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Free-Flow Variability on the Jess and Souza Ranches, Altamont Pass

R. Nierenberg
Altamont Energy Corporation
San Rafael, California

Prepared under DOE/SERI Cooperative Agreement No. DE-FC023-86CH10253

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Solar Energy Research Institute
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Golden, Colorado 80401-3393

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PREFACE

The following report is the sixth in a series of such documents that present the findings of field tests conducted under the Department of Energy's (DOE) Cooperative Field Test Program with the U.S. wind industry. This report provides the results of a study to collect data at two windfarms. The two wind turbine arrays, located in the Altamont Pass east of San Francisco, were instrumented with anemometers and a central monitoring computer. To obtain a high spatial density of wind-speed measurements, every other turbine in both arrays was instrumented. Wind-speed data were collected over a period of four days during the summer high-wind season with all turbines shut down. The resultant data set was analyzed to determine the spatial variability of the wind resource in the two arrays. Because no turbine wakes were present, variation in the flow was caused by the interaction of the flow with the terrain and was not a function of turbine wake interaction.

The free-flow data sets can be used by other researchers to refine numerical free-flow computer models. The data sets will be used to fine tune and validate these computer models. In addition, the free-flow data will be compared to results of a wake energy deficit study also under way on these turbine arrays.

The success of this project is due to a number of people, who the author wishes to acknowledge. Gary Wayne and Tom Morton of Altamont Energy Corporation conceived the idea. Morton, along with Brian Smith of Grant Line Energy Corporation (now KENETECH Service Company) managed the entire project. Richard Farrell and Kevin O'Keefe of Altamont Energy Corporation assisted in arranging private-sector funding. Dave Kresse, of KENETECH Service Company, helped supervise the installation and operation of the data collection network. Philip Frame, a consulting meteorologist, provided wind forecasts and synoptic weather discussions and assisted with network installation and data processing. Walter Sass, Ken Cohn, and Mike Sacarny, of Second Wind, Inc., designed and built the central monitoring computer, communications hardware, and software, which operated flawlessly. Dennis Elliott, of Pacific Northwest Laboratory (PNL), and Alan Miller, formerly with PNL, assisted in the project planning, subsequent execution, and review. Warren Bollmeier of the Solar Energy Research Institute (SERI) and Steve Sargent of DOE assisted in the management of this project. Special thanks go to Howden Wind Parks Inc., for making their acoustic doppler measurements of the inversion on the Souza Ranch available.

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SUMMARY

The objective of the free-flow study was to collect a sufficient wind data base to describe the general spring/summer (high-wind season) wind flow over the Jess and Souza Ranch areas. To do this, a central monitoring computer was installed on each ranch. The computers were connected by communication cables to 50 turbines on the Souza Ranch and 150 turbines on the Jess Ranch. Anemometers were installed on every other turbine on 12-ft booms 35 ft above ground level (AGL). Spacing between anemometers was approximately 200 ft in the crosswind direction by 450 ft in the parallel direction. A total of 23 turbines on the Souza Ranch were instrumented this way, as were two multilevel meteorological towers. On the Jess Ranch, 77 turbines were instrumented, about half at 35 ft AGL and half at 50 ft AGL, and four additional towers were also instrumented.

Wind data were collected for approximately a 100-hour period on each ranch. All turbines were shut down during these periods so that no turbine wakes would be present. The data periods were selected by the meteorologist to insure that they occurred during typical spring/summer flow regimes.

There were several reasons for collecting this free-flow data:

- The data were to be analyzed to determine the flow variability over the study area. The high density of sensors, which was nearly unprecedented in previous publicly funded micrositing studies, allowed a microscale examination of the spatial flow variability. Large variations in energy production had been observed previously within these turbine arrays and at other similar arrays. The free-flow data set allowed a determination of how much of this variability was caused by differences in ambient flow conditions, without turbine wakes.
- The two ranches had different levels of terrain complexity; this would allow a comparison of terrain influences on the two ranches.
- The variations in available energy would be compared to subsequent wake energy-deficit measurements to be made on the same ranches.
- The data set would be useful to other researchers, especially those interested in computer modeling of flow over complex terrain.

The raw data collected by the central computer consisted of 10-minute averages. These 10-minute averages were processed into hourly averages. The hourly averages were screened to ensure the quality of the data. When that process was completed, the data from all turbine anemometers were correlated to a designated upwind reference anemometer. Correlation coefficients and speed ratios were calculated between the turbines and the reference site. The ratios were then plotted on topographic maps, and isopleths were drawn around areas of equal speed ratios. By observation, patterns in the flow were quite apparent.

On the Souza Ranch, speed ratios to the reference tower ranged from 77% to 110%, for a range of 33%. On the Jess Ranch, ratios ranged from 60% to 100%, for a range of 40%. On both ranches, flow variations over very small areas were present. For example, within a distance of 400 ft, changes of 20% in speed and 35% in theoretical energy were measured.

Elevation enhances flow, as expected. However, upstream terrain features appear to play the most significant role in flow variability in these study areas. Several valleys oriented parallel to the predominant flow appear to channel the flow to a great extent. Turbine anemometers downwind of the valleys had enhanced wind speeds relative to other turbines away from the outflow from these valleys. Small hills approximately 150 ft higher than the surrounding terrain had the opposite effects of the valleys. Turbines located up to 1500 ft downwind of these hills had lower speed ratios than did surrounding turbines. Correlation coefficients at these sites were also affected by these hills. The coefficients were generally lowest at these sites. However, the correlation coefficients improved dramatically as the height of the low-level subsidence inversion increased. The speed ratios at these sites also improved as the inversion height increased. Terrain features upwind of the site appear to play as significant a role in the flow variability as do terrain features within the site.

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1.0 INTRODUCTION

Approximately 7000 wind turbines, ranging in size from 20 kW to 750 kW, have been installed in the Altamont Pass during the 1980s. Few wind developers had the opportunity to conduct detailed micrositing studies. Many felt it was adequate to make wind measurements at one to five sites per square mile. Thus, wind turbine developers and operators have been amazed at the enormous variability in energy production within the pass, both between turbine arrays and, especially, within the arrays. The enormous variations could be caused by (1) individual turbine operating characteristics, (2) free-flow variability from terrain, or (3) wake effects. This free-flow study was conducted to explain turbine production variability and, in particular, to address the free-flow variability. A second study was also conducted simultaneously to address the wake effects.

1.1 Meteorological Discussion of the Altamont Pass

A brief discussion about the driving mechanism of the winds in the Altamont Pass is appropriate. The Altamont Pass is located in a gap in the California coastal range, approximately 45 miles east of San Francisco. To the east of the pass lies the great Central Valley, and to the west lies several ranges of coastal hills, the San Francisco Bay, and the Pacific Ocean. During the spring and summer months, the high-wind season, there is a large temperature gradient between the cool Pacific Ocean and the hot interior valleys. The coastal waters near San Francisco remain in the high 50s (15°C), whereas the Central Valley temperatures rise to nearly 100° (35°C). As the interior temperatures rise, air density decreases and the hot, low-density air rises. This creates a low-pressure area over the interior, known as a thermal trough. The thermal trough can usually be found in the summer months, extending from the Coachella Valley in southeastern California up through the Central Valley (Sacramento - San Joaquin). Over the eastern Pacific Ocean, which is cool by comparison, the Pacific high-pressure cell is nearly always present. Thus, there is a pressure difference or gradient between the coast and the inland valleys. The result of this pressure difference is wind that blows from areas of high pressure to low pressure.

A second important meteorological feature is the subsidence inversion. An inversion occurs when a layer of warm air is found over a layer of cool air. Associated with the Pacific high-pressure cell is the west-coast subsidence inversion, the culprit blamed for trapping California smog. This inversion is present along the California coast and over the eastern Pacific during most of the spring and summer months. The mean summer height of the inversion base, measured at the Oakland airport (about 35 miles west of the pass) is 1350 ft above mean sea level (MSL). Measurements of the inversion height in the pass itself show it to be several hundred feet AGL, which is slightly lower than it is in Oakland.

The significance of the inversion is that it acts as a lid. Air flowing inland from high pressure to low pressure is accelerated through coastal gaps like the Altamont Pass. The presence of the inversion enhances the venturi effect of the pass by providing an additional constriction to the flow, from the top. Thus, air flow is squeezed from the bottom and sides by the pass itself, and from the top by the inversion. In addition, the inversion can enhance the blocking capability of obstacles such as hills. If the inversion is strong and fairly close to the ground, the wind is forced to flow around hills rather than over them.

The inland pressure gradient and the inversion are the basic elements responsible for the persistent spring/summer winds in the Altamont Pass. As mentioned earlier, the height of the inversion in the pass is only several hundred feet AGL. Wind speeds are higher below the inversion, and decrease with height above the inversion. At times, the inversion is very close to the ground and vertical wind shear is negative (i.e., wind speeds decrease with height).

The free-flow data were collected during typical spring/summer conditions. A detailed synoptic discussion of the meteorological conditions during the free-flow periods can be found in Appendix A.

2.0 STUDY METHODOLOGY

The methodology for the free-flow study was to collect several days of 10-minute-average wind data from the anemometer arrays. The data were collected during typical spring/summer (high-wind) season flow regimes. All turbines were shut down during the data collection periods.

The 10-minute data were processed to hourly averages and analyzed on a mainframe computer. The analysis consisted of calculating correlation coefficients and speed ratios between a designated reference site and all other sites. The values were then manually plotted, and isopleths were drawn.

2.1 Study Areas

The Jess Ranch study area is in the eastern portion of the Altamont Pass. The ranch is on relatively flat terrain, by Altamont Pass standards, with elevation dropping gently to the northeast. Although the study area is relatively flat, the terrain immediately upwind is quite complex. There are two hills just west of the Jess Ranch that are several hundred feet higher than the ranch. Elevations in the study area range from 600 ft MSL in the southwest corner to 400 ft MSL in the northeast corner. The study area is approximately one-half square mile, one mile long (in the north-south direction) and one-half mile wide. The northern half of the ranch has Nordtank turbines, and the southern half has ESI turbines. Figure 2-1 is a topographic map of the Jess Ranch and surrounding terrain.

The Souza Ranch study area is in the northern portion of the Altamont Pass, about six miles north-northwest of the Jess Ranch. The terrain in the Souza study area is more complex than that in the Jess study area. The study area is on gently rolling hills. Immediately south of the study area is a canyon trending east-west, with an elevation of about 350 ft MSL. Elevations in the study area range from 440 ft MSL in the western portion to 300 ft MSL in the eastern portion. The Souza study area is about half the size of the Jess area. All turbines in the Souza Ranch study area are Nordtanks. Figure 2-2 is a topographic map of the Souza area and surrounding terrain.

2.2 Monitoring Equipment

2.2.1 Anemometry

Due to the relatively flat terrain on the Jess Ranch, the turbines are laid out in straight rows, normal to the west-southwest flow. Spacing between turbines, within rows, is 100 ft (2 rotor diameters); spacing between rows is about 450 ft (9 rotor diameters). Anemometers were installed on every other turbine, so the spacing between sensors is 200 ft crosswind by 450 ft downwind. Figure 2-3 is a topographic map of the Jess Ranch and shows the locations of the turbines and anemometer towers. The large letters indicate the locations of groups of turbines. Individual turbines are plotted as small triangles, and only the end turbines in a given row are labeled. For example, see the upper left corner of Figure 2-3, in the row adjacent to the J-08 anemometer. Here, there are six turbines, but only L1 and L6 are labeled.

A total of 77 anemometers were installed on the Jess Ranch on booms on every other turbine. Again, the southern half of the Jess Ranch consists of ESI-54S

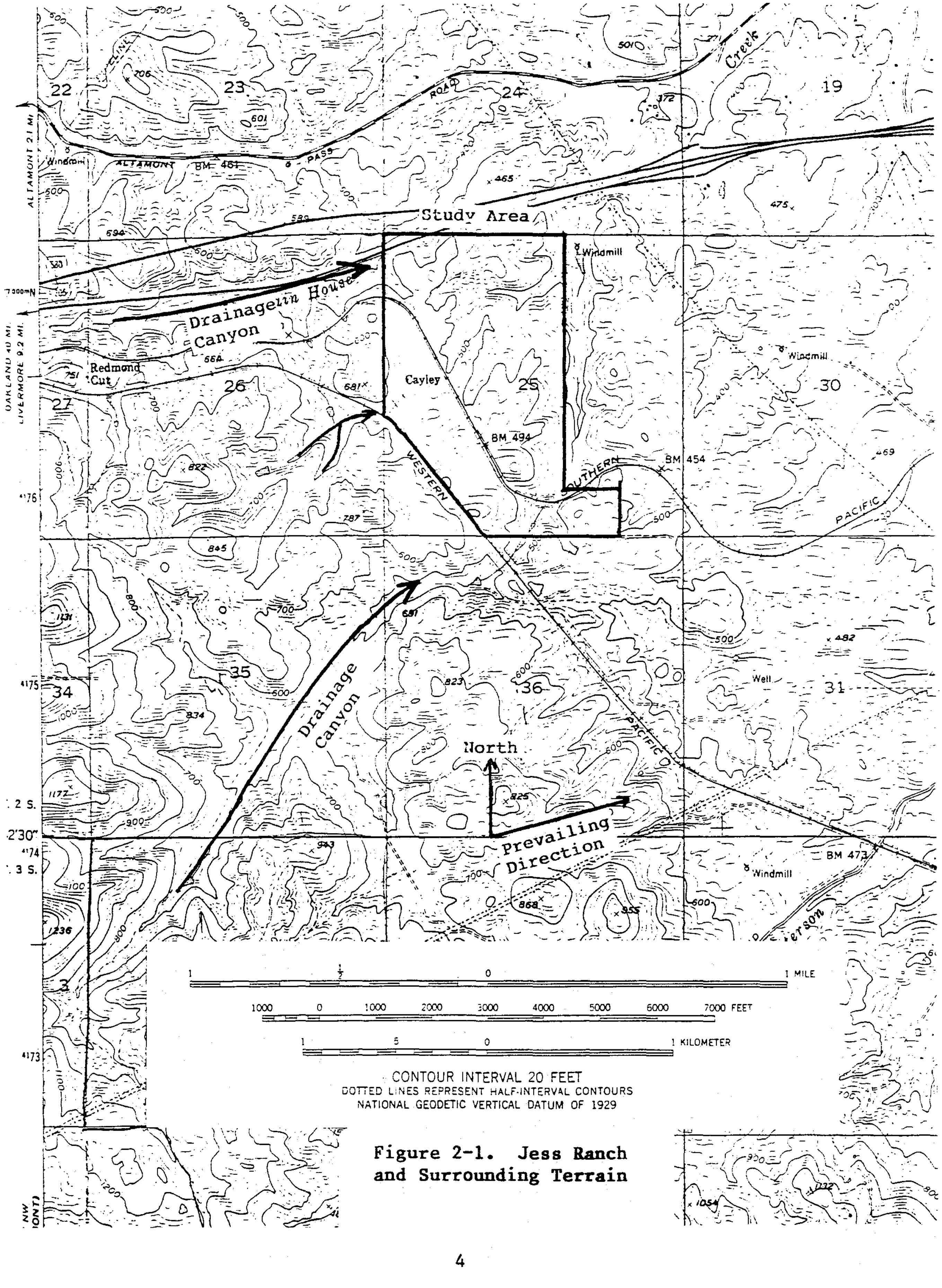

Figure 2-1. Jess Ranch and Surrounding Terrain

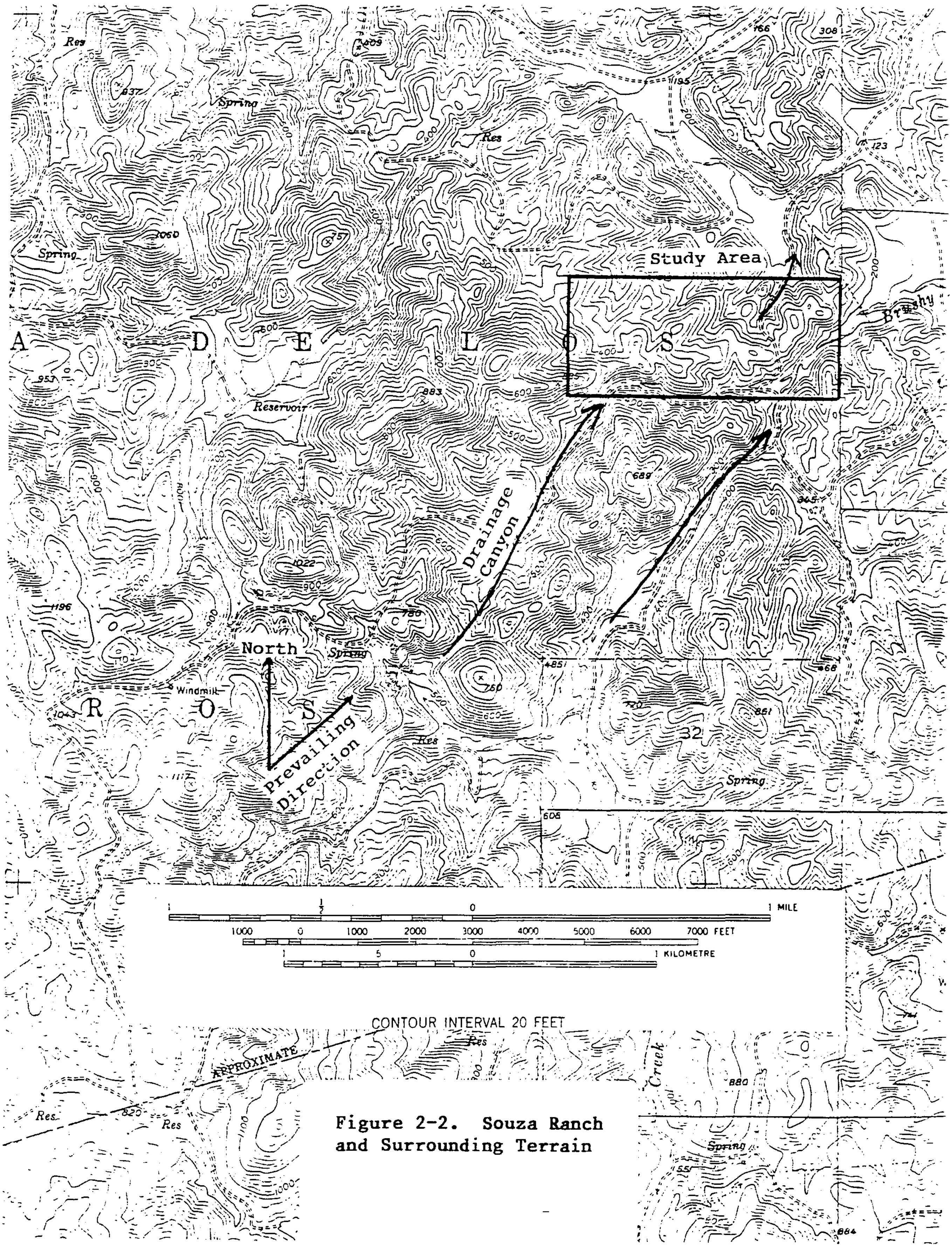

Figure 2-2. Souza Ranch and Surrounding Terrain

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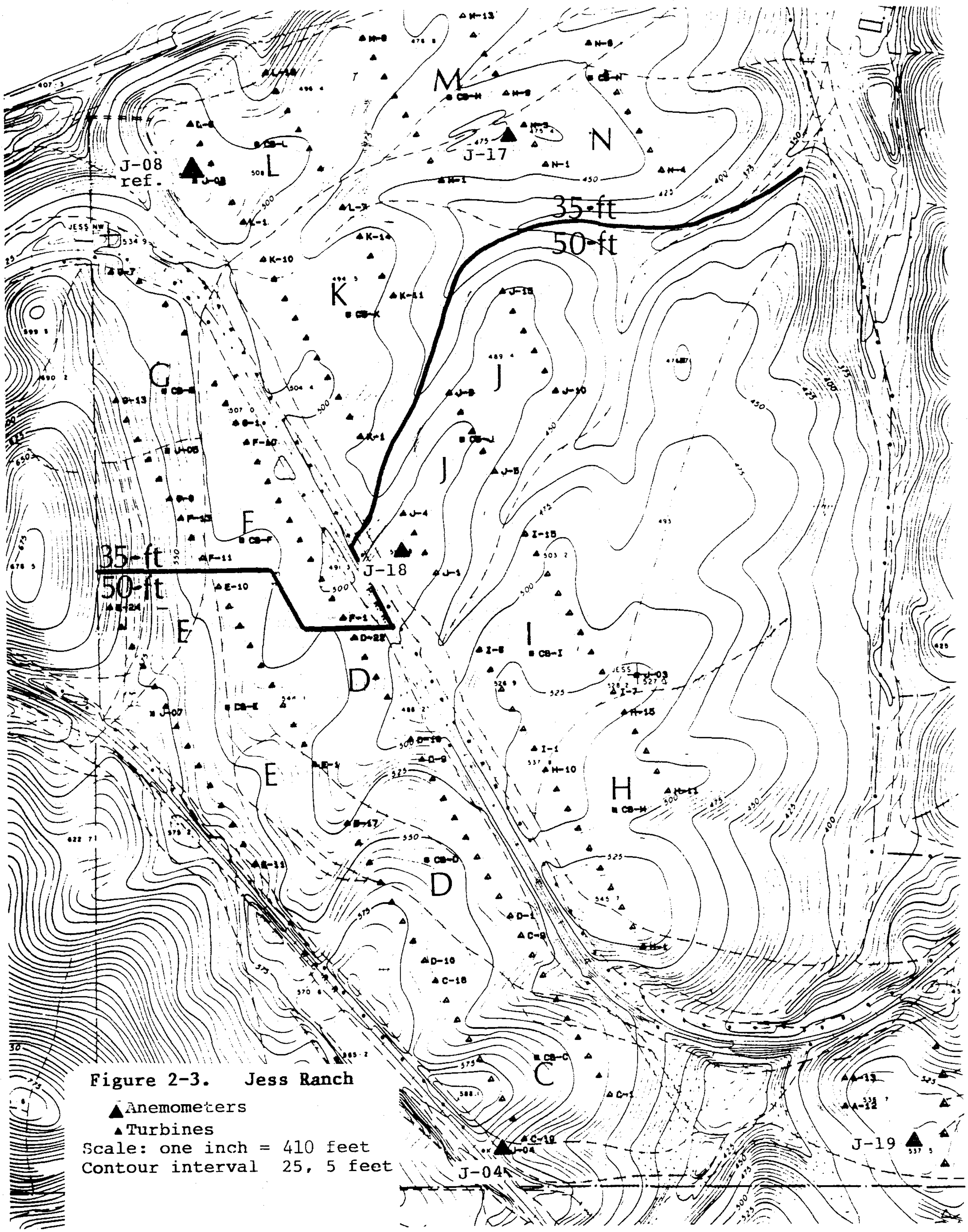

Figure 2-3. Jess Ranch

▲ Anemometers
▲ Turbines
Scale: one inch = 410 feet
Contour interval 25, 5 feet

turbines on 80-ft towers. On Figure 2-3, these are in the C, D, E, H, I, and J groups. The northern half of the ranch consists of Nordtank 65-kW turbines on 72-ft towers. These are in groups F, G, K, L, M, and N. Anemometers were installed on the ESI-54S turbines on existing 5-ft booms at 50 ft AGL. Anemometers were installed on the Nordtank turbines on 12-ft booms at 35 ft AGL. A longer boom was used on the Nordtanks because of their large tubular tower (versus the open-lattice ESI tower). The anemometers were installed at the 35-ft (versus 50-ft) level to keep them below the rotor. The boom orientation was north-northwest, which is normal to the flow, so there was no tower shadow. On the Nordtank turbines, 35 ft AGL is about 11 ft below the bottom of the rotor; on the ESI turbines, 50 ft AGL is 3 ft below the rotor. Of course, the rotors were stationary during the free-flow data collection period, so no interference was expected.

In addition to the 77 anemometers installed on turbines, there were five additional meteorological towers. Table 2-1 lists the towers, their locations, measurement levels, and sensor types. Note that two of the Jess Ranch towers were not integrated with the central monitoring computer (to be discussed hereafter), and data collected at these towers were hourly averages, not 10-minute averages.

