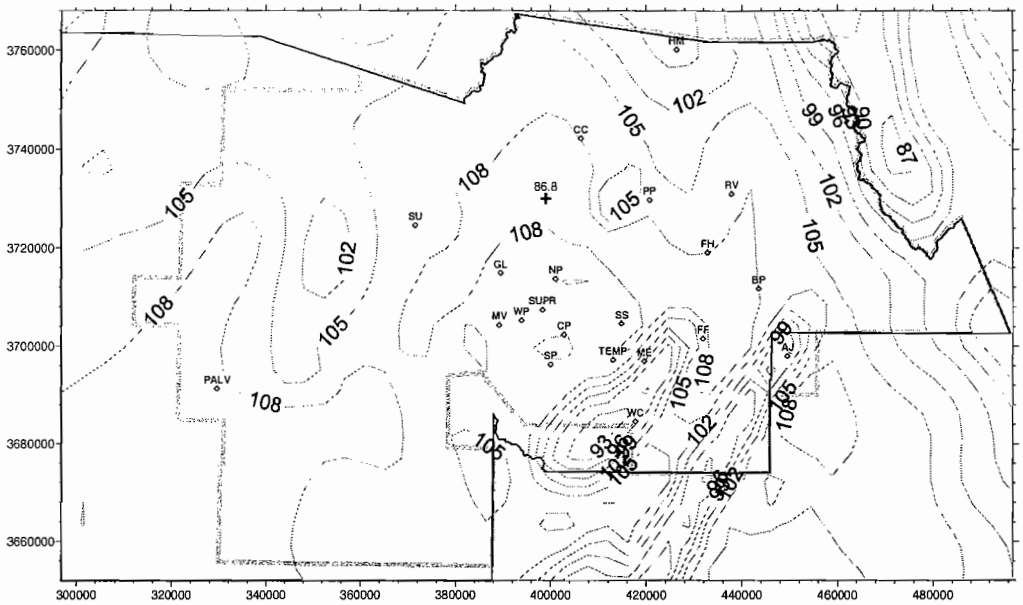
Surface MM5 Temperature (°F) on July 9, 2002 8:00-9:00 LST



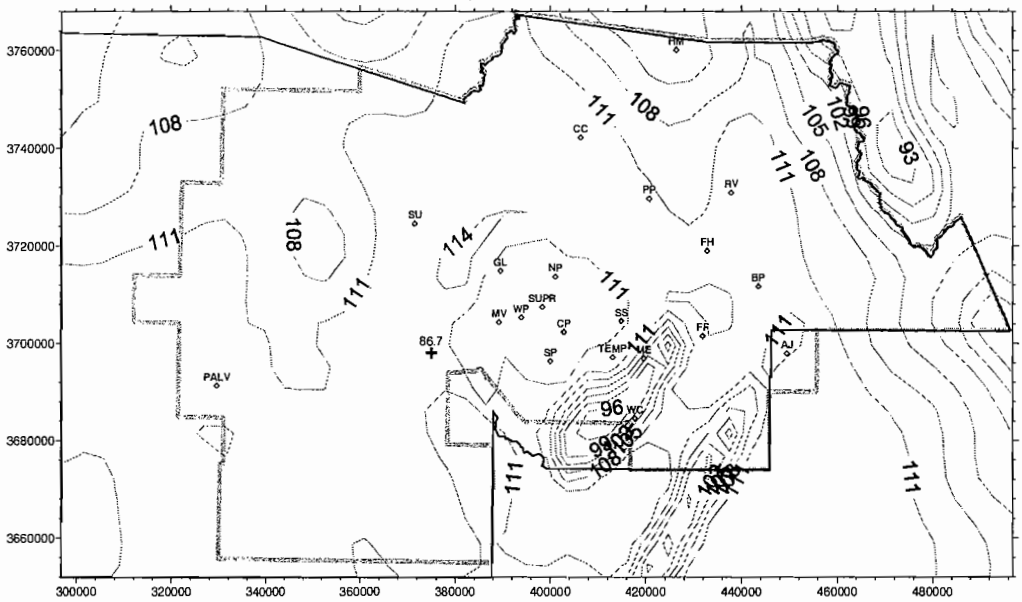
Surface MM5 Temperature (°F) on July 9, 2002 9:00-10:00 LST



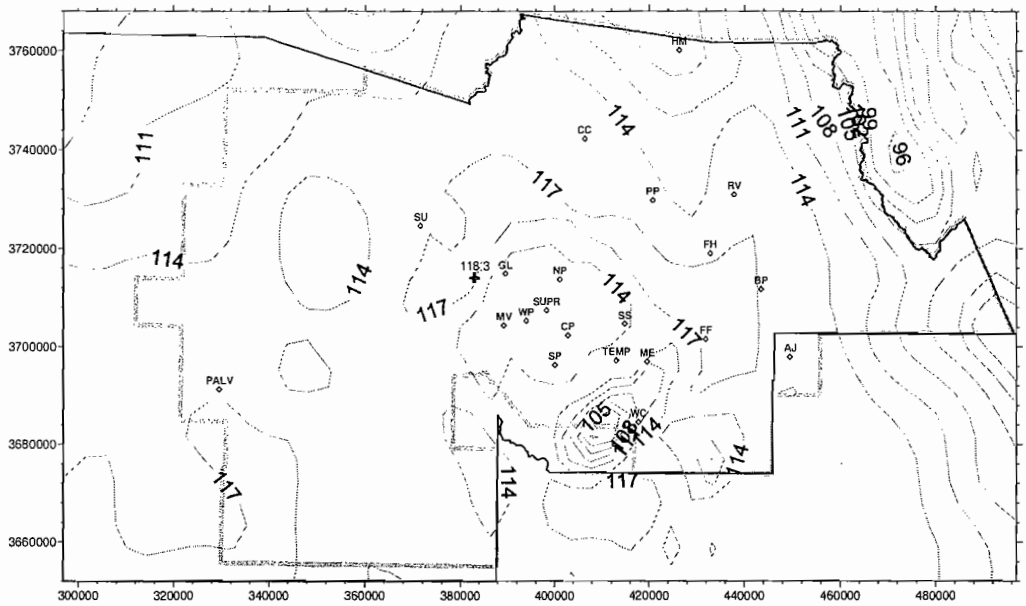
Surface MM5 Temperature (°F) on July 9, 2002 10:00-11:00 LST



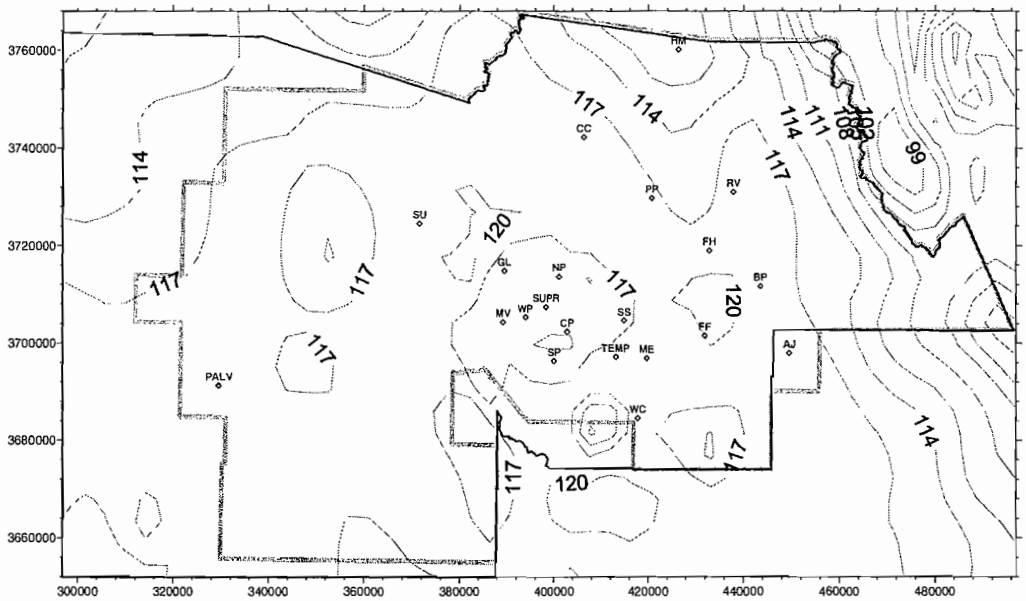
Surface MM5 Temperature (°F) on July 9, 2002 11:00-12:00 LST



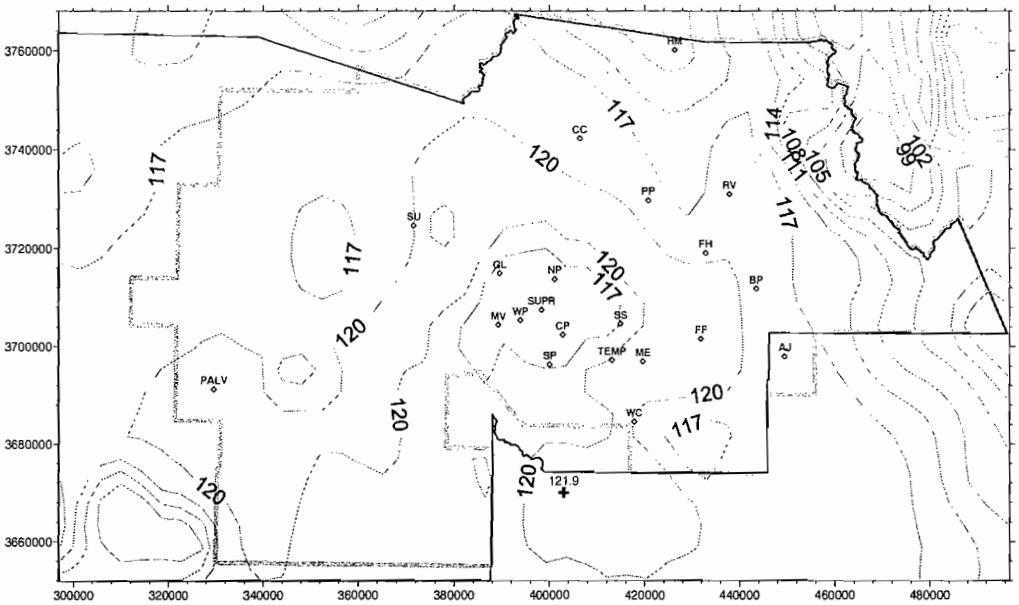
Surface MM5 Temperature (°F) on July 9, 2002 12:00-13:00 LST



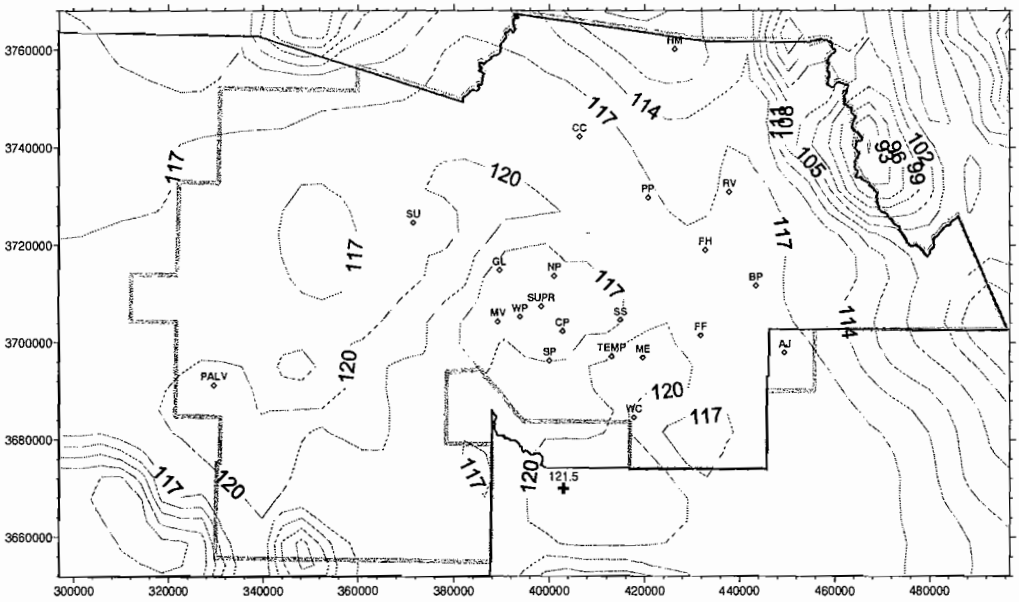
Surface MM5 Temperature (°F) on July 9, 2002 13:00-14:00 LST



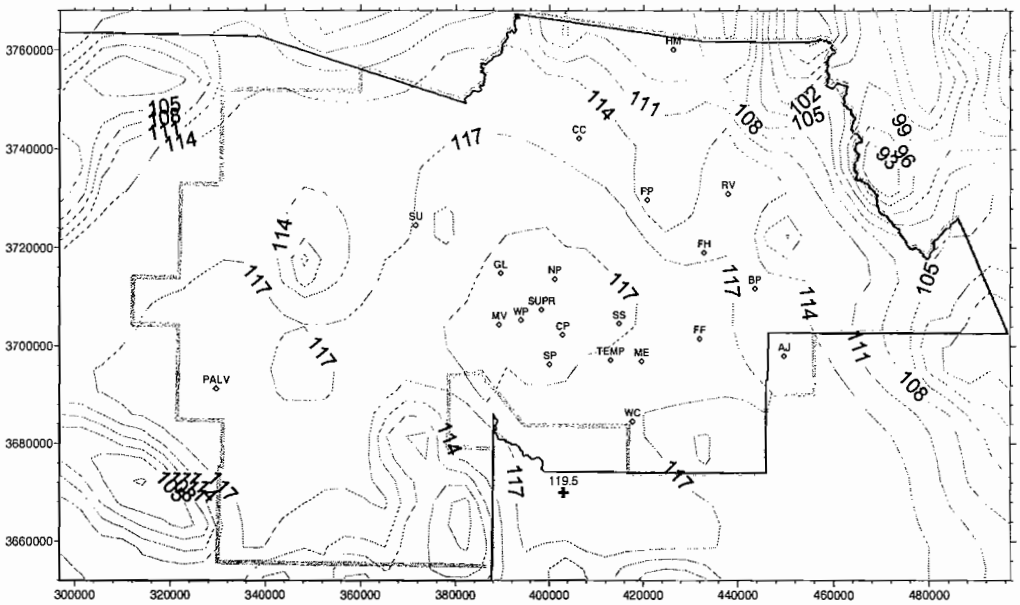
Surface MM5 Temperature (°F) on July 9, 2002 14:00-15:00 LST



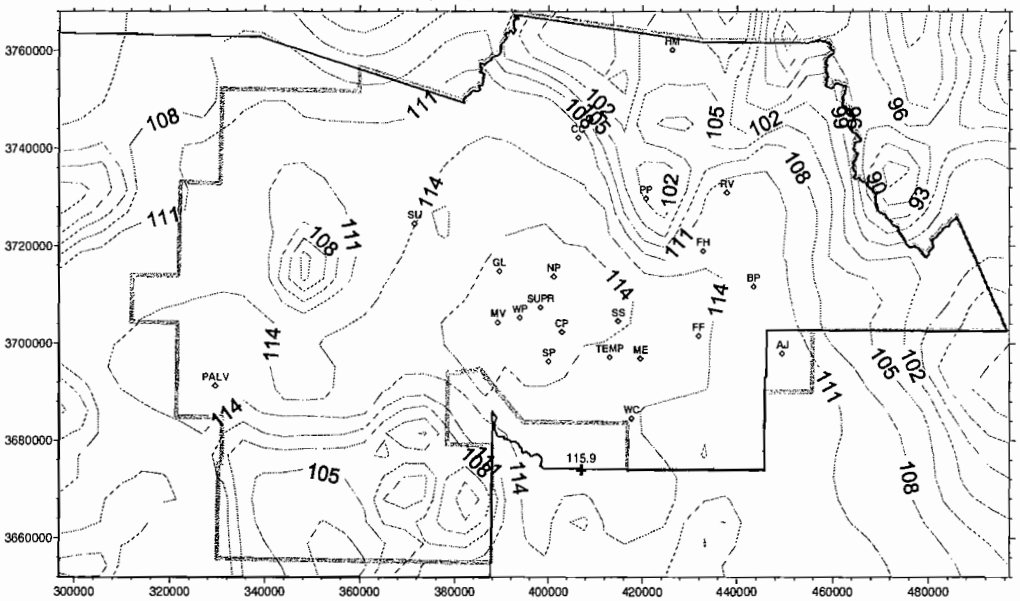
Surface MM5 Temperature (°F) on July 9, 2002 15:00-16:00 LST



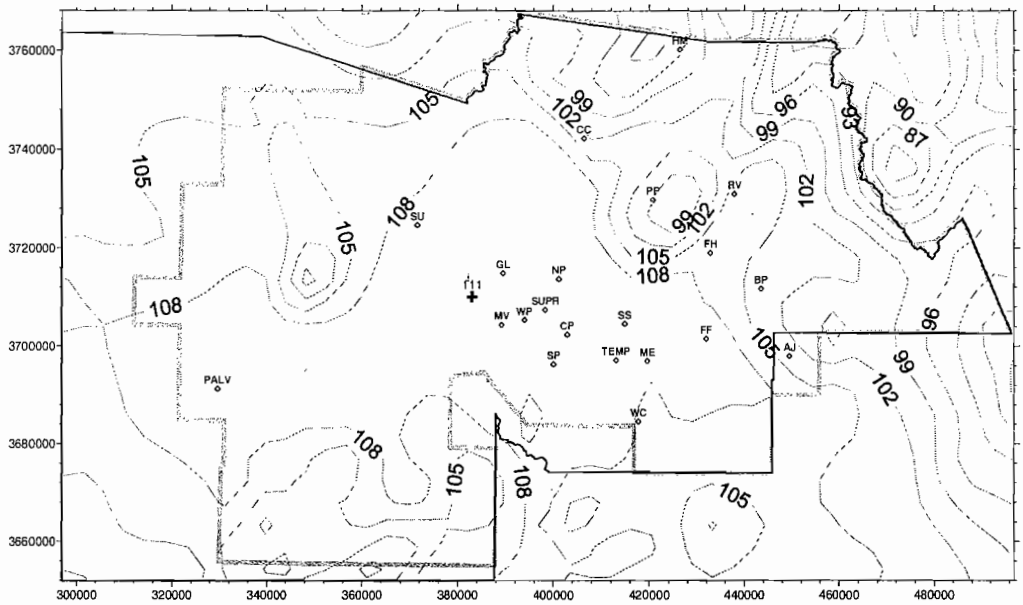
Surface MM5 Temperature (°F) on July 9, 2002 16:00-17:00 LST



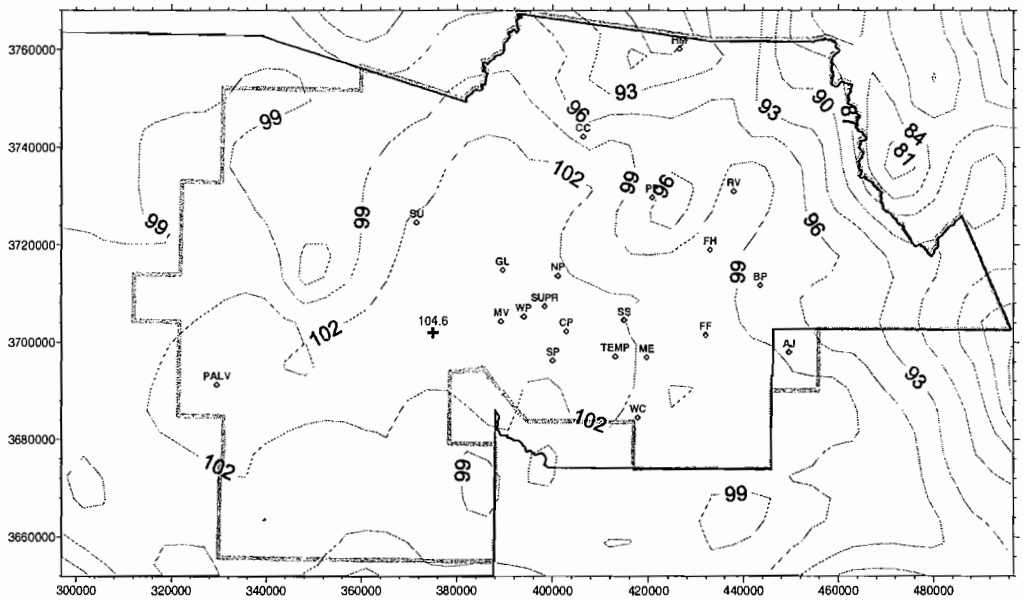
Surface MM5 Temperature (°F) on July 9, 2002 17:00-18:00 LST



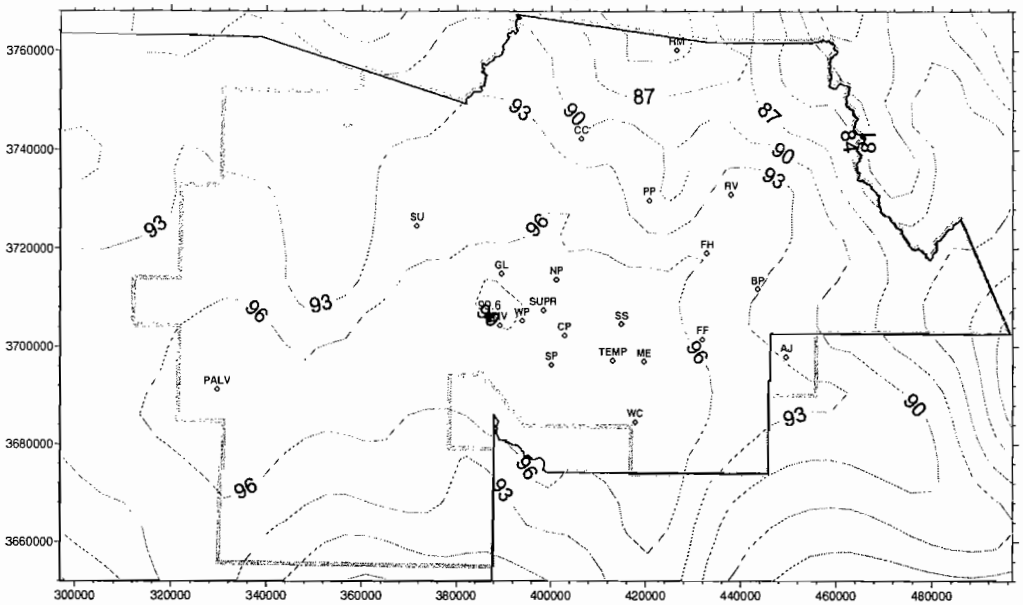
Surface MM5 Temperature (°F) on July 9, 2002 18:00-19:00 LST



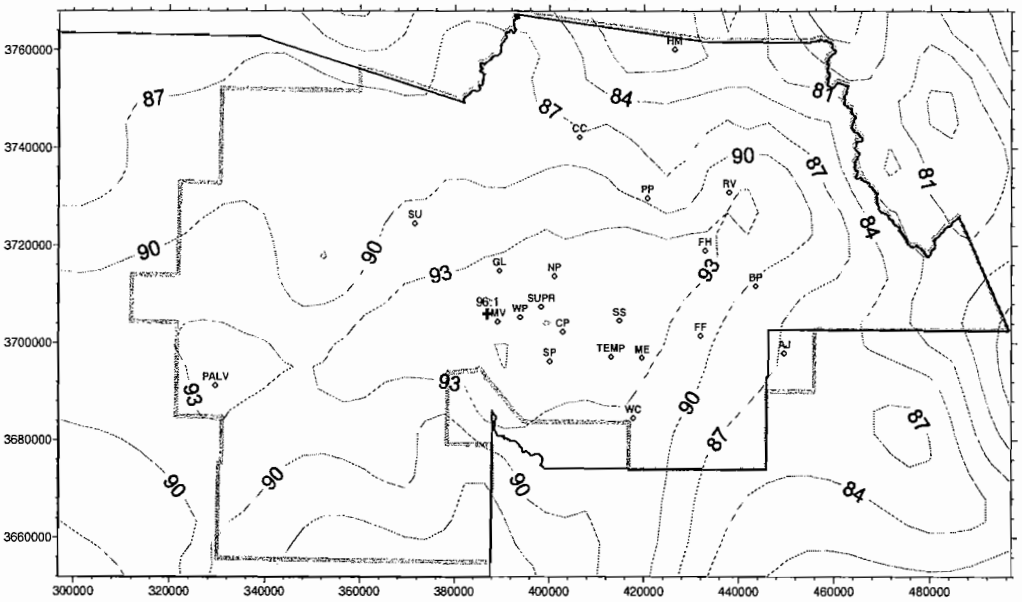
Surface MM5 Temperature (°F) on July 9, 2002 19:00-20:00 LST



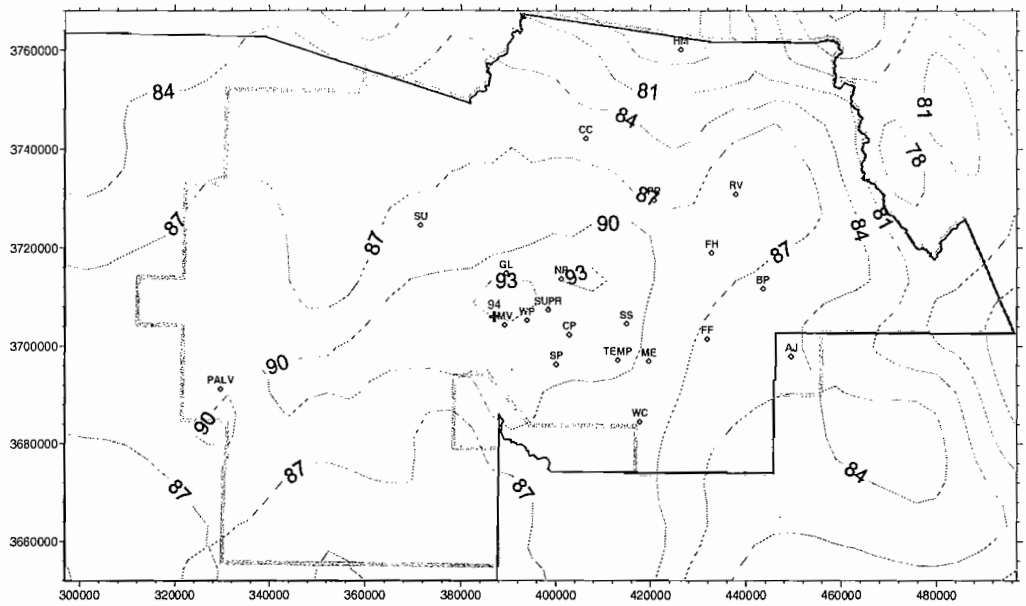
Surface MM5 Temperature (°F) on July 9, 2002 20:00-21:00 LST



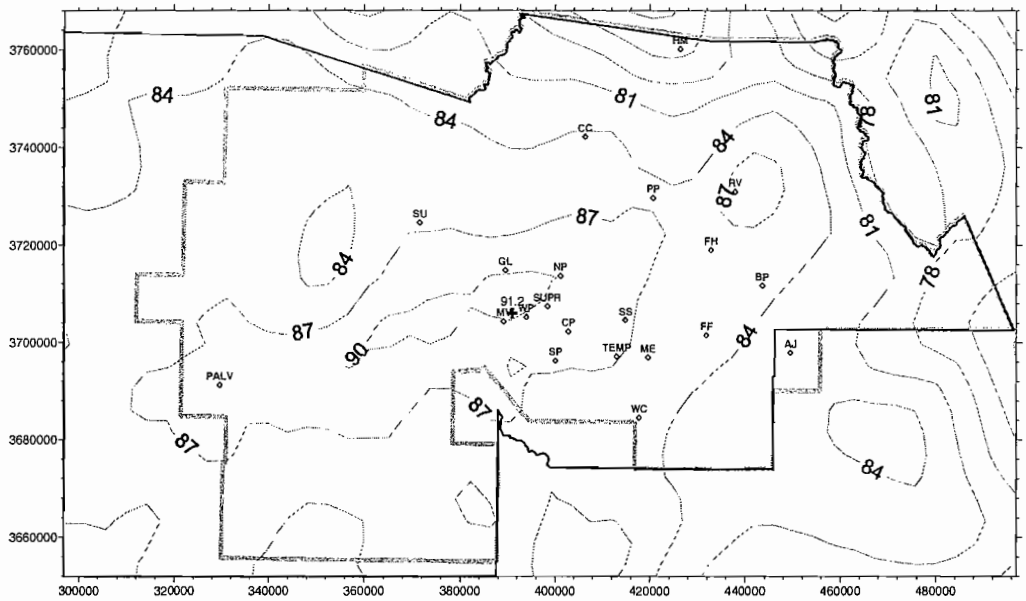
Surface MM5 Temperature (°F) on July 9, 2002 21:00-22:00 LST



Surface MM5 Temperature (°F) on July 9, 2002 22:00-23:00 LST



Surface MM5 Temperature (°F) on July 9, 2002 23:00-24:00 LST

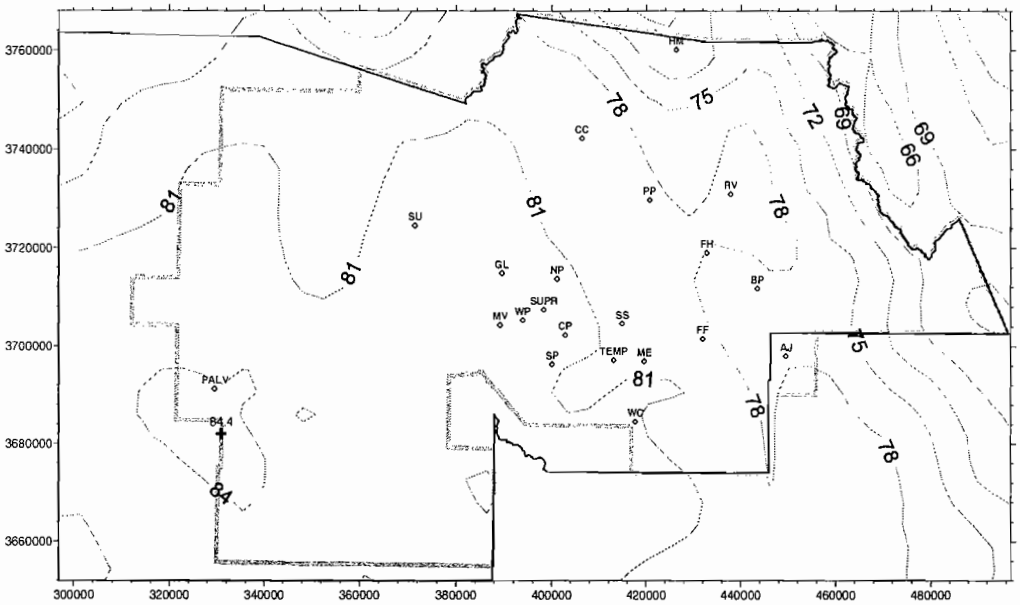


Appendix III-ix

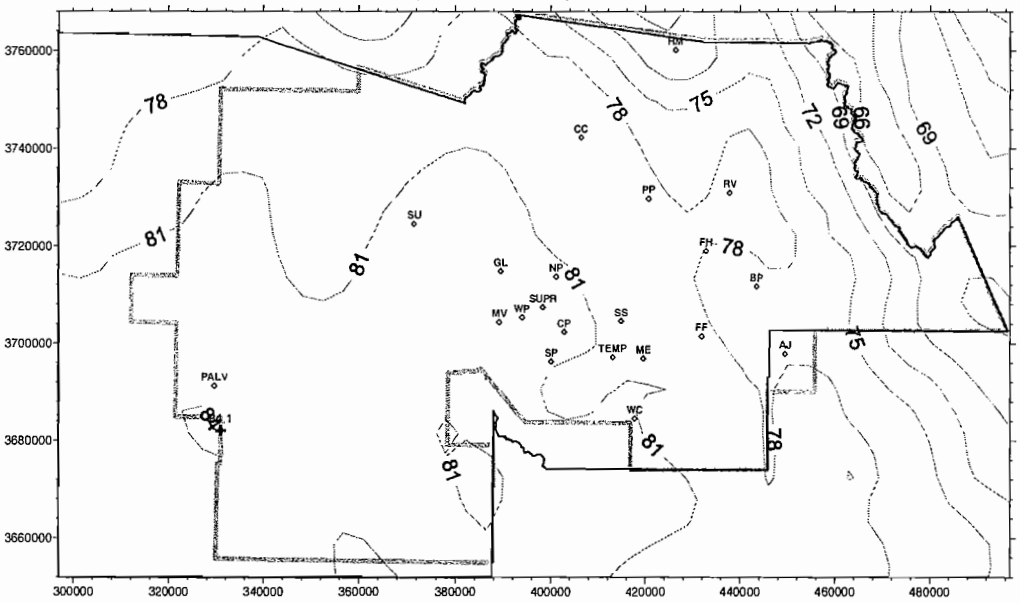
MODELED TEMPERATURE FOR THE AUGUST 2001 EPISODE

The plots shown here are the simulated MM5 temperatures. These hourly temperatures are from 0:00 to 24:00 LST on August 10, 2001.

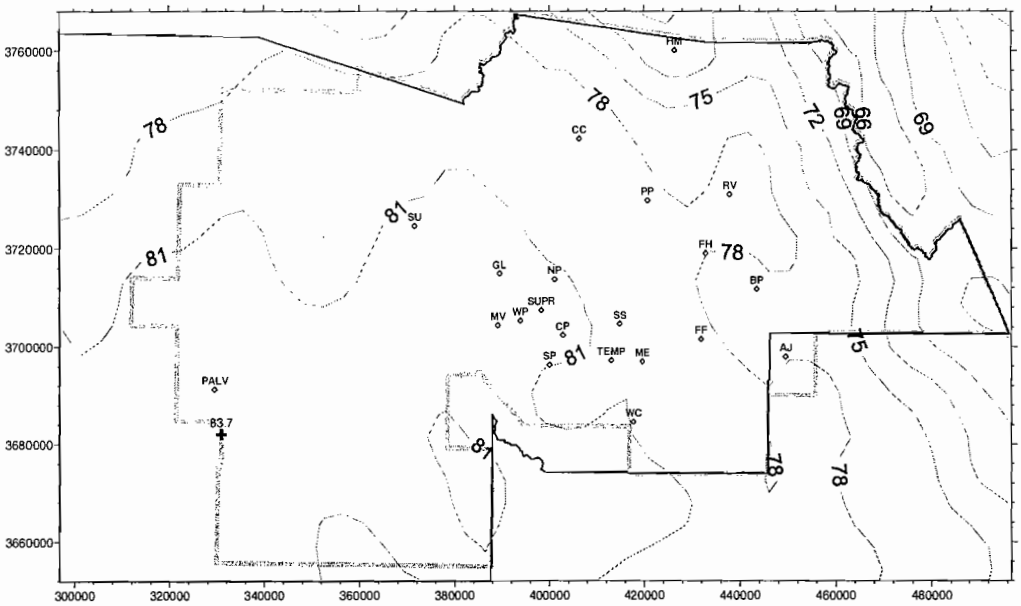
Surface MM5 Temperature (°F) on August 10, 2001 0:00-1:00 LST



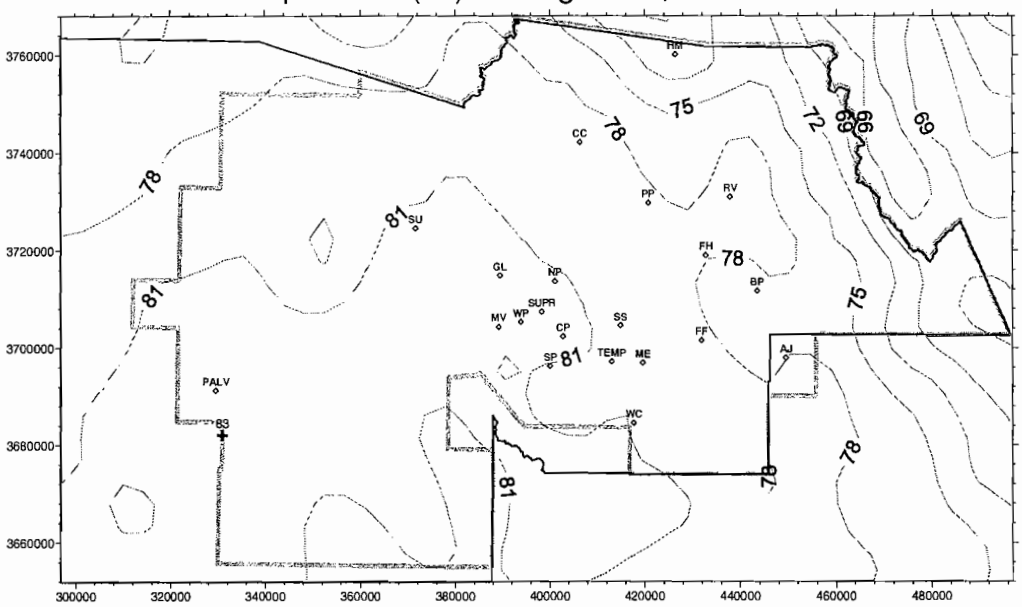
Surface MM5 Temperature (°F) on August 10, 2001 1:00-2:00 LST



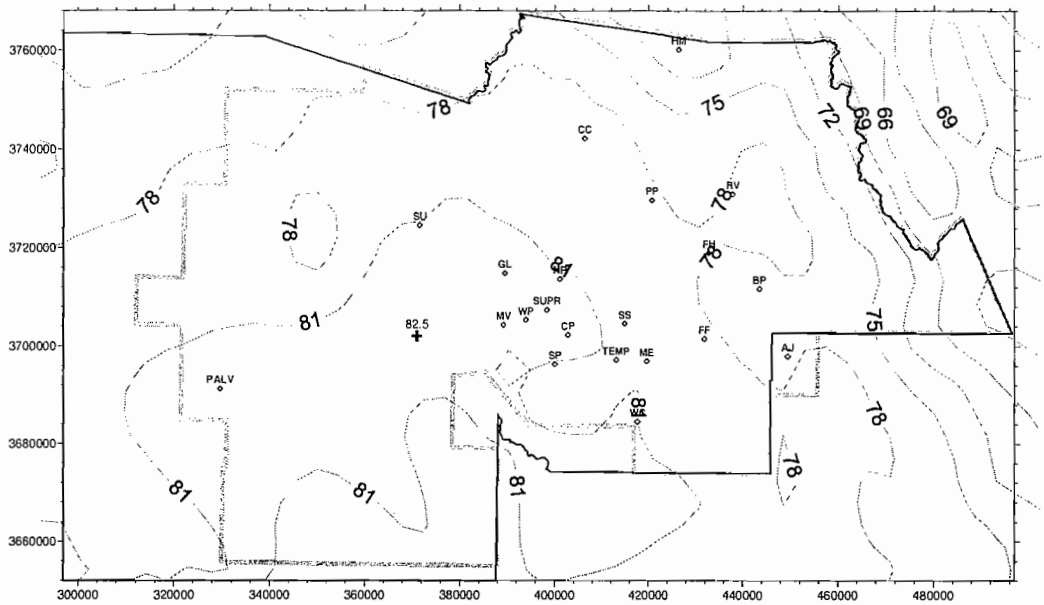
Surface MM5 Temperature (°F) on August 10, 2001 2:00-300 LST



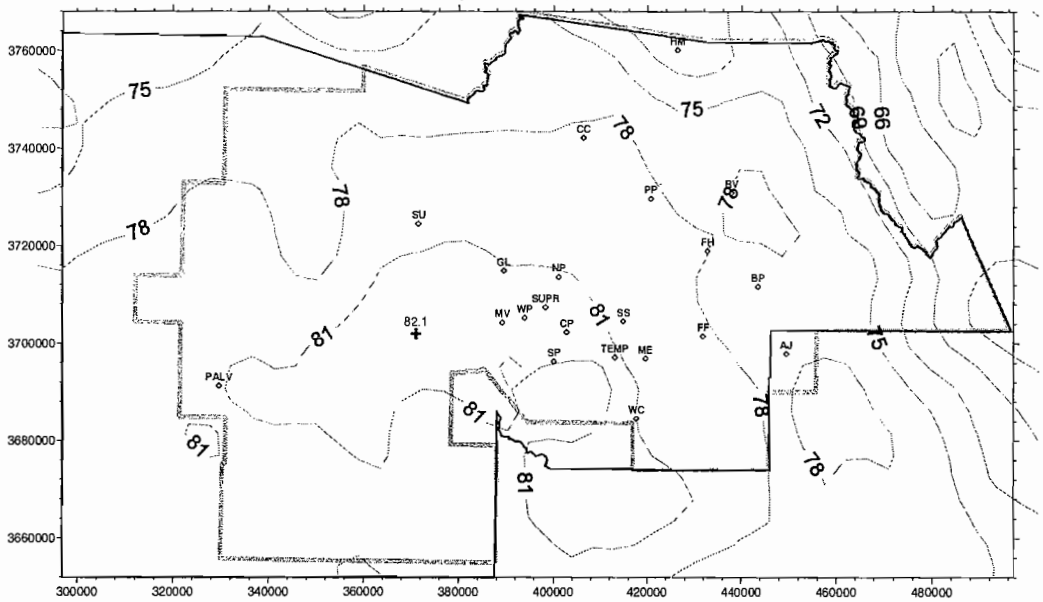
Surface MM5 Temperature (°F) on August 10, 2001 3:00-4:00 LST



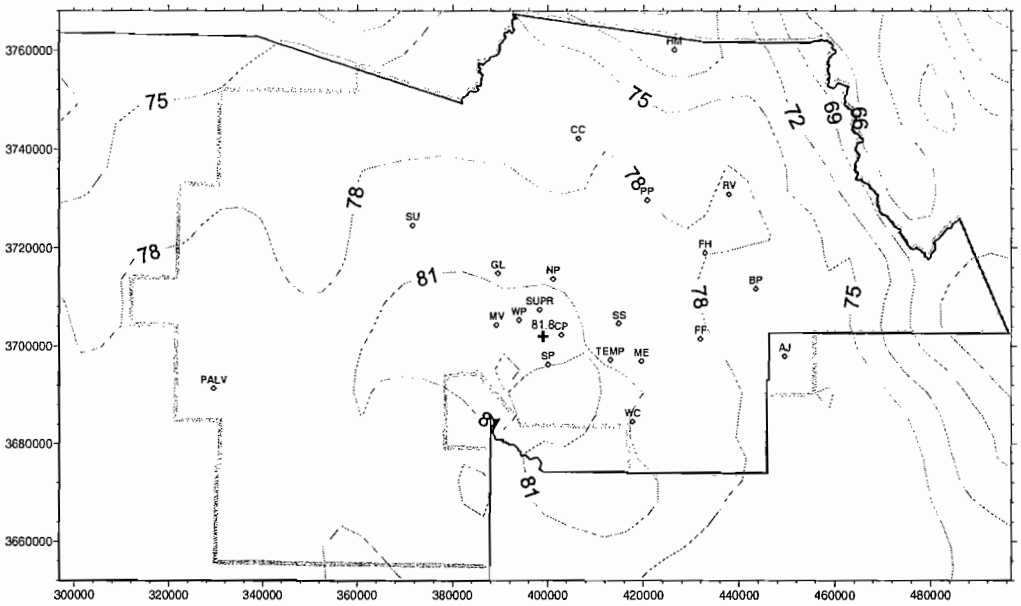
Surface MM5 Temperature (°F) on August 10, 2001 4:00-5:00 LST



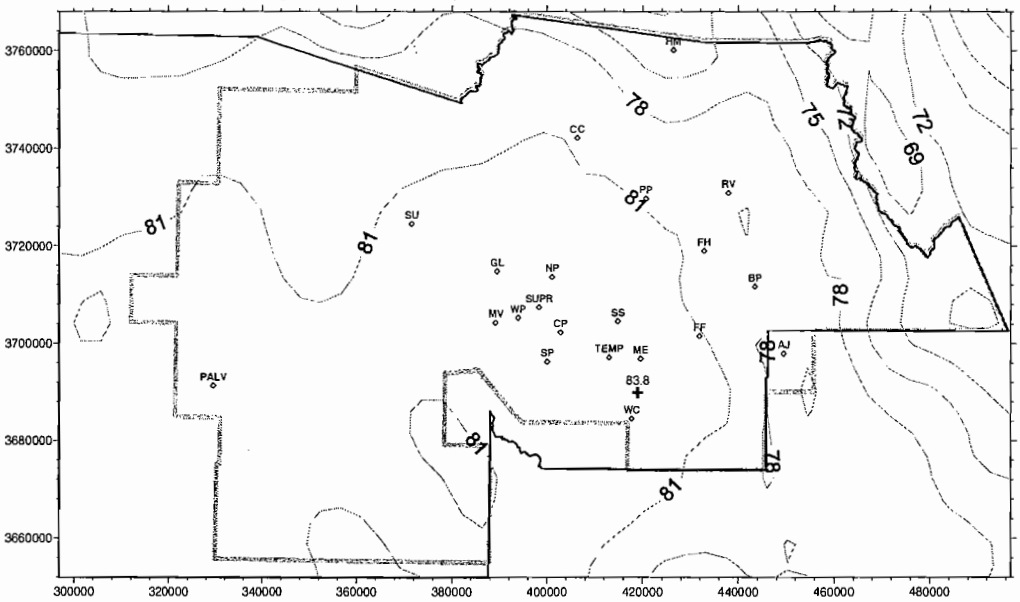
Surface MM5 Temperature (°F) on August 10, 2001 5:00-6:00 LST



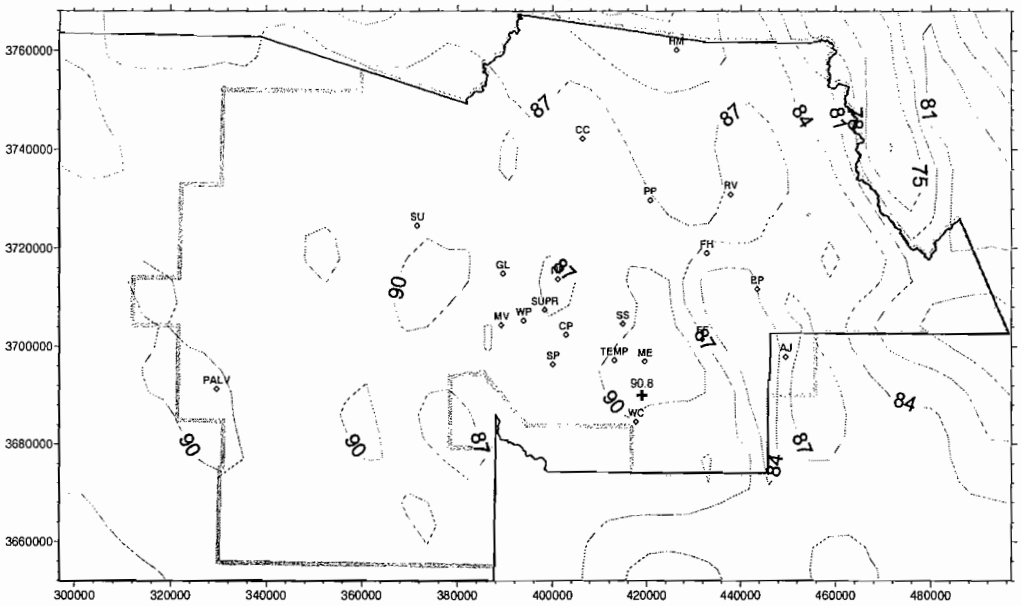
Surface MM5 Temperature (°F) on August 10, 2001 6:00-7:00 LST



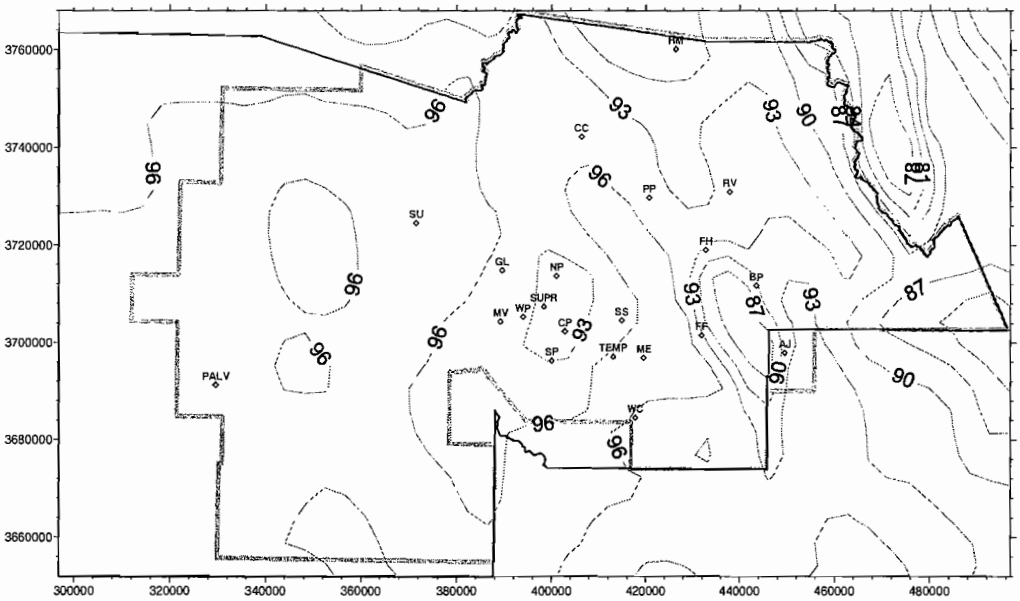
Surface MM5 Temperature (°F) on August 10, 2001 7:00-8:00 LST



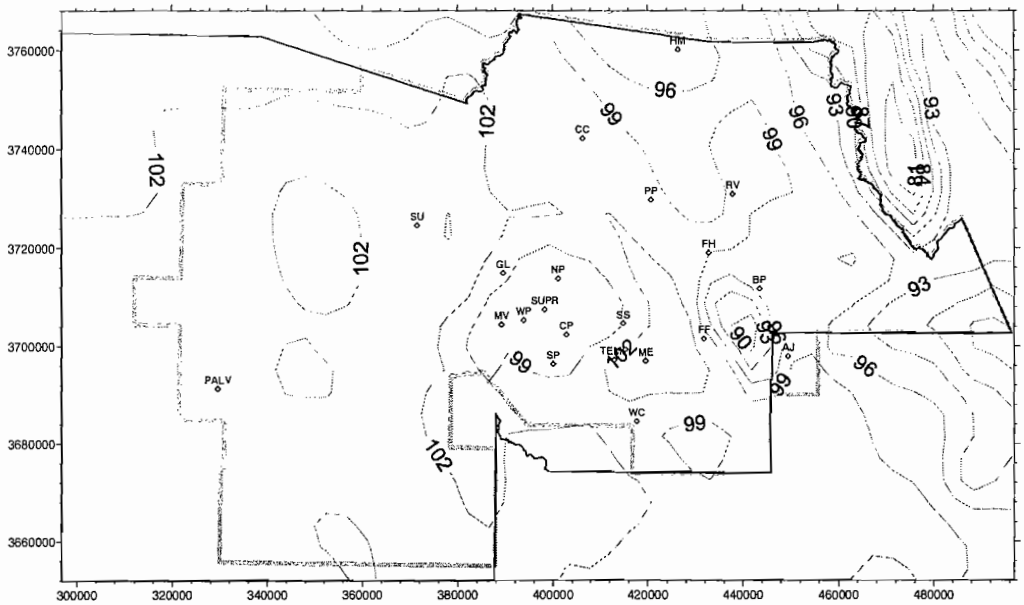
Surface MM5 Temperature (°F) on August 10, 2001 8:00-9:00 LST



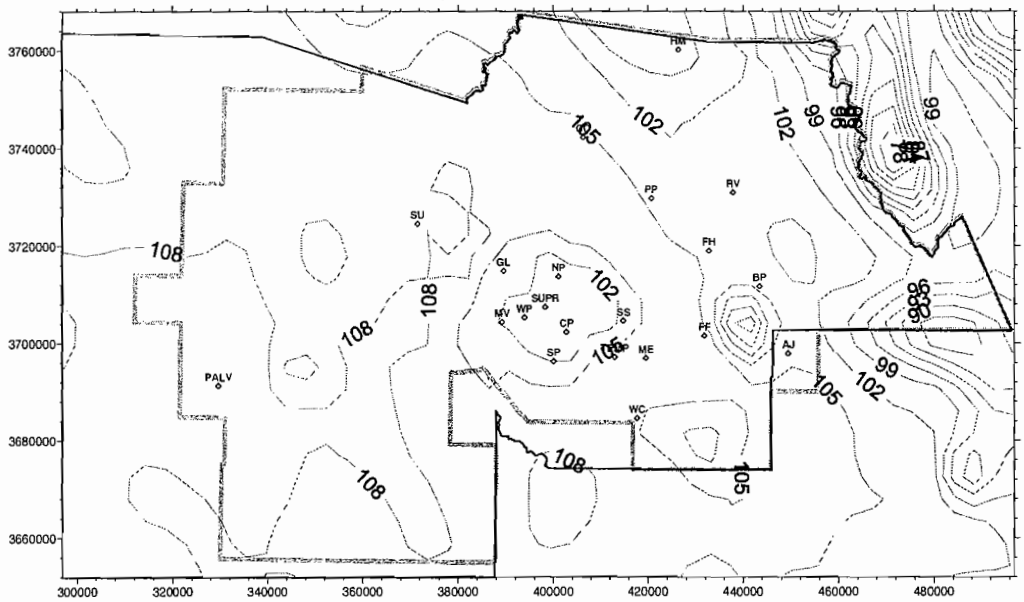
Surface MM5 Temperature (°F) on August 10, 2001 9:00-10:00 LST



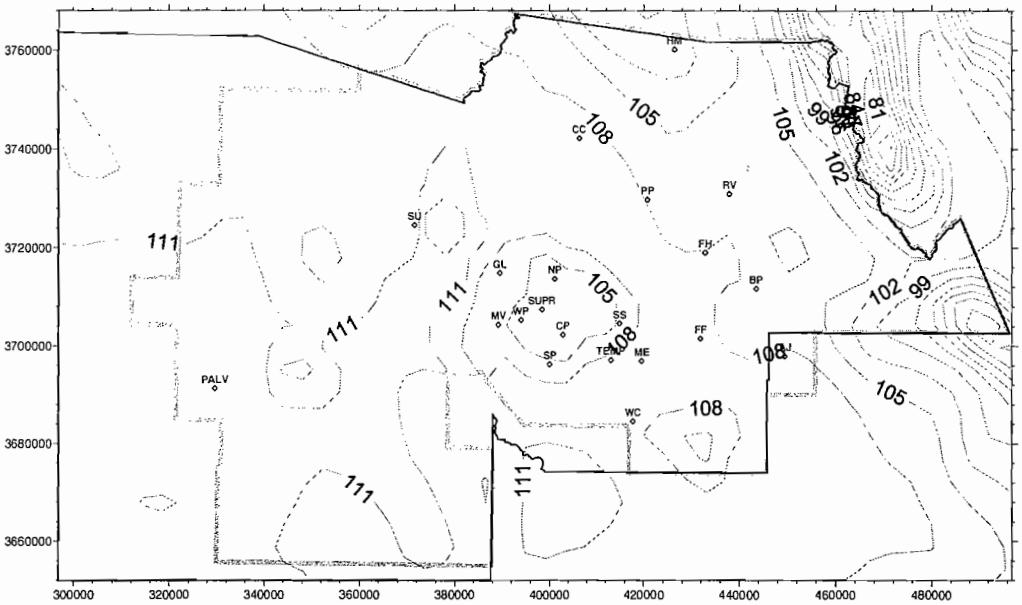
Surface MM5 Temperature (°F) on August 10, 2001 10:00-11:00 LST



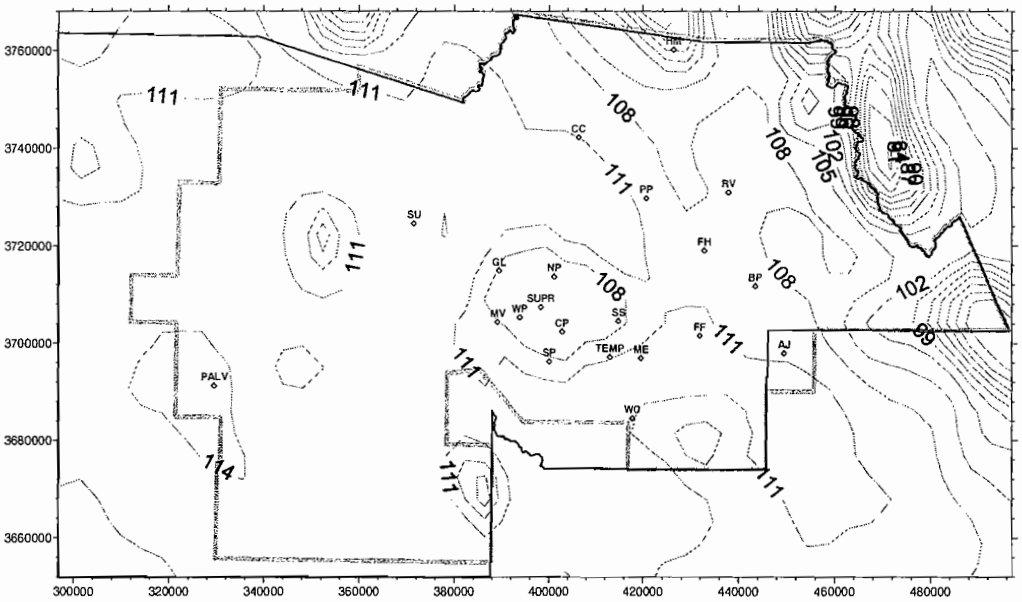
Surface MM5 Temperature (°F) on August 10, 2001 11:00-12:00 LST



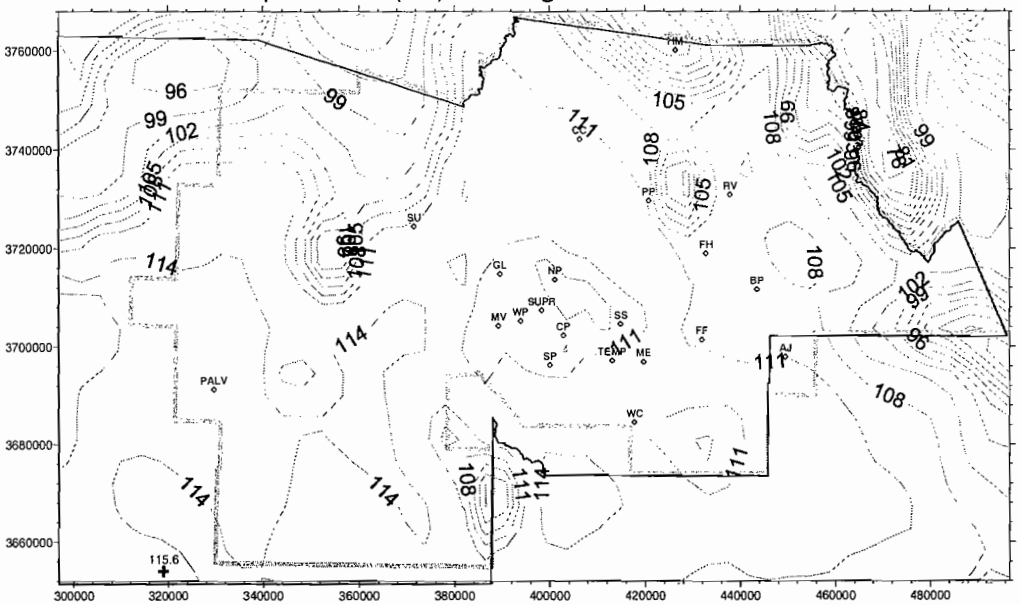
Surface MM5 Temperature (°F) on August 10, 2001 12:00-13:00 LST



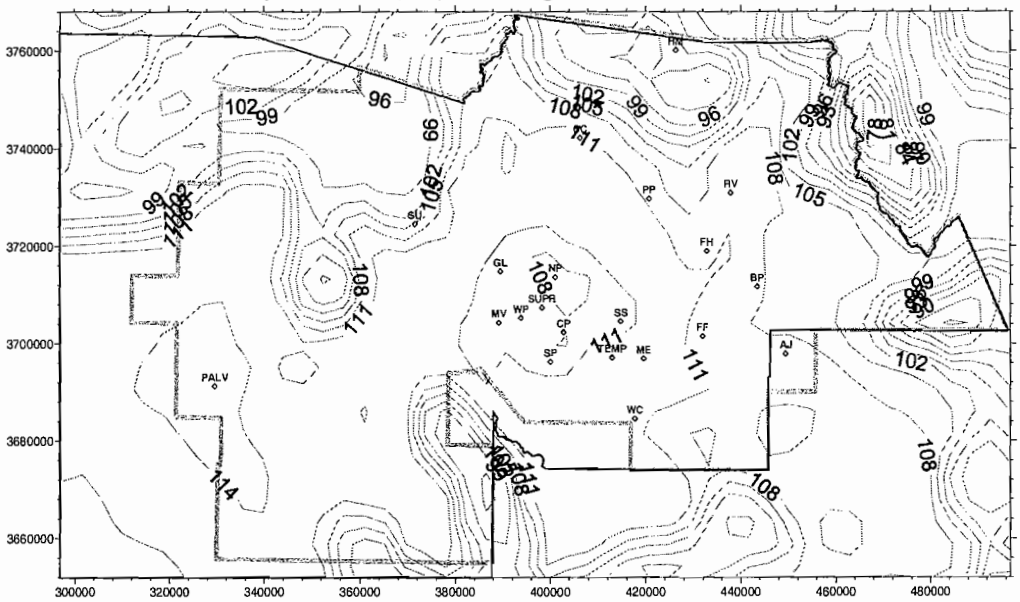
Surface MM5 Temperature (°F) on August 10, 2001 13:00-14:00 LST



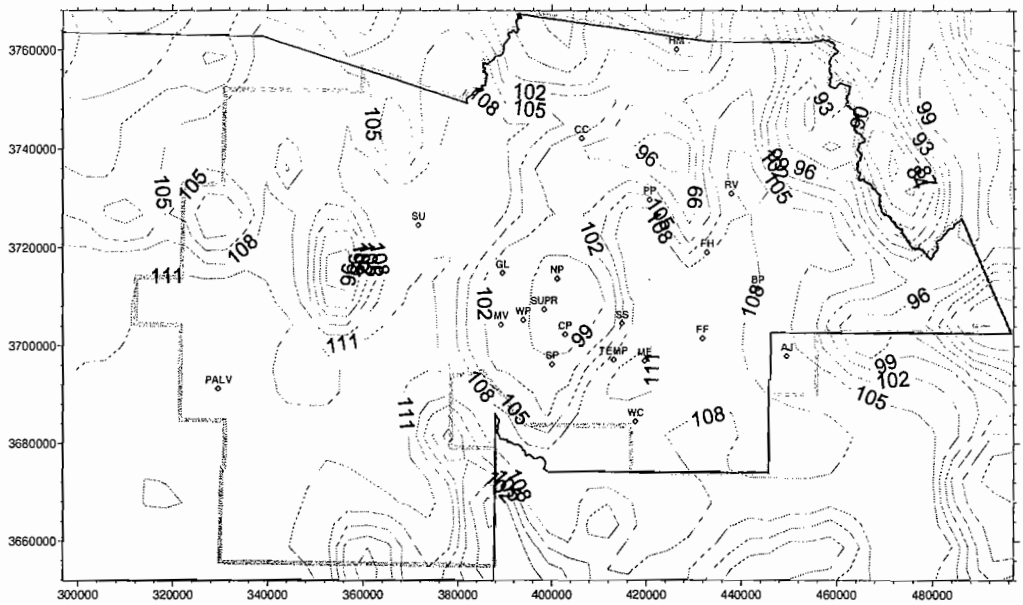
Surface MM5 Temperature (°F) on August 10, 2001 14:00-15:00 LST



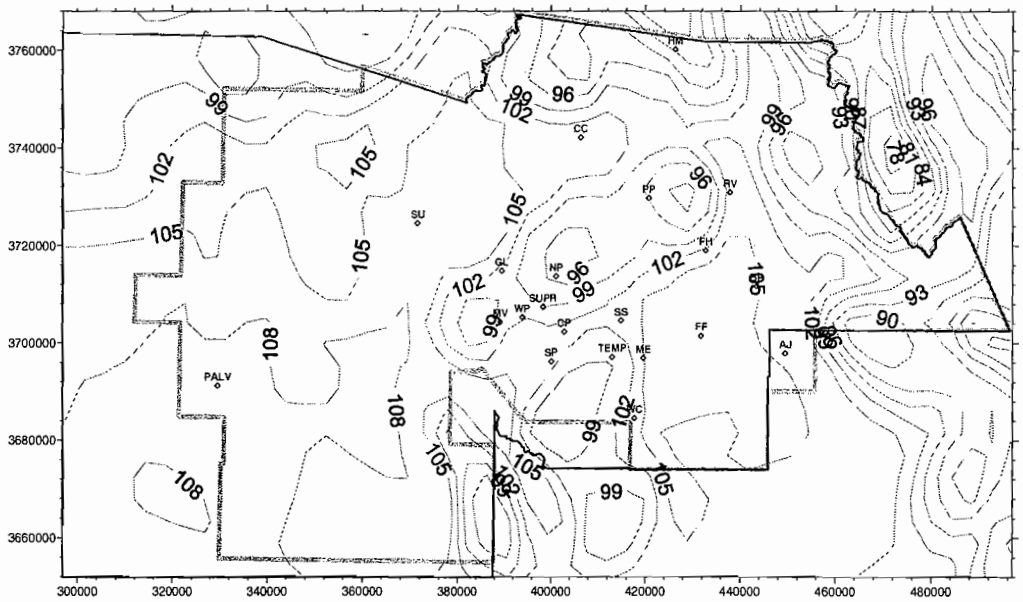
Surface MM5 Temperature (°F) on August 10, 2001 15:00-16:00 LST



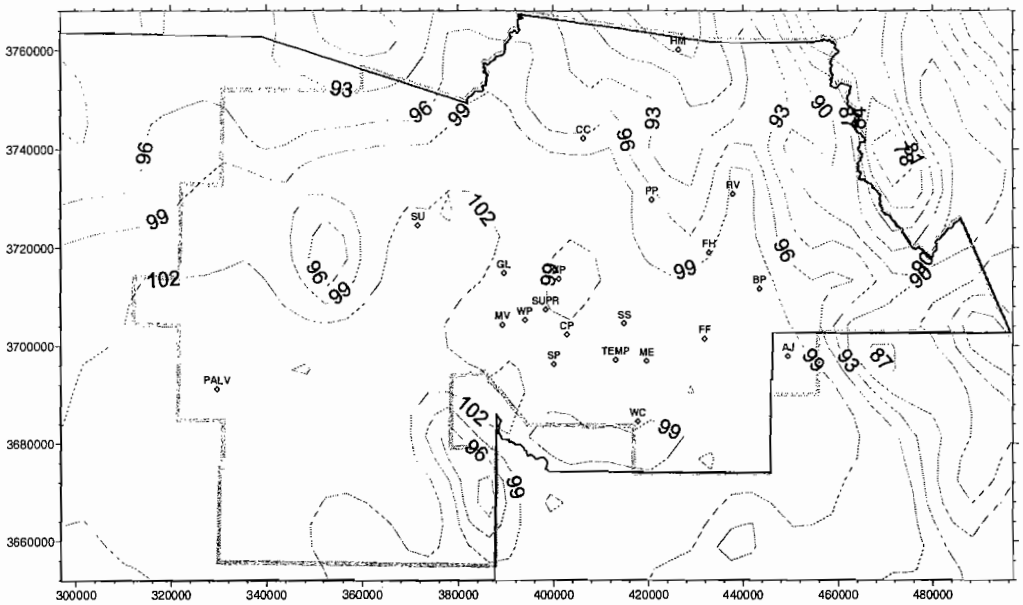
Surface MM5 Temperature (°F) on August 10, 2001 16:00-17:00 LST