Table 2-1. Jess Ranch Meteorological Towers

Tower	Location	Sensor Height (ft)	Sensor Type	Status
J-08	Upwind of turbine L4	50	R.M. Young propvane	Reference tower, integrated with central monitoring computer.
J-17	Upwind of turbine N3	35, 70	Maximum cup	Integrated with central monitoring computer.
J-18	Upwind of turbine J3	35, 70	Maximum cup	Integrated with central monitoring computer.
J-04	Adjacent to turbine C10	120	Maximum cup	Not integrated with central computer. Separate data logger records hourly averages.
J-19	Near A-12	40, 80	Maximum cup	Not integrated with central computer. Separate data logger records hourly averages.

The Souza Ranch terrain is slightly more complex than that of the Jess study area, and the turbine rows follow the local ridge lines to some extent. The turbine rows are not as straight, nor are they all parallel. Spacing between anemometers and sensor height is the same as on the Jess Ranch. However, the boom orientation is northwesterly because the prevailing wind direction is southwesterly. Figure 2-4 is a topographic map showing the location of turbine anemometers and towers. Anemometers were installed on 23 Souza turbines as well as 3 meteorological towers. Table 2-2 lists the characteristics of these towers. All three towers were connected to the central monitoring computer.

Table 2-2. Souza Ranch Meteorological Towers

Tower	Location	Sensor Height (ft)	Sensor Type	Status
S-13	Upwind of turbine G5	35, 70	35' = Maximum cup 70' = R.M. Young Propvane	reference tower
S-27	Adjacent to turbine E7	45, 80	Maximum cup	
S-29	Upwind of turbine D9	50	Maximum cup	

Except for those on the two reference towers, all sensors were Maximum type 40 cups. The sensors are molded-lexan 3-cup anemometers. The transducer is an alternating current (AC) generator that produces a sine wave signal. The signal frequency is proportional to wind speed. The manufacturer specifies the accuracy to be +2.5% of actual speed and the distance constant to be 9.7 ft.

The two reference towers, J-08 on Jess and S-13 on Souza, had R.M. Young "Wind Monitor" Model #05103 propvanes. Wind direction is measured with a potentiometer, and wind speed is measured with an AC sine wave generator. The manufacturer specifies the distance constant to be 8.9 ft and the accuracy to be +2.0% of actual speed.

Approximately 60 of the Maximum cups and both propvanes were tested in the University of California at Davis wind tunnel. The test procedure called for approximately 30 samples for each sensor in wind speeds ranging from 10 to 60 mph. Almost all of the cups tested read 1%-2% below tunnel speed, and the mean speed of all cups tested was 98.7% of tunnel speed. The two propvanes read about 1% above tunnel speed. Appendix B lists the results of the wind tunnel tests and the location of sensors.

2.2.2 Central Monitoring Computer and Communicating Turbine Monitors (CTMs)

The Second Wind, Inc., monitoring system on each ranch has two main components: (1) the central computer and (2) the CTMs. Each individual turbine has a CTM that monitors turbine status, turbine power, and wind speed and direction (if wind sensors are installed). The CTMs operate on a one-second scan interval and calculate and store 10-minute averages. The CTMs are connected

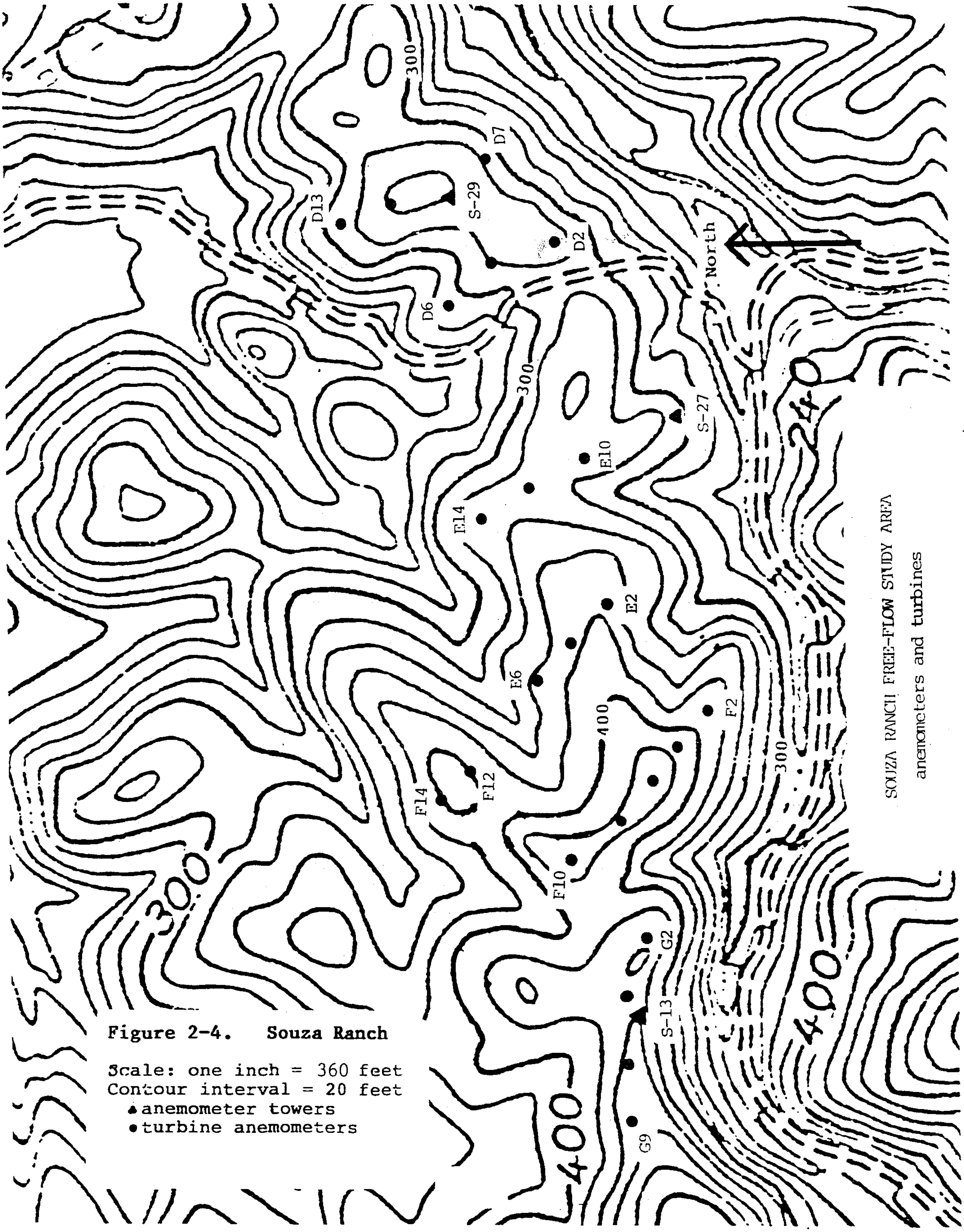

Figure 2-4. Souza Ranch

Scale: one inch = 360 feet
Contour interval = 20 feet
▲ anemometer towers
● turbine anemometers

via cable to the central computer, which interrogates all turbines once a minute. The central computer performs many functions; of particular importance to this study is the data archiving function. The 10-minute data are stored on a Bernoulli disk drive, which permits these data to be accessed by other computers.

Because of the electrical noise in a wind-farm environment, the CTM has a threshold voltage for wind-speed signals. This threshold is equivalent to roughly 2 mph for a Maximum cup and slightly higher for an R.M. Young prop-vane. A one-second scan below this 2-mph threshold would be interpreted as a 0-mph reading. Thus, a 10-minute average of 0 mph could actually have been between 0 and 2 mph. Furthermore, during any 10-minute period below about 5 mph, there could be excursions below 2 mph that would be read as zero. Thus, a true average wind speed of 5 mph could be archived as a 4.5-mph average. As the average wind speed increases, there are fewer excursions below 2 mph, and this bias goes to zero. Almost all of the data collected were in winds well above 10 mph, so this problem is trivial. However, there are a few averages in the data set in the range of 0-5 mph that are negatively biased.

2.3 Data Processing

The Second Wind, Inc., field computer stores the 10-minute averages. These data are transferred to the office computer on a Bernoulli disk. The office computer has two programs that were used to access these data. One program is a Data Dump facility that allows the user to specify a start and end time and a range of parameters. It creates a file that can be printed out for review of the 10-minute records. A second program is the hourly program that computes hourly averages from the six 10-minute records. The program creates an hourly average for any hour when three or more valid 10-minute records were available. The hourly program was used on all sites to generate hourly data. The hourly averages were transferred from the office computer to a PRIME mainframe computer for quality assurance (QA) and subsequent analysis.

2.3.1 QA Procedures

The hourly averages were loaded into a PRIME computer, where an extensive wind energy data base and software library resides. The QA procedures required calculating correlation coefficients and speed ratios, and also reviewing and plotting these. This was followed by scrutinizing any outlying data points that were revealed by these plots, and making some subjective judgment as to the data points' validity. Specifically, the following steps were taken:

1. Calculate correlation coefficients and speed ratios between the reference anemometer and all other sites on the ranch
2. Calculate correlation coefficients and speed ratios between all adjacent pairs of anemometers
3. Review the correlation coefficients and speed ratios, and investigate any sites that had peculiar speed ratios or correlations below 0.9
4. Scan both the hourly and 10-minute data listings to spot any suspect data points (an example of a suspect data point might be a 0-mph wind speed at one level of a tower and a 20-mph wind speed at another level)
5. Delete any invalid data

6. Recalculate correlation coefficients without invalid data and verify that a significant improvement in correlation was achieved
7. Fill in gaps where data were deleted using surrogate data from closest adjacent site (surrogate data points were created using linear regression equations).

Review of the Souza data set revealed no spurious data. All correlations were between 0.94 and 1.00. A total of 2726 parameter-hours of data were collected, with a data recovery of 100%.

Review of the Jess data set revealed suspect data at six sites. In most cases, the suspect data were for 0.0-mph wind speeds when other levels or adjacent sites had strong winds. It has not been determined if the cause was a sensor, sensor wire, CTM, or communication failure. Table 2-3 lists suspect data sites.

Table 2-3. Jess Ranch Suspect Data

Site	Number of Invalid Hours	Status
J-17 70-ft	23	Spurious data deleted and replaced with surrogate data.
E-13	2	"
F-12	13	"
K-01	17	"
F-05	all data	Recorded zero wind speed; all data deleted.
I-12	all data	"

Thus, two sites, F5 and I12, were deleted altogether; an additional 55 hours of data from four turbines were also deleted. A total of 8717 parameter-hours of valid data were collected out of a possible 8976 parameter-hours, for a net data recovery of 97.1%. The 55 hours of data were filled in at the four sites listed above; however, no attempt was made to fill in data from turbines F5 and I12. Data recovery for the entire study, including both areas, was 97.8%. This is an excellent rate of data recovery for a study of this scale.

2.3.2 Site J-08 Sensor Problems

Two problems were detected with the R.M. Young sensor at site J-08. This sensor was installed on September 7, 1987. Prior to this installation, three years of data had been collected at this site, as well as at site J-04. The established speed ratio between these sites for the previous three Septembers was 98.8% (J-08 was 98.8% of J-04). After installation of the R.M. Young sensor, this ratio jumped 2.8%, to 101.6% of J-04. It was felt that the J-08 sensor might have a positive bias. To determine if this were true (in the field), a calibrated Maximum cup was installed at J-08 at the same level, in the field in January 1988. Three months of concurrent wind-speed data were collected by these two sensors. Correlation of all concurrent wind data, in winds of 10 mph or greater, showed that the R.M. Young sensor was reading 2% higher than was the Maximum cup. The correlation was perfect. As a result, all wind speeds at J-08 were reduced by 2% to reflect this field calibration.

The other problem with site J-08 was in orientation of the vane. It was discovered that the north point on the wind vane was oriented toward 22.5°, or 22.5° east of true north. With this orientation, all wind-direction data would be recorded 22.5° too low. (For example, a true north wind at 360° would read 337.5°.) It was evident from the base plate and guy wires that the mast had not turned but had been installed incorrectly. Therefore, 22.5° have been added to J-08 wind-direction data.

These problems were not evident at the other R.M. Young sensor installed at site S-13 on the Souza Ranch.

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3.0 DATA ANALYSIS

3.1 Data Sets

Data collection took place on the Souza Ranch from September 10, 1987 at 1600 Pacific Daylight Time (PDT) through September 14, 1987 at 1400 PDT. The duration of the data collection phase was 94 hours, representing 564 10-minute samples. Data collection on the Jess Ranch took place in two periods: from October 1, 1987 at 1400 PDT through October 3, 1987 at 0500 PDT; and from October 7, 1987 at 0800 PDT through October 10, 1987 at 0900 PDT. During the first period on the Jess Ranch, light and variable winds occurred on October 2; these data were not included in the final data set. The duration of the Jess data collection phase was 102 hours, representing 612 10-minute samples. Although data collection took place in October on the Jess Ranch, the meteorological conditions were typical of summer, as shown in Appendix A. Appendix A is a detailed synoptic discussion of the atmospheric conditions that occurred during the free-flow periods. A descriptive paragraph and two weather maps are included for every 12-hour period. The weather maps are a western U.S./eastern Pacific surface map and an "upper air" map of the 500-mb (18,000-ft) level. This appendix will be of particular interest to meteorologists or readers with some knowledge of the subject.

A complete listing of the hourly data can be found in Appendix C, which lists up to 48 hours of data for 15 sites on each page. Data are listed synoptically (i.e., each line of data lists data for one hour for 15 sites).

3.2 Linear Correlations

Correlation is defined as the degree of relationship between variables. The correlation coefficient is a dimensionless number that varies from -1 to +1. A positive correlation means that variable y tends to increase as variable x increases. A negative or inverse correlation means that variable y tends to decrease as variable x increases. The correlation coefficient should not be confused with a ratio; two variables or sites could have a high degree of correlation, close to 1.0, but have a ratio very different from unity. The square of the correlation coefficient is called the coefficient of determination. It is a useful term that is equal to the ratio of explained variation between two variables to the total variation.

Artificially high linear correlations can exist between two variables if both variables depend on time. Because many meteorological parameters are time-dependent, the reader is cautioned that to some degree the high correlations discussed hereafter could be due to this phenomenon.

3.2.1 Souza Ranch

The first step in the data analysis was the correlation of all wind-speed data to the reference towers. Table 3-1 lists all the linear correlation coefficients to reference site S-13. The sample size for all sites was 94 data points.

The table shows that all sites on Souza had correlation coefficients of 0.94 or better, which indicates excellent correlations. The mean correlation coefficient to site S-13 was 0.97. The data on Table 3-1 are plotted on Figure 3-1.

Table 3-1. Souza Hourly Correlation Coefficients (r) to S-13 at 70 ft

Site and Level	r
S-13, 35 ft	1.00
S-27, 45 ft	0.97
S-27, 80 ft	0.97
S-29, 50 ft	0.98
D02, 35 ft	0.98
D04 "	0.97
D06 "	0.95
D07 "	0.97
D11 "	0.97
D13 "	0.95
E02 "	0.97
E04 "	0.98
E06 "	0.99
E10 "	0.94
E12 "	0.96
E14 "	0.97
F02 "	0.96
F04 "	0.98
F06 "	0.99
F08 "	0.98
F10 "	1.00
F12 "	0.99
F14 "	0.98
G02 "	0.99
G04 "	1.00
G07 "	0.98
G09 "	0.95
Mean	0.97

3.2.2 Jess Ranch

Table 3-2 lists the correlation coefficients for the Jess Ranch. The correlations include the surrogate data points at the four sites listed in Table 2-3. The Jess sites were also correlated to the J-04, 120-ft tower. J-04 and J-08 are at opposite ends of the study area (see Figure 2-3). Table 3-2 lists the correlation coefficients to these two sites. Sample size at all sites was 102 data points. In addition, the table lists the correlation of all sites to their adjacent site. The table shows that the mean correlation coefficient to adjacent sites was 0.98, which is excellent. The mean correlation coefficient to Site J-08 was 0.89. This analysis on Jess was done as part of the QA process. Poor or fair correlations may be indicative of invalid data points.

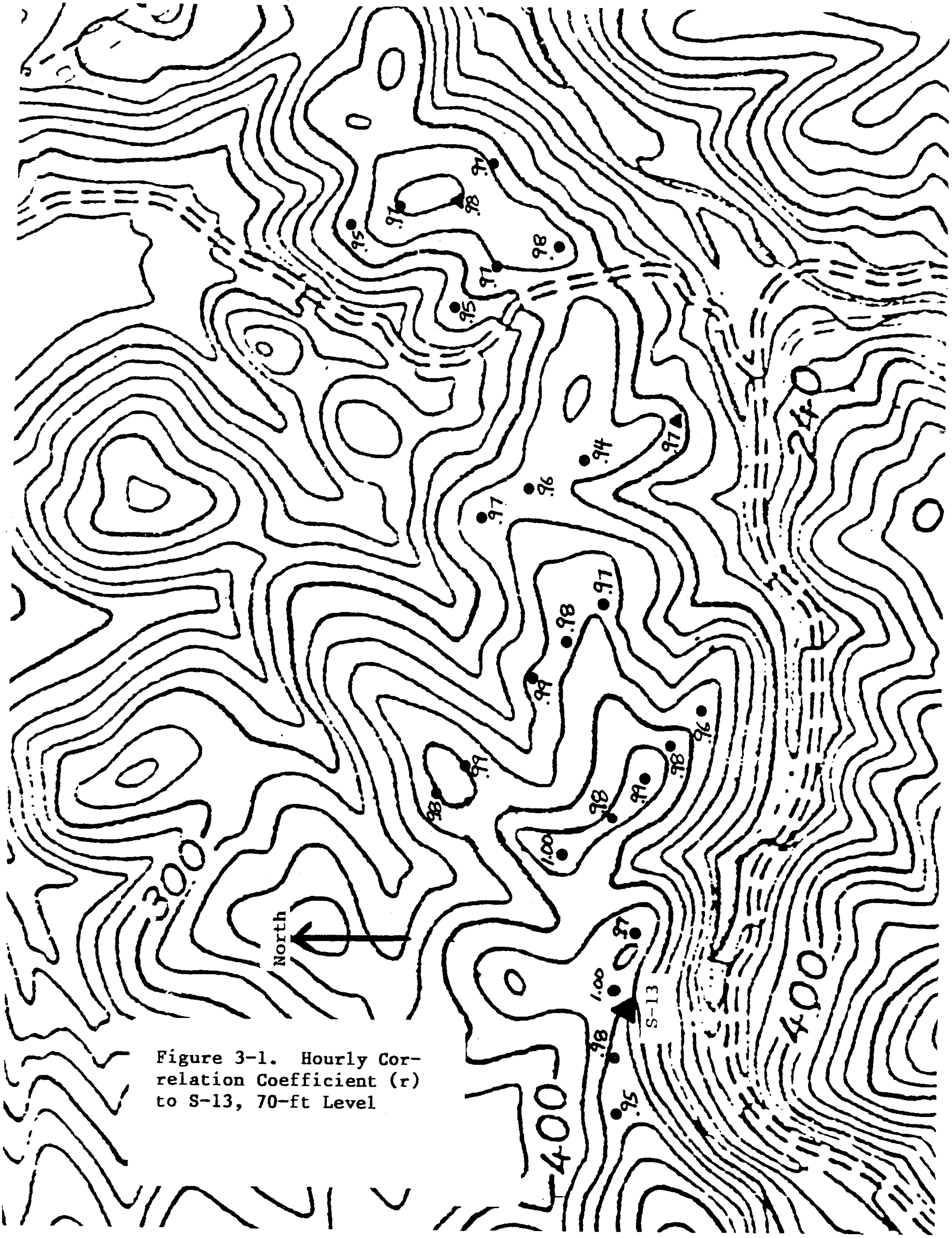

Figure 3-1. Hourly Correlation Coefficient (r) to S-13, 70-ft Level

Table 3-2. Jess Ranch Hourly Correlation Coefficients to Reference Anemometers and Adjacent Sites

Location and Level	J-08	J-04	Adjacent Site
Site J-08, 50 ft (reference)		0.90	1.00
Site J-04, 120 ft	0.90		0.99
Site J-19, 40 ft	0.87	0.93	1.00
Site J-17, 35 ft	0.96	0.83	1.00
Site J-17, 70 ft	0.95	0.83	1.00
Site J-18, 35 ft	0.85	0.84	1.00
Site J-18, 70 ft	0.85	0.85	1.00
Turbine C-1, 50 ft	0.89	0.98	0.99
Turbine C-3, 50 ft	0.87	0.98	0.99
Turbine C-5, 50 ft	0.89	0.98	0.99
Turbine C-7, 50 ft	0.87	0.96	0.99
Turbine C-9, 50 ft	0.86	0.95	0.98
Turbine C-12, 50 ft	0.91	0.99	0.99
Turbine C-14, 50 ft	0.90	0.99	0.98
Turbine C-16, 50 ft	0.87	0.97	0.98
Turbine C-18, 50 ft	0.86	0.95	0.97
Turbine D-2, 50 ft	0.86	0.94	0.98
Turbine D-4, 50 ft	0.83	0.90	0.98
Turbine D-6, 50 ft	0.80	0.87	0.98
Turbine D-13, 50 ft	0.83	0.90	0.99
Turbine D-15, 50 ft	0.80	0.87	0.99
Turbine D-21, 50 ft	0.85	0.90	0.96
Turbine E-2, 50 ft	0.86	0.91	0.96
Turbine E-4, 50 ft	0.89	0.93	0.96
Turbine E-6, 50 ft	0.86	0.90	0.95
Turbine E-8, 50 ft	0.90	0.88	0.95
Turbine E-10, 50 ft	0.92	0.93	0.97
Turbine E-11, 50 ft	0.84	0.89	0.98
Turbine E-13, 50 ft	0.85	0.91	0.98
Turbine E-15, 50 ft	0.89	0.93	0.95
Turbine E-18, 50 ft	0.88	0.92	0.95
Turbine E-20, 50 ft	0.90	0.90	0.97
Turbine E-22, 50 ft	0.93	0.94	0.97
Turbine F-1, 35 ft	0.85	0.87	0.97
Turbine F-3, 35 ft	0.88	0.88	0.97
Turbine F-7, 35 ft	0.83	0.88	0.98
Turbine F-9, 35 ft	0.78	0.84	0.98
Turbine F-12, 35 ft	0.76	0.83	0.99

Table 3-2. Jess Ranch Hourly Correlation Coefficients to Reference Anemometers and Adjacent Sites (Continued)

Location and Level	J-08	J-04	Adjacent Site
Turbine G-1, 35 ft	0.84	0.86	0.96
Turbine G-3, 35 ft	0.90	0.86	0.96
Turbine G-5, 35 ft	0.97	0.87	0.98
Turbine G-7, 35 ft	0.99	0.87	0.98
Turbine G-8, 35 ft	0.81	0.81	0.95
Turbine G-10, 35 ft	0.88	0.84	0.97
Turbine G-12, 35 ft	0.94	0.87	0.97
Turbine H-1, 50 ft	0.85	0.94	1.00
Turbine H-2, 50 ft	0.85	0.95	1.00
Turbine H-7, 50 ft	0.86	0.93	0.97
Turbine H-10, 50 ft	0.83	0.88	0.97
Turbine H-12, 50 ft	0.83	0.91	0.94
Turbine H-15, 50 ft	0.83	0.88	0.94
Turbine I-1, 50 ft	0.83	0.87	0.99
Turbine I-3, 50 ft	0.82	0.86	0.99
Turbine I-5, 50 ft	0.83	0.87	0.99
Turbine I-9, 50 ft	0.81	0.86	0.96
Turbine I-14, 50 ft	0.82	0.85	0.96
Turbine J-6, 50 ft	0.87	0.86	0.97
Turbine J-8, 50 ft	0.86	0.88	0.97
Turbine J-11, 50 ft	0.86	0.86	0.98
Turbine J-13, 50 ft	0.84	0.85	0.98
Turbine K-1, 35 ft	0.82	0.84	0.95
Turbine K-3, 35 ft	0.84	0.87	0.96
Turbine K-5, 35 ft	0.90	0.86	0.96
Turbine K-7, 35 ft	0.95	0.84	0.97
Turbine K-9, 35 ft	0.97	0.85	0.97
Turbine K-12, 35 ft	0.94	0.84	0.98
Turbine K-14, 35 ft	0.96	0.82	0.98
Turbine L-1, 35 ft	0.99	0.88	0.99
Turbine L-3, 35 ft	1.00	0.90	1.00
Turbine L-5, 35 ft	1.00	0.91	0.99
Turbine L-8, 35 ft	0.99	0.88	0.99
Turbine L-10, 35 ft	1.00	0.89	1.00
Turbine L-12, 35 ft	0.99	0.89	1.00
Turbine M-2, 35 ft	0.97	0.85	0.99
Turbine M-4, 35 ft	0.98	0.88	0.99
Turbine M-6, 35 ft	0.99	0.89	1.00
Turbine M-8, 35 ft	0.99	0.89	1.00
Turbine M-9, 35 ft	0.96	0.86	0.99

Table 3-2. Jess Ranch Hourly Correlation Coefficients to Reference Anemometers and Adjacent Sites (Concluded)

Location and Level	J-08	J-04	Adjacent Site
Turbine M-11, 35 ft	0.96	0.86	1.00
Turbine M-13, 35 ft	0.97	0.87	1.00
Turbine N-1, 35 ft	0.94	0.83	0.97
Turbine N-4, 35 ft	0.89	0.81	0.97
Turbine N-6, 35 ft	0.90	0.79	0.99
Turbine N-8, 35 ft	0.93	0.80	0.99
Mean	0.89	0.89	0.98

The data listed in Table 3-2 are plotted on Figures 3-2 and 3-3. Figure 3-2 shows the correlations to J-08, and Figure 3-3 shows the correlations to J-04. Both figures show the areas of high correlation in the vicinity of the reference tower used. Well-exposed sites such as L-3, L-5, and C-10 through C-14 show good correlations to both towers. Figure 3-2 shows that there are two areas with relatively low correlation coefficients to J-08. These two areas are downwind of hills on the adjacent ranch. The hills are marked with "X". Evidently, the hills act as obstacles to the flow. The low correlations at these sites indicate a relatively high degree of variability in the wind in these two small areas. Site F-12, in the northern area, had the lowest correlation coefficient to Site J-08.