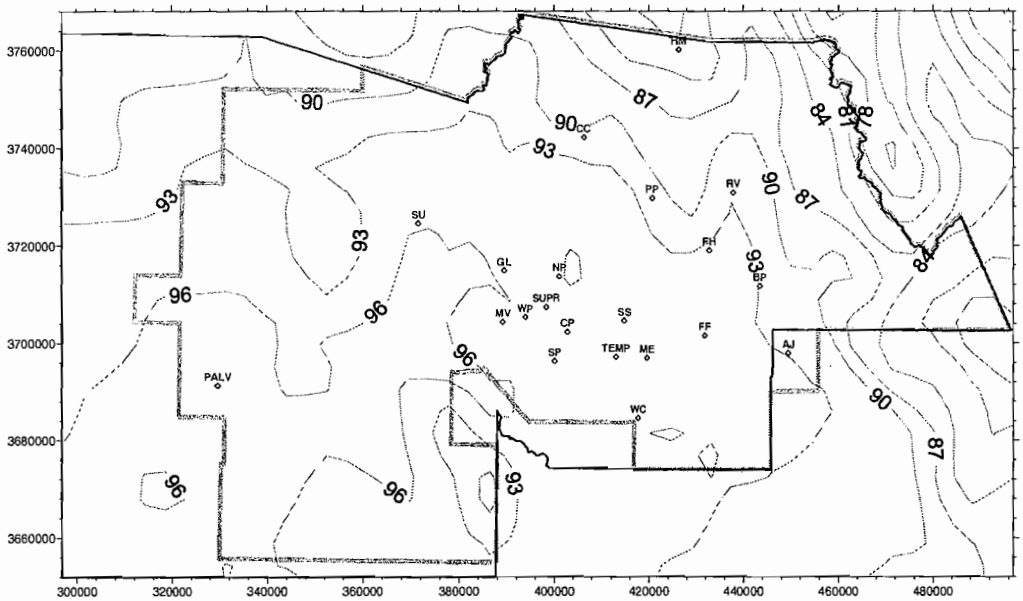
Surface MM5 Temperature (°F) on August 10, 2001 17:00-18:00 LST



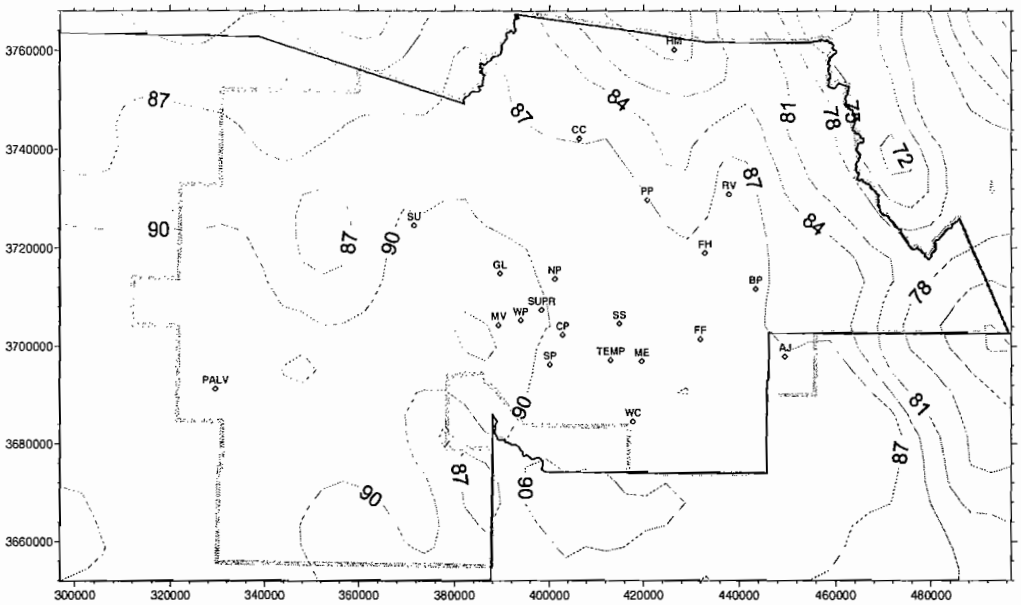
Surface MM5 Temperature (°F) on August 10, 2001 18:00-19:00 LST



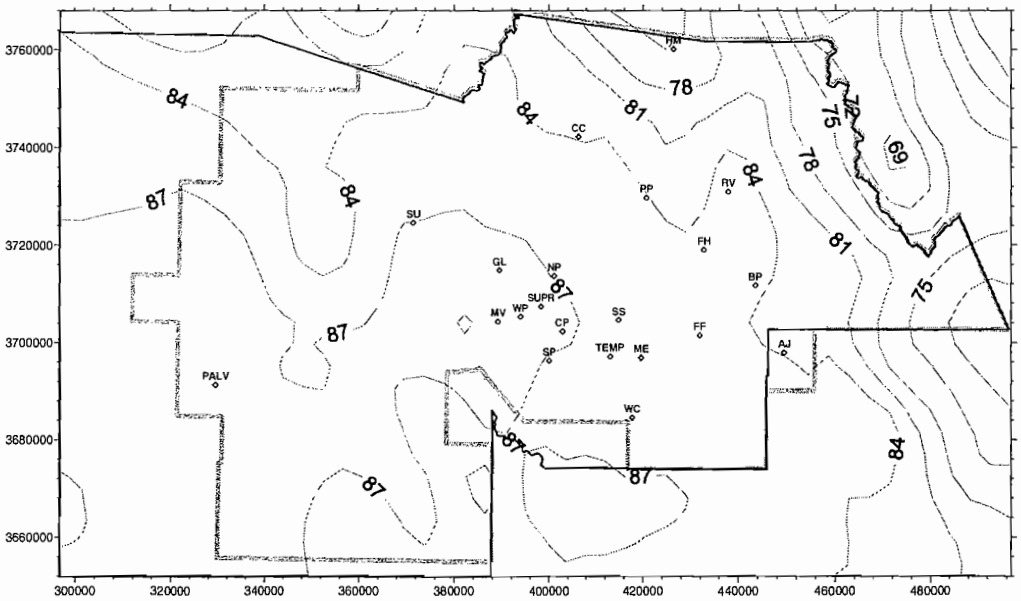
Surface MM5 Temperature (°F) on August 10, 2001 19:00-20:00 LST



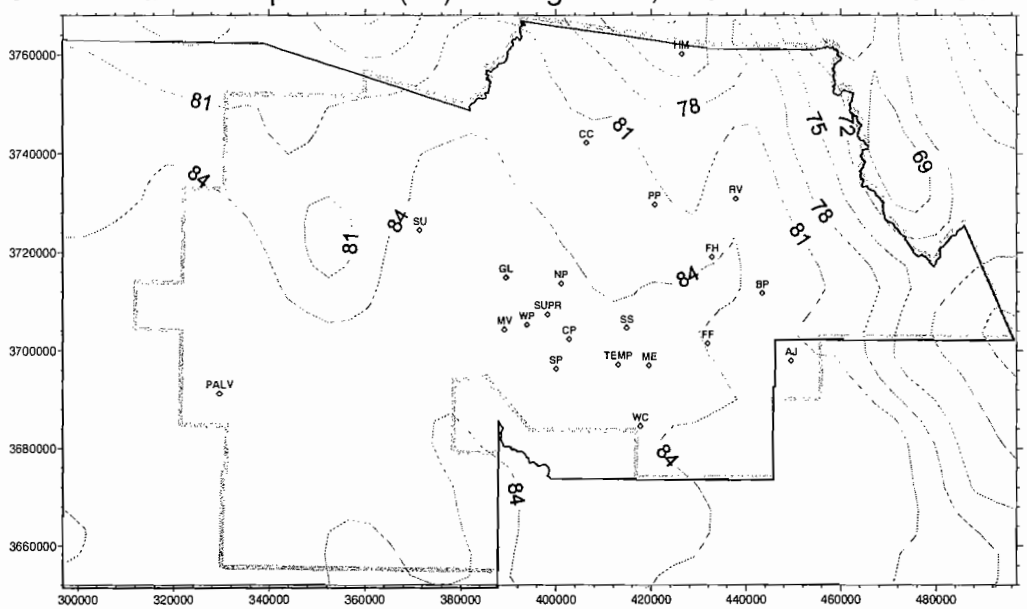
Surface MM5 Temperature (°F) on August 10, 2001 20:00-21:00 LST



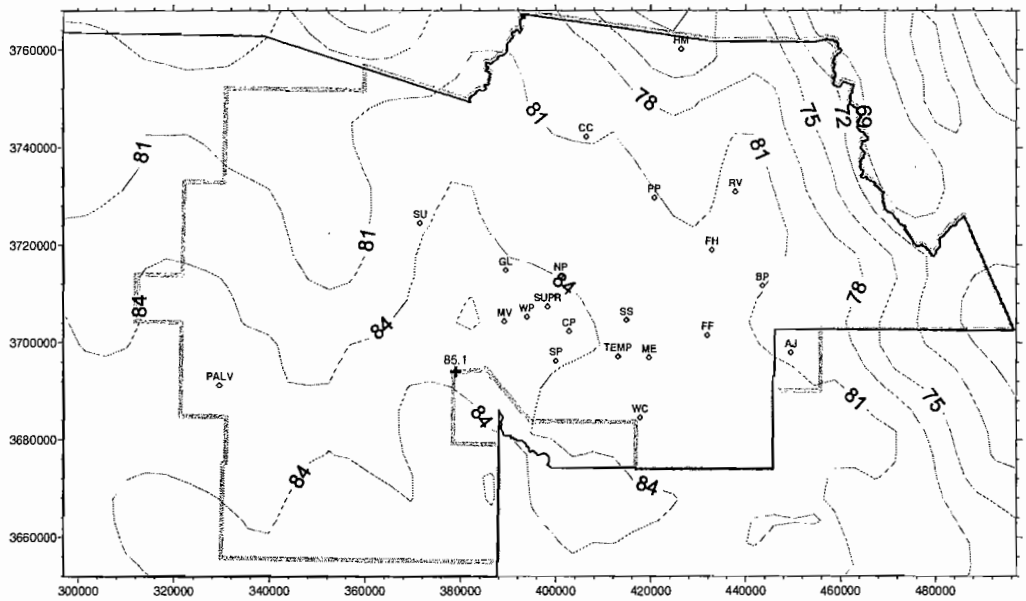
Surface MM5 Temperature (°F) on August 10, 2001 21:00-22:00 LST



Surface MM5 Temperature (°F) on August 10, 2001 22:00-23:00 LST



Surface MM5 Temperature (°F) on August 10, 2001 23:00-24:00 LST

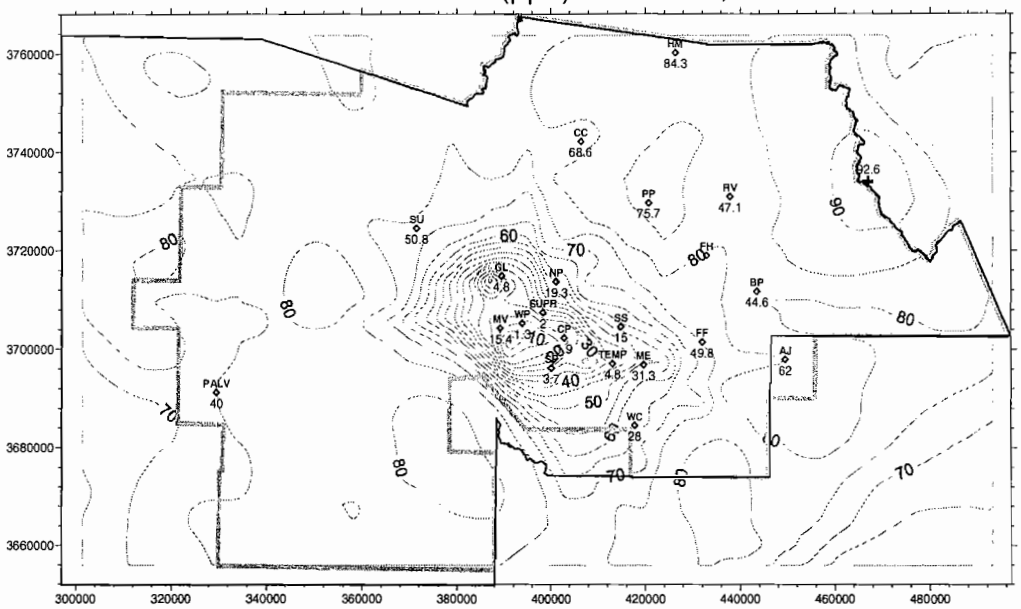


Appendix III-x

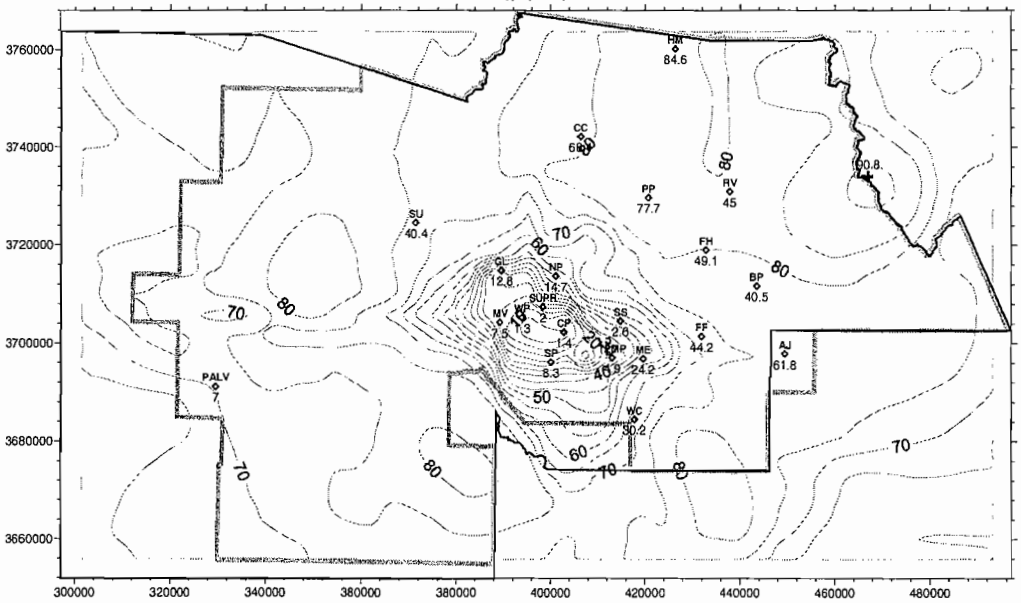
MODELED 1-HOUR OZONE FOR THE JUNE 2002 EPISODE

The plots shown here are the simulated 1-hour ozone. These hourly ozone concentrations are from 0:00 to 24:00 LST on June 6, 2002.

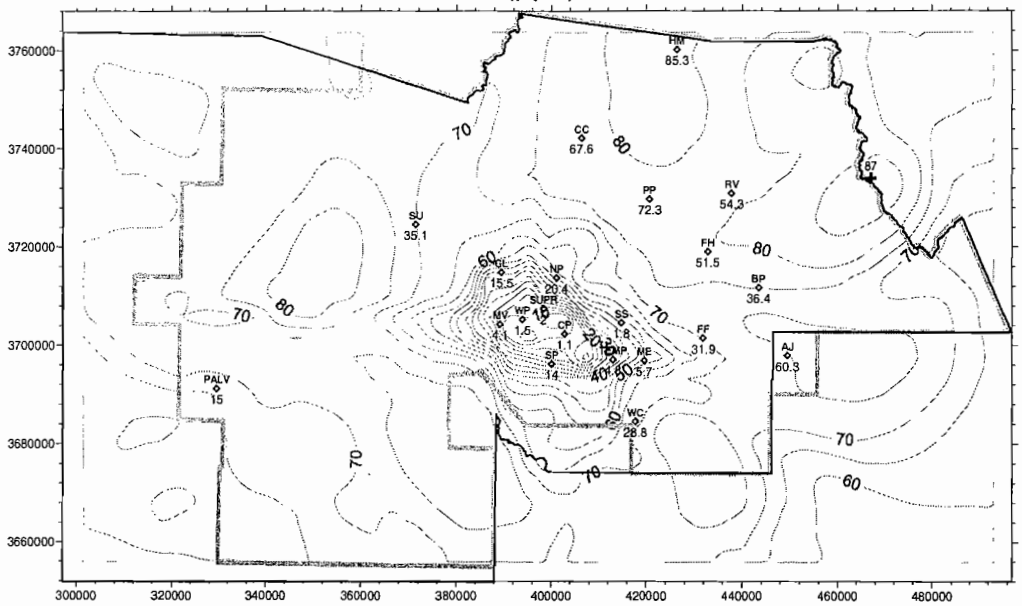
Surface 1-hour ozone concentration (ppb) on June 6, 2002 0:00-1:00 LST



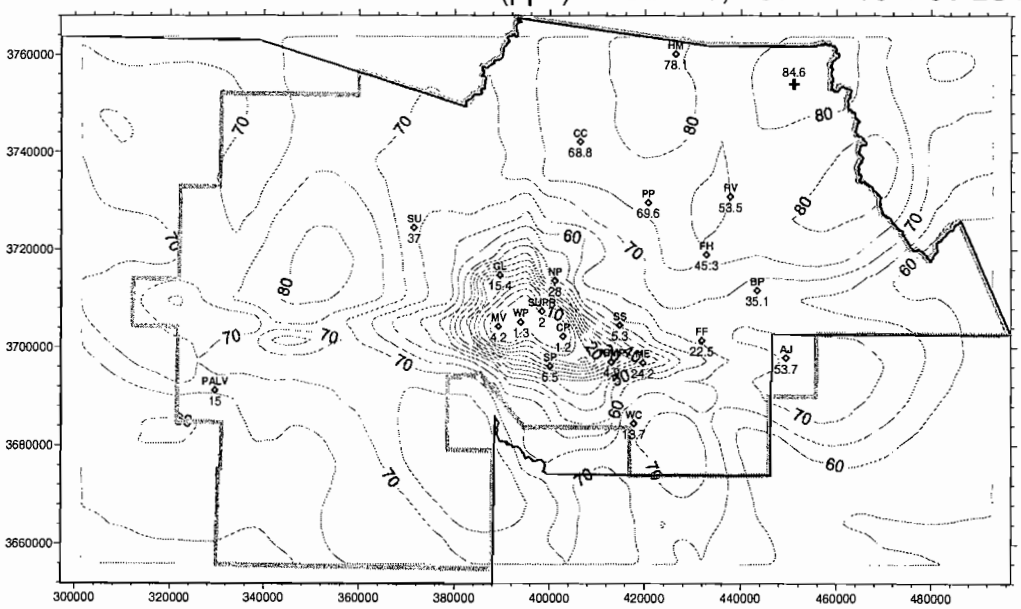
Surface 1-hour ozone concentration (ppb) on June 6, 2002 1:00-2:00 LST



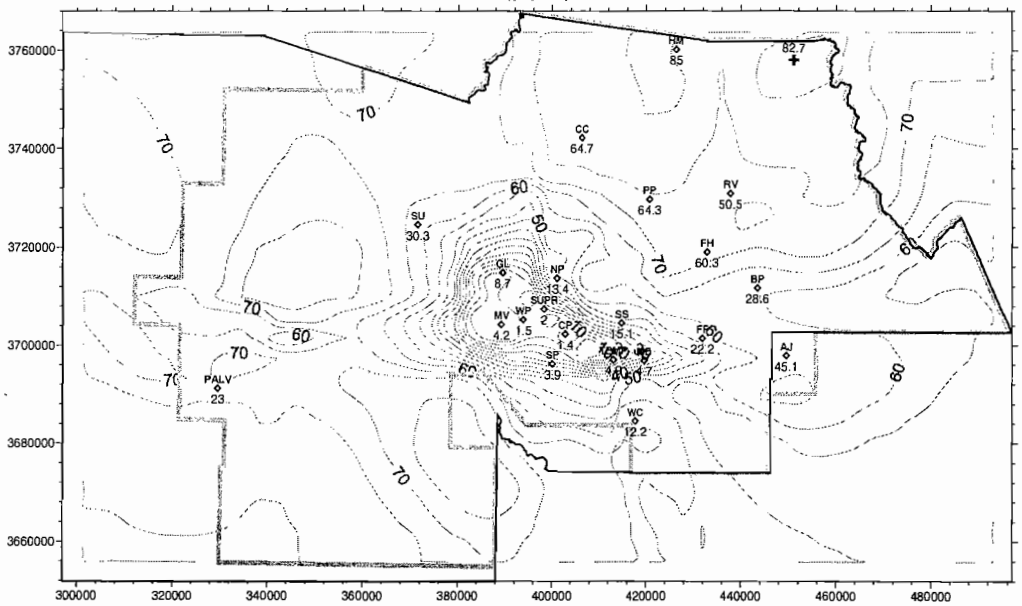
Surface 1-hour ozone concentration (ppb) on June 6, 2002 2:00-300 LST



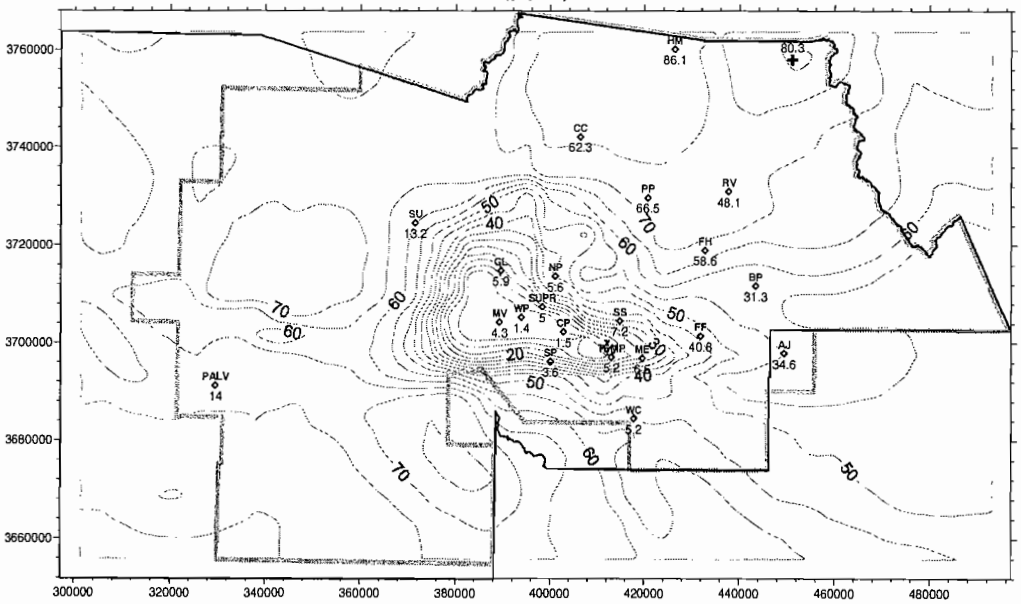
Surface 1-hour ozone concentration (ppb) on June 6, 2002 3:00-4:00 LST



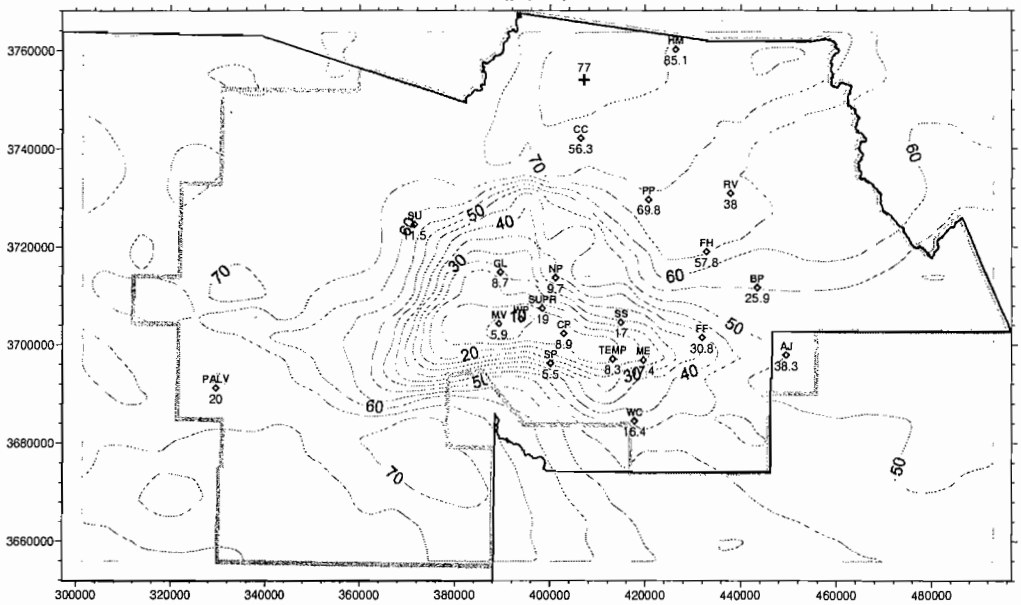
Surface 1-hour ozone concentration (ppb) on June 6, 2002 4:00-5:00 LST



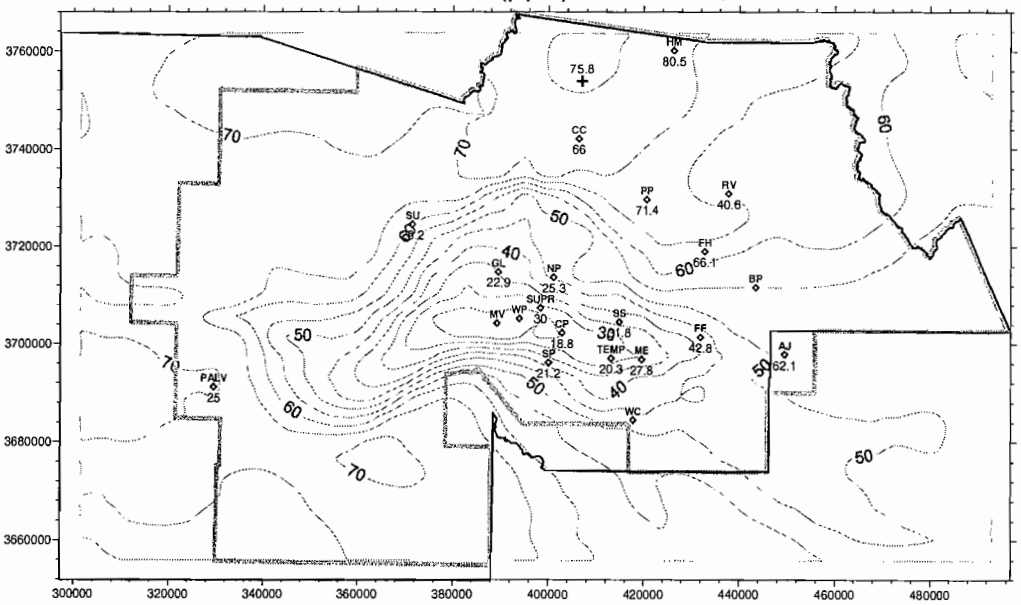
Surface 1-hour ozone concentration (ppb) on June 6, 2002 5:00-6:00 LST



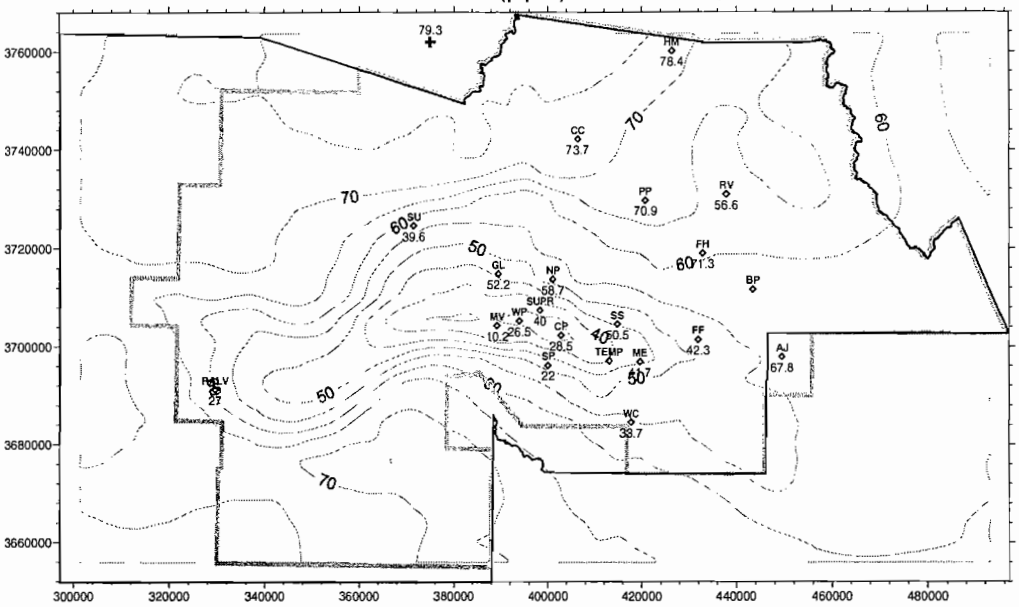
Surface 1-hour ozone concentration (ppb) on June 6, 2002 6:00-7:00 LST



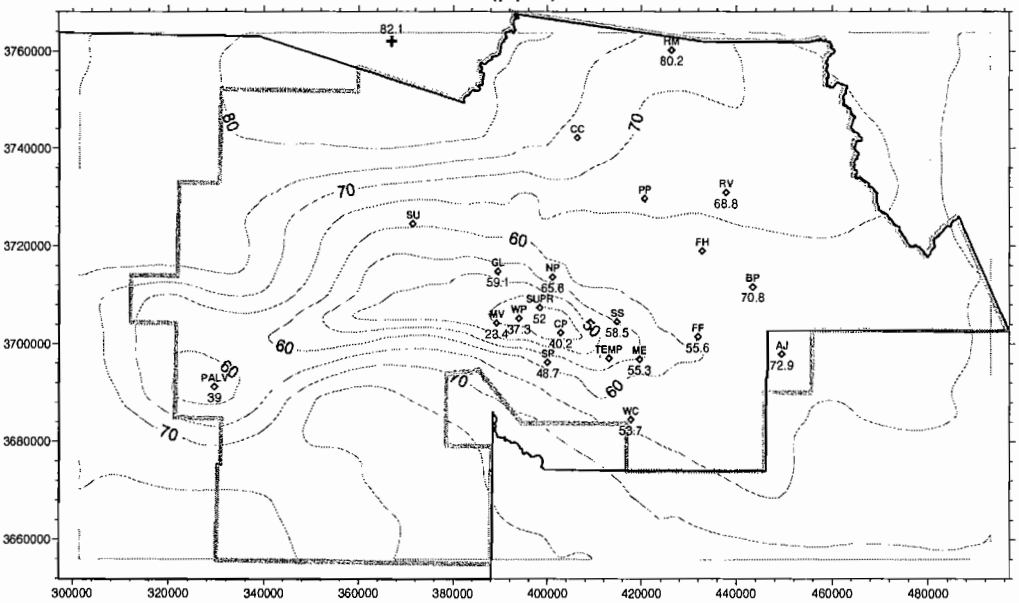
Surface 1-hour ozone concentration (ppb) on June 6, 2002 7:00-8:00 LST



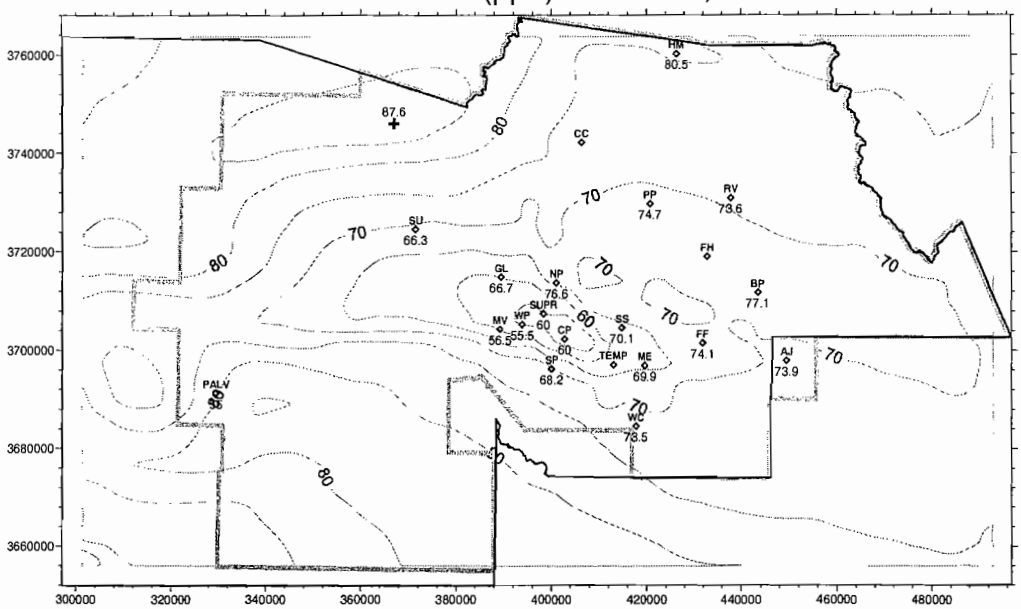
Surface 1-hour ozone concentration (ppb) on June 6, 2002 8:00-9:00 LST



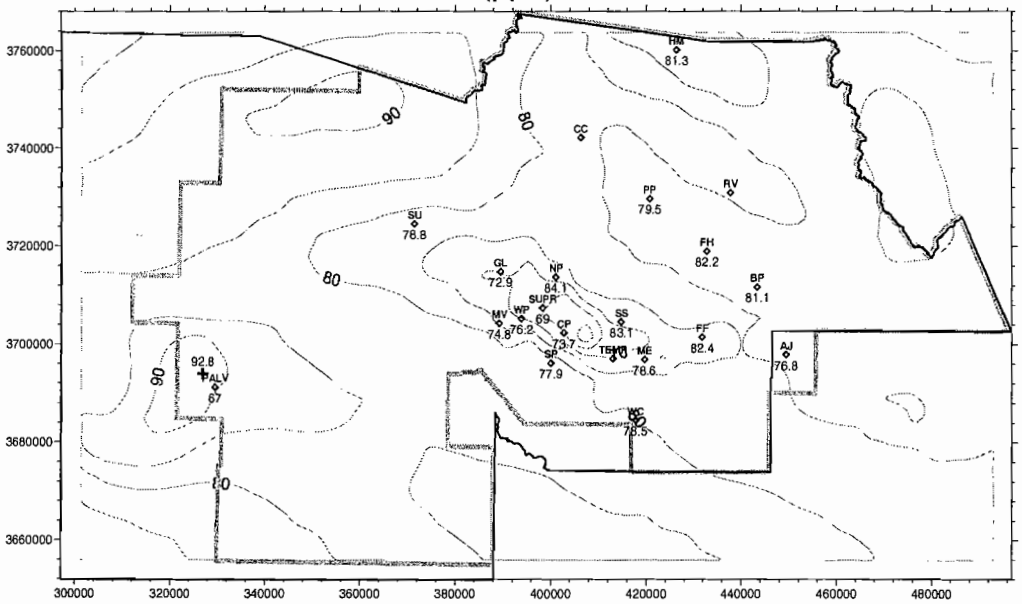
Surface 1-hour ozone concentration (ppb) on June 6, 2002 9:00-10:00 LST



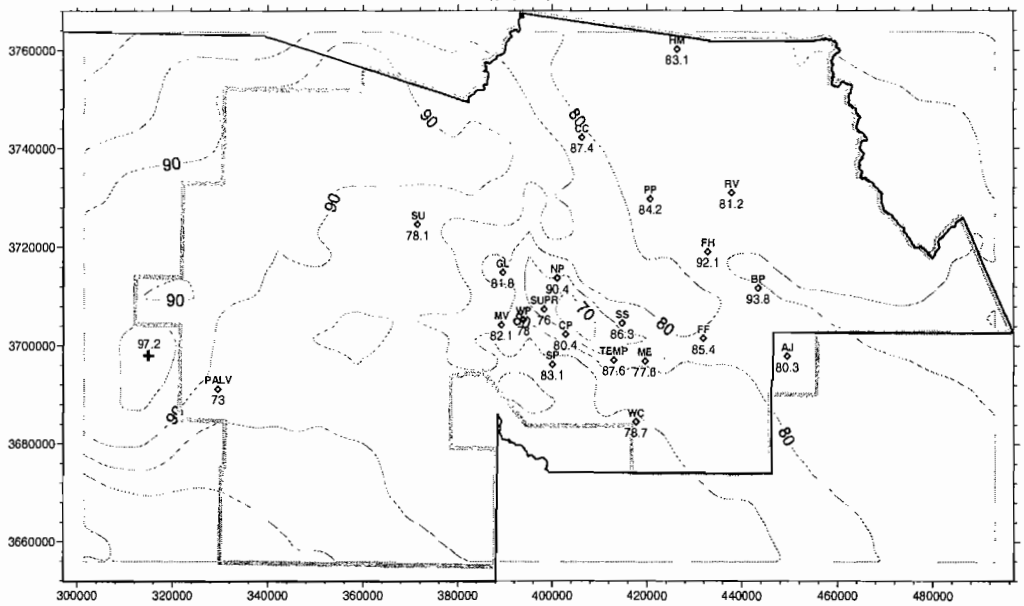
Surface 1-hour ozone concentration (ppb) on June 6, 2002 10:00-11:00 LST



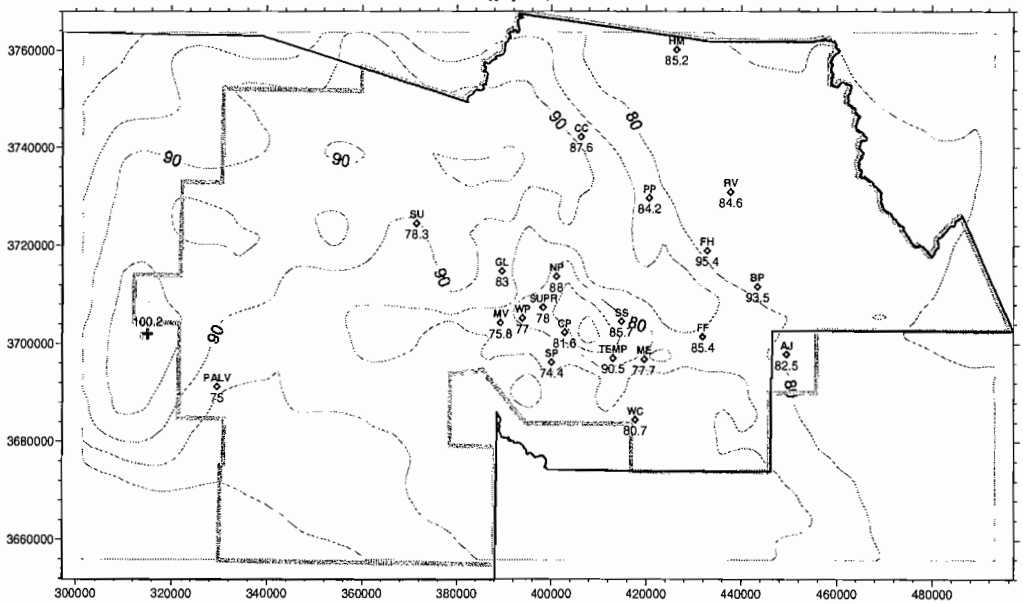
Surface 1-hour ozone concentration (ppb) on June 6, 2002 11:00-12:00 LST



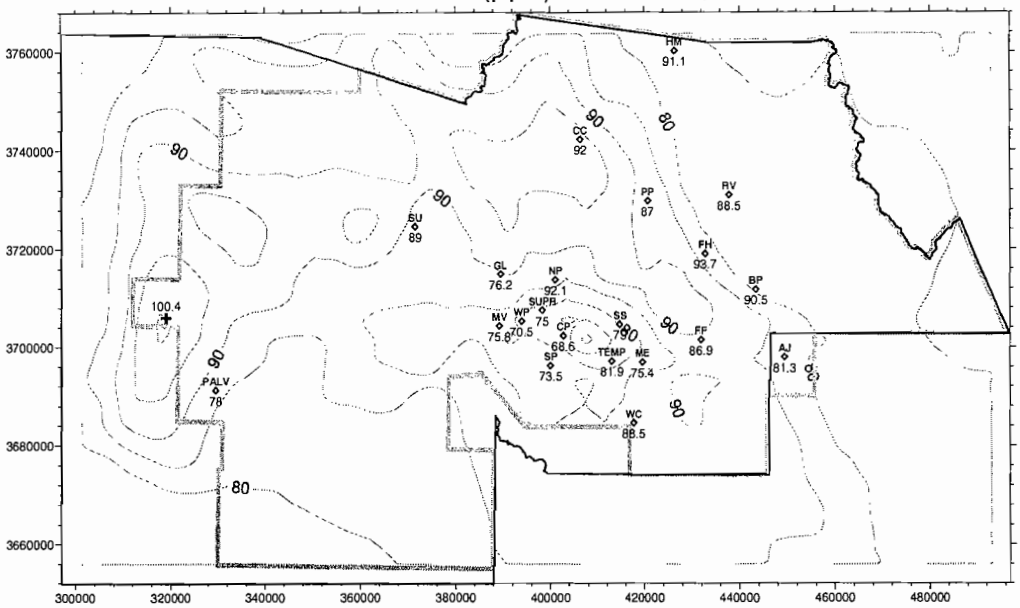
Surface 1-hour ozone concentration (ppb) on June 6, 2002 12:00-13:00 LST



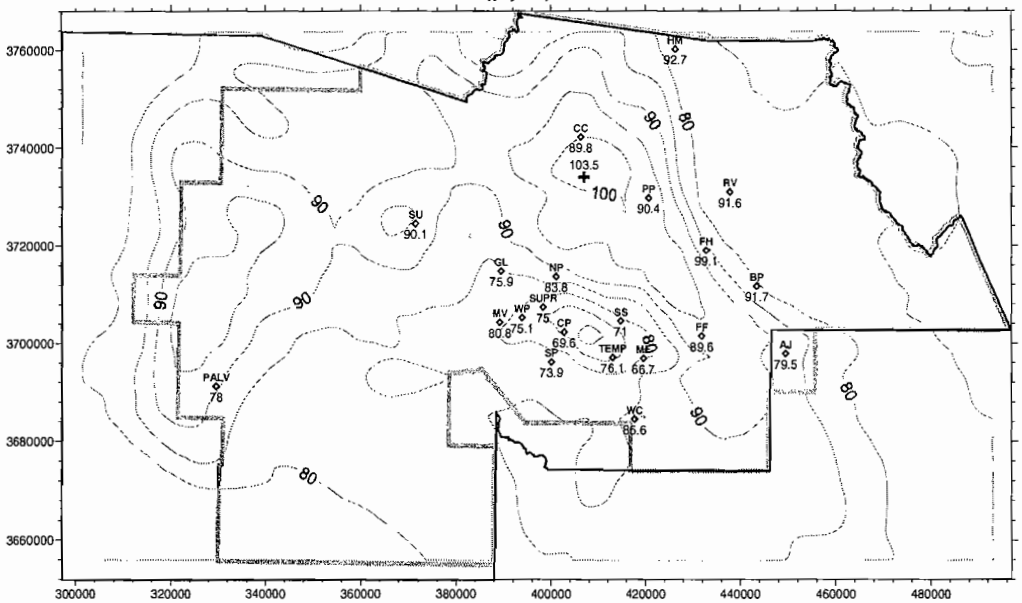
Surface 1-hour ozone concentration (ppb) on June 6, 2002 13:00-14:00 LST



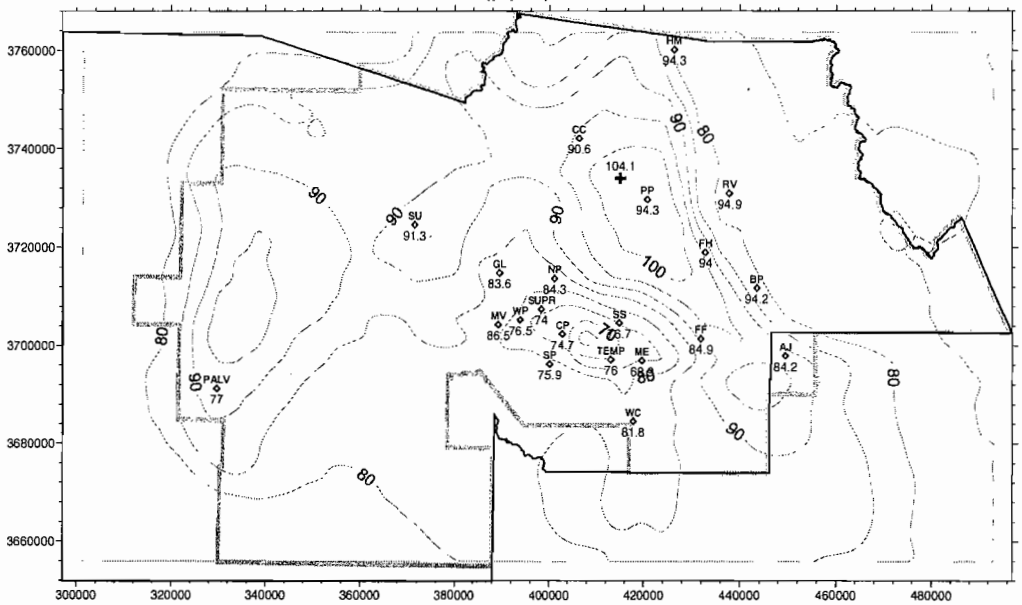
Surface 1-hour ozone concentration (ppb) on June 6, 2002 14:00-15:00 LST



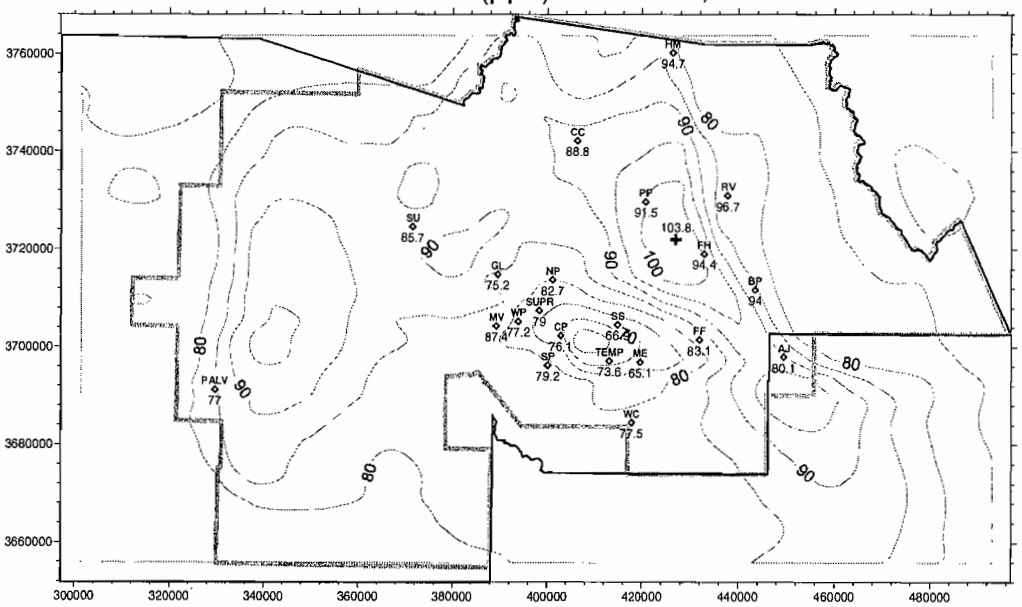
Surface 1-hour ozone concentration (ppb) on June 6, 2002 15:00-16:00 LST



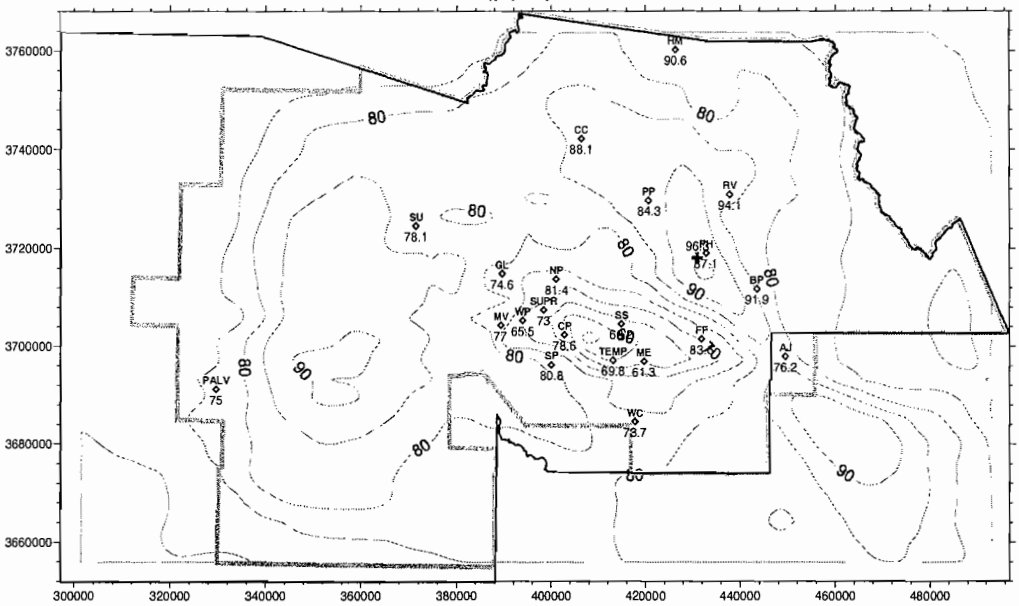
Surface 1-hour ozone concentration (ppb) on June 6, 2002 16:00-17:00 LST



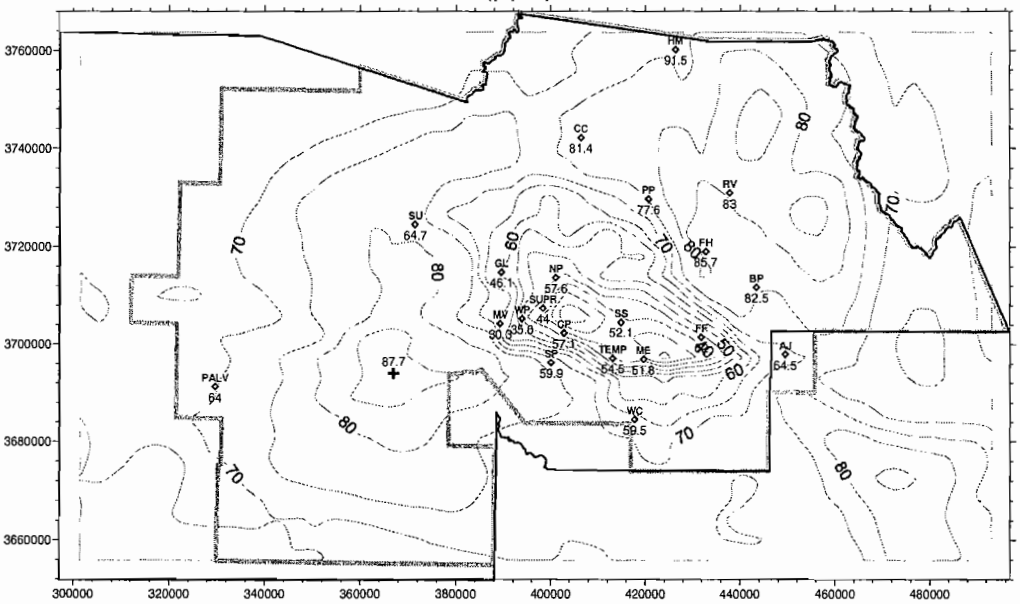
Surface 1-hour ozone concentration (ppb) on June 6, 2002 17:00-18:00 LST



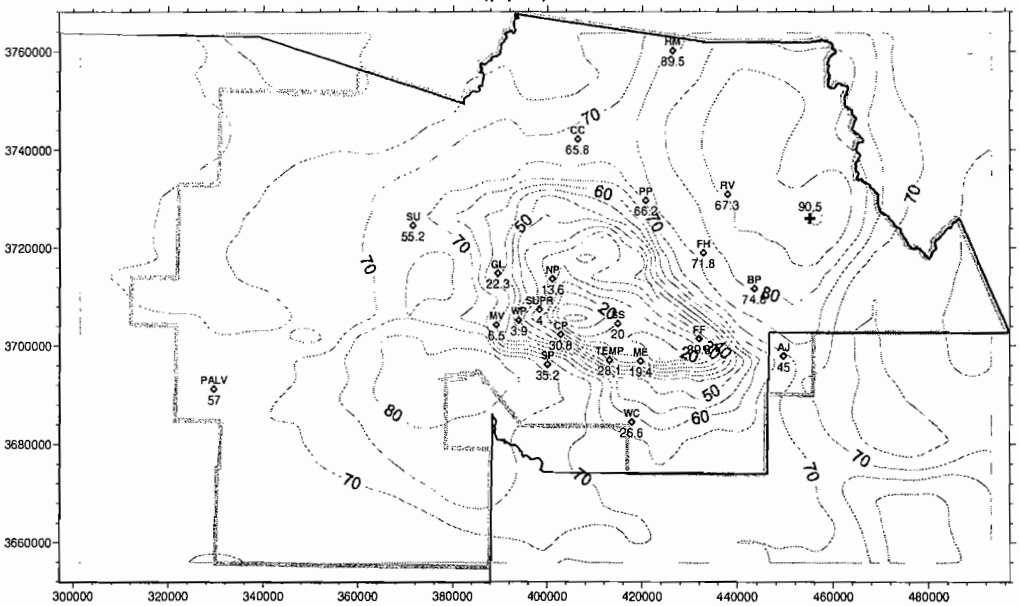
Surface 1-hour ozone concentration (ppb) on June 6, 2002 18:00-19:00 LST



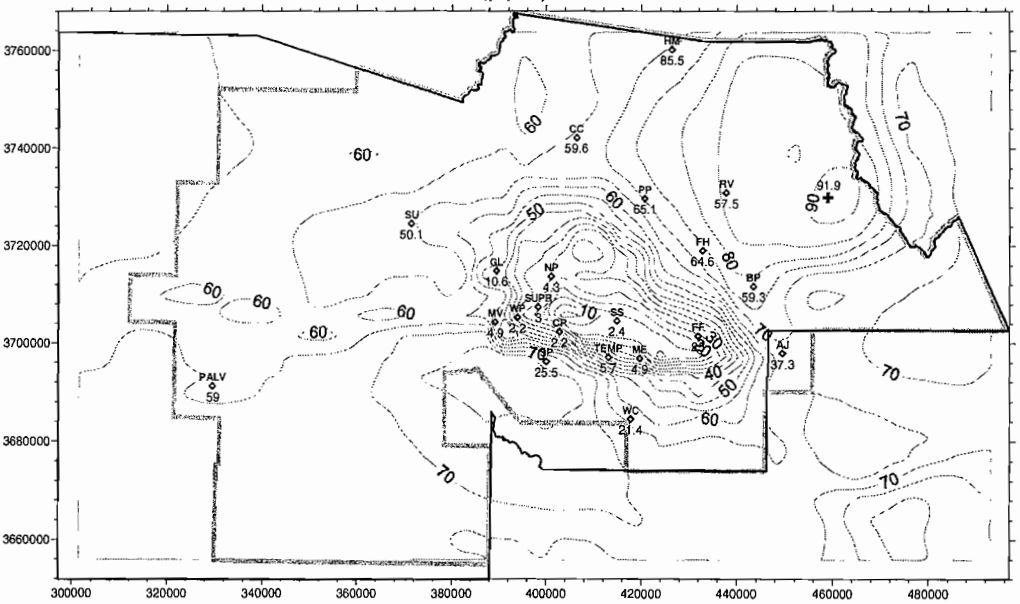
Surface 1-hour ozone concentration (ppb) on June 6, 2002 19:00-20:00 LST



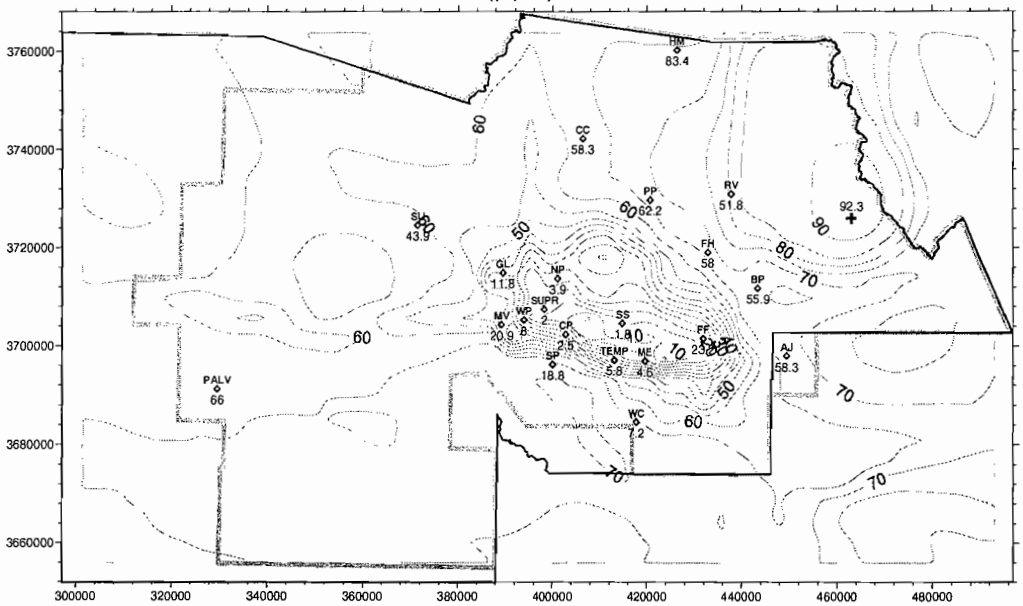
Surface 1-hour ozone concentration (ppb) on June 6, 2002 20:00-21:00 LST



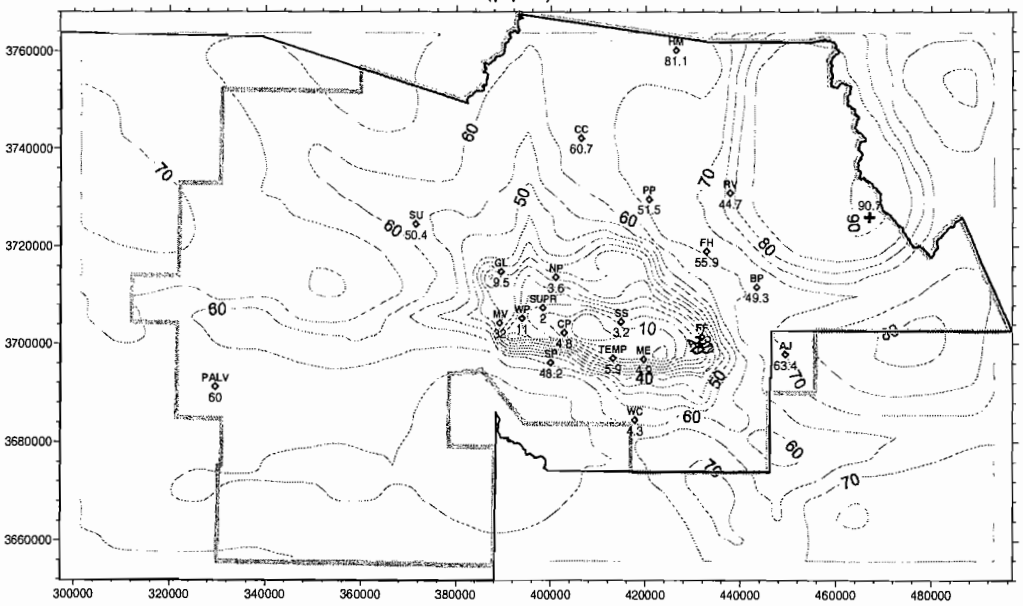
Surface 1-hour ozone concentration (ppb) on June 6, 2002 21:00-22:00 LST



Surface 1-hour ozone concentration (ppb) on June 6, 2002 22:00-23:00 LST



Surface 1-hour ozone concentration (ppb) on June 6, 2002 23:00-24:00 LST

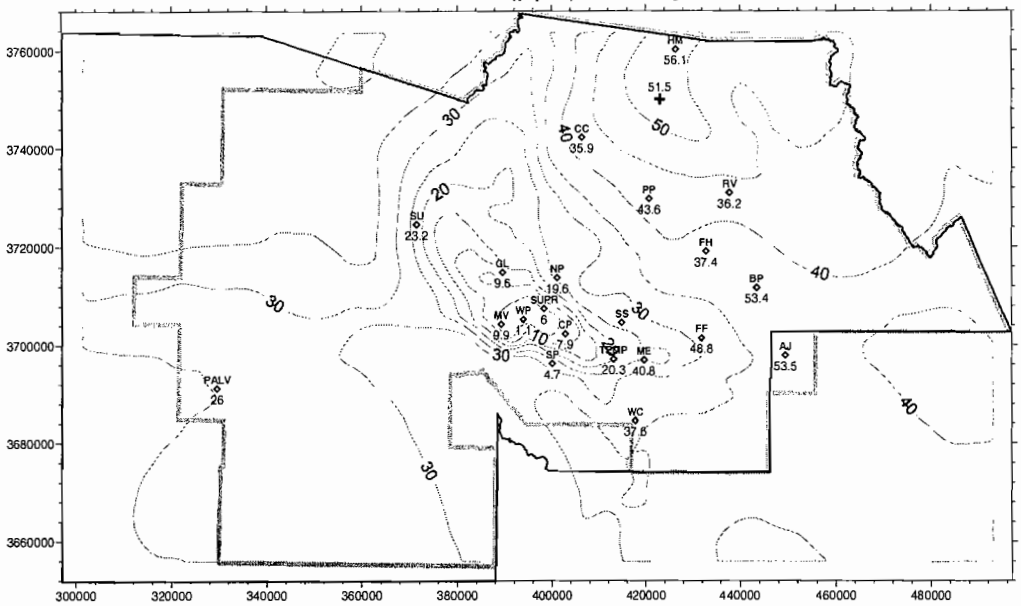


Appendix III-xi

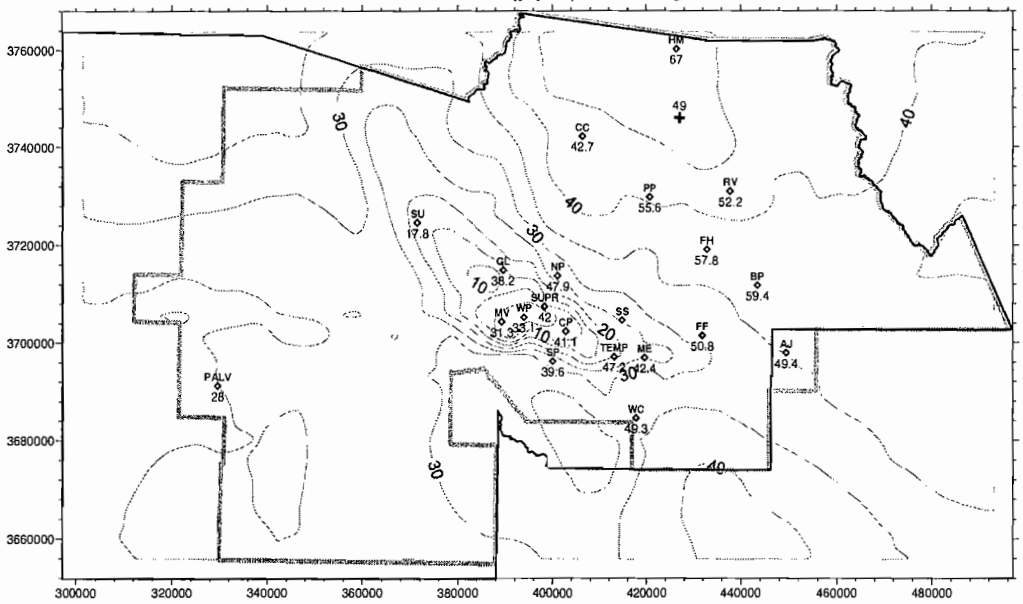
MODELED 1-HOUR OZONE FOR THE JULY 2002 EPISODE

The plots shown here are the simulated 1-hour ozone. These hourly ozone concentrations are from 0:00 to 24:00 LST on July 9, 2002.

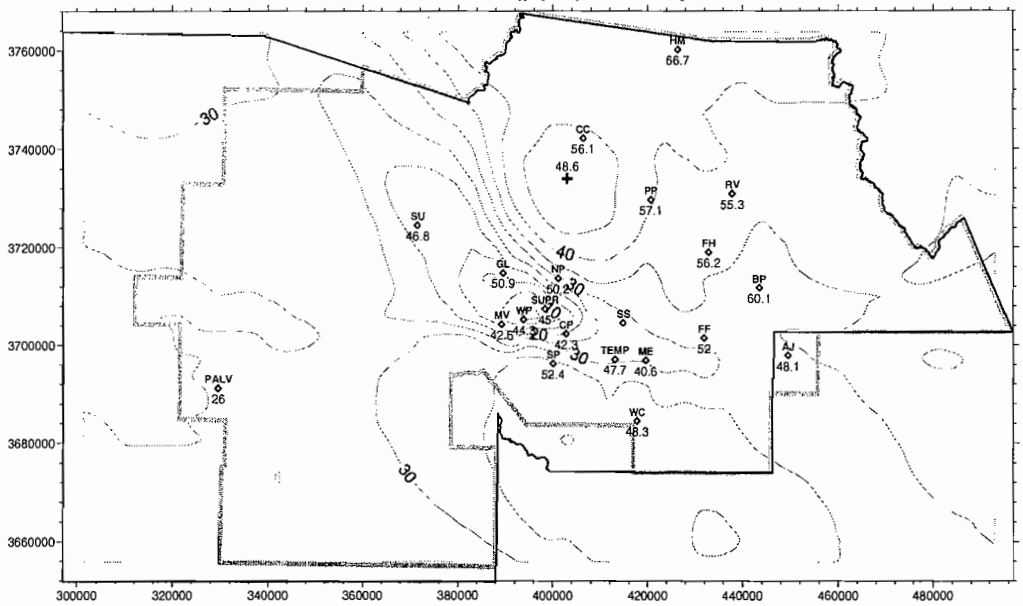
Surface 1-hour ozone concentration (ppb) on July 9, 2002 0:00-1:00 LST



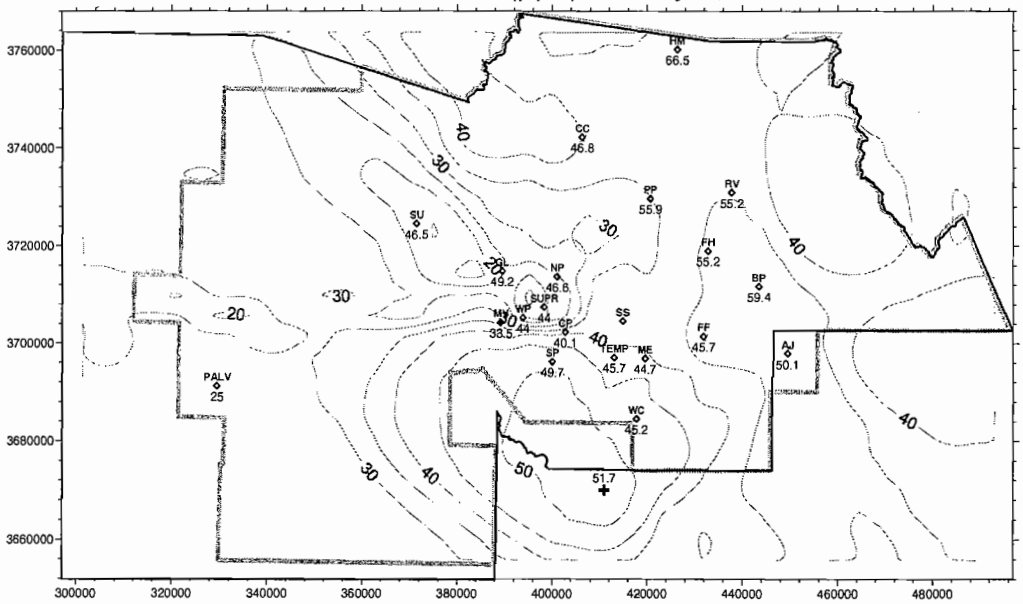
Surface 1-hour ozone concentration (ppb) on July 9, 2002 1:00-2:00 LST



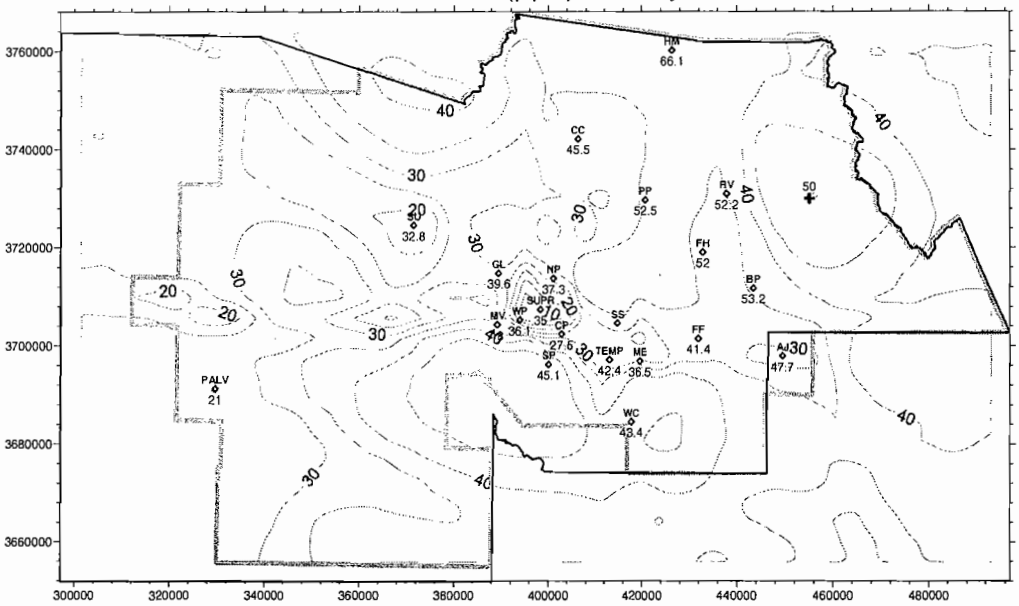
Surface 1-hour ozone concentration (ppb) on July 9, 2002 2:00-300 LST



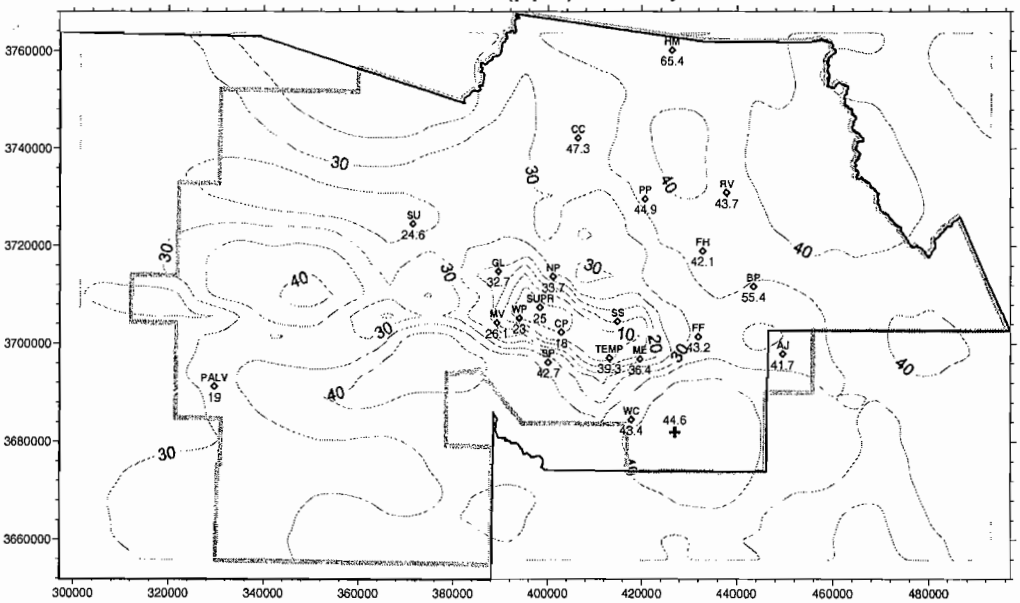
Surface 1-hour ozone concentration (ppb) on July 9, 2002 3:00-4:00 LST



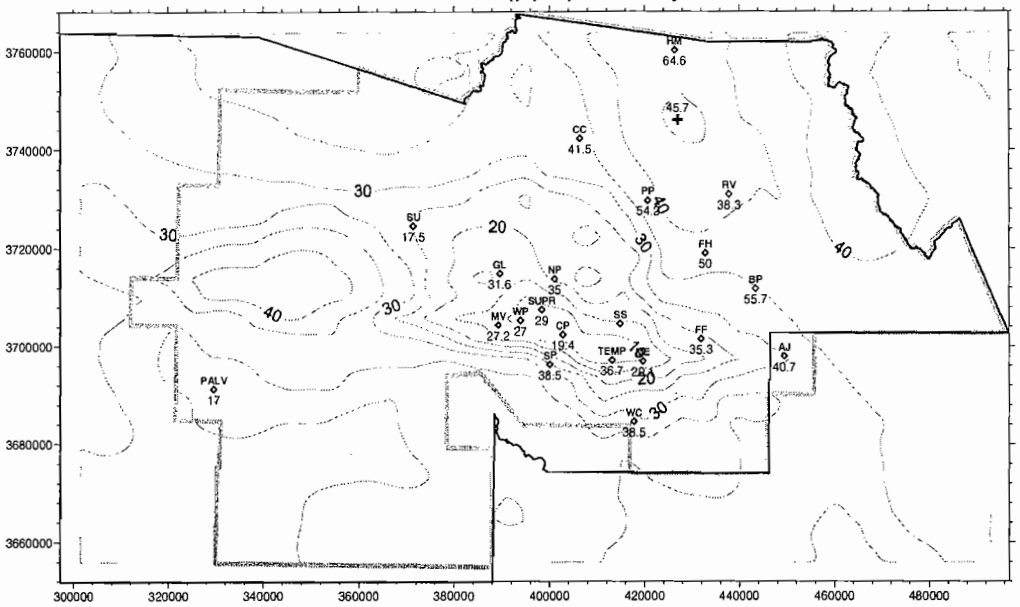
Surface 1-hour ozone concentration (ppb) on July 9, 2002 4:00-5:00 LST



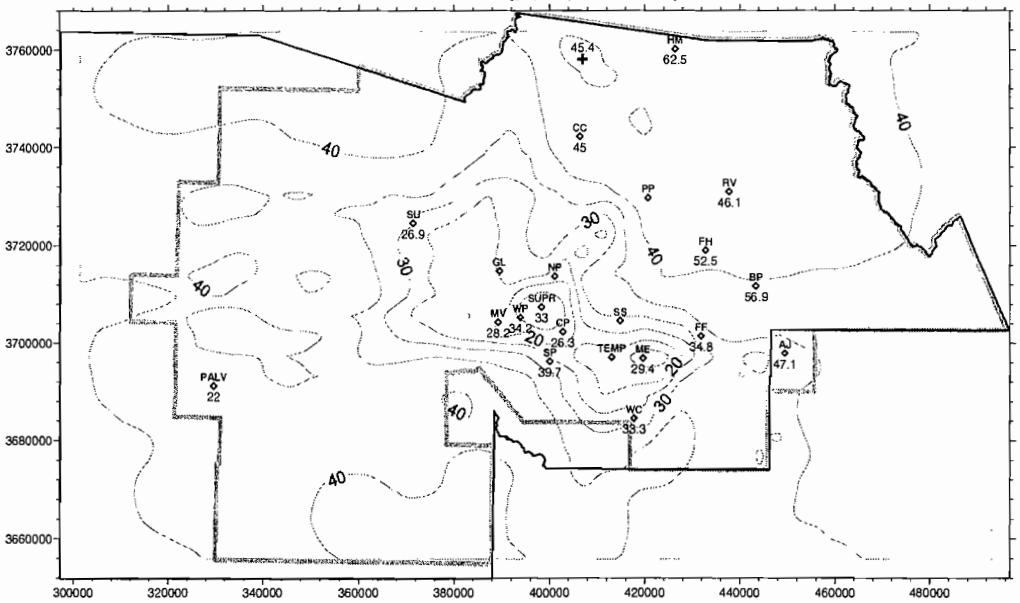
Surface 1-hour ozone concentration (ppb) on July 9, 2002 5:00-6:00 LST



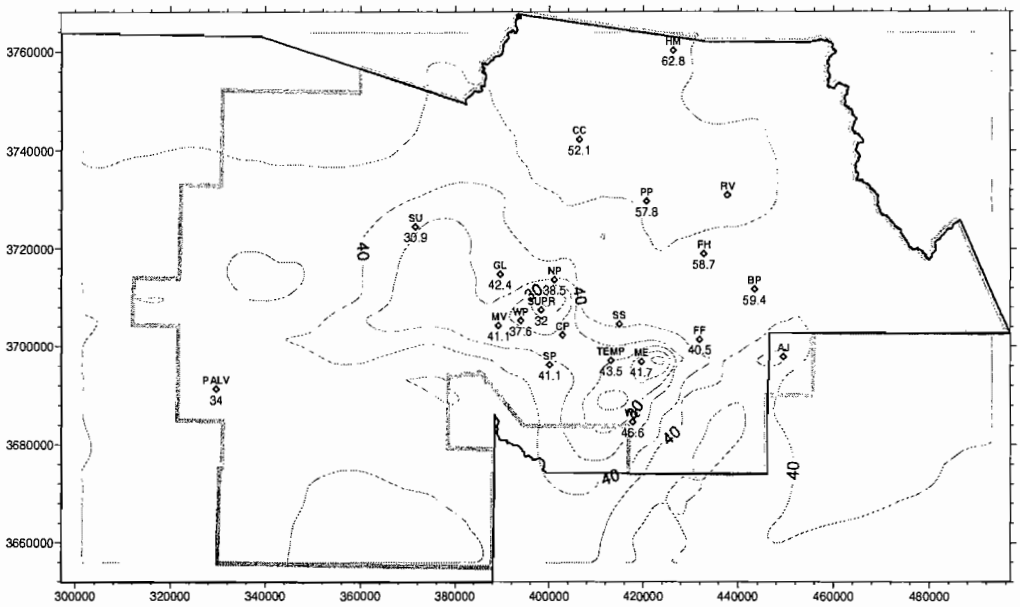
Surface 1-hour ozone concentration (ppb) on July 9, 2002 6:00-7:00 LST



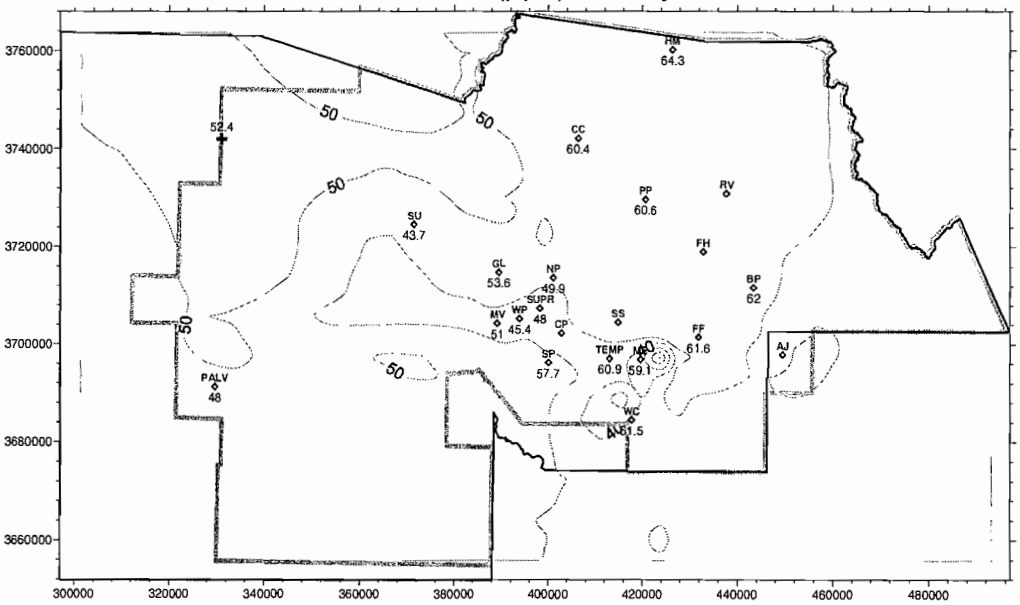
Surface 1-hour ozone concentration (ppb) on July 9, 2002 7:00-8:00 LST



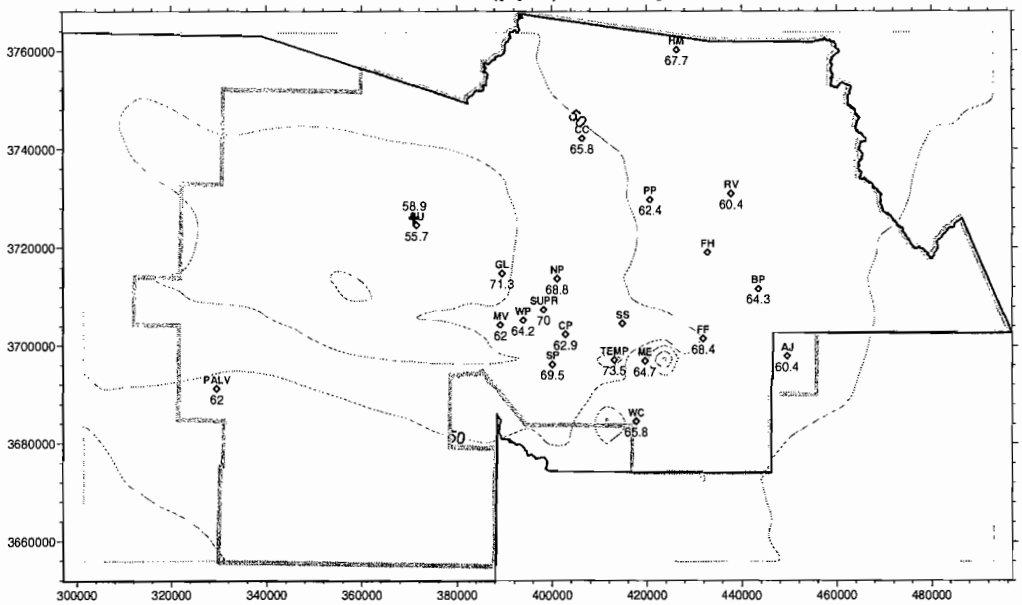
Surface 1-hour ozone concentration (ppb) on July 9, 2002 8:00-9:00 LST



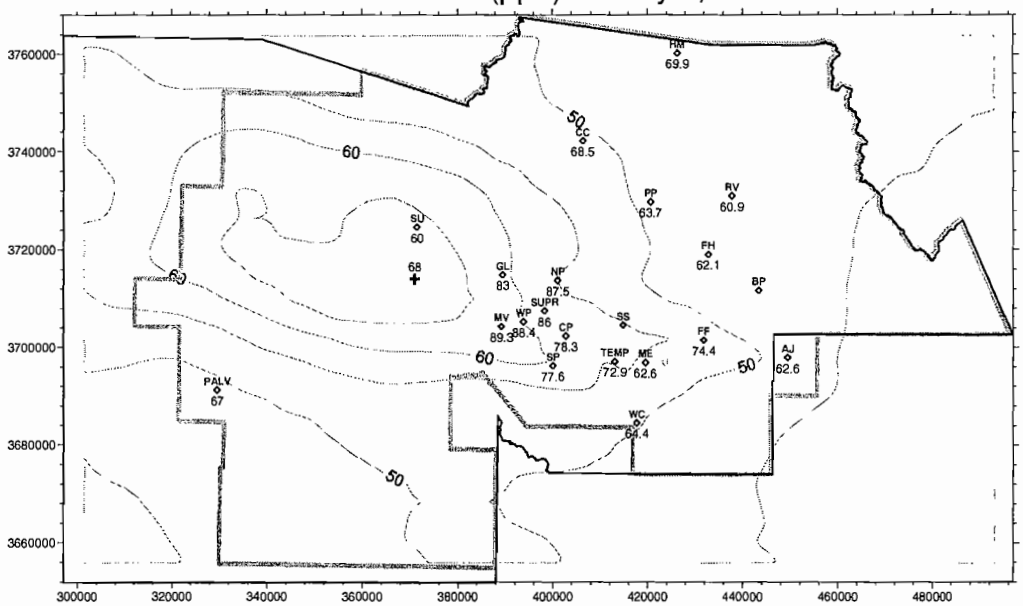
Surface 1-hour ozone concentration (ppb) on July 9, 2002 9:00-10:00 LST



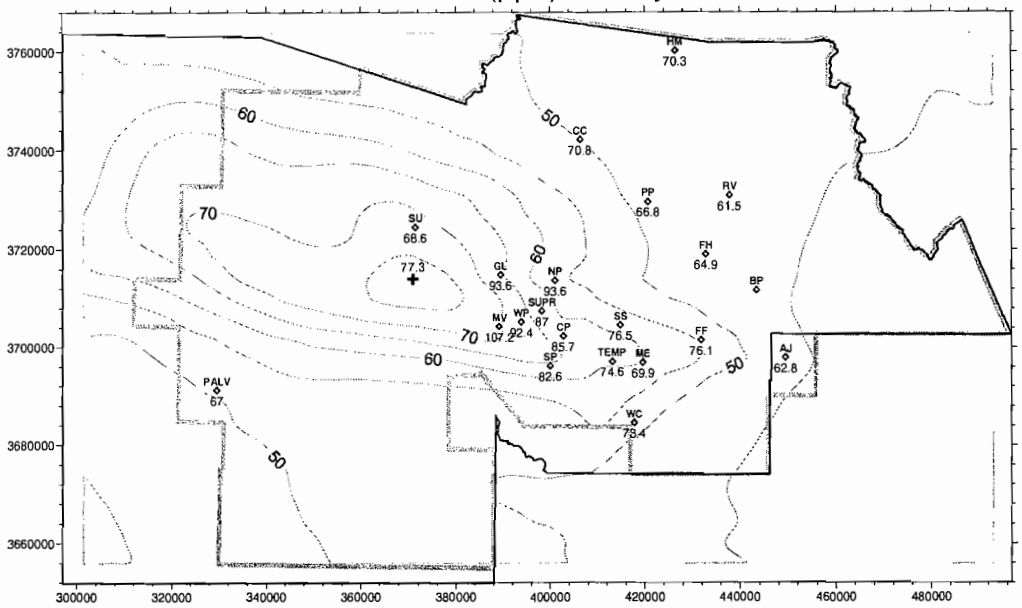
Surface 1-hour ozone concentration (ppb) on July 9, 2002 10:00-11:00 LST



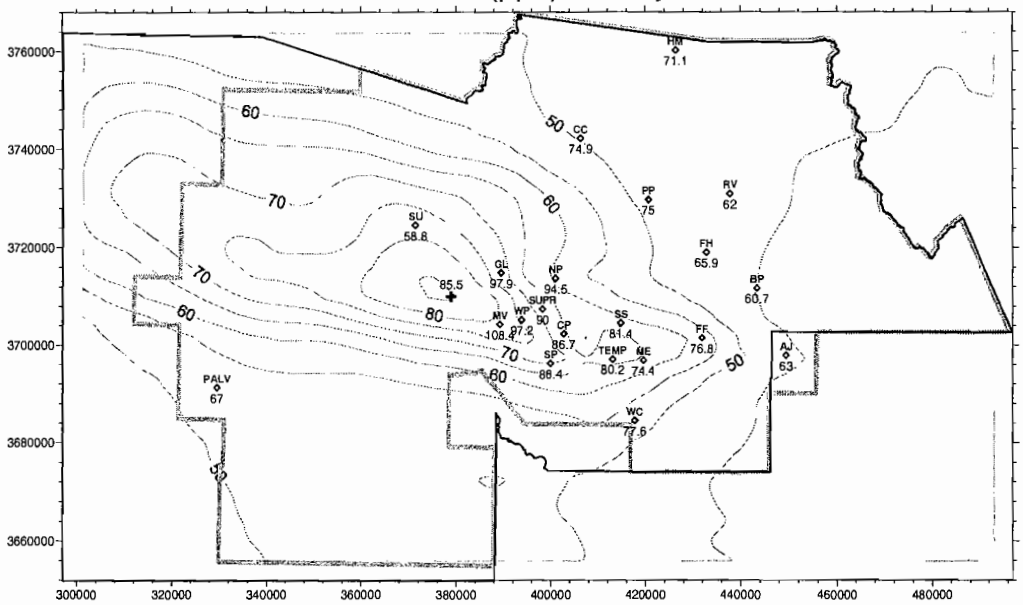
Surface 1-hour ozone concentration (ppb) on July 9, 2002 11:00-12:00 LST



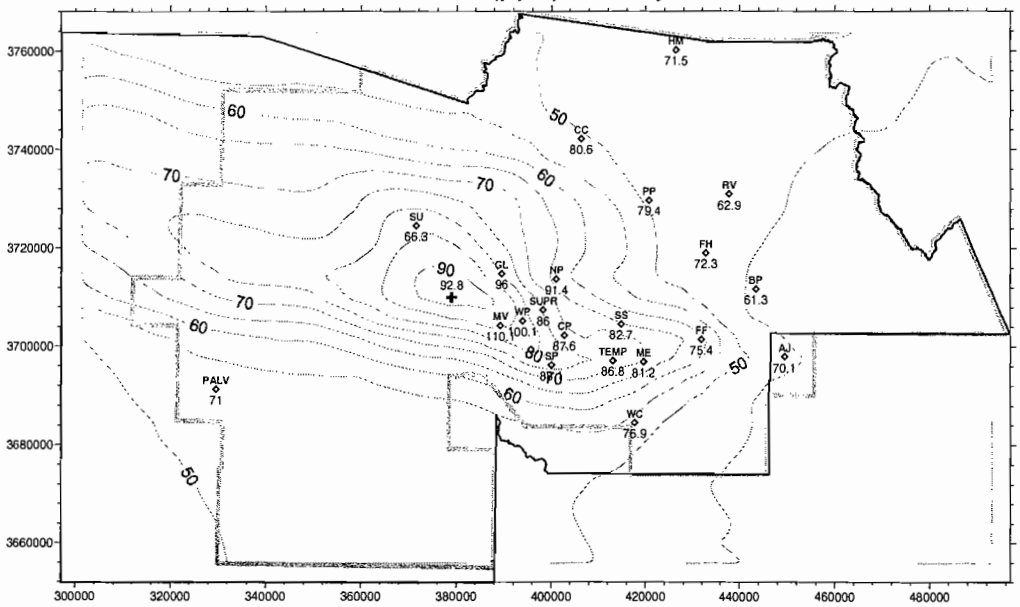
Surface 1-hour ozone concentration (ppb) on July 9, 2002 12:00-13:00 LST



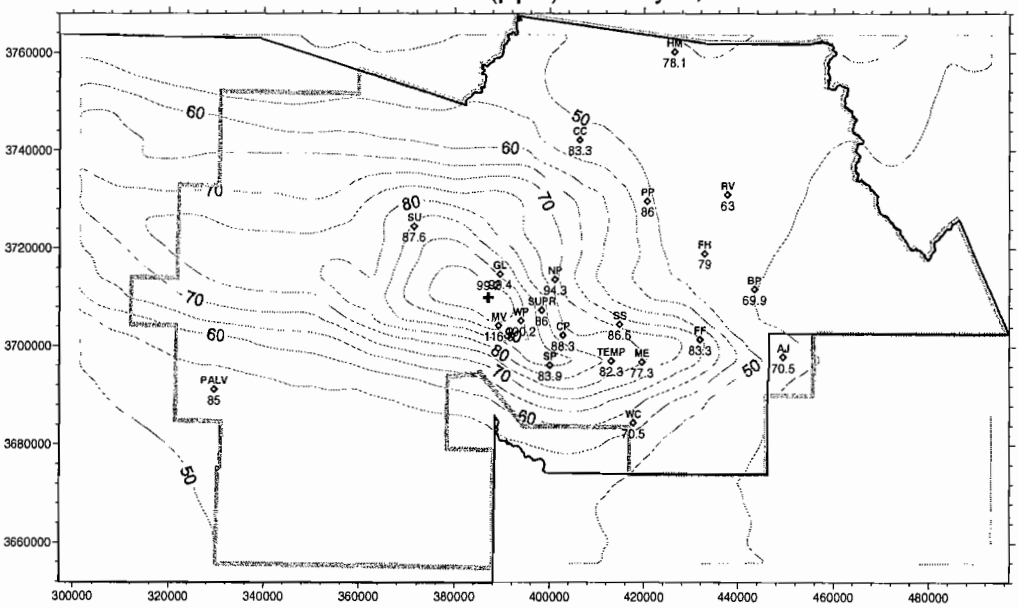
Surface 1-hour ozone concentration (ppb) on July 9, 2002 13:00-14:00 LST



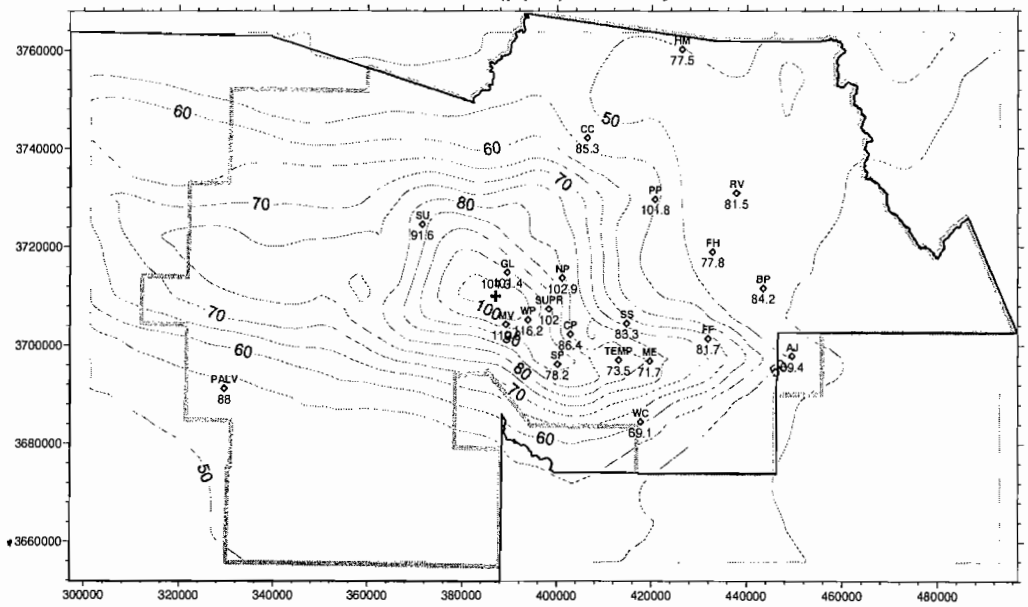
Surface 1-hour ozone concentration (ppb) on July 9, 2002 14:00-15:00 LST



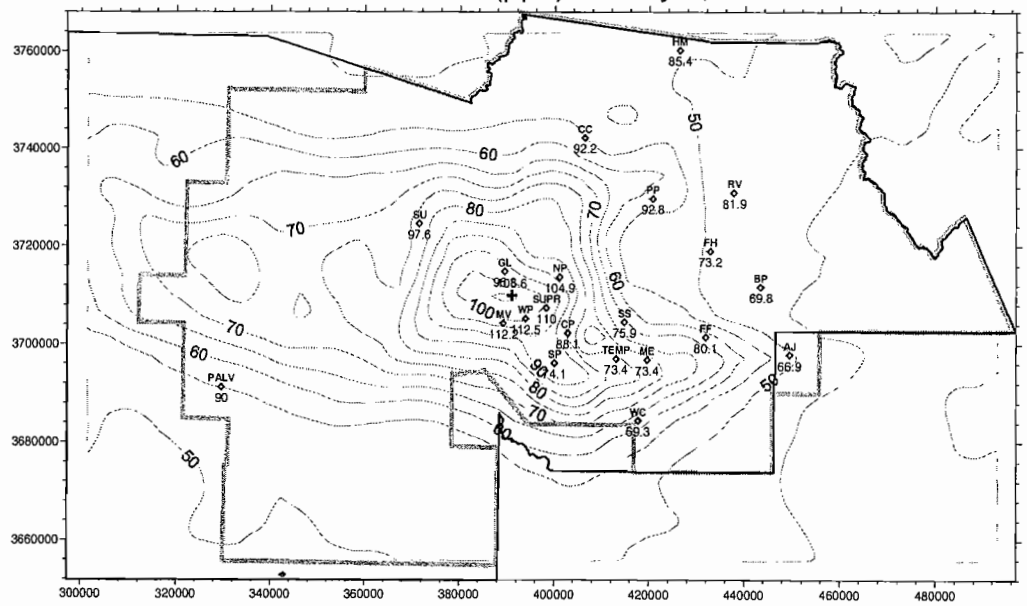
Surface 1-hour ozone concentration (ppb) on July 9, 2002 15:00-16:00 LST



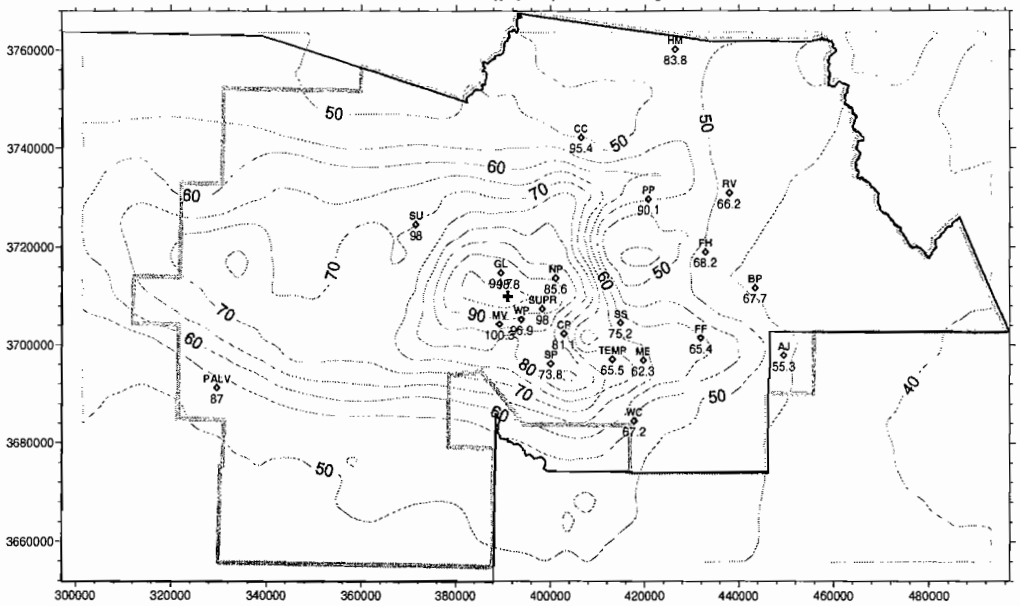
Surface 1-hour ozone concentration (ppb) on July 9, 2002 16:00-17:00 LST



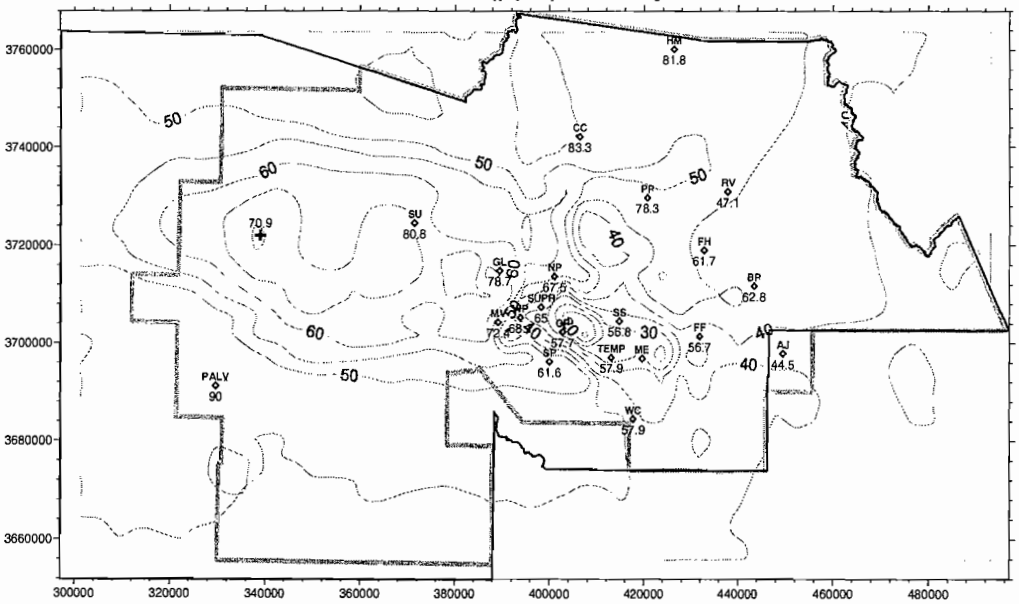
Surface 1-hour ozone concentration (ppb) on July 9, 2002 17:00-18:00 LST



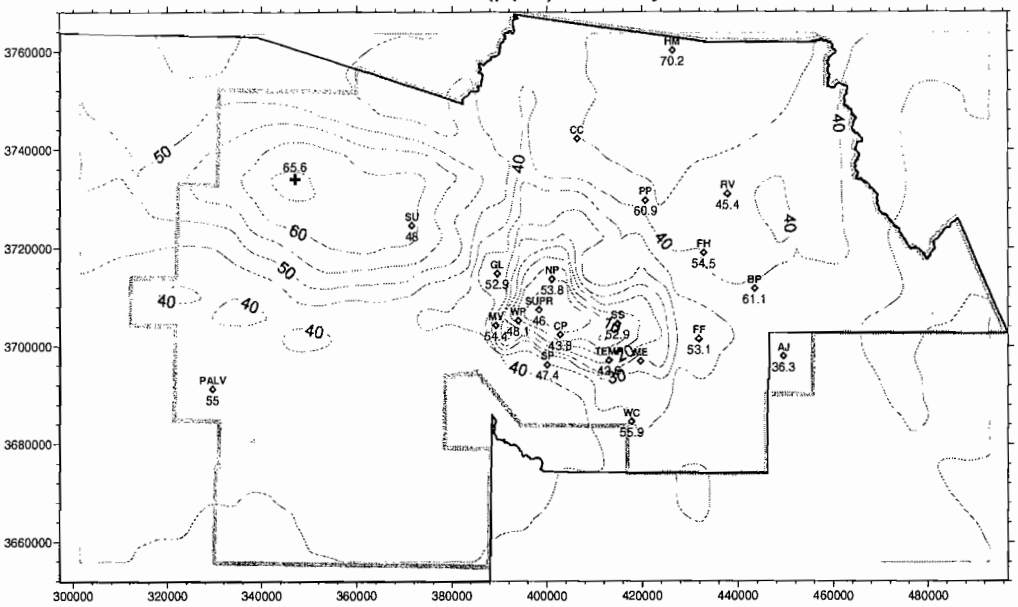
Surface 1-hour ozone concentration (ppb) on July 9, 2002 18:00-19:00 LST



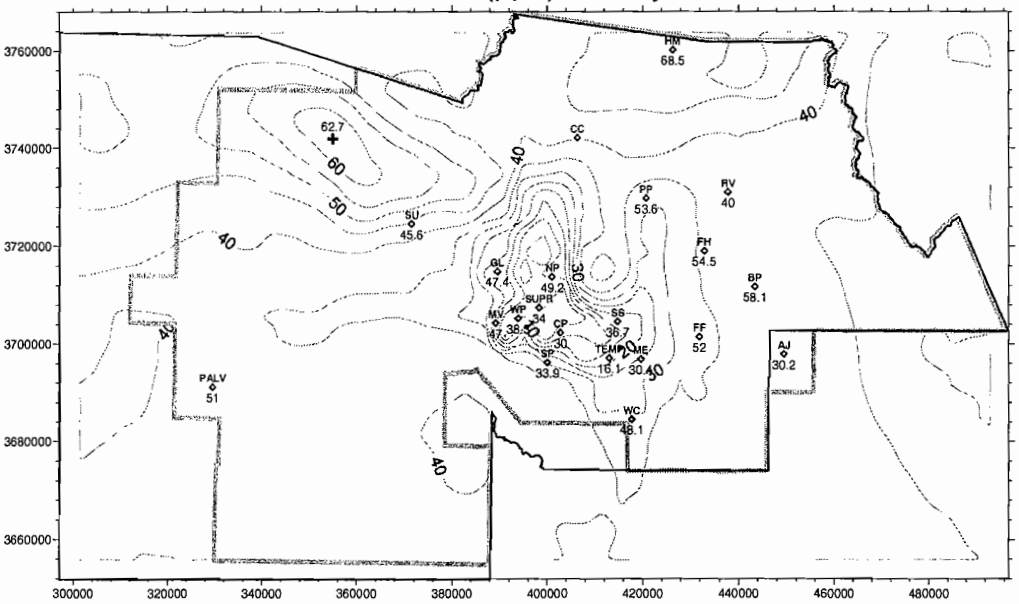
Surface 1-hour ozone concentration (ppb) on July 9, 2002 19:00-20:00 LST



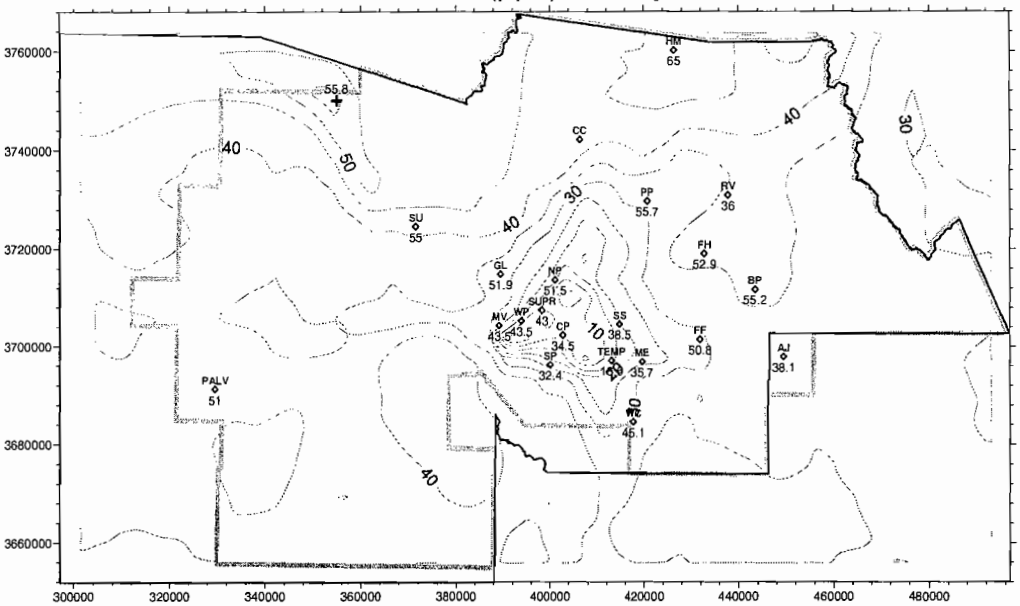
Surface 1-hour ozone concentration (ppb) on July 9, 2002 20:00-21:00 LST



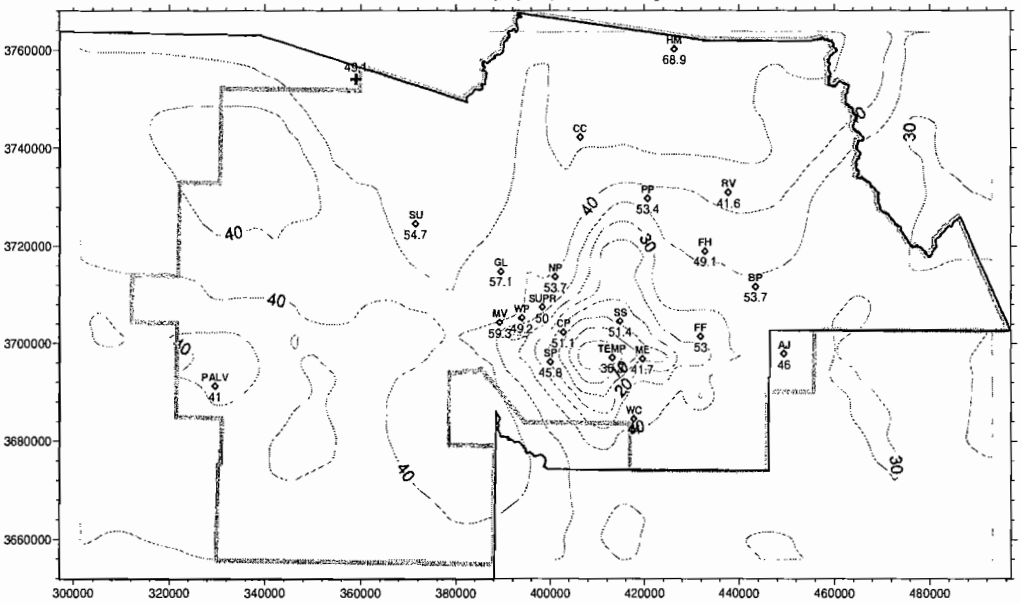
Surface 1-hour ozone concentration (ppb) on July 9, 2002 21:00-22:00 LST



Surface 1-hour ozone concentration (ppb) on July 9, 2002 22:00-23:00 LST



Surface 1-hour ozone concentration (ppb) on July 9, 2002 23:00-24:00 LST

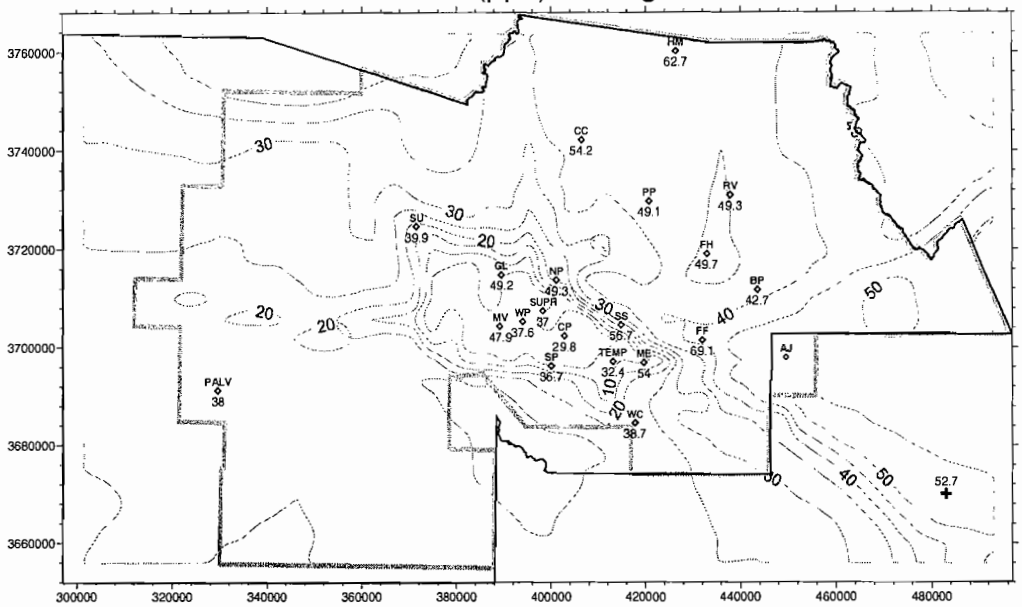


Appendix III-xii

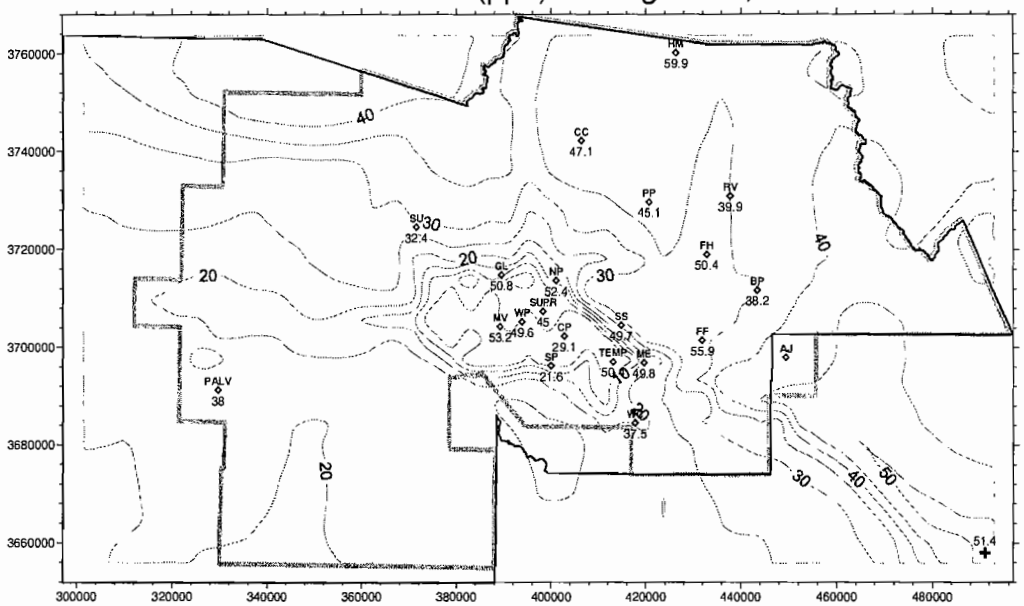
MODELED 1-HOUR OZONE FOR THE AUGUST 2001 EPISODE

The plots shown here are the simulated 1-hour ozone. These hourly ozone concentrations are from 0:00 to 24:00 LST on August 10, 2001.

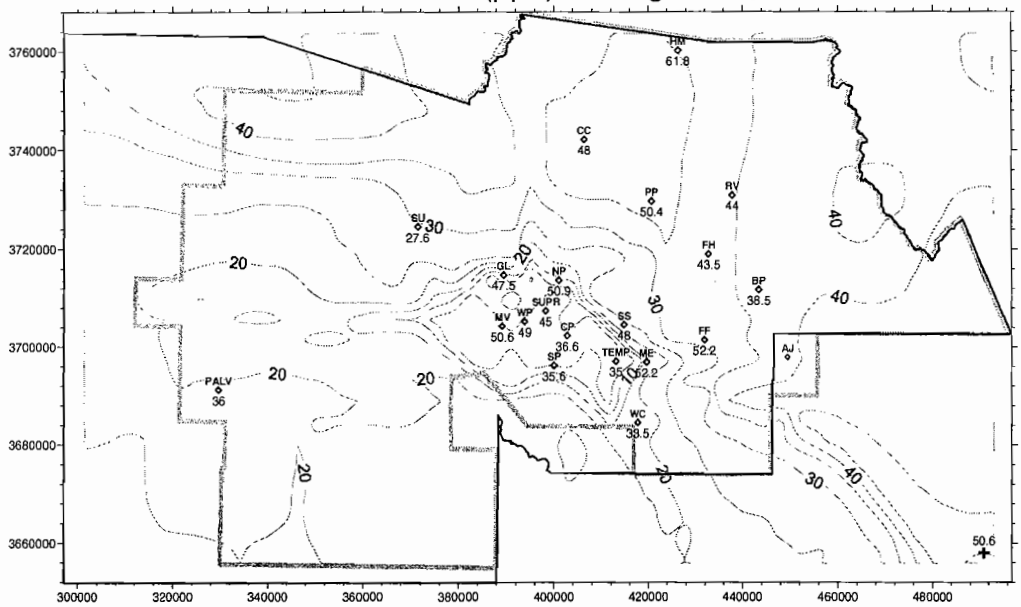
Surface 1-hour ozone concentration (ppb) on August 10, 2001 0:00-1:00 LST



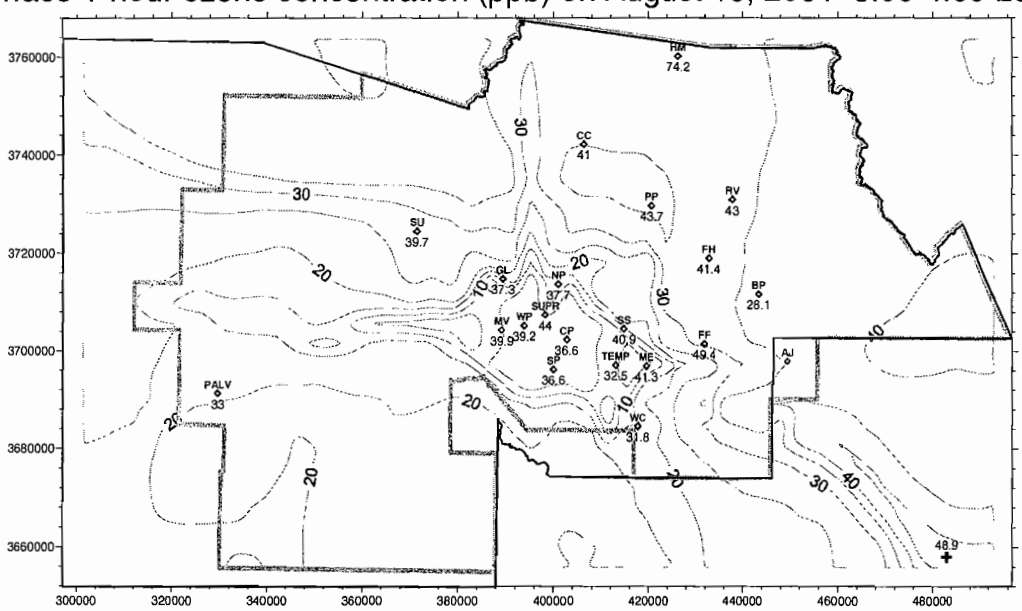
Surface 1-hour ozone concentration (ppb) on August 10, 2001 1:00-2:00 LST



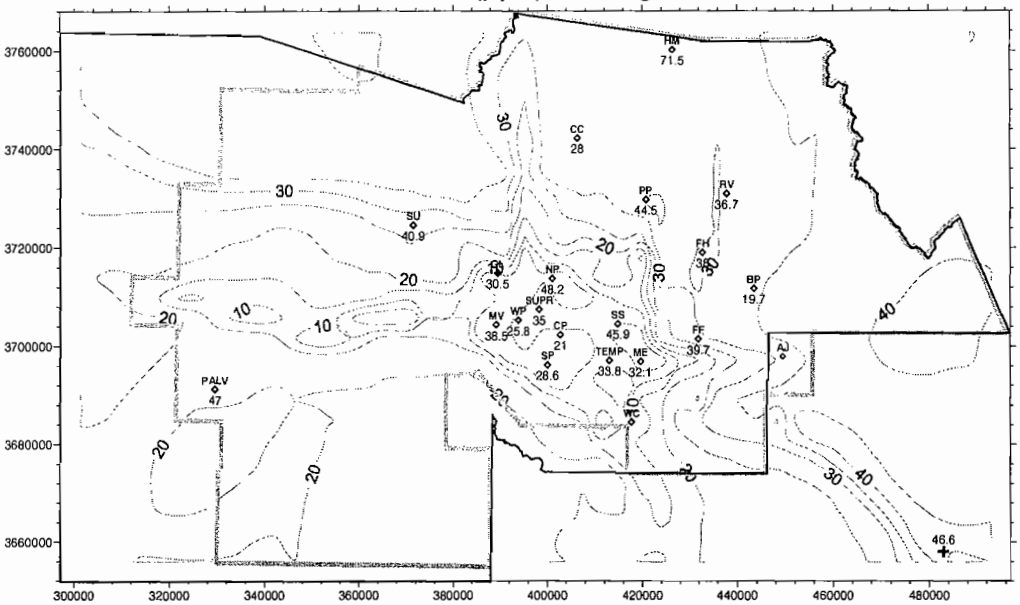
Surface 1-hour ozone concentration (ppb) on August 10, 2001 2:00-300 LST



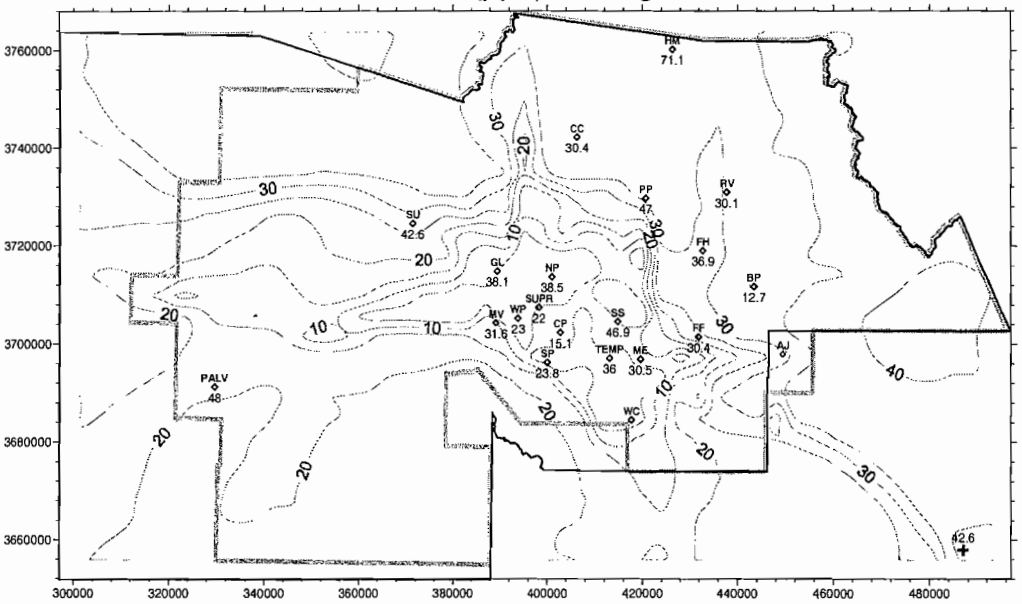
Surface 1-hour ozone concentration (ppb) on August 10, 2001 3:00-4:00 LST



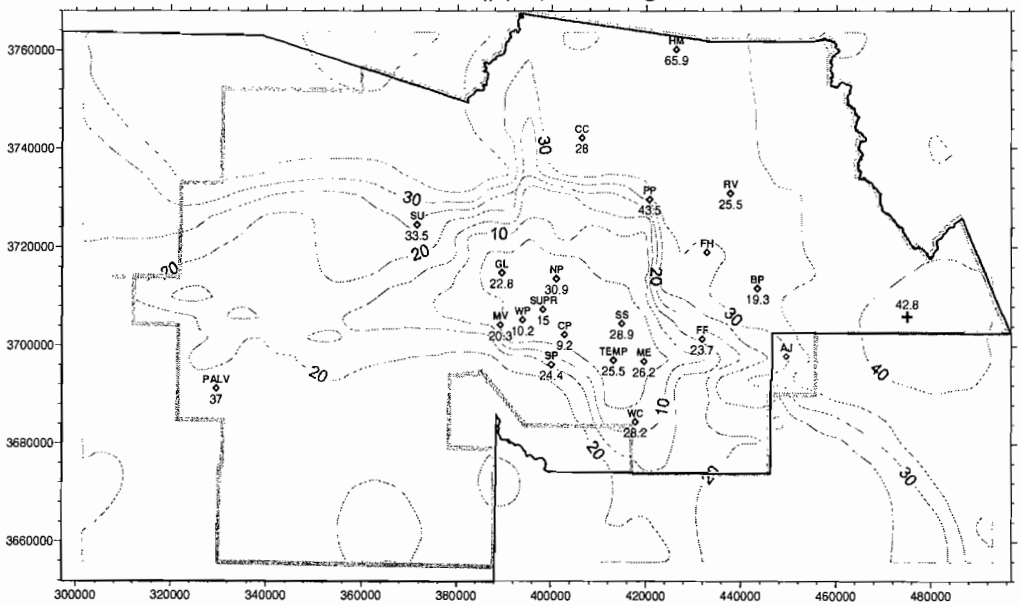
Surface 1-hour ozone concentration (ppb) on August 10, 2001 4:00-5:00 LST



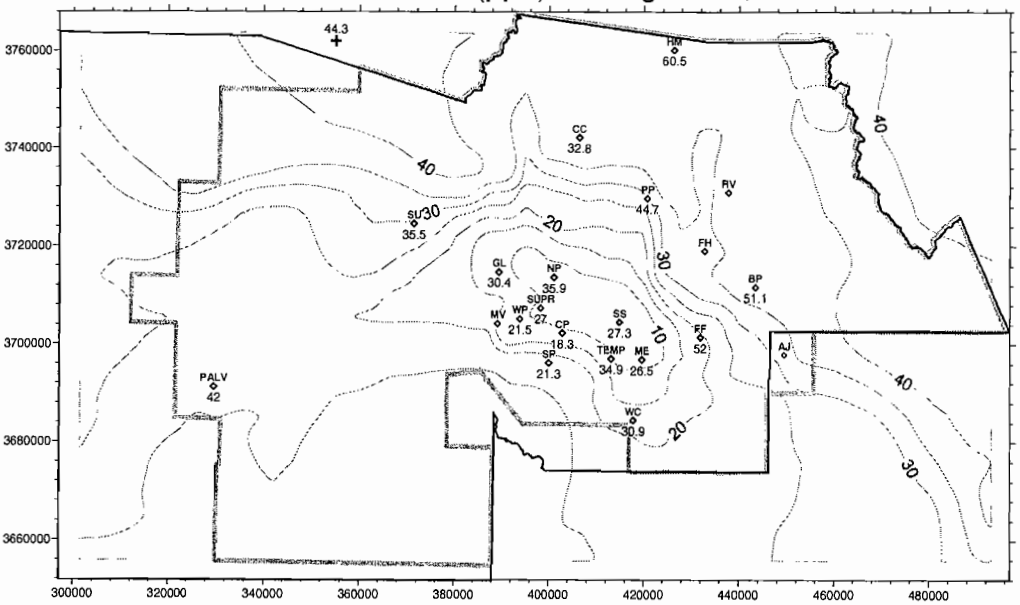
Surface 1-hour ozone concentration (ppb) on August 10, 2001 5:00-6:00 LST



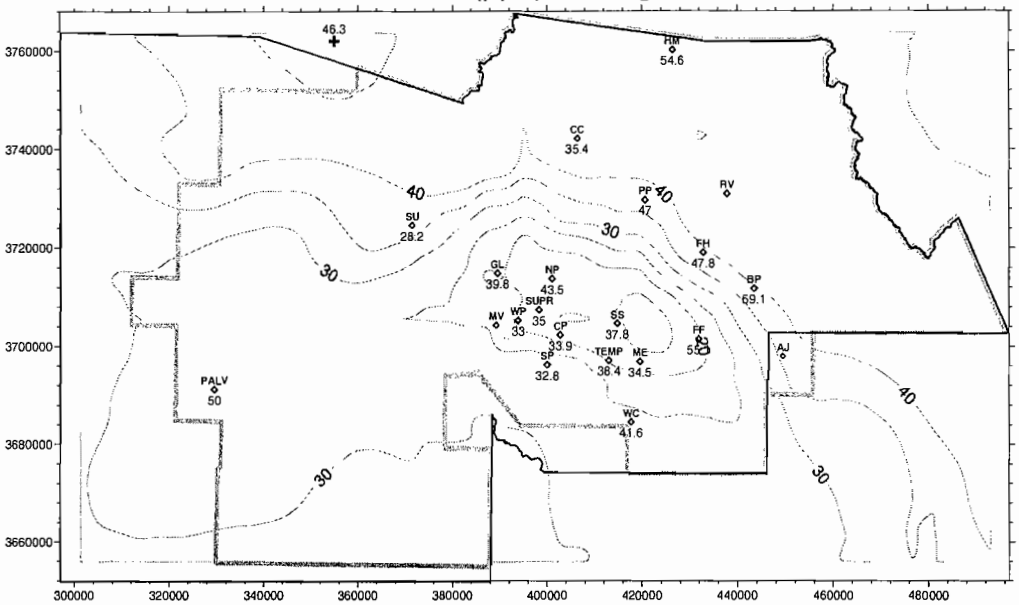
Surface 1-hour ozone concentration (ppb) on August 10, 2001 6:00-7:00 LST



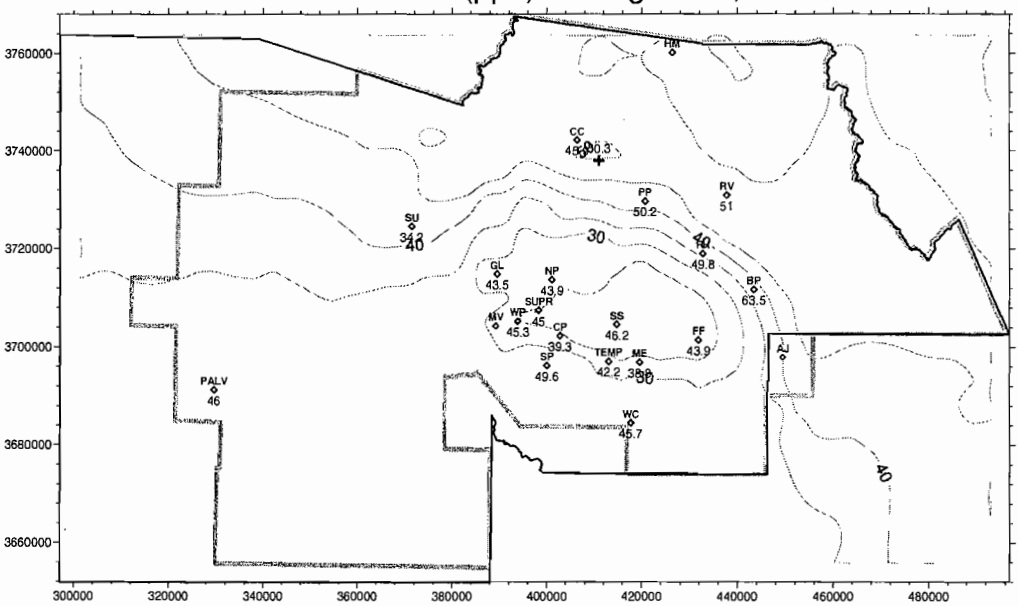
Surface 1-hour ozone concentration (ppb) on August 10, 2001 7:00-8:00 LST



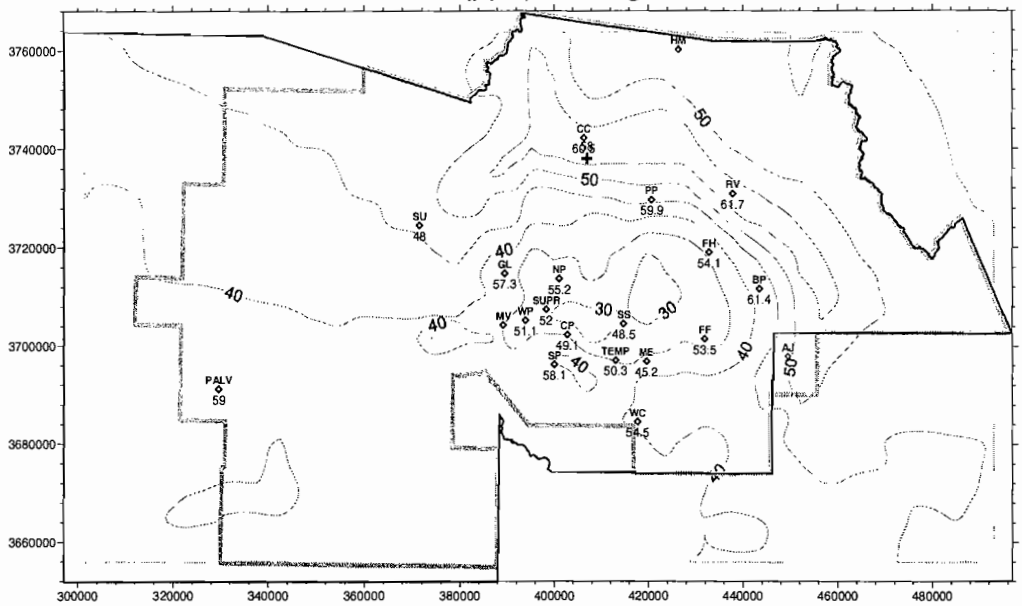
Surface 1-hour ozone concentration (ppb) on August 10, 2001 8:00-9:00 LST



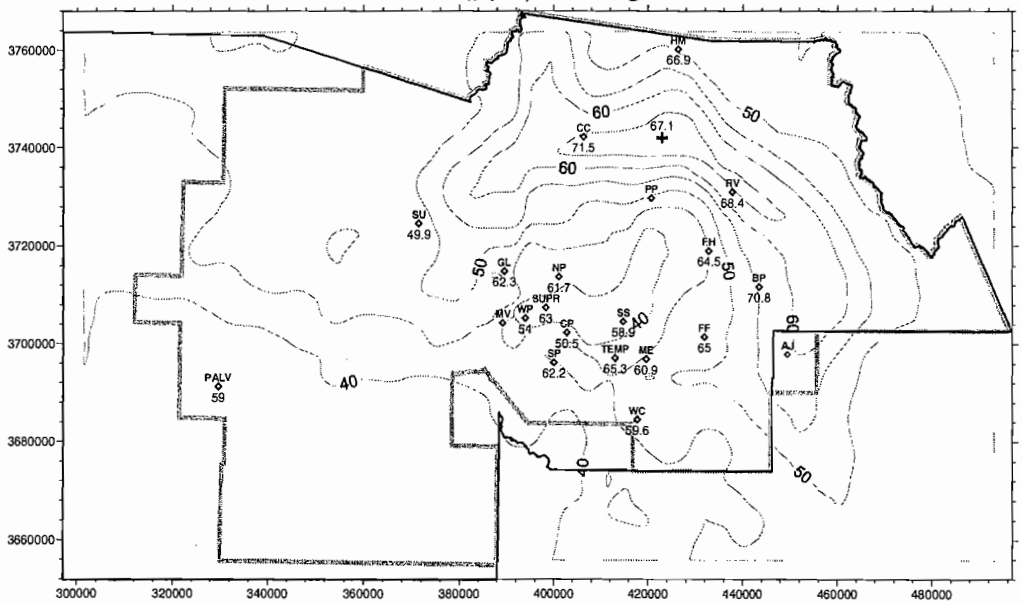
Surface 1-hour ozone concentration (ppb) on August 10, 2001 9:00-10:00 LST