Additional analysis was done to determine the effect of inversion height on the degree of correlation. Inversion height data were collected on the Souza Ranch by Howden Wind Parks Inc. These data were made available by Howden. The analysis showed that for low inversion heights, with an inversion top below 1000 ft MSL, the correlation coefficient at F-12 drops to 0.56. However, when the inversion top is above 1000 ft MSL, the correlation coefficient jumps to 0.91. For comparison, site M-13 was analyzed, which is in the northeast portion of the Jess study area and not downwind of the 678-ft hill. This site has a correlation coefficient of 0.97 for both low and high inversions, so the inversion has no effect on the correlation at this site. This exercise illustrates the combined effect of the low inversion and the topography. When the inversion is low, the wind at sites such as F-12 is highly variable; this variability is a local effect, not seen at J-08. This variability may be caused partially by wave activity within the inversion. The inversion rises and falls, and as it does, flow over the 678-ft hill may be interrupted. The result could be that the wind might come in spurts downwind of this hill whenever the right combination of inversion height and wave activity occurs. When the inversion is higher the flow over the entire Jess Ranch is deeper. This leads to a more homogeneous wind resource over the ranch because the hills upwind do not obstruct the flow significantly.

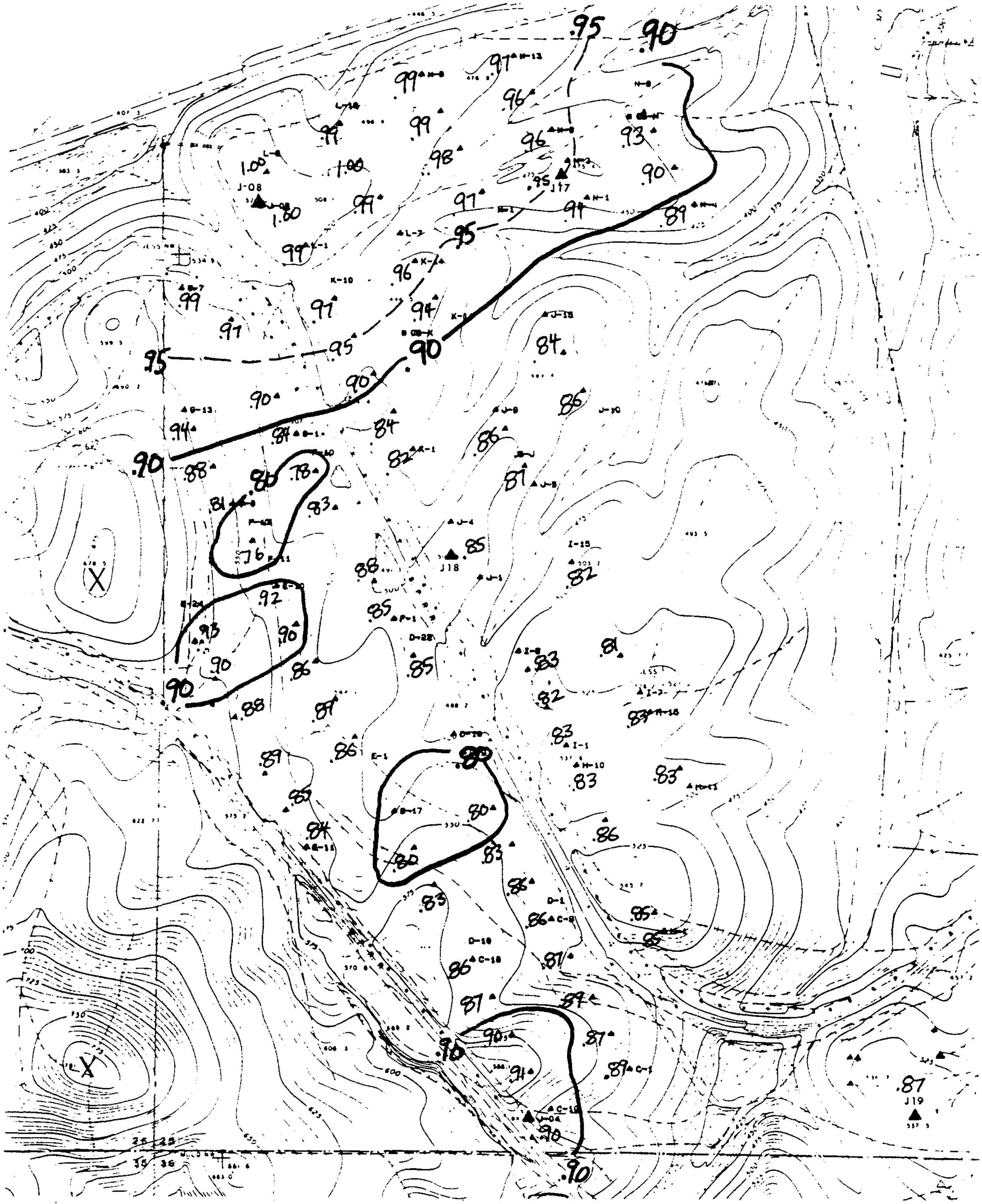

Figure 3-2. Hourly Correlation Coefficient (r) to Site J-08

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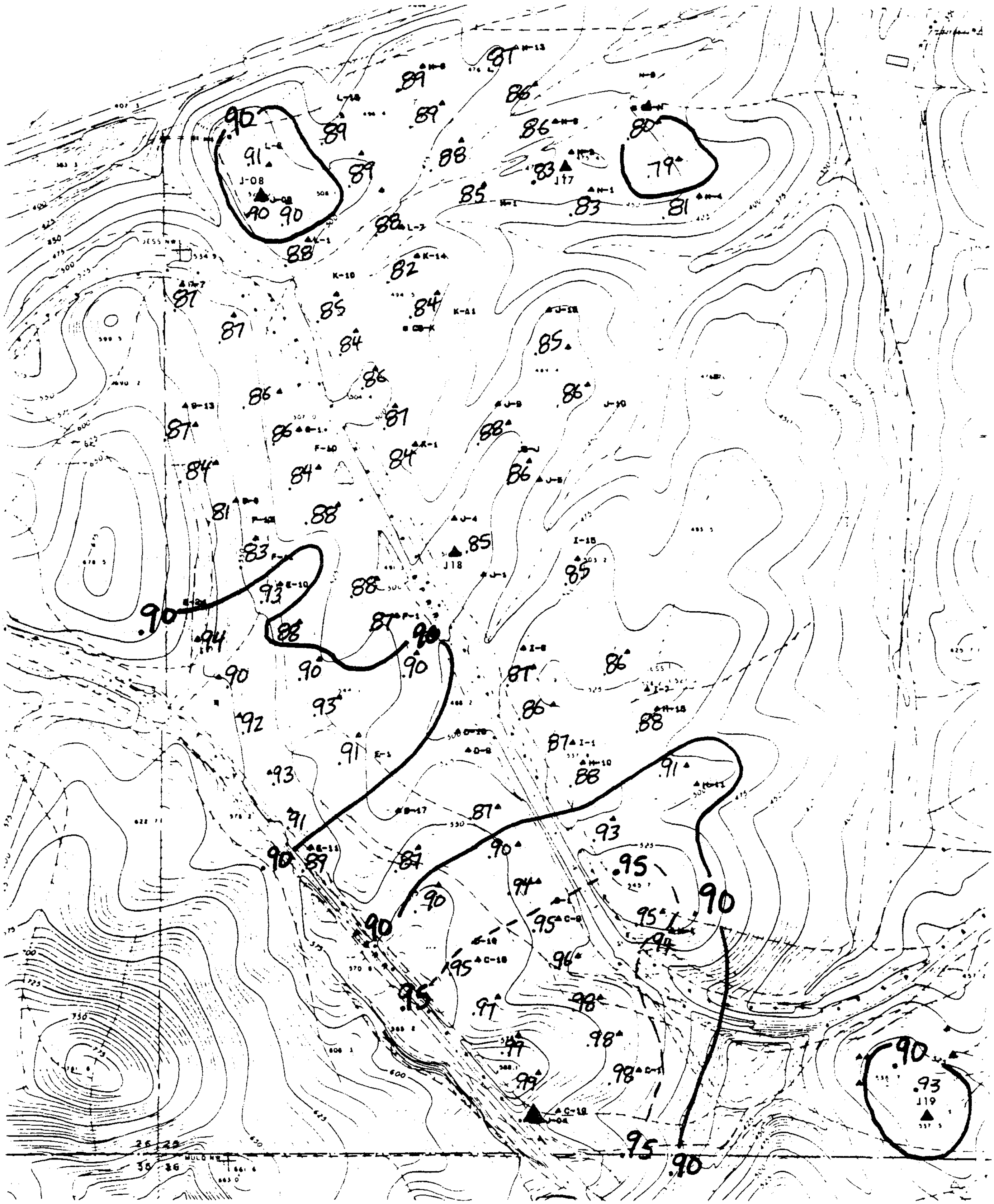

Figure 3-3. Hourly Correlation Coefficient (r) to Site J-04

This type of analysis was not done on Souza for two reasons: (1) the correlation coefficients to the reference tower were all quite high on Souza, and (2) the mean height of the inversion was considerably higher during the Souza free-flow period than it was during the Jess period. It is believed that the higher inversion during the Souza study is responsible, in part, for the higher correlation coefficients on Souza.

3.3 Wind Roses

Tables 3-3 and 3-4 are joint-frequency distributions of wind speed and direction for sites S-13 and J-08, respectively. The data are grouped in 5-mph speed bins and 5° direction bins. Table 3-3 shows that wind directions ranged from 210° to 255°, south-southwest through west-southwest. Table 3-3 also shows that almost all the data fall in a 15° band from 220° to 235°. This is typical of spring/summer flow at site S-13. The table shows that most of the hourly mean speeds were between 20 and 30 mph.

Table 3-3. S-13 Joint Frequency Distribution. Hours of Occurrence at the 70-ft Level (Sept. 10-14, 1987).

Wind Direction (Degrees)	Wind Speed (mph)							
	10 to 15	15 to 20	20 to 25	25 to 30	30 to 35	35 to 40	40 to 45	Total
210-215	-	-	2	-	-	-	-	2
215-220	-	2	4	3	-	-	-	9
220-225	1	4	8	7	2	-	-	22
225-230	-	4	10	12	4	4	-	34
230-235	-	4	2	4	4	4	1	19
235-240	1	1	-	-	-	1	-	3
240-245	1	-	-	-	-	-	-	1
245-250	1	-	-	-	-	-	-	1
250-255	3	-	-	-	-	-	-	3
Total	7	15	26	26	10	9	1	94

Note: Values in a category are greater than or equal to the lower bound, and less than the upper bound of the category.

Table 3-4 shows that there was a narrower range of directions at J-08, from 235° to 260°. Most of the hours fall in a 15° band, from 240° to 255°, or west-southwest. This is the normal spring/summer direction at this site. The table also shows that most of the speeds were between 20 and 30 mph.

Table 3-4. J-08 Joint Frequency Distribution. Hours of Occurrence at the 50-ft Level (Oct. 1-10, 1987).

Wind Direction (Degrees)	Wind Speed (mph)						
	10 to 15	15 to 20	20 to 25	25 to 30	30 to 35	35 to 40	Total
235-240	-	1	-	2	1	-	4
240-245	1	4	9	11	3	1	29
245-250	2	2	7	12	4	4	31
250-255	2	5	8	11	3	2	31
255-260	2	3	1	1	-	-	7
Total	7	15	25	37	11	7	102

Note: Values in a category are greater than or equal to the lower bound, and less than the upper bound of the category.

3.4 Diurnal Mean Speeds

Table 3-5 lists the diurnal (time-of-day) mean speeds for the Souza and Jess reference sites. Note that each diurnal average contains only four or five

Table 3-5. Diurnal Mean Wind Speeds

Hour	Wind Speed (mph)	
	S-13	J-08
01	29.5	27.0
02	26.9	25.4
03	25.5	24.6
04	24.5	21.7
05	24.6	19.9
06	24.8	21.9
07	23.7	20.9
08	23.7	21.5
09	23.4	23.2
10	22.6	26.6
11	19.6	26.0
12	18.3	25.6
13	18.3	24.8
14	18.8	25.6
15	20.6	25.5
16	20.7	26.1
17	21.3	24.7
18	24.8	26.0
19	27.6	25.6
20	32.8	26.1
21	34.5	27.3
22	32.4	28.1
23	30.7	28.7
24	31.3	27.4
Mean	25.1	25.0

hours of data, so the typical diurnal pattern may not be reflected in the data. The data from S-13 show the typical diurnal pattern of an Altamont site: highest winds just before midnight and lowest winds around noon. The data from the midday lulls at J-08 on October 2, 3, and 10 were deleted from the data set. Thus, J-08 does not show this pattern.

A complete listing of the diurnal mean speeds at all sites can be found in Appendix D. These summaries are interesting because they allow a comparison of different sites' diurnal patterns and mean speeds.

3.5 Vertical Shear

In all, five two-level towers were available for this study, three on Jess and two on Souza. Vertical wind shear is often expressed as an exponent, alpha. Normally, in neutral atmospheric stability in areas of flat terrain, alpha is equal to 1/7 or about 0.14. Because of the inversion (which results in high stability) and the complex terrain, vertical shear in the Altamont Pass varies considerably from this value and is often less than 0.14. In the Altamont Pass, alpha values are generally very low on well-exposed ridges and higher at sheltered sites. The low values on well-exposed sites are because of speed-up effects near the ground.

Alpha has been calculated for each hour of data at all five towers. Table 3-6 is a diurnal summary of these data. (Note that the units in the table are "100 or %," so all values have been multiplied by 100. Thus, an alpha of 14.0 in the table is actually 0.14.) The table shows that all five towers have alpha values below 0.14. On the Jess Ranch, the mean of the alpha values ranged from 0.114 at site J-18 to a low of 0.058 at J-19. Site J-19 is on a well-exposed knoll, which helps explain its lower shear.

There is no clear diurnal pattern shared by all sites. J-18 and J-19 have lower shear in the midday than at night. Shear often increases after sunset as the lack of thermal instability creates less downward mixing of momentum. Because of the lack of mixing at night, flow lifts or separates from the ground, resulting in stronger shear. This phenomenon has been discussed quite extensively in meteorological and air-quality literature.

The Souza sites also have mean alpha values below 0.14. In fact, site S-27 has a mean shear close to zero, indicating that wind speeds are the same at both levels. Site S-13's shear is larger, 0.075, and is about half the "normal" value.

As noted in Section 2.2.1, there were two turbine anemometer heights on the Jess Ranch: 35 and 50 ft AGL. The vertical shear measured at the three Jess two-level towers suggests that the speed difference between 35 and 50 ft would be 2%-4%.

3.6 Wind-Speed Frequency Distribution and Theoretical Energy

Theoretical energy production is calculated by integrating the measured frequency distribution over a given time period and by using a power curve. This calculation has been done for the two reference sites, with the Nordtank power curve. In the calculation, the power curve has been adjusted to 97% of sea-level density, which is a close approximation based on the altitude and temperature. Wind-speed data at S-13 were collected at hub height, so no shear

Table 3-6. Diurnal Wind Shear Summary. Units are Shear Exponent, Alpha × 100.

	Jess Ranch Sites (Oct. 1-10, 1987)			Souza Ranch Sites (Sept. 10-14, 1987)	
Hour	J-17	J-18	J-19	S-13	S-27
1	9.3	11.0	6.0	7.5	-0.7
2	9.0	13.0	4.9	5.4	-0.9
3	10.3	13.8	5.6	5.7	-0.1
4	8.9	15.4	7.8	6.0	0.4
5	9.5	17.1	7.5	5.9	0.2
6	10.0	22.2	9.0	5.8	1.0
7	9.4	9.5	7.6	7.4	1.8
8	12.7	21.3	7.5	7.7	1.3
9	10.0	12.6	7.6	8.0	-0.2
10	6.0	9.2	3.3	8.1	-0.3
11	10.7	9.0	6.4	8.3	-1.6
12	10.8	7.6	2.6	7.5	-2.3
13	5.4	6.8	0.6	6.3	-1.4
14	11.4	6.5	1.9	7.2	-1.6
15	11.7	6.7	-0.5	10.8	0.1
16	11.3	6.1	2.1	8.9	-0.7
17	11.4	6.7	1.7	10.0	-0.1
18	11.4	8.3	4.8	9.7	-0.2
19	13.2	10.5	7.1	9.4	1.3
20	12.4	12.9	7.4	7.3	2.9
21	12.8	9.7	7.4	6.2	2.5
22	11.3	9.8	7.9	6.4	-0.1
23	10.6	10.0	8.6	6.9	-0.1
24	10.3	10.3	7.7	8.2	1.0
Mean	10.5	11.4	5.8	7.5	0.1
Valid hours	102	102	102	94	94

Note: Measurement levels for sites J-17, J-18, and S-13 were 35 ft and 70 ft. Measurement levels for site J-19 were 40 ft and 80 ft. Measurement levels for sites S-27 were 45 ft and 80 ft.

adjustment is necessary. J-08 data were collected at 50 ft, which is 22 ft below hub height. However, based on the excellent exposure of J-08 (on a bluff), the shear between 50 and 72 ft AGL is probably negligible; therefore, no correction has been made.

Tables 3-7 and 3-8 are the distributions for S-13 and J-08, respectively. The tables show that theoretical energy at these sites during the free-flow period was about 4300 kWh at S-13 and about 4700 kWh at J-08.

Table 3-7. Wind Speed Frequency Distribution for Site S-13. 70-ft Reference, Sept. 10-14, 1987.

Speed* (mph)	Hours	Nordtank 65 Power** (kW)	Nordtank 65 Energy (kWh)
10	0	2.2	0.0
11	0	4.5	0.0
12	0	6.8	0.0
13	3	9.4	28.1
14	3	12.0	35.9
15	2	14.5	29.1
16	2	18.6	37.2
17	0	22.7	0.0
18	1	26.8	26.8
19	5	30.8	154.2
20	8	34.9	279.4
21	5	38.0	190.1
22	4	41.1	164.5
23	7	44.2	309.6
24	6	47.3	284.0
25	6	50.4	302.6
26	3	52.1	156.2
27	8	53.7	429.4
28	4	55.3	221.2
29	6	56.9	341.4
30	1	58.5	58.5
31	5	60.1	300.7
32	0	60.7	0.0
33	2	61.4	122.7
34	2	62.0	123.9
35	3	62.6	187.7
36	3	63.2	189.5
37	1	63.8	63.8
38	3	64.4	193.2
39	0	66.0	0.0
40-60	1	67.0	67.0
Total	94		4296.8

*Mean wind speed = 25.1 mph.
**Corrected to 97.0% density.

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Table 3-8. Wind Speed Frequency Distribution for Site J-08. 50-ft Reference, Oct. 1-10, 1987.

		Nordtank 65	
Speed* (mph)	Hours	Power** (kW)	Energy (kWh)
10	0	2.2	0.0
11	1	4.5	4.5
12	0	6.8	0.0
13	1	9.4	9.4
14	2	12.0	23.9
15	4	14.5	58.2
16	4	18.6	74.5
17	5	22.7	113.5
18	3	26.8	80.3
19	2	30.8	61.7
20	3	34.9	104.8
21	3	38.0	114.1
22	3	41.1	123.4
23	4	44.2	176.9
24	7	47.3	331.4
25	8	50.4	403.5
26	9	52.1	468.5
27	8	53.7	429.4
28	5	55.3	276.4
29	9	56.9	512.2
30	4	58.5	234.1
31	2	60.1	120.3
32	2	60.7	121.5
33	3	61.4	184.1
34	2	62.0	123.9
35	2	62.6	125.1
36	3	63.2	189.5
37	1	63.8	63.8
38	1	64.4	64.4
39	1	66.0	66.0
40-60	9	67.0	0.0
Total	102		4659.2

*Mean wind speed = 25.0 mph.
**Corrected to 97.0% density.

Theoretical energy at J-08 was slightly higher, partly because of the longer integrating period (102 hours versus 94 hours). Thus, the two periods were quite similar in energy content at these two sites. The mean wind speeds were nearly identical also. The data periods in these two tables are not identical because the free-flow measurements took place on different dates on these two ranches.

3.7 Speed and Energy Ratios

The principal analysis tool of this report was the calculation of speed ratios between the reference site and all other sites. Ratios have been calculated for the entire data set and for a number of subsets. The subsets were based on stratification by a third parameter. The stratifications were done by the following:

1. Wind direction at the reference site
2. Wind speed at the reference site
3. Day versus night hours
4. Data period (at Jess, where there were two periods).

Theoretical energy ratios were also calculated for the entire data set, using the Nordtank 65-kW power curve.

After these various ratios were calculated, the data were plotted on topographic maps, and isopleths were drawn. The maps are an excellent vehicle for presenting this large amount of data, as the wind speed ratio patterns are quite apparent, when plotted out. In some cases, the ratios of a particular stratification class did not reveal any difference in overall pattern from the entire data set. In these cases, the maps are redundant and have not been included in this report.

3.7.1 Souza Ranch Ratios

Table 3-9 lists the speed ratios to S-13 for the various stratifications, as well as the energy ratios for the entire data set. Reviewing Table 3-9 reveals that stratification by wind direction changes the ratios from the entire data set; however, stratification by speed and time of day shows fewer changes. There are four ratio maps included in this section:

1. Speed ratios to S-13 for the entire data set
2. Energy ratios to S-13 for the entire data set
3. Speed ratios for wind direction band 210°-226°
4. Speed ratios for wind direction band 226°-255°.

Before reviewing these figures, it is useful to look at Figure 2-2, the topographic map of the Souza Ranch and surrounding terrain. Notice the location of the canyon aligned with the southwest flow that intersects the lower left (southwest) corner of the study area.

Figure 3-4 is a plot of the speed ratios to S-13 for the entire data period. The wind speeds were quite uniform, except at G9. Almost all the site ratios were within a range of 90% to 110% of S-13. There are two high-wind areas: in the west area near G2 and F2-F8, and in the east area around D11 and D13. The first area is on a ridge downwind of the principal canyon axis, as mentioned above. The second area is a lower ridge jutting into a small drainage canyon (also aligned southwest). The areas with speed ratios of 100% or higher have been lightly shaded on the Souza maps. All sites with ratios above 100% are on ridges that intersect or jut into small drainage canyons, aligned with the prevailing flow. Turbine G9 is in a low-wind area that appears to be sheltered by the terrain immediately west of it.