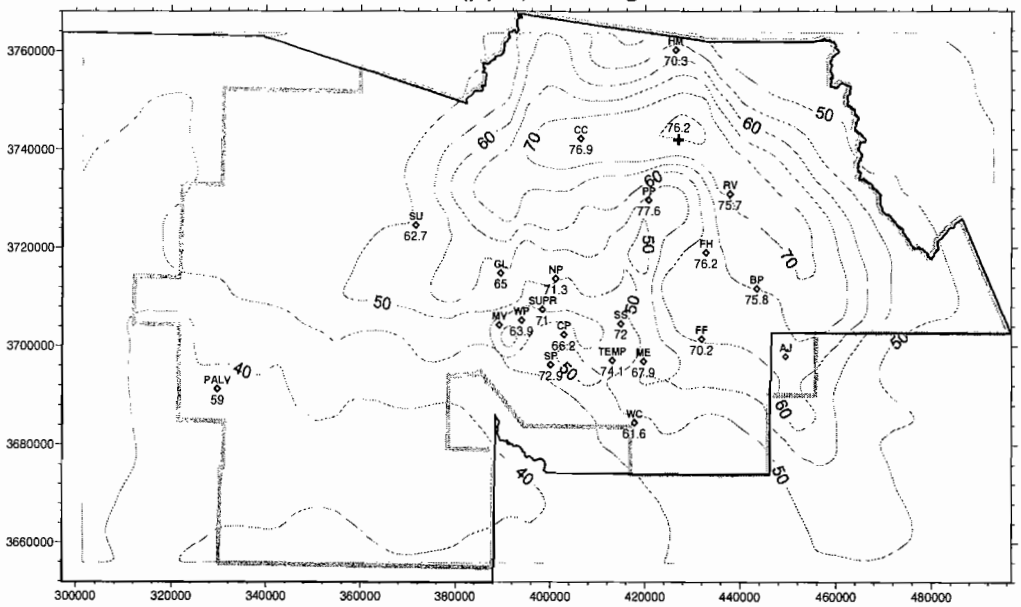
Surface 1-hour ozone concentration (ppb) on August 10, 2001 10:00-11:00 LST



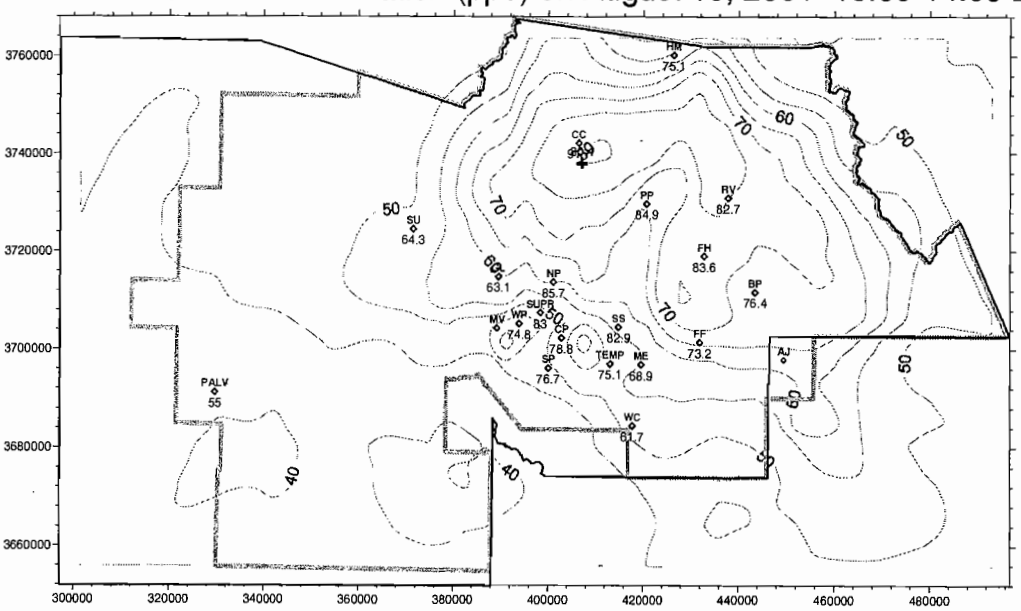
Surface 1-hour ozone concentration (ppb) on August 10, 2001 11:00-12:00 LST



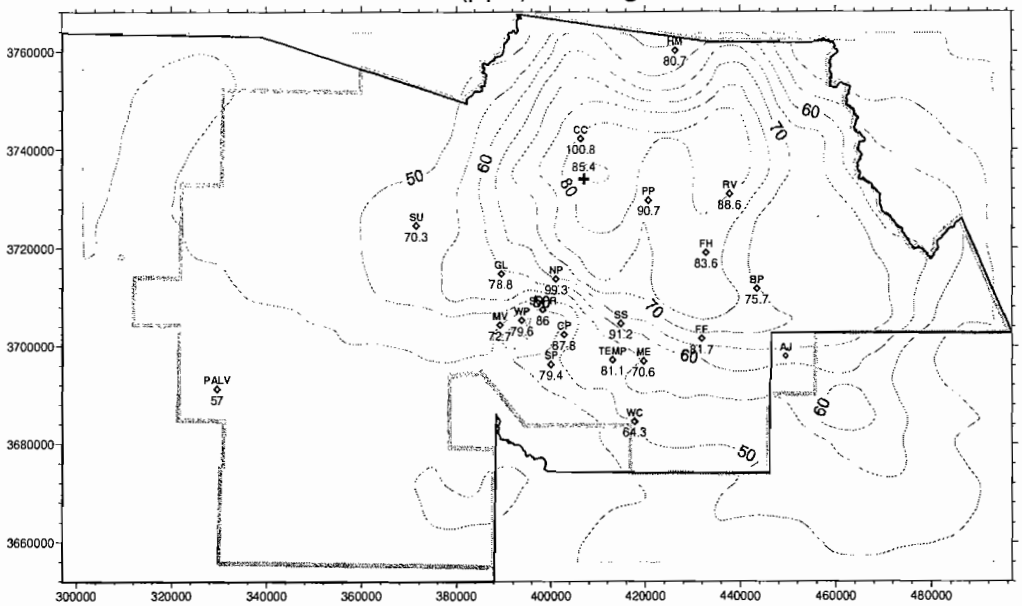
Surface 1-hour ozone concentration (ppb) on August 10, 2001 12:00-13:00 LST



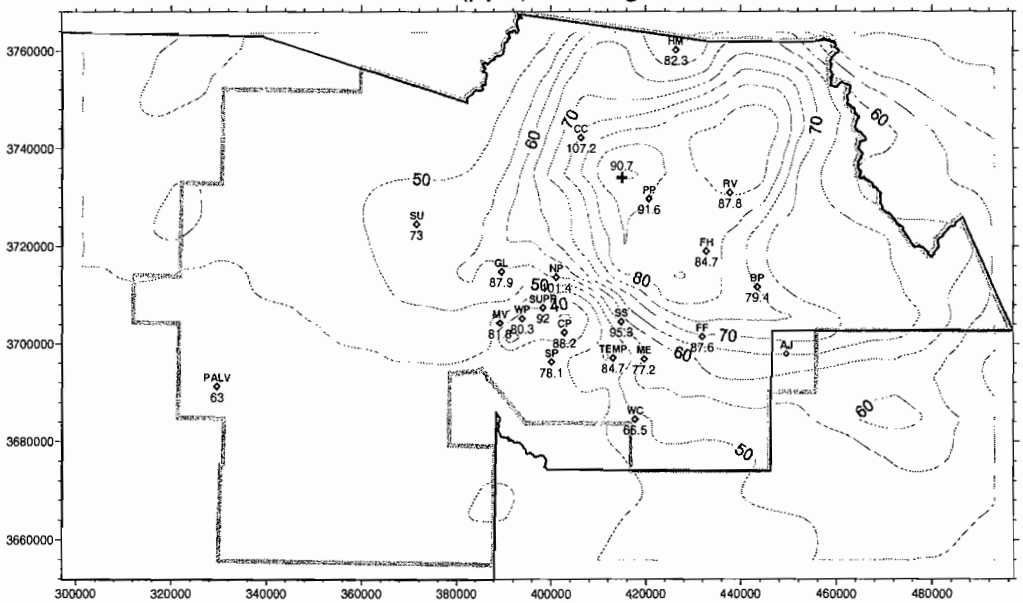
Surface 1-hour ozone concentration (ppb) on August 10, 2001 13:00-14:00 LST



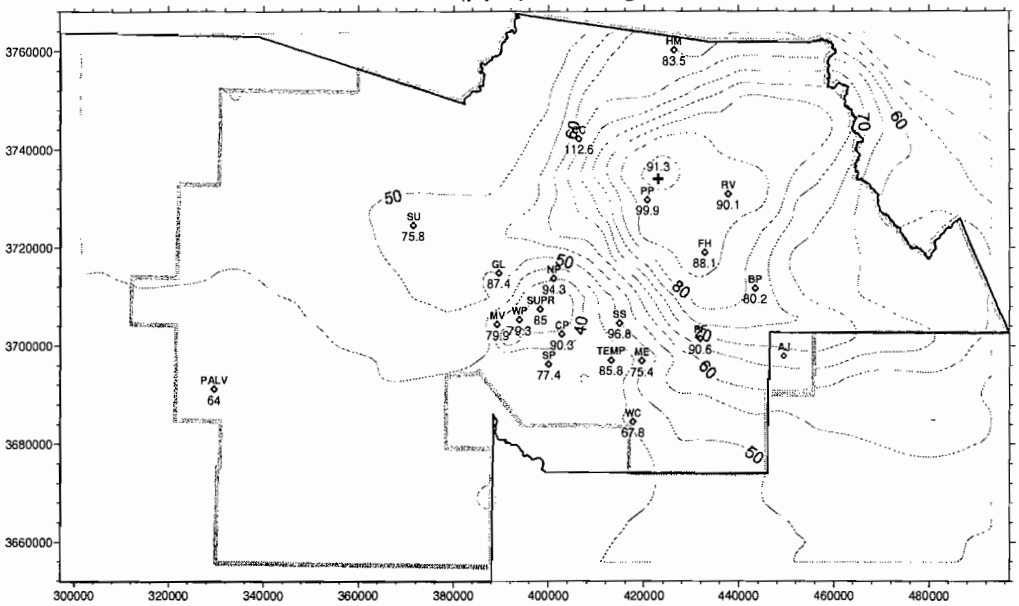
Surface 1-hour ozone concentration (ppb) on August 10, 2001 14:00-15:00 LST



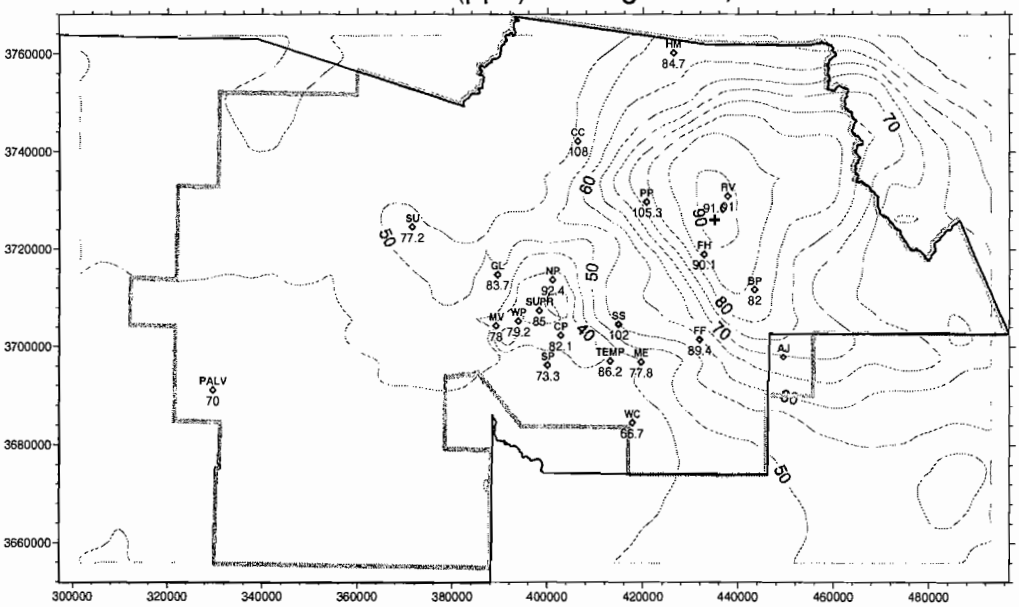
Surface 1-hour ozone concentration (ppb) on August 10, 2001 15:00-16:00 LST



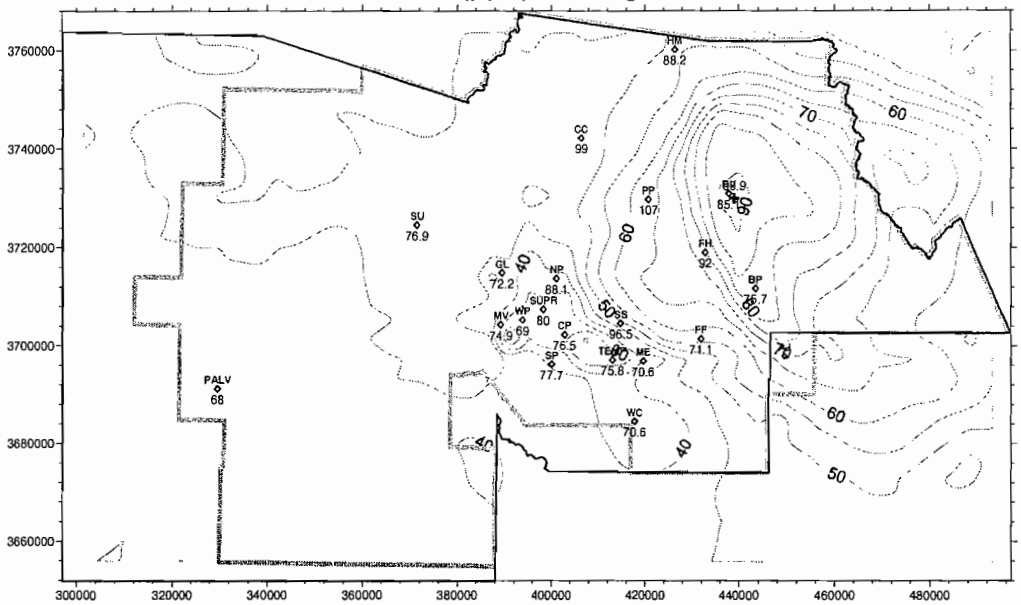
Surface 1-hour ozone concentration (ppb) on August 10, 2001 16:00-17:00 LST



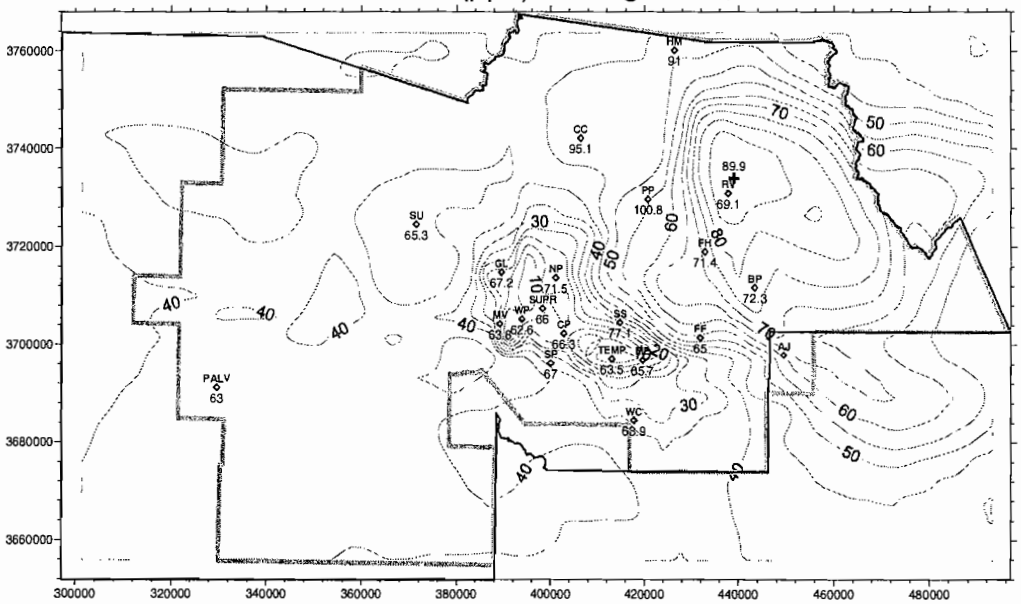
Surface 1-hour ozone concentration (ppb) on August 10, 2001 17:00-18:00 LST



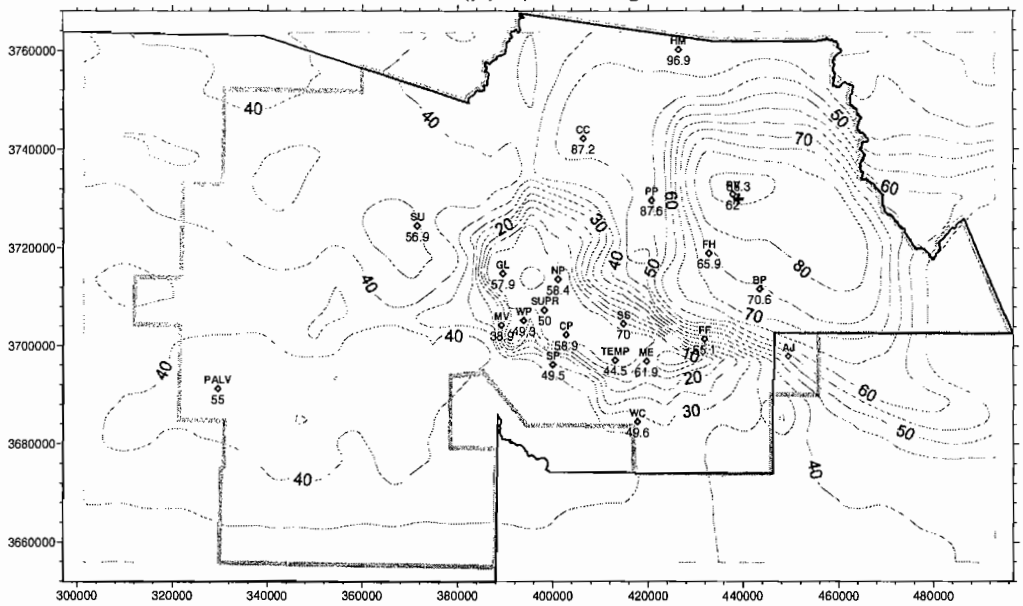
Surface 1-hour ozone concentration (ppb) on August 10, 2001 18:00-19:00 LST



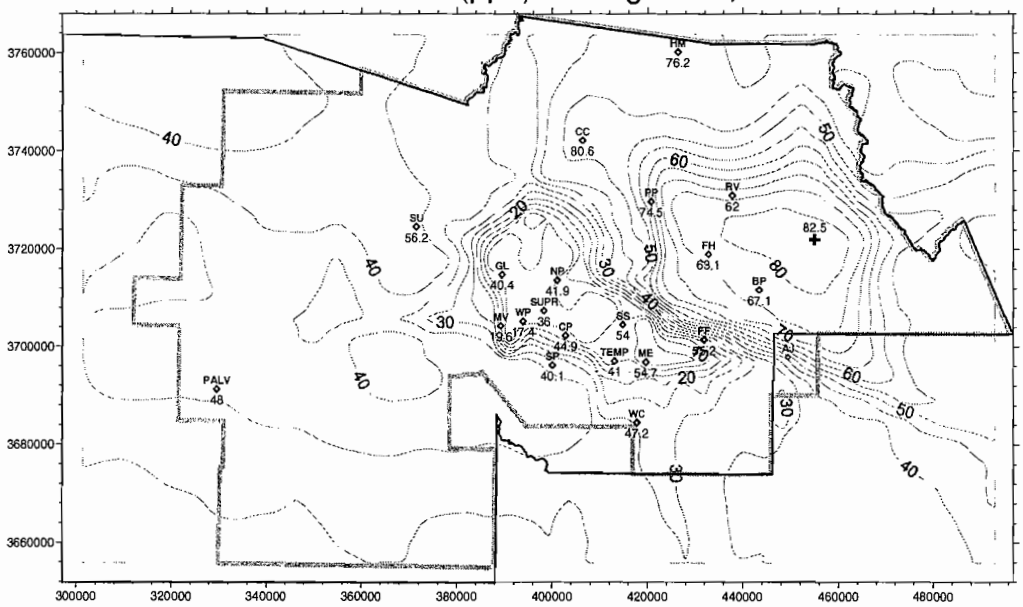
Surface 1-hour ozone concentration (ppb) on August 10, 2001 19:00-20:00 LST



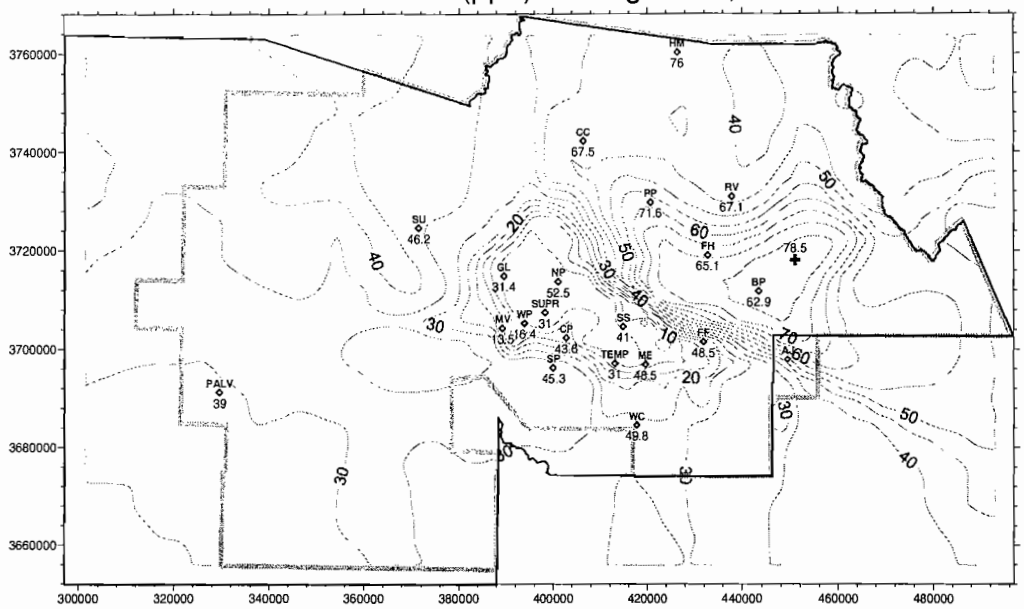
Surface 1-hour ozone concentration (ppb) on August 10, 2001 20:00-21:00 LST



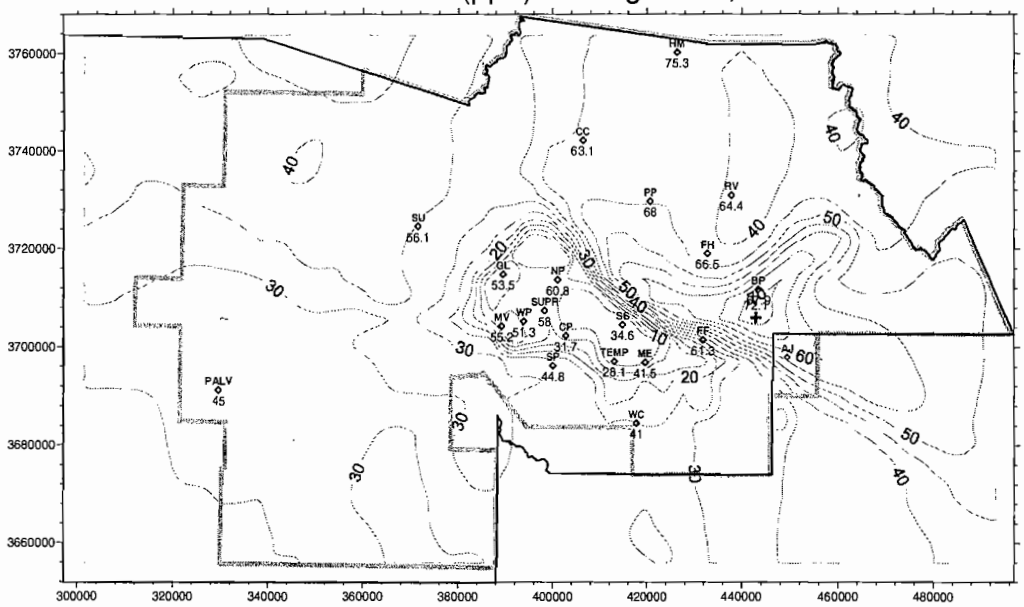
Surface 1-hour ozone concentration (ppb) on August 10, 2001 21:00-22:00 LST



Surface 1-hour ozone concentration (ppb) on August 10, 2001 22:00-23:00 LST



Surface 1-hour ozone concentration (ppb) on August 10, 2001 23:00-24:00 LST



APPENDIX IV

2008 EMISSIONS INVENTORY DEVELOPMENT

Appendix IV-i

On-Road Vehicle Emission Factor Estimation Procedure For 2008

Appendix IV-i is followed by an attachment containing a sample of the MOBILE6.2 input files for 2008.

ONROAD VEHICLE EMISSION FACTOR ESTIMATION PROCEDURE FOR 2008

Emission Factor Model

Hydrocarbons in the form of volatile organic compounds (VOCs), carbon monoxide (CO), and oxides of nitrogen (NOx) vehicle exhaust emission factors were calculated using MOBILE6.2, a model developed by the Environmental Protection Agency (EPA) for the purpose of estimating motor vehicle emission factors. The MOBILE6.2 runs were executed by the Maricopa Association of Governments (MAG). The contact person for the MOBILE6.2 emission estimates is Taejoo Shin (602-254-6300). More information about the MOBILE6.2 model may be found in the EPA User's Guide to MOBILE6.1 and MOBILE6.2: Mobile Source Emission Factor Model, August 2003, EPA420-R-02-026, which may be found at the web site http://www.epa.gov/otaq/models.htm.

A series of MOBILE6.2 runs were performed to create a complete set of emission factors for input to the M6Link model.

Two Inspection/maintenance (I/M) scenarios were modeled:

1. With an I/M program in place.
2. No I/M program in place.

Five area types were modeled:

1. Central Business District
2. Urban Area
3. Urban Fringe
4. Suburban
5. Rural

Eight days for June episode, ten days for July episode, and ten days for August episode: total twenty eight days for 2008 were modeled:

1. May 31 (Friday) - 7 (Friday), 2008
2. August 2 (Thursday) - 11 (Saturday), 2008
3. July 5 (Friday) - 14 (Sunday), 2008

Two sets of control measures were applied to the MOBILE6.2 inputs, depending upon the location:

1. Area A

2. Outside Area A

Combinations of the above scenarios were processed through the MOBILE6.2 model for the creation of detailed MOBILE6.2 output files (2 I/M status conditions X 5 area types X 28 days X 2 control measure subareas).

The results of the I/M and non-I/M runs for each of the five area types were combined to reflect the proportions of I/M and non I/M vehicles by the M6Link program. The term I/M vehicles means vehicles which are required to undergo an emission test and inspection under the Arizona Vehicle Inspection/Maintenance Program. It is important to note that the I/M program is assumed to be required for all vehicles of the appropriate age *registered* in the Area A. In addition, it is assumed that 91.6 percent of the vehicles *operating* within the Area A will participate in the I/M program, and that 8.4 percent will not participate in the program. Refer to ATTACHMENT ONE for the actual input files for the 2008 runs.

Development of Model Inputs

The inputs to MOBILE6.2 are grouped into three categories: Header inputs, Run inputs, and Scenario inputs. The input values used in the above described MOBILE6.2 runs are specified and explained below.

Header Section

1. **MOBILE6 INPUT FILE** identifies a MOBILE6.2 input file as a regular command input file rather than a batch file.

2. **DATABASE OUTPUT** instructs MOBILE6.2 to report output in database format.

3. **WITH FIELDNAMES** specifies that a header record of field names is to be generated for the database output file.

4. **DATABASE EMISSIONS : 2222 2222** indicates that all emissions types are reported in database output format if appropriate. The eight emission types are exhaust running emissions, exhaust start emissions, evaporative hot soak emissions, evaporative diurnal emissions, evaporative resting loss emissions, evaporative running loss emissions, evaporative crankcase emissions, and evaporative refueling emissions. For carbon monoxide and NOx, only exhaust running emissions and exhaust start emissions are relevant.

5. **DATABASE FACILITIES : Arterial Freeway Local Ramp None** instructs MOBILE6.2to output emissions in the database output table specific to each of the four roadway types modeled by MOBILE6.2. Also, emissions that are independent

of roadway type are output separately by MOBILE6.

6. **DATABASE VEHICLES : 22222 22222222 2 222 22222222 222** instructs MOBILE6.2to output emission factors for all 28 vehicle classes considered by MOBILE6.

Run Data Section

The run data section includes information about the local inspection and maintenance programs, the anti-tampering program, and local vehicle registration data.

1. **NO 2007 HDDV RULE:** instructs overriding the default settings for the 2007 Heavy Duty Vehicle emissions standards.

2. **STAGE II REFUELING:94 1 80.77 80.77** instructs MOBILE6.2 to model a Stage II program that started in 1994, was phased in over one year, and was 80.77 percent efficient for LDGVs and LDGTs and 80.77 percent efficient for HDGVs.

3. **I/M PROGRAM :1 1977 2050 1 T/O LOADED/IDLE** instructs MOBILE6.2to model an I/M program with an I/M program start year of 1977 and 2050 end year. The program is an annual program "1". The program is a Test only rather than test and repair program "T/O". Finally, the program is a loaded/idle program. It is important to note that this command (and the majority of all commands dealing with I/M settings) appears five times in the MAG I/M run reflecting five components of the I/M program.

4. **I/M MODEL YEARS : 1 1967 2050** instructs MOBILE6.2 that the portion of the I/M program defined in the "I/M PROGRAM" line is applied to model year 1967 through 2050 model year vehicles.

5. **I/M VEHICLES : 1 11111 22222222 2** this instructs MOBILE6.2 which vehicle classes are subject to this component of the I/M program where the number two indicates that a particular vehicle class is subject to the program and the number one indicates that a particular vehicle class is not subject to the program.

6. **I/M STRINGENCY : 1 28.0** defines that the expected exhaust inspection failure rate for pre-1981 model year vehicles covered by the I/M program is 28.0 percent.

7. **I/M COMPLIANCE : 1 97.0** describes the expected compliance rate within this portion of the I/M program where the compliance rate is the percentage of vehicles in the fleet that complete the I/M program and receive either a certificate of compliance or a waiver.

8. **I/M WAIVER RATES: 1 1.3 1.0** specifies the percentage of vehicles that fail an initial I/M test and do not pass a retest but receive a certificate of compliance. This input instructs MOBILE6.2to set the waiver rate at 1.3 percent for pre-1981 model years and 1.0 percent for 1981 and later model years for this portion of the I/M

program. These values reflect the implementation of the control measure "One-time Waiver from Vehicle Emissions Test".

9. **I/M GRACE PERIOD : 1 5** specifies that the vehicles first become subject to the local I/M program at five years of age.

10. **ANTI-TAMP PROG : 87 75 80 22222 22222222 2 11 097. 22111222** indicates information for the local anti-tampering program. Note that there may be more than one component of an anti-tampering program, requiring multiple inputs of this data.

    "**87**" indicates that the program began in 1987.
    "**75**" indicates that the earliest model year covered by the program is 1975.
    "**80**" indicates that the last model year covered by the program is 1980.
    "**22222**" indicates that the five light duty gasoline vehicle classes considered by MOBILE6.2are all subject to this portion of the anti-tampering program.
    "**22222222**" indicates that the eight heavy duty gasoline vehicle classes considered by MOBILE6.2are all subject to this portion of the anti-tampering program.
    "**2**" indicates that the gasoline powered buses are subject to this portion of the anti-tampering program.
    "**11**" indicates that credit is to be taken for the anti-tampering program and that the test is performed annually.
    "097." indicates that the program compliance rate is 97 percent.
    "**22111222**" indicates that the ATP program consists of an air pump system disablement test, catalyst removal test, evaporative system disablement test, PCV system disablement test, and missing gas cap test. Omitted from the program are a fuel inlet restrictor disablement test, tailpipe lead deposit test, and EGR disablement test.

11. **REG DIST: 02reg08.d** indicates that local registration distribution data is provided for MOBILE6.2 use, rather than national default data, and that these data may be found in the external data file 02reg08.d. The data input to the runs performed for this analysis reflect ADOT registration data developed in 2002.

12. **DIESEL FRACTIONS :** indicates that the user is inputting data to reflect the fraction of vehicles by vehicle class that are diesel powered, where appropriate. In the case of MAG analysis, local data is used for the vehicle classes light duty gasoline vehicles, light duty trucks 1, and light duty trucks 2. For the remaining vehicle classes, MOBILE6.2 default data was input. Please note that the 42 lines of registration data following the DIESEL FRACTIONS: command have not been reproduced here, but may be seen in the sample MOBILE6.2input file provided with this document.

Scenario Data Section

1. **SCENARIO RECORD : I/M Scenario** is a required field that provides a unique identifier to each scenario analyzed. The individual MOBILE6.2 runs performed by MAG for this analysis each have only one scenario.

2. **CALENDAR YEAR : 2008** indicates that the year analyzed is 2008.

3. **EVALUATION MONTH : 7** indicates that the month analyzed was July (where January and July are the only months available for analysis by MOBILE6.2). Since the periods subject to analysis were June, July and August, the closest months available to model were July of 2008.

4. **ALTITUDE : 1** indicates that the runs are being performed for a low-altitude region. The low altitude flag represents approximately 500 feet above sea level and the high altitude flag represents approximately 5,500 feet above sea level.

5. **HOURLY TEMPERATURES:** indicates the 24 hourly temperatures for the day being modeled, starting at 6 a.m. and ending at 5 a.m. the next morning in degrees Fahrenheit.

6. **RELATIVE HUMIDITY:** indicates the 24 hourly humidity values for the day being modeled, starting at 6 a.m. and ending at 5 a.m. the next morning in percent.

7. **BAROMETRIC PRESSURE: 28.5** indicates the average daily barometric pressure expressed in inches of mercury.

8. **SPEED VMT: 086R1A.txt** indicates that the user has chosen to provide an external data file, 086A1A.txt, that contains hourly speed distributions for both freeway and arterial roadway types. In this case, the file reflects "A" for Area A, "1" in the area type 1 "R" for the Thursday design day of June "6" in 2008 "08".

9. **FUEL PROGRAM: 2 S** instructs MOBILE6.2 that the gasoline in use will be reformulated gasoline in use for the southern region.

10. **FUEL RVP : 7.0** indicates that the measure of fuel volatility Reid Vapor Pressure is expected to be 7.0 pounds per square inch during the period modeled.

Model Outputs

MOBILE6.2 was executed with the inputs described above to obtain a database of emission factors in grams per mile (g/mi) for CO, NOx, and the hydrocarbon (volatile organic compounds) emissions. The database of emission factors represented emission factors split out by the vehicle classes, vehicle ages, hour of the day, roadway (facility) type on which the vehicle is driving. These outputs, in the units of grams per mile were input to the M6Link system for further processing.

ATTACHMENT ONE

MOBILE6.2 INPUT FILES

Attachment One contains a portion of the MOBILE6.2 input files for the I/M and no I/M runs for Area A and no I/M run for outside Area A for the modeling year 2008. The sample inputs reflects Area Type number 1 (central business district) and the Thursday, Tuesday, and Friday modeling days. The I/M input is first followed by the no I/M input for Area A and then followed by no I/M input for outside Area A.

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222


RUN DATA
NO 2007 HDDV RULE  :
STAGE II REFUELING :
94 1 80.77 80.77
I/M PROGRAM        : 1 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 1 1967 2050
I/M VEHICLES       : 1 11111 22222222 2
I/M STRINGENCY     : 1 28.0
I/M COMPLIANCE     : 1 97.0
I/M WAIVER RATES   : 1 1.3 1.0
I/M GRACE PERIOD   : 1 5
I/M PROGRAM        : 2 1977 2050 2 T/O IM240
I/M MODEL YEARS    : 2 1981 1995
I/M VEHICLES       : 2 22222 11111111 1
I/M STRINGENCY     : 2 28.0
I/M COMPLIANCE     : 2 97.0
I/M WAIVER RATES   : 2 1.3 1.0
I/M GRACE PERIOD   : 2 5
I/M CUTPOINTS      : 2 CUTPNT08.d
I/M PROGRAM        : 3 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 3 1967 1980
I/M VEHICLES       : 3 22222 11111111 1
I/M STRINGENCY     : 3 28.0
I/M COMPLIANCE     : 3 97.0
I/M WAIVER RATES   : 3 1.3 1.0
I/M PROGRAM        : 4 2001 2050 2 T/O OBD I/M
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M STRINGENCY     : 4 28.0
I/M COMPLIANCE     : 4 97.0
I/M WAIVER RATES   : 4 1.3 1.0
I/M GRACE PERIOD   : 4 5
I/M PROGRAM        : 5 2001 2050 2 T/O EVAP OBD & GC
I/M MODEL YEARS    : 5 1996 2050
I/M VEHICLES       : 5 22222 11111111 1
I/M STRINGENCY     : 5 28.0
I/M COMPLIANCE     : 5 97.0
I/M WAIVER RATES   : 5 1.3 1.0
I/M GRACE PERIOD   : 5 5

ANTI-TAMP PROG     :
87 75 80 22222 22222222 2 11 097. 22111222
ANTI-TAMP PROG     :
87 81 95 11111 22222222 2 11 097. 22111222

REG DIST           : 02reg08.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009
0.0009 0.0009 0.0009 0.0006 0.0001 0.0003 0.0006 0.0013 0.0004 0.0004
0.0001 0.0027 0.0032 0.0097 0.0162
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0007 0.0033 0.0048 0.0120
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0007 0.0033 0.0048 0.0120
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083
0.0072 0.0082 0.0124 0.0135 0.0169
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
```

```
0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083
0.0072 0.0082 0.0124 0.0135 0.0169
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998
0.1998 0.1998 0.1998 0.2578 0.2515 0.3263 0.2784 0.2963 0.2384 0.2058
0.1756 0.1958 0.2726 0.2743 0.3004
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774
0.6774 0.6774 0.6774 0.7715 0.7910 0.8105 0.8068 0.8280 0.8477 0.7940
0.7488 0.7789 0.7842 0.6145 0.5139
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606
0.8606 0.8606 0.8606 0.8473 0.8048 0.8331 0.7901 0.7316 0.7275 0.7158
0.5647 0.3178 0.2207 0.1968 0.1570
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647
0.4647 0.4647 0.4647 0.4384 0.3670 0.4125 0.3462 0.2771 0.2730 0.2616
0.1543 0.0615 0.0383 0.0333 0.0255
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300
0.6300 0.6300 0.6300 0.6078 0.5246 0.5767 0.5289 0.5788 0.5617 0.4537
0.4216 0.4734 0.4705 0.4525 0.4310
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563
0.8563 0.8563 0.8563 0.8443 0.7943 0.8266 0.7972 0.8279 0.8177 0.7440
0.7184 0.7588 0.7567 0.7431 0.7261
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992
0.9992 0.9992 0.9992 0.9989 0.9987 0.9989 0.9977 0.9984 0.9982 0.9979
0.9969 0.9978 0.9980 0.9979 0.9976
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585
0.9585 0.9585 0.9585 0.8857 0.8525 0.8795 0.9900 0.9105 0.8760 0.7710
0.7502 0.7345 0.6733 0.5155 0.3845

SCENARIO RECORD    : I/M Scenario
CALENDAR YEAR      : 2008
EVALUATION MONTH   : 7
ALTITUDE           : 1
HOURLY TEMPERATURES: 78.0 82.0 88.0 92.0 97.0 102.0 102.0 107.0 109.0 107.0 109. 108.
                     107.0 106.0 105.0 99.0 98.0 98.0 93.0 91.0 89.0 85.0 87.0 82.0
RELATIVE HUMIDITY  : 22.0 18.0 14.0 12.0 11.0 9.0 8.0 6.0 6.0 6.0 5.0 4.0
                      5.0 6.0 6.0 9.0 9.0 9.0 11.0 14.0 14.0 19.0 14.0 22.0
BAROMETRIC PRES    : 28.6
SPEED VMT          : 086R1A.txt
FUEL RVP           : 7.0
FUEL PROGRAM       : 2 S

END OF RUN
```

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222


RUN DATA
NO 2007 HDDV RULE  :
STAGE II REFUELING :
94 1 80.77 80.77
REG DIST           : 02reg08.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009
0.0009 0.0009 0.0009 0.0006 0.0001 0.0003 0.0006 0.0013 0.0004 0.0004
0.0001 0.0027 0.0032 0.0097 0.0162
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0007 0.0033 0.0048 0.0120
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0007 0.0033 0.0048 0.0120
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083
0.0072 0.0082 0.0124 0.0135 0.0169
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083
0.0072 0.0082 0.0124 0.0135 0.0169
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998
0.1998 0.1998 0.1998 0.2578 0.2515 0.3263 0.2784 0.2963 0.2384 0.2058
0.1756 0.1958 0.2726 0.2743 0.3004
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774
0.6774 0.6774 0.6774 0.7715 0.7910 0.8105 0.8068 0.8280 0.8477 0.7940
0.7488 0.7789 0.7842 0.6145 0.5139
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606
0.8606 0.8606 0.8606 0.8473 0.8048 0.8331 0.7901 0.7316 0.7275 0.7158
0.5647 0.3178 0.2207 0.1968 0.1570
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647
0.4647 0.4647 0.4647 0.4384 0.3670 0.4125 0.3462 0.2771 0.2730 0.2616
0.1543 0.0615 0.0383 0.0333 0.0255
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300
0.6300 0.6300 0.6300 0.6078 0.5246 0.5767 0.5289 0.5788 0.5617 0.4537
0.4216 0.4734 0.4705 0.4525 0.4310
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563
0.8563 0.8563 0.8563 0.8443 0.7943 0.8266 0.7972 0.8279 0.8177 0.7440
0.7184 0.7588 0.7567 0.7431 0.7261
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992
0.9992 0.9992 0.9992 0.9989 0.9987 0.9989 0.9977 0.9984 0.9982 0.9979
0.9969 0.9978 0.9980 0.9979 0.9976
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585
0.9585 0.9585 0.9585 0.8857 0.8525 0.8795 0.9900 0.9105 0.8760 0.7710
0.7502 0.7345 0.6733 0.5155 0.3845

SCENARIO RECORD    : I/M Scenario
CALENDAR YEAR      : 2008
EVALUATION MONTH   : 7
ALTITUDE           : 1
HOURLY TEMPERATURES: 78.0 82.0 88.0 92.0 97.0 102.0 102.0 107.0 109.0 107.0 109.0 108.0
                     107.0 106.0 105.0 99.0 98.0 98.0 93.0 91.0 89.0 85.0 87.0 82.0
RELATIVE HUMIDITY  : 22.0 18.0 14.0 12.0 11.0 9.0 8.0 6.0 6.0 6.0 5.0 4.0
                      5.0 6.0 6.0 9.0 9.0 9.0 11.0 14.0 14.0 19.0 14.0 22.0
BAROMETRIC PRES    : 28.6
SPEED VMT          : 086R1A.txt
FUEL RVP           : 7.0
```

```
FUEL PROGRAM        : 2 S

END OF RUN
```

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222


RUN DATA
NO 2007 HDDV RULE  :

*the tech12.d file must be located with Mobile6 execution file
*the user tech file tech12.1me should be renamed as tech12.d
*Two more I/M programs should not have overlapped motor vehicles.

REG DIST           : 02reg08.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009
0.0009 0.0009 0.0009 0.0006 0.0001 0.0003 0.0006 0.0013 0.0004 0.0004
0.0001 0.0027 0.0032 0.0097 0.0162
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0007 0.0033 0.0048 0.0120
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0007 0.0033 0.0048 0.0120
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083
0.0072 0.0082 0.0124 0.0135 0.0169
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083
0.0072 0.0082 0.0124 0.0135 0.0169
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998
0.1998 0.1998 0.1998 0.2578 0.2515 0.3263 0.2784 0.2963 0.2384 0.2058
0.1756 0.1958 0.2726 0.2743 0.3004
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774
0.6774 0.6774 0.6774 0.7715 0.7910 0.8105 0.8068 0.8280 0.8477 0.7940
0.7488 0.7789 0.7842 0.6145 0.5139
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606
0.8606 0.8606 0.8606 0.8473 0.8048 0.8331 0.7901 0.7316 0.7275 0.7158
0.5647 0.3178 0.2207 0.1968 0.1570
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647
0.4647 0.4647 0.4647 0.4384 0.3670 0.4125 0.3462 0.2771 0.2730 0.2616
0.1543 0.0615 0.0383 0.0333 0.0255
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300
0.6300 0.6300 0.6300 0.6078 0.5246 0.5767 0.5289 0.5788 0.5617 0.4537
0.4216 0.4734 0.4705 0.4525 0.4310
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563
0.8563 0.8563 0.8563 0.8443 0.7943 0.8266 0.7972 0.8279 0.8177 0.7440
0.7184 0.7588 0.7567 0.7431 0.7261
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992
0.9992 0.9992 0.9992 0.9989 0.9987 0.9989 0.9977 0.9984 0.9982 0.9979
0.9969 0.9978 0.9980 0.9979 0.9976
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585
0.9585 0.9585 0.9585 0.8857 0.8525 0.8795 0.9900 0.9105 0.8760 0.7710
0.7502 0.7345 0.6733 0.5155 0.3845

SCENARIO RECORD    : I/M Scenario
CALENDAR YEAR      : 2008
EVALUATION MONTH   : 7
ALTITUDE           : 1
HOURLY TEMPERATURES: 81.0 84.0 87.0 93.0 95.0 98.0 102.0 106.0 106.0 108.0 108.0 108.0
                     107.0 106.0 104.0 98.0 95.0 96.0 91.0 93.0 91.0 87.0 84.0 81.0
RELATIVE HUMIDITY  : 20.0 16.0 16.0 12.0 12.0 10.0 9.0 7.0 8.0 7.0 6.0 6.0
                     6.0 7.0 8.0 11.0 12.0 10.0 14.0 14.0 15.0 20.0 23.0 23.0
```

```
BAROMETRIC PRES     : 28.5
SPEED VMT           : 086R1O.txt
FUEL RVP            : 7.8

END OF RUN
```

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222

RUN DATA
NO 2007 HDDV RULE  :
STAGE II REFUELING :
94 1 80.77 80.77
I/M PROGRAM        : 1 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 1 1967 2050
I/M VEHICLES       : 1 11111 22222222 2
I/M STRINGENCY     : 1 28.0
I/M COMPLIANCE     : 1 97.0
I/M WAIVER RATES   : 1 1.3 1.0
I/M GRACE PERIOD   : 1 5
I/M PROGRAM        : 2 1977 2050 2 T/O IM240
I/M MODEL YEARS    : 2 1981 1995
I/M VEHICLES       : 2 22222 11111111 1
I/M STRINGENCY     : 2 28.0
I/M COMPLIANCE     : 2 97.0
I/M WAIVER RATES   : 2 1.3 1.0
I/M GRACE PERIOD   : 2 5
I/M CUTPOINTS      : 2 CUTPNT08.d
I/M PROGRAM        : 3 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 3 1967 1980
I/M VEHICLES       : 3 22222 11111111 1
I/M STRINGENCY     : 3 28.0
I/M COMPLIANCE     : 3 97.0
I/M WAIVER RATES   : 3 1.3 1.0
I/M PROGRAM        : 4 2001 2050 2 T/O OBD I/M
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M STRINGENCY     : 4 28.0
I/M COMPLIANCE     : 4 97.0
I/M WAIVER RATES   : 4 1.3 1.0
I/M GRACE PERIOD   : 4 5
I/M PROGRAM        : 5 2001 2050 2 T/O EVAP OBD & GC
I/M MODEL YEARS    : 5 1996 2050
I/M VEHICLES       : 5 22222 11111111 1
I/M STRINGENCY     : 5 28.0
I/M COMPLIANCE     : 5 97.0
I/M WAIVER RATES   : 5 1.3 1.0
I/M GRACE PERIOD   : 5 5
ANTI-TAMP PROG     :
87 75 80 22222 22222222 2 11 097. 22111222
ANTI-TAMP PROG     :
87 81 95 11111 22222222 2 11 097. 22111222

REG DIST           : 02reg08.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009
0.0009 0.0009 0.0009 0.0006 0.0001 0.0003 0.0006 0.0013 0.0004 0.0004
0.0001 0.0027 0.0032 0.0097 0.0162
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0007 0.0033 0.0048 0.0120
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0007 0.0033 0.0048 0.0120
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083
0.0072 0.0082 0.0124 0.0135 0.0169
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
```

```
0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083
0.0072 0.0082 0.0124 0.0135 0.0169
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998
0.1998 0.1998 0.1998 0.2578 0.2515 0.3263 0.2784 0.2963 0.2384 0.2058
0.1756 0.1958 0.2726 0.2743 0.3004
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774
0.6774 0.6774 0.6774 0.7715 0.7910 0.8105 0.8068 0.8280 0.8477 0.7940
0.7488 0.7789 0.7842 0.6145 0.5139
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606
0.8606 0.8606 0.8606 0.8473 0.8048 0.8331 0.7901 0.7316 0.7275 0.7158
0.5647 0.3178 0.2207 0.1968 0.1570
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647
0.4647 0.4647 0.4647 0.4384 0.3670 0.4125 0.3462 0.2771 0.2730 0.2616
0.1543 0.0615 0.0383 0.0333 0.0255
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300
0.6300 0.6300 0.6300 0.6078 0.5246 0.5767 0.5289 0.5788 0.5617 0.4537
0.4216 0.4734 0.4705 0.4525 0.4310
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563
0.8563 0.8563 0.8563 0.8443 0.7943 0.8266 0.7972 0.8279 0.8177 0.7440
0.7184 0.7588 0.7567 0.7431 0.7261
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992
0.9992 0.9992 0.9992 0.9989 0.9987 0.9989 0.9977 0.9984 0.9982 0.9979
0.9969 0.9978 0.9980 0.9979 0.9976
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585
0.9585 0.9585 0.9585 0.8857 0.8525 0.8795 0.9900 0.9105 0.8760 0.7710
0.7502 0.7345 0.6733 0.5155 0.3845

SCENARIO RECORD    : I/M Scenario
CALENDAR YEAR      : 2008
EVALUATION MONTH   : 7
ALTITUDE           : 1
HOURLY TEMPERATURES: 93. 93. 94. 97. 101. 103. 106. 108. 107. 108. 109. 111.
                     111. 109. 91. 89. 90. 91. 87. 89. 89. 88. 88. 88.
RELATIVE HUMIDITY  : 32. 33. 33. 30. 25. 22. 19. 17. 17. 17. 16. 15. 15. 17.
                     41. 50. 47. 41. 45. 38. 39. 42. 43. 42.
BAROMETRIC PRES    : 28.7
SPEED VMT          : 087T1A.txt
FUEL RVP           : 7.0
FUEL PROGRAM       : 2 S

END OF RUN
```

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222


RUN DATA
NO 2007 HDDV RULE  :

REG DIST           : 02reg08.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009
0.0009 0.0009 0.0009 0.0006 0.0001 0.0003 0.0006 0.0013 0.0004 0.0004
0.0001 0.0027 0.0032 0.0097 0.0162
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0007 0.0033 0.0048 0.0120
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0007 0.0033 0.0048 0.0120
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083
0.0072 0.0082 0.0124 0.0135 0.0169
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083
0.0072 0.0082 0.0124 0.0135 0.0169
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998
0.1998 0.1998 0.1998 0.2578 0.2515 0.3263 0.2784 0.2963 0.2384 0.2058
0.1756 0.1958 0.2726 0.2743 0.3004
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774
0.6774 0.6774 0.6774 0.7715 0.7910 0.8105 0.8068 0.8280 0.8477 0.7940
0.7488 0.7789 0.7842 0.6145 0.5139
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606
0.8606 0.8606 0.8606 0.8473 0.8048 0.8331 0.7901 0.7316 0.7275 0.7158
0.5647 0.3178 0.2207 0.1968 0.1570
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647
0.4647 0.4647 0.4647 0.4384 0.3670 0.4125 0.3462 0.2771 0.2730 0.2616
0.1543 0.0615 0.0383 0.0333 0.0255
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300
0.6300 0.6300 0.6300 0.6078 0.5246 0.5767 0.5289 0.5788 0.5617 0.4537
0.4216 0.4734 0.4705 0.4525 0.4310
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563
0.8563 0.8563 0.8563 0.8443 0.7943 0.8266 0.7972 0.8279 0.8177 0.7440
0.7184 0.7588 0.7567 0.7431 0.7261
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992
0.9992 0.9992 0.9992 0.9989 0.9987 0.9989 0.9977 0.9984 0.9982 0.9979
0.9969 0.9978 0.9980 0.9979 0.9976
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585
0.9585 0.9585 0.9585 0.8857 0.8525 0.8795 0.9900 0.9105 0.8760 0.7710
0.7502 0.7345 0.6733 0.5155 0.3845

SCENARIO RECORD    : I/M Scenario
CALENDAR YEAR      : 2008
EVALUATION MONTH   : 7
ALTITUDE           : 1
HOURLY TEMPERATURES: 93. 93. 94. 97. 101. 103. 106. 108. 107. 108. 109. 111.
                     111.0 109.0 91.0 89.0 90.0 91.0 87.0 89.0 89.0 88.0 88.0 88.0
RELATIVE HUMIDITY  : 32.0 33.0 33.0 30.0 25.0 22.0 19.0 17.0 17.0 17.0 16.0 15.0
                     15.0 17.0 41.0 50.0 47.0 41.0 45.0 38.0 39.0 42.0 43.0 42.0
BAROMETRIC PRES    : 28.7
SPEED VMT          : 087T1O.txt
FUEL RVP           : 7.8
END OF RUN
```

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222


RUN DATA
NO 2007 HDDV RULE  :
STAGE II REFUELING :
94 1 80.77 80.77
I/M PROGRAM        : 1 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 1 1967 2050
I/M VEHICLES       : 1 11111 22222222 2
I/M STRINGENCY     : 1 28.0
I/M COMPLIANCE     : 1 97.0
I/M WAIVER RATES   : 1 1.3 1.0
I/M GRACE PERIOD   : 1 5
I/M PROGRAM        : 2 1977 2050 2 T/O IM240
I/M MODEL YEARS    : 2 1981 1995
I/M VEHICLES       : 2 22222 11111111 1
I/M STRINGENCY     : 2 28.0
I/M COMPLIANCE     : 2 97.0
I/M WAIVER RATES   : 2 1.3 1.0
I/M GRACE PERIOD   : 2 5
I/M CUTPOINTS      : 2 CUTPNT08.d
I/M PROGRAM        : 3 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 3 1967 1980
I/M VEHICLES       : 3 22222 11111111 1
I/M STRINGENCY     : 3 28.0
I/M COMPLIANCE     : 3 97.0
I/M WAIVER RATES   : 3 1.3 1.0
I/M PROGRAM        : 4 2001 2050 2 T/O OBD I/M
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M STRINGENCY     : 4 28.0
I/M COMPLIANCE     : 4 97.0
I/M WAIVER RATES   : 4 1.3 1.0
I/M GRACE PERIOD   : 4 5
I/M PROGRAM        : 5 2001 2050 2 T/O EVAP OBD & GC
I/M MODEL YEARS    : 5 1996 2050
I/M VEHICLES       : 5 22222 11111111 1
I/M STRINGENCY     : 5 28.0
I/M COMPLIANCE     : 5 97.0
I/M WAIVER RATES   : 5 1.3 1.0
I/M GRACE PERIOD   : 5 5
ANTI-TAMP PROG     :
87 75 80 22222 22222222 2 11 097. 22111222
ANTI-TAMP PROG     :
87 81 95 11111 22222222 2 11 097. 22111222

REG DIST           : 02reg08.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009
0.0009 0.0009 0.0009 0.0006 0.0001 0.0003 0.0006 0.0013 0.0004 0.0004
0.0001 0.0027 0.0032 0.0097 0.0162
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0007 0.0033 0.0048 0.0120
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0007 0.0033 0.0048 0.0120
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083
0.0072 0.0082 0.0124 0.0135 0.0169
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0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083
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0.0072 0.0082 0.0124 0.0135 0.0169
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998
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0.1756 0.1958 0.2726 0.2743 0.3004
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774
0.6774 0.6774 0.6774 0.7715 0.7910 0.8105 0.8068 0.8280 0.8477 0.7940
0.7488 0.7789 0.7842 0.6145 0.5139
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606
0.8606 0.8606 0.8606 0.8473 0.8048 0.8331 0.7901 0.7316 0.7275 0.7158
0.5647 0.3178 0.2207 0.1968 0.1570
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647
0.4647 0.4647 0.4647 0.4384 0.3670 0.4125 0.3462 0.2771 0.2730 0.2616
0.1543 0.0615 0.0383 0.0333 0.0255
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300
0.6300 0.6300 0.6300 0.6078 0.5246 0.5767 0.5289 0.5788 0.5617 0.4537
0.4216 0.4734 0.4705 0.4525 0.4310
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563
0.8563 0.8563 0.8563 0.8443 0.7943 0.8266 0.7972 0.8279 0.8177 0.7440
0.7184 0.7588 0.7567 0.7431 0.7261
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992
0.9992 0.9992 0.9992 0.9989 0.9987 0.9989 0.9977 0.9984 0.9982 0.9979
0.9969 0.9978 0.9980 0.9979 0.9976
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0.9585 0.9585 0.9585 0.8857 0.8525 0.8795 0.9900 0.9105 0.8760 0.7710
0.7502 0.7345 0.6733 0.5155 0.3845

SCENARIO RECORD     : I/M Scenario
CALENDAR YEAR       : 2008
EVALUATION MONTH    : 7
ALTITUDE            : 1
HOURLY TEMPERATURES: 82.0 83.0 81.0 85.0 88.0 89.0 92.0 95.0 97.0 98.0 97.0 96.0
                     97.0 96.0 96.0 95.0 94.0 93.0 91.0 87.0 87.0 86.0 86.0 87.0
RELATIVE HUMIDITY   : 74.0 67.0 77.0 65.0 57.0 59.0 52.0 46.0 43.0 43.0 45.0 46.0
                     46.0 49.0 42.0 43.0 44.0 47.0 54.0 51.0 50.0 55.0 55.0 55.0
BAROMETRIC PRES     : 28.7
SPEED VMT           : 088F1A.txt
FUEL RVP            : 7.0
FUEL PROGRAM        : 2 S

END OF RUN
```

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222


RUN DATA
NO 2007 HDDV RULE  :
STAGE II REFUELING :
94 1 80.77 80.77

REG DIST           : 02reg08.d
DIESEL FRACTIONS   :
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0.0009 0.0009 0.0009 0.0006 0.0001 0.0003 0.0006 0.0013 0.0004 0.0004
0.0001 0.0027 0.0032 0.0097 0.0162
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0.0000 0.0007 0.0033 0.0048 0.0120
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0.0072 0.0082 0.0124 0.0135 0.0169
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0.0072 0.0082 0.0124 0.0135 0.0169
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0.1998 0.1998 0.1998 0.2578 0.2515 0.3263 0.2784 0.2963 0.2384 0.2058
0.1756 0.1958 0.2726 0.2743 0.3004
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0.6774 0.6774 0.6774 0.7715 0.7910 0.8105 0.8068 0.8280 0.8477 0.7940
0.7488 0.7789 0.7842 0.6145 0.5139
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0.4647 0.4647 0.4647 0.4384 0.3670 0.4125 0.3462 0.2771 0.2730 0.2616
0.1543 0.0615 0.0383 0.0333 0.0255
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0.6300 0.6300 0.6300 0.6078 0.5246 0.5767 0.5289 0.5788 0.5617 0.4537
0.4216 0.4734 0.4705 0.4525 0.4310
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0.7184 0.7588 0.7567 0.7431 0.7261
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0.9969 0.9978 0.9980 0.9979 0.9976
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0.9585 0.9585 0.9585 0.8857 0.8525 0.8795 0.9900 0.9105 0.8760 0.7710
0.7502 0.7345 0.6733 0.5155 0.3845

SCENARIO RECORD    : I/M Scenario
CALENDAR YEAR      : 2008
EVALUATION MONTH   : 7
ALTITUDE           : 1
HOURLY TEMPERATURES: 82.0 83.0 81.0 85.0 88.0 89.0 92.0 95.0 97.0 98.0 97.0 96.0
                     97.0 96.0 96.0 95.0 94.0 93.0 91.0 87.0 87.0 86.0 86.0 87.0
RELATIVE HUMIDITY  : 74.0 67.0 77.0 65.0 57.0 59.0 52.0 46.0 43.0 43.0 45.0 46.0
                     46.0 49.0 42.0 43.0 44.0 47.0 54.0 51.0 50.0 55.0 55.0 55.0
BAROMETRIC PRES    : 28.7
SPEED VMT          : 088F1A.txt
```

```
FUEL RVP            : 7.0
FUEL PROGRAM        : 2 S

END OF RUN
```

```
MOBILE6 INPUT FILE :
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DATABASE EMISSIONS : 2222 2222
DATABASE FACILITIES: Arterial Freeway Local Ramp None
DATABASE VEHICLES  : 22222 22222222 2 222 22222222 222


RUN DATA
NO 2007 HDDV RULE  :

REG DIST           : 02reg08.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009
0.0009 0.0009 0.0009 0.0006 0.0001 0.0003 0.0006 0.0013 0.0004 0.0004
0.0001 0.0027 0.0032 0.0097 0.0162
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0.0000 0.0007 0.0033 0.0048 0.0120
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0.0000 0.0007 0.0033 0.0048 0.0120
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0.0126 0.0126 0.0126 0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083
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0.1756 0.1958 0.2726 0.2743 0.3004
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0.7488 0.7789 0.7842 0.6145 0.5139
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0.8606 0.8606 0.8606 0.8473 0.8048 0.8331 0.7901 0.7316 0.7275 0.7158
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0.4647 0.4647 0.4647 0.4384 0.3670 0.4125 0.3462 0.2771 0.2730 0.2616
0.1543 0.0615 0.0383 0.0333 0.0255
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300
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0.4216 0.4734 0.4705 0.4525 0.4310
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563
0.8563 0.8563 0.8563 0.8443 0.7943 0.8266 0.7972 0.8279 0.8177 0.7440
0.7184 0.7588 0.7567 0.7431 0.7261
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992
0.9992 0.9992 0.9992 0.9989 0.9987 0.9989 0.9977 0.9984 0.9982 0.9979
0.9969 0.9978 0.9980 0.9979 0.9976
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0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585
0.9585 0.9585 0.9585 0.8857 0.8525 0.8795 0.9900 0.9105 0.8760 0.7710
0.7502 0.7345 0.6733 0.5155 0.3845

SCENARIO RECORD    : I/M Scenario
CALENDAR YEAR      : 2008
EVALUATION MONTH   : 7
ALTITUDE           : 1
HOURLY TEMPERATURES: 82.0 83.0 81.0 85.0 88.0 89.0 92.0 95.0 97.0 98.0 97.0 96.0
                     97.0 96.0 96.0 95.0 94.0 93.0 91.0 87.0 87.0 86.0 86.0 87.0
RELATIVE HUMIDITY  : 74.0 67.0 77.0 65.0 57.0 59.0 52.0 46.0 43.0 43.0 45.0 46.0
                     46.0 49.0 42.0 43.0 44.0 47.0 54.0 51.0 50.0 55.0 55.0 55.0
BAROMETRIC PRES    : 28.7
SPEED VMT          : 088F1O.txt
FUEL RVP           : 7.8
END OF RUN
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Appendix IV-ii

Traffic Data

Appendix IV-ii contains a detailed description of the traffic data used to estimate onroad mobile source emissions.

SOCIOECONOMIC PROJECTIONS

In accordance with the Arizona Governor's Executive Order 95-2, the population projections used for all State agency planning purposes are to be updated by the Arizona Department of Economic Security (DES) every five years after a decennial or mid-decennial census. Since DES did not prepare official projections after the 2000 Census, MAG prepared interim projections based on Maricopa County control totals developed by the Arizona State University Center for Business Research (ASU) and data from the 2000 Census, 2000 MAG Employment Survey, and the MAG GIS and Database Enhancement Study.

The ASU population and employment projections for Maricopa County were "stepped down" to smaller geographic areas using the latest available data and state-of-the-art land use models. MAG applied the nationally-recognized DRAM/EMPAL model to allocate county projections of households and employment to 148 regional analysis zones (RAZs) based upon the pre-existing location of these activities, land consumption, and transportation system accessibility. The allocation of population and employment from RAZs to one-acre grids was accomplished with the GIS-based, Subarea Allocation Model-Information Manager (SAM-IM), which assesses the suitability of each grid for development based on measures such as adjacent land use, highway access, and proximity to other development.

Population and employment at the one-acre level is aggregated to 1,995 traffic analysis zones (TAZs) using SAM-IM. The interim population and employment projections for Maricopa County at the TAZ level were accepted by the MAG Regional Council in June 2003.

Following the release of 2005 Census Survey data in June 2006, DES prepared a new set of Maricopa County population projections. MAG is in the process of allocating the DES projections for Maricopa County to TAZs using the DRAM/EMPAL and SAM-IM land use models. It is anticipated that these new projections by TAX will be approved by the MAG Regional Council in the Spring of 2007. Unfortunately, these TAZ projections were not available in time to be used in transportation modeling for the eight-hour ozone plan.

The new 2010 population projection for Maricopa County is expected to be about two percent higher than the previous forecast and the comparable vehicle miles of travel (VMT) is expected to be about three percent higher. Therefore, the 2008 onroad mobile source emissions used in the attainment demonstration were increased by three percent to accommodate the expected increase in VMT. All other anthropogenic emissions, except point sources, were also increased by three percent, to ensure that the eight-hour standard will be attained, in spite of the higher levels of population and employment in the new forecasts.

TRANSPORTATION MODELS

Like many other metropolitan planning organizations in the United States, MAG uses EMME/2 software to perform traffic and transit assignments. The MAG transportation

models follow a traditional four-step process: trip generation, trip distribution, mode choice, and traffic/transit assignment. Trip generation determines the number of person trips produced and attracted by traffic analysis zone. Trip distribution links the productions and attractions by TAZ. The recently updated mode choice model determines the number of person trips allocated to each of the following modes: auto drivers, two person carpools, three or more person carpools, express bus, local bus, and rail. The mode choice model is sensitive to highway and transit travel times, as well as pricing variables such as automobile operating costs, parking costs, and transit fares. Highway and transit route choice is determined in the assignment step, based on operating costs, travel times, and distances. Capacity-restrained traffic assignments are performed for the AM peak period, midday, the PM peak period, and nighttime. A feedback loop between traffic assignment and trip distribution is utilized to achieve near-equilibrium highway speeds. A peak spreading model is applied to derive the AM and PM peak hour traffic volumes.

The MAG transportation models were re-calibrated in 2005 based on a 2001 MAG household travel survey and a 2001 RPTA on-board bus survey. The models simulate traffic volumes by time of day for more than 30,000 highway links, as well as transit trips on bus and future light rail routes. Transportation model estimates of vehicle miles of travel (VMT) are validated using actual traffic counts. In 2006, the MAG transportation models were validated against more than 3,000 traffic counts collected in 2002. Vehicle miles of travel by link, output by the highway assignment process, are input to the emissions models used in estimating onroad mobile source emissions for the eight-hour ozone plan. In addition to the latest population and employment projections, The transportation models take into account programmed and planned highway and transit improvements that will take place through the year 2008.

The 2001, 2002, 2008 population and employment estimates for Maricopa County assumed in developing onroad mobile emissions for the 8-hour ozone plan are summarized in Table 1. The estimates for 2008 do not include the additional three percent increase applied to all non-point source anthropogenic VOC and NOx emissions in 2008.

One output of the MAG EMME/2 travel demand models that is important in estimating onroad mobile source emissions is a traffic assignment. Traffic assignments are useful in preparing a spatially-accurate representation of VOC and NOx emissions from onroad mobile sources. To support the eight-hour ozone plan, 2001, 2002 and 2008 traffic assignments were prepared using the latest socioeconomic projections available at the time, the EMME/2 transportation models, and 2008 highway and transit networks that are consistent with the 2006 Conformity Analysis for the FY 2007-2011 Transportation Improvement Program (TIP) and Regional Transportation Plan - 2006 Update (RTP). The Federal Highway Administration and Federal Transit Administration made a finding of conformity on this TIP and RTP in August 2006.

For the eight-hour ozone plan, each traffic assignment was performed for four vehicle classes (light-duty commercial truck, medium-duty commercial truck, heavy-duty commercial truck, and all other vehicles) and four times of day (AM peak, midday, PM peak,

and nighttime). Each of these sixteen assignments provides the number of vehicles and capacity-restrained speeds on each highway link. There are more than 30,000 one-way links in a typical MAG highway network.

Table 1 provides capacity (freeway lane miles) and performance (PM peak speeds) measures that are output by MAG traffic assignments for 2001, 2002 and 2008. Table 2 provides the vehicle miles of travel stratified by road type. It is important to note that the data in Tables 1 and 2 apply to the 6,500 square mile transportation modeling area which is larger than the eight-hour ozone nonattainment area of 4,880 square miles. MAG uses GIS to extract the highway links and associated VMT and speed data that fall within the eight-hour ozone 4 km grid modeling domain for each of the traffic assignments. The sixteen link files (4 vehicle types x 4 times of day) for the 4 km modeling domain are input to the M6Link onroad mobile source emissions program described in Appendix III-i.

TABLE 1
TRAFFIC ASSIGNMENT CHARACTERISTICS

Year	Resident Population[a] (1,000's)	Total Employment[a] (1,000's)	VMT[b] (1,000's)	Freeway Lane Miles[c]	PM Peak Speed[d] (mph)
2001	3,330	1,666	82,144	2,224	32.8
2002	3,455	1,726	85,701	2,224	32.1
2008	4,206	2,088	107,151	2,676	27.2

TABLE 2
VMT BY FACILITY TYPE[b]
(in thousands)

Year	Freeways[c]	Arterials	Collectors	Local Streets	Total
2001	31,530	38,694	2,389	9,531	82,144
2002	32,673	40,535	2,538	9,954	85,701
2008	43,159	48,692	3,030	12,270	107,151

a Population and employment estimates for the 6,500 square mile transportation modeling area (TMA) in Maricopa and Pinal Counties are based on the 2000 U.S. Census.
b Average weekday vehicle miles of travel (VMT) estimated by the MAG EMME/2 transportation models for the TMA..
c Ramps and high occupancy vehicle (HOV) lanes are included in freeways.
d Average speed on freeways, expressways, and arterials in the TMA between 3-6 p.m.
e VMT associated with 2001 socioeconomic data was assigned to the 2002 transportation network.

Appendix IV-iii

Growth Factors

Appendix IV-iii contains growth factors based on the population and employment projections accepted by the MAG Regional Council in June 2003.

In evaluating attainment of the National Ambient Air Quality Standards (NAAQS) for eight-hour ozone, an estimate of ozone precursor emissions in 2008 was necessary. MAG has created the growth factors to project emissions from the 2002 Periodic Emissions Inventory for Ozone Precursors, MCAQD, June 2004 to the ozone modeling year 2008. The growth factors were developed to estimate future emissions based on changes in population, employment, aircraft operations, and vehicle miles of travel between the base year, 2002, and the forecast year, 2008.

BACKGROUND

The growth factors used to project the 2001 and 2002 NOx and VOC emissions to 2008 are described below. The 2002 Periodic Emissions Inventory for Ozone Precursors, MCAQD, June 2004, and the EPA guidance document Procedures For Preparing Emissions Projections, EPA450/4-91-019, May, 1991 were used to develop growth factors. The following equation, obtained from the Procedures document, illustrates the calculation of growth factors:

$$\begin{matrix}\textit{Projected Year}\\ \textit{Growth Factor}\end{matrix} = \frac{\begin{matrix}\textit{Value of Growth}\\ \textit{Indicator in Projection Year}\end{matrix}}{\begin{matrix}\textit{Value of Growth}\\ \textit{Indicator in Periodic Year}\end{matrix}}$$

Growth factors were applied to the 2001 and 2002 NOx and VOC emissions for point (except power plant emissions), area and nonroad mobile sources to determine annual projected emissions.

As indicated above, this methodology was not applied to project 2008 emissions from power plants. To simulate a worst case condition, maximum permitted emissions (potential to emit) and hourly peaking emissions were applied to project 2008 emissions for base load and peaking units, respectively. The power plant emissions rates were provided to MAG by the Maricopa County Air Quality Department (MCAQD).

Growth Factors

Details on the growth factor estimation procedure are discussed in this section. For each standard industrial classification (SIC), growth factors were applied on the basis of the most appropriate growth indicator. The growth indicators that were applied to each SIC were reviewed by MCAQD. The growth factors were interpolated, since the socioeconomic data were only available in ten-year increments (i.e., 2000 and 2010).

Socioeconomic Growth Factors

In June 2003, the MAG Regional Council approved interim population and employment projections based on the 2000 Special Census. These interim projections were based on Maricopa County control totals developed by the Arizona State University Center for Business Research (ASU) and data from the 2000 U.S. Census, 2000 MAG Employment Survey, and the MAG GIS and Database Enhancement Study. Estimated population and employment by traffic analysis zone (TAZ) in Maricopa County for 2001, 2002 and 2010, were interpolated from the MAG interim projections for 2000 and 2010.

The Maricopa County population and employment for 2001, 2002 and 2008 are summarized in Table 1. The general methodology for creating a growth factor consisted of dividing the value of the growth indicator in the projection year (2008) by the value of the growth indicator in the base year (2002). For example, the growth factor from 2002 to 2008 for a category based on industrial employment is 468,534 divided by 385,056 or 1.22.

TABLE 1. POPULATION, EMPLOYMENT, AND VMT FOR 2001, 2002, AND 2008

	2001	2002	2008
Maricopa County			
Population (POP)	3,200,380	3,304,160	3,926,840
Retail Employment (Retail)	427,469	439,855	514,171
Office Employment (Office)	376,567	393,962	498,332
Public Employment (Public)	215,843	221,600	260,600
Industrial Employment (Industrial)	371,143	385,056	468,534
Construction Employment (Construction)	51,500	52,000	55,200
Other Employment (Other)	228,530	137,600	149,500
Total Employment (EMP)	1,619,552	1,670,000	1,997,900
Eight-Hour Ozone Modeling Domain (4 km)			
Daily Vehicle Miles of Travel (VMT)	67,052,128	69,884,669	86,879,914

Table 2 displays the growth factors for point sources other than power plants. It is important to note that emissions from the existing peaking power plants and the new base load units for 2008 were estimated by MCAQD based on potential operation levels (either potential to emit for base load units or hourly peaking values for peaking units). The data listed in the "Reference" column in Table 2 identifies the growth indicator from Table 1 that was used to create the growth factor for each point source. Sources based on a growth indicator of mining employment (MINING) were assumed to remain constant between 2002 and 2008.

TABLE 2. 2008 POINT SOURCE GROWTH FACTORS

BUSINESS NAME	INSCC	INSIC	GF-02_08	Ref
23RD AVE WASTEWATER TREATMENT PLANT	10300603	4952	1.19	POP
91ST AVE WASTEWATER TREATMENT PLANT	20300102	4952	1.19	POP
A F LORTS COMPANY INC	40201901	2511	1.22	Industrial
ACME GIN CO INC	10201002	0724	1.19	POP
ADESA PHOENIX LLC	40201699	7532	1.22	Industrial
AG PRODUCTS	40202501	3443	1.22	Industrial
LUKE AFB - CES/CEV	20400101	9711	1	No Growth
ALLIED TUBE & CONDUIT CORP-PHX OPERATION	40202599	3317	1.22	Industrial
ALLIED WASTE IND INC SW REG FACILITY	50100433	4953	1.19	POP
AMERON INTL-WATER TRANSMISSION GROUP	20200102	3272	1.22	Industrial
ANABOLIC LABORATORIES INC	30106011	2834	1.22	Industrial
ANDERSON CLAYTON CORP-VALENCIA GIN	10201002	0724	1.19	POP
THE PHOENICIAN RESORT	10300603	7011	1	No Growth
ARIZONA GALVANIZING INC	10200603	3479	1.22	Industrial
ARIZONA STATE UNIVERSITY	40600399	8211	1.19	POP
BILLBOARD POSTER COMPANY INC	40500301	7312	1.22	Industrial
BONDED LOGIC INC	10100602	2297	1.19	POP
BP WEST COAST PRODUCTS LLC/PHX TERMINAL	40400178	5171	1.22	Industrial
BRYANT INDUSTRIES INC	40202105	2431	1.22	Industrial
BUILDING PRODUCTS CO	30500311	3259	1.19	POP
BUTTERFIELD STATION	50382001	4953	1.19	POP
CALJET	10200602	4226	1.22	Industrial
CASE FURNITURE & DESIGN LLC	40200410	2521	1.22	Industrial
CAVCO INDUSTRIES LLC	40299999	2451	1.22	Industrial
CAVCO INDUSTRIES LLC/DURANGO PLANT	40200701	2451	1.22	Industrial
CAVE CREEK SCHOOL DIST	20300204	8211	1.19	POP
CEMEX MESA PLANTS NO #61 & #71	20200102	3273	1.22	POP
APS WEST PHX POWER PLANT	20100201	4911	1	No Growth
CENTURY GRAPHICS LLC	40500401	2752	1.22	Industrial
CESAR COLOR INC	10200603	2759	1.22	Industrial
CHARLES SCHWAB & CO INC	20100102	6211	1.19	POP
CHEVRON USA INC	40400121	5171	1.22	Industrial
CHOLLA CUSTOM CABINETS INC	40201999	2434	1.22	Industrial
CHRIS FISCHER PRODUCTIONS INC	40201901	2431	1.22	Industrial
CORESLAB STRUCTURES (ARIZ) INC	40600399	3272	1.22	Industrial
COURIER GRAPHICS CORP	40500401	2752	1.22	Industrial
CRAFTSMEN IN WOOD MFG	40201901	2431	1.22	Industrial
CREATIVE SHUTTERS INC	40202111	2431	1.22	Industrial
DAIMLERCHRYSLER ARIZONA PROVING GROUNDS	20301001	8734	1.19	POP
DESERT SUN FIBERGLASS	30800722	3089	1.22	Industrial
DOLPHIN INC	30405001	3324	1.22	Industrial
DUKE ENERGY ARLINGTON VALLEY LLC	10100602	4911	1	No Growth
EAGLE INDUSTRIES LLC	10200603	2511	1.22	Industrial
EARNHARDT FORD	40201699	7532	1.22	Industrial
EARTHGRAINS BAKING COMPANIES INC	30203201	2051	1.22	Industrial
EMPIRE MACHINERY CO	20200204	5082	1.22	Industrial

BUSINESS NAME	INSCC	INSIC	GF-02_08	Ref
EXECUTIVE DOOR	40200701	2431	1.22	Industrial
FARMERS GIN INC	10201002	0724	1.19	POP
FLEETWOOD HOMES OF ARIZONA INC #21	40299999	2451	1.22	Industrial
FLIPCHIP INTERNATIONAL LLC	31306599	3674	1.22	Industrial
FREESCALE SEMICONDUCTOR INC	10200603	3674	1.22	Industrial
GCR TRUCK TIRE CENTER	30800133	7534	1.26	Office
GENERAL MILLS	30203202	2051	1.22	Industrial
KYRENE GENERATING STATION	20100101	4911	1	No Growth
GLENDALE MUN SANITARY LANDFILL/FLD OPER	50100410	4953	1.19	POP
GOOD SAMARITAN REGIONAL MEDICAL CENTER	10300602	8062	1.19	POP
GOODRICH AIRCRAFT INTERIOR PRODUCTS	40299998	3069	1.19072	Industrial
HALNA INC	10200603	3354	1.22	Industrial
OCOTILLO POWER PLANT	10100604	4911	1	No Growth
HENRY PRODUCTS INC	10200602	3086	1.22	Industrial
HIGHLAND PRODUCTS INC	10200603	3086	1.22	Industrial
HOGUE PRINTING INC	40500212	2752	1.22	Industrial
HOLSUM BAKERY INC	30203299	2051	1.22	Industrial
HOLSUM BAKERY/TEMPE	30203299	2051	1.22	Industrial
HONEYWELL ENGINES SYS & SERVICE PHX R&O	40299999	3724	1.19072	Industrial
HONEYWELL INTERNATIONAL INC	40100398	3724	1.19072	Industrial
IMSAMET OF ARIZONA	30400102	3341	1.22	Industrial
INSULFOAM	30800801	3086	1.22	Industrial
INTEL CORP-OCOTILLO CAMPUS (FAB 12 & 22)	31306599	3674	1.22	Industrial
ISOLA LAMINATE SYSTEMS CORP	10200603	3679	1.22	Industrial
PALO VERDE NUCLEAR GENERATING STATION	20200102	4911	1	No Growth
L & M LAMINATES & MARBLE	30800799	3087	1.22	Industrial
LEGENDS FURNITURE INC	40201901	2511	1.22	Industrial
LITTON ELECTRO-OPTICAL SYSTEMS	40100399	3672	1.22	Industrial
PINNACLE WEST ENERGY CORP	20100201	4911	1	No Growth
M E GLOBAL INC	10200603	3325	1.22	Industrial
MAAX SPAS ARIZONA	40299999	3087	1.22	Industrial
SANTAN GENERATING STATION	20100201	4911	1	No Growth
MAGIC WOODS INC	40201999	2512	1.22	Industrial
MAIL-WELL ENVELOPE	40500401	2677	1.22	Industrial
MARLAM INDUSTRIES INC	30800720	3089	1.22	Industrial
MASTER BLOCK INC	10200603	3272	1.22	Industrial
MASTERCRAFT CABINETS INC	40202101	2434	1.22	Industrial
MESA FULLY FORMED INC	30800799	3087	1.22	Industrial
SRP AGUA FRIA GENERATING STATION	20100101	4911	1	No Growth
ALLECO STONE LLC	20100102	1442	1	Mining
METAL MANAGEMENT ARIZONA INC	20200102	5093	1.19	POP
MICROCHIP TECHNOLOGY INC	10200603	3674	1.22	Industrial
MONIER LIFETILE LLC	39999999	3272	1.22	Industrial
MORTON SALT GLENDALE FACILITY	20200301	2899	1.22	Industrial
MTD SOUTHWEST INC	20400401	3524	1.22	Industrial
MUNTERS CORP	30701399	3585	1.22	Industrial
NATIONAL GYPSUM CO	10200603	3275	1.19	POP
NESCO MFG INC	40299999	3086	1.22	Industrial
NEW DIRECTIONS INC	40201901	2511	1.22	Industrial

BUSINESS NAME	INSCC	INSIC	GF-02_08	Ref
CEMEX USA (SUN CITY)	40600702	1442	1	Mining
NORTHWEST REGIONAL LANDFILL	20200102	4953	1.19	POP
OAK CANYON MANUFACTURING INC	40201901	2511	1.22	Industrial
OAKCRAFT INC	40201901	2434	1.22	Industrial
OASIS BEDROOM CO	40201901	2511	1.22	Industrial
HANSON AGGREGATES OF ARIZONA INC	40600399	1442	1	Mining
O'NEIL PRINTING INC	40500401	2752	1.22	Industrial
PACIFIC DESIGNS	40201901	2511	1.22	Industrial
PALM HARBOR HOMES INC	40299999	2451	1.22	Industrial
MADISON GRANITE SUPPLIES	20200102	1442	1	Mining
PALOMA GIN PROPERTIES LLC	10200603	0724	1.19	POP
PAN-GLO WEST	40202599	3479	1.22	Industrial
PARKER HANNIFIN GTFSD	40100399	3724	1.22	Industrial
PENN RACQUET SPORTS INC	10200602	3949	1.22	Industrial
PHOENIX AGRO INVEST INC	40600702	0724	1.19	POP
PHOENIX BRICK YARD	30500311	3251	1.22	Industrial
PHOENIX NEWSPAPERS INC	40500401	2711	1.22	Industrial
MESA MATERIALS INC	10200503	1442	1	Mining
PRESTO CASTING CO	40299999	3369	1.22	Industrial
PURCELLS WESTERN STATES TIRE	30800501	7534	1.26	Office
QUEBECOR WORLD-PHOENIX DIVISION	40500401	2752	1.22	Industrial
QUINCY JOIST COMPANY	40202599	3441	1.22	Industrial
RED MOUNTAIN MINING INC	20200102	3299	1.19	POP
REDMAN HOMES INC	40200701	2451	1.22	Industrial
REXAM BEVERAGE CAN COMPANY	40201799	3411	1.22	Industrial
RIVER RANCH PLANT	40600399	3273	1.22	POP
ROGERS CORP/ADVANCED CIRCUIT MATERIALS	10200602	3083	1.19	POP
SANMINA PHOENIX DIVISION	31306599	3672	1.22	Industrial
SUN STATE ROCK & MATERIALS	20200102	1442	1	Mining
SCHUFF STEEL CO	40299999	3441	1.22	Industrial
SCHULT HOMES	40299999	2451	1.22	Industrial
SCOTTSDALE HEALTH CARE HOSPITAL	10300503	8062	1.19	POP
SFPP LP	40400179	4226	1.22	Industrial
SHELL OIL / PHOENIX TERMINAL	40400199	5171	1.22	Industrial
SKUNK CREEK LANDFILL	50100410	4953	1.19	POP
SKYLINE STEEL INC	40202501	3448	1.19	POP
SOUTH MOUNTAIN GIN	10200603	0724	1.19	POP
UNITED METRO PLANT #11	10200603	1442	1	Mining
ST MICROELECTRONICS	31306505	3674	1.22	Industrial
STACO ARCHITECTURAL ROOF TILE	30599999	3272	1.22	Industrial
STONE CREEK INC	40201999	2511	1.22	Industrial
UNITED METRO PLANT #12	10200503	1442	1	Mining
SUNLAND BEEF CO	30203803	2011	1.22	Industrial
TEAM TWO DESIGN ASSOC INC	40201901	2511	1.22	Industrial
THE BOEING COMPANY	40100398	3721	1.19072	Industrial
THE HEIL COMPANY	40201699	3799	1.22	Industrial
VULCAN MATERIALS CO-WESTERN DIVISION	40600399	1442	1	Mining
THE PROCTER & GAMBLE MFG CO	30106099	2834	1.22	Industrial
THORNWOOD FURNITURE MFG	40201901	2511	1.22	Industrial

BUSINESS NAME	INSCC	INSIC	GF-02_08	Ref
THUNDERBIRD FURNITURE	40201901	2511	1.22	Industrial
TPAC A DIVISION OF KIEWIT WESTERN CO	10200603	3272	1.22	Industrial
TRENDWOOD INC	40201999	2511	1.22	Industrial
TRW VEHICLE SAFETY SYSTEMS INC	39999993	3714	1.19	POP
U HAUL INTL/TECHNICAL CENTER	40299999	7538	1.17	Retail
ULTRA INSTALLATIONS INC	30800799	3087	1.22	Industrial
UNITED DAIRYMEN OF ARIZONA	10200602	2023	1.22	Industrial
WICKENBURG FACILITY	20200102	1442	1	Mining
GILA RIVER POWER STATION	20100201	4911	1	No Growth
VULCAN MATERIALS CO-WESTERN DIVISION	10200603	2951	1.22	Industrial
MESQUITE GENERATING STATION	20100201	4911	1	No Growth
W R MEADOWS OF AZ INC	10200603	2899	1.22	Industrial
WESTERN ORGANICS INC	40600702	5191	1.19	POP
WESTERN SHUTTER LLC	40202199	2431	1.22	Industrial
WESTERN STATES PETROLEUM	40400108	5171	1.22	Industrial
NEW HARQUAHALA	20100201	4911	1	No Growth
WINCUP HOLDINGS INC	10200602	3086	1.22	Industrial
WOODCASE FINE CABINETRY INC	40202101	2434	1.22	Industrial
WOODSTUFF MANUFACTURING INC	40201901	2511	1.22	Industrial

Table 3 displays the growth factors for area sources. The "Reference" column identifies the growth indicator in Table 1. The agricultural acreage growth factor was extrapolated from historical Arizona Agricultural Statistics for Maricopa County in 2000-2005.

TABLE 3. 2008 AREA SOURCE OZONE GROWTH FACTORS

Area Source Category	SCC	GF-02_08	Ref
Stationary Source Fuel Combustion, Industrial	2102004000	1.22	Industrial
Stationary Source Fuel Combustion Industrial	2102006000	1.22	Industrial
Stationary Source Fuel Combustion Commercial/Institutional	2103004000	1.26	Office
Stationary Source Fuel Combustion Commercial/Institutional	2103006000	1.26	Office
Stationary Source Fuel Combustion Commercial/Institutional	2103007000	1.26	Office
Stationary Source Fuel Combustion Commercial/Institutional	2103011000	1.26	Office
Stationary Source Fuel Combustion Residential	2104004000	1.19	POP
Stationary Source Fuel Combustion Residential	2104006000	1.19	POP
Stationary Source Fuel Combustion Residential	2104007000	1.19	POP
Stationary Source Fuel Combustion Residential	2104008000	1	No growth
Stationary Source Fuel Combustion Residential	2104011000	1.19	POP
Industrial Processes Chemical Manufacturing: SIC 28	2301010000	1.19	POP
Industrial Processes Chemical Manufacturing: SIC 28	2301030000	1.19	POP

Area Source Category	SCC	GF-02_08	Ref
Industrial Processes Food and Kindred Products: SIC 20	2302002100	1.17	Retail
Industrial Processes Food and Kindred Products: SIC 20	2302002200	1.17	Retail
Industrial Processes Food and Kindred Products: SIC 20	2302003000	1.17	Retail
Industrial Processes Food and Kindred Products: SIC 20	2302003100	1.17	Retail
Industrial Processes Food and Kindred Products: SIC 20	2302003200	1.17	Retail
Industrial Processes Food and Kindred Products: SIC 20	2302050000	1.17	Retail
Industrial Processes Secondary Metal Production: SIC 33	2304000000	1.22	Industrial
Industrial Processes Mineral Processes: SIC 32	2305000000	1.22	Industrial
Industrial Processes Rubber/Plastics: SIC 30	2308000000	1.22	Industrial
Industrial Processes Fabricated Metals: SIC 34	2309000000	1.22	Industrial
Industrial Processes , Machinery: SIC 35	2312000000	1.22	Industrial
Industrial Processes-Industrial Processes: NEC	2399000000	1.22	Industrial
Solvent Utilization-Surface Coating	2401001000	1.19	POP
Solvent Utilization-Surface Coating	2401005000	1.17	Retail
Solvent Utilization-Surface Coating	2401008000	1.19	POP
Solvent Utilization-Surface Coating	2401015000	1.22	Industrial
Solvent Utilization-Surface Coating	2401020000	1.22	Industrial
Solvent Utilization-Surface Coating	2401025000	1.22	Industrial
Solvent Utilization-Surface Coating	2401030000	1.22	Industrial
Solvent Utilization-Surface Coating	2401055000	1.22	Industrial
Solvent Utilization-Surface Coating	2401060000	1.22	Industrial
Solvent Utilization-Surface Coating	2401065000	1.22	Industrial
Solvent Utilization-Surface Coating	2401070000	1.22	Industrial
Solvent Utilization-Surface Coating	2401075000	1.22	Industrial
Solvent Utilization-Surface Coating	2401080000	1.22	Industrial
Solvent Utilization-Surface Coating	2401090000	1.22	Industrial
Solvent Utilization-Surface Coating	2401100000	1.22	Industrial
Solvent Utilization-Surface Coating	2401200000	1.22	Industrial
Solvent Utilization-Degreasing	2415000000	1.22	Industrial
Solvent Utilization-Dry Cleaning	2420000000	1.19	POP
Solvent Utilization-Graphic Arts	2425000000	1.22	Industrial
Solvent Utilization-Rubber/Plastics	2430000000	1.22	Industrial
Solvent Utilization-Miscellaneous Industrial	2440000000	1.22	Industrial
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	2460100000	1.19	POP
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	2460200000	1.19	POP
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	2460500000	1.19	POP
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	2460600000	1.19	POP
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	2460800000	1.19	POP
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	2460900000	1.19	POP

Area Source Category	SCC	GF-02_08	Ref
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	2461021000	1.19	POP
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	2461022000	1.19	POP
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	2461023000	1.19	POP
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	2461850000	0.68	Agricultural acreage
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	2465400000	1.19	POP
Storage and Transport Petroleum and Petroleum Product Storage	2501050120	1.24	VMT
Storage and Transport Petroleum and Petroleum Product Storage	2501060052	1.24	VMT
Storage and Transport Petroleum and Petroleum Product Storage	2501060053	1.24	VMT
Storage and Transport Petroleum and Petroleum Product Storage	2501060100	1.24	VMT
Storage and Transport Petroleum and Petroleum Product Storage	2501060201	1.24	VMT
Storage and Transport Petroleum and Petroleum Product Transport	2505030120	1.24	VMT
Storage and Transport Petroleum and Petroleum Product Transport	2505040120	1.24	VMT
Storage and Transport Organic Chemical Storage	2510000000	1.22	Industrial
Waste Disposal, Treatment, and Recovery On-site Incineration	2601000000	1.22	Industrial
Waste Disposal, Treatment, and Recovery Open Burning	2610000500	1	No growth
Waste Disposal, Treatment, and Recovery Landfills	2620000000	1.19	POP
Waste Disposal, Treatment, and Recovery Wastewater Treatment	2630000000	1.19	POP
Waste Disposal, Treatment, and Recovery TSDFs	2640000000	1.19	POP
Waste Disposal, Treatment, and Recovery Scrap and Waste Materials	2650000000	1.19	POP
Waste Disposal, Treatment, and Recovery Leaking Underground Storage Tanks	2660000000	1.24	VMT
Miscellaneous Area Sources Other Combustion	2810030000	1.19	POP
Miscellaneous Area Sources Other Combustion	2810040000	1.22	Industrial
Miscellaneous Area Sources Other Combustion	2810050000	1.19	POP
Miscellaneous Area Sources Other Combustion	2810060100	1.19	POP
Miscellaneous Area Sources Catastrophic/Accidental Releases	2830000000	1.22	Industrial
Miscellaneous Area Sources Health Services	2850000000	1.19	POP
Miscellaneous Area Sources Other Combustion	2810001000	1	No growth

NONROAD Growth Factors

The 2008 growth factors for Maricopa County shown in Attachment Four are default values obtained from the EPA NONROAD2005 model. These growth factors were applied to base year (1996) equipment population estimates by the NONROAD model. The methodology for estimating growth in activity levels is described in "*Nonroad Engine Growth Estimates, Office of Transportation and Air Quality, US EPA, 2004*".

Aviation Growth Factors

Total operations by airport were obtained from the MAG Regional Aviation System Plan ["Regional Aviation System Plan Update, Working Paper No.1, MAG, 2001"]for the years 1995 to 2000. Total operations for 2005 were obtained from the Federal Aviation Administration. The 2008 aircraft operations were calculated for each airport by extrapolating the 1995 through 2005 data. The 2008 growth factors for general aviation were based on the ratio of 2008 total operations to 2005 total operations by airport. The same ratios were used to project the ground service equipment activity levels (towered airports) in Maricopa County. Table 5 provides the data used to develop the 2008 growth factors, including the 2005 operations, forecasted 2008 operations, and 2008 growth factors by airport.

Table 5. Maricopa County Aviation Statistics/Growth Factors

Airport	2005 Operations	Forecasted 2008 Operations	2008 Growth Factor
Buckeye	90000	97200	1.08
Chandler	249811	469645	1.88
Estrella	16500	16500	1
Gila Bend	52000	26520	0.51
Glendale	112570	245403	2.18
Memorial	2300	11684	5.08
Mesa Falcon Field	274665	403758	1.47
Phoenix - Deer Valley	370779	441227	1.19
Phoenix - Goodyear	142458	245027	1.72
Phoenix-Sky Harbor	580000	562600	0.97
Pleasant Valley	52000	82680	1.59
Scottsdale	207032	469963	2.27
Sky Ranch Carefree	4732	3880	0.82
Stellar	40880	29842	0.73
Wickenburg	19846	16670	0.84
Williams	158489	226639	1.43

ATTACHMENT FOUR

Growth Factors for Nonroad Equipment

NONROAD EQUIPMENT GROWTH FACTORS					
Nonroad Equipment Type	**SCC**	**CLASSIFICATION**	**Engine Type**	**Fuel Type**	**2008 GF**
Motorcycles: Off-Road	2260001010	Recreational Equipment	2 Stroke	Gasoline	1.243
Snowmobiles	2260001020	Recreational Equipment	2 Stroke	Gasoline	1.243
ATVs	2260001030	Recreational Equipment	2 Stroke	Gasoline	1.243
Specialty Vehicles/Carts	2260001060	Recreational Equipment	2 Stroke	Gasoline	1.243
Tampers/Rammers	2260002006	Construction and Mining Equipment	2 Stroke	Gasoline	1.201
Plate Compactors	2260002009	Construction and Mining Equipment	2 Stroke	Gasoline	1.201
Paving Equipment	2260002021	Construction and Mining Equipment	2 Stroke	Gasoline	1.201
Signal Boards/Light Plants	2260002027	Construction and Mining Equipment	2 Stroke	Gasoline	1.201
Concrete/Industrial Saws	2260002039	Construction and Mining Equipment	2 Stroke	Gasoline	1.201
Crushing/Proc. Equipment	2260002054	Construction and Mining Equipment	2 Stroke	Gasoline	1.201
Sweepers/Scrubbers	2260003030	Industrial Equipment	2 Stroke	Gasoline	1.459
Other General Industrial Eqp	2260003040	Industrial Equipment	2 Stroke	Gasoline	1.459
Rotary Tillers < 6 HP	2260004015	Lawn and Garden Equipment (Res)	2 Stroke	Gasoline	1.243
Chain Saws < 6 HP	2260004020	Lawn and Garden Equipment (Res)	2 Stroke	Gasoline	1.243
Trimmers/Edgers/Brush Cutter	2260004025	Lawn and Garden Equipment (Res)	2 Stroke	Gasoline	1.243
Leafblowers/Vacuums	2260004030	Lawn and Garden Equipment (Res)	2 Stroke	Gasoline	1.243
Snowblowers	2260004035	Lawn and Garden Equipment (Res)	2 Stroke	Gasoline	1.243
Sprayers	2260005035	Agricultural Equipment	2 Stroke	Gasoline	1.333
Generator Sets	2260006005	Commercial Equipment	2 Stroke	Gasoline	1.459
Pumps	2260006010	Commercial Equipment	2 Stroke	Gasoline	1.459
Air Compressors	2260006015	Commercial Equipment	2 Stroke	Gasoline	1.459
Hydro Power Units	2260006035	Commercial Equipment	2 Stroke	Gasoline	1.459
Motorcycles: Off-Road	2265001010	Recreational Equipment	4 Stroke	Gasoline	1.243
ATVs	2265001030	Recreational Equipment	4 Stroke	Gasoline	1.243
Golf Carts	2265001050	Recreational Equipment	4 Stroke	Gasoline	1.243
Specialty Vehicles/Carts	2265001060	Recreational Equipment	4 Stroke	Gasoline	1.243
Pavers	2265002003	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Tampers/Rammers	2265002006	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Plate Compactors	2265002009	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Rollers	2265002015	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Paving Equipment	2265002021	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Surfacing Equipment	2265002024	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Signal Boards/Light Plants	2265002027	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Trenchers	2265002030	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Bore/Drill Rigs	2265002033	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Concrete/Industrial Saws	2265002039	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Cement & Mortar Mixers	2265002042	Construction and Mining Equipment	4 Stroke	Gasoline	1.201

NONROAD EQUIPMENT GROWTH FACTORS					
Nonroad Equipment Type	**SCC**	**CLASSIFICATION**	**Engine Type**	**Fuel Type**	**2008 GF**
Cranes	2265002045	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Crushing/Proc. Equipment	2265002054	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Rough Terrain Forklifts	2265002057	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Rubber Tire Loaders	2265002060	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Tractors/Loaders/Backhoes	2265002066	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Skid Steer Loaders	2265002072	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Dumpers/Tenders	2265002078	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Other Construction Equipment	2265002081	Construction and Mining Equipment	4 Stroke	Gasoline	1.201
Aerial Lifts	2265003010	Industrial Equipment	4 Stroke	Gasoline	1.459
Forklifts	2265003020	Industrial Equipment	4 Stroke	Gasoline	1.459
Sweepers/Scrubbers	2265003030	Industrial Equipment	4 Stroke	Gasoline	1.459
Other General Industrial Eqp	2265003040	Industrial Equipment	4 Stroke	Gasoline	1.459
Other Material Handling Eqp	2265003050	Industrial Equipment	4 Stroke	Gasoline	1.459
AC\Refrigeration	2265003060	Industrial Equipment	4 Stroke	Gasoline	1.459
Terminal Tractors	2265003070	Industrial Equipment	4 Stroke	Gasoline	1.459
Lawn mowers	2265004010	Lawn and Garden Equipment (Res)	4 Stroke	Gasoline	1.243
Rotary Tillers < 6 HP	2265004015	Lawn and Garden Equipment (Res)	4 Stroke	Gasoline	1.243
Trimmers/Edgers/Brush Cutter	2265004025	Lawn and Garden Equipment (Res)	4 Stroke	Gasoline	1.243
Leafblowers/Vacuums	2265004030	Lawn and Garden Equipment (Res)	4 Stroke	Gasoline	1.243
Snowblowers	2265004035	Lawn and Garden Equipment (Res)	4 Stroke	Gasoline	1.243
Rear Engine Riding Mowers	2265004040	Lawn and Garden Equipment (Res)	4 Stroke	Gasoline	1.243
Rear Engine Riding Mowers	2265004041	Lawn and Garden Equipment (Com)	4 Stroke	Gasoline	1.243
Lawn & Garden Tractors	2265004055	Lawn and Garden Equipment (Res)	4 Stroke	Gasoline	1.243
Other Lawn & Garden Eqp.	2265004075	Lawn and Garden Equipment (Res)	4 Stroke	Gasoline	1.243
2-Wheel Tractors	2265005010	Agricultural Equipment	4 Stroke	Gasoline	1.333
Agricultural Tractors	2265005015	Agricultural Equipment	4 Stroke	Gasoline	1.333
Combines	2265005020	Agricultural Equipment	4 Stroke	Gasoline	1.333
Balers	2265005025	Agricultural Equipment	4 Stroke	Gasoline	1.333
Agricultural Mowers	2265005030	Agricultural Equipment	4 Stroke	Gasoline	1.333
Sprayers	2265005035	Agricultural Equipment	4 Stroke	Gasoline	1.333
Tillers > 6 HP	2265005040	Agricultural Equipment	4 Stroke	Gasoline	1.333
Swathers	2265005045	Agricultural Equipment	4 Stroke	Gasoline	1.333
Other Agricultural Equipment	2265005055	Agricultural Equipment	4 Stroke	Gasoline	1.333
Irrigation Sets	2265005060	Agricultural Equipment	4 Stroke	Gasoline	1.333
Generator Sets	2265006005	Commercial Equipment	4 Stroke	Gasoline	1.459

NONROAD EQUIPMENT GROWTH FACTORS					
Nonroad Equipment Type	**SCC**	**CLASSIFICATION**	**Engine Type**	**Fuel Type**	**2008 GF**
Pumps	2265006010	Commercial Equipment	4 Stroke	Gasoline	1.459
Air Compressors	2265006015	Commercial Equipment	4 Stroke	Gasoline	1.459
Welders	2265006025	Commercial Equipment	4 Stroke	Gasoline	1.459
Pressure Washers	2265006030	Commercial Equipment	4 Stroke	Gasoline	1.459
Hydro Power Units	2265006035	Commercial Equipment	4 Stroke	Gasoline	1.459
Other Oil Field Equipment	2265010010	Industrial Equipment	4 Stroke	Gasoline	1.459
Specialty Vehicle Carts	2267001060	Recreational Equipment	LPG	LPG	1.243
Pavers	2267002003	Construction and Mining Equipment	LPG	LPG	1.201
Rollers	2267002015	Construction and Mining Equipment	LPG	LPG	1.201
Paving Equipment	2267002021	Construction and Mining Equipment	LPG	LPG	1.201
Surfacing Equipment	2267002024	Construction and Mining Equipment	LPG	LPG	1.201
Trenchers	2267002030	Construction and Mining Equipment	LPG	LPG	1.201
Bore/Drill Rigs	2267002033	Construction and Mining Equipment	LPG	LPG	1.201
Concrete/Industrial Saws	2267002039	Construction and Mining Equipment	LPG	LPG	1.201
Cranes	2267002045	Construction and Mining Equipment	LPG	LPG	1.201
Crushing/Proc. Equipment	2267002054	Construction and Mining Equipment	LPG	LPG	1.201
Rough Terrain Forklifts	2267002057	Construction and Mining Equipment	LPG	LPG	1.201
Rubber Tire Loaders	2267002060	Construction and Mining Equipment	LPG	LPG	1.201
Tractors/Loaders/Backhoes	2267002066	Construction and Mining Equipment	LPG	LPG	1.201
Skid Steer Loaders	2267002072	Construction and Mining Equipment	LPG	LPG	1.201
Other Construction Equipment	2267002081	Construction and Mining Equipment	LPG	LPG	1.201
Aerial Lifts	2267003010	Industrial Equipment	LPG	LPG	1.459
Forklifts	2267003020	Industrial Equipment	LPG	LPG	1.459
Sweepers/Scrubbers	2267003030	Industrial Equipment	LPG	LPG	1.459
Other General Industrial Equipment	2267003040	Industrial Equipment	LPG	LPG	1.459
Other Material Handling Equipment	2267003050	Industrial Equipment	LPG	LPG	1.459
Terminal Tractors	2267003070	Industrial Equipment	LPG	LPG	1.459
Other Agricultural Equipment	2267005055	Agricultural Equipment	LPG	LPG	1.333
Irrigation Sets	2267005060	Agricultural Equipment	LPG	LPG	1.333
Generator Sets	2267006005	Commercial Equipment	LPG	LPG	1.459
Pumps	2267006010	Commercial Equipment	LPG	LPG	1.459
Air Compressors	2267006015	Commercial Equipment	LPG	LPG	1.459
Welders	2267006025	Commercial Equipment	LPG	LPG	1.459
Pressure Washers	2267006030	Commercial Equipment	LPG	LPG	1.459

NONROAD EQUIPMENT GROWTH FACTORS					
Nonroad Equipment Type	**SCC**	**CLASSIFICATION**	**Engine Type**	**Fuel Type**	**2008 GF**
Hydro Power Units	2267006035	Commercial Equipment	LPG	LPG	1.459
Other Construction Equipment	2268002081	Construction and Mining Equipment	CNG	CNG	1.201
Forklifts	2268003020	Industrial Equipment	CNG	CNG	1.459
Sweepers/Scrubbers	2268003030	Industrial Equipment	CNG	CNG	1.459
Other General Industrial Equipment	2268003040	Industrial Equipment	CNG	CNG	1.459
AC\Refrigeration	2268003060	Industrial Equipment	CNG	CNG	1.459
Terminal Tractors	2268003070	Industrial Equipment	CNG	CNG	1.459
Other Agricultural Equipment	2268005055	Agricultural Equipment	CNG	CNG	1.333
Irrigation Sets	2268005060	Agricultural Equipment	CNG	CNG	1.333
Generator Sets	2268006005	Commercial Equipment	CNG	CNG	1.459
Pumps	2268006010	Commercial Equipment	CNG	CNG	1.459
Air Compressors	2268006015	Commercial Equipment	CNG	CNG	1.459
Gas Compressors	2268006020	Commercial Equipment	CNG	CNG	1.459
Hydro Power Units	2268006035	Commercial Equipment	CNG	CNG	1.459
Other Oil Field Equipment	2268010010	Industrial Equipment	CNG	CNG	1.459
Speciality Vehicle Carts	2270001060	Recreational Equipment	Diesel	Diesel	1.243
Pavers	2270002003	Construction and Mining Equipment	Diesel	Diesel	1.201
Tampers/Rammers	2270002006	Construction and Mining Equipment	Diesel	Diesel	1.201
Plate Compactors	2270002009	Construction and Mining Equipment	Diesel	Diesel	1.201
Rollers	2270002015	Construction and Mining Equipment	Diesel	Diesel	1.201
Scrapers	2270002018	Construction and Mining Equipment	Diesel	Diesel	1.201
Paving Equipment	2270002021	Construction and Mining Equipment	Diesel	Diesel	1.201
Surfacing Equipment	2270002024	Construction and Mining Equipment	Diesel	Diesel	1.201
Signal Boards/Light Plants	2270002027	Construction and Mining Equipment	Diesel	Diesel	1.201
Trenchers	2270002030	Construction and Mining Equipment	Diesel	Diesel	1.201
Bore/Drill Rigs	2270002033	Construction and Mining Equipment	Diesel	Diesel	1.201
Excavators	2270002036	Construction and Mining Equipment	Diesel	Diesel	1.201
Concrete/Industrial Saws	2270002039	Construction and Mining Equipment	Diesel	Diesel	1.201
Cement & Mortar Mixers	2270002042	Construction and Mining Equipment	Diesel	Diesel	1.201
Cranes	2270002045	Construction and Mining Equipment	Diesel	Diesel	1.201
Graders	2270002048	Construction and Mining Equipment	Diesel	Diesel	1.201
Off-highway Trucks	2270002051	Construction and Mining Equipment	Diesel	Diesel	1.201

NONROAD EQUIPMENT GROWTH FACTORS					
Nonroad Equipment Type	**SCC**	**CLASSIFICATION**	**Engine Type**	**Fuel Type**	**2008 GF**
Crushing/Proc. Equipment	2270002054	Construction and Mining Equipment	Diesel	Diesel	1.201
Rough Terrain Forklifts	2270002057	Construction and Mining Equipment	Diesel	Diesel	1.201
Rubber Tire Loaders	2270002060	Construction and Mining Equipment	Diesel	Diesel	1.201
Tractors/Loaders/Backhoes	2270002066	Construction and Mining Equipment	Diesel	Diesel	1.201
Crawler Tractor/Dozers	2270002069	Construction and Mining Equipment	Diesel	Diesel	1.201
Skid Steer Loaders	2270002072	Construction and Mining Equipment	Diesel	Diesel	1.201
Off-Highway Tractors	2270002075	Construction and Mining Equipment	Diesel	Diesel	1.201
Dumpers/Tenders	2270002078	Construction and Mining Equipment	Diesel	Diesel	1.201
Other Construction Equipment	2270002081	Construction and Mining Equipment	Diesel	Diesel	1.201
Aerial Lifts	2270003010	Industrial Equipment	Diesel	Diesel	1.459
Forklifts	2270003020	Industrial Equipment	Diesel	Diesel	1.459
Sweepers/Scrubbers	2270003030	Industrial Equipment	Diesel	Diesel	1.459
Other General Industrial Eqp	2270003040	Industrial Equipment	Diesel	Diesel	1.459
Other Material Handling Eqp	2270003050	Industrial Equipment	Diesel	Diesel	1.459
AC\Refrigeration	2270003060	Industrial Equipment	Diesel	Diesel	1.459
Terminal Tractors	2270003070	Industrial Equipment	Diesel	Diesel	1.459
2-Wheel Tractors	2270005010	Agricultural Equipment	Diesel	Diesel	1.333
Agricultural Tractors	2270005015	Agricultural Equipment	Diesel	Diesel	1.333
Combines	2270005020	Agricultural Equipment	Diesel	Diesel	1.333
Balers	2270005025	Agricultural Equipment	Diesel	Diesel	1.333
Agricultural Mowers	2270005030	Agricultural Equipment	Diesel	Diesel	1.333
Sprayers	2270005035	Agricultural Equipment	Diesel	Diesel	1.333
Tillers > 6 HP	2270005040	Agricultural Equipment	Diesel	Diesel	1.333
Swathers	2270005045	Agricultural Equipment	Diesel	Diesel	1.333
Other Agricultural Equipment	2270005055	Agricultural Equipment	Diesel	Diesel	1.333
Irrigation Sets	2270005060	Agricultural Equipment	Diesel	Diesel	1.333
Generator Sets	2270006005	Commercial Equipment	Diesel	Diesel	1.459
Pumps	2270006010	Commercial Equipment	Diesel	Diesel	1.459
Air Compressors	2270006015	Commercial Equipment	Diesel	Diesel	1.459
Gas Compressors	2270006020	Commercial Equipment	Diesel	Diesel	1.459
Welders	2270006025	Commercial Equipment	Diesel	Diesel	1.459
Pressure Washers	2270006030	Commercial Equipment	Diesel	Diesel	1.459
Hydro Power Units	2270006035	Commercial Equipment	Diesel	Diesel	1.459
Outboard	2282005010	Pleasure Craft	2 Stroke	Gasoline	1.243
Personal Water Craft	2282005015	Pleasure Craft	2 Stroke	Gasoline	1.243
Inboard/Sterndrive	2282010005	Pleasure Craft	4 Stroke	Gasoline	1.243
Inboard/Sterndrive	2282020005	Pleasure Craft	Diesel	Diesel	1.243
Outboards	2282020010	Pleasure Craft	Diesel	Diesel	1.243
Railway Maintenance	2285002015	Railroad Equipment	Diesel	Diesel	1.243
Railway Maintenance	2285004015	Railroad Equipment	4 Stroke	Gasoline	1.243
Railway Maintenance	2285006015	Railroad Equipment	LPG	LPG	1.243

Appendix IV-iv

Committed Attainment Measures

COMMITTED ATTAINMENT MEASURE #1

Summer Fuel Reformulation: California Phase 2 and Federal Phase II Reformulated Gasoline with 7 psi from May 1 through September 30

The "Summer Fuel Reformulation: California Phase 2 and Federal Phase II Reformulated Gasoline with 7 psi from May 1 through September 30" measure affects emissions from onroad vehicle gasoline-powered engines. With the implementation of this measure, a cleaner burning formulation of gasoline than would otherwise be used will be sold in the modeling area during the ozone season. The methodology used to estimate the benefit is described below. In this analysis, all onroad credit for committed measure package gasoline is applied using the MOBILE6 model.

To estimate the effect of the expected gasoline formulation on onroad emissions, the MOBILE6 model was used. MOBILE6 accepts as input data for the gasoline vapor pressure (RVP), oxygenate content, and sulfur content. The MOBILE6 model runs performed for this analysis in 2008 incorporate the committed maintenance measure package RVP value (7.0 psi). Additionally, in MOBILE6, a flag is available to indicate that reformulated gasoline is to be assumed in the analysis.

To estimate the effect of the cleaner burning gasoline, MOBILE6 was performed using both the committed measure package and the base case (2002 conditions) formulations. The emissions estimated by the two runs were processed through the M6Link program independently and the difference in final emissions estimates was calculated. The reformulated gasoline was set to reflect the southern location of Arizona using the "S" option. The credit for this measure is applied to the entire modeling domain as it is assumed that the gasoline quality is consistent across the modeling domain due to the structure of the Arizona gasoline distribution system. Additional information about the options available to the user of MOBILE6 for the modeling of gasoline quality may be found on pages 148 through 167 of the User's Guide to MOBILE6.1 and MOBILE6.2 Mobile Source Emission Factor Model, October 2002.

No specific credit was taken for reformulated gasoline on nonroad emissions as it is assumed that the very stringent nonroad engine standards include that the engines will use cleaner burning reformulated gasoline.

The base year inventory for 2001 and 2002 reflected actual monitored gasoline formulation qualities from the summer season. The impact of this attainment measure in 2008 is a 3.5% decrease in anthropogenic NOx emissions and less than a 0.1% increase in anthropogenic VOC emissions.

COMMITTED ATTAINMENT MEASURE #2

Phased-In Emission Test Cutpoints

The "Phased-In Emission Test Cutpoints" measure affects onroad emissions. With the implementation of this measure, vehicles which are subject to the enhanced I/M program are held to a stricter set of cutpoints than would otherwise be the case. The stricter cutpoints were implemented in January 2000. If a vehicle exceeds the emission levels set by the cutpoint for carbon monoxide, hydrocarbons, or NOx, the vehicle fails the test.

The Arizona Department of Environmental Quality (ADEQ) provided a table of emission testing cutpoints for each model year vehicle subject to the enhanced I/M program in the May 28, 2001 ADEQ memo Cutpoints for IM147 for MOBILE6. These cutpoints are entered into a data file in a format appropriate for input to the MOBILE6 model. The format for the table appropriate for input to MOBILE6 may be found in section 2.8.9.4.g of the User's Guide to MOBILE6.1 and MOBILE6.2: Mobile Source Emission Factor Model, EPA420-R-02-028, October 2002.

The composite cutpoints (I/M147 program) that reflect the enhanced program are indicated in the following table. The LDGV cutpoints were used in the MOBILE6 Block 1 cutpoint values. The LDGT1 cutpoints were used in Block 2. The LDGT2 cutpoints were used in Blocks 3 and 4.

Model Year	Vehicle Class	Hydrocarbons	CO	NOx
1981-1982	LDGV	3.00	25.00	3.50
1983-1985	LDGV	2.40	20.00	3.50
1986-1989	LDGV	1.60	15.00	2.50
1990-1993	LDGV	1.00	12.00	2.50
1994+	LDGV	0.80	12.00	2.00
1981-1985	LDGT1	4.00	40.00	5.50
1986-1989	LDGT1	3.00	25.00	4.50
1990-1993	LDGT1	2.00	20.00	4.00
1994+	LDGT1	1.60	20..0	3.00
1981-1985	LDGT2	4.40	48.00	7.00
1986-1987	LDGT2	4.00	40.00	5.50
1988-1989	LDGT2	3.00	25.00	5.50
1990-1993	LDGT2	3.00	25.00	5.00
1994+	LDGT2	2.40	25.00	4.00

While the previous table lists the cutpoints used for model years back to 1981, due to the structure of MOBILE6. Only the cutpoints back to the model year 1984 are considered when performing a 2008 run. This is because the MOBILE6 model only considers the most recent 25 model years in any particular run. In 2008, the 25th model year included in the modeling is a 1984 vehicle. The enhanced I/M program with the I/M cutpoints was removed as the base case.

The benefit from the enhanced I/M program with the cutpoints was estimated by running the M6Link model with the MOBILE6 outputs developed using the base case without the enhanced I/M program and then rerunning M6Link with the MOBILE6 outputs developed using the enhanced I/M program with the cutpoints. In both cases, MOBILE6 was run with a five year grace period from the I/M program for the newest model year vehicles.

The anthropogenic emission reductions attributable to this attainment measure in 2008 are 0.9% and 1.2% for NOx and VOC, respectively.

COMMITTED ATTAINMENT MEASURE #3

One Time Waiver from Vehicle Emissions Test

The "One Time Waiver from Vehicle Emissions Test" measure affects onroad emissions. With the implementation of this measure, vehicles are allowed no more than a single I/M waiver after January 1, 1997. The methodology used to estimate the emissions reduction is described below.

MOBILE6 uses as input the waiver rates for two age groups of vehicles. The first age group is vehicles of model years before 1981. The second age group is vehicles of model years 1981 and newer. It is assumed that absent this control measure, the waiver rate for pre-1981 model year vehicles would be four percent and the waiver rate for model year vehicles 1981 and newer would be three percent. The base case waiver rates incorporate no set limit on the number of waivers which a given vehicle may receive. This measure sets a limit of one on the number of waivers which any vehicle may receive.

It has been estimated that the average remaining life span of a vehicle which has received a waiver is three years (page E-5 of Feasibility and Cost-Effective Study of New Air Pollution Control Measures Pertaining to Mobile Sources, Sierra Research, Inc., June 1993). This measure effectively reduces that three-year life to one year, and result in approximately two thirds of the reductions of a change to zero waivers. With the implementation of this control measure, the waiver rate for pre-1981 model year vehicles is one and one third percent and the waiver rate for model year vehicles 1981 and newer is one percent.

The 2008 base case input to MOBILE6 of three percent waivers for 1981 and newer model year vehicles was changed to one percent to reflect this measure.

The anthropogenic emission reductions attributable to this attainment measure in 2008 are less than 0.1% for both NOx and VOC.

COMMITTED ATTAINMENT MEASURE #4

Coordinate Traffic Signal Systems

The "Coordinate Traffic Signal Systems" measure affects onroad emissions. With the implementation of this measure, vehicles in the modeling area spend less time idling at traffic lights than is assumed in the base case. The methodology used to estimate the emissions reduction is described below.

This measure affects onroad emissions through a reduction in idling time at traffic signals. The estimation of the benefit from the measure involves the estimation of three factors, which were multiplied together to estimate a total emission reduction.

The three factors involved in the calculation of the benefit from this measure are as follows:

- The idling emission rate per hour from an average onroad vehicle,
- The reduction in idle time per intersection, and
- The total number of intersections which will be affected by this measure.

Estimate of the idling emission rate per hour from an average onroad vehicle

The average idling rate was estimated using MOBILE6. Two MOBILE6 runs were performed, reflecting I/M and non-I/M. One vehicle speed, 2.5 miles per hour was used. Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparation, EPA, January 2002 recommends running the mobile model at a speed of 2.5 miles per hour since the mobile model does not calculate idle emissions directly. The output from MOBILE6, in units of grams per mile, was converted to the desired units of grams per hour by multiplication of 2.5 miles per hour.

Hourly temperatures were input, from which MOBILE6 calculated the ambient daily temperature internally. The I/M and non-I/M results were weighted (0.916 for I/M and 0.084 non-I/M) to determine the net emission rate. The MOBILE6 calculated emission rates are shown in the following table.

	I/M	non-IM	Net
VOC Emission rate (grams per mile) 2008	1.766	1.913	1.78
CO Emission rate (grams per mile) 2008	7.924	10.020	8.10
NOx Emission rate (grams per mile) 2008	1.204	1.287	1.21
Weighting Fraction	0.916	0.084	1.000

The net VOC emission rate of 1.78 grams per mile, or 4.45 grams per hour were obtained from the weighting of the emission rates. The net CO emission rate is 8.10 grams per mile, or 20.25 grams per hour. The net NOx emission rate is 1.21 grams per mile, or 3.03 grams per hour.

Estimate of reduction in idle time per intersection

The amount of vehicle idling time per intersection saved with implementation of the measure was estimated using data from the Final Report of the Governor's Alternative Transportation System Task Force, November 1996. That report referenced a study which estimated that, on average, 16,366 hours of delay per intersection would be saved through enhanced traffic signal coordination. This annual benefit was calculated with the assumption that retiming primarily affects weekday time periods other than late at night. With approximately 260 weekdays per year, 16,366 hours of delay per year equates to approximately 62.9 hours of delay per weekday.

Estimate of the total number of intersections which will be affected by this measure

It is estimated that 151 signals in the CO nonattainment area were upgraded between 2002 and 2006 as a result of this measure. This is likely a conservative estimate since the ozone modeling domain is larger than the CO modeling domain, and additional signals will be synchronized after 2006.

Estimate of the Total Emission Reduction

Combining the estimated reduction in idling due to the synchronization of the traffic signals, the reduction in VOC emissions is 0.04 metric tons per day,

$$151 \text{ intersections} \times \frac{62.9 \text{ hours}}{\text{intersection}} \times \frac{4.45 \text{ grams}}{\text{hour}} \times \frac{1 \text{ metric ton}}{1 \times 10^6 \text{ grams}} = \frac{0.04 \text{ metric tons}}{\text{day}}$$

the reduction in CO emissions is 0.19 metric tons per day,

$$151 \text{ intersections} \times \frac{62.9 \text{ hours}}{\text{intersection}} \times \frac{20.3 \text{ grams}}{\text{hour}} \times \frac{1 \text{ metric ton}}{1 \times 10^6 \text{ grams}} = \frac{1.19 \text{ metric tons}}{\text{day}}$$

and the reduction in NOx emissions is 0.03 metric tons per day,

$$151 \text{ intersections} \times \frac{62.9 \text{ hours}}{\text{intersection}} \times \frac{3.03 \text{ grams}}{\text{hour}} \times \frac{1 \text{ metric ton}}{1 \times 10^6 \text{ grams}} = \frac{0.03 \text{ metric tons}}{\text{day}}$$

This measure was not modeled through the M6Link program, but as a post-processing measure to M6Link. The net emissions reduction in metric tons resulting from this control measure was estimated using the method described above. The net reduction was compared to the total onroad emissions, estimated before post-processing, output by the M6Link model. The fractional reduction in the total emissions from M6Link resulting from this control measure was applied to the M6Link output using the M6Link utility program.

The anthropogenic emission reductions attributable to this attainment measure in 2008 are less than 0.1% for both NOx and VOC.

COMMITTED ATTAINMENT MEASURE #5

Develop Intelligent Transportation Systems

The "Develop Intelligent Transportation Systems" measure affects onroad emissions. With the implementation of this measure, vehicles in the modeling area will spend less time idling at traffic lights and will be better able to avoid traffic congestion than is assumed in the base case.

The benefit of this measure was quantified for Intelligent Transportation Systems (ITS) projects in the MAG Transportation Improvement Program that were funded with federal Congestion Mitigation and Air Quality Improvement (CMAQ) funds in FY 2003 through FY 2006. A summary of these projects and attendant emission reduction benefits is provided in the Table below. The methodology used in quantifying the benefits of the projects is documented in "*Methodologies for Evaluating Congestion Mitigation and Air Quality Improvement Projects*", prepared by the Maricopa Association of Governments, August 15, 2005.

The total emissions reductions for NOx, VOC, and CO from 2003 to 2006 for all the ITS projects are

Project#	City	Year	TOG kg/day	NOx kg/day	CO kg/day
900A063 (part)	ADOT	2003	100.09	n/a	1261.14
900A063 (part)	ADOT	2003	0.01	n/a	0.08
051A003	ADOT	2003	1592.96	n/a	17043.25
CHN0023	Chandler	2003	0.22	n/a	1.52
GLN0025	Glendale	2003	7.85	n/a	102.11
GLN0026	Glendale	2003	0.94	n/a	12.27
MES0025	Mesa	2003	10.18	n/a	82.65
PVY0001	Peoria	2003	0.15	n/a	1.23
SCT0013	Scottsdale	2003	1.02	n/a	17.99
PEO0008	Peoria	2004	8.57	8.57	29.50
MMA0044	Maricopa County	2004	1.22	1.22	4.21
SCT0015	Scottsdale	2005	1.20	1.20	4.49
SCT0014	Scottsdale	2004	0.37	0.37	1.26
PHX0052	Phoenix	2004	1.79	2.09	8.37
MMA04-114	Maricopa County	2005	6.65	7.10	36.97
AVN07-301R	Avondale	2005	2.13	2.09	9.87
MMA07-301D1	Maricopa County	2005	4.61	4.91	25.59
CHN03-108R	Chandler	2005	2.29	2.46	17.20
GLB06-203A	Gilbert	2005	64.21	68.80	481.57
MES05-501	Mesa	2005	100.28	93.37	420.15
MES03-121RC	Mesa	2005	5.73	6.14	43.00
MES09-606R	Mesa	2005	150.42	140.05	630.22
GLN01-001C	Glendale	2006	7.28	3.55	-13.15
PHX06-225C	Phoenix	2006	62.50	45.09	172.89
TMP06-630	Tempe	2006	49.07	36.93	99.43
Total			**2181.74**	**423.93**	**20493.83**

**The calculations are based on the CMAQ Annual Reports for FY 2003, 2004, 2005, and 2006 .The TOG and NOx reductions are taken but not CO, because the CO was calculated using winter temperatures.

The total 2008 reduction in onroad mobile source emissions due to the implementation of these FY 2003-2006 ITS projects are:0.4 metric tons/day for NOx and 2.2 metric tons/day for VOC. The reductions in anthropogenic emissions attributable to this attainment measure in 2008 are 0.1% for NOx and 0.9% for VOC.

COMMITTED ATTAINMENT MEASURE #6

Tougher Enforcement of Vehicle Registration and Emission Test Compliance

The "Tougher Enforcement of Vehicle Registration and Emission Test Compliance" measure affects onroad emissions. With the implementation of this measure, the number of vehicles which are expected to be registered in the nonattainment area and tested in the I/M program is increased, resulting in a cleaner onroad vehicle fleet. The methodology used to estimate the emissions reduction is described below.

Without this control measure, the weighting of I/M versus non-I/M emission factors from the EPA MOBILE6 model (MOBILE6) was assumed to be 89.6 percent I/M and 10.4 percent non-I/M. The weighting factors are an input to the M6Link control file. This measure was modeled by adjusting the weighting between I/M and non-I/M emission factors from MOBILE6.

The Report of the Governor's Air Quality Strategies Task Force, December 2, 1996 estimated that an additional 41,000 vehicles would be emission tested as a result of this measure. This estimate was confirmed with the Arizona Department of Environmental Quality and the Arizona Department of Transportation as being a reasonable, and perhaps conservative, estimate of the number of vehicles registered as a result of this measure.

This measure was modeled by an adjustment of the weighting between I/M and non-I/M emission factors from MOBILE6. The number of vehicles registered in Maricopa County is during the time of the Task Force estimate was approximately 1.83 million. The inspection of an additional 41,000 vehicles would be an additional 2.0 percent of the vehicles being emissions tested. It is assumed that the increase in the vehicles being emission tested, taken as a fraction, would remain constant or increase over time. The number of vehicles which participate in the I/M program was increased by 2.0 percent for the 2008 analysis, changing the weighting from 89.6/10.4 to 91.6/8.4.

The anthropogenic emission reductions attributable to this attainment measure in 2008 are less than 0.1% for both NOx and VOC.

COMMITTED ATTAINMENT MEASURE #7

Maricopa County Rule 358:

Maricopa County adopted Rule 358 in October, 2006 to implement reasonably available control technology (RACT) for Solvent industries. The rule was approved into the SIP effective November 19, 1999 (64 FR 50759). The purpose of the rule is to limit the emissions of volatile organic compounds from the solvent industries.

This SIP approved measure is a RACT measure in the Serious Area Ozone Plan and a RACT and committed measure in the Maintenance Plan. Additional information on this measure can be found in the Serious Area Ozone Plan on page 2-4. Rule 358 has a control efficiency of 80% and rule effectiveness of 80% for SIC code 3086.

Since CNTLEM can not be run on point sources in EPS3.0, this measure was applied to the appropriate point sources/SCC codes in a spreadsheet and then entered into the 2008 point source emission inventory files (in EPS3.0 AFS format) and run through the EPS3.0 modeling chain.

The anthropogenic emission reduction attributable to this attainment measure in 2008 is 0.2% for VOC. This measure has no effect on NOx emissions.

APPENDIX V

WEIGHT OF EVIDENCE ANALYSIS

ENVIRON

MEMORANDUM

To: Cathy Arthur, MAG Associate
Taejoo Shin, MAG Air Quality Modeling Program Manager
Ieesuck Jung, MAG Air Quality Engineer

From: Chris Emery and Greg Yarwood

Date: 21 February 2007

Subject: Weight of Evidence Analysis to Support the Maricopa 8-Hour Ozone SIP

Introduction

This technical memorandum provides weight of evidence (WOE) support, based on analyses of available data and numerical grid modeling, of continuing ozone air quality improvement in the Maricopa Nonattainment Area (MNA) for 8-hour ozone. Analyses include ambient concentration trends, precursor emission trends, and ozone sensitivity to changes in NOx vs. VOC. These analyses support the numerical modeling demonstration that the MNA will attain the 8-hour ozone standard by the attainment year of 2009 given expected growth rates and current emission reduction programs.

Figure 1 shows the locations of the ambient monitoring sites within Marciopa County and relative to the boundaries of the MNA and the ozone modeling domain. Table 1 displays the site names and period of operation for ozone.

Concentration and Emission Trends

Eight-hour ozone air quality in the MNA is improving as a result of existing control measures. Despite a continuous increase in the population in Maricopa and Pinal counties (Figure 2) and increases in other factors such as vehicle miles traveled (Figure 3), the MNA is exhibiting decreasing trends for ozone and its precursors, NOx and VOC.

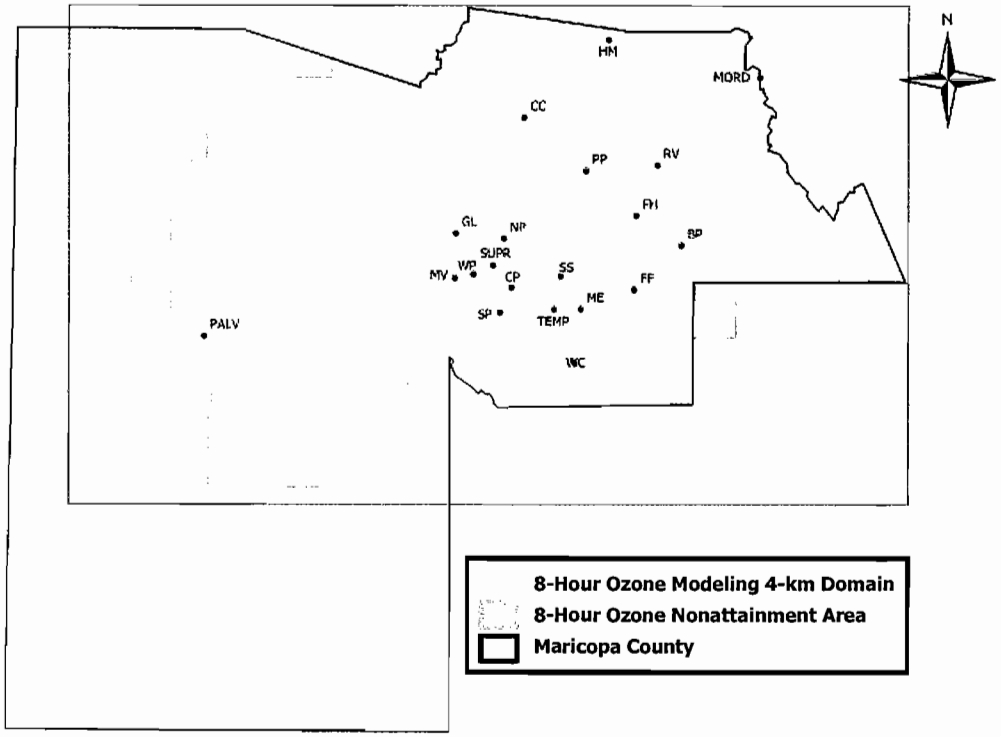

Figure 1. Locations of ambient monitoring sites within Marcopa County. See Table 1 for a description of sites.

Table 1. Ozone monitoring site names and period of operation.

Site Abbreviation	Site Name	Period of Operation
BP	Blue Point	1997 – present
CC	Cave Creek	2001 – present
CP	Central Phoenix	1994 – present
FF	Falcon Field	1997 – present
FH	Fountain Hills	1997 – present
GL	Glendale	1994 – present
HM	Humboldt Mtn.	1997 – present
ME	Mesa	1994 – 2002
MORD	Mt. Ord	1997 – 2001
MV	Maryvale	1997 – 2003
NP	North Phoenix	1994 – present
PALV	Palo Verde	1996 – 2004
PP	Pinnacle Peak	1994 – present
RV	Rio Verde	1997 – present
SP	South Phoenix	1999 – present
SS	South Scottsdale	1994 – present
SUPR	Supersite	1996 – present
TEMP	Tempe	2000 – present
WC	West Chandler	2000 – present
WP	West Phoenix	1994 – present

Appendix ✓

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thru
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anthropogenic NOx emissions decrease ~6% from 1999 to 2006, and ~18% from 1999 to 2015; total VOC emissions decrease ~9% from 1999 to 2006, and ~15% from 1999 to 2015.