Table 3-9. Souza Ranch Ratios to Site S-13, 70-ft Reference Anemometer

	All Data		Speed Ratios by Stratification					
Site	Speed Ratio	Energy Ratio	Day	Night	210-226 degrees	226-255 degrees	10-24.6 mph	24.6-41 mph
S-13 35'	.95	.94	.94	.95	.96	.95	.95	.96
S-27 45'	.94	.92	.94	.94	.96	.92	.95	.94
S-27 80'	.94	.93	.93	.94	.96	.93	.95	.94
S-29 50'	.96	.96	.96	.95	.97	.95	.98	.95
D02 35'	.96	.96	.97	.96	.98	.95	.98	.95
D04	.94	.93	.93	.94	.97	.92	.96	.93
D06	.93	.91	.91	.93	.96	.89	.93	.92
D07	.94	.93	.93	.94	.98	.91	.95	.93
D11	1.08	1.09	1.07	1.09	1.11	1.06	1.09	1.08
D13	1.10	1.10	1.08	1.10	1.15	1.05	1.11	1.09
E02	1.03	1.03	1.02	1.02	1.07	.99	1.04	1.02
E04	.95	.94	.95	.94	.98	.92	.96	.94
E06	.96	.95	.97	.94	.98	.94	.97	.95
E10	.99	.98	.97	.99	1.04	.94	.99	.99
E12	.93	.92	.92	.93	.97	.89	.94	.92
E14	.92	.91	.92	.91	.95	.89	.94	.91
F02	1.05	1.06	1.07	1.03	1.08	1.02	1.06	1.04
F04	1.06	1.07	1.08	1.04	1.07	1.05	1.08	1.05
F06	1.11	1.11	1.13	1.09	1.12	1.10	1.12	1.10
F08	1.06	1.07	1.08	1.05	1.09	1.04	1.07	1.06
F10	.98	.97	.99	.98	.99	.98	.98	.98
F12	1.02	1.01	1.01	1.02	1.02	1.01	1.01	1.02
F14	.98	.95	.95	.99	.98	.97	.96	.99
G02	1.05	1.05	1.06	1.03	1.06	1.03	1.06	1.05
G04	.98	.97	.97	.8	.99	.97	.98	.98
G07	.92	.88	.89	.93	.94	.89	.90	.93
G09	.77	.68	.75	.78	.80	.74	.76	.78
Mean	.98	.97	.98	.98	1.01	.96	.99	.98

Figure 3-5 is a plot of the theoretical energy ratios for the entire data period. The pattern is the same as that of Figure 3-4. Note that no shear adjustments were made to correct the 35-ft data to hub height (72 ft). Vertical-shear data for the Souza sites were discussed in Section 3.5. As mentioned, site S-13's shear was about one-half the "normal" value of 0.14 (for flat terrain) and S-27's shear was about zero. At sites that are not on the tops of well-exposed ridges, shear values may be close to 0.14. This is probably true at many of the "E" sites, which are on terrain that slopes gently down behind a ridge. Therefore, the energy ratios on Figure 3-5 may be artificially low at these sites. However, trying to estimate wind shear at individual sites is difficult; the resulting errors could be larger than if simply presenting the data as-is.

Figure 3-6 is a plot of speed ratios for the more south-southwesterly winds (210°-226°). The ratios are about 3% higher overall than on Figure 3-4, but the general pattern is the same. Figure 3-7 is a plot of the speed ratios for

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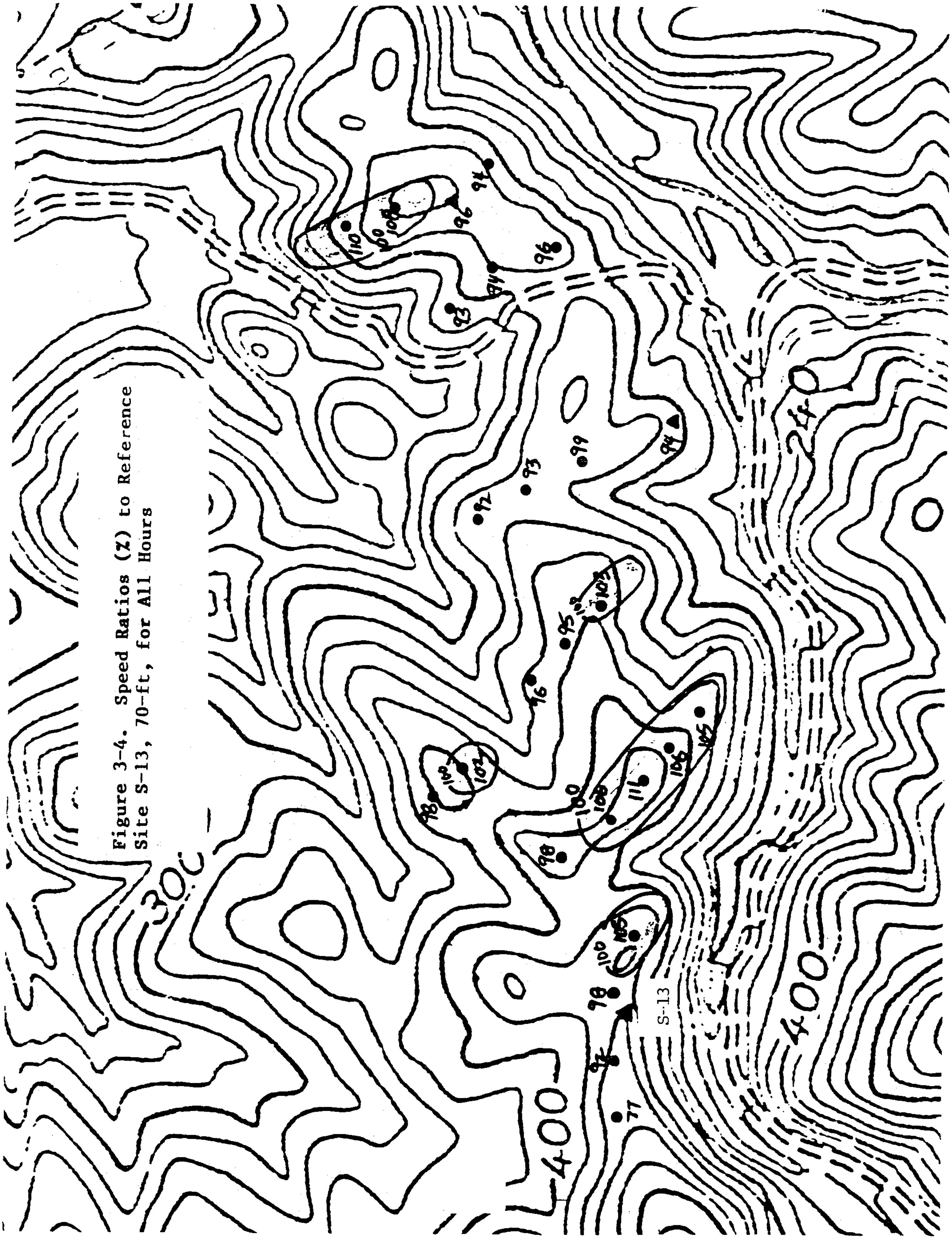

Figure 3-4. Speed Ratios (%) to Reference Site S-13, 70-ft, for All Hours

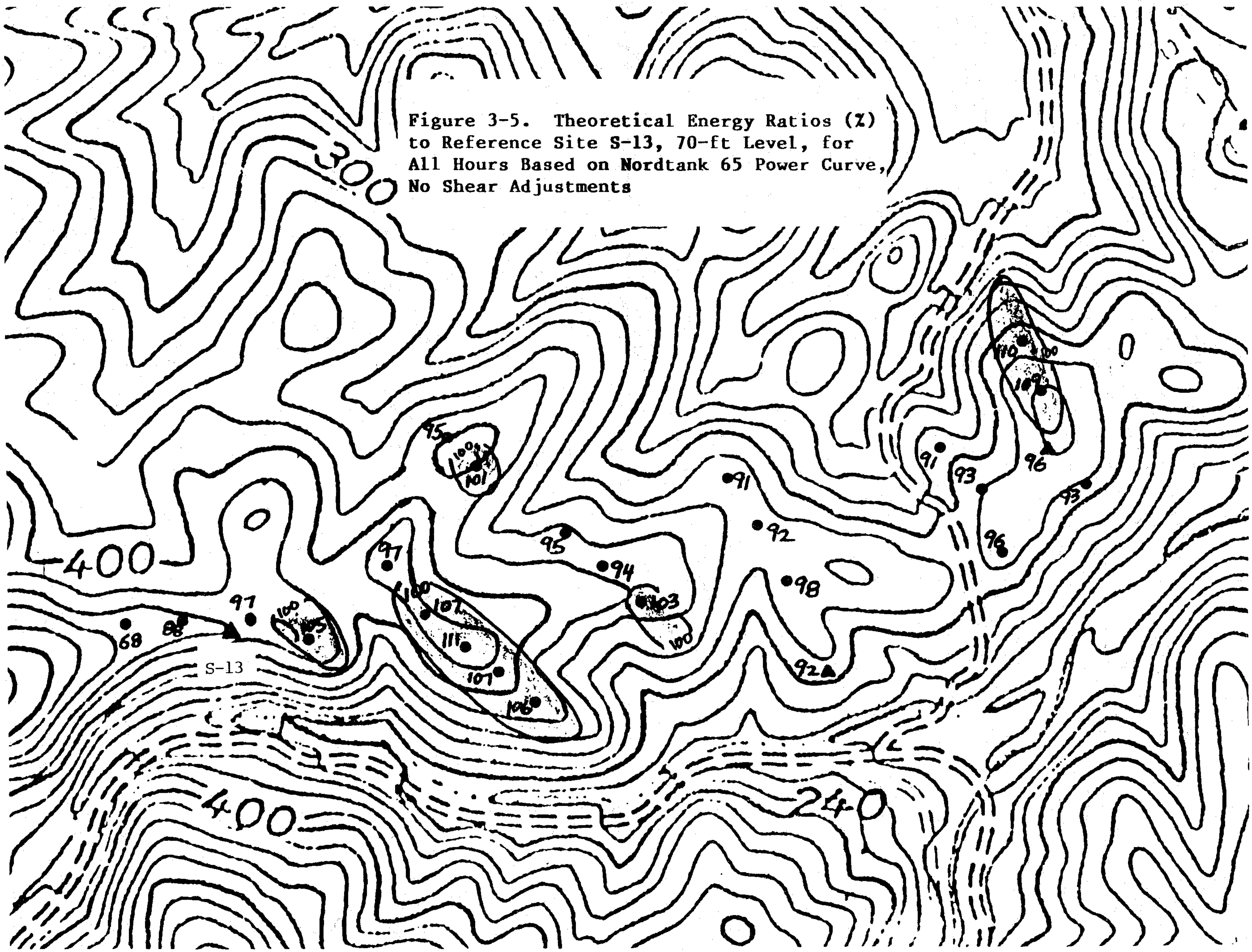

Figure 3-5. Theoretical Energy Ratios (%) to Reference Site S-13, 70-ft Level, for All Hours Based on Nordtank 65 Power Curve, No Shear Adjustments

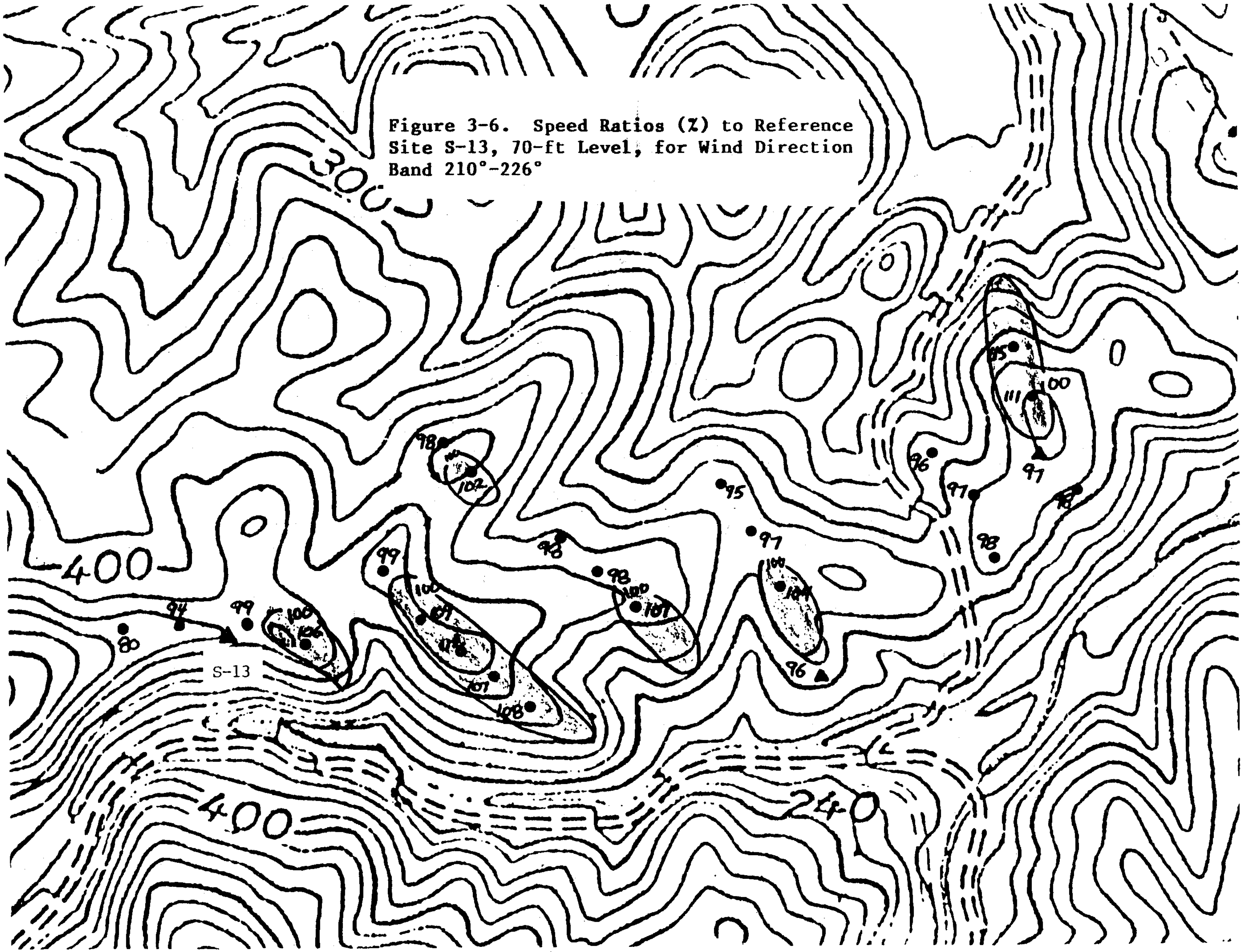

Figure 3-6. Speed Ratios (%) to Reference Site S-13, 70-ft Level, for Wind Direction Band 210°-226°

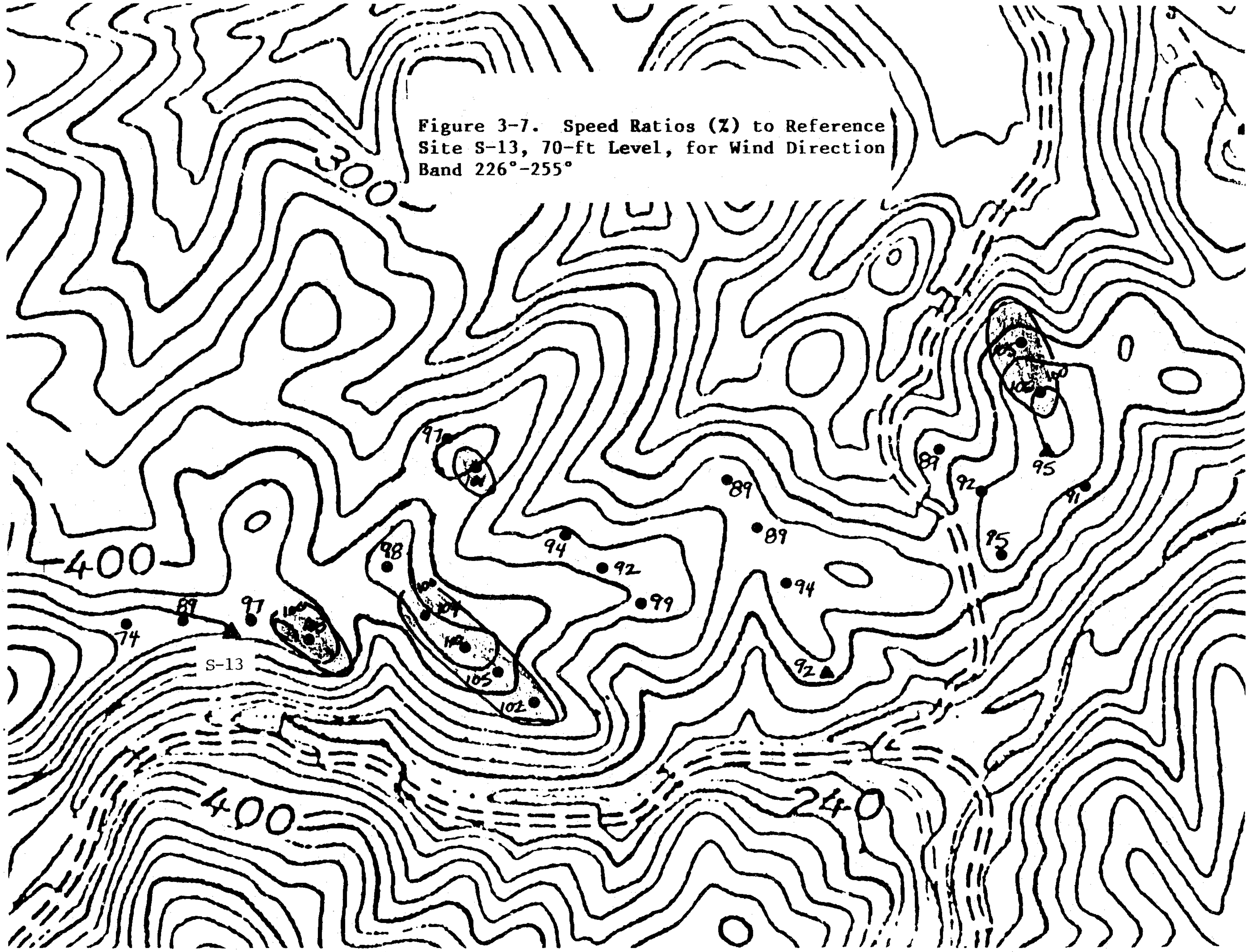

Figure 3-7. Speed Ratios (%) to Reference Site S-13, 70-ft Level, for Wind Direction Band 226°-255°

the more west-southwesterly winds (226°-255°). The ratios are about 2% lower overall than those of Figure 3-4 and 5% lower than those of Figure 3-6.

3.7.2 Jess Ranch Ratios

Table 3-10 lists the speed ratios to J-08 for the various stratification classes, as well as the energy ratios for the entire data set. The speed ratios are for anemometer height and have not been normalized, except for those for site J-04. The ratios from the four sites that had some invalid data points are calculated from the data sets that include the surrogate data. As with Souza, the stratification by wind direction changes the ratios more than does stratification by wind speed or time of day. The first data period, October 1-3, was characterized by somewhat weaker flow, and it also shows numerous changes in the speed ratios relative to the entire data set. Thus, there are five ratio maps included in this section:

1. Speed ratios to J-08 for the entire data set
2. Energy ratios to J-08 for the entire data set
3. Speed ratios for wind direction band 210°-247°
4. Speed ratios for wind direction band 247°-262°
5. Speed ratios for the October 1-3 data period.

Before reviewing the figures, it is useful to refer back to Figure 2-1 to study the upwind terrain. Notice the locations of the canyons aligned with the southwest flow, upwind of the ranch. Two large canyons and one small canyon should be noted. The largest canyon intersects the southern border of the study area and continues southwest for two miles, through sections 35 and 2. A second large canyon, which contains the southern lanes of Interstate 580, is west of the northern part of the study area. A small, third canyon can be seen in the southeast portion of Section 26. The canyons are marked with arrows. One additional terrain feature is the 681-ft hill upwind of Jess just west of the area marked "Cayley." This is the same hill discussed in Section 3.2.2, the Jess correlation discussion.

Figure 3-8 is a plot of the speed ratios to J-08. All ratios are based on data from 35-ft or 50-ft levels with the following caveats.

1. J-04 is adjusted from 120 ft to 50 ft using an alpha of 0.10. This value of alpha is considered a good estimate because J-04 is located in a slight depression. This terrain feature would result in a higher alpha than that measured at nearby site J-19, which has an alpha of about 0.06.
2. J-19 data is actually from 40 ft (unadjusted).
3. J-08 data is actually from 50 ft (unadjusted).
4. Ratios for the 35-ft turbine anemometer are adjusted to the 50-ft level using an alpha of 0.10. Data collected on turbines on the northern half of the ranch were at 35 ft, versus 50 ft on the southern half. It is possible that using an alpha of 0.10 could yield a speed ratio error of ±3% based on the expected range of shear values at these sites. Using an alpha of 0.10 is considered a good compromise based on data from J-17 and J-18.

Table 3-10. Jess Ranch Free-Flow Data Analysis

Speed and Energy Ratios to Site J-08 for different stratification classes

site	all hours	232-247 degrees	247-262 degrees	10-25.6 mph	25.6-45 mph	Daytime hours	Night hours	Oct 1-3	Oct 7-10	ENERGY RATIOS
J04 e50'	0.91	0.95	0.86	0.92	0.90	0.91	0.91	0.87	0.92	0.93
J04 120'	0.99	1.04	0.94	1.00	0.98	0.99	0.99	0.95	1.00	0.99
J19 40'	0.96	1.01	0.91	0.98	0.95	0.92	0.99	0.95	0.97	1.03
J19 80'	1.00	1.06	0.94	1.01	1.00	0.95	1.04	0.99	1.01	0.99
J17 35'	0.80	0.79	0.81	0.80	0.80	0.79	0.80	0.81	0.80	0.82
J17 70'	0.86	0.86	0.87	0.86	0.87	0.85	0.87	0.87	0.86	0.82
J18 35'	0.72	0.76	0.67	0.70	0.74	0.75	0.70	0.60	0.76	0.71
J18 70'	0.78	0.82	0.72	0.76	0.79	0.80	0.76	0.65	0.81	0.70
C1 50'	0.94	0.97	0.90	0.96	0.92	0.93	0.94	0.91	0.94	0.97
C3 50'	0.92	0.96	0.88	0.94	0.90	0.89	0.93	0.90	0.92	0.93
C5 50'	0.83	0.86	0.80	0.84	0.83	0.80	0.85	0.82	0.84	0.81
C7 50'	0.76	0.80	0.72	0.78	0.76	0.74	0.78	0.74	0.77	0.71
C9 50'	0.78	0.82	0.74	0.78	0.78	0.74	0.81	0.75	0.79	0.72
C12 50'	0.93	0.97	0.88	0.93	0.92	0.92	0.93	0.89	0.94	0.94
C14 50'	1.02	1.07	0.97	1.02	1.02	1.00	1.04	1.00	1.03	1.04
C16 50'	0.82	0.87	0.77	0.82	0.83	0.79	0.84	0.77	0.84	0.79
C18 50'	0.80	0.84	0.75	0.79	0.80	0.75	0.83	0.77	0.81	0.74
D2 50'	0.77	0.81	0.72	0.77	0.77	0.73	0.80	0.77	0.77	0.71
D4 50'	0.75	0.79	0.71	0.76	0.75	0.72	0.78	0.77	0.75	0.68
D6 50'	0.73	0.75	0.70	0.73	0.72	0.69	0.75	0.77	0.72	0.64
D13 50'	0.76	0.78	0.73	0.76	0.76	0.71	0.79	0.81	0.74	0.69
D15 50'	0.73	0.74	0.71	0.73	0.73	0.69	0.76	0.78	0.71	0.65
D21 50'	0.70	0.74	0.65	0.70	0.70	0.70	0.70	0.64	0.72	0.61
E2 50'	0.73	0.75	0.70	0.72	0.73	0.70	0.74	0.74	0.72	0.65
E4 50'	0.70	0.74	0.67	0.69	0.71	0.70	0.70	0.66	0.72	0.62
E6 50'	0.63	0.67	0.59	0.62	0.64	0.65	0.62	0.55	0.66	0.50
E8 50'	0.71	0.73	0.67	0.68	0.72	0.73	0.69	0.62	0.73	0.62
E10 50'	0.76	0.80	0.73	0.74	0.78	0.76	0.76	0.70	0.78	0.72
E11 50'	0.68	0.69	0.68	0.68	0.68	0.66	0.70	0.73	0.67	0.57
E13 50'	0.72	0.73	0.70	0.71	0.72	0.69	0.73	0.73	0.71	0.63
E15 50'	0.71	0.72	0.69	0.69	0.71	0.69	0.72	0.71	0.70	0.62
E18 50'	0.70	0.74	0.67	0.69	0.71	0.71	0.70	0.65	0.72	0.61
E20 50'	0.75	0.77	0.72	0.73	0.76	0.77	0.73	0.67	0.77	0.69
E22 50'	0.84	0.86	0.81	0.81	0.85	0.83	0.83	0.80	0.84	0.82
F1 35'	0.68	0.72	0.63	0.67	0.69	0.71	0.66	0.57	0.71	0.63
F3 35'	0.64	0.67	0.59	0.60	0.66	0.66	0.61	0.52	0.67	0.56
F7 35'	0.71	0.77	0.65	0.70	0.72	0.71	0.70	0.62	0.74	0.68
F9 35'	0.62	0.68	0.56	0.62	0.62	0.63	0.61	0.53	0.65	0.53
F12 35'	0.63	0.70	0.56	0.62	0.64	0.64	0.62	0.50	0.67	0.55
G1 35'	0.58	0.63	0.53	0.57	0.59	0.60	0.57	0.50	0.61	0.45
G3 35'	0.56	0.59	0.53	0.55	0.57	0.58	0.55	0.51	0.58	0.40
G5 35'	0.74	0.75	0.74	0.72	0.76	0.76	0.73	0.71	0.75	0.71
G7 35'	0.84	0.84	0.84	0.81	0.86	0.85	0.83	0.82	0.85	0.87
G8 35'	0.58	0.62	0.53	0.56	0.59	0.61	0.56	0.46	0.61	0.46
G10 35'	0.63	0.67	0.59	0.60	0.65	0.65	0.61	0.52	0.66	0.54
G12 35'	0.70	0.72	0.68	0.68	0.72	0.72	0.68	0.64	0.72	0.65