The 1-hour ozone inventory trends are consistent with the 8-hour ozone inventory trends. Between 2002 and 2008, point and area NOx and VOC emissions are projected to continue to increase, but this growth is more than compensated by decreases in the on-road and nonroad categories. Total anthropogenic emissions are expected to decrease by 11% for NOx, and by 7% for VOC. This reduction represents a consistent continuation of the 1999-2006 emission reduction rates reported in the 1-hour ozone maintenance plan (MAG, 2004).

From a historical perspective, according to MAG (2005) VMT in the region has grown by 80% since 1990. To offset this growth, vehicle emissions would have had to decrease by about 44% between 1990 and 2005. According to the EPA's MOBILE6 model, VOC and NOx emissions have decreased by 68% and 48%, respectively, due to federal emission controls over this time. Hence, primarily Tier 1 controls have more than offset VMT growth in the region, and have contributed to reductions in ozone concentrations.

In the future, VMT is projected to grow by another 84% in the next 20 years. To offset this growth, 2005 vehicle emissions would need to decrease by:

- 12% by 2009 (8-hour ozone attainment year);
- 29% by 2015
- 46% by 2025

According to MOBILE6, more stringent federal emission standards for cars, trucks, and fuels will lead to VOC and NOx emissions reductions that are double the offsets listed above:

- 27% VOC, 32% NOx by 2009
- 52% VOC, 78% NOx by 2015
- 71% VOC, 84% NOx by 2025

Representation of VOC Speciation: Model vs. Observations

Accurate estimates of VOC and NOx emissions in both base and projection years are critically important for modeling the ozone response to growth and controls. Key factors include their temporal and spatial distribution, and the speciation of total VOC to the Carbon Bond compounds that represent the various classes of hydrocarbons that are active in the photochemical process. The quantity, timing, spatial pattern, and speciation of VOC emissions all influence how VOC generate radicals, which in turn ultimately determines the ozone production efficiency.

The characterization of VOC emissions in time and space is defined according to locally derived information such as source-specific activity profiles, and population, commercial/industrial, and vehicular distributions throughout the basin. MAG utilized many detailed and rigorous datasets

to define these distributions, and is thus confident in the resulting spatio-temporal mix of VOC and NOx within the MNA. However, VOC speciation remains an uncertain component given the variety of emission sources and fuel types, and the chemical complexities associated with the Carbon Bond mechanism. Inadequate allocation of VOC to higher reactivity CB4 compounds in particular, such as aromatics and aldehydes, might be a cause for insufficient sources of radicals in the model, and thus provides an uncertainty in the resulting effects of emission changes.

VOC speciation was checked against ambient samples collected at two Photochemical Assessment Monitoring System (PAMS) sites operating in the MNA. The longest-running and principal PAMS site (referred to as "Supersite") is located in central Phoenix. Given its proximity to several major freeways and major inner-city routes, VOC measurements at Supersite should be dominated by on-road motor vehicle emissions. For the local MNA modeling grid, MAG employed a set of speciation profiles for gasoline exhaust, running loss, and evaporative loss that were based on 1999 California Phase 2 reformulated gasoline (which is similar to the Federal Phase 2 gasoline currently used in Phoenix).

PAMS VOC measurements were processed into CB4 components. CAMx performance in replicating the speciated VOC concentrations at the PAMS Supersite for three measurement periods on June 7, 2002 are compared graphically in Figure 13. Comparing modeled and observed VOC during the early morning period (5-8 AM) is an important aspect of validating VOC speciation since the effect of daytime chemical destruction of fresh local emissions is not yet significant. In general we see very good agreement between the model and observed profiles for all times. The relative quantity of each of the CB4 species is consistent, even for the more reactive aromatic compounds (e.g., toluene and xylene). This analysis shows that the modeled VOC is accurately reproducing the compounds measured in central Phoenix.

Ozone Sensitivity to NOx vs. VOC

Evaluation of NOx-Disbenefit

MAG conducted some simple NOx and VOC reduction tests using the June 2008 CAMx modeling dataset following the EPA document, "Guidance on Limiting Nitrogen Oxides (NOx) Requirements Related to 8-Hour Ozone Implementation" (January 14, 2005). Following the recommendations set forth in Chapter 4 of EPA (2005), MAG compared three anthropogenic emission reduction scenarios: 40% cut in VOC, 40% cut in NOx, and 40% cut in VOCs plus NOx. According to these tests, reductions in NOx and VOC plus NOx increased ozone in the urbanized portion of the nonattainment area relative to 40% reductions in VOC alone, but not on the periphery of the nonattainment area. Further analysis revealed that the area in which ozone increased with the NOx reductions covers 90% of the 2008 population distribution.

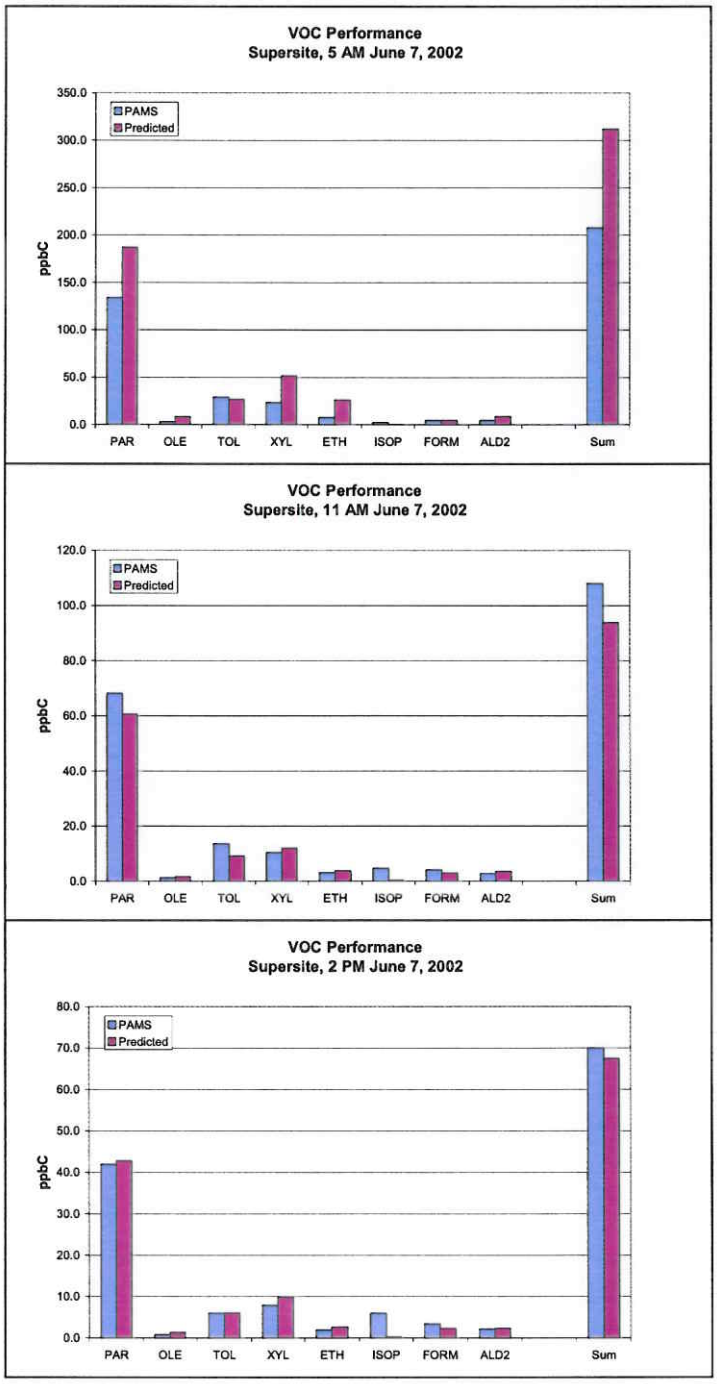


Figure 13. Comparison of measured and predicted CB4-speciated VOC for three sampling times on June 7, 2002 at the Supersite PAMS site.

Per EPA Region IX suggestion (Bohning, personal communication), MAG also ran a June 2008 NOx RACT scenario for peaking power plants in the MNA that would reduce point source NOx emissions by 50-70% and total NOx emissions by 8-10%. Again, ozone increased in the urbanized area of Phoenix and would expose 90% of the population in the nonattainment area to higher ozone levels. Peak 8-hour ozone concentrations at the North Phoenix monitor would increase by 0.7 – 0.9 ppb and cause the 2008 modeled peak concentration of 84.6 ppb to exceed the standard of 85 ppb. This would require a 16 – 20% decrease in total VOC emissions to offset the NOx RACT reductions.

VOC:NOx ratio

The ratio of total VOC to NOx is often referred to as a photochemical "indicator", meaning that it can indicate whether ozone formation is limited by the availability of NOx or VOC, and therefore it can help determine how ozone would respond to NOx and VOC reductions. VOC:NOx ratios of less than 5 or 6 indicate NOx-rich conditions and ozone formation is limited by the availability of VOC to initiate and propagate radicals. VOC:NOx ratios greater than about 12 indicate VOC-rich conditions and ozone formation is limited by the availability of NOx to generate ozone through photolysis of NO_2. Optimum ozone formation efficiency occurs between ratios of 7 to 10, wherein the effects of ozone chemical sinks are minimized.

Table 4 presents VOC, NOx, and VOC:NOx measurements for June 1 and 7, 2002 (the only days available in the PAMS database during the June 2002 episode), for three measurement periods: 5-8 AM, 11 AM - 2 PM, and 2-5 PM. Given the minimal measurement data available during this episode, it is important to gauge these results with some caution as they may not represent performance over the episode or basin as a whole.

Table 4. Measured total VOC, NOx, and VOC:NOx ratio at the Phoenix PAMS sites during the June 2002 modeling episode.

Site / VOC sample duration / date	VOC (ppbC)	NOx (ppb)	VOC:NOx
Super Site (3-hr) 6/7/2002 5:00:00 AM	208	49	4.3
Super Site (3-hr) 6/7/2002 11:00:00 AM	107	18	6.0
Super Site (3-hr) 6/7/2002 2:00:00 PM	69	8	8.7
Queen Valley (3-hr) 6/1/2002 5:00:00 AM	19	4	5.3
Queen Valley (3-hr) 6/1/2002 11:00:00 AM	15	3	5.6
Queen Valley (3-hr) 6/1/2002 2:00:00 PM	11	3	4.1
Queen Valley (3-hr) 6/7/2002 5:00:00 AM	19	3	5.6
Queen Valley (3-hr) 6/7/2002 11:00:00 AM	11	3	3.9
Queen Valley (3-hr) 6/7/2002 2:00:00 PM	10	3	3.8

Supersite shows that on June 7 the 5-8 AM VOC:NOx ratio is near 4, and then increases to about 8 into the early afternoon. The ratio for the earliest sample provides the best indication of the potential for generating ozone since the peak commute emissions are relatively fresh in the absence of active photochemistry. In this case then, conditions in central Phoenix during the commute hours indicate a NOx-rich and VOC-lean condition. The increase in VOC:NOx later into the day shows the disproportional reduction in NOx due to reduced mobile emissions and increased photochemical activity. At the Queen Valley PAMS site east of Phoenix, observed VOC:NOx remains consistently in the 3-5 range, again suggesting rather NOx-rich conditions even in this more suburban environment.

Process Analysis

CAMx includes several "Process Analysis" (PA) tools that may be used to understand more about the physical and chemical process being simulated within the model. The goal of process analysis is to explain "how the model got the answer it got." MAG performed a CAMx Chemical Process Analysis (CPA) application for the June 2002 episode using base year anthropogenic emission inputs and biogenic emissions derived from the GloBEIS model. The CPA tool was applied over the entire 4-km modeling grid to reveal important chemical signals within the Phoenix urban plume. A review of the PA/CPA results revealed important chemistry information:

1. The urban "plume" downwind of Phoenix is VOC-limited – according to the fact that the indicator ratio of peroxide produced to nitric acid produced is less than 0.35, and that the nitric acid produced from OH reacting with NO_2 is about half of the total HOx reacted.
2. Biogenic VOC makes little contribution in the VOC-limited urban area – according to the fact that the ratio of OH reacted with isoprene to OH reacted with all organic compounds approaches zero within the urban plume.
3. Ozone production in the urban plume would respond to greater radical production – according to the fact that more than 50% of the new OH comes from ozone photolysis within the urban plume (an ozone sink) as opposed to VOC.

MAG also used the CPA tool to investigate the impact of using an alternative biogenic emissions inventory. The MEGAN biogenic emission inventory was developed using a model that reflects current understanding of processes controlling biogenic emissions, supported by Phoenix-specific landcover and emission factor data gathered in a 2006 field study (Mansell et al., 2006). In contrast, the GloBEIS biogenic emission inventory was developed using a predecessor model to MEGAN with national-level landcover and emission factor data. The biogenic VOC emissions from MEGAN are generally lower than from GloBEIS, especially in the urban/suburban areas of Phoenix.

A series of plots (Figure 15) compares CPA results for the CAMx simulations with alternate biogenic emissions. The figures show noon on the last day of the simulation (June 7) when there was an organized urban plume extending to the northwest of Phoenix. Other episode days showed qualitatively similar CPA results. The interpretation of Figure 15 is presented in Table

5.

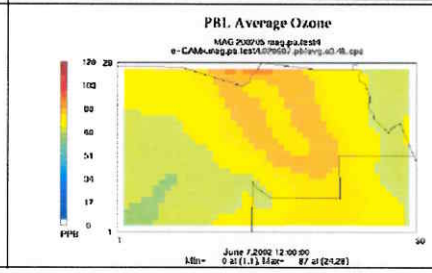
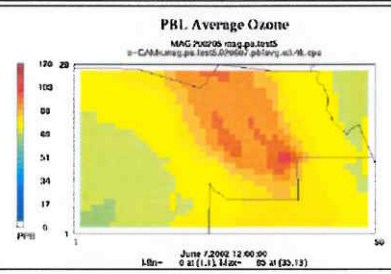
Date	MEGAN	GloBEIS
6/7/2002		

Figure 14(a). Ozone (ppb) averaged through the PBL depth at noon on June 7, 2002 with biogenic VOC emissions estimated by MEGAN and GloBEIS.

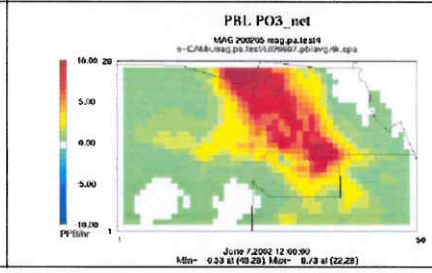
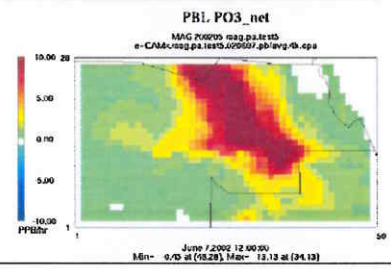
Date	MEGAN	GloBEIS
6/7/2002		

Figure 14(b). Ozone production rate (ppb/hr) averaged through the PBL depth at noon on June 7, 2002.

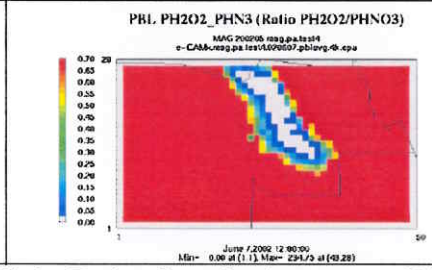
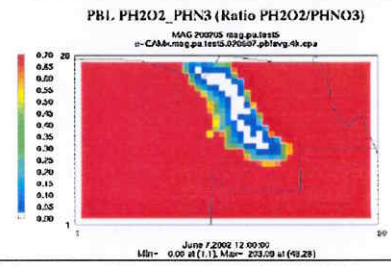
Date	MEGAN	GloBEIS
6/7/2002		

Figure 14(c). Ratio of production rates of H_2O_2 to HNO_3 used to distinguish VOC-sensitive (gray-blue) from NOx-sensitive (red-green) areas at noon on June 7, 2002.

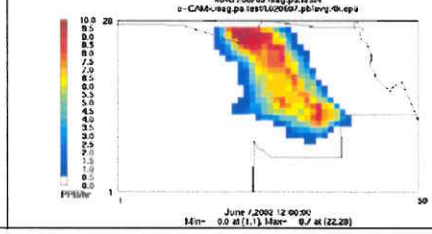
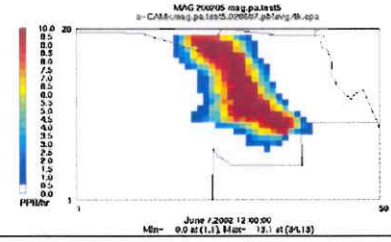
Date	MEGAN	GloBEIS
6/7/2002		

Figure 14(d). Ozone production rate (ppb/hr) in areas determined to be VOC-sensitive

(see Figure 15c) at noon on June 7, 2002.

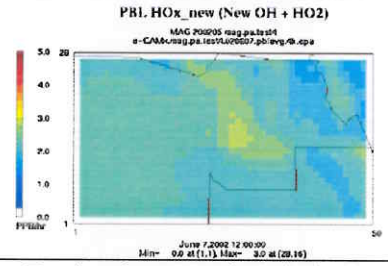
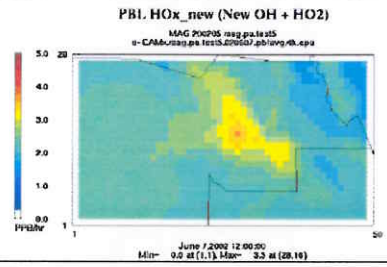
Date	MEGAN	GloBEIS
6/7/2002		

Figure 14(e). Production rate (ppb/hr) of new HOx (= OH + HO_2) radicals at noon on June 7, 2002.

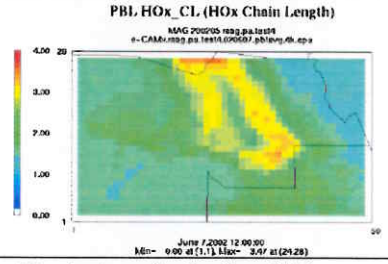
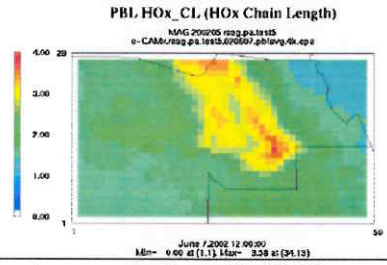
Date	MEGAN	GloBEIS
6/7/2002		

Figure 14(f). Chain length for the HOx reaction cycle at noon on June 7, 2002.

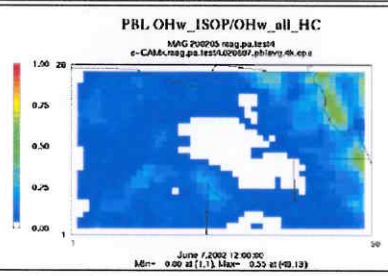
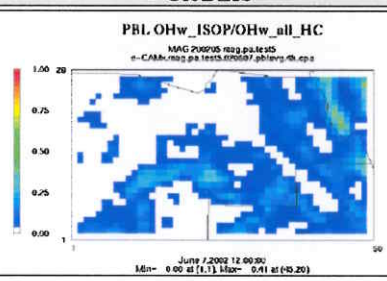
Date	MEGAN	GloBEIS
6/7/2002		

Figure 14(g). Fractional contribution of isoprene to reaction of OH radicals with VOCs at noon on June 7, 2002.

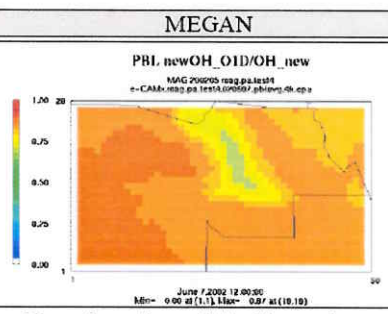
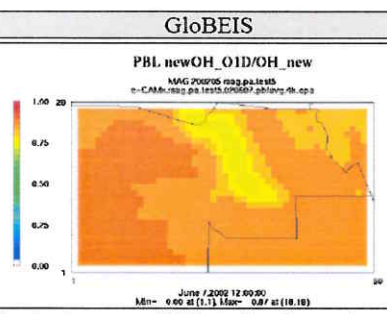
Date	MEGAN	GloBEIS
6/7/2002		

Figure 14(h). Fractional contribution of ozone photolysis to new OH radical production at noon on June 7, 2002.

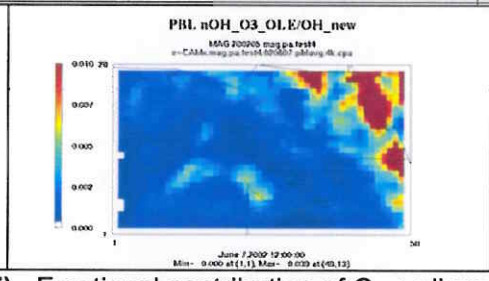
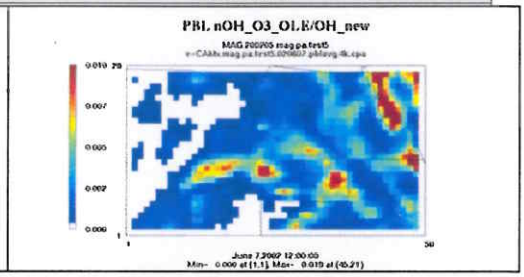
Date	MEGAN	GloBEIS
6/7/2002		

Figure 14(i). Fractional contribution of O_3 + alkene reactions to new OH radical production at noon on June 7, 2002.

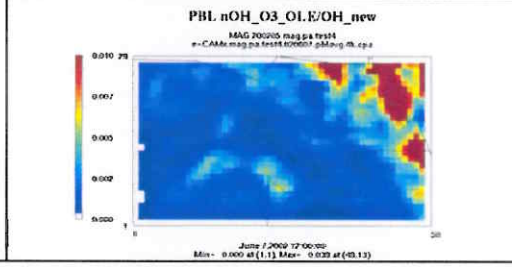
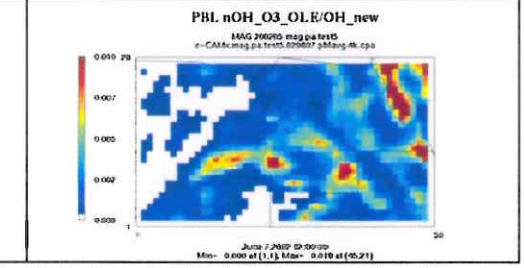
Date	MEGAN	GloBEIS
6/7/2002		

Figure 14(j). Fractional contribution of HONO photolysis to new OH radical production at noon on June 7, 2002.

Table 5. Summary of CPA results from Figure 14 and their interpretation for noon on June 7, 2002.

Figure	Showing	Interpretation
a	Ozone concentration (ppb)	• An ozone plume extends northwest of Phoenix and ozone concentrations are lower with MEGAN than GloBEIS biogenic emissions.
b	Ozone production rate (ppb/hr)	• Ozone production rates are much higher inside than outside the urban plume. • The rate of ozone production in the urban plume is faster with GloBEIS than MEGAN, explaining Figure a.
c	Areas of VOC-sensitive and NOx-sensitive ozone production	• The core of the Phoenix urban plume is determined to be VOC sensitive. • The edges of the plume transition to NOx-sensitive. • Changing the biogenic emission inventory does not alter this pattern.
d	Ozone production rate (ppb/hr) in VOC-sensitive areas	• This figure combines Figures b and c to show that the most rapid ozone production occurs in the VOC-sensitive core of the Phoenix plume. • Adding VOCs to the VOC-sensitive core of the Phoenix urban plume can be expected to increase the ozone production rate.
e	Production rate of "new HOx radicals" HOx = OH + HO_2	• It can be useful to consider the sum of OH and HO_2 radicals (called HOx) because they can be inter-converted rapidly. • The production rate of "new HOx radicals" is important because OH initiates reactions of VOCs and NOx, whereas HO_2 radicals can cause O_3 production. • New HOx production in the Phoenix urban plume is more intense with biogenic emissions from GloBEIS than MEGAN. • Higher HOx production leads to both faster ozone production and faster VOC reaction.
f	HOx chain length	• OH and HO_2 radicals can be inter-converted rapidly. The average number of conversion cycles (e.g., OH converted to HO_2 and then back to OH) can be called the chain length. • The total amount of HOx reacting equals the HOx chain length multiplied by the rate of new HOx production. • The HOx chain length is longer at the edges of the Phoenix urban plume (about 3 - 4) than in the plume center (about 2 - 3). This is an indication that the rate of ozone production in the plume center could increase with more new radical production.
g	Fractional contribution of isoprene to reaction of OH radicals with VOCs	• Only a small fraction of OH radicals reacting with VOCs in the Phoenix urban plume are reacting with (biogenic) isoprene. This fraction is low with GloBEIS biogenic emissions and almost zero with MEGAN biogenic emissions. • Biogenic VOCs other than isoprene (i.e., terpenes and other VOCs) may be driving the impact of biogenic emissions on ozone production in Phoenix.
h - j	Fractional contributions of ozone photolysis and O_3 + alkene reactions to	• Sources of "new OH radicals" are important because they initiate reactions of VOCs and NOx. • Throughout most of the 4-km grid ozone photolysis ($O_3 + h\nu \rightarrow O(^1D) + H_2O \rightarrow 2\ OH$) is the dominant source (70-90%)

Figure	Showing	Interpretation
	sources of "new OH radicals"	of the new OH radicals. This result is typical. • The contribution of O_3 photolysis to new OH is lower in the Phoenix urban plume where there are other sources of new OH such as HONO photolysis and O_3 + alkene reactions. • Compared to GloBEIS, the MEGAN biogenic emissions decrease the contribution of O_3 + alkene reactions to new OH in the Phoenix urban plume.

The findings from our analysis of MAG's CPA results are as follows:

- The regions of greatest ozone production in Phoenix urban plume are VOC-sensitive. Changing between biogenic emissions estimated with MEGAN and GloBEIS does not alter this finding.
- Ozone production is slower in the Phoenix urban plume with MEGAN than GloBEIS because MEGAN estimates lower biogenic emission than GloBEIS in the Phoenix urban/suburban area.
- Ozone production in the Phoenix urban plume is sensitive to the strength of radical sources (such as photolysis of ozone, formaldehyde or nitrous acid). Any potential biases in the radical source strength should be investigated. Radical production could be biased low for the following hypothetical reasons:
  - Low water vapor concentration (a dry bias) due either to a systematic bias in MM5 or failure to account for impacts of irrigation and other forms of open water use in the urban area (i.e., lack of an desert urban "humidity island").
  - Low fraction of aldehydes in VOC speciation profiles (comparisons to date do not support this hypothesis, as described earlier).
  - Low concentration of nitrous acid (HONO) due to an incorrect emissions speciation for NOx, or a missing chemical reaction that produces HONO (possibly a heterogeneous reaction).
- The contribution of urban biogenic emissions to ozone formation in Phoenix is not dominated by isoprene and may depend on other VOCs and terpenes. The CB05 chemical mechanism has improvements that treat OVOC and terpene emissions better than CB4; for this and other technical reasons, MAG adopted the use of the CB05 mechanism in CAMx[1] for their modeling support of the 8-hour ozone SIP.

Observed Weekday-Weekend Effects

Given the good quantity of VOC data over the summer of 2002, we were able to identify any signals of weekday/weekend effects on precursor emission rates. As with other large urban areas, this signal is caused by the reduced traffic volumes on weekend days, and hence less NOx relative to VOC. Given the PA results described above, we might expect one implication of this

[1] EPA is switching to CB05 in the next CMAQ release and disregarding CB4 altogether. CB05 results in similar urban ozone effects as SAPRC99, including higher ozone production in NOx-rich conditions, but CB05 is much easier to implement and more consistent with MAG's work to date.

trend to be a type of natural analogue to the NOx-disbenefit signal. We can check this as a change in photochemical efficiency as metered by the VOC:NOx ratio.

Table 6 presents results from the 2002 summer-season evaluation of VOC, NOx, and VOC:NOx ratio from the PAMS Supersite. Measurement data were taken from the 5 AM samples, and hourly NOx was averaged over the same 5-8 AM period to calculate the VOC:NOx ratio. Included in the table are breakdowns for weekday averages and weekend averages. As is typical of large urban areas that are dominated by motor vehicle emissions, the central Phoenix data yield a fairly solid weekend-weekday signal in the VOC and NOx emissions. Weekday chemistry can be characterized as slightly NOx-rich and VOC-limited, while weekend chemistry is more balanced and close to an optimum mix for efficient ozone production (VOC:NOx ratio around 10).

Table 6. Summer-season average weekend and weekday VOC, NOx, and VOC:NOx ratio calculated from 2002 PAMS Supersite data.

	Weekdays	Weekends
VOC (ppbC)	273	251
NOx (ppb)	49	26
VOC:NOx	5.9	9.6

Since our weekday-weekend analysis focused on conditions during the summer of 2002, it may not be particularly relevant in evaluating long-term conditions or trends. Furthermore, given the small sample size of high ozone days during the summer of 2002, and commensurately less high ozone days during the weekends, a review of peak 8-hour ozone on 2002 weekday vs. weekends would not yield meaningful results. A long-term weekday-weekend ozone analyses for Phoenix is addressed by Blanchard and Tanenbaum (2005) in their report for the National Renewable Energy Laboratory (NREL). Blanchard and Tanenbaum (hereafter referred to as TB05) reviewed ambient concentration data during the period 1998-2003 for several cities in the U.S. We have extracted their results from Phoenix for this report.

Figure 15 (TB05) shows the Wednesday to Sunday difference in peak 8-hour ozone averaged over all days in the dataset (March – October 1998-2003) and averaged over just high ozone days. The figures present the differences as percent of weekday average. The Sunday average peak ozone is up to 20% higher over all days, and up to 10% higher on high ozone days. Note that some ozone reductions are seen at the outermost rural sites on the highest ozone days, a result that is very parallel to MAG's 40% across-the-board NOx and NOx RACT reduction tests. TB05 long-term analysis results support the CAMx simulation results that indicate that additional NOx controls will tend to increase ozone in the most populated areas of the domain.

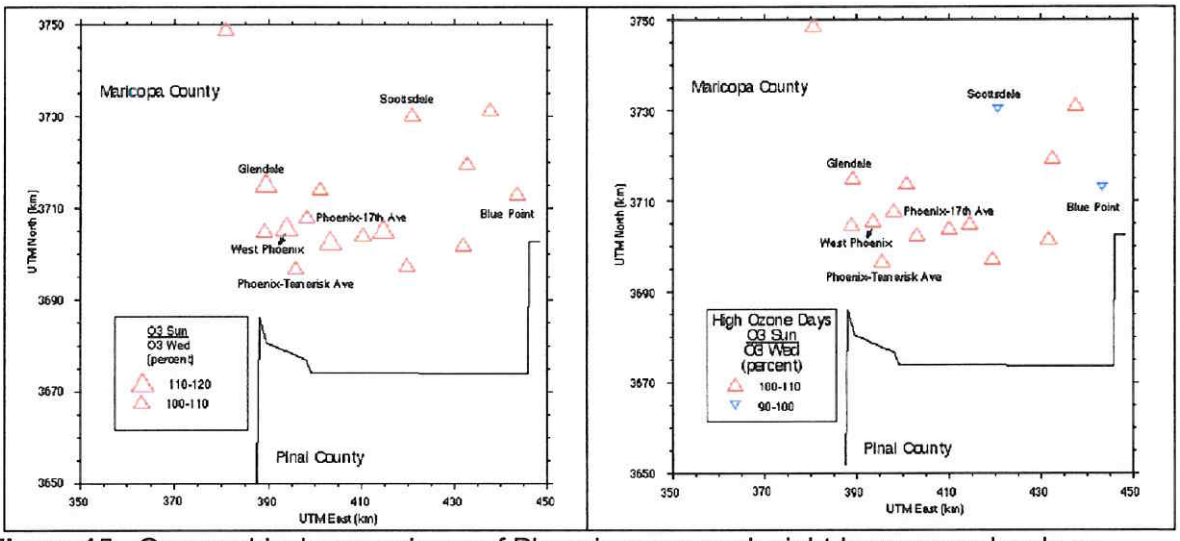


Figure 15. Geographical comparisons of Phoenix mean peak eight-hour ozone levels on Wednesdays and Sundays, March-October 1998-2003. Left plot indicates ozone response for all days, right plot indicates ozone response for high-ozone days (top three peak 8-hour ozone days per day of week per year).

Figure 16 (TB05) displays day-of-week average peak ozone and daytime NOx concentrations from the same data period. NOx at urban sites clearly show the weekend signal due to reduced traffic volume. However, the average peak ozone on high ozone days suggests just 1 or 2 ppb increase on Sundays. While this suggests that the weekday-weekend effect is not particularly large, the magnitude of the signal is in line with modeling results conducted by MAG.

Figure 17 provides an indication of the change in ozone production efficiency from the TB05 analyses. Both plots in the Figure exhibit classic signs of NOx-rich, VOC-limited responses to reduced weekend NOx emissions. Ozone cannot accumulate when NO levels are high (since ozone and NO react), so an indicator of when ozone begins accumulating is the time when ozone concentrations first exceed NO levels (Fujita et al., 2003a). Comparisons of ozone and NO levels indicate that ozone began accumulating approximately 1 to 2 hours earlier on weekend days than on Wednesdays (left plot of Figure 17), which would be expected if weekday NOx levels were limiting ozone production. Furthermore, the amount of ozone formed locally per unit NOx increased by as much as 50% on Sundays (right plot of Figure 17). In both figures, the Wednesday commute period is readily obvious, and a more rapid weekend rise in ozone indicates a higher production efficiency. Therefore, local ozone formation was inhibited, and not limited, by the availability of NOx on weekdays.

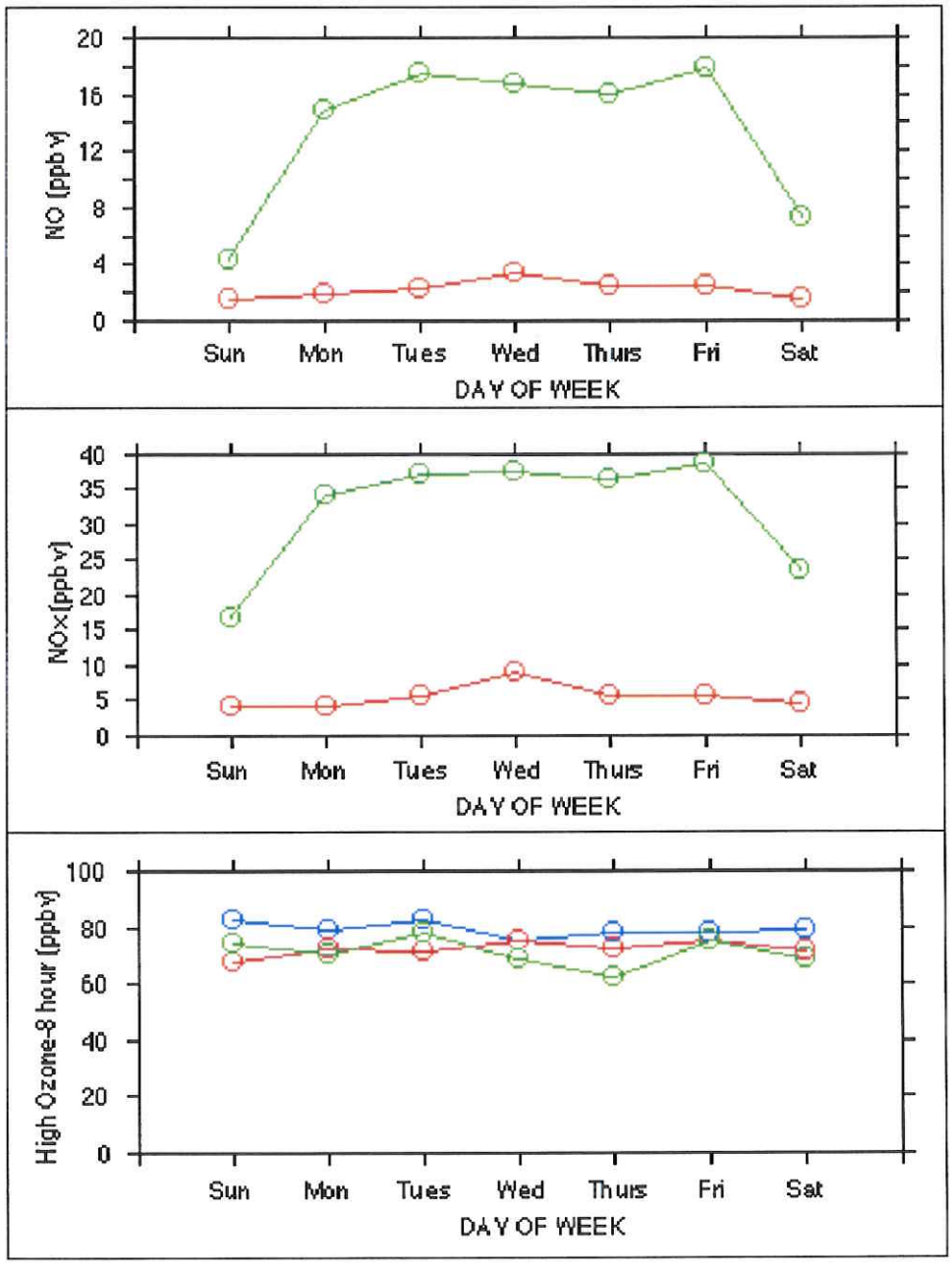


Figure 16. Mean day-of-week peak 8-hour ozone and daytime NO and NOx concentrations at sites upwind (red), within (green), and downwind (blue) of Phoenix.

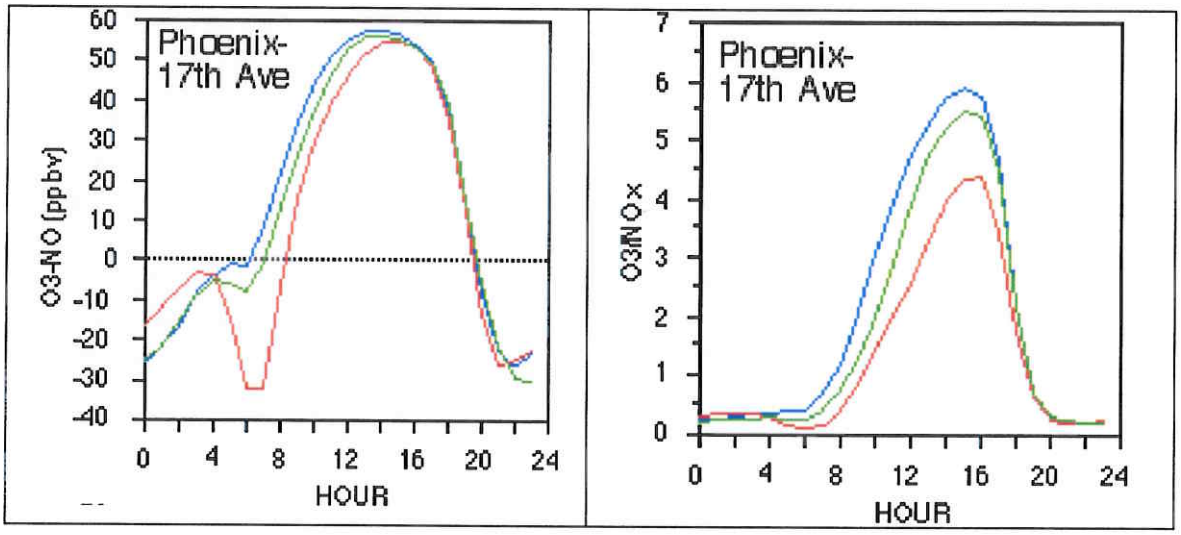


Figure 17. Diurnally-averaged concentrations of the O3–NO difference (left) and the O3/NOx ratio (right) from March-October of 1998-2003, for Sundays (blue), Saturdays (green), and Wednesdays (red).

Summary

The observational and modeling analyses presented in this report provide weight of evidence support of continuing ozone air quality improvement in the MNA. Eight-hour ozone air quality in the MNA is improving as a result of existing control measures for NOx and VOC, despite a large and continuous increase in the local population and associated activity factors (e.g., vehicle miles traveled). The weight of evidence analyses support the numerical modeling demonstration that the MNA will attain the 8-hour ozone standard by the attainment year of 2009 with current emission reduction programs and existing assumptions for population growth and economic development.

The weight of evidence analyses considered include ambient ozone and NOx concentration trends, precursor emission trends, and ozone sensitivity to changes in NOx vs. VOC. The following conclusions are drawn:

- The MNA is exhibiting downward trends in ozone using several metrics, namely the number of annual violations of the 8-hour standard, the basinwide 8-hour ozone Design Value, and the basinwide annual 4th highest 8-hour ozone concentration;
- The largest ozone reductions have occurred for urban sites;
- Weaker ozone reductions are apparent for rural sites downwind of metropolitan area of the MNA, which could indicate a shift in peak ozone to farther distances downwind;
- Background ozone levels at upwind sites during high ozone events in Phoenix (e.g., Palo Verde in the MNA and the Chiricahua National Monument CASTNET site) consistently show regional ozone levels in the 60-70 ppb ranges, which suggests that locally produced ozone levels have decreased by as much as 40-60% over background levels in the past

decade;

- The MNA is exhibiting large reductions in ozone precursor (NOx and VOC) emissions:
    - Historically, mobile-source controls have more than offset VMT growth in the region and have contributed to reductions in ozone precursor concentrations;
    - In the future, VMT is projected to grow by 84% in the next 20 years but increasingly stringent federal emission standards for vehicles and fuels will lead to VOC and NOx emissions reductions that are about double the needed offsets to maintain the ozone standard;
- Comparison of modeled and measured VOC composition (i.e., PAMS measurements) shows that the model is accurately reproducing VOC composition in central Phoenix. This finding builds confidence in the ability of the photochemical model to characterize ozone photochemistry in Phoenix;
- Analysis of measured VOC:NOx ratio during the summer of 2002, along with Process Analysis modeling results, clearly indicate that the Phoenix urban core is NOx-rich and ozone formation is VOC-limited. These findings suggest a NOx-inhibition effect on ozone formation that is consistent with observational evidence that:
    - Peak ozone is now occurring farther downwind than in years past;
    - Lower weekend NOx results in higher weekend ozone;
- Independent weekday-weekend observational analyses (Blanchard and Tanenbaum, 2005) for Phoenix also support the notion that reduced NOx on weekend days due to the lack of a commute (a natural analog to NOx reduction sensitivity) may lead to slightly higher ozone concentrations on the order of 1-2 ppb on high ozone days.
- Observational and modeling evidence for a NOx-inhibition effect on ozone suggest that further NOx emission reductions without attendant VOC reductions may hinder progress toward attaining the 8-hour ozone standard.

References

Blanchard, C.L., S. Tanenbaum. 2005. "Final Report: Weekday/Weekend Differences in Ambient Concentrations of Primary and Secondary Air Pollutants in Atlanta, Baltimore, Chicago, Dallas-Fort Worth, Denver, Houston, New York, Phoenix, Washington, and Surrounding Areas." Prepared for the National Renewable Energy Laboratory, by ENVAIR, Albany, CA. (NREL Project ES04-1, NREL Subcontract No. LDX-4-44213-01, July 30, 2005).

EPA. 2005. "Guidance on Limiting Nitrogen Oxides (NOx) Requirements Related to 8-Hour Ozone Implementation." Prepared by the Air Quality and Standards Division, Office of Air Quality Planning and Standards, Research Triangle Park, NC (January 14, 2005).

Fujita, E.M., W.R. Stockwell, D.E. Campbell, R.E. Keislar, and D.R. Lawson. 2003. "Evolution of the magnitude and spatial extent of the weekend ozone effect in California's South Coast Air Basin." *J. Air Waste Manage. Assoc.*, **53**, 802-815.

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Mansell, G., G. Yarwood, A. Gunther, C. Wiedinmyer. 2006. "Maricopa Association of Governments: 2006 Biogenics Study." Prepared for the Maricopa Association of Governments, Phoenix, AZ, by ENVIRON International Corporation, Novato, CA (September 1, 2006).

EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

APPENDIX B

JUNE 2007

MARICOPA ASSOCIATION of GOVERNMENTS

EIGHT-HOUR OZONE PLAN
FOR THE MARICOPA NONATTAINMENT AREA

APPENDIX B

EXHIBIT 1

PUBLIC HEARING PROCESS DOCUMENTATION

CERTIFICATION OF HOLDING OF PUBLIC HEARING ON THE MAG EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

I affirm that a public hearing was held jointly by the Arizona Department of Environmental Quality and the Maricopa Association of Governments (MAG) starting at 5:30 p.m. Friday, June 1, 2007 at the MAG Offices, Saguaro Room, 302 North 1st Avenue, Phoenix, Arizona and that the hearing was held in accordance with the Arizona open meeting laws and 40 CFR 51.102 (d) to receive public comment on the MAG Eight-Hour Ozone Plan for the Maricopa Nonattainment Area.

June 4, 2007
Date

Lindy Bauer
Lindy Bauer, MAG
Environmental Director

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

Personally appeared before me the above-named Lindy Bauer known to me to be the same person who executed the foregoing instrument and to be the Environmental Director for the Maricopa Association of Governments and acknowledged to me that she executed the same as her free act.

SUBSCRIBED AND SWORN TO before me on this 4th day of June 2007.

Valerie Day
Notary Public

My Commission Expires:
August 16, 2008

OFFICIAL SEAL
VALERIE DAY
NOTARY PUBLIC-ARIZONA
MARICOPA COUNTY
My Comm. Expires Aug. 16, 2008

CERTIFICATION OF HOLDING OF PUBLIC HEARING ON THE MAG EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

I affirm that a public hearing was held jointly by the Arizona Department of Environmental Quality and the Maricopa Association of Governments (MAG) starting at 5:30 p.m. Monday, June 4, 2007 at the MAG Offices, Saguaro Room, 302 North 1st Avenue, Phoenix, Arizona and that the hearing was held in accordance with the Arizona open meeting laws and 40 CFR 51.102 (d) to receive public comment on the MAG Eight-Hour Ozone Plan for the Maricopa Nonattainment Area.

6/4/07
Date

Joe Gibbs, City of Phoenix
Member of the MAG Air Quality Technical
Advisory Committee/Hearing Officer

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

Personally appeared before me the above-named Joe Gibbs known to me to be the same person who executed the foregoing instrument and to be the City of Phoenix representative on the Maricopa Association of Governments Air Quality Technical Advisory Committee and acknowledged to me that he executed the same as his free act.

SUBSCRIBED AND SWORN TO before me on this 4th day of June 2007.

Valerie Day
Notary Public

OFFICIAL SEAL
VALERIE DAY
NOTARY PUBLIC-ARIZONA
MARICOPA COUNTY
My Comm. Expires Aug. 16, 2008

My Commission Expires:
August 16, 2008

PUBLIC HEARING ON THE EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

June 1, 2007 - 5:30 p.m.
MAG Offices, Saguaro Room
302 North 1st Avenue, Second Floor
Phoenix, Arizona 85003

The Arizona Department of Environmental Quality (ADEQ) and Maricopa Association of Governments (MAG) will jointly conduct a public hearing on the Draft Eight-Hour Ozone Plan for the Maricopa Nonattainment Area. The purpose of the hearing is to receive public comments.

According to the federal Clean Air Act, an eight-hour ozone plan is required to be submitted to the U.S. Environmental Protection Agency. The plan contains a variety of air pollution control measures such as summer reformulated gasoline, vehicle emissions testing, traffic signal coordination, intelligent transportation systems, and a County rule for polystyrene foam operations. The plan demonstrates attainment of the eight-hour ozone standard by June 15, 2009 with federal, state, and local control measures that have already been implemented in the Maricopa nonattainment area.

The draft document is available for review at the MAG Offices, third floor, from 8:00 a.m. to 5:00 p.m. Monday through Friday. Public comments are welcome at the hearing, or may be submitted in writing by 5:30 p.m. on June 1, 2007 to Lindy Bauer at the address below. After considering the public comments, the MAG Regional Council Executive Committee may take action on the plan on June 11, 2007. The ADEQ may then adopt the plan for submittal to the EPA.

Contact Person: Lindy Bauer, MAG (602) 254-6300
302 North 1st Avenue, Suite 300
Phoenix, AZ 85003
Fax: (602) 254-6490
Published: May 3, 2007

AFFIDAVIT OF PUBLICATION

THE ARIZONA REPUBLIC

STATE OF ARIZONA
COUNTY OF MARICOPA } SS.

Robert Lane, being first duly sworn, upon oath deposes and says: That he is a legal advertising representative of the Arizona Business Gazette, a newspaper of general circulation in the county of Maricopa, State of Arizona, published at Phoenix, Arizona, by Phoenix Newspapers Inc., which also publishes The Arizona Republic, and that the copy hereto attached is a true copy of the advertisement published in the said paper on the dates as indicated.

The Arizona Republic

May 3, 2007

Sworn to before me this
3RD day of
May A.D. 2007

OFFICIAL SEAL
MARILYN GREENWOOD
NOTARY PUBLIC-ARIZONA
MARICOPA COUNTY
My Comm. Expires May 23, 2007

Notary Public

AFFIDAVIT OF PUBLICATION

THE ARIZONA REPUBLIC

STATE OF ARIZONA
COUNTY OF MARICOPA } SS.

Marilyn Greenwood, being first duly sworn, upon oath deposes and says: That she is a legal advertising representative of the Arizona Business Gazette, a newspaper of general circulation in the county of Maricopa, State of Arizona, published at Phoenix, Arizona, by Phoenix Newspapers Inc., which also publishes The Arizona Republic, and that the copy hereto attached is a true copy of the advertisement published in the said paper on the dates as indicated.

The Arizona Republic

May 6, 2007

PUBLIC HEARINGS ON THE EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

June 1, 2007 - 5:30 p.m.
June 4, 2007 - 5:30 p.m.
MAG Offices, Saguaro Room
302 North 1st Avenue, Second Floor, Phoenix, Arizona 85003

The Arizona Department of Environmental Quality (ADEQ) and Maricopa Association of Governments (MAG) will jointly conduct two public hearings on the Draft Eight-Hour Ozone Plan for the Maricopa Nonattainment Area on June 1 and June 4, 2007, at 5:30 p.m. The purpose of these hearings is to receive public comments.

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Contact Person: Lindy Bauer, MAG (602) 254-6300
302 N. 1st Avenue, Suite 300
Phoenix, AZ 85003
Fax: (602) 254-6490
Published May 6, 2007

Sworn to before me this
9TH day of
May A.D. 2007

Notary Public - Arizona
Maricopa County
My Comm. Expires Aug 3, 2010

Notary Public

MARICOPA ASSOCIATION of GOVERNMENTS
302 North 1st Avenue, Suite 300 • Phoenix, Arizona 85003
Phone (602) 254-6300 • FAX (602) 254-6490
E-mail: mag@mag.maricopa.gov • Web site: www.mag.maricopa.gov

May 4, 2007

TO: Interested Parties for Air Quality

FROM: Lindy Bauer, Environmental Director

SUBJECT: PUBLIC HEARINGS ON THE EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

Public Hearings
June 1, 2007 at 5:30 p.m.
June 4, 2007 at 5:30 p.m.
MAG Offices, Saguaro Room
302 North 1st Avenue, Second Floor
Phoenix, Arizona 85003

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For your information and convenience, a copy of the public hearing notice is enclosed. The document is available for agency and public review on the MAG website at www.mag.maricopa.gov. In addition, the draft document is available for review at the MAG Offices, third floor, from 8:00 a.m. to 5:00 p.m. Monday through Friday.

Attachment

PUBLIC HEARINGS ON THE EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

June 1, 2007 - 5:30 p.m.
June 4, 2007 - 5:30 p.m.
MAG Offices, Saguaro Room
302 North 1st Avenue, Second Floor
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The draft document is available for review at the MAG Offices, third floor, from 8:00 a.m. to 5:00 p.m. Monday through Friday. Public comments are welcome at these hearings, or may be submitted in writing by 5:30 p.m. on June 4, 2007 to Lindy Bauer at the address below. After considering the public comments, the MAG Regional Council Executive Committee may take action on the plan on June 11, 2007. The ADEQ may then adopt the plan for submittal to the EPA.

Contact Person: Lindy Bauer, MAG (602) 254-6300
302 N. 1st Avenue, Suite 300
Phoenix, AZ 85003
Fax: (602) 254-6490

TITLE VI
LETTER EXAMPLE

MARICOPA ASSOCIATION of GOVERNMENTS

302 North 1st Avenue, Suite 300 • Phoenix, Arizona 85003
Phone (602) 254-6300 • FAX (602) 254-6490
E-mail: mag@mag.maricopa.gov • Web site: www.mag.maricopa.gov

May 7, 2007

Ms. Dara Johnson
Acting Executive Director
Governor's Council on Developmental Disabilities
3839 North 3rd Street, Suite 306
Phoenix, Arizona 85012

Dear Ms. Johnson:

You are cordially invited to public hearings on the Draft Eight-Hour Ozone Plan for the Maricopa Nonattainment Area. The hearings will be held jointly by the Arizona Department of Environmental Quality and Maricopa Association of Governments on Friday, June 1, 2007 and Monday, June 4, 2007 at 5:30 p.m. in the Saguaro Room at the MAG Offices, 302 North 1st Avenue, Second Floor, Phoenix, Arizona, 85003. The purpose of the hearing is to discuss the draft document and receive comments. Written and verbal comments are welcomed at the public hearing. After considering the public comments, the MAG Regional Council Executive Committee may take action on the plan on June 11, 2007.

According to the federal Clean Air Act, an eight-hour ozone plan is required to be submitted to the U.S. Environmental Protection Agency. The plan contains a variety of air pollution control measures such as summer reformulated gasoline, vehicle emissions testing, traffic signal coordination, intelligent transportation systems, and a County rule for polystyrene foam operations. The plan demonstrates attainment of the eight-hour ozone standard by June 15, 2009 with federal, state, and local control measures that have already been implemented in the Maricopa nonattainment area.

The draft document is available for review at the MAG Offices, third floor, from 8:00 a.m. to 5:00 p.m., Monday through Friday. The document is available for agency and public review on the MAG website at www.mag.maricopa.gov/detail.cms?item=7377. We hope to see you or your representative at the hearing and to include your input in future planning efforts. For your convenience, a copy of the public hearing notice is attached. If you have any questions or would like to set up a time for us to meet with your organization, please call me at (602) 254-6300.

Sincerely,

Lindy Bauer

Lindy Bauer
Environmental Director

Attachment

PUBLIC HEARINGS ON THE EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

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Phoenix, Arizona 85003

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MARICOPA ASSOCIATION of GOVERNMENTS

302 North 1st Avenue, Suite 300 ▲ Phoenix, Arizona 85003
Phone (602) 254-6300 ▲ FAX (602) 254-6490
E-mail: mag@mag.maricopa.gov ▲ Web site: www.mag.maricopa.gov

May 4, 2007

TO: Leslie Rogers, Federal Transit Administration
Robert Hollis, Federal Highway Administration
Victor Mendez, Arizona Department of Transportation
Stephen Owens, Arizona Department of Environmental Quality
Dave Boggs, Regional Public Transportation Authority
Debbie Cotton, City of Phoenix Public Transit Department
Robert Kard, Maricopa County Air Quality Department
Maxine Leather, Central Arizona Association of Governments
Don Gabrielson, Pinal County Air Quality Control District
Wienke Tax, U. S. Environmental Protection Agency, Region IX

FROM: Lindy Bauer, Environmental Director

SUBJECT: TRANSMITTAL OF THE DRAFT EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

The Maricopa Association of Governments has prepared a Draft Eight-Hour Ozone Plan for the Maricopa Nonattainment Area. The document is available for agency and public review on the MAG website at www.mag.maricopa.gov/detail.cms?item=7377. In addition, the draft document is available for review at the MAG Offices, third floor, from 8:00 a.m. to 5:00 p.m. Monday through Friday. Any comments are requested by 5:30 p.m. on June 4, 2007.

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On June 1 and June 4, 2007, public hearings will be conducted jointly by the Arizona Department of Environmental Quality and MAG at the MAG Offices, Saguaro Room, Second Floor, Phoenix, Arizona at 5:30 p.m. After considering public comments, the MAG Regional Council Executive Committee may take action on the plan on June 11, 2007. If you have any questions, please do not hesitate to contact me at (602) 254-6300.

cc: Nancy Wrona, Arizona Department of Environmental Quality

MARICOPA ASSOCIATION of GOVERNMENTS
302 North 1st Avenue, Suite 300 • Phoenix, Arizona 85003
Phone (602) 254-6300 • FAX (602) 254-6490
E-mail: mag@mag.maricopa.gov • Web site: www.mag.maricopa.gov

May 4, 2007

TO: Interested Parties for Air Quality

FROM: Lindy Bauer, Environmental Director

SUBJECT: PUBLIC HEARINGS ON THE EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

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The Arizona Department of Environmental Quality (ADEQ) and Maricopa Association of Governments (MAG) will jointly conduct two public hearings on the Draft Eight-Hour Ozone Plan for the Maricopa Nonattainment Area on June 1 and June 4, 2007, at 5:30 p.m. The purpose of these hearings is to receive public comments.

According to the federal Clean Air Act, an eight-hour ozone plan is required to be submitted to the U.S. Environmental Protection Agency. The plan contains a variety of air pollution control measures such as summer reformulated gasoline, vehicle emissions testing, traffic signal coordination, intelligent transportation systems, and a County rule for polystyrene foam operations. The plan demonstrates attainment of the eight-hour ozone standard by June 15, 2009 with federal, state, and local control measures that have already been implemented in the Maricopa nonattainment area.

For your information and convenience, a copy of the public hearing notice is enclosed. The document is available for agency and public review on the MAG website at www.mag.maricopa.gov. In addition, the draft document is available for review at the MAG Offices, third floor, from 8:00 a.m. to 5:00 p.m. Monday through Friday.

Attachment

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

AND

MARICOPA ASSOCIATION OF GOVERNMENTS

PUBLIC HEARING

Eight-Hour Ozone Plan

for the Maricopa Nonattainment Area

ORIGINAL

Phoenix, Arizona
June 1, 2007
5:30 p.m.

Prepared For:

MARICOPA ASSOCIATION OF GOVERNMENTS

(Original)

Prepared By:

LORENA K. WAGNER
Court Reporter

1 I N D E X

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3 SPEAKER PAGE

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1 ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
2 AND
3 MARICOPA ASSOCIATION OF GOVERNMENTS
4
5 Eight-Hour Ozone Plan
6 for the Maricopa Nonattainment Area
7
8 commenced at 5:30 p.m. on June 1, 2007, at the offices
9 of Maricopa Association of Governments, 302 North
10 First Avenue, Suite 300, Phoenix, Arizona, before
11 LORENA K. WAGNER, a Court Reporter in and for the
12 County of Maricopa, State of Arizona.
13
14 * * * * *
15
16 A P P E A R A N C E S
17
18 Arizona Department of Environmental Quality:
Diane Arnst
19
20
Maricopa Association of Governments:
21 Lindy Bauer
22
23
24
25

1 Phoenix, Arizona
June 1, 2007
2 5:35 p.m.
3
4 * * * * *
5
6 PROCEEDINGS
7
8 MS. BAUER: I want to welcome all of you to
9 our public hearing.
10 This is a public hearing on the Eight-Hour
11 Ozone Plan for the Maricopa Nonattainment Area.
12 This public hearing is being held jointly
13 by the Arizona Department of Environmental Quality.
14 We have Diane Arnst here representing the Department.
15 Diane is in the ADEQ Air Quality Division.
16 And it's also being held by the Maricopa
17 Association of Governments. And my name is
18 Lindy Bauer, and I'll be serving as the hearing
19 officer for this evening.
20 Those of you that drove to the meeting and
21 who parked in the garage can have your tickets
22 validated by the MAG staff this evening.
23 Dean is over there with validation in case
24 you need validation for the parking garage.
25 Now, the public hearing this evening will

1 begin with an overview presentation by the MAG staff.
2 Following the presentation, hearing participants are
3 invited to make comments for the public record.
4 A court reporter, sitting over there by the
5 podium, is there to prepare an official public record
6 of the hearing. Written comments are also welcome at
7 this hearing.
8 For those participants wishing to speak,
9 please fill out a form on the table to the left side
10 of the entryway over there and place it in a box; and
11 one of our staff will bring it up to the table.
12 If you need to speak early to meet a bus
13 schedule, please tell the MAG staff; and we will
14 accommodate your request.
15 As you come up to the podium, please state
16 some information for the formal record: Your name and
17 who you represent.
18 We also want to point out to you that we
19 have some handouts for you this evening on the table
20 by the door on the left entry. We have for you an
21 outline for the public hearing and then also a copy of
22 the Executive Summary for the Draft Eight-Hour Ozone
23 Plan for the Maricopa Nonattainment Area.
24 We would also like to note that we have a
25 timer to assist the public with their presentations.

1 We have a three-minute time limit. When two minutes
2 have elapsed, the yellow light will come on notifying
3 the speaker that they have one minute to sum up. At
4 the end of the three-minute period, a red light will
5 come on.
6 And now I would like to move into the
7 presentation for the MAG Eight-Hour Ozone Plan and
8 introduce Cathy Arthur with MAG staff.
9 MS. ARTHUR: Thank you.
10 I'm Cathy Arthur, and I'm a MAG associate.
11 I've been working on this plan with the air quality
12 staff at MAG for about almost two years now, and I'm
13 going to present you with some highlights of this
14 plan. It's actually a very extensive document, and
15 there was a lot of commuter modeling that had to go on
16 to show attainment.
17 First of all, the green area shown in this
18 map is the Eight-Hour Ozone Nonattainment Area. It's
19 about 5,000 square miles. And as you can see, it's
20 quite larger than any of the nonattainment areas we
21 have to work with.
22 The good news with the Eight-Hour Ozone is
23 that for the last two years we've not had any
24 violations of the standard. However, the numbers are
25 very close; so we're having to monitor this very

1 closely. And we may have to take action if things
2 don't continue in a positive manner.
3 EPA designated us as a nonattainment area
4 in 2004, and we have the plan due in 14 days.
5 There are some requirements for modeling
6 and also using the latest emissions inventory. And
7 probably more importantly, we need to show attainment
8 at the monitors in 2006, '07, and '08 in order to
9 attain by 2009.
10 This shows some of the nonattainment area
11 designations throughout the country. We are
12 considered a basic area, which is fairly close to the
13 standard. Some other areas have longer to meet the
14 standard but also have much higher concentrations.
15 Las Vegas, as you can see, is also green,
16 which means they have the same designation we do. And
17 their plan is due the same time as ours as are a lot
18 of urban areas in the east.
19 I mentioned that we have been working on
20 this for quite some time. We developed a modeling
21 protocol to explain to everyone up-front how we were
22 going to approach this modeling, and we reviewed some
23 state of the art models to accomplish the attainment
24 designation.
25 We actually modeled three different

1 episodes because ozone is highly dependent on
2 meteorology. And in order to make sure that you can
3 attain under any meteorology, you need to pick the
4 worst-case ozone under various meteorological
5 conditions. And so we have done that in the three
6 episode periods that were modeled in 2001 and 2002
7 where we had really high ozone.
8 In some cases, we had a lot of transport
9 from either Mexico or California; and in other cases,
10 the problem was predominantly local. So we modeled
11 all three cases.
12 You can see that Eight-Hour Ozone is a
13 complex issue because in order to model it, you have
14 to model the western half of the United States.
15 This shows the modeling domain that was
16 used for our work; and you can see that you can have a
17 lot of influence from California, from New Mexico, and
18 from Mexico on the meteorological end.
19 The red area shown in this diagram is the
20 area that we actually modeled at the highest
21 resolution. That means this four-kilometer grid area.
22 So we were focusing our team demonstration on this
23 area, which is actually larger than the Eight-Hour
24 Ozone Nonattainment Area. So we made sure that
25 everywhere in this red rectangle that we ought to be

1 able to start attainment in the nonattainment area.
2 These are the measures that were utilized
3 to show attainment. There are seven attainment
4 measures, and there are five contingency measures.
5 EPA requires that you check contingency measures as
6 well as measures that allow you to show attainment.
7 And the modeling that we did demonstrates
8 attainment for all three of those episodes I showed
9 you if we project to 2008. And EPA requires that you
10 show attainment in the ozone season of 2008 in order
11 to meet the standard by June 15, 2009.
12 In addition to doing modeling, we did some
13 other tests because we wanted to make sure that we're
14 right on this. And one of the things was a
15 comprehensive weight of the evidence analysis based on
16 trends in ozone concentrations, in volatile organic
17 compound concentrations, and then emissions of those
18 same ozone precursors, as well as the relationship
19 between them. So there is a lot of analyses that are
20 above and beyond the modeling. And all three of
21 these, the weight of the evidence, the screening test,
22 that we did, and the modeling all indicate that we
23 will attain by the summer of 2008.
24 This is an example of the kind of contour
25 that you'll see in the plan. This happens to be for

1 the June episode, which is the one that's
2 predominantly transport. And these contours tell us
3 that the maximum concentration is about 84 parts per
4 billion. And if you reach 85 parts per billion, then
5 you are in exceedance. So that's why I say we're very
6 close, but we are under in all three of the episodes
7 in 2008. And we find the trends are continuing in a
8 positive manner.
9 The weight of evidence analyses are
10 actually done by one of the leading consultants called
11 Environ. And they are the ones who analyzed all the
12 data and came to the conclusion that we would attain
13 in 2008.
14 This shows you the individual measures, the
15 benefits of the individual measures that were modeled
16 for attainment.
17 And you can see that the largest benefit in
18 terms of the VOC is the emissions testing program, the
19 cutpoints that were established.
20 For the nitrogen oxide emissions in both
21 VOC and NOx react chemically in the presence of
22 sunlight to form ozone, so we need to have a handle on
23 both of these pollutants. In this case, the summer
24 fuel reformulation had the biggest impact on the
25 reduction in ozone.

1 And these are the pie charts which show you
2 source contributions, in this case volatile organic
3 compound. And you can see that the biggest component
4 in the 5,000 square mile area that we are modeling is
5 biogenics. Biogenics are a natural vegetation.
6 What people don't realize is that natural
7 vegetation produces hydrocarbon emissions. And
8 although those emissions don't always have a lot to do
9 with the ozone concentrations of the urban area, they
10 do exist. And when you're doing inventories, you're
11 supposed to accumulate all of the emissions in your
12 modeling area.
13 In terms of nitrogen oxide, which is
14 totally different, on-road modal sources are the
15 biggest contributor in 2008 and is even higher than
16 this in the base year. So we still have vehicles
17 contributing quite a bit of nitrogen oxide.
18 I mentioned that EPA requires you to also
19 provide contingency measures in your plan. We have
20 done that, and they set a guideline that the total of
21 all emissions from these contingency measures have to
22 exceed three percent.
23 And you can see by these charts that the
24 accumulative amount is quite a bit higher than three
25 percent, so we're satisfied with that criteria for

1 contingency measures.
2 In addition, we need to establish
3 transportation conformity budgets. And these are
4 utilized to ensure that the transportation plans and
5 programs in the future don't violate the standard or
6 force you to have a higher emissions and higher
7 concentrations than you have today. So these budgets
8 have been established, and they won't go into effect
9 until EPA either finds them to be adequate or approves
10 this plan; but once they are approved, we will be
11 using them here at MAG to do a conformity analysis.
12 The schedule for this plan -- As I
13 mentioned, we're going to try to submit it by
14 June 15th. So we are having a public hearing today as
15 well as one on Monday, and we're responding to
16 comments. And we hope to have the Executive Committee
17 approve this so we can forward this to ADEQ and EPA by
18 the 15th of June.
19 And that concludes my overview.
20 MS. BAUER: Okay. Thank you very much,
21 Cathy.
22 And now we will move into the public
23 hearing portion for public comments.
24 At this time, we're inviting public
25 comments; and if any of you have not filled out a

form, we would advise you to do so. The forms are outside.

So first, we have two forms. We'll begin by calling you to come up to present your comments.

Our first one is Dianne Barker.

PUBLIC COMMENTS

MS. BARKER: Good evening.

My name is Dianne Barker, and I reside in Phoenix, Arizona.

I have been coming to MAG meetings. I'm very interested on your actions and the education that you provide with your presentation. I'm always learning.

I thought when I was listening to your presentation it's too bad that our children can't hear some of this in school. It seems to me that many times, having been a school teacher, the children take the ideas back to their adults and their parents.

From what I see, this is a problem. Ozone is increasingly in a nonattainment area. From what I see, you've modeled certain days that could be some of the worst days next year. And you've taken your measures, and you believe that it will defer us having

1 an ozone problem.
2 I don't like to be doomsday, but I'm a
3 realist. This area is growing without the individual
4 help of persons that are involved in creating most of
5 the emissions for nitrogen oxide on roads. It's the
6 behavior of people going and buying gasoline, for one,
7 and making the emissions.
8 I don't see that the reformulation is going
9 to be that good for our overall pollution, it may, as
10 you are looking at the ozone that is decreased because
11 of reformulation; but it's a chemical exchange.
12 You're taking petroleum, and you're changing the
13 chemicals. I believe that we'll have more aldehydes.
14 Aldehydes are carcinogen.
15 So I don't see any of your measures. I
16 don't understand why -- unless for some reason or
17 another -- you know why you didn't put in encouraging
18 people to ride-share or even to go out and purchase
19 hybrid automobiles that aren't using petroleum,
20 reformulated, or otherwise.
21 As far as the vegetation goes, I understand
22 it makes a lot of emissions; but I don't believe that
23 it's as harmful as using reformulated gasoline.
24 I do believe also that we shouldn't lighten
25 this problem by saying that we didn't have any

1 violations because it's my understanding we had
2 monitors that were near the alarm violation. So we do
3 have a problem. It is increasing.
4 I'm here, for one, to help be part of the
5 solution. I do use the natural-gas bus. I do
6 understand that it has pollution, but I did ride my
7 bicycle, and I did walk today. Downtown I find riding
8 my bicycle is much easier through all of these
9 barricades anyway. I get there faster than the cars,
10 and I know I'm not polluting.
11 People can put some of these types of
12 alternative transportation to use that I use and other
13 people too in their daily life. It needs a lot of
14 encouraging.
15 I'd like to see MAG as a group make a
16 commitment that they -- Some people in MAG are using
17 alternative transportation, but our people in
18 government should be models for the other community
19 but are part of the problem.
20 It's easy to say I'm not going to do
21 anything as long as the other guy isn't; but guess
22 what, folks? It's where we live. Remember it's
23 important to earn a living, but it's not worth having
24 any toys or any houses if you can't breathe.
25 And so I'm here to say thank you for the

1 bus tickets. If you can get here in the most
2 nonpolluting way even less than a bus -- I'm not here
3 just to sell the bus, but I do care about the valley.
4 I do care about our lives. I do care about people.
5 Somebody asked, Who are you representing?
6 I said I'll represent anybody that needs to be
7 represented. There are a lot of people -- They're not
8 here because they're out in their cars. They're
9 creating the problem, okay; so we need to educate
10 them.
11 I'd like to see basically in your measures
12 a place where you would make more outreach education.
13 I'd like to see our children educated about this as
14 well as adults. And I'd like to see more inspiration
15 from MAG in their own personal commitment and also
16 with trying to inspire people to use the kinds of
17 transportation that's less polluting.
18 Thank you.
19 MS. BAUER: Thank you very much. And we
20 appreciate you coming to our hearing and your interest
21 in air quality.
22 Thank you.
23 MS. BARKER: Do you have any bus tickets?
24 MS. BAUER: He can help you there.
25 Our next comment this evening will be from

1 Michael Hernandez.
2 MR. HERNANDEZ: Ms. Lindy Bauer, each and
3 every one here, good evening.
4 I'm Michael Hernandez. I reside in
5 Sun Lakes, and I'm also a resident along with you here
6 in our great county of Maricopa. And I thank you very
7 much for affording me this opportunity to speak to you
8 in addressing a very serious and volatile public
9 safety matter.
10 In that regard, the Arizona Department of
11 Transportation Natural Resource Division -- when
12 they're out there conducting their chemical and
13 vegetation control operations without properly and
14 effectively communicating the risk for the traveling
15 public by putting up the signs.
16 In the following example of the
17 Maricopa County Department of Transportation better
18 known as ADOT -- When they are out there fogging for
19 mosquitoes carrying the West Nile Virus, they do take
20 the responsibility of notifying everyone here in
21 Maricopa County what areas they are going to target
22 when they are spraying for mosquitoes. So they are on
23 the radio, television, the Internet, et cetera.
24 My experience of being exposed to chemical
25 spray when I was a former ADOT highway maintenance

1 personnel in Casa Grande -- I was exposed to
2 Amine 424D. Amine is spelled A-m-i-n-e.
3 Now, this is Agent Orange. I did my
4 research with the National Pesticides Information
5 Center technically known as NPIC of the Oregon State
6 University. You can get them online, and the bottom
7 line is it's Agent Orange.
8 Now, this Amine 424D, Agent Orange, is on
9 the Federal Hazardous Material List as being very
10 dangerous. I learned that when I pulled up the
11 Maricopa.gov website. That is www.maricopa.gov, and I
12 went on to the environmental areas, and I surfed it,
13 and I researched, and I saw that.
14 Now, I realize Maricopa County is a tenth
15 here in Arizona like all the other system counties,
16 and I realize MCDOT is junior to ADOT.
17 However, you do have a constitutional right
18 to speak up and say, Hey, you're in our county
19 spraying herbicide chemical Agent Orange. We need to
20 get the handle on things, and we need to communicate
21 about the risks effectively.
22 Now, I've learned a lot from the
23 presentation that was just given a few minutes ago
24 regarding the ozone. Now, perhaps these aerosol
25 herbicide chemical agents could be affecting the ozone

1 which we can always go back to the website,
2 Maricopa.gov, and do a little more research.
3 I must say to you in honesty that I don't
4 know everything. I'm not the expert, but
5 unfortunately I feel like I was a lab rat back on
6 May 22 of 2000 out there on Interstate 10 down in
7 Pichaco where two of my fellow coworkers and I were
8 sprayed down with Amine 424D. And who knows how long
9 this has been going on.
10 Back in 1999, several people with multiple
11 chemical sensitivity, MCS, report this.
12 Unfortunately, they are debunked. I learned about
13 that through the Federal Highway Administration of the
14 US Department of Transportation in Washington, D.C.,
15 Arizona Center for Disability Laws.
16 Is that the proper name of the agency?
17 They know about this. They had some
18 documentation. So then we can go back there to see
19 what happened to these people, but unfortunately
20 nothing was ever done.
21 So I thank you very much for affording me
22 this opportunity to come and be a part of you in this
23 outstanding setting. I find you all to be very
24 knowledgeable, and thank you for doing what you do for
25 us. I don't know if anybody ever says thank you for

1 what you do.
2 Usually they're on the Burger King
3 syndrome. They expect to have it their way and end up
4 with a Happy Meal, but it's people like you that make
5 a difference.
6 So thank you very much. And that's all I
7 have to say at this time.
8 If anybody has a question for me, feel free
9 to ask; and I'll be more than happy to answer.
10 MS. BAUER: Well, thank you very much. We
11 appreciate you coming to our hearing this evening.
12 MS. BARKER: Yes. I have a question for
13 him.
14 Am I allowed to input anymore? I seem to
15 have left something out of my presentation.
16 MS. BAUER: I think that you can go ahead
17 and input a little more.
18 MS. BARKER: Oh, okay. Then I won't direct
19 it really to Mr. Hernandez.
20 MS. BAUER: If you have more comments.
21 MS. BARKER: Yeah. Okay. Thank you,
22 Chair Lady, Lindy Bauer.
23 Again, my name is Dianne Barker residing in
24 Phoenix.
25 And it was called to my attention from a

1 community activist that sent me an e-mail, and it
2 listed from Maricopa Government Air Quality Division.
3 They had one and a half million in fines in
4 2007. The website listed the different offenders.
5 Some of the top ones had something like eight to 14
6 different violations from gasoline, dust, open fire,
7 and permit problems. So I do call your attention to
8 www.maricopa.gov/pr_detail.aspx?releaseid=551. You
9 might find that interesting in our area on these
10 violation listings.
11 Thank you.
12 MS. BAUER: Thank you.
13 Would anyone else like to make any comments
14 this evening?
15 Okay. Well, I want to thank all of you for
16 coming to our public hearing. Maricopa Association of
17 Governments appreciates your interests in our Regional
18 Air Quality issues.
19 Your comments that you've made this evening
20 will be presented to the MAG Air Quality Technical
21 Advisory Committee at the June 7th, 2007 meeting at
22 one-thirty. A response to comments will also be
23 prepared and included in our planned documents.
24 Thank you again for your participation this
25 evening.

1 And now we'll close the public hearing.
2 Thank you.
3 (The proceedings concluded at 6:01 p.m.)
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STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I HEREBY CERTIFY that the foregoing was taken before me, LORENA K. WAGNER; that all proceedings had upon the taking of said hearing were taken down by me on a stenograph machine as a backup and thereafter reduced to writing by me; and that the foregoing 22 pages contain a full, true, and correct transcript of said record, all done to the best of my skill and ability.

WITNESS my hand this 2nd day of June, 2007.

Lorena K. Wagner
LORENA K. WAGNER
Court Reporter

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

AND

MARICOPA ASSOCIATION OF GOVERNMENTS

PUBLIC HEARING

Eight-Hour Ozone Plan

for the Maricopa Nonattainment Area

Phoenix, Arizona

June 4, 2007

5:30 p.m.

Prepared For:

MARICOPA ASSOCIATION OF GOVERNMENTS

ORIGINAL

Prepared By:

LORENA K. WAGNER

Court Reporter

1 I N D E X

2

3 SPEAKER PAGE

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5 Ms. Bauer 6

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12 County of Maricopa, State of Arizona.
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14 * * * * *
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16 A P P E A R A N C E S
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18 Arizona Department of Environmental Quality:
Diane Arnst
19
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MAG Air Quality Technical Advisory Committee:
21 Joe Gibbs
22
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24
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1 Phoenix, Arizona
June 4, 2007
2 5:36 p.m.
3
4 * * * * *
5
6 PROCEEDINGS
7
8 MR. GIBBS: I would like to call this
9 public hearing to order.
10 My name is Joe Gibbs. I'll be the hearing
11 officer for the hearing on the MAG Eight-Hour Ozone
12 Plan for the Maricopa County Nonattainment Area.
13 Today is Monday; June 4th, 2007. The time
14 is 5:36 p.m.
15 I'd like to welcome those in attendance at
16 this hearing.
17 This public hearing is being held jointly
18 by the Arizona Department of Environmental Quality and
19 Maricopa Association of Governments to receive public
20 comments on the Draft MAG Eight-Hour Ozone Plan for
21 the Maricopa County Nonattainment Area.
22 Those driving to the meeting who parked in
23 the garage can have their tickets validated by MAG
24 staff.
25 I'd like to go into the public hearing

1 process now. The public hearing will begin, and
2 another review presentation will be given by MAG
3 staff.
4 Following the presentation, hearing
5 participants are invited to make comments for the
6 public record, and a court reporter is present to
7 provide an official record of the hearing. Written
8 comments are also welcome at the hearing.
9 For those participants wishing to speak,
10 please fill out the form on the table and place it in
11 the box. If you need to speak early to meet a bus
12 schedule, please tell the MAG staff; and we will
13 accommodate the request.
14 As you come up to the podium, please state
15 some information for the formal record: Your name and
16 who you represent.
17 I would like to note that we have a timer
18 to assist the public with their presentations. We
19 have a three-minute time limit. When two minutes have
20 elapsed, a yellow light will come on notifying the
21 speaker that they have one minute to sum up. And at
22 the end of the three-minute time period, the red light
23 will come on. At that time, I will ask you to sum up
24 very quickly or to stop.
25 At this time, I'd like to introduce

1 Lindy Bauer of MAG who will give the presentation on
2 the MAG Eight-Hour Ozone Plan.
3 MS. BAUER: Thank you very much.
4 My name is Lindy Bauer for the MAG staff.
5 I'm the MAG Environmental Director, and I too would
6 like to welcome you this evening to the public hearing
7 of the Eight-Hour Ozone Plan.
8 The Eight-Hour Ozone Nonattainment Area is
9 shown in the map in the green area. It's the largest
10 of our nonattainment area, so we have this region to
11 plan for. It's approximately a 4,880 square mile
12 area.
13 We do have some good news for the
14 Eight-Hour Ozone at the monitors. This monitor data
15 is showing a downward trend in the number of violating
16 monitors for the eight-hour ozone standard.
17 As you can see in 2000, there were seven.
18 This number has now come down to zero for 2005 and
19 2006. So the good news is that we have a downward
20 trend.
21 And secondly, there have been no violating
22 monitors for the last two years. And we certainly
23 hope to keep up this trend. However, I want to point
24 out to you at the monitors the numbers are very close
25 to the standard, so we're going to have to watch this

1 pollutant very carefully as measured at the monitors.

2 The Eight-Hour Ozone Nonattainment

3 Designations were completed by EPA and were effective

4 on June 15th, 2004. The Maricopa Nonattainment Area

5 was classified as a basic area because this region was

6 only slightly over the standard. As a basic area,

7 this region is required to meet the requirements of

8 Part D, Subpart 1, of the Clean Air Act.

9 The plan is due to the Environmental

10 Protection Agency by June 15th, 2007. It has to be

11 based upon the most recent emissions inventory for

12 using the 2002 inventory prepared by Maricopa County.

13 The plan is also required to demonstrate attainment of

14 the standard using air quality modeling.

15 Now, the nonattainment date that this

16 region has is June 15th, 2009. However, in order to

17 show attainment of the standard, EPA is requiring that

18 attainment has to be modeled for the season of 2008

19 because June 15th actually lands in the midst of the

20 ozone season.

21 EPA will be judging attainment at the

22 monitors also. They're going to be looking at data

23 based on 2006, '07, and '08. So the monitor data

24 averaged over three years has to be an attainment for

25 the standard in order for EPA to determine that the

1 region has indeed obtained the standard.

2 Now, this next map shows the nonattainment

3 area designations around the country. The Maricopa

4 area is basic as we mentioned before since this region

5 was very close to the standard just slightly over.

6 Las Vegas is a similar area as well.

7 Now, other regions around the country have

8 more severe ozone problems; and they have also been

9 given a longer time to attain the standard.

10 We have been going back to this Eight-Hour

11 Ozone Plan. The Eight-Hour Ozone Plan modeling

12 protocol was finalized in January of 2006. The

13 protocol indicates the modeling approach that we will

14 be using for the Eight-Hour Ozone Plan. We shared

15 this modeling protocol with the air quality planning

16 team, which is composed of DEQ, ADOT, and

17 Maricopa County air quality requirement; and it was

18 also reviewed by the Environmental Protection Agency.

19 In order to select the model, MAG reviewed

20 a variety of state of the art models to use for ozone

21 in order to determine which models would be

22 appropriate for this region. And this is a listing of

23 the models that we're using.

24 I wanted to highlight the MEGAN Biogenic

25 Model. This is the model that was specifically for

1 this region.

2 The nonattainment area for Eight-Hour

3 Ozone, as I mentioned, is very large and includes a

4 lot of vegetation. And the vegetation can also

5 contribute to ozone formation. So having a model that

6 captured the biogenics or natural vegetation is very

7 important for ozone modeling.

8 The MOBILE6.2 was used for emissions; EPS3

9 for the emissions processor; and MM5, which is a

10 meteorological model; and the CAMx photochemical grid

11 model was used as well.

12 For the modeling, we are required to look

13 at worst-case conditions to predict public health; so

14 three ozone episodes with different meteorology were

15 modeled.

16 The August 5th through the 11th, 2001:

17 Now, in this episode, it appeared that some of the

18 ozone concentrations were due to local conditions as

19 well as transport.

20 Then June 3rd through 7th, 2002: This

21 episode day was predominantly transport.

22 And July 8 through 14th, 2002: This was

23 predominantly local.

24 Some of our transport comes from either

25 Mexico or California. So that's why we took a look at

1 transport as well, but those were the three-day
2 worst-case conditions that we modeled.
3 Now, the red area in this next diagram
4 shows the area that we actually modeled. It's a
5 four-kilometer grid area.
6 Now, to put this in perspective, the next
7 slide showing you that the red area here, the
8 rectangle -- This is the modeled area again. And this
9 is actually larger than the Eight-Hour Ozone
10 Nonattainment Area.
11 The Eight-Hour Ozone modeling is very
12 complex because ozone is formed through a chemical
13 reaction as opposed to being directly emitted from a
14 source. So in order to model this pollutant, we
15 modeled the western half of the United States in order
16 to capture all of the influence or transport that
17 would be coming from California and New Mexico.
18 Now, the measures that we use for the
19 attainment demonstration are indicated on this chart.
20 It's important to point out that these are
21 existing measures. These measures are already in
22 place. So as we did with the one-hour ozone
23 maintenance plan as well as the carbon monoxide
24 maintenance plan, we showed where the existing
25 measures were sufficient to keep this region in

1 maintenance. We used a similar approach this time,
2 and we were able to demonstrate that the seven
3 nonattainment measures were able to keep the region in
4 attainment.
5 Now, we hope again at the monitors that we
6 have a third summer with no violating monitors. So
7 the part that I'm talking about now is projecting it
8 for the model as well.
9 As far as contingency measures, there were
10 five contingency measures that we also evaluated.
11 Again, these are existing contingency measures that
12 are already in place.
13 Now, the Environmental Protection Agency
14 allows for early implementation of contingency
15 measures; but for this demonstration, we show where
16 the measures that have already been implemented will
17 be sufficient to meet the EPA requirements.
18 Now, turning to the actual modeling
19 nonattainment demonstration with all of the
20 nonattainment measures, the model Eight-Hour Ozone
21 Plan values in 2008 met the standard for all three
22 episodes. The numbers were very close; so because the
23 numbers were close, additional analyses were performed
24 by MAG.
25 Screening tests were done to ensure the

1 accuracy of the modeling. And we also performed a
2 weight of the evidence approach, which is based on
3 ozone trends at the monitors.
4 Now, this is very important because the
5 monitors are measuring the ambient air. They're the
6 proof of the pudding, if you will. Modeling these are
7 projections into the future. And so it's very
8 important that we take a look at our monitor data to
9 make sure that our modeling approach and modeling data
10 is as accurate as possible.
11 The analyses conclude that the standard
12 will be attained in the summer of 2008.
13 Now, this next plot is an example of a
14 contoured plot that we have in our Eight-Hour Ozone
15 Plan. This was for the June episode. And this will
16 indicate the various concentrations at various points
17 throughout the nonattainment area and also the area
18 modeled.
19 In addition, we performed the weight of the
20 evidence approach. Now, this again is primarily based
21 on monitor data and the trend at the monitors. And
22 this was performed by Environ, which is a leading
23 consultant with ozone modeling. And Environ came to
24 the same conclusion that attainment would be met using
25 the weight of the evidence approach.

1 As I mentioned previously, ozone is not
2 directly emitted from a source. It's formed by a
3 chemical reaction that can occur with volatile organic
4 compounds, nitrogen oxide, in the presence of sunlight
5 and warm temperatures with minimum wind.
6 So when we take a look at ozone modeling
7 and also at the measures, we look at both volatile
8 organic compounds and nitrogen oxides.
9 So the impact from the measures for
10 volatile organic compounds are indicated on this
11 chart. You can see the measure that has the biggest
12 impact for volatile organic compounds would be the
13 emissions testing program, the phasing of those
14 cutpoints in 2008. Then taking a look at nitrogen
15 oxides, the measure that has the biggest impact is the
16 summer reformulations.
17 Now, when we do our modeling, it also
18 produces emission pie charts for the 2008 attainment
19 year. The pie chart shows the source contribution in
20 the attainment year. So in 2008, we can see biogenics
21 for volatile organic compound emissions. That is the
22 biggest portion of this pie chart. Again, this is
23 natural vegetation.
24 And then also in looking at 2008 for NOx
25 emissions, you can see that mobile sources are the

1 biggest part of the pie chart. Those onroad emissions
2 comprise 51 percent of nitrogen oxide emissions.
3 Now, turning to the impact of the
4 contingency measures for volatile organic compound
5 reductions: According to EPA guidance, contingency
6 measures need to reduce emissions by three percent.
7 Our contingency measures actually exceed that.
8 For volatile organic compound reductions
9 coming from the contingency measures, you can see that
10 the Federal Nonroad Equipment controls are the biggest
11 producers of VOC reductions as far as the contingency
12 measures.
13 And then taking a look at NOx reductions
14 again, the Federal Nonroad Equipment Standard also has
15 the biggest impact in reducing nitrogen oxide
16 emissions.
17 And finally, I wanted to mention conformity
18 budgets.
19 Conformity is another requirement under the
20 Clean Air Act designed to ensure that transportation
21 plans, programs, and projects do not contribute to air
22 quality violations.
23 So those pie charts that you just viewed
24 for the 2008 year establish mobile source emission
25 budgets for Eight-Hour Ozone. And once those are

1 approved by the Environmental Protection Agency, MAG
2 will be using those when we do our conformity
3 analysis.
4 The plan produced a VOC mobile source
5 emission budget of 67.9 metric tons per day and a NOx
6 budget of 138.2 metric tons per day.
7 I would like to point out that the NOx
8 budget contains a five-percent safety margin, which
9 has been built in as well. And again, these budgets
10 will be used once they have been approved by the
11 Environmental Protection Agency.
12 This is our schedule that we are proceeding
13 on.
14 Our documents were available for public
15 review May 3rd. We've had two public hearings,
16 June 1st and one this evening, June 4th. We plan to
17 go to the June 11th Executive Committee of MAG to take
18 action on the plan. We will then submit the plan to
19 DEQ; and then on June 15th, DEQ intends to submit the
20 plan to the Environmental Protection Agency.
21 And that concludes my presentation.
22 Thank you very much.
23 MR. GIBBS: Thank you, Lindy.
24 At this time, I'd like to open up the
25 public hearing to the public comment portion. And I'd

1 like to indicate that we have received a letter dated
2 June 4, 2007 from the Arizona Center for the Law and
3 Public Interest as comments to be entered into the
4 record.
5 And at this time, I'd like to invite public
6 comments. And also written comments from the Arizona
7 Department of Environmental Quality Planning
8 Section -- I'd also like to enter those into the
9 record.
10 At this time, I'd like to open it up to any
11 attendees who would like to submit written or verbal
12 comments.
13 Again, if you would like to speak, please
14 fill out a speaker form and place it in the box.
15 Please adhere to the three-minute time limit.
16 Is there anybody here that would like to
17 speak?
18 I see no hands.
19 Nobody would like to speak?
20 I'd like to close this public hearing now.
21 Maricopa Association of Governments
22 appreciates your interest in regional air quality
23 issues. Your comments will be presented to the MAG
24 Air Quality Technical Advisory Committee at the
25 June 7, 2007 meeting. It is at 1:30 p.m.

1 A response to comments will be prepared and
2 included in the planned documents.
3 And thank you for your participation this
4 evening.
5 The time is now 5:55 p.m., and that
6 concludes our public hearing.
7 (The proceedings concluded at 5:55 p.m.)
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1 STATE OF ARIZONA)
) ss.
2 COUNTY OF MARICOPA)
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4
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6
7 I HEREBY CERTIFY that the foregoing was
8 taken before me, LORENA K. WAGNER; that all
9 proceedings had upon the taking of said hearing were
10 taken down by me on a stenograph machine as a backup
11 and thereafter reduced to writing by me; and that the
12 foregoing 17 contain a full, true, and correct
13 transcript of said record, all done to the best of my
14 skill and ability.
15
16 WITNESS my hand this 5th day of June, 2007.
17
18
19
20 Lorena K. Wagner
LORENA K. WAGNER
21 Court Reporter
22
23
24
25

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MARICOPA ASSOCIATION of GOVERNMENTS

PUBLIC HEARING ON THE
MAG EIGHT-HOUR OZONE PLAN
FOR THE MARICOPA NONATTAINMENT AREA

June 1, 2007

Date 6-1-07

Name Dianne Barker
(Please Print)

Address 5131 N. 40th St. A319 Phone 602 999.4448

Title Citizens

Representing Whoever wants representation
(Organization, etc.)

Do you wish to be heard? Yes ☒ No ☐ If Necessary ☐

Dianne Barker
Signature

MARICOPA ASSOCIATION of GOVERNMENTS

PUBLIC HEARING ON THE
MAG EIGHT-HOUR OZONE PLAN
FOR THE MARICOPA NONATTAINMENT AREA

June 1, 2007

Date 1 June 2007

Name Michael Hernandez
(Please Print)

Address P.O. Box # 12453 Chandler, AZ Phone (602) 410-3984

Title Private Citizen / MSgt. - USMC (Ret.)

Representing Public Safety
(Organization, etc.)

Do you wish to be heard? Yes ☒ No ☐ If Necessary ☐

Michael A. Hernandez
Signature

RESPONSE TO PUBLIC COMMENTS ON THE DRAFT MAG EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

JUNE 1, 2007 AND JUNE 4, 2007 PUBLIC HEARINGS

The Maricopa Association of Governments (MAG) appreciates the comments made during the public comment period for the Draft MAG Eight-Hour Ozone Plan for the Maricopa Nonattainment Area. Two advertised public hearings were conducted on June 1, 2007 and June 4, 2007. Verbal testimony was presented at the June 1, 2007 public hearing. No verbal testimony was presented at the June 4, 2007 public hearing. Written comments were submitted from three entities. The following represents the MAG response to the comments received.

COMMENTS FROM DIANNE BARKER (Testimony at the June 1, 2007 public hearing)

Comment: Your presentation would be good for school children to hear so they can teach the ideas back to adults and their parents.

Response: The Maricopa Association of Governments appreciates the comment.

Comment: Ozone is increasing in the nonattainment area. You've modeled certain days that could be some of the worst days and you've modeled the measures. This is a rapidly growing area. It is people buying gasoline that are causing emissions. Reformulated fuel is not that good for overall pollution. I believe that we'll have more aldehydes. Aldehydes are carcinogens.

Response: According to the air quality monitors, the number of eight-hour ozone violations has been decreasing. In 2005 and 2006, there were no violating monitors. Reformulated fuel is a clean burning gasoline that reduces emissions which cause ozone. Reformulated fuel has a large impact since it reduces tailpipe emissions from all vehicle trips, rather than a specific type of trip such as work trips.

Comment: I don't see any measures to encourage people to rideshare or to go out and purchase hybrid automobiles that aren't using petroleum, reformulated, or otherwise.

Response: The MAG Eight-Hour Ozone Plan for the Maricopa Nonattainment Area relies on the State, County, and local commitments to implement control measures in the Serious Area Carbon Monoxide Plan, One-Hour Ozone Maintenance Plan, and the Serious Area Ozone State Implementation Plan which have all been approved by the Environmental Protection Agency. The Serious Area Carbon Monoxide Plan includes Employer Rideshare Program Incentives; Preferential Parking for Carpools and Vanpools; Expansion of Public Transportation Programs; Encouragement of Pedestrian Travel; Encouragement of Bicycle Travel; and Development of Bicycle Travel Facilities.

Comment: I'm here to be part of the solution. I do use the natural gas bus and I also rode my

bicycle and walked today. Some people in MAG are using alternative transportation. Governments should serve as models for the community.

Response: The Maricopa Association of Governments participates in the Maricopa County Trip Reduction Program. MAG encourages the use of alternative modes of transportation.

Comment: The Maricopa Government Air Quality Division listed $1.5 million dollars in fines in 2007 from offenders for gasoline, dust, open fires, and permit problems.

Response: The Maricopa County Air Quality Department issues permits and has regulatory authority. The fines were posted on the Maricopa County Air Quality Department website.

COMMENTS FROM MICHAEL HERNANDEZ (Testimony at the June 1, 2007 public hearing)

Comment: The Arizona Department of Transportation Natural Resources Division is out there conducting their chemical and vegetation control operations without properly and effectively communicating the risk for the traveling public by putting up signs. When the Maricopa County Department of Transportation is fogging for mosquitoes with West Nile Virus, the County takes the responsibility for notifying everyone what areas will be targeted for spraying.

Response: The Maricopa Association of Governments will convey your concerns regarding chemical spraying to the Arizona Department of Transportation. In addition, it is suggested that you contact the Maricopa County Air Quality Department.

Comment: I was exposed to Amine 424D which is Agent Orange in May 22, 2000 on Interstate 10 while working for the Arizona Department of Transportation. Two of my fellow coworkers and I were sprayed down with Amine 424D. Back in 1999, several people with multiple chemical sensitivity, MCS, reported this. I have learned about this through the Federal Highway Administration of the U.S. Department of Transportation in Washington D.C., Arizona Center for Disability Laws.

Response: As the designated Regional Air Quality Planning Agency for this area, the Maricopa Association of Governments does not have authority over the application of pesticides and other chemicals. Your comments will be conveyed to the Arizona Department of Transportation. It is also suggested that you contact the Maricopa County Air Quality Department.

Comment: Thank you very much for affording me this opportunity to come and be a part of this outstanding setting. I find you all to be very knowledgeable and thank you for doing what you do for us.

Response: The Maricopa Association of Governments appreciates your comments.

COMMENTS FROM THE U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)
(Letter from Colleen McKaughan, dated May 31, 2007 received by e-mail May 31, 2007)

EPA Comments on Chapter 1

Comment: *Provisions to prohibit sources from impacting air quality in other states* (page 1-7). ADEQ recently completed and has submitted to EPA the *Arizona Interstate Transport SIP* to address the requirements of section 110(a)(2)(D)(I) of the CAA. A reference to this SIP in this section would be appropriate.

Response: A reference to the Arizona Interstate Transport SIP has been added to this section.

Comment: *Meet the applicable requirements of section 110(a)(2)(M)* (page 1-9). It would be helpful to specify the consultation which occurred with affected entities for this particular plan.

Response: More detail on the consultation process has been added to this section.

Comment: *RACT*. Since Maricopa County is designated a subpart 1 non-attainment area for ozone, and expects to show attainment by 2009, RACT is deemed to be met with the control requirements associated with a demonstration that the NAAQS is attained as expeditiously as practicable. (70 FR71612, 11/29/2005, section IV.G.1)

Response: This language has been added to the section discussing RACT.

Comment: There are a number of typographical errors in Table 1-1 of VOC RACT measures (see Attachment A). Also, it would be helpful to explain that NOx RACT was not required under 1-hour ozone because of the 1995 NOx exemption.

Response: The Maricopa County Air Quality Department (MCAQD) provided Table 1-1 to MAG for inclusion in the Eight-Hour Ozone Plan. In response to this comment, MCAQD has provided MAG with a corrected Table 1-1 that will be included in the Final Plan. A sentence on the 1995 NOx exemption has been added to page 1-10.

Comment: MAG should include an updated negative declaration regardless of whether such negative declarations were made for an earlier SIP. This is necessary since there may now be sources in the area that previously did not exist. Language similar to the following may be appropriate:

> Maricopa County AQD has reviewed its permit files and the emission inventory for its federal Clean Air Plan, [include any other information sources searched such as SIC Codes and telephone yellow pages], and has determined that there are no stationary sources or emitting facilities for the following CTG categories. MCAQD also does not anticipate these sources in the future.

GUIDANCE DOCUMENT TITLE	DOCUMENT TYPE	DOCUMENT NUMBER
Control of Refinery Vacuum Producing Systems, Wastewater Separators, and Process Unit Turnarounds	CTG	EPA-450/2-77-025

Response: The Maricopa County Air Quality Department has indicated that based upon discussions with EPA, an updated negative declaration is not necessary.

Comments on Chapter 2

Comment: It is not clear how the detailed discussion on p. 2-3 to 2-15 concerning the transportation system, congestion management process, and public transit system relates to air quality or 8-hour ozone planning.

Response: Onroad mobile sources produce a significant share of the ozone precursor emissions, (i.e., 51% of the nitrogen oxides and 10% of the volatile organic compounds in 2008). For the Eight-Hour Ozone Plan, the emission rates for onroad mobile sources were estimated with the EPA MOBILE6.2 model, using speeds by facility and area type estimated by the MAG transportation models. The highway speeds represent congestion levels at four different times of day (AM peak, midday, PM peak and nighttime). The speeds input to MOBILE6.2 differ in the base case (2001 and 2002) and attainment (2008) years, due to differences in the magnitude and distribution of population, employment, and transportation supply (e.g., freeway and arterial lane miles, bus service, light rail). The MOBILE 6.2 emission rates are applied to the vehicle miles of travel, simulated by the MAG transportation models, to estimate onroad mobile source emissions. The present and future regional transportation systems are discussed in Chapter 2, because these systems influence the speeds and vehicle miles of travel used in developing onroad mobile source emissions for the Plan.

EPA Comments on Chapter 3

Comment: *Emissions Inventory*. The pie chart in the executive summary shows biogenic emissions constitute 65% of total emissions. However, the emissions inventory in Table 3-1 indicates biogenics are about 22% of total emissions. Can you explain the discrepancy and clarify which is the correct number? We understand that you relied on a biogenics study done by a consultant; can you make this document and all the references you cite in the plan and TSD publicly available?

Response: The biogenic emissions for the attainment demonstration were estimated by MEGAN (Model of Emissions of Gases and Aerosols from Nature) using vegetative emissions rates measured in Maricopa County during June 2005. MEGAN is a state-of-the-art biogenics model developed by Dr. Alex Guenther, under the sponsorship of EPA, the National Science Foundation, and the National Center for Atmospheric Research. Unlike other biogenic models (i.e., GLOBEIS, MAGBEIS), MEGAN uses a bottom-up approach that more accurately reflects current understanding of the processes controlling biogenic emissions. The pie charts in Figure ES-2 (for 2002) and Figure ES-5 (for 2008) of the Executive Summary represent biogenic emissions estimated by MEGAN for the ozone modeling domain.

Table 3-1 summarizes data from the 2002 Maricopa County Periodic Emissions Inventory (PEI) for ozone precursors. This inventory is included in Chapter 3, because EPA requires that the most recent inventory be included in the Plan. (See Appendix A, Exhibit 1.), even if some of the assumptions differ from the emissions inventories developed to model attainment. The biogenic emissions in the 2002 PEI were prepared using MAGBEIS and default emission rates based primarily on measurements of East Coast vegetation. The Maricopa County Air Quality Department (MCAQD) is in the process of preparing the 2005 PEI for ozone precursors that will include the biogenic emissions estimates from MEGAN.

MAG has mailed a copy of the Final Report for the MAG 2006 Biogenics Study to Colleen McKaughan. We would be happy to provide any other reports cited in the Plan. Please let us know what other reports you would like to obtain.

Comment: *Emissions Inventory.* The emissions inventory is in English tons, while the control measure emissions reductions are in metric tons. This could be confusing to the public. Can you use consistent units and/or provide the conversions to the other unit, for example 1.0 English tons (__ metric tons).

Response: The conversion from English tons to metric tons will be added as a footnote to Figure 3-1 and Table 3-1. The only use of English tons in the Plan is in the 2002 PEI in Chapter 3 and Appendix A, Exhibit 1. As discussed above, the PEI is included in the Plan because it is the latest emissions inventory for ozone precursors submitted to EPA. In addition to use of a different biogenics model, the PEI represents average conditions (e.g. temperatures, vehicle miles of travel) during the 2002 ozone season, while the modeling inventories are specific to the episode days in August 2001, June 2002 and August 2002. The modeling emissions inventories presented in the Executive Summary and Chapter 5 of the Plan are consistently expressed in terms of metric tons. A more detailed description of the assumptions used in developing the modeling inventories is provided in Chapter V of the Technical Support Document.

Comment: *Monitoring.* The text and tables refer to a total of both 19 and 20 monitors.

Response: The text in Chapter 3 indicates that there are nineteen monitoring stations within the Maricopa County eight-hour ozone nonattainment area that monitor ozone. The Tonto National Monument site also monitors ozone and is located just outside the nonattainment area in Gila County, downwind of the Phoenix Metropolitan Area. The text and tables in Chapter 3 include the nineteen monitoring stations within the Maricopa County eight-hour ozone nonattainment area and the Tonto National Monument monitor.

EPA Comments on Chapter 4

Comment:

Control Measures

The plan indicates the following (page 4-2) "Maricopa County Rule 348 was a maintenance measure for which credit was taken in the One-Hour Ozone Maintenance Plan. However, since Rule 348 was

adopted in 1999, it has been assumed in the base case 2001 and 2002 emissions inventories, rather than as an attainment measure in this Plan." There are several other control measures which were adopted a number of years ago, and yet this same caveat was not applied to these other measures, such as *Phased in Emission Test Cutpoints, One-Time Waiver from Vehicle Emissions Test,* and *Tougher Enforcement of Vehicle Registration and Emission Test Compliance.* Can you please clarify this discrepancy?

Response: The general approach applied in the Eight-Hour Ozone Plan was to quantify the emissions reductions for the same measures that were quantified in the One-Hour Ozone Maintenance Plan. These quantified measures were called maintenance measures in the One-Hour Ozone Maintenance Plan. They are called attainment measures in the Eight-Hour Ozone Plan, because numeric credit was applied in modeling attainment. Rule 348 was removed from the attainment measures, and Rule 358 was added, at the request of Jo Crumbaker of the Maricopa County Air Quality Department. Chapter Four describes the seven attainment measures and Table 5-2 shows the emission reductions for each of these measures in 2008. Emission reductions for attainment measures implemented prior to the base year are applied in modeling the base year, as well as the attainment year.

Comment: *Arizona Cleaner Burning Gasoline (CBG)* – both the Executive Summary (on page ES-5) and the control measure discussion on page 4-3 indicate an increase in VOC emissions from the Phoenix CBG program. Can you explain how this ozone precursor control measure increases emissions of VOCs? A minor correction, the most recent Arizona CBG approval was published in the *Federal Register* on March 4, 2004 (citing the date of publication rather than signature provides the public with the information to find the *Federal Register* notice) and was signed by the Regional Administrator for Region 9, not the EPA Administrator.

Response: The benefit of the CBG control measure was modeled by setting the MOBILE6.2 flag for reformulated gasoline, indicating fuel use in the southern U.S., and specifying an RVP of 7.0 psi. The emissions resulting from this run were compared with MOBILE 6.2 output using actual fuel specifications in 2002 provided by the Arizona Department of Weights and Measures. Since the fuel in 2002 had an RVP less than 7.0 psi, the CBG program showed a slight increase in VOC emissions, compared with the base case. The sentence alluding to the approval of the CBG by EPA has been corrected.

Comment: *Measures That Improve Air Quality But Were Not Used for Numeric Credit.* 38 measures are included in the plan under this category. We suggest that you take them out of the plan unless it is MAG's intent to make these measures federally-enforceable by including them in the SIP. If so, you need to provide an implementing agency, a specific commitment to implement, including evidence of funding for the measure, and a timeframe for implementation in order to make them approvable. [CAA section 110(a)(2)]

Response: The Eight-Hour Ozone Plan indicates that some of the committed measures from the EPA approved Serious Area Carbon Monoxide Plan, Carbon Monoxide Redesignation Request and Maintenance Plan, and One-Hour Ozone Redesignation Request and Maintenance Plan improve air quality but were not used for numeric credit in those approved plans. The reduction in ozone precursor emissions attributable to these measures was not easily quantified or may not have been

possible to quantify. Some of these committed measures may continue to reinforce the air quality benefits of the measures for which numeric credit towards attainment was taken. As requested by ADEQ, the two measures which have been repealed have been removed from Chapter Four and a more general discussion will be included.

Comment: *Transportation Control Measure (TCM) Implementation.* For the purposes of verifying timely implementation of TCMs, it would be helpful if you could specifically identify TCMs and their implementation dates, implementing agency, funding source, and timeframe for implementation.

Response: The Revised MAG 1999 Serious Area Carbon Monoxide Plan, approved by EPA on March 9, 2005, includes the implementation dates, agency, funding source, and timeframes for the TCMs that were adopted as part of that plan.

EPA Comments on Chapter 5

Comment:

Motor Vehicle Emissions Budgets (MVEBs) for Transportation Conformity

On page 5-14, the plan indicates that the NOx MVEB for 2008 is 138.2 mtpd, but on page 5-15 the NOx MVEB is listed as 133.1 mtpd. Which is the correct value?

Response: 138.2 mtpd is the correct value; the value on page 5-15 has been corrected.

Comment:

Contingency Measures

HB2538 (2001), Expansion of Area A. Wouldn't this measure already be included in the emissions reductions associated with the measures which apply to Area A in Maricopa County's baseline 2002 emissions inventory? It is not clear how this measure would assist in reducing emissions in the event of a violation of the NAAQS.

Response: Maricopa County's baseline 2002 emissions inventory would include benefits for the expansion of Area A attributable to HB2538. However, in the emissions inventories used to validate the models on the episode days in 2001 and 2002, the benefits of this measure have been removed using GIS. Only credit for the Area A measures within the boundary defined by SB1427 have been assumed in modeling the base years. Additional contingency measures will be considered in the event there is a violation of the NAAQS for eight-hour ozone. (See the response to the comment on Contingency Measures in the EPA Comments on the TSD below).

Comment: In total, the contingency measures are estimated to reduce emissions of VOC by 2.3 percent and NOx emissions by 6.4 percent, whereas the control measures for which credit was taken in total reduce VOC emissions by about 2.3 percent and NOx emissions by about 4.5 percent. If the contingency measures achieve additional reductions equal to or larger than the control measures

credited in the attainment demonstration, and they are already implemented, why do we not see the benefits from the contingency measures in peak ozone concentrations in the modeling?

Response: EPA has published guidelines for the reductions in base case emissions that should be attributable to contingency measures (i.e., at least a 3 percent reduction in VOC and NOx with at least a 0.3 percent reduction in VOC). EPA allows measures that have already been implemented, including federal programs, to be used as contingency measures. However, you must be able to demonstrate that attainment can be modeled without taking emission reduction credit for the contingency measures. The benefits of the contingency measures were removed from the 2008 emissions inventory used to model attainment. The methodologies used to remove the contingency measures are described on pages V-20 through V-24 of the TSD.

EPA Comments on the TSD

Comment:

Modeling

Diagnostic Analyses. MAG should provide documentation of sensitivity and diagnostic analyses performed, and any conclusions from these. The modeling protocol (TSD Appendix I) lists various diagnostic analyses that could be performed using the model, to ensure that it responds in a physically reasonable way to altered inputs. The list included zero boundary conditions, zero initial conditions, diffusion break heights, and other tests such changes in emission levels, emission speciation; alternative wind fields could be added to this list. There should be a summary of any such sensitivity and diagnostic analyses that were performed. This could be an expansion of the "Corroboratory Tests" section. The summary could include references to certain of the analyses that are already described, such as some for meteorology (TSD App. III-ii "Addendum to ENVIRON's Report to MAG: MM5 Meteorological Simulation", 5/19/06 p. III-51), and process analysis (in TSD App. V at page 17). But it should also describe pertinent results from, e.g. the across-the-board and other VOC and NOx emission reduction simulations that MAG performed (these are referred to, but not described, in TSD App. V section on weekend effects.

Response: MAG performed several sensitivity and diagnostic analyses and they are presented in TSD chapter IV-2. Analyses include zero boundary conditions, zero initial conditions, and zero emission sources. MAG will conduct further diagnostic analyses and any conclusions from these analyses will be supplied later as supplemental information.
The summary of the analyses mentioned above (meteorology and process analysis) will be included in the final TSD. The pertinent results from the across-the-board NOx and NOx RACT reduction tests referred in TSD Appendix V was removed from the Draft TSD at the last moment because MAG decided not to apply for a NOx exemption. This results will be supplied later as supplemental information.

Comment: It would be highly desirable to include a color version of TSD App. V in the final electronic document, since some of the graphs are very difficult to interpret in black and white.

Response: A color version of Appendix V will be included in the final document on the MAG website.

Comment: *Unmonitored Area Analysis (UAA).* MAG should carry out an analysis of unmonitored areas using gradient-adjusted spatial fields. If this cannot be completed in time for the submittal deadline, it can be supplied later as supplemental information. The TSD section on "Corroboratory Tests" (p. V-87, in the Attainment Demonstration section) shows results of screening tests to address attainment at locations not at a monitor, and appear to have been adequately carried out and to have shown favorable results. The screening test was described in the 2/17/05 version of EPA's attainment demonstration guidance. This test was superceded by the "unmonitored area analysis" described in the October 2005 guidance version, and in the final version, "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze", EPA-454/B-07-002, April 2007 (web page: http://www.epa.gov/scram001/guidance_sip.htm direct link: http://www.epa.gov/scram001/guidance/guide/final-03-pm-rh-guidance.pdf). Under the later guidelines, Relative Reduction Factors (RRFs) are applied not directly to fields of spatially-interpolated monitoring values, but rather to the fields adjusted using model output gradients. EPA has developed "Modeled Attainment Test Software" (MATS) to carry out this adjustment; MATS has been available in a beta version for several months. An additional corroboratory analysis MAG could consider for unmonitored areas is the direct absolute ozone results from simulation of the future year (i.e., model output for each grid cell, without using RRFs).

Response: Since MAG conducted attainment demonstration based on the October 2005 guidance version, which does not include any information about MATS, gradient-adjusted spatial fields could not be applied for the attainment demonstration. MAG will conduct additional corroboratory analyses as EPA suggested and provide results later as supplemental information.

Comment:

Contingency Measures

Section V-2-2 on page V-16 of the TSD has the following statement: "The Eight-Hour Ozone Plan discusses procedures that will be followed to consider and implement additional contingency measures if they are needed." We did not see this discussion in the plan or TSD.

Response: The following language has been added to the end of the section on Contingency Measures in Chapter Five of the Plan: "The success of an air quality program is measured by the concentrations recorded at the monitors. A violation of the eight-hour ozone standard occurs when the three-year average of the fourth highest annual value at a monitor is 0.085 ppm or greater. Ambient air quality monitoring data will be examined to determine if a violation has occurred. If the standard is violated at any monitor, additional contingency measures will be considered, which may include new measures or the strengthening of existing measures. If a violation occurs, additional contingency measures would be considered on the following schedule: (A) verification of the monitoring data to be completed three months after the violation occurs; (B) applicable contingency measure(s) to be considered for adoption six months after the date established in (A) above, and © contingency measure(s) to be implemented within six to twelve months after adoption, depending upon the time needed to put the measure in place."

Comment:

Control Measures

Coordinate Traffic Signal Systems. The discussion of the control measure Coordinate Traffic Signal Systems on page V-13 indicates that 151 traffic signals would be coordinated between 1997 and 2008. How did you ascertain that only the traffic signals modified since 2002 were credited, since signals synchronized between 1997 and 2002 would be in the base year of the inventory?

Response: State law (ARS 9-500.04 2.) requires jurisdictions to synchronize traffic signals at intersections in Area A that exceed 15,000 motor vehicles per day. MAG applied GIS techniques to 2002 and 2008 traffic assignments to quantify the number of intersections with more than 15,000 average daily trips (ADT). The growth in the number of intersections exceeding 15,000 ADT between 2002 and 2008 was 151 in the CO nonattainment area. This represents a conservative estimate because the law actually applies to intersections in a much larger area (i.e., Area A).

Comment: *Tougher Enforcement of Vehicle Registration and Emission Test Compliance.* Pages V-14 and V-15 of the TSD indicate that the Arizona Department of Transportation has increased staff for this program. However, increased staff does not necessarily translate into increased emissions reductions. How were the emissions reductions associated with this program calculated? The TSD states that "the number of vehicles which participate in the I/M program was increased by 2.0 percent." Was this a total of 2 percent, or 2 percent per year? What is the basis for the 2 percent number? Why would this 2 percent emissions reduction not be included in the baseline 2002 emissions inventory?

Response: At the bottom of Page V-15, under Modeling Methodology, it indicates that the 2 percent was applied by "changing the weighting from 89.6 for I/M and 10.4 for non-I/M to 91.6 and 8.4 respectively." These percentage weights were applied to the emission factors obtained from MOBILE 6.2 run with and without the I/M program. This is consistent with the methodology used to model this measure in the Serious Area CO Plan and the CO and One-Hour Ozone Redesignation Request and Maintenance Plans, all of which were approved by EPA. This shift in the I/M weighting results in a very small emissions reduction: less than a 0.1 percent reduction in anthropogenic VOC and NOx emissions in 2008. As discussed in the first response under Chapter 4, credit for attainment measures that were implemented before the base years was applied to the 2001 and 2002 modeling emissions inventories, as well as the 2008 attainment modeling emissions inventory.

COMMENTS FROM THE ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY (Letter from Nancy C. Wrona dated June 4, 2007 received by e-mail and hand delivery June 4, 2007)

Comment: ADEQ understands the complexity of this planning effort and recognizes that MAG has worked diligently to develop this plan, including collaboration with ADEQ. At the same time, ADEQ has concluded that implementation of additional control measures will be necessary to attain the eight-hour ozone standard. ADEQ is aware that recent staff work by EPA recommended changing the eight-hour ozone standard to below .080 parts per million to as low as .060 parts per million to protect public health for sensitive groups. For those reasons, ADEQ does not concur that committed measures in the Serious Area Carbon Monoxide Plan, Carbon Monoxide Maintenance

Plan, and the One-Hour Ozone Maintenance Plan will result in attainment of the eight-hour averaged ozone standard.

Response: Based upon local air quality monitoring data, there have been no violating monitors for the eight-hour ozone standard for two consecutive three year periods: 2003-2005 and 2004-2006. The air quality monitoring data indicates that the eight-hour ozone standard has already been attained with the existing measures. According to the EPA Final Rule to Implement the Eight-Hour Ozone National Ambient Air Quality Standard-Phase I, dated April 30, 2004, "attainment is determined based on an average of the 4th high reading at a monitor over a three year period. Thus, the 4th high reading for an area could be above the NAAQS for one or both of the years proceeding the attainment year, but so long as the 4th high level for the other year(s) was low enough to produce an average at or below 0.84 parts per million, the area would be attaining the NAAQ."

In reviewing the air quality monitoring data for the eight-hour ozone standard for the last seven years, there has been a downward trend in the number of violating monitors. In 2000, there were seven violating monitors. In 2005 and 2006, there were no violating monitors based upon the three year average of the 4th high readings. In addition, the air quality modeling demonstration and weight of the evidence demonstration in the Eight-Hour Ozone Plan indicate attainment of the standard for 2008 ozone season.

The current eight-hour ozone standard was promulgated by EPA in 1997. The EPA nonattainment area designations were not effective until June 15, 2004. This region is classified as a Basic Area under Subpart 1 of the Clean Air Act and has a June 15, 2009 attainment date. The current air quality monitoring data indicates that the standard has been met well before the attainment date.

Based upon the EPA 2007 Fact Sheet entitled, Review of National Ambient Air Quality Standards for Ozone Final Staff Paper, Human Exposure and Risk Assessments and Environmental Report, EPA indicated that it will propose action to revise or retain the current ozone standards by June 20, 2007 and then take final action by March 12, 2008. If EPA revises the eight-hour ozone standard to be more stringent, it is anticipated that EPA would then make the nonattainment area designations in 2011. This timeline assumes no delays due to ensuing legal challenges.

Comment: To that end, the Plan should have evaluated the following control measures: A Liquid Leaker Test component added to the Vehicle Emissions Test; Seasonal Open Burning Ban 5/1 through 9/30 each year and Cleaner Burning Gasoline (CBG) in western Pinal County.

Response: At this time, there are no commitments to implement the Liquid Leaker Test, Seasonal Open Burning Ban, and Cleaner Burning Gasoline for western Pinal County. These measures would fall under the authority of the Arizona Legislature and the Legislature has not passed the necessary legislation.

In accordance with the Clean Air Act, only measures with commitments for implementation may be included in the adopted plan and modeling attainment demonstration. To rely on measures with no commitments for implementation to attain the eight-hour ozone standard would be a direct violation of the Clean Air Act requirements in Section 110 (a)(2). If the legislature passes legislation with additional controls, additional submittals may be made to EPA to include the measures in the Eight-Hour Ozone Plan.

At the national level, the Environmental Protection Agency has added new ozone control measures for Consumer and Commercial Products under Section 183(e) of the Clean Air Act. On May 30, 2007, EPA issued an Emission Reduction Credit Memorandum regarding these measures.

Comment: ADEQ has determined that the documents that MAG made available on the Internet for public review are not adequate to help interested publics review the complex and lengthy documents. The posted plan was not searchable, and because it was in black and white many of the graphics were difficult to interpret. Appendices III and IV of the Technical Support Document were not listed on the website, and it was later determined that they were included at the end of the file labeled Appendix II. The website should include information on how to obtain copies of MAG studies.

Response: The public hearing advertisements for the Draft Eight-Hour Ozone Plan for the Maricopa Nonattainment Area indicate that the draft document is available for public review at the MAG Office, third floor, from 8:00 a.m. to 5:00 p.m. Monday through Friday. Often times, members of the public come to the MAG Office and review the draft documents in the library. The website was not used to comply with the document availability for public review.

As ADEQ acknowledges, the draft document was also available on the MAG website. Appendices III and IV of the Technical Support Document were appropriately located behind Appendix II. MAG will take into consideration your suggestions to make the website more convenient. If ADEQ is experiencing difficulty navigating the website, ADEQ is welcome to call MAG for assistance, as the ADEQ staff member did in this case.

Comment: Although the June 15, 2007 submittal deadline has been known for several years, the Eight-Hour Ozone Planning Team did not meet until February 1, 2007. Its second and last meeting was February 9, 2007 to discuss both the Eight-Hour Ozone Plan and the Five Percent Plan for PM-10. One identified issue was resolved in subsequent teleconference calls on April 20 and 27, 2007. The remaining issues identified in this comment letter were never elevated or referred by the Planning Team to the Air Quality Policy Team for consideration. The Silt Loading Study and Biogenics Study were not provided to the Planning Team. When an ADEQ employee contacted MAG on May 29 to access the Biogenics Study, he learned that it was not electronically available on the website but that a photocopy would be provided to him.

Response: The Maricopa Nonattainment Area was classified as a Basic Area effective June 15, 2004. The June 15, 2007 plan deadline has been known for three years as opposed to several years.
The Air Quality Planning Team members include the staff from the Arizona Department of Environmental Quality, Arizona Department of Transportation, Maricopa County Air Quality Department and Maricopa Association of Governments. Any member of the Air Quality Planning Team may call a meeting or elevate issues to the Air Quality Policy Team at any time. If any member of the Air Quality Planning Team would like a copy of the various MAG studies mentioned by ADEQ, the member may request a copy.

Regarding the preparation of the Eight-Hour Ozone Plan, ADEQ is incorrect in stating that the Planning Team did not meet until February 1, 2007. Specifically, Planning Team meetings were conducted on October 19, 2005; December 13, 2006; and February 9, 2007. The February 1, 2007 meeting was on the Eight-Hour Ozone Plan and included not only staff on the Air Quality Planning Team but others as well. The Air Quality Planning Team was also provided with a copy of the Draft

Ozone Modeling Protocol on October 5, 2005. In addition, there were several Air Quality Planning Team meetings to discuss the data, issues and implications of the eight-hour ozone boundary. There have also been discussions and presentations on the preparation of the Eight-Hour Ozone Plan and the modeling at the MAG Air Quality Technical Advisory Committee meetings, which include the members of the Air Quality Planning Team.

Comment: The MAG Air Quality Policy Committee in existence in 1992 was subsequently recast by MAG as the Air Quality Technical Advisory Committee (AQTAC) without amendment to the Memorandum of Agreement.

Response: The MAG Air Quality Policy Committee was established by MAG in 1975, approximately seventeen years before the Air Quality Memorandum of Agreement. In 1994, the MAG Regional Council established the Air Quality Technical Advisory Committee, in addition to the Air Quality Policy Committee. In 1999, MAG streamlined its committee structure and the Air Quality Policy Committee was replaced by the Air Quality Technical Advisory Committee. The Standing and Special Committees of MAG are created by the MAG Regional Council pursuant to the MAG Bylaws. According to the Air Quality Memorandum of Agreement, the Agreement may be amended at any time upon mutual written agreement of all parties.

Comment: MAG scheduled the Public Hearing on Friday, June 1, 2007 at 5:30 p.m. After ADEQ advised MAG that the general public would not be well served by that schedule, a second Public Hearing was scheduled for the following Tuesday.

Response: MAG scheduled the first Public Hearing for Friday, June 1, 2007 at 5:30 p.m. When ADEQ indicated that Friday may be questionable, MAG then promptly offered to schedule a second Public Hearing for Monday, June 4, 2007 at 5:30 p.m. Two public verbal testimonies were presented at the Friday, June 1, 2007 Public Hearing. No public verbal testimonies were presented at the Monday, June 4, 2007 Public Hearing. MAG was pleased to offer two Public Hearing opportunities to the general public.

Comment: MAG has not added any new control measures to achieve the new eight-hour ozone standard despite the narrow margin relied upon for its attainment demonstration. ADEQ is not confident that the modeled attainment demonstration will be achieved unless the additional control measures identified on the first page of this comment are added to the plan.

Response: The modeling attainment demonstration and weight of the evidence demonstration included in the Eight-Hour Ozone Plan indicate attainment of the eight-hour ozone standard in the ozone season of 2008 which is prior to the attainment date of June 15, 2009. Currently, the air quality monitor data indicates that there have been no violating monitors for the three year average of the 4th high readings for the two consecutive three year periods of 2003-2005 as well as 2004-2006.

On May 30, 2007, the EPA issued an Emission Reduction Credit Memorandum for three Federal Rules for Categories of Consumer and Commercial Products under Section 183(e) of the Clean Air Act. These federal rules may yield additional emissions reductions for ozone precursors.

As stated previously, if the Arizona Legislature passes legislation to implement the three ozone control measures discussed by ADEQ, there will be additional control measures to reduce emissions

which contribute to ozone formation. Additional supplements may be prepared at any time to include additional ozone control measures in the eight-hour ozone plan.

Comment: The Plan also included 38 measures from past CO Plans and the One-Hour Ozone Maintenance Plan and stated that emission reduction benefits associated with these measures were not quantifiable. Many of these measures were repealed, not fully implemented or should have been reflected in the base case. ADEQ recommends retention of only those measures that have been fully implemented and are not reflected in the base case.

Response: The Eight-Hour Ozone Plan indicates that some of the committed measures from the EPA approved Serious Area Carbon Monoxide Plan, Carbon Monoxide Redesignation Request and Maintenance Plan, and One-Hour Ozone Redesignation Request and Maintenance Plan improve air quality but were not used for numeric credit in those approved plans. The reduction in ozone precursor emissions attributable to these measures was not easily quantified or may not have been possible to quantify. Some of these committed measures may continue to reinforce the air quality benefits of the measures for which numeric credit towards attainment was taken. As requested by ADEQ and EPA, the two measures which have been repealed have been removed from Chapter Four and a more general discussion will now be included in the plan.

Comment: Control measures and the Emission Inventory should both be expressed in English tons to enable evaluation of the efficiency of the measures.

Response: The conversion from English tons to metric tons will be added as a footnote to Figure 3-1 and Table 3-1. The only use of English tons in the Plan is in the 2002 PEI in Chapter 3 and Appendix A, Exhibit 1.

Comment: With the addition of the control measures identified on the first page of the comment and additional modeling consistent with the suggestions above, ADEQ is confident that the Phoenix Eight-Hour Ozone Planning Area will attain the national public health standard on or before the deadline of December 31, 2008, ADEQ appreciates the time and effort MAG has devoted to technical planning work.

Response: At the national level, the Environmental Protection Agency has added new ozone control measures for Consumer and Commercial Products under Section 183(e) of the Clean Air Act. On May 30, 2007, EPA issued an Emission Reduction Credit Memorandum regarding these measures. If the Arizona Legislature passes legislation with commitments to implement the three measures identified by ADEQ, the additional measures may be submitted in a supplement to EPA to include the measures in the eight-hour ozone plan. At this time however, there are no commitments to implement those measures.

ADEQ Comments on Emissions Inventory

Comment: *Population.* The population estimates for 2010 for "County Areas" reflecting unincorporated portions of the County, minus Indian Country, should be corrected to 231,390 instead of 92,900. The corrected figure is based on the Department of Economic Security estimate for July 1, 2006. The total at the bottom of the 2010 column should be increased by 138, 490 to read 4,272,890.

Response: The population for the unincorporated portion of the County and the population of County Areas rely on two different geographies. The correct figure for County Areas in 2010 is 92,900.

The population of the July 1, 2006 **unincorporated portion** of the county is the difference between the July 1, 2006 population of twenty four cities and towns based on their CURRENT boundaries along with three Indian communities (Maricopa County portion of the Gila River Indian Community, the Salt River Pima-Maricopa Indian Community and the Fort McDowell Yavapai Nation), and the total population of Maricopa County. In 2006 this figure is 231,605.
The projected population of **County Areas** for 2010 is the difference between the sum of the projected population of twenty-four cities and towns and the Indian Communities, based on their anticipated FUTURE boundaries, and the total population of Maricopa County. These future boundaries are referred to Municipal Planning Areas, and include areas that are currently in the unincorporated area of the county. Therefore, County Areas do not include the "county islands" that fall within Municipal Planning Areas. In 2010 the projected population of the County Areas is 92,900 based upon the MAG 2003 Interim Socioeconomic Projections.

In addition to the difference in definitions between the unincorporated area and County Areas, it should be noted that the July 1, 2006 population estimates are for a period in time that is four years earlier than the 2010 projections.

Comment: MAG should add an explanation on page 5-5 of the Plan, or cross-reference the appropriate page of the Technical Support Document, to explain its choice to increase anthropogenic VOC and NOx emissions for the 2001 and 2002 episodes it modeled by only 3% for the 2008 estimates. MAG's population estimates in Table 2-1 show a linear population increase of 18.8% from 2002 to 2008, far greater than the 3% increase MAG selected for modeling purposes. The reason for the difference between population increase and MAG's projected anthropogenic emissions increase is not apparent and has not been explained in the Plan.

Response: Anthropogenic VOC and NOx emissions for 2008 were estimated from the emissions for the 2001 and 2002 episodes applying growth factor. Then additional three percent was applied to the 2008 estimates to reflect an expected increase in population and employment projections for the modeling domain based on the 2005 Census Survey. In other words, the 2008 projection was increased by three percent in addition to the referenced 18.8 percent linear population increase between 2002 and 2008. This paragraph could be found in *V-3. Future Year Emission Inventories* of the Eight-Hour Ozone Technical Support Document. As well as the TSD, the paragraphs on page 5-5 are self-explanatory about this issue and Tables 5-3 and 4 showing emission comparison between base year and future year provide information that projected emissions increase is more than three percent. Additional information on the growth factors is presented in Appendix IV-iii.

Comment: *Biogenics*. Definition: Figure 3-1 on page 3-3 of the Plan divides the 65% to show 33.2% "Residential Wood burning... wildfires" and 32.5% biogenic emissions. The Plan needs to explain what was included in the term "biogenics" in the 2002 Periodic Emissions Inventory and compare it to the use of the same term on page 3-3 for purposes of the 2005 Emissions Inventory.

Response: Table 3-1 summarizes data from the 2002 Maricopa County Periodic Emissions Inventory (PEI) for ozone precursors. This inventory is included in Chapter 3, because EPA requires that the

most recent inventory be included in the Plan. (See Appendix A, Exhibit 1.), even if some of the assumptions differ from the emissions inventories developed to model attainment. The biogenic emissions in the 2002 PEI were prepared using MAGBEIS and default emission rates based primarily on measurements of East Coast vegetation. The Maricopa County Air Quality Department (MCAQD) is in the process of preparing the 2005 PEI for ozone precursors that will include the biogenic emissions estimates from MEGAN.

Comment: *Biogenics*. Study Area Selected: The 8-Hour Ozone Nonattainment Area is nearly twice the size of the 1-Hour Ozone Nonattainment area. Although the 8-Hour nonattainment area is approximately 12,533 square kilometers (4880 square miles), the Study Area that MAG's contractor ENVIRON selected covers 33,562 square kilometers-2.68 times the size of the Nonattainment Area. The largest of the 25 land use categories in the Study area, entitled Palo Verde-Mixed Cacti-Scrub, exceeds the size of the entire Nonattainment Area at 14,852 square kilometers. ENVIRON's study placed an inappropriate emphasis on areas downwind and outside of the expanded 8-Hour Ozone Nonattainment Area. These areas to the east of the Nonattainment Area are downwind from the most significant portion of the diurnal isoprene cycle. Biogenic emissions are lower in the urbanized areas that constitute the majority of the actual Nonattainment Area.

Response: The size of the Eight-Hour Ozone Nonattainment Area is approximately 12,638 square kilometers and the size of the eight-hour ozone modeling domain is 23,200 square kilometers, which is 1.84 times the size of the Eight-Hour Ozone Nonattainment Area. Traditionally, air quality models adapt rectangular modeling domain. In that reason, to run a model for the area having irregular shape, like the Eight-Hour Ozone Nonattainment Area, a rectangular domain covering the whole interest area is configured. When MAG set up the modeling domain in consultation with ENVIRON, it was considered and the eight-hour ozone modeling domain was set to cover all the edges of the Eight-Hour Ozone Nonattainment Area. Therefore the current modeling domain size is almost the minimal as we could get. Also the Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS states that isolated nonattainment areas of the western U.S. that are not impacted by regional ozone and ozone precursors may be able to use a relatively small domain. The biogenic study area means the eight-hour ozone modeling domain instead of the Eight-Hour Ozone Nonattainment Area. It explains the size of area covered by Paloverde-Mixed Cacti-Scrub, which is 14,852 square kilometers, is less than the study area and the value is correct.

Comment: *Biogenics*. Local Emission Factors: ENVIRON developed its very first emission factors for desert vegetation in its new MEGAN Model Biogenics Study for the Phoenix area. ADEQ has concluded that these emission factors are over estimated.

- ENVIRON's in-situ, small sampling techniques produced results that are not in agreement with widely recognized estimates and appear to err on the high side by substantial amounts.

- ADEQ has compared the ENVIRON emission factors to published U.S. Geological Survey (USGS) factors and has found that ENVIRON's factors are substantially higher. For example, ENVIRON has assigned the Palo Verde-Mixed Cacti-Scrub category an emissions rate that is 87% of the USGS emissions rate for a deciduous forest. Likewise, ENVIRON assigned an emission factor 5.5 times the USGS factor for conifer forests to the Pinon-Juniper.

The Plan should explain the differences between the ENVIRON emission rates and the USGS emission rates or revise the emission rates used in the Plan. MAG should also revise page ES-7 and Figure 3-1 of the Draft Plan to focus on the vegetation that contributes to ozone formation inside the boundaries of the nonattainment area-not downwind vegetation.

Response: The biogenic emissions for the attainment demonstration were estimated by MEGAN (Model of Emissions of Gases and Aerosols from Nature) using vegetative emissions rates measured in Maricopa County during June 2005. MEGAN is a state-of-the-art biogenics model developed by Dr. Alex Guenther, under the sponsorship of EPA, the National Science Foundation, and the National Center for Atmospheric Research. Unlike other biogenic models (i.e., GLOBEIS, MAGBEIS), MEGAN uses a bottom-up approach that more accurately reflects current understanding of the processes controlling biogenic emissions. The pie charts in Figure ES-2 (for 2002) and Figure ES-5 (for 2008) of the Executive Summary present biogenic emissions estimated by MEGAN for the ozone modeling domain.

Table 3-1 summarizes data from the 2002 Maricopa County Periodic Emissions Inventory (PEI) for ozone precursors. This inventory is included in Chapter 3, because EPA requires that the most recent inventory be included in the Plan. (See Appendix A, Exhibit 1.), even if some of the assumptions differ from the emissions inventories developed to model attainment. The biogenic emissions in the 2002 PEI were prepared using MAGBEIS and default emission rates based primarily on measurements of East Coast vegetation. The Maricopa County Air Quality Department (MCAQD) is in the process of preparing the 2005 PEI for ozone precursors that will include the biogenic emissions estimates from MEGAN.