Table 3-10. Jess Ranch Free-Flow Data Analysis

site	all hours	232-247 degrees	247-262 degrees	10-25.6 mph	25.6-45 mph	Daytime hours	Night hours	Oct 1-3	Oct 7-10	ENERGY RATIOS
H1 50´	1.02	1.06	0.98	1.03	1.01	0.95	1.07	1.03	1.01	1.04
H2 50´	0.98	1.02	0.93	0.98	0.97	0.91	1.01	0.97	0.97	0.98
H7 50´	0.84	0.88	0.79	0.84	0.83	0.80	0.87	0.84	0.84	0.82
H10 50´	0.82	0.86	0.78	0.83	0.82	0.80	0.83	0.83	0.82	0.80
H12 50´	0.84	0.88	0.79	0.85	0.83	0.78	0.87	0.84	0.84	0.82
H15 50´	0.79	0.83	0.74	0.80	0.79	0.78	0.80	0.78	0.79	0.76
I1 50´	0.80	0.84	0.76	0.81	0.80	0.79	0.81	0.80	0.80	0.78
I3 50´	0.82	0.85	0.78	0.82	0.81	0.81	0.82	0.81	0.82	0.79
I5 50´	0.80	0.84	0.76	0.81	0.80	0.80	0.80	0.77	0.81	0.78
I9 50´	0.77	0.82	0.71	0.76	0.77	0.77	0.77	0.73	0.78	0.73
I14 50´	0.84	0.89	0.78	0.84	0.84	0.85	0.83	0.75	0.87	0.84
J6 50´	0.80	0.85	0.75	0.79	0.81	0.82	0.79	0.71	0.83	0.78
J8 50´	0.80	0.86	0.72	0.77	0.81	0.80	0.78	0.66	0.84	0.78
J11 50´	0.82	0.87	0.76	0.81	0.82	0.83	0.81	0.73	0.84	0.80
J13 50´	0.81	0.87	0.73	0.79	0.81	0.81	0.80	0.69	0.84	0.79
K1 35´	0.68	0.72	0.63	0.69	0.68	0.68	0.69	0.60	0.71	0.62
K3 35´	0.72	0.77	0.65	0.71	0.71	0.73	0.70	0.62	0.74	0.68
K5 35´	0.71	0.73	0.68	0.71	0.70	0.73	0.69	0.66	0.72	0.66
K7 35´	0.67	0.67	0.68	0.66	0.68	0.69	0.66	0.65	0.68	0.59
K9 35´	0.76	0.75	0.77	0.75	0.76	0.76	0.75	0.77	0.75	0.74
K12 35´	0.72	0.71	0.72	0.72	0.71	0.73	0.70	0.70	0.72	0.67
K14 35´	0.82	0.80	0.83	0.81	0.82	0.82	0.81	0.82	0.81	0.83
L1 35´	0.86	0.85	0.87	0.85	0.87	0.86	0.86	0.87	0.86	0.90
L3 35´	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.90	0.91	0.98
L5 35´	0.96	0.96	0.95	0.95	0.96	0.96	0.95	0.94	0.96	1.03
L8 35´	0.86	0.86	0.87	0.85	0.87	0.86	0.86	0.87	0.86	0.90
L10 35´	0.92	0.91	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.98
L12 35´	0.96	0.96	0.97	0.97	0.96	0.96	0.96	0.97	0.96	1.04
M2 35´	0.84	0.82	0.85	0.83	0.84	0.83	0.84	0.84	0.83	0.87
M4 35´	0.84	0.84	0.85	0.85	0.84	0.84	0.85	0.85	0.84	0.88
M6 35´	0.91	0.91	0.91	0.92	0.91	0.91	0.91	0.91	0.91	0.98
M8 35´	0.96	0.96	0.96	0.97	0.95	0.95	0.96	0.97	0.95	1.04
M9 35´	0.86	0.85	0.86	0.86	0.85	0.85	0.86	0.86	0.85	0.90
M11 35´	0.88	0.87	0.88	0.89	0.87	0.86	0.88	0.89	0.87	0.93
M13 35´	0.96	0.95	0.96	0.97	0.95	0.94	0.96	0.98	0.95	1.03
N1 35´	0.85	0.85	0.86	0.86	0.85	0.85	0.85	0.84	0.85	0.88
N4 35´	0.80	0.81	0.79	0.81	0.80	0.80	0.80	0.78	0.81	0.82
N6 35´	0.78	0.77	0.78	0.79	0.77	0.77	0.78	0.78	0.77	0.78
N8 35´	0.78	0.77	0.78	0.78	0.78	0.76	0.78	0.78	0.78	0.78
MEAN:	0.79	0.82	0.76	0.79	0.80	0.79	0.80	0.76	0.80	0.77

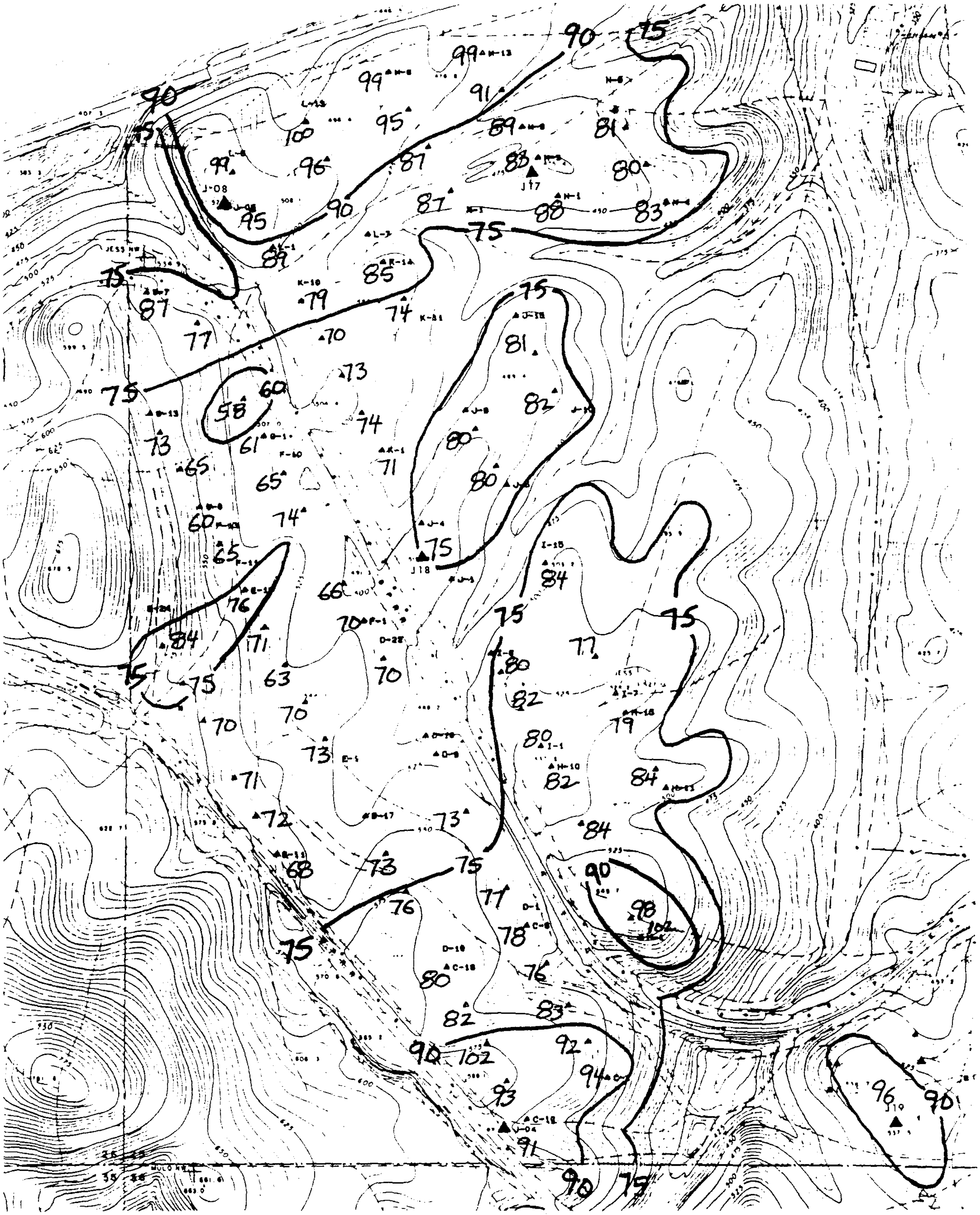

Figure 3-8. Normalized Speed Ratios (%) to J-08 for All Hours

Note that almost all ratios are less than 100%. This is because of site J-08's excellent exposure. J-08 is situated on a bluff, which juts into the large canyon that Interstate 580 runs through. J-08 is exposed to this channel, which is oriented parallel to the west-southwest flow. There are three relatively high wind areas; one around J-08 (extending downwind of it), one in the southern part of the study area at J-19, and another in the southern part of the study area (around H-1, H-2, C-10, C-12, and C-14). These areas are aligned with the large canyons discussed previously. A fourth, smaller area of relatively high winds can be found near E-10 and E-22. This area is aligned with the third small canyon discussed previously. A relatively low wind-speed area can be found around G-1, G-3, and G-8. This area appears to be blocked by the 681-ft hill to the immediate southwest. Recall that this is close to the area with low correlation coefficients discussed in Section 3.2.2. Limited analysis shows that speed ratios at these low-wind sites increase with increased inversion height. The increase in speed ratios is on the order of 10% when the inversion top is above 1000 ft MSL.

It is interesting to note that the range of ratios on Jess is considerably larger than that of the ratios on Souza. The Jess study area is larger than Souza, but more homogeneity was expected because of its flatter terrain. Analysis of the inversion data collected on the Souza Ranch, as well as at the Oakland Airport, which is about 30 miles west of the Altamont Pass, shows that the mean inversion height was several hundred feet lower during the Jess free-flow period. Because of the interaction of the terrain with the inversion, the lower inversion heights during the Jess study are believed to be responsible, in part, for the wider range of ratios on the Jess Ranch.

Figure 3-9 is a plot of the energy ratios to J-08. Note that all sites except J-08 have been normalized to hub height (72 ft) using a vertical wind shear exponent of 0.10. Meteorological towers J-17, J-18, and J-19 use their hub-height sensors for this map. Tower J-04 has been adjusted (down) from the 120-ft level. All turbines have been adjusted (up) from the 35-ft or 50-ft levels. Vertical wind shear has been discussed in Sections 3.5 and 3.7.1. In Section 3.5, it was shown that sites J-17 and J-18 had shear exponents of about 0.10. These sites have exposure that is representative of many of the sites on Jess. They are in fairly flat areas, not on highly exposed knolls like J-08 and J-19. Using an alpha of 0.10 is a good compromise. Some sites, like turbines L-3 and L-5, probably have less positive shear because of their similar exposure to J-08. Thus, their theoretical energy production may be biased positively. Other sites, like G-1, G-3, and G-8, are downwind of a hill and probably have higher shear than 0.10. Thus, they may be negatively biased. As mentioned in Section 3.7.1, estimating individual sites' vertical shear is difficult, so the reader is cautioned that individual energy ratios on Table 3-10 and Figure 3-9 could be in error by as much as 10%. Figure 3-9 shows a similar pattern to that of Figure 3-8, except that there is a wider range of ratios (the lows are lower).

Figure 3-10 is a plot of the normalized (to the 50-ft level) speed ratios to J-08 for wind directions from 232° to 247°. The pattern is similar to that of Figure 3-8, except that many sites have higher ratios. This is especially true in the southern and central parts of the study area. The ratios in the northern area, around J-08, are unchanged.

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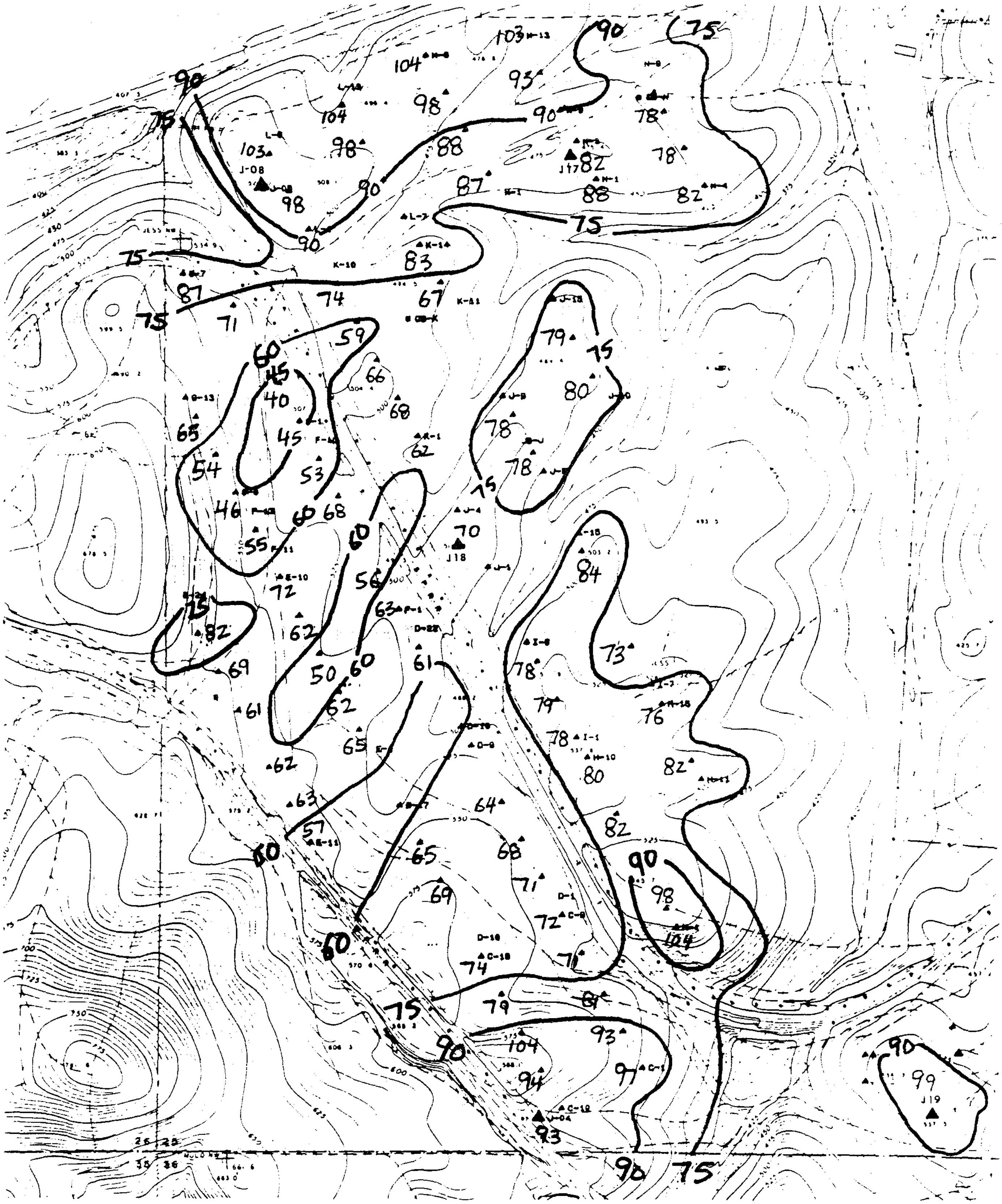

Figure 3-9. Theoretical Energy Ratios (%) to J-08, Nordtank 65 Curve, Assumed Alpha 0.10

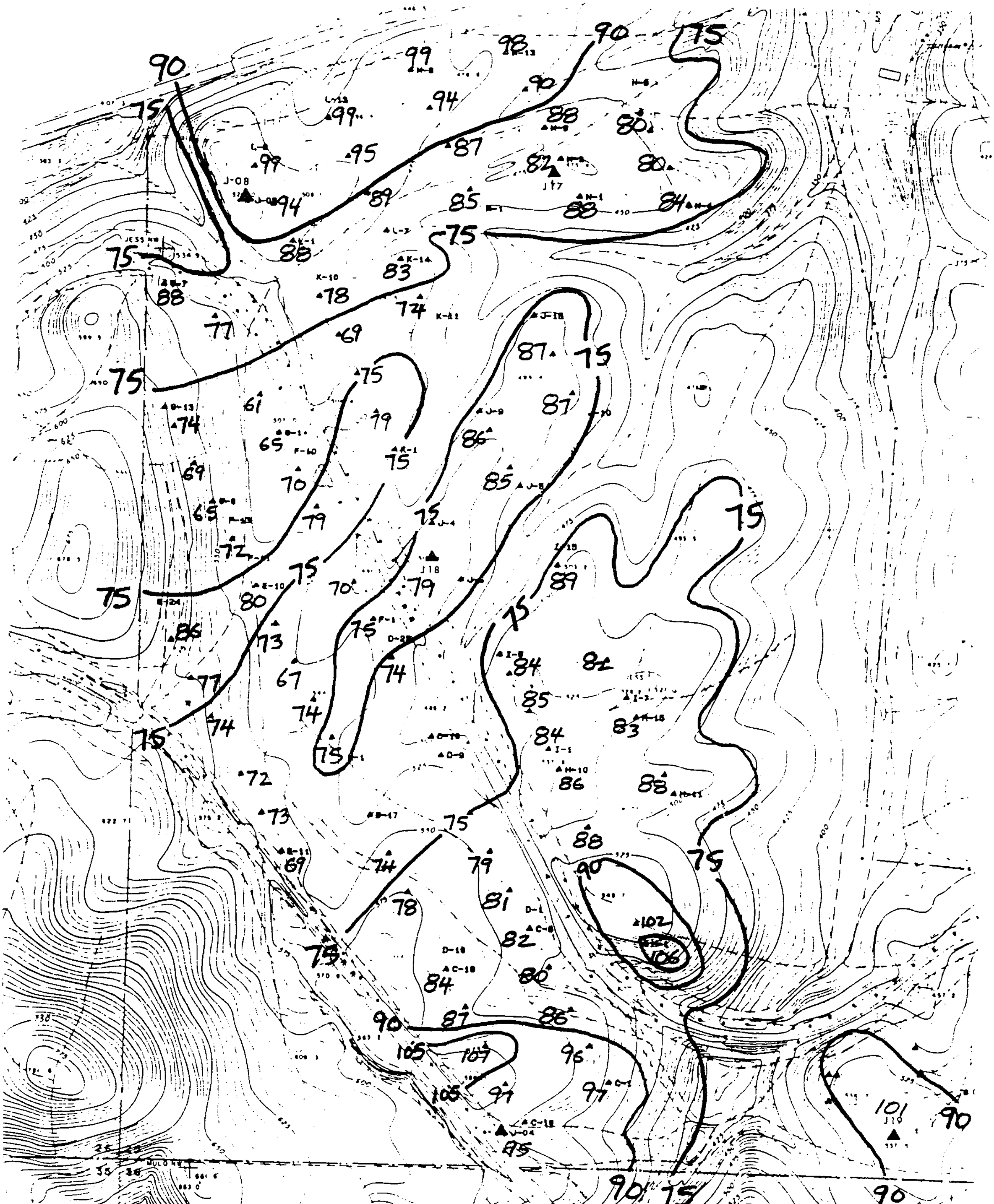

Figure 3-10. Normalized Speed Ratios (%) to J-08 for Wind Direction Band 232°-247°

Figure 3-11 is a plot of the normalized speed ratios to J-08 for wind directions from 247° to 262°. On this figure, many of the ratios are lower than those on Figure 3-8. As in Figure 3-10, the largest swing occurs in the southern and central parts of the study area, with the northern area unchanged. A possible explanation is that in winds with a more southerly component (Figure 3-10) the large canyon near the southern part of the study area (see Figure 2-1) is more aligned with the flow. Thus, these areas get an additional boost and the ratios increase. With more of a westerly component, this canyon is not as well aligned and the ratios fall.

Figure 3-12 is a plot of the normalized speed ratios to J-08 for the first study period. In this figure, the ratios in the center of the ranch drop considerably. This is especially noticeable around tower J-18 and the F, G, J, and K turbines. Sites at the northern and southern ends of the study area show little change relative to Figure 3-8.

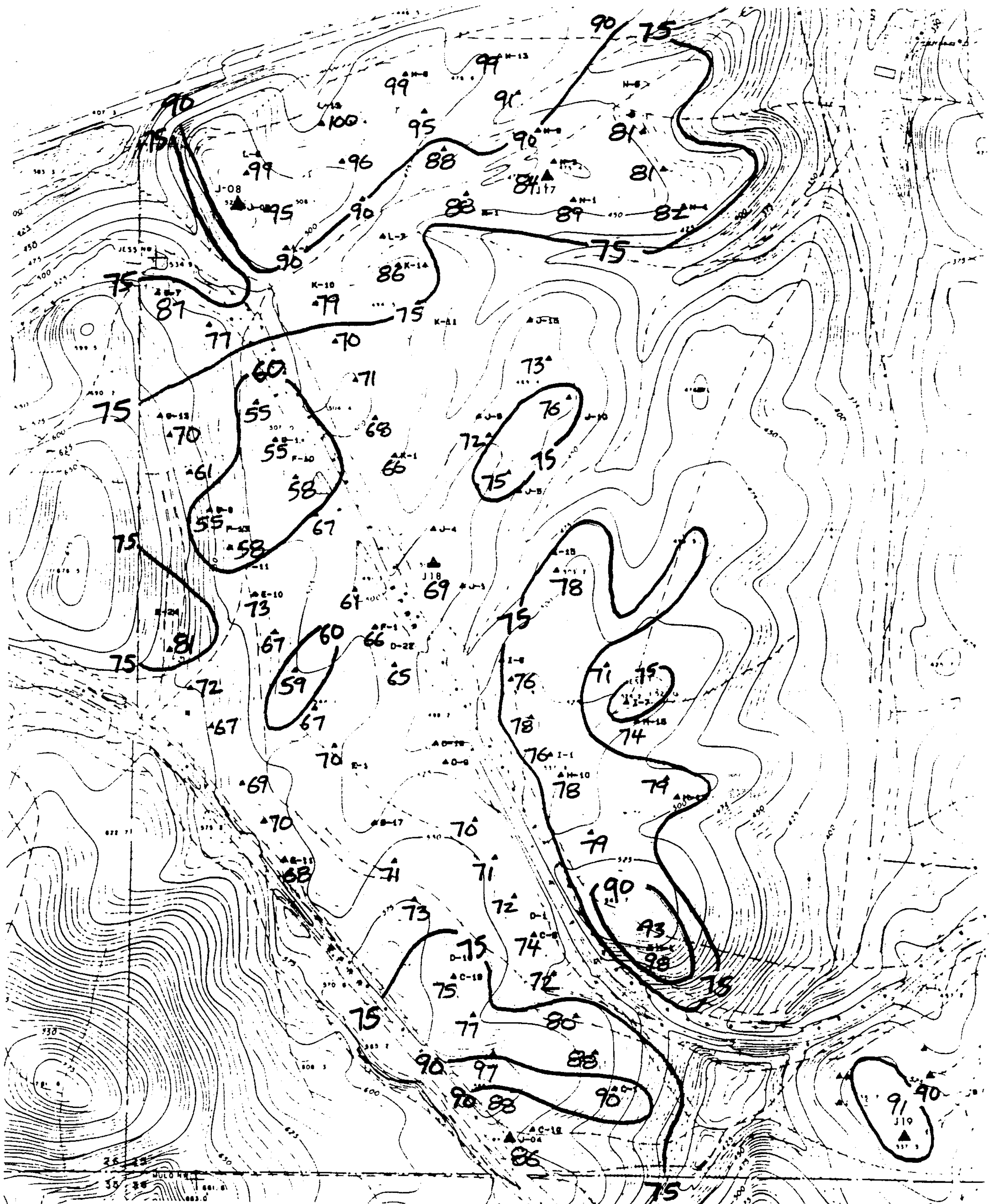

Figure 3-11. Normalized Speed Ratios (%) to J-08 for Wind Direction Band 247°-262°

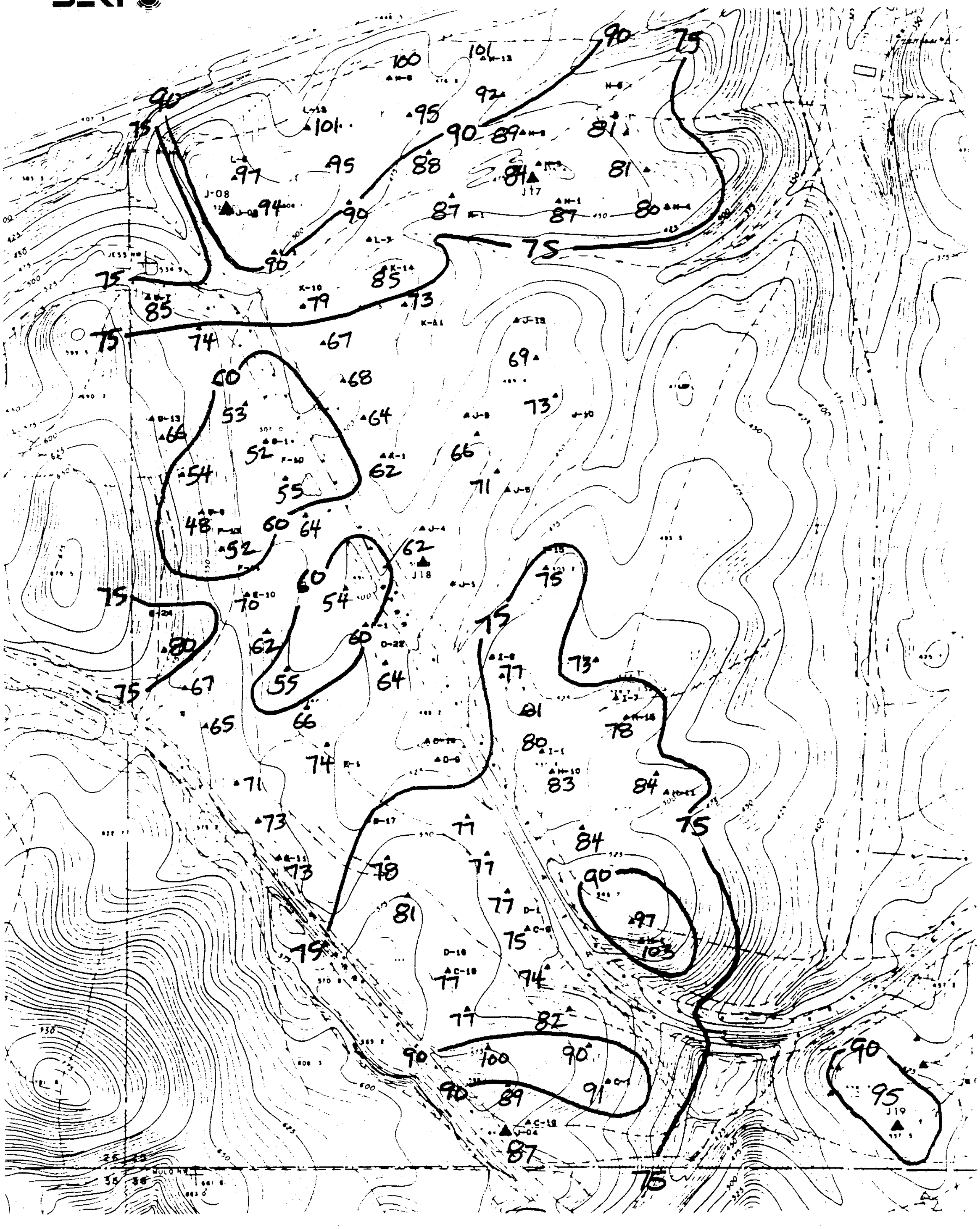

Figure 3-12. Normalized Speed Ratios (%) to J-08 for October 1-3

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SECTION 4.0

CONCLUSIONS

Wind-speed data were collected from two dense networks on two wind farms in the Altamont Pass. The data were collected during typical spring/summer conditions, with no turbines operating in the study areas. Data were analyzed to determine variability of the wind resource. The principal method for doing this was to calculate wind-speed ratios to a single reference location.

The smaller test area, the Souza Ranch, has moderately complex terrain. The topography slopes gently downward and is punctuated with some small ridge lines that trend perpendicular to the flow. In spite of the complex terrain, the data set revealed a fairly homogeneous resource. All sites were highly correlated to the reference tower, and the mean speed ratio was 98%. The range of speed ratios was 77% to 111%; however, all but two sites had ratios within a band from 90% to 110% of the reference. Site elevation appears to enhance the flow. A topographic pattern at least as significant as the elevation is a combination of ridges and canyons. Specifically, ridges normal to the flow that jut into drainage canyons, parallel to the flow, appear to have the highest wind resource.

The Jess Ranch study area has slightly complex terrain. It slopes gently downward, with a few ridges and valleys oriented parallel to the terrain. The data set was not as homogeneous as the Souza data set. This may be due in part to the lower height of the subsidence inversion during the Jess study period. The average correlation coefficient between the reference site and the other sites was 0.89. Speed ratios ranged from 56% to 102%, with a mean ratio of 79%. The range of theoretical energy ratios was 40% to 104%. Thus, the ratio between the best and worst turbine's theoretical energy production is 260%. These turbines are separated by about a half-mile and an elevation difference of only 60 ft. The low speed ratios to J-08 were due to the excellent exposure of the reference site relative to the other sites. Site elevation does not appear to be a factor at this ranch. However, the topographic pattern observed at Souza was seen here as well. Sites on ridges that jut into drainage canyons, or that are downwind of drainage canyons, have the best resource. Conversely, a hill rising 150 ft above the surrounding terrain appears to disturb the flow for a downwind distance of approximately ten times the hill height. The flow disturbance caused by the hill is accentuated by the subsidence inversion. When low inversion heights were measured, the sites downwind of the hill had lower correlation coefficients and lower speed ratios. The strong positive effect of the drainage canyons parallel to the flow may not have universal application. This is true in the Altamont Pass because of the shallow, stable flow under the inversion. In areas with deeper layers or higher instability, these canyons might not have such a dramatic effect.

APPENDIX A

SYNOPTIC METEOROLOGICAL SUMMARIES FOR THE SOUZA AND JESS FREE-FLOW STUDIES

A.1 Summaries for the Souza Study, September 10-14, 1987

September 10

On the afternoon of September 10, 1987, at 1600 Pacific Standard Time (PST), the semipermanent, subtropical Pacific surface high-pressure area was centered southwest of San Francisco at 32°N 132°W, with a central pressure of 1026 millibars (mb). A thermal low-pressure area, also a semipermanent feature, was centered over the southern tip of Nevada, with a central pressure of 1006 mb. The axis of this trough extended into southeast British Columbia. (Figure A-1 has the important weather map features labeled.) The surface pressure gradient between the coast and the San Joaquin Valley was moderate at 3 mb. Aloft, southwest winds of 10 knots (kt) and a height of 585 decameters (Dm) were reported at the 500-mb level over Oakland, as the upper winds circulated around a low-pressure area with a central height of 574 Dm, located at 40°N 134°W (see Figure A-2). The height of the marine layer was at a typical summertime level of 400 m. Winds at Souza were 20-30 mph at this time. Although the thermal trough axis was east of its usual position, and extended much farther north than it normally does, this was more or less a typical summertime weather pattern over the western United States.

September 11

At 0400 PST on September 11, surface high pressure was centered at 33°N 137°W, with a central pressure of 1025 mb. The thermal low was centered over southwest Arizona, with a central pressure of 1005 mb, and the axis continued east of its normal position and extended through Nevada, Oregon, and into eastern Washington (see Figure A-3). The surface pressure gradient from the coast to the valley at this time had diminished to 2.0-2.5 mb. The 500-mb low moved eastward to 40°N 130°W. At Oakland, the wind at 500 mb had increased to 15 kt out of the southwest, and the height of the 500 mb surface had dropped 5 Dm (which is greater than the fall that normally occurs during that part of the day) to 580 Dm (see Figure A-4). The marine layer at this time continued at a depth of about 400 m. Winds at Souza had increased slightly to 25-30 mph.

At 1600 PST, the thermal low center had deepened to 1002 mb and moved into southeastern California, with the trough axis extending into eastern Washington. Along this axis, there was another low center of 1005 mb in central Nevada, and one of 1007 mb in northeast Oregon (see Figure A-5). These last two centers were probably due more to atmospheric dynamics rather than surface heating. The surface pressure gradient had increased to 3.0-3.5 mb. At 500 mb, the upper level low moved southeast toward the area and intensified slightly to 573 Dm at 38°N 128°W (see Figure A-6). This caused the winds at this level to back down to the south and increase to 20 kt above Oakland, and the level of the 500-mb surface dropped to 577 Dm at a time of day when it normally rises. It also allowed the marine layer to deepen to 800 m. The winds at Souza had increased to 25-35 mph in a weather pattern that is quite common in spring but occurs infrequently in the summertime.

September 12

At 0400 PST on September 12, the Pacific high-pressure area was centered at 35°N 150°W. The thermal low had a central pressure of 1003 mb and was centered over southern Nevada; the axis extended southward into extreme northwestern Mexico and northward into eastern Oregon (see Figure A-7). The surface pressure gradient had slackened to about 2 mb. The 500-mb low continued its southeast trek to a position at 35°N 125°W, and the central pressure dropped to 570 Dm. At Oakland, the 500-mb winds became southeast and diminished to 5 kt, while the level of the 500-mb surface fell to 573 Dm (see Figure A-8). The marine layer was somewhat shallower, at 650 m. As the pressure gradient had diminished and the marine layer had become thinner, the winds at Souza had decreased to about 25 mph.

At 1600 PST, the Pacific high-pressure area had a central pressure of 1025 mb and was located at 34°N 143°W. The thermal low was centered over southeastern California, with a central pressure of 1002 mb; a trough axis extended into the southern Sierra Nevada. A dynamic low-pressure center of 1000 mb was located in northwestern Nevada, and a secondary center of 1002 mb was centered over western Idaho (see Figure A-9). The pressure difference from the coast to the valley had increased to 3 mb. Aloft, the 500-mb disturbance intensified to 569 Dm and moved to a position just off the California coast at Point Conception. In response, the winds at that level became east-northeast above Oakland (see Figure A-10). The marine layer continued at about the same depth at 700 m. The winds at the site also changed little, at 25-35 mph, in a West Coast weather pattern that is typical in the spring but quite unusual in the summertime.

September 13

On September 13, at 0400 PST, surface high pressure was centered at 32°N 141°W, with a central pressure of 1025 mb. The thermal low-pressure system was gone, and dynamic low-pressure centers of 1004 mb and 1003 mb were located over southern Nevada and southwestern Idaho, respectively (see Figure A-11). The surface pressure gradient between the coast and the valley was about 2 mb. Aloft, the upper low moved into southern California; winds above Oakland were from the northeast at 10 kt, with the 500-mb surface measured at 574 Dm (see Figure A-12). With cyclonic curvature aloft, the layer of marine air deepened to 950 m. At Souza, the winds had diminished to about 20-25 mph.

At 1600 PST, surface high pressure continued well offshore. The low-pressure center that had been over southern Nevada at 0400 PST was now centered over southern Arizona with a central pressure of 1009 mb. The low over southwestern Idaho continued to be nearly stationary with a central pressure of 1003 mb (see Figure A-13). The surface gradient between San Francisco and Sacramento had increased to 2.7 mb. At the 500-mb level, the upper low had moved into southern Nevada, and at Oakland, the 500-mb height had risen to 581 Dm, with the winds becoming north-northwest at 15 kt. These winds were in response to the movement of the upper level low out of the area and the upstream ridge moving in behind it (see Figure A-14). With the upper air flow becoming anticyclonic, and the marine layer becoming shallower at 600 m, the winds at Souza decreased to 10-20 mph in the "spring-like" weather pattern.

September 14

At 0400 PST on September 14, high pressure at the surface was centered at 42°N 154°W, with a weak ridge extending into northern California and Oregon. Once again, the thermal trough was absent; but the dynamic low pressure center over southwestern Idaho continued, though weakening, with a central pressure of 1010 mb (see Figure A-15). The surface gradient between the coast and the Central Valley had diminished to 1.0-1.5 mb. The upper low was over southeastern Utah at this time, and the ridge that had been upstream 12 h earlier had just passed Oakland. Heights continued to rise at Oakland, as the 500-mb surface was measured at 583 Dm and the upper winds at Oakland were out of the northwest at 15 kt (see Figure A-16). The marine layer had deepened a little to a depth of 750 m. The winds at Souza increased slightly to 15-25 mph.

At 1600 PST, the surface high-pressure area was centered at 42°N 150°W, and a surface cold front extended from southeastern British Columbia through eastern Washington and Oregon and northwestern California. The thermal low had reformed over southern California, with a central pressure of 1010 mb (see Figure A-17). The surface gradient had increased to 2.0-2.5 mb. At 500 mb, heights continued to rise at Oakland to 587 Dm, and the upper winds were west-northwest at 20 kt (see Figure A-18). The marine layer quickly became very shallow, with the base of the inversion reported at the surface at Oakland. The winds at Souza at 1300 PST, when the study ended, were 15-20 mph. Although the weather was in the process of returning to normal summertime conditions, it was still in a springtime weather pattern.

A.2 Summaries for the Jess Study, October 1-3 and October 7-10, 1987

October 1

On the afternoon of October 1, 1987 at 1600 PST, the semipermanent, subtropical Pacific surface high-pressure area was centered southwest of San Francisco at 29°N 130°W, with a central pressure of 1019 mb. A thermal low-pressure area of 1008 mb was centered over the Imperial Valley, with a trough axis extending northward over the Central Valley, through western Oregon, and into western Washington (see Figure A-19). The surface pressure gradient between the California coast and the Central Valley at this time was rather large at 4 mb. Aloft, south-southeast winds of 15 kt, with a 500-mb height of 586 Dm, were reported at Oakland. The winds were the result of the circulation around an upper level high-pressure area with a central pressure of 588 Dm, located over southern Idaho (see Figure A-20). Because of the anticyclonic motion and high heights aloft, the layer of marine air was shallow at 300 m. Although the surface pressure gradient was quite large, the winds at Jess Ranch were only 20-25 mph because of the influence of the shallow marine layer in this typical summertime weather pattern.

October 2

At 0400 PST on October 2, surface high pressure developed a center of 1022 mb at 41°N 128°W and was starting to build inland over the Pacific Northwest behind a weak, diffuse, cold front. The thermal low had a central pressure of 1011 mb and was located over the east coast of Baja California, with the trough axis extending northward through the San Joaquin Valley into the Sacramento Valley (see Figure A-21). The surface pressure gradient was still large at 2.5-3.0 mb. At the 500-mb level, heights continued to be high at Oakland, with 585 Dm reported. The wind at that level was out of the southwest at 5 kt in the circulation around a strong upper level low-pressure area that was centered in the Gulf of Alaska (see Figure A-22). As a result, the marine layer deepened to 500 m. With the pressure gradient weakening and surface high pressure building into the Pacific Northwest, the winds at Jess had diminished to 15-25 mph and would continue to decline and even become northerly during the day.

At 1600 PST, surface high pressure was centered at 37°N 133°W, with a central pressure of 1026 mb and a weak ridge extending into the Pacific Northwest. The thermal low was centered over extreme northwestern Mexico, with a central pressure of 1010 mb, and the trough axis extended northward through southern California, the Central Valley, Oregon, and eastern Washington (see Figure A-23). The pressure gradient was a moderate 2.4 mb. Aloft, Oakland was sandwiched between high-pressure centers of 589 Dm at (36°N 132°W) and 591 Dm over Utah. The level of the 500 mb surface at Oakland had risen to 589 Dm, greater than the normal daytime rise (see Figure A-24). Winds over Oakland were light and variable, and the marine layer became quite shallow at 100 m under the influence of the strong high pressure aloft. At Jess, the winds that had become light northerly earlier in the day continued out of that direction, and they would not become southwest again until 1700 PST in the typical summertime weather pattern.

October 3

At 0400 PST on October 3, the Pacific high was centered at 38°N 135°W, with a central pressure of 1030 mb and a weak ridge extending over Washington and Oregon. The thermal low was centered in northern Baja California; the trough extended northward off the southern California coast to Point Conception, then inland over the coast range through the Sacramento Valley (see Figure A-25). The pressure gradient between the central California coast and the Central Valley had slackened to 1.7 mb at this time. At 500 mb, high pressure was centered at 38°N 129°W, with a center of 592 Dm (see Figure A-26). In response to the movement of the upper high toward the coast, the winds above Oakland had become northerly at 10 kt and the heights continued to rise to 590 Dm. The marine layer was very shallow at this time, less than 100 m. The winds at Jess that had been about 15 mph at 0300 had stopped completely at this time, and the study ended. The winds would later become northerly in a pattern that was developing the characteristics of a classic late summer/early fall coastal heat wave.

October 7

On the morning of October 7 at 0400 PST, the semipermanent, subtropical eastern Pacific surface high-pressure area was centered southwest of San Francisco at 27°N 130°W, with a central pressure of 1020 mb. The thermal low-pressure area was located over the Mexico/Arizona border and had a central pressure of 1008 mb, with a weak trough axis extending northwestward along the southern Sierra Nevada (see Figure A-27). The surface pressure gradient between the California coast and the Central Valley at this time was large at 3.5 mb. Aloft, a weak trough just offshore was spinning out of a deep upper level low-pressure area centered at 38°N 145°W with a central pressure of 551 Dm. This caused west-southwest winds of 20 kt, with a height of 581 Dm at the 500 mb level, over Oakland (see Figure A-28). Because of the approaching upper level trough and the west-southwest winds aloft, the summertime layer of marine air was a little deeper than usual at 500 m. With an ample marine layer and a strong pressure gradient, the winds at the Jess Ranch were quite high at 30-35 mph.

At 1600 PST, the Pacific high had moved toward California and was centered at 30°N 127°W, with a central pressure of 1021 mb. The thermal low was nearly unchanged, with a weak trough over the southern Sierra Nevada (see Figure A-29). The surface pressure gradient between the coast and the San Joaquin Valley continued at about 3.5 mb. At the 500-mb level, the weak trough that was offshore at 0400 was now over the Sierra, while the upper low had filled to 561 Dm and was now located at 39°N 141°W (see Figure A-30). In response, the winds at Oakland had become west-northwest at 20 kt, and the height of the 500-mb surface had risen to 583 Dm. The depth of the marine layer continued at 500 m. The winds at Jess Ranch had decreased to 25-30 mph in the typical summertime weather pattern.

October 8

At 0400 PST on October 8, surface high pressure was centered at 26°N 130°W, with a central pressure of 1019 mb. The thermal low was centered over southwest Arizona, with a central pressure of 1008 mb, and the axis was oriented along the southern Sierra Nevada, through the Sacramento Valley, and through northwestern California (see Figure A-31). The surface pressure gradient from the coast to the valley at this time was a moderate 2.0-2.5 mb. The 500-mb low moved eastward slightly to 39°N 140°W, with a central pressure of 560 Dm. At Oakland, the wind at 500 mb was out of the west-northwest at 15 kt, and the height of the 500-mb surface remained 583 Dm in response to a weak upstream ridge just offshore (see Figure A-32). The marine layer deepened slightly to 700 m. The winds at Jess were about 25 mph.

At 1600 PST, the thermal low center had deepened to 1006 mb and moved into southeastern California, with the trough axis along the Sierra Nevada (see Figure A-33). The surface pressure gradient had increased rapidly to over 3.5 mb. At 500 mb, the upper level low moved to 38°N 136°W, with a central pressure of 566 Dm. The axis of the weak ridge that had been offshore at 0400 had just passed Oakland and was now approaching the Sierra, causing the upper winds at Oakland to back to the southwest at 10 kt (see Figure A-34). The winds at Jess continued at 25 mph in the typical summertime weather pattern.

October 9

At 0400 PST on October 9, the Pacific high-pressure area was centered at 25°N 133°W. The thermal low had a central pressure of 1008 mb and was centered over the California-Arizona border, with the axis extending northward along the west side of the Central Valley, into northwestern California, and along the Oregon coast. A dynamic surface low (a reflection of the low in the upper atmosphere) with a central pressure of 1010 mb was centered at 36°N 135°W (see Figure A-35). The surface pressure gradient had slackened to 2.0-2.5 mb. The 500-mb low continued its slow eastward trek to a position at 37°N 135°W, with a central pressure of 565 Dm. At Oakland, the 500-mb winds continued out of the southwest and increased to 20 kt while the level of the 500-mb surface fell to 578 Dm (see Figure A-36). The marine layer was deep at 700 m. As the pressure gradient had diminished, the winds at Jess had decreased slightly to 20 mph.

At 1600 PST, the Pacific high was ill defined while the thermal low was centered over southeastern California, with a central pressure of 1008 mb, and the trough axis extended northward along the Sierra Nevada. A dynamic low-pressure area was centered over the Pacific at 34°N 132°W, with a central pressure of 1010 mb (see Figure A-37). The pressure difference from the coast to the valley had increased to 2.5-3.0 mb. Aloft, the 500-mb low-pressure area was now situated at 34°N 132°W, directly above the surface low, with a central pressure of 567 Dm. In response, the winds at that level became southerly at 25 kt above Oakland (see Figure A-38). The marine layer was somewhat shallower, at a depth of 550 m. The winds at Jess increased slightly to 25 mph in a West Coast weather pattern that is typical in the spring but occurs infrequently in the summertime.

October 10

On October 10 at 0400 PST, surface high pressure was centered at 30°N 122°W, with a central pressure of 1017 mb. Surface low pressure was centered at 34°N 131°W with a central pressure of 1010 mb. The thermal low was centered near Yuma, Ariz., with a central pressure of 1012 mb. The thermal trough axis extended out of the low, up the southern Sierra Nevada, through the Sacramento Valley, and into the California-Oregon border region (see Figure A-39). The surface pressure gradient between the coast and the valley had decreased significantly to about 1.5 mb. Aloft, the upper low was directly above the surface low at 34°N 131°W, and Oakland had south-southeast winds of 30 kt at 500 mb, with a height of 578 Dm reported (see Figure A-40). With cyclonic curvature aloft, the layer of marine air deepened to 750 m. At Jess, the winds had diminished slightly to about 15-20 mph in the "spring-like" weather pattern.