In addition, local emission factors estimated by MEGAN, which are based on the local measurement, are expected to be different from the USGS factors, which are based on the normalized values for the entire Arizona.

Comment: *Biogenics*. Modeling versus Weight of Evidence Analyses: Figure IV-19 in the TSD shows that zeroing out biogenic emissions results in peak ozone concentration dropping by 8 ppb on June 7, 2002. In contrast, the Weight of Evidence Analysis in Appendix V, page 17, states that isoprene (a major component of biogenic VOCs) has little impact on ozone formation. This inconsistency needs further explanation.

Response: The description of Figure 14(g) showing the Fractional contribution of isoprene to reaction of OH radicals with VOCs in Table 5 of the Weight of Evidence Analysis in Appendix V, page 21, presents its interpretation as below:

- Only a small fraction of OH radicals reacting with VOCs in the Phoenix urban plum are reacting with (biogenic) isoprene. This fraction is low with GloBEIS biogenic emissions and almost zero with MEGAN biogenic emissions.

- Biogenic VOCs other than isoprene (i.e., terpenes and other VOCs) may be driving the impact of biogenic emissions on ozone production in Phoenix.

It describes that isoprene has little impact on ozone formation in the Phoenix urban plum but some impact in the other area. In Table IV-16 in the TSD shows that daily maximum one-hour ozone for zeroing out biogenic emissions occurs in suburban area and this result accords with the statement above in the Weight of Evidence Analysis.

Comment: Mobile Sources. The calculation of on-road mobile emissions used for the Draft Plan is problematic. Appendix IV presents several MOBILE6 input files. MAG used the command "FUEL PROGRAM: 2 S" to simulate Cleaner Burning Gasoline (CBG) in Area A and added another command, "FUEL RVP: 7.0", to specify Reid Vapor Pressure (RVP) in Area A. The command "FUEL PROGRAM: 2 S" models the effect of a Federal Reformulated Gasoline (RFG) program in the Southern region. In MOBILE6, the default fuel properties for the Federal RFG option for the summer of calendar 2008 are as follows:

RVP: 6.8 psi;
Ether oxygen content: 2.1% by weight;
Ether market share: 100%.

No matter what value is specified in the command "FUEL RVP", the command "FUEL PROGRAM: 2 S" overrides it. The net effect of using the two commands MAG chose was to set RVP at 6.8 psi and ether oxygen content at 2.1% by weight. However, Arizona banned all ether oxygenates in gasoline effective on January 1. 2005. The ether oxygen content for gasoline is 0% instead of "2.1% by weight," and the "Ether market share" in the 8-Hour Ozone Planning Area is also 0%. Therefore, the following commands should be used in the MOBILE6 modeling for this Plan: "FUEL PROGRAM: 4" to set the sulfur content and "RVP" to specify the actual RVP. The 2006 retail sampling, conducted by the Arizona Department of Weights and Measures for the months of May through September, show average sulfur content of 50 ppm and RVP of 6.5 psi. Note that additional emission reductions may need to be applied to account for the fact that summertime CBG meets federal RFG standards. This modeling should be repeated using the revised inputs.

Response: As presented in the TSD Appendix II-BASE YEARS EMISSION INVENTORY DEVELOPMENT, MAG used "FUEL PROGRAM: 4" with RVP of 6.5 psi for the base years, which is exactly the same configuration suggested by ADEQ, with collaboration from the Arizona Department of Weights and Measures (Mr. Yantorno). One of attainment measures for the future year in the Eight-Hour Ozone Plan is summer fuel reformulation (California Phase 2 and Federal Phase II Reformulated Gasoline). To adapt this measure to MOBILE6, the FUEL PROGRAM command options 2 or 4 could be used. MOBILE6 treats FUEL PROGRAM command option 4 as a conventional gasoline program with alternate sulfur levels so that additional emission reductions are required to account for the fact that summertime Arizona CBG meets federal RFG standards as ADEQ noted. In addition, although MOBILE6 allows users to enter alternate sulfur levels, user-

supplied sulfur levels in the FUEL PROGRAM command option 4 just approximates the non-sulfur effects of RFG. On the contrary, the FUEL PROGRAM command option 2 S more closely reflected the summertime CBG in Area A to meet the federal RFG standards without additional emission reductions. For this reason, the FUEL PROGRAM command option 2 S was used in the One-Hour Ozone Maintenance Plan approved by EPA on June 14, 2005 and also in the Eight-Hour Ozone Plan.

ADEQ Comments on Attainment Demonstration Modeling

Comment: *Mathematical demonstration.* The attainment demonstration relies on truncating a modeled value of 0.0847 parts per million (ppm), as allowed by Federal regulations. Rounding up to 0.085 ppm would demonstrate nonattainment. The demonstration relies on a statistical margin of 0.0003 ppm, which is considerably less than the margin of error for this type of modeling demonstration.

Response: The Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze (page 41) states that the final future design value is *truncated.* This effectively defines attainment in the modeled test as <= 84.999 ppb and nonattainment as >= 85.0 ppb. This guidance does not mention about the margin of error for modeling demonstration but additional analyses to supplement the primary modeling analysis for the attainment case, in which the projected future design value is closer to the NAAQS. Thus, MAG provided weight of evidence analysis as supplemental analysis.

Comment: *Validation of actual episodes.* The uncertainties in this modeling demonstration are high because the model only successfully simulated the transport episode (June 2002). It significantly underestimated peak ozone concentrations for both the local production-dominated episode (July 2002) and the combination of the transport and local formation episode (August 2001). The cause of the underestimation has not been clearly identified in the Plan or TSD. This unresolved bias, which could be due to a bias in meteorological field or bias in chemistry, call into question the validity of the modeling analysis.

Response: In the TSD, page IV-29, it was mentioned that the modeled wind speed and wind direction misdirect the ozone plume in the July 2002 episode. MAG may consider to provide additional diagnostic analyses to identify any bias causing the underestimation for both the July 2002 and August 2001 episodes later as supplemental analysis.

Comment: *Predicted emissions reductions.* The modeling does not convincingly demonstrate attainment because the predicted reduction of peak ozone concentrations is nearly zero.

- The model predicts that total NOx emissions are only reduced by 1.7% and that total VOC emissions increase by 0.5%. These small modeled changes in ozone precursors are not sufficient to guarantee attainment.

- For many monitoring sites, the predicted peak ozone concentration is increased from the baseline conditions.

- MAG has projected concentrations for 6 of the 18 monitoring sites to be greater than 95% of the National Ambient Air Quality Standard in the attainment year.

- Attainment is demonstrated in this modeling because only one of the 18 values used in the baseline design value is an exceedance, not because of the effectiveness of the control measures in the Plan.

Response: The Plan and TSD present that total NOx and VOC emissions reductions from attainment measures are approximately 4.6% and 2.4%, respectively. Concerning of short time frame from the Plan submission to the attainment deadline, these changes in ozone precursors are not small. Although the predicted reduction of peak ozone concentrations is not significant, the modeling demonstrates attainment because of the effectiveness of the control measures in the Plan. In addition, the Weight of Evidence Analysis concludes that ozone concentrations in the Maricopa Nonattainment area are trending downward and that the federal standard for eight-hour ozone will be attained by June 15, 2009.

Comment: *Meteorological modeling*. Vertical diffusivity: Typically, modelers choose a single vertical diffusivity calculation for all episodes modeled in the same region in the same season. The TSD at page III-47 states that two different vertical diffusivity calculation options were applied according to the results of sensitivity testing, one for the transport-dominated episode and the combination episode, and the other for the local formation-dominated episode.

- The Plan should explain why two different options were chosen for the same ozone season and the same region, and it should explain the criteria used to select each of the two options.

- In the alternative, a single vertical diffusivity calculation should be used for additional modeling.

Response: Although modelers may typically choose a single vertical diffusivity calculation for all episodes modeled in the same region in the same season, the EPA's guidance does not mention about consistency of vertical diffusivity calculation for all modeling episodes. In addition, these vertical diffusivity options were adapted in consultation with ENVIRON.

Comment: *Meteorological modeling*. Mixing height: Past work by Sonoma Technology and others demonstrates that the diurnal variation of mixing height is even more important than the maximum value. Studies have shown that slow development of mixing height is a cause of excessive ground-level ozone.

- It would be helpful to understand the impact of mixing height on peak ozone concentrations by plotting diurnal mixing height for the peak ozone grid cells for all three episodes.

- ADEQ's wind profiler data for the past two years may be available for use to determine the hourly mixing heights. These data may be used to explore the typical mixing height for the design dates.

Response: MAG may consider to exam the impact of mixing height on peak ozone concentrations by plotting diurnal mixing height for the peak ozone grid cells for all three episodes.

Comment: *Meteorological modeling*. Site-to-site variation: A model/observation comparison is provided in the ~~Plan~~ TSD for means, not for individual sites. For the July 2002 and August 2001 episodes, when ozone is underestimated, observational precipitation, humidity, temperature and wind data near the peak location could be compared with the modeled values.

- Site-to-site variation could be significant; averaging them could mask the actual impact. Site-specific comparisons of meteorological data may reveal the factor or factors that contribute most to the under-prediction of ozone by the model.

Response: A model/observation comparison in the TSD Appendix III-i was provided by ENVIRON. Those statistical evaluations for typical meteorological model performance (not for individual sites but entire region by averaging) have been widely adopted in many local and regional air quality modeling studies throughout the U.S.

Comment: *Sensitivity Testing*. The TSD at page IV-85 states that sensitivity test for emissions were conducted by simply modeling 100% emission reductions from (zeroing out) each entire emission category: mobile sources, area sources, and point sources.

- Zeroing out on-road and off-road NOx emissions should reduce modeled ozone concentrations, because Reformulated Gasoline resulted in actual reductions of ozone in this Planning Area, but MAG's modeling shows inconsistent patterns of ozone concentrations when these sources were eliminated For the June 2002 episode, the modeled peak ozone concentration increased as mobile source emissions were eliminated in the 2nd-4th days, but decreased on the 5th day (TSD at page IV-87). A similar pattern occurred in the other two modeled episodes. A consistent pattern would have been expected on all five days.

- The Plan does not clearly explain why removing significant ozone precursors (especially NOx from mobile sources) would lead to a higher peak ozone concentration at all, much less on three of five days in an episode. This modeling performance should be explained.

- Sensitivity testing should be used to evaluate the effectiveness of each control measure selected for inclusion in the Plan.

- Since the Emission Inventory shows the dominant contributor to NOx to be mobile source (63%) and the dominant contributor to VOCs to be biogenic emissions (65%), the elimination of the majority of NOx or VOC emissions does not represent a realistic scenario. Sensitivity testing should be conducted in an incremental manner such as 20% or 30% emission reductions.

Response: As referred in the comments, MAG conducted sensitivity tests for emissions (both NOx and VOC) by modeling 100% emission reductions (zeroing out) from each emission category: on-road, non-road, area, point, and biogenic sources. Zeroing out on-road and off-road reduces not only NOx emissions but also VOC emissions. Since photochemical model predicts ozone concentrations from the process of the complex chemical reactions under various meteorological conditions, it may not be expected to have consistent responses to a certain amount of emissions reduction for both NOx and VOC in a certain modeling episode. However, we may expect a consistent pattern when we reduce emissions for a single component, either NOx or VOC. Under the NOx-rich and VOC-limited conditions in urban Phoenix area, it is expected to have consistent patterns that NOx reductions will increase ozone concentrations and VOC reductions will decrease ozone concentrations. These phenomena were consistently observed on the other sensitivity tests for NOx exemption, which was not included in the TSD. To reflect ADEQ's suggestions, MAG may consider to conduct a series of sensitivity tests for each source category for each emission category (NOx and VOC) in an incremental manner such as 20% or 30% emission reductions and to evaluate the effectiveness of each control measure selected in the Plan. These results may be supplied later as supplemental information.

Comment: Weekday versus weekend. ADEQ suggests that MAG also examine the differences in weekday versus weekend ozone concentrations for the July 2002 episode. For this local production-dominated episode, the predicted weekend ozone concentrations for July 12-13 are significantly higher than some of the predicted weekday concentrations.

- This result is unexpected for a local formation-dominated episode when local ozone precursor emissions are significantly reduced.

Response: In the July 2002 episode, weekend days are July 13 (Saturday) and 14 (Sunday). Figure IV-9 in the TSD shows the predicted weekend ozone concentrations are not significantly higher than the predicted weekday ozone concentrations at most sites. Although, at the few number of sites, weekend ozone concentrations, especially July 13 (Saturday), were predicted slightly higher than some of weekday ozone concentrations, the same phenomenon was observed at those monitoring sites. In any case, MAG will examine the differences in weekday versus weekend ozone concentrations for the July 2002 episode and the results will be supplied later as supplemental information.

Comment: *Transported ozone*. ADEQ suggests further examination of the contribution of transported ozone and the possible larger contribution of locally produced ozone than this modeling shows.

- The ozone-precursor relationship in the July 2002 episode could provide insight on the contribution of regional transport to high ozone and on the effectiveness of controlling mobile emissions to reduce peak ozone.

- ADEQ suggests conducting source apportionment analysis, or at least quantitatively estimating the transported ozone versus the locally formed ozone.

- The qualitative discussion in the Weight of Evidence Analysis is not sufficient, since it only indicates an upper limit of the transport ozone. Ozone may also be transported from aloft over a longer distance, which could not be reliably captured by upwind surface monitors.

- ADEQ suggests plotting ozone versus altitude to see the vertical ozone distribution. This may help to identify ozone transport from aloft and reveal regional transport. These exercises could help diagnose the contribution of transport compared to locally-formed ozone and point to effective control measures necessary for attainment and maintenance.

Response: MAG may consider to conduct further examination of the contribution of transported ozone suggested by ADEQ. Examination may include the ozone-precursor relationship in the July 2002 episode, the vertical ozone distribution, and quantitative estimation of the transported ozone versus the locally formed ozone. The results may be provided later as supplemental information.

Comment: *Precursors*. MAG compared modeled ozone to monitored ozone data.

- ADEQ recommends comparing modeled NOx concentrations with monitored NOx data, and comparing modeled VOC concentrations to monitored VOC data. Five NOx monitors and two VOC monitors are in the Planning Area, and ADEQ and Maricopa County Air Quality Department data are available. These comparisons will provide information on how well the model replicates actual photochemistry.

- ADEQ also recommends plotting modeled peak ozone versus modeled NOx concentrations, VOC concentrations, and the VOC/NOx ratio for the June 2002 and July 2002 meteorological regimes to see if there is any correlation.

Response: MAG may consider to provide additional analyses dealing with comparing modeled NOx/VOC concentrations with monitored NOx/VOC data, plotting modeled peak ozone versus modeled NOx concentrations, VOC concentrations, and the VOC/NOx ratio for the June 2002 and July 2002 later as supplemental information.

Comment: *Relative ~~Response~~ Reduction Factor (RRF)*. According to the 'Guidance on the Use of Models and Other Analysis for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze' [EPA, April 2007 at page 145], RRF should be calculated based on no less than 5 modeled days to provide statistical robustness. To support the use of less than 5 days in the RRF calculation, the variability of daily RRF should be analyzed. In this Plan, most RRFs are calculated based on 4 or fewer modeled days, raising the uncertainty of these RRF values-especially when the attainment demonstration is so marginal. The RRF ranges from 0.990 to 1.013, showing very little emission reduction, if any. Again, the control measures in this Plan do not appear to be sufficient to reduce ozone concentrations.

Response: As presented in the Eight-Hour Ozone Modeling Protocol and the Eight-Hour Ozone Plan, modeled days are 5 (June 2002 episode) or 7 days (July 2002 and August 2001 episodes). Therefore, none of modeled episodes has less than 5 modeled days. In addition, before MAG submitted the Protocol, number of modeling days was discussed with EPA Region IX (Scott Bohning) and it was allowed to use these numbers of days. Also the Protocol was accepted by EPA Region IX.

Comment: *NOx Waiver versus Safety Margin.* The Draft Technical Support Document should be revised on Page I-2 to be consistent with the NOx safety margin in the Draft Plan, which replaced an earlier NOx waiver concept. The following sentences are no longer accurate: "A secondary objective of the modeling was to evaluate the complex chemical relationships between precursor emissions of volatile organic compounds and nitrogen oxides and the formation of ozone. This evaluation has concluded that additional reductions in NOx emissions do not contribute to attainment of the eight-hour ozone standard in 2008; and therefore, the Maricopa nonattainment area qualifies for a NOx exemption under section 182(f) of the Clean Air Act."

Response: This language has been revised on the section.

ADEQ Comments on Weight of Evidence Analysis

Comment: TSD Appendix V, page 10: The trend analyses for NOx and VOC emissions show sizable reductions for seven (1999-2006) or nine (2006-2015) year periods, averaging a reduction of 2-3 tons per day; however, the NOx concentration trend analysis shows up and down trends in the time period from 1999-2006. The model results also show that a 5 tons per day reduction in NOx does not provide any reliable ozone concentration reduction (RRF for June 2002 in a range of 0.990-1.013). It appears that the magnitude of the emission reductions is not sufficient to reduce ozone.

Response: As described in the Weight of Evidence Analysis in Appendix V, the VOC/NOx ratio and process analyses indicate that the condition in central Phoenix is NOx-rich and VOC-limited, which means decrease of NOx will tend to increase ozone and decrease of VOC will tend to decrease ozone. Even the suburban areas have similar conditions. Therefore, any magnitude of NOx reduction is not sufficient to reduce ozone concentration and the model results accords with this. Inconsistent trends between the trend analysis for NOx emissions and the NOx concentration trend analysis are reasonable because observed concentrations, which are the resultant of the complex chemical reactions under various meteorological conditions, may not directly correlate with anthropogenic emissions.

Comment: TSD Appendix V, page 16: VOC/NOx ratio analysis was only done for June 7, 2002. It should also be conducted for the July 2002 episode, since it is assumed to be an entirely different meteorological regime. This analysis does not provide sufficient explanation of how the modeled ozone concentration would respond to changes in the VOC/NOx ratio.

Response: MAG may consider conducting additional VOC/NOx ratio analysis for the July 2002 episode. If it is decided to conduct additional analysis, the results will be provided later as supplemental information.

Comment: TSD Appendix V, page 17: Process Analysis was only conducted for June 2002 episode. The net ozone production rate for noon on June 7 is 7-10 ppbv/hour. This episode was identified as transport dominated, but the net ozone production rate is substantial. The process analysis should also be conducted for the July and August episodes. The net ozone production and other chemical quantities should be compared for these three episodes to see whether the model predicted different patterns under different meteorological conditions.

Response: MAG may consider conducting additional Process Analysis for the July 2002 and August 2001 episodes. If it is decided to conduct additional analysis, the results will be provided later as supplemental information.

COMMENTS FROM THE ARIZONA CENTER FOR LAW IN THE PUBLIC INTEREST (Letter from Joy E. Herr-Cardillo dated June 4, 2007 received by e-mail on June 4, 2007)

Comment: We are very disappointed to see that the proposed 8 Hour Ozone Plan does not include any additional control measures and instead, simply relies upon those measures already implemented as part of the One Hour Ozone Maintenance Plan. As EPA cautioned ADEQ recently, the values at several of the monitors are very close to the standard and it will be very difficult for the area to maintain those values without taking some additional steps. In particular, the 3 year average for the monitors at Fountain Hills, North Phoenix, and Rio Verde rely upon the 2004 values to bring the three year average in under .085 ppm. If the fourth highest reading for 2007 for any of these monitors comes in at .085, there will be a violation, and in the case of North Phoenix the fourth high reading need only reach .083 to put the average over .084 ppm. Under these circumstances, it is simply irresponsible for the state not to proactively address the problem without additional control measures to ensure attainment.

Response: At the national level, the Environmental Protection Agency has added new ozone control measures for Consumer and Commercial Products under Section 183 (e) of the Clean Air Act. On May 30, 2007, EPA issued an Emission Reduction Credit Memo regarding these measures.

If the Arizona Legislature passes legislation with commitments to implement the Liquid Leaker Test component for the Vehicle Emissions Test; Seasonal Open Burning Ban 5/1 through 9/30 each year and Clean Burning Gasoline in western Pinal County, there may be additional emission reductions from those measures and a supplement could be submitted to EPA. However, the Arizona Legislature has not yet taken action and no commitments have been received.

According to the air quality monitoring data, there have been no violating monitors for the eight-hour ozone standard for two consecutive three year periods: 2003-2005 and 2004-2006. The air quality monitoring data indicates that the eight-hour ozone standard has already been attained with the existing measures. The EPA Final Rule to Implement the Eight-Hour Ozone National Ambient Air Quality Standard-Phase I, dated April 30, 2004, indicates that "attainment is determined based on an average of the 4th high reading at a monitor over a three year period. Thus, the 4th high reading for an area could be above the NAAQS for one or both of the years proceeding the attainment year, but so long as the 4th high level for the other year(s) was low enough to produce an average at or below 0.84 parts per million, the area would be attaining the NAAQS."

In reviewing the air quality monitoring data for the eight-hour ozone standard for the last seven years, there has been a downward trend in the number of violating monitors. In 2000, there were seven violating monitors. In 2005 and 2006, there were no violating monitors based upon the three year average of the 4th high readings. In addition, the air quality modeling demonstration and weight of the evidence demonstration in the Eight-Hour Ozone Plan indicate attainment of the standard for the 2008 ozone season.

Comment: As noted in the draft plan, Section 172(c)(1) of the Clean Air Act requires the plan to include all "reasonably available control measures." The Draft Plan, however, makes no effort to demonstrate that it has, in fact, complied with this requirement. Rather the plan simply sets forth the various control measures already implemented in the area and includes a model that demonstrates that these measures will be sufficient to reach attainment. The plan makes reference to a previous RACT demonstration, but does not attempt to update the demonstration to consider new control measures or changes in technology that would make previously rejected control measures now reasonably available. The omission of this fundamental requirement renders the plan noncompliant and incomplete under the Clean Air Act.

Response: According to the Maricopa County Air Quality Department, the "Final Rule to Implement the 8-Hour Ozone National Ambient Air Quality Standard" (70 FR 71612, 11/25/2005, Section IV.G.1) states, "For subpart 1 areas that submit a demonstration of attainment for 5 or less years after designation (i.e. do not request an attainment date extension beyond 5 years after designation), the CAA's RACT requirement is met with the control requirements associated with a demonstration that the NAAQS is attained as expeditiously as practicable." In contrast, the rule specifically requires subpart 1 areas that request an attainment date extension to submit a RACT SIP updating the RACM or RACT analysis. To clarify the requirements applicable to subpart 1 areas demonstrating attainment by 2009, the following text has been inserted on page 1-10 in section (10) A, "Since the Maricopa nonattainment area is designated as a subpart 1 area for ozone, and expects to show attainment by 2009, RACT is deemed to be met with control requirements associate with a demonstration that the NAAQS is attained as expeditiously as practicable (70 FR 71612, 11/29/2005, Section IV.G.1)."

EPA received a similar comment regarding the RACT provision in section 172(c)(1) during the rulemaking cited above. Their response to that comment on page 71653 provided the following explanation:

"The general RACT provision under subpart 1 in the statute, is found in section 172(c)(1). It is a portion of the RACM provision found in that same section. Our long-standing interpretation of the RACM provision is that areas need only submit such RACM as will contribute to timely attainment and meet RFP, and that measures which might be available but would not advance attainment or contribute to RFP need not be considered RACM. This interpretation has been upheld in several recent court cases. *See Sierra Club v. EPA,* 294 F.39 155, 162 (D.C. Circuit, 2002) (concerning the Metropolitan Washington, D.C., attainment demonstration) and *Sierra Club v. EPA,* No. 01-60537 (5th Circuit, 2002) (concerning the Beaumont attainment demonstration). Since subpart 1 RACT is a portion of RACM, these cases also support a conclusion that, where we are dealing only with section 172 RACT, it is reasonable to require only such RACT as will meet RFP and advance attainment. In view of these court cases, EPA disagrees with the comments opposing the approach that, in subpart 1 areas, RACT would be met by control measures in a SIP demonstrating attainment of the standard as expeditiously as practicable and meeting RFP."

This response was prepared by the Maricopa County Air Quality Department.

Comment: Finally, we disagree that the Draft Plan properly includes contingency measures. The measures designated as contingency measures in the Draft Plan are already implemented. According

to Section 175(d), the purpose of contingency provisions is to assure that the state will immediately implement additional control measures without further action if the area fails to attain by the deadline. Obviously, if these so called contingency measures are already being implemented when the triggering event occurs, there is nothing to suggest that their continued implementation would ensure that the situation will be corrected and the public health protected. Simply showing contingency measures on paper, as the Draft Plan does, is contrary to the intent and purpose of the Act's requirement.

Response: The Environmental Protection Agency allows for the early implementation of contingency measures as indicated in the August 13, 1993 EPA memorandum on the Early Implementation of Contingency Measures for Ozone and Carbon Monoxide Nonattainment Areas. Committed measures that have already been implemented may be contingency measures if they are not needed to show attainment and do not hasten attainment. According to the EPA Final Rule to Implement the 8-Hour Ozone National Ambient Air Quality Standard dated November 29, 2005, EPA also allows federal measures to be contingency measures if they are not needed for attainment.

The combined VOC and NOx reductions of 8.7 percent surpasses the EPA-recommended three percent. In addition, the 2.3 percent reduction in VOC emissions greatly exceeds the EPA-recommended value of 0.3 percent. Therefore, the EPA guidelines for emission reductions from contingency measures are satisfied.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

May 31, 2007

Maricopa Association of Governments
Received
JUN 04 2007

Ms. Lindy Bauer
Environmental Planning Manager
Maricopa Association of Governments
302 N. 1st Avenue, Suite 300
Phoenix, AZ 85003

Dear Lindy,

Thank you for the opportunity to review the *Draft Eight Hour Ozone Plan for the Maricopa Nonattainment Area* ("Draft Plan"). We have reviewed the Draft Plan with regard to the Clean Air Act (CAA) requirements for 8-hour ozone state implementation plans (SIPs) that EPA will consider after the SIP has been formally submitted to EPA as a revision to the Arizona SIP. We are committed to working with you and your staff to address any future issues in a timely manner to move towards our common goal of approving a plan that demonstrates how the 8-hour ozone National Ambient Air Quality Standards (NAAQS) will be attained.

Attached please find our preliminary comments on the Draft Plan. Please note that we have reviewed the Draft Plan as thoroughly as possible given the limited time frame for our review, but our comprehensive review will follow the formal submittal of the SIP by the Arizona Department of Environmental Quality (ADEQ). We note that monitored 8-hour ozone values in the Phoenix-Mesa nonattainment area are very close to the ambient standard based on monitored air quality data from 2004–2006. As we indicated in our letter from EPA Regional Administrator Wayne Nastri to ADEQ Director Stephen Owens on April 20, 2007, we are concerned that Maricopa County will not be able to maintain these monitored values without taking additional steps. We urge you to consider measures in addition to those state and local agencies have already put in place.

We want to remind you of three additional considerations. We still do not know the outcome of the South Coast Air Quality Management Dist. v. E.P.A., 472 F.3d 882 (DC Cir. December 22, 2006) litigation. We will keep you apprised of any changes to our guidance on implementation of the 8-hour ozone standard. In addition, on June 20th, EPA may propose a revised ozone standard. We urge you to keep this in mind as you finish this current plan. We also finalized our guidance entitled "Emission Reduction Credit for

Three Federal Rules for Categories of Consumer and Commercial Products under Section 183(e) of the Clean Air Act ". We forwarded the guidance memo to you yesterday.

Thank you for the opportunity to provide comments on the Draft Plan. We are committed to working with you and your staff on any of the topics in the attachment, or other issues that arise before the final SIP is submitted. If you have any questions, please contact me at 520-498-0118, or Wienke Tax at 520-622-1622.

Sincerely,

Colleen

Colleen McKaughan

cc: Nancy Wrona, Arizona Department of Environmental Quality
Robert Kard, Maricopa County Air Quality Department
Don Gabrielson, Pinal County Air Quality Control Department

Chapter 1

Provisions to prohibit sources from impacting air quality in other states (page 1-7). ADEQ recently completed and has submitted to EPA the *Arizona Interstate Transport SIP* to address the requirements of section 110(a)(2)(D)(i) of the CAA. A reference to this SIP in this section would be appropriate.

Meet the applicable requirements of section 110(a)(2)(M) (page 1-9). It would be helpful to specify the consultation which occurred with affected entities for this particular plan.

RACT. Since Maricopa County is designated a subpart 1 non-attainment area for ozone, and expects to show attainment by 2009, RACT is deemed to be met with the control requirements associated with a demonstration that the NAAQS is attained as expeditiously as practicable. (70 FR71612, 11/29/2005, section IV.G.1)

There are a number of typographical errors in Table 1-1 of VOC RACT measures (see Attachment A). Also, it would be helpful to explain that NOx RACT was not required under 1-hour ozone because of the 1995 NOx exemption.

MAG should include an updated negative declaration regardless of whether such negative declarations were made for an earlier SIP. This is necessary since there may now be sources in the area that previously did not exist. Language similar to the following may be appropriate:

> Maricopa County AQD has reviewed its permit files and the emission inventory for its federal Clean Air Plan, [include any other information sources searched such as SIC Codes and telephone yellow pages], and has determined that there are no stationary sources or emitting facilities for the following CTG categories. MCAQD also does not anticipate these sources in the future.

GUIDANCE DOCUMENT TITLE	DOCUMENT TYPE	DOCUMENT NUMBER
Control of Refinery Vacuum Producing Systems, Wastewater Separators, and Process Unit Turnarounds	CTG	EPA-450/2-77-025

Chapter 2

It is not clear how the detailed discussion on p. 2-3 to 2-15 concerning the transportation system, congestion management process, and public transit system relates to air quality or 8-hour ozone planning.

Chapter 3

Emissions Inventory. The pie chart in the executive summary shows biogenic emissions constitute 65% of total emissions. However, the emissions inventory in Table 3-1 indicates biogenics are about 22% of total emissions. Can you explain the discrepancy and clarify which is the correct number? We understand that you relied on a biogenics study done by a consultant; can you make this document and all the references you cite in the plan and TSD publicly available?

Emissions Inventory. The emissions inventory is in English tons, while the control measure emissions reductions are in metric tons. This could be confusing to the public. Can you use consistent units and/or provide the conversions to the other unit, for example 1.0 English tons (__ metric tons).

Monitoring. The text and tables refer to a total of both 19 and 20 monitors.

Chapter 4

<u>Control Measures</u>

The plan indicates the following (page 4-2) "Maricopa County Rule 348 was a maintenance measure for which credit was taken in the One-Hour Ozone Maintenance Plan. However, since Rule 348 was adopted in 1999, it has been assumed in the base case 2001 and 2002 emissions inventories, rather than as an attainment measure in this Plan." There are several other control measures which were adopted a number of years ago, and yet this same caveat was not applied to these other measures, such as *Phased in Emission Test Cutpoints, One-Time Waiver from Vehicle Emissions Test,* and *Tougher Enforcement of Vehicle Registration and Emission Test Compliance.* Can you please clarify this discrepancy?

Arizona Cleaner Burning Gasoline (CBG) – both the Executive Summary (on page ES-5) and the control measure discussion on page 4-3 indicate an increase in VOC emissions from the Phoenix CBG program. Can you explain how this ozone precursor control measure increases emissions of VOCs? A minor correction, the most recent Arizona CBG approval was published in the *Federal Register* on March 4, 2004 (citing the date of publication rather than signature provides the public with the information to find the *Federal Register* notice) and was signed by the Regional Administrator for Region 9, not the EPA Administrator.

Measures That Improve Air Quality But Were Not Used for Numeric Credit. 38 measures are included in the plan under this category. We suggest that you take them out of the plan unless it is MAG's intent to make these measures federally-enforceable by including them in the SIP. If so, you need to provide an implementing agency, a specific commitment to implement, including evidence of funding for the measure, and a

Transportation Control Measure (TCM) Implementation. For the purposes of verifying timely implementation of TCMs, it would be helpful if you could specifically identify TCMs and their implementation dates, implementing agency, funding source, and timeframe for implementation.

Chapter 5

Motor Vehicle Emissions Budgets (MVEBs) for Transportation Conformity

On page 5-14, the plan indicates that the NOx MVEB for 2008 is 138.2 mtpd, but on page 5-15 the NOx MVEB is listed as 133.1 mtpd. Which is the correct value?

Contingency Measures

HB2538 (2001), Expansion of Area A. Wouldn't this measure already be included in the emissions reductions associated with the measures which apply to Area A in Maricopa County's baseline 2002 emissions inventory? It is not clear how this measure would assist in reducing emissions in the event of a violation of the NAAQS.

In total, the contingency measures are estimated to reduce emissions of VOC by 2.3 percent and NOx emissions by 6.4 percent, whereas the control measures for which credit was taken in total reduce VOC emissions by about 2.3 percent and NOx emissions by about 4.5 percent. If the contingency measures achieve additional reductions equal to or larger than the control measures credited in the attainment demonstration, and they are already implemented, why do we not see the benefits from the contingency measures in peak ozone concentrations in the modeling?

TSD

Modeling

Diagnostic Analyses. MAG should provide documentation of sensitivity and diagnostic analyses performed, and any conclusions from these. The modeling protocol (TSD Appendix I) lists various diagnostic analyses that could be performed using the model, to ensure that it responds in a physically reasonable way to altered inputs. The list included zero boundary conditions, zero initial conditions, diffusion break heights, and other tests such changes in emission levels, emission speciation; alternative wind fields could be added to this list. There should be a summary of any such sensitivity and diagnostic analyses that were performed. This could be an expansion of the "Corroboratory Tests" section. The summary could include references to certain of the analyses that are already described, such as some for meteorology (TSD App. III-ii "Addendum to ENVIRON's Report to MAG: MM5 Meteorological Simulation", 5/19/06 p. III-51), and process analysis (in TSD App. V at page 17). But it should also describe pertinent results from, e.g. the across-the-board and other VOC and NOx emission reduction simulations that MAG performed (these are referred to, but not described, in TSD App. V section on

weekend effects).

It would be highly desirable to include a color version of TSD App. V in the final electronic document, since some of the graphs are very difficult to interpret in black and white.

Unmonitored Area Analysis (UAA). MAG should carry out an analysis of unmonitored areas using gradient-adjusted spatial fields. If this cannot be completed in time for the submittal deadline, it can be supplied later as supplemental information. The TSD section on "Corroboratory Tests" (p. V-87, in the Attainment Demonstration section) shows results of screening tests to address attainment at locations not at a monitor, and appear to have been adequately carried out and to have shown favorable results. The screening test was described in the 2/17/05 version of EPA's attainment demonstration guidance. This test was superceded by the "unmonitored area analysis" described in the October 2005 guidance version, and in the final version, "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze", EPA-454/B-07-002, April 2007 (web page: http://www.epa.gov/scram001/guidance_sip.htm direct link: http://www.epa.gov/scram001/guidance/guide/final-03-pm-rh-guidance.pdf). Under the later guidelines, Relative Reduction Factors (RRFs) are applied not directly to fields of spatially-interpolated monitoring values, but rather to the fields adjusted using model output gradients. EPA has developed "Modeled Attainment Test Software" (MATS) to carry out this adjustment; MATS has been available in a beta version for several months. An additional corroboratory analysis MAG could consider for unmonitored areas is the direct absolute ozone results from simulation of the future year (i.e., model output for each grid cell, without using RRFs).

Contingency Measures

Section V-2-2 on page V-16 of the TSD has the following statement: "The Eight-Hour Ozone Plan discusses procedures that will be followed to consider and implement additional contingency measures if they are needed." We did not see this discussion in the plan or TSD.

Control Measures

Coordinate Traffic Signal Systems. The discussion of the control measure Coordinate Traffic Signal Systems on page V-13 indicates that 151 traffic signals would be coordinated between 1997 and 2008. How did you ascertain that only the traffic signals modified since 2002 were credited, since signals synchronized between 1997 and 2002 would be in the base year of the inventory?

Tougher Enforcement of Vehicle Registration and Emission Test Compliance. Pages V-14 and V-15 of the TSD indicate that the Arizona Department of Transportation has increased staff for this program. However, increased staff does not necessarily translate

into increased emissions reductions. How were the emissions reductions associated with this program calculated? The TSD states that "the number of vehicles which participate in the I/M program was increased by 2.0 percent." Was this a total of 2 percent, or 2 percent per year? What is the basis for the 2 percent number? Why would this 2 percent emissions reduction not be included in the baseline 2002 emissions inventory?

ATTACHMENT A

Corrections to Table 1-1, Maricopa County VOC RACT Rules and SIP Status

"Control Techniques Guidelines" should be a subheading in the table, at the same level as "Major Sources Subject to RACT."

"Gasoline Loading Terminals: MC Rules 350 and 351" should not be in the heading of the table at all.

The FR cite for first entry in the table, MC Rule 350, should read 60 FR 46024.

The sixth entry in the table, "Miscellaneous Refinery Sources" should not say "Submitted" right after the source category. The 3rd column should say "Submitted December 14, 2000."

For Rule 331, Solvent Metal Cleaning, the 3rd column should read: Revised June 22, 1991, revised June 19, 1996, Revised April 21, 2004; approved February 1, 1996, (61 FR 3578), approved February 9, 1998, (63 FR 6489), approved December 21, 2004 (69 FR 76417).

An entry for Paper Products should follow the entry for "Surface Coating of Fabrics". The entry should read as follows:

Rule	Adoption	Revisions and Approvals
Rule 336 - Paper Products	July 13, 1988	Revised September 21, 1992, June 16, 1996, April 7, 1999; approved September 20, 1999 (64 FR 50759)

There should be no "submitted" after the entry name for "Magnetic Wire."

The entry for Rule 350- "External Floating Roof Petroleum Tanks" should have an FR approval citation of 60 FR 46024.

Rule 337 – Graphic Arts, was submitted on February 26, 1997.

Rule 358 was not a negative declaration, though "Manufacture of High-Density Polyethylene, Polypropylene, and Polystyrene Resins" was. The entry should read as follows:

Rule	Adoption	Revisions and Approvals
Manufacture of High-	Negative declaration	Submitted December 14,

Density Polyethylene, Polypropylene, and Polystyrene Resins		2000, approved August 26, 2002 (67 FR 54741)

The entry for "Industrial Wasted Water" should read "Industrial Wastewater."

Rule 331, "Cleaning Solvents", was also revised April 21, 2004.

Rule 334, "Rubber Sports Ball Manufacturing" was approved on February 2, 1998.

Janet Napolitano
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

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Stephen A. Owens
Director

June 4, 2007

Ms. Lindy Bauer
Environmental Planning Manager
Maricopa Association of Governments
302 N. 1st Avenue, Suite 300
Phoenix, AZ 85003

SUBJECT: Draft 8-Hour Ozone Plan

Dear Ms. Bauer:

The Arizona Department of Environmental Quality (ADEQ) is hereby submitting comments on the Draft Plan the Maricopa Association of Governments (MAG) has prepared for submittal to the U.S. EPA on June 15th. ADEQ understands the complexity of this planning effort and recognizes that MAG has worked diligently to develop this Plan, including collaboration with ADEQ.

At the same time, ADEQ has concluded that implementation of additional control measures will be necessary to attain the 8-hour ozone standard. In addition, ADEQ is aware that recent staff work by EPA recommended changing the National Ambient Air Quality Standards for eight-hour ozone below 0.080 parts per million (ppm) to as low as 0.060 ppm to better protect public health for sensitive groups. For reasons that are set forth below, ADEQ does not concur that committed measures in the Serious Area Carbon Monoxide Plan (2001), the Carbon Monoxide Maintenance Plan (2003), and the 1-Hour Ozone Maintenance Plan (2004) will result in attainment of the 8-Hour Averaged Ozone standard. To that end, the Plan should have evaluated the following control measures:

- A Liquid Leaker Test component added to the Vehicle Emissions Test
  VOC reductions estimate: 3,595 Tons per Year (TPY)
- Seasonal Open Burning Ban 5/1 through 9/30 each year
  VOC reductions estimate: 8 TPY
  NOx reductions estimate: 4 TPY

In addition, the General Preamble provides that the modeling domain for ozone planning areas extends 25 miles beyond the official nonattainment area border. Requirements for Cleaner Burning Gasoline (CBG) in western Pinal County, populated by many drivers who commute into the nonattainment area for employment and recreation, are currently being considered as part of SB 1552. MAGG should have also evaluated this control measure, considering its significant additional emission reductions:

VOC reductions estimate:	8,640 TPY
NOx reductions estimate:	5,525 TPY.

General Comments

ADEQ has determined that the documents MAG made available on the Internet for public review are not adequate to help interested publics review the complex and lengthy documents. MAG should post a searchable PDF version of the Plan and Technical Support Document in color, clearly identifying each of the four (4) separate Appendices, on its Web site for the general public. This posted Plan was not searchable, and because it was in black and white many of the graphics were difficult to interpret. Appendices III and IV of the Technical Support Document were not listed on MAG's Web site, and it was later determined that they were included at the end of the file labeled "Appendix II." Public review of documents that are hundreds of pages in length is impaired when electronic documents are not searchable. In addition, MAG's Web site should include information on how to obtain a copy (electronic or otherwise) of MAG's Silt Loading Study and Biogenics Study that were used to develop the Emissions Inventory. More detailed comments appear below.

Emissions Inventory

Population. The population estimates for 2010 for "County Areas" reflecting unincorporated portions of the County, minus Indian Country, should be corrected to **231,390** instead of 92,900. The corrected figure is based on the Department of Economic Security estimate for July 1, 2006. The total at the bottom of the 2010 column should be increased by 138,490 to read **4,272,890**.

MAG should add an explanation on page 5-5 of the Plan, or cross-reference the appropriate page of the Technical Support Document, to explain its choice to increase anthropogenic VOC and NOx emissions for the 2001 and 2002 episodes it modeled by only 3% for the 2008 estimates. MAG's population estimates in Table 2-1 show a linear population increase of 18.8% from 2002 to 2008, far greater than the 3% increase MAG selected for modeling purposes. The reason for the difference between population increase and MAG's projected anthropogenic emissions increase is not apparent and has not been explained in the Plan.

Biogenics. MAG's Executive Summary on page ES-7 of the Draft Plan lists the contribution of biogenic emissions as 65% of Total VOCs --an eightfold increase over the 2002 Periodic Inventory. ADEQ expressed concerns about ENVIRON's MEGAN model preliminary conclusions in February, that biogenics contribute 62% of total Volatile Organic Compound (VOC) emissions for the desert nonattainment area and that percentage would be unchanged from 2002 to 2008. This percentage is especially jarring when compared with the 2002 Periodic Emissions Inventory for the 1-Hour ozone Nonattainment Area that listed only 8% of VOCs

from biogenics. The MAG BEIS2 model was used in 2002. ADEQ suspects that the ENVIRON MEGAN Model Biogenics Study distorts the emissions estimates for the official 8-Hour Ozone nonattainment area by as much as 300% for the reasons set forth below.

Definition: Figure 3-1 on page 3-3 of the Plan divides the 65% to show 33.2% "Residential Wood burning...wildfires" and 32.5% biogenic emissions. The Plan needs to explain what was included in the term "biogenics" in the 2002 Periodic Emissions Inventory and compare it to the use of the same term on page 3-3 for purposes of the 2005 Emissions Inventory.

Study Area Selected: The 8-Hour Ozone Nonattainment Area is nearly twice the size of the 1-Hour Ozone Nonattainment area. Although the 8-Hour nonattainment area is approximately 12,533 square kilometers (4880 square miles), the Study Area that MAG's contractor ENVIRON selected covers 33,562 square kilometers—2.68 times the size of the Nonattainment Area. The largest of the 25 land use categories in the Study area, entitled Palo Verde-Mixed Cacti-Scrub, exceeds the size of the entire Nonattainment Area at 14,852 square kilometers. ENVIRON's study placed an inappropriate emphasis on areas downwind and outside of the expanded 8-Hour Ozone Nonattainment Area. These areas to the east of the Nonattainment Area are downwind from the most significant portion of the diurnal isoprene cycle. Biogenic emissions are lower in the urbanized areas that constitute the majority of the actual Nonattainment Area.

Local Emission Factors. ENVIRON developed its very first emission factors for desert vegetation in its new MEGAN Model Biogenics Study for the Phoenix area. ADEQ has concluded that these emission factors are over estimated.

- ENVIRON's in-situ, small sampling techniques produced results that are not in agreement with widely recognized estimates and appear to err on the high side by substantial amounts.
- ADEQ has compared the ENVIRON emission factors to published U.S. Geological Survey (USGS) factors and has found that ENVIRON's factors are substantially higher. For example, ENVIRON has assigned the Palo Verde-Mixed Cacti-Scrub category an emissions rate that is 87% of the USGS emissions rate for a deciduous forest. Likewise, ENVIRON assigned an emission factor 5.5 times the USGS factor for conifer forests to the Pinon-Juniper.

The Plan should explain the differences between the ENVIRON emission rates and the USGS emission rates or revise the emission rates used in the Plan. MAG should also revise page ES-7 and Figure 3-1 of the Draft Plan to focus on the vegetation that contributes to ozone formation inside the boundaries of the nonattainment area—not downwind vegetation.

Further, no attempt was made to reconcile the emission estimates with the publicly-available Photochemical Assessment Monitoring System data that ADEQ has been collecting for nearly a decade. These data show that isoprene, the widely-prevalent biogenic compound, constitutes less than 2% of total VOCs in the ambient air.

Land Use Conversion: MAG assumed biogenic emissions do not change over time, despite conversion of land to housing and other uses. The 2008 biogenic emission rate is the same as the rates for 2002 and 2001. The Plan should explain either why this emission rate should not be adjusted due to land conversion or apply a corrected emissions rate for 2008.

Modeling versus Weight of Evidence Analysis: Figure IV-19 in the TSD shows that zeroing out biogenic emissions results in peak ozone concentration dropping by 8 ppb on June 7, 2002. In contrast, the Weight of Evidence Analysis in Appendix V, page 17, states that isoprene (a major component of biogenic VOCs) has little impact on ozone formation. This inconsistency needs further explanation.

Mobile Sources. The calculation of on-road mobile emissions used for the Draft Plan is problematic. Appendix IV presents several MOBILE6 input files. MAG used the command "FUEL PROGRAM: 2 S" to simulate Cleaner Burning Gasoline (CBG) in Area A and added another command, "FUEL RVP: 7.0", to specify Reid Vapor Pressure (RVP) in Area A. The command "FUEL PROGRAM: 2 S" models the effect of a Federal Reformulated Gasoline (RFG) program in the Southern region. In MOBILE6, the default fuel properties for the Federal RFG option for the summer of calendar 2008 are as follows:

RVP: 6.8 psi;
Ether oxygen content: 2.1% by weight;
Ether market share: 100%.

No matter what value is specified in the command "FUEL RVP", the command "FUEL PROGRAM:2 S" overrides it. The net effect of using the two commands MAG chose was to set RVP at 6.8 psi and ether oxygen content at 2.1% by weight. However, Arizona banned all ether oxygenates in gasoline effective on January 1, 2005. The ether oxygen content for gasoline is 0 % instead of "2.1% by weight," and the "Ether market share" in the 8-Hour Ozone Planning Area is also 0%. Therefore, the following commands should be used in the MOBILE 6 modeling for this Plan: "FUEL PROGRAM: 4" to set the sulfur content and "RVP" to specify the actual RVP. The 2006 retail sampling, conducted by the Arizona Department of Weights and Measures for the months of May through September, show average sulfur content of 50 ppm and RVP of 6.5 psi. Note that additional emission reductions may need to be applied to account for the fact

that summertime CBG meets federal RFG standards. This modeling should be repeated using the revised inputs.

2002 Baseline. The Plan should clearly identify which control and contingency measures in the Plan (to achieve emission reductions in 2002-2008) have already been accounted for in the 2002 Baseline. Only those control and contingency measures that are not already in the 2002 Baseline should be listed as control measures to attain the 8-Hour Ozone Standard.

The Emissions Inventory is a critical component of the attainment demonstration, and comments specific to the modeling are addressed next.

Attainment Demonstration Modeling

The demonstration of attainment in the Plan is uncertain at best and precariously close to the National Ambient Air Quality Standard. The committed control measures do not convincingly demonstrate attainment. Therefore, ADEQ recommends assessing the modeled impact of the additional control measures listed above.

In addition, several aspects of the computer modeling raise issues that require either further explanation in the Plan and the Technical Support Document or further modeling using more accurate inputs.

Mathematical demonstration. The attainment demonstration relies on truncating a modeled value of 0.0847 parts per million (ppm), as allowed by Federal regulations. Rounding up to 0.085 ppm would demonstrate nonattainment. The demonstration relies on a statistical margin of 0.0003 ppm, which is considerably less than the margin of error for this type of modeling demonstration.

Validation of actual episodes. The uncertainties in this modeling demonstration are high because the model only successfully simulated the transport episode (June 2002). It significantly underestimated peak ozone concentrations for both the local production-dominated episode (July 2002) and the combination of the transport and local formation episode (August 2001). The cause of the underestimation has not been clearly identified in the Plan or TSD. This unresolved bias, which could be due to a bias in meteorological field or bias in chemistry, call into question the validity of the modeling analysis.

Predicted emissions reductions. The modeling does not convincingly demonstrate attainment because the predicted reduction of peak ozone concentrations is nearly zero.

- The model predicts that total NOx emissions are only reduced by 1.7% and that total VOC emissions *increase* by 0.5%. These small modeled changes in ozone precursors are not sufficient to guarantee attainment.

- For many monitoring sites, the predicted peak ozone concentration is *increased* from the baseline conditions.
- MAG has projected concentrations for 6 of the 18 monitoring sites to be greater than 95% of the National Ambient Air Quality Standard in the attainment year.
- Attainment is demonstrated in this modeling because only one of the 18 values used in the baseline design value is an exceedance, not because of the effectiveness of the control measures in the Plan.

Meteorological modeling. Several special modeling treatments were employed without sufficient justification in the Plan. MAG should either add a more detailed justification for these treatments or re-model following the recommendations outlined below.

Vertical diffusivity. Typically, modelers choose a single vertical diffusivity calculation for all episodes modeled in the same region in the same season. The TSD at page III-47 states that two different vertical diffusivity calculation options were applied according to the results of sensitivity testing, one for the transport-dominated episode and the combination episode, and the other for the local formation-dominated episode.

- The Plan should explain why two different options were chosen for the same ozone season and the same region, and it should explain the criteria used to select each of the two options.
- In the alternative, a single vertical diffusivity calculation should be used for additional modeling.

Mixing height. Past work by Sonoma Technology and others demonstrates that the diurnal variation of mixing height is even more important than the maximum value. Studies have shown that slow development of mixing height is a cause of excessive ground-level ozone.

- It would be helpful to understand the impact of mixing height on peak ozone concentrations by plotting diurnal mixing height for the peak ozone grid cells for all three episodes.
- ADEQ's wind profiler data for the past two years may be available for use to determine the hourly mixing heights. These data may be used to explore the typical mixing height for the design dates.

Site-to-site variation. A model/observation comparison is provided in the Plan for means, not for individual sites. For the July 2002 and August 2001 episodes, when ozone is underestimated,

observational precipitation, humidity, temperature and wind data near the peak location could be compared with the modeled values.

- Site-to-site variations could be significant; averaging them could mask the actual impact. Site-specific comparisons of meteorological data may reveal the factor or factors that contribute most to the under-prediction of ozone by the model.

Sensitivity Testing. The TSD at page IV-85 states that sensitivity tests for emissions were conducted by simply modeling 100% emission reductions from (zeroing out) each entire emission category: mobile sources, area sources, and point sources.

- Zeroing out on-road and off-road NOx emissions should reduce modeled ozone concentrations, because Reformulated Gasoline resulted in actual reductions of ozone in this Planning Area, but MAG's modeling shows inconsistent patterns of ozone concentrations when these sources were eliminated For the June 2002 episode, the modeled peak ozone concentration increased as mobile source emissions were eliminated in the 2nd – 4th days, but decreased on the 5th day (TSD at page IV-87). A similar pattern occurred in the other two modeled episodes. A consistent pattern would have been expected on all five days.
- The Plan does not clearly explain why removing significant ozone precursors (especially NOx from mobile sources) would lead to a higher peak ozone concentration at all, much less on three of five days in an episode. This modeling performance should be explained.
- Sensitivity testing should be used to evaluate the effectiveness of each control measure selected for inclusion in the Plan.
- Since the Emission Inventory shows the dominant contributor to NOx to be mobile sources (63%) and the dominant contributor to VOCs to be biogenic emissions (65%), the elimination of the majority of NOx or VOC emissions does not represent a realistic scenario. Sensitivity testing should be conducted in an incremental manner such as 20% or 30% emission reductions.

Weekday versus weekend. ADEQ suggests that MAG also examine the differences in weekday versus weekend ozone concentrations for the July 2002 episode. For this local production-dominated episode, the predicted weekend ozone concentrations for July 12-13 are significantly higher than some of the predicted weekday concentrations.

- This result is unexpected for a local formation-dominated episode when local ozone precursor emissions are significantly reduced.

Transported ozone. ADEQ suggests further examination of the contribution of transported ozone and the possibly larger contribution of locally produced ozone than this modeling shows.

- The ozone- precursor relationship in the July 2002 ~~is~~ episode could provide insight on the contribution of regional transport to high ozone and on the effectiveness of controlling mobile emissions to reduce peak ozone.
- ADEQ suggests conducting source apportionment analysis, or at least quantitatively estimating the transported ozone versus the locally formed ozone.
- The qualitative discussion in the Weight of Evidence Analysis is not sufficient, since it only indicates an upper limit of the transport ozone. Ozone may also be transported from aloft over a longer distance, which could not be reliably captured by upwind surface monitors.
- ADEQ suggests plotting ozone versus altitude to see the vertical ozone distribution. This may help to identify ozone transport from aloft and reveal regional transport. These exercises could help diagnose the contribution of transport compared to locally-formed ozone and point to effective control measures necessary for attainment and maintenance.

Precursors. MAG compared modeled ozone to monitored ozone data.

- ADEQ recommends comparing modeled NOx concentrations with monitored NOx data, and comparing modeled VOC concentrations to monitored VOC data. Five NOx monitors and two VOC monitors are in the Planning Area, and ADEQ and Maricopa County Air Quality Department data are available. These comparisons will provide information on how well the model replicates actual photochemistry.
- ADEQ also recommends plotting modeled peak ozone versus modeled NOx concentrations, VOC concentrations, and the VOC/NOx ratio for the June 2002 and July 2002 meteorological regimes to see if there is any correlation.

Relative Response Factor (RRF). According to the 'Guidance on the Use of Models and Other Analysis for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze' [EPA, April 2007 at page 145], RRF should be calculated based on no less than 5 modeled days to provide statistical robustness. To support the use of less than 5 days in the RRF calculation, the variability of daily RRF should be analyzed. In this Plan, most RRFs are calculated based on 4 or fewer modeled days, raising the uncertainty of these RRF values- especially when the attainment demonstration is so marginal. The RRF ranges from 0.990 to

1.013, showing very little emission reduction, if any. Again, the control measures in this Plan do not appear to be sufficient to reduce ozone concentrations.

Contingency Measures. According to the TSD at page V-16, only the aggregated emissions reduction is estimated for all five contingency control measures. ADEQ suggests conducting additional CAMx model run to quantify the reduction of peak ozone concentrations due to each individual measure that is not already accounted for in the 2002 Baseline.

NOx Waiver versus Safety Margin. The Draft Technical Support Document should be revised on Page I-2 to be consistent with the NOx safety margin in the Draft Plan, which replaced an earlier NOx waiver concept. The following sentences are no longer accurate: "A secondary objective of the modeling was to evaluate the complex chemical relationships between precursor emissions of volatile organic compounds and nitrogen oxides and the formation of ozone. This evaluation has concluded that additional reductions in NOx emissions do not contribute to attainment of the eight-hour ozone standard in 2008; and therefore, the Maricopa nonattainment area qualifies for a NOx exemption under section 182(f) of the Clean Air Act".

Weight of Evidence Analysis

ADEQ has identified several inconsistencies in the Technical Support document that should be reconciled.

- TSD Appendix V, page 10: The trend analyses for NOx and VOC emissions show sizable reductions for seven (1999 – 2006) or nine (2006-2015) year periods, averaging a reduction of 2–3 tons per day; however, the NOx concentration trend analysis shows up and down trends in the time period from 1999 – 2006. The model results also show that a 5 tons per day reduction in NOx does not provide any reliable ozone concentration reduction (RRF for June 2002 in a range of 0.990 – 1.013). It appears that the magnitude of the emission reductions is not sufficient to reduce ozone.
- TSD Appendix V, page 16: VOC/NOx ratio analysis was only done for June 7, 2002. It should also be conducted for the July 2002 episode, since it is assumed to be an entirely different meteorological regime. This analysis does not provide sufficient explanation of how the modeled ozone concentration would respond to changes in the VOC/NOx ratio.
- TSD Appendix V, page 17: Process Analysis was only conducted for June 2002 episode. The net ozone production rate for noon on June 7 is 7 – 10 ppbv/hour. This episode was identified as transport dominated, but the net ozone production rate is substantial. The process analysis should also be conducted for the July and August episodes. The net ozone production and other chemical quantities should be compared for these three

episodes to see whether the model predicted different patterns under different meteorological conditions.

Planning and Consultation Process

Although the June 15, 2007, Plan submittal deadline had been known for several years, the 8-Hour Ozone Planning Team did not meet until February 1, 2007. Its second and last meeting was on February 9th to discuss both the 8-Hour Ozone Plan and the 5% Reasonable Further Progress PM_{10} Plan. One identified issue, the NOx waiver issue, was resolved in subsequent teleconference calls on April 20th and April 27th. The remaining issues identified in this comment letter were never elevated or referred by the Planning Team to the MAG Air Quality Policy Team for resolution.

Copies of MAG's Silt Loading Study and MAG's Biogenics Study were not provided to the Planning Team. When an ADEQ employee contacted MAG on May 29th to access the Biogenics Study, he learned that it was not electronically available, had not been posted on the website with the other Public Comment documents, but that a photocopy would be provided to him.

The MAG Air Quality Policy Committee in existence in 1992 was subsequently recast by MAG as the Air Quality Technical Advisory Committee (AQTAC) *without* amendment to the Memorandum of Agreement. Although some conclusions were shared with AQTAC, neither the Silt Loading Study nor the Biogenics Study was presented for review by the MAG Air Quality Technical Advisory Committee, the Maricopa County Air Quality Department (charged with development of the Emission Inventory), ADEQ or EPA.

MAG scheduled the Public Hearing on Friday June 1st at 5:30 PM. After ADEQ advised MAG that the general public would not be well served by that schedule, a second Public Hearing was scheduled for the following Tuesday evening.

Control Measures

MAG has not added any new control measures to achieve the new 8-Hour Ozone standard despite the narrow margin relied upon for its attainment demonstration. ADEQ is not confident that the modeled attainment demonstration will be achieved unless the additional control measures identified on the first page of this comment are added to the plan.

The Plan also included 38 measures from past CO Plans and the One-Hour Ozone Maintenance Plan and stated that emission reduction benefits associated with these measures were not quantifiable. Many of these measures were repealed, not fully implemented or should have been reflected in the 2002 base case. As a result, many of these measures may not be considered to be binding legal commitments to reduce ozone precursor emissions. ADEQ recommends retention of only those measures that have been full implemented and are not reflected in the base case in this Plan. The following table lists measures by their number in the Draft Plan that MAG should reconsider for inclusion in the Final Plan.

MEASURES THAT IMPROVE AIR QUALITY BUT WERE NOT USED FOR NUMERIC CREDIT				
Implemented Measures Included in Base Case	Implemented Measures that Need Updating	Implemented Measures that Require Documentation on Actual Implementation	Measures that Have Been Repealed	Measures that Were Never Implemented
3, 14, 16, 20, 25, 29, 32, 34, 35	4*, 6, 7, 11, 17, 19, 28, 30, 31, 33, 38	12, 15, 18, 21, 22, 23, 24, 26, 27	8, 9	1, 2, 10, 37

Specific Comments:
Measure No.5, *Diesel Fuel Sampling and Reporting*, is a reporting requirement only and is inappropriate for inclusion in the SIP.

Measure No. 13, *Encourage the Use of Temporary Electrical Power Lines rather than Portable Generators at Construction Sites*, has been included in this section; however, implementation of this measure has been limited due to local requirements that developments receive certificates of occupancy prior to connection to utility-provided power.

Measure No. 36, *Voluntary Vehicle Repair and Retrofit Program*, has been included in this section when it is an implemented measure for which extensive documentation on emissions reductions are available. In fact, the importance of this measure should necessitate its inclusion in the base case.

Consistent Measurement Units. Control measures and the Emission Inventory should both be expressed in metric tons or both be expressed in English tons to enable evaluation of the efficacy of the measures.

Conclusion

With the addition of the control measures identified on the first page of this comment and additional modeling consistent with the suggestions above, ADEQ is confident that the Phoenix 8-Hour Ozone Planning Area will attain the national public health standard on or before the deadline of December 31, 2008. ADEQ appreciates the time and effort MAG has devoted to technical planning work and looks forward to timely, coordinated decision making by all of the parties to achieve and maintain standards that protect citizens in the fastest growing County in the fastest growing State in the nation.

Very truly yours,

Nancy C. Wrona, Director
Air Quality Division

NCW:DLA:MBL

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JOY E. HERR-CARDILLO
STAFF ATTORNEY

June 4, 2007

VIA ELECTRONIC MAIL

Lindy Bauer
Maricopa Association of Governments
302 N. 1st Avenue, Suite 300
Phoenix, AZ 85003

Re: Draft Eight Hour Ozone Plan

Dear Ms. Bauer,

We provide the following comments on the above-referenced Draft Plan:

1. Failure to Include Additional Control Measures.

We are very disappointed to see that the proposed 8 Hour Ozone Plan does not include any additional control measures and instead, simply relies upon those measures already implemented as part of the One Hour Ozone Maintenance Plan. As EPA cautioned ADEQ recently (see Letter dated April 20, 2007 from Wayne Nastri to Steven Owens), the values at several of the monitors are very close to the standard and it will be very difficult for the area to maintain those values without taking some additional steps. In particular, the 3 year average for the monitors at Fountain Hills, North Phoenix, and Rio Verde rely upon the 2004 values to bring the three year average in under .085 PPM. If the fourth highest reading for 2007 for any of these three monitors comes in at .085, there will be a violation, and in the case of North Phoenix the fourth high reading need only reach .083 to put the average over .084 PPM. Under these circumstances, it is simply irresponsible for the state not to proactively address the problem with additional control measures to ensure attainment.

2. Failure to Include Updated RACM or RACT Analysis

As noted in the draft plan, Section 172(c)(1) of the Clean Air Act requires the plan to include all "reasonably available control measures." The Draft Plan, however, makes no effort to demonstrate that it has, in fact, complied with this requirement. Rather the plan simply sets forth the various control measures already implemented in the area and includes a model that purportedly demonstrates that these measures will be sufficient to reach attainment by the deadline. The plan makes reference to previous RACT demonstration, but does not attempt to update the demonstration to consider new control measures or other changes in technology that would make previously rejected control measures now "reasonably available." The omission of this fundamental requirement renders the plan noncompliant and incomplete under the Clean Air Act.

3. Contingency Measures.

Finally, we disagree that the Draft Plan properly includes contingency measures. The measures designated as "contingency measures" in the Draft Plan are already implemented. Thus, the plan contains no additional measures that would be immediately implemented in the event the area fails to demonstrate reasonable further progress or fails to attain the standard by the deadline. According to Section 175(d), the purpose of contingency provisions is to assure that the state will immediately implement additional control measures without further action if the area fails to make further reasonable progress or fails to attain by the deadline. At that point, the fact that some of the implemented measures were not included in the modeling used to demonstrate attainment is of little help to the public. Obviously, if these so called "contingency measures" are already being implemented when the triggering event occurs, there is nothing to suggest that their continued implementation would ensure that the situation will be corrected and the public health protected. That is why the Act clearly envisions *additional* measures that are automatically and immediately implemented if and when a violation occurs. Simply showing "contingency measures" on paper, as the Draft Plan does, is contrary to the intent and purpose of the Act's requirement.

Sincerely,

s/Joy E. Herr-Cardillo
Joy E. Herr-Cardillo
Staff Attorney

EIGHT-HOUR OZONE PLAN
FOR THE MARICOPA NONATTAINMENT AREA

APPENDIX B

EXHIBIT 2

CERTIFICATION OF ADOPTION

CERTIFICATION OF ADOPTION OF THE
MAG EIGHT-HOUR OZONE PLAN
FOR THE MARICOPA NONATTAINMENT AREA

An Excerpt from the June 11, 2007 MAG Regional Council Executive Committee Meeting Minutes

Mayor Hawker moved to adopt the MAG Eight-Hour Ozone Plan for the Maricopa Nonattainment Area. Mayor Shafer seconded, and the motion carried unanimously.

I certify that on June 11, 2007, the MAG Regional Council Executive Committee adopted the MAG Eight-Hour Ozone Plan for the Maricopa Nonattainment Area.

Dennis Smith
MAG Executive Director

6/11/07
Date

RESOLUTION TO ADOPT THE MAG EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

WHEREAS, the Maricopa Association of Governments (MAG) is a Council of Governments composed of twenty-five cities and towns within Maricopa County and the contiguous urbanized area, the County of Maricopa, the Gila River Indian Community, the Salt River Pima-Maricopa Indian Community, Fort McDowell Yavapai Nation, Arizona Department of Transportation, and Citizens Transportation Oversight Committee; and

WHEREAS, the Governor of Arizona designated MAG as the regional air quality planning agency and metropolitan planning organization for transportation in Maricopa County; and

WHEREAS, the Maricopa nonattainment area has been classified by the U.S. Environmental Protection Agency as a Basic Area for the eight-hour ozone standard with a June 15, 2009 attainment date according to the Clean Air Act; and

WHEREAS, the Maricopa nonattainment area has had two years with no violating monitors in 2005 and 2006; and

WHEREAS, MAG has prepared the Eight-Hour Ozone Plan for the Maricopa Nonattainment Area, including the modeling attainment demonstration; and

WHEREAS, A.R.S. 49-406 H. requires that the governing body of the metropolitan planning organization adopt the nonattainment area plan; and

WHEREAS, The U.S. Environmental Protection Agency requires that the Eight-Hour Ozone Plan for the Maricopa Nonattainment Area be submitted by June 15, 2007 and the regularly scheduled MAG Regional Council meeting is June 27, 2007; and

WHEREAS, The MAG by-laws provide that the business and affairs of the corporation which arise between meetings of the Regional Council shall be conducted by the Executive Committee.

NOW THEREFORE, BE IT RESOLVED BY THE MARICOPA ASSOCIATION OF GOVERNMENTS REGIONAL COUNCIL EXECUTIVE COMMITTEE as follows:

SECTION 1. That the MAG Regional Council Executive Committee adopts the MAG Eight-Hour Ozone Plan for the Maricopa Nonattainment Area which demonstrates attainment of the eight-hour ozone standard by the ozone season of 2008.

SECTION 2. That the MAG Regional Council Executive Committee authorizes the submission of the plan to the Arizona Department of Environmental Quality and the U.S. Environmental Protection Agency.

PASSED AND ADOPTED BY THE REGIONAL COUNCIL EXECUTIVE COMMITTEE OF THE MARICOPA ASSOCIATION OF GOVERNMENTS THIS ELEVENTH DAY OF JUNE 2007.

James M. Cavanaugh, Chair
MAG Regional Council
Executive Committee

ATTEST:

Dennis Smith
Executive Director