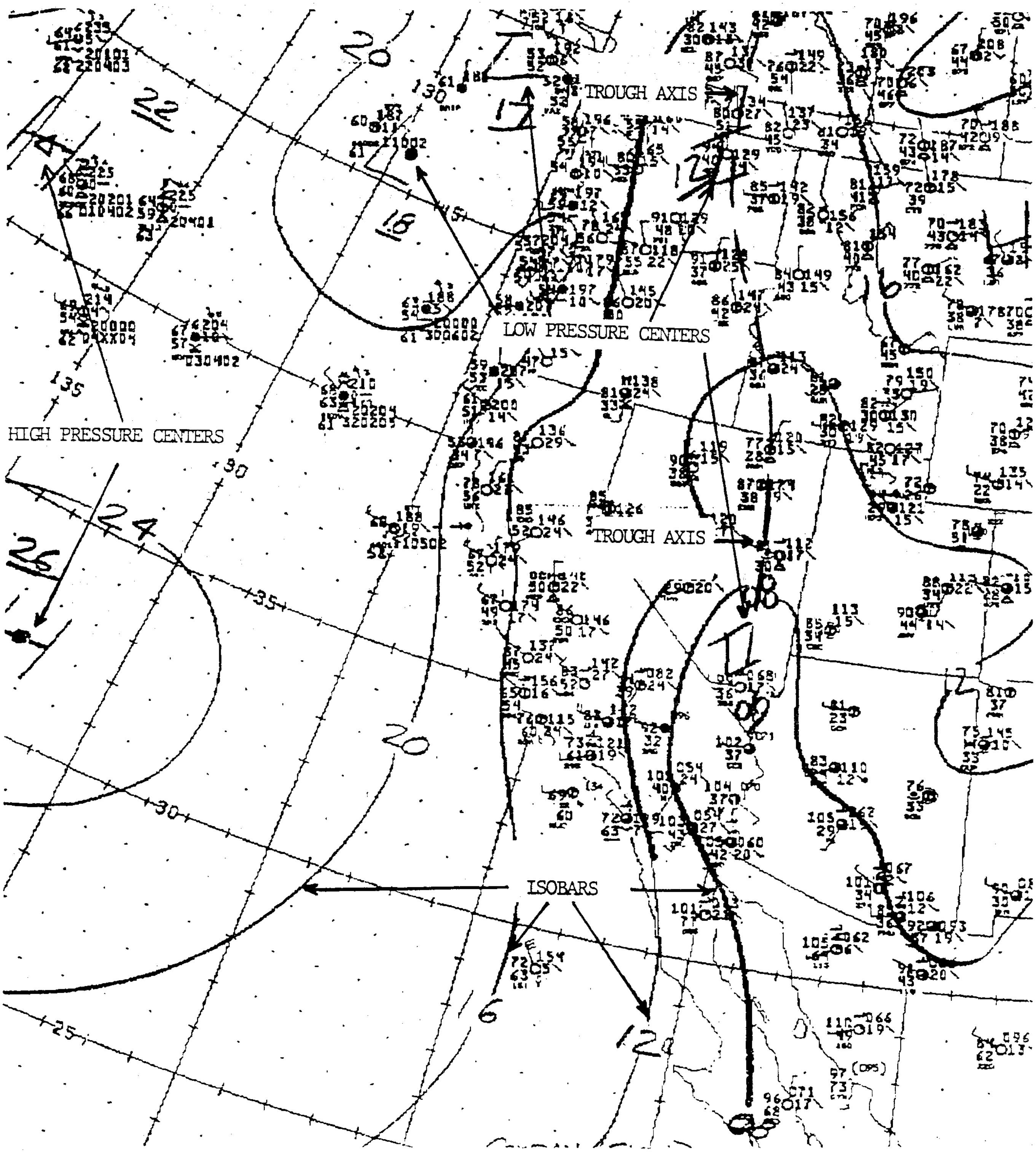

Figure A-1. Surface Weather Map for September 19, 1600 PST

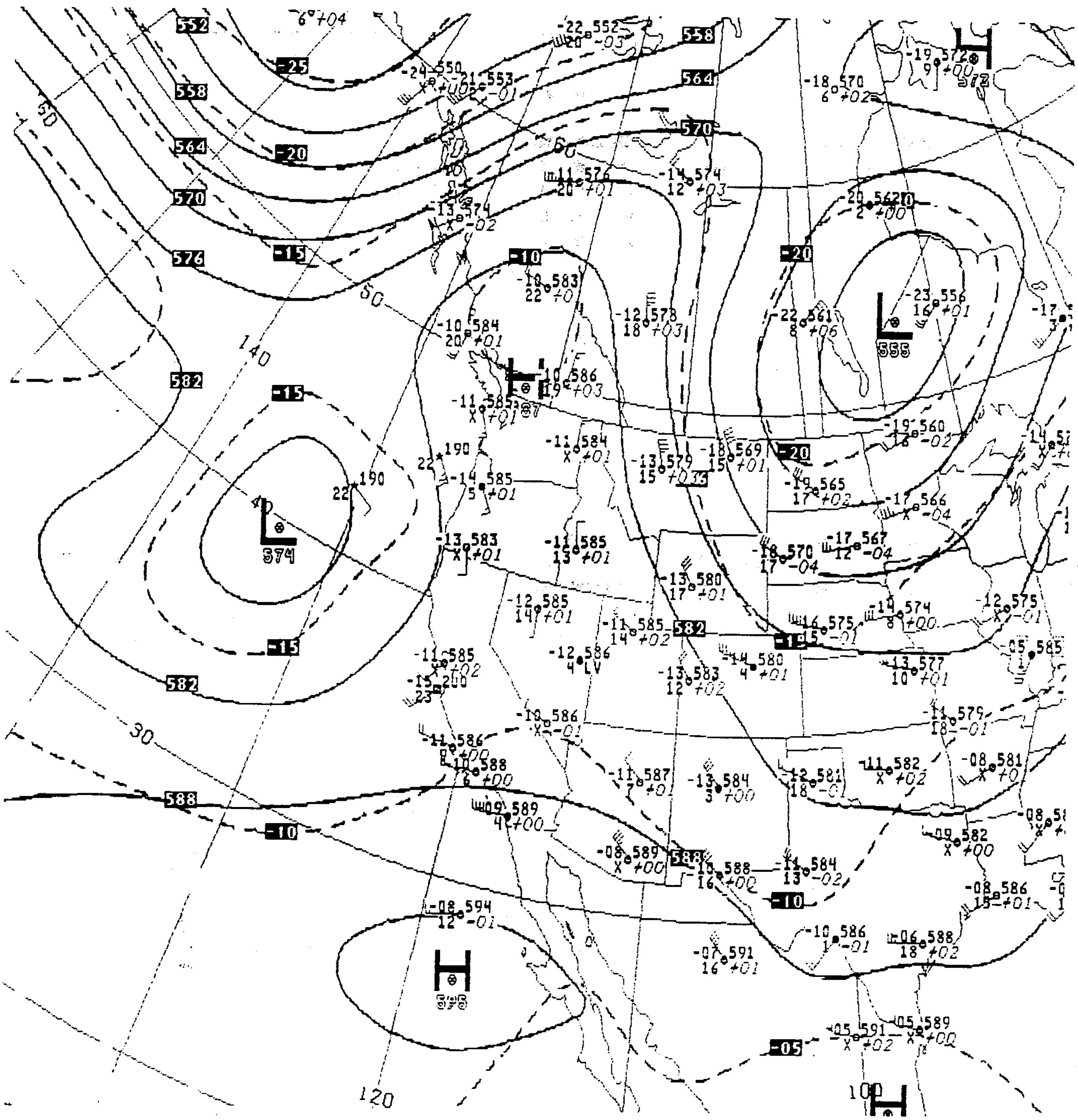

Figure A-2. 500-mb Map for September 10, 1600 PST

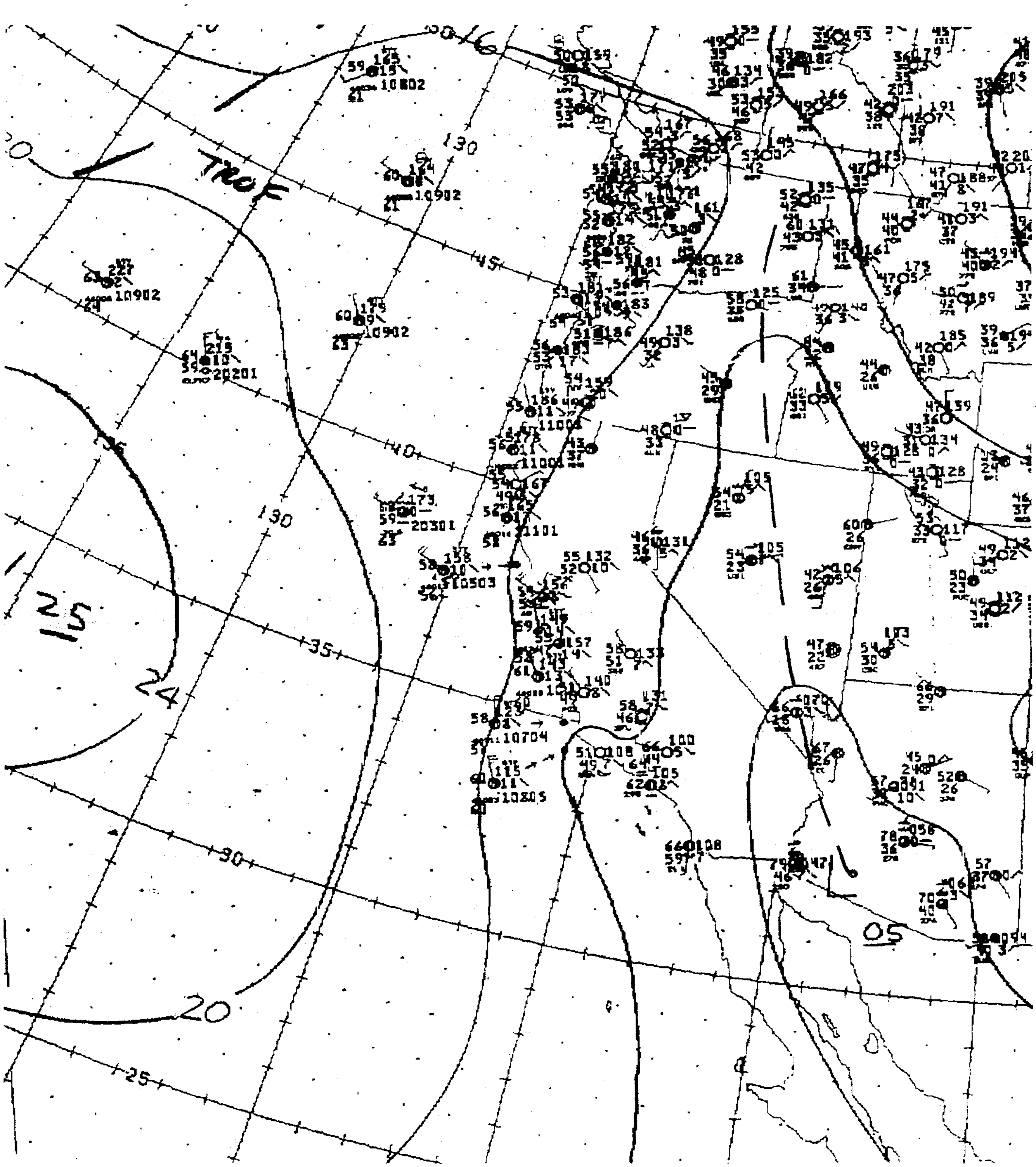

Figure A-3. Surface Weather Map for September 11, 0400 PST

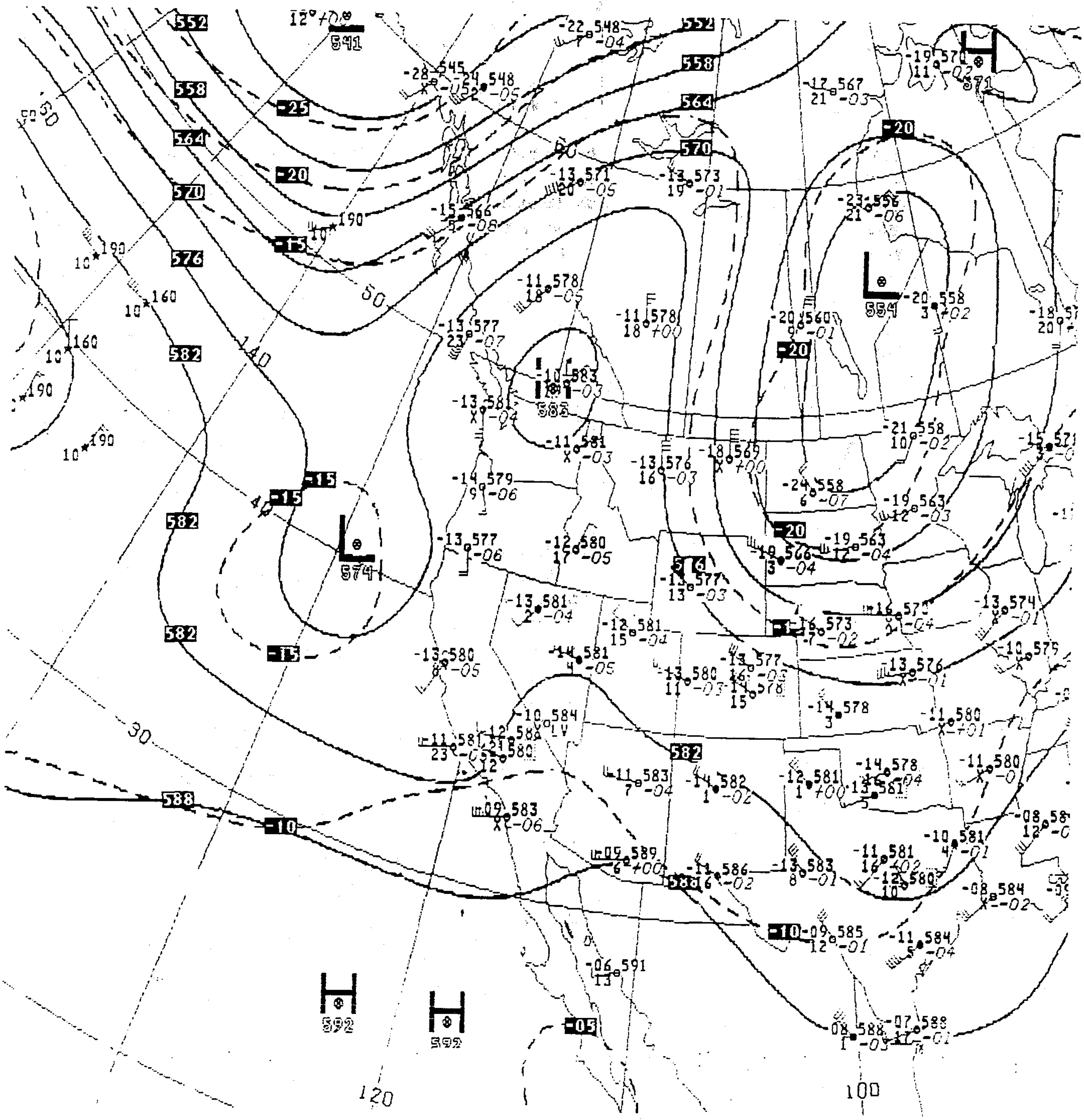

Figure A-4. 500-mb Map for September 11, 0400 PST

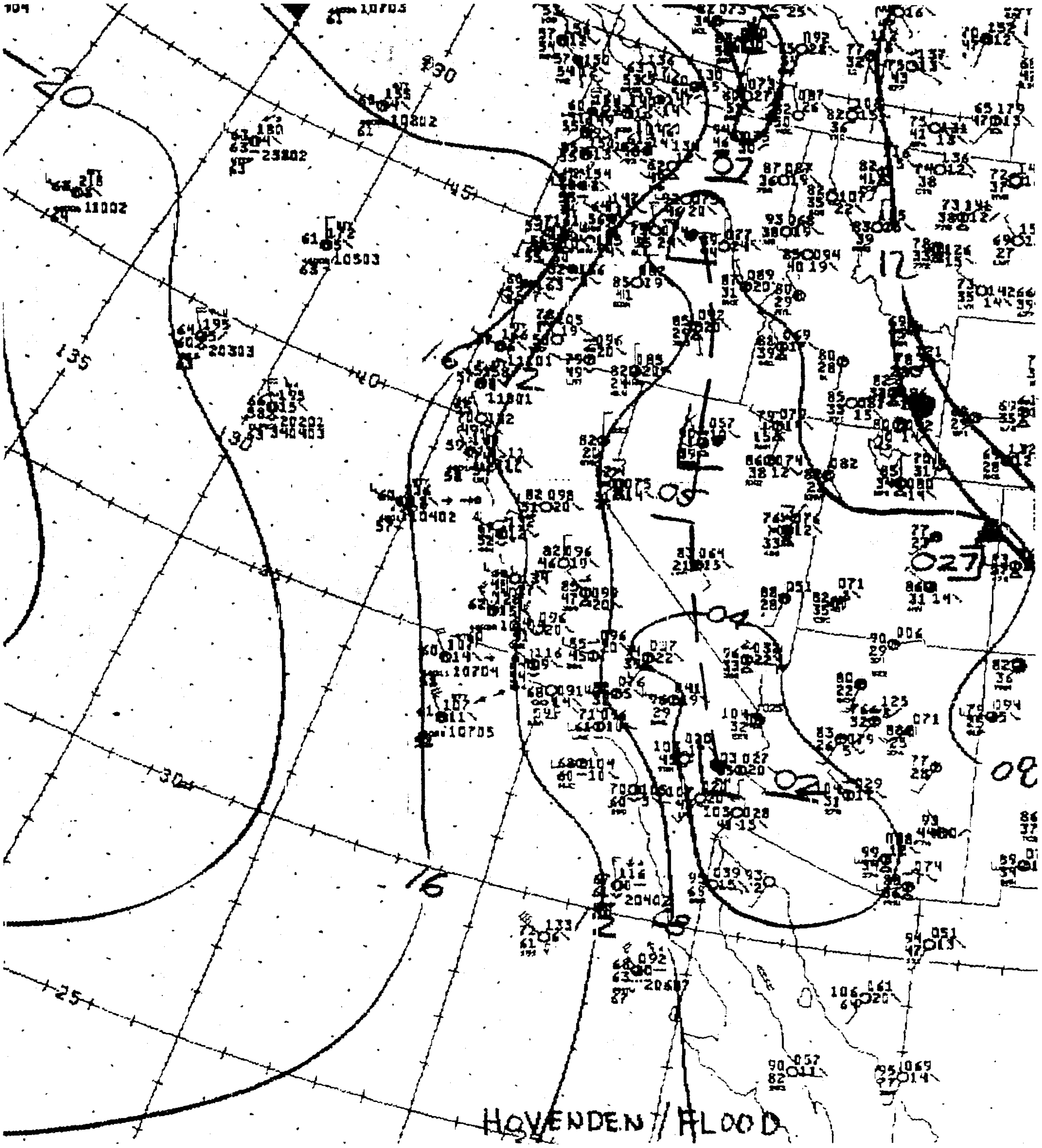

Figure A-5. Surface Weather Map for September 11, 1600 PST

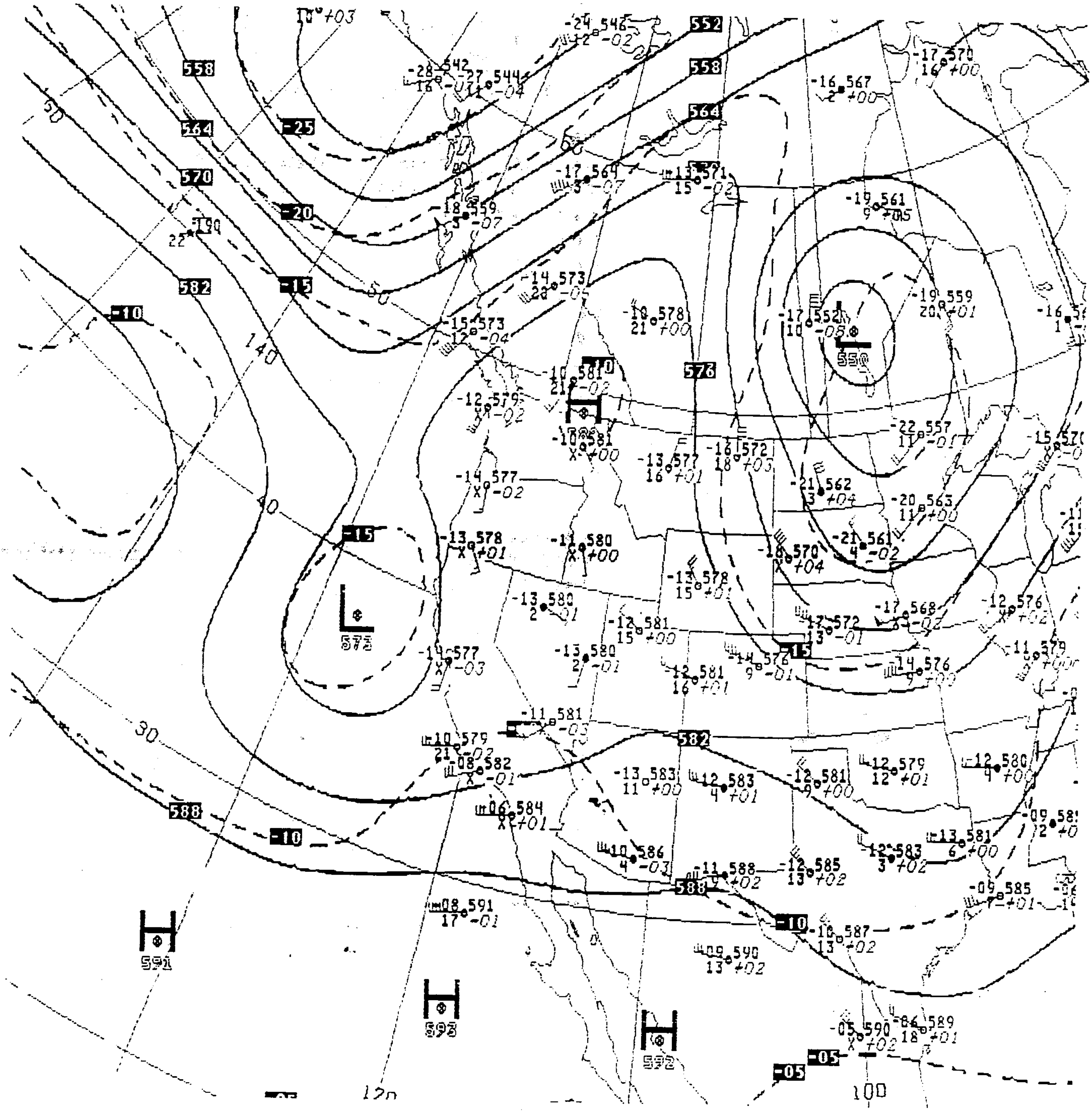

Figure A-6. 500-mb Map for September 11, 1600 PST

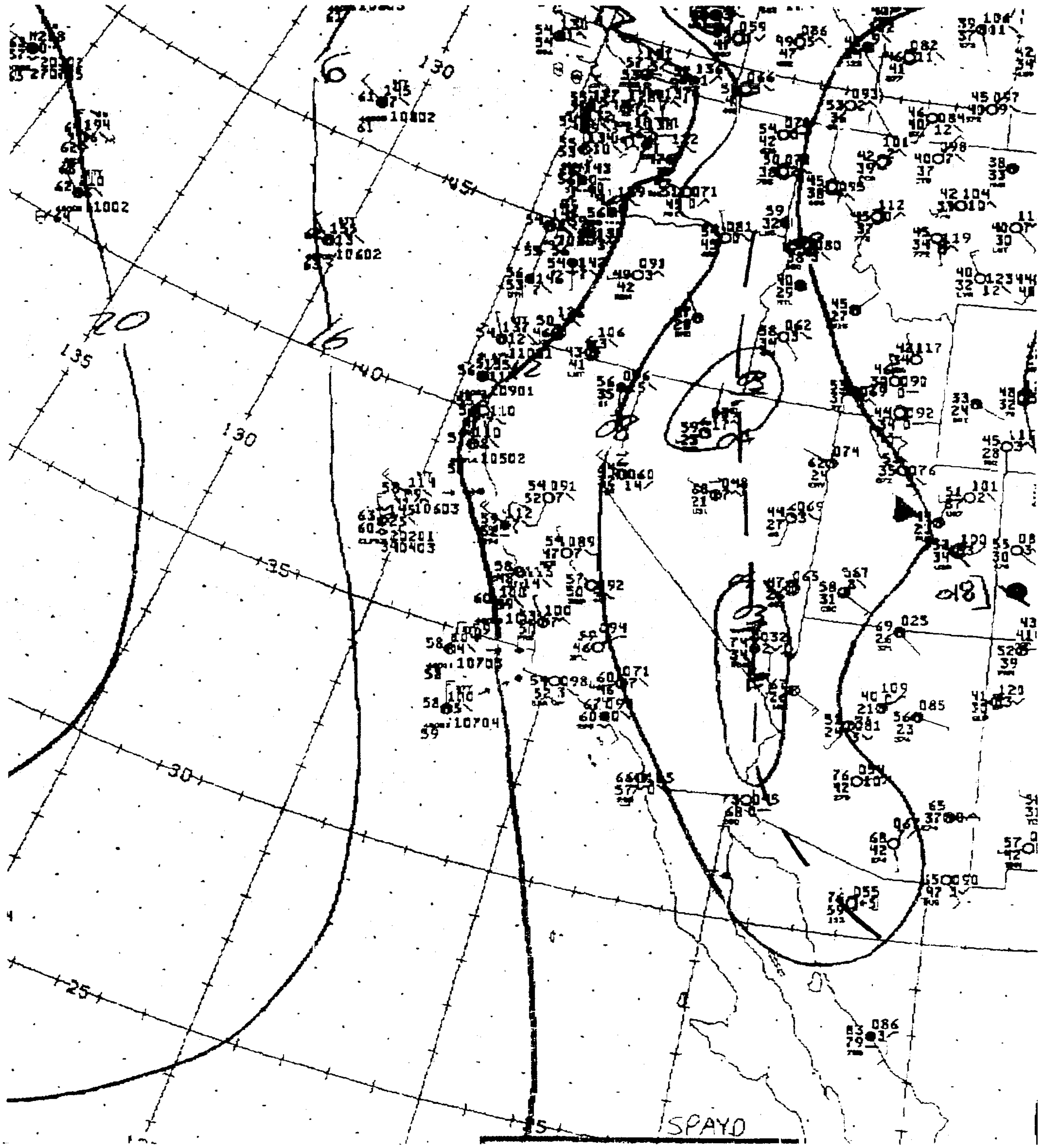

Figure A-7. Surface Weather Map for September 12, 0400 PST

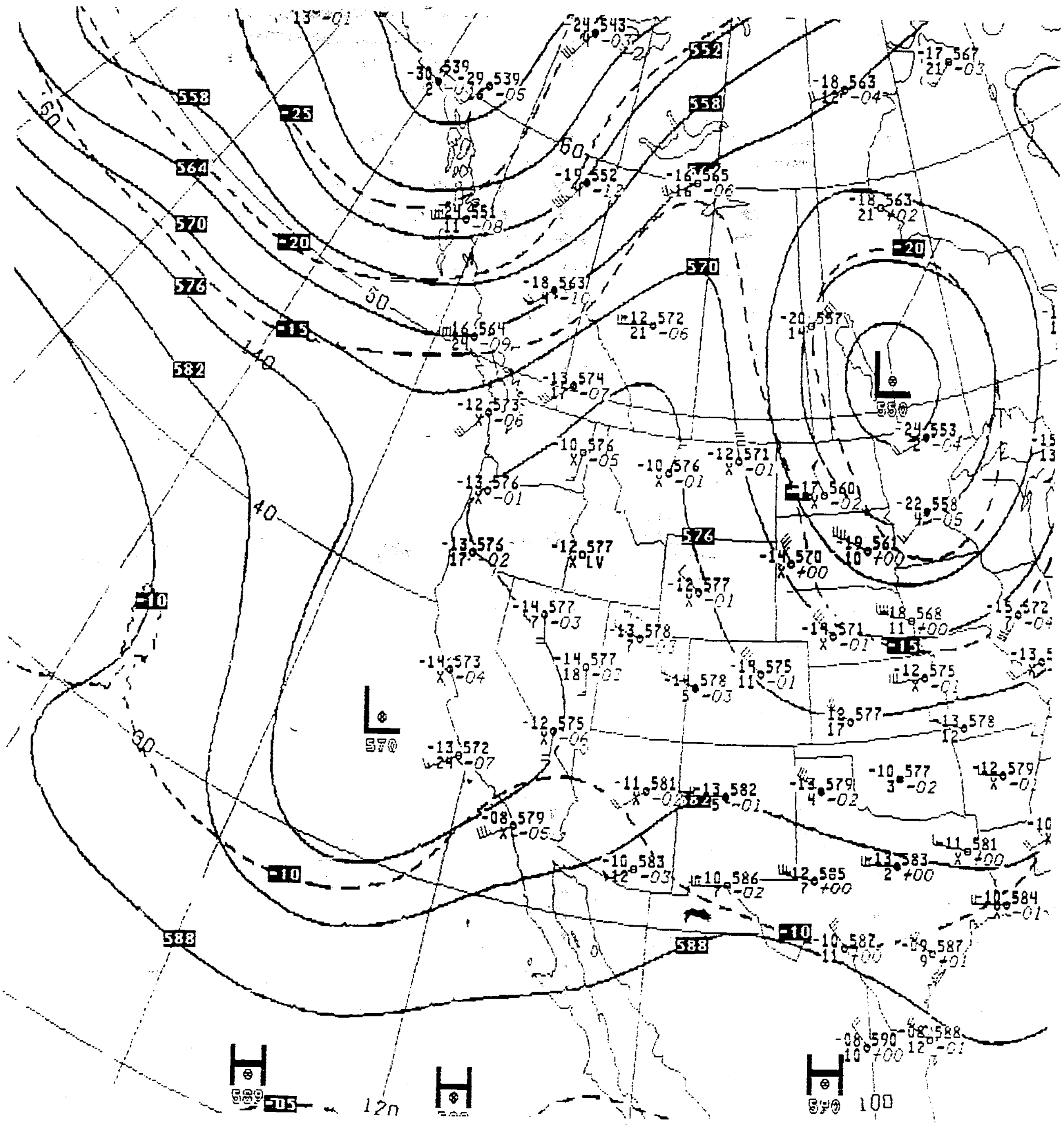

Figure A-8. 500-mb Map for September 12, 0400 PST

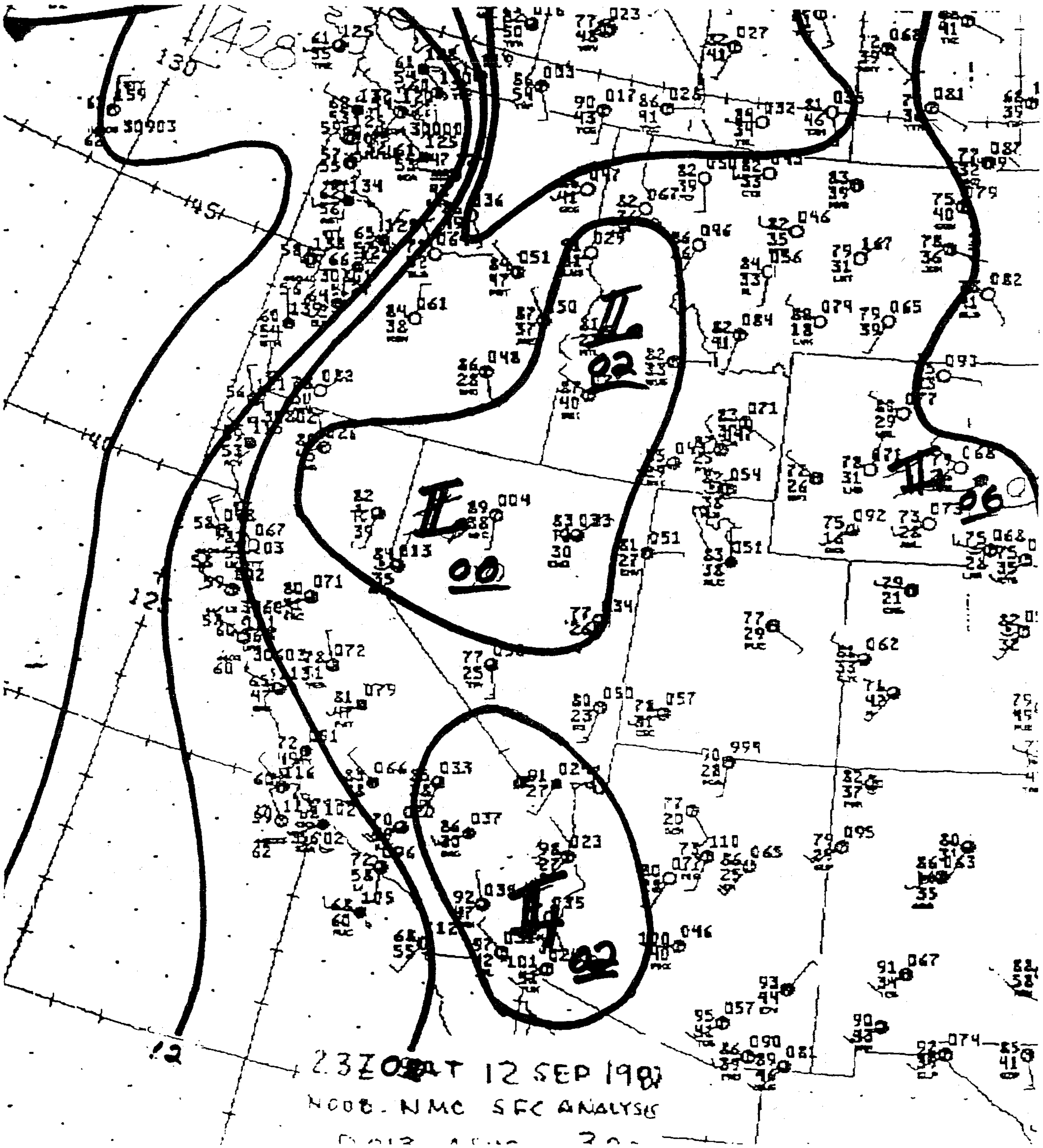

Figure A-9. Surface Weather Map for September 12, 1500 PST

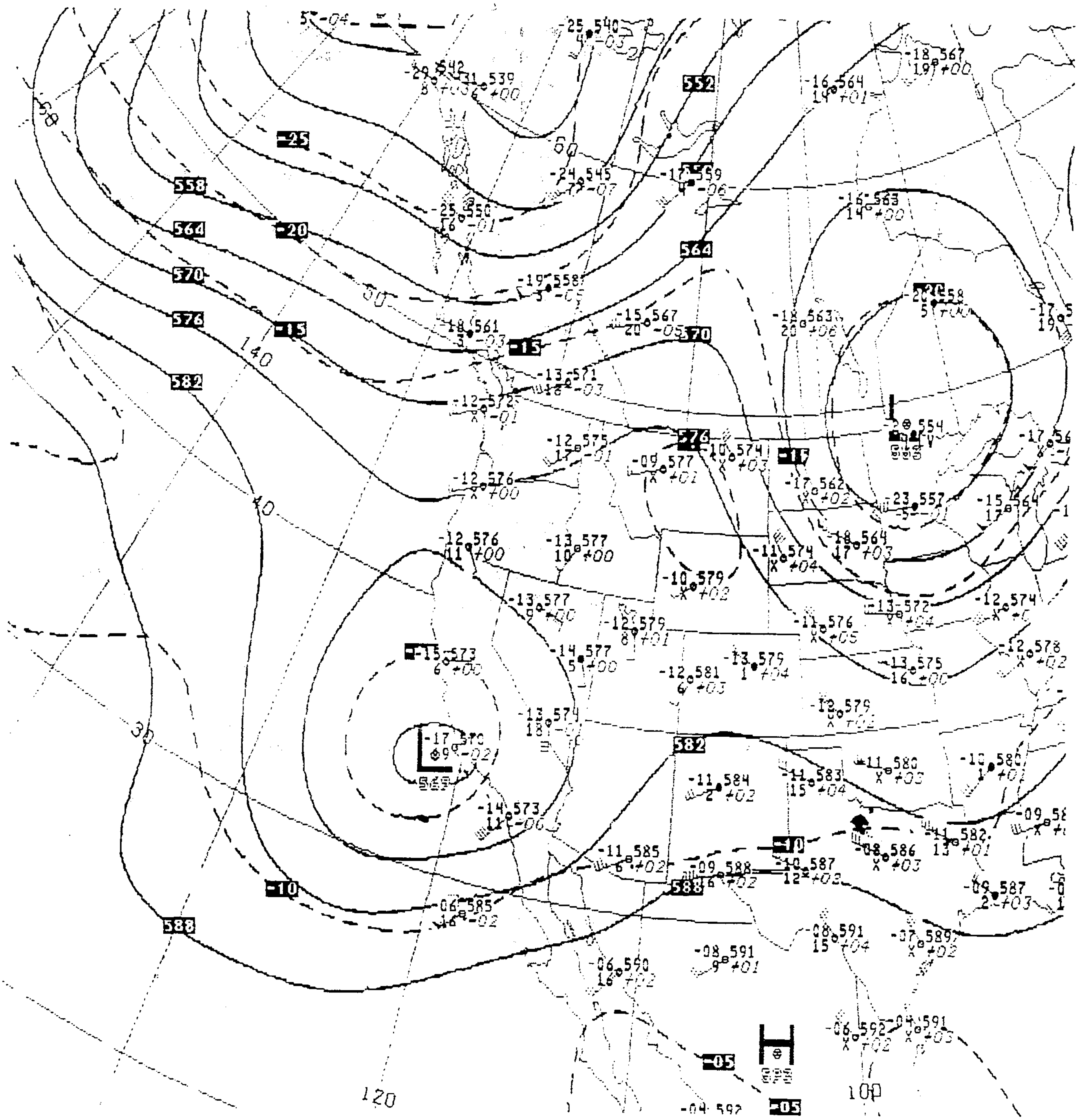

Figure A-10. 500-mb Map for September 12, 1600 PST

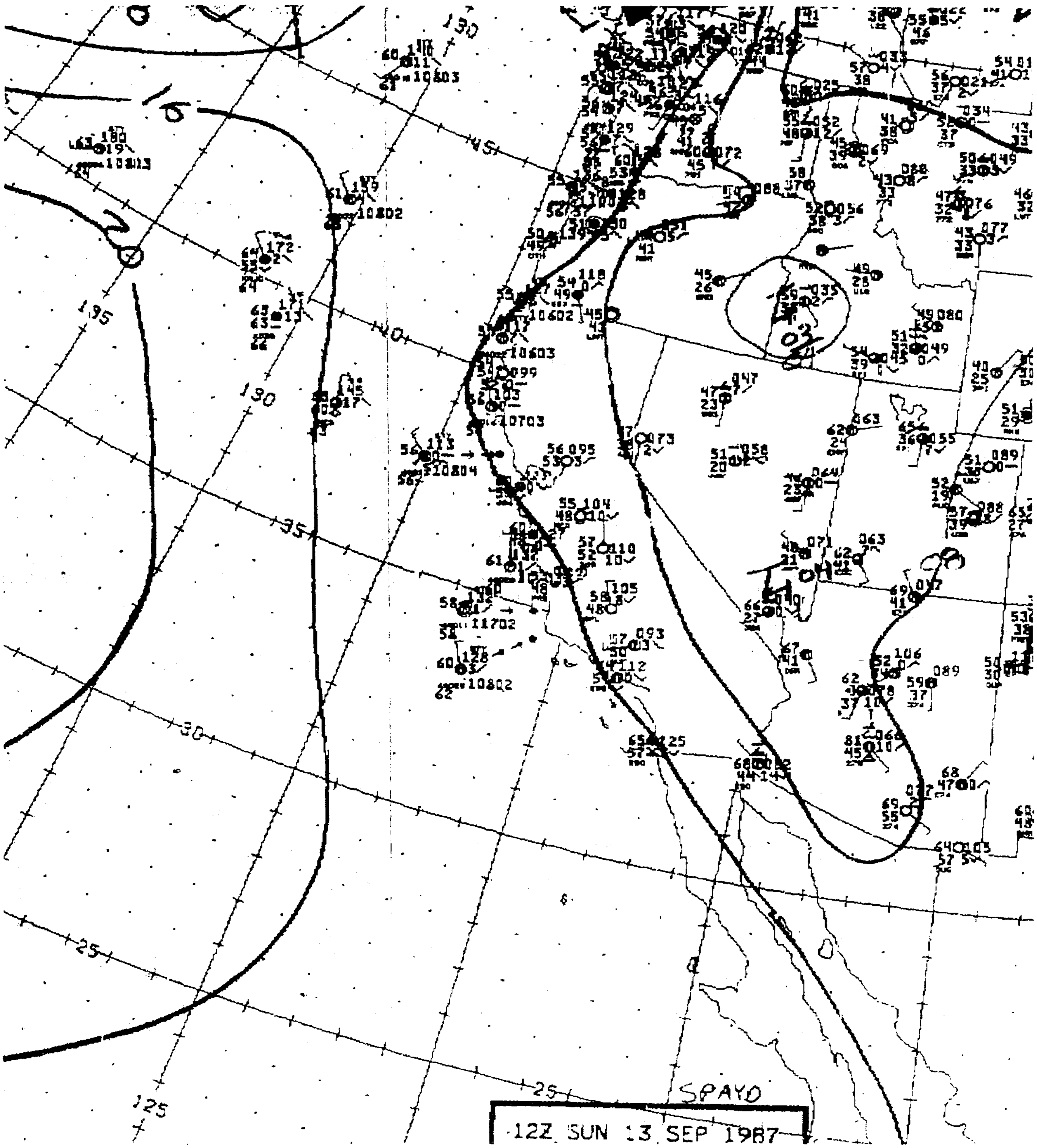

Figure A-11. Surface Weather Map for September 13, 0400 PST

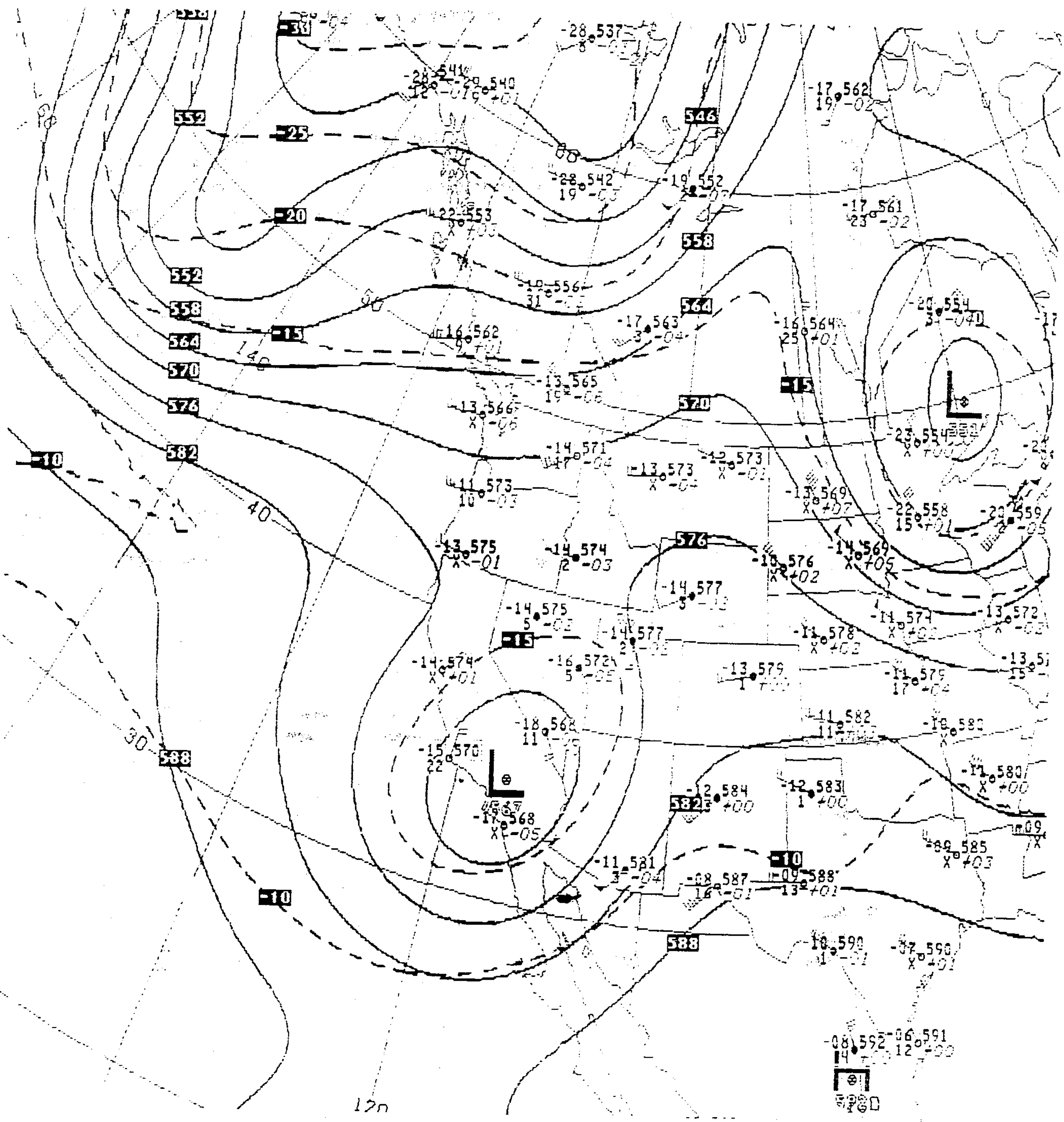

Figure A-12. 500-mb Map for September 13, 0400 PST

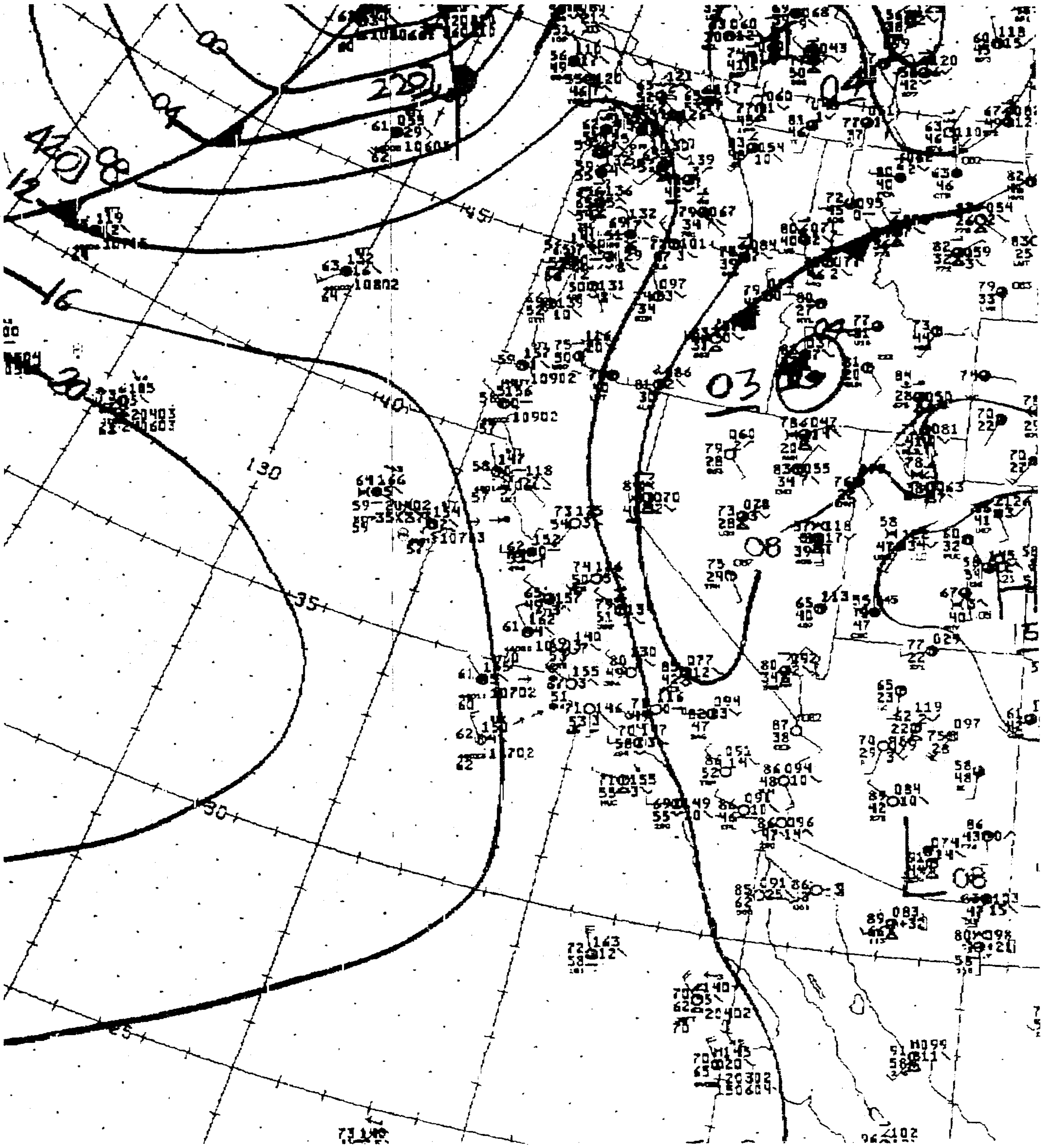

Figure A-13. Surface Weather Map for September 13, 1600 PST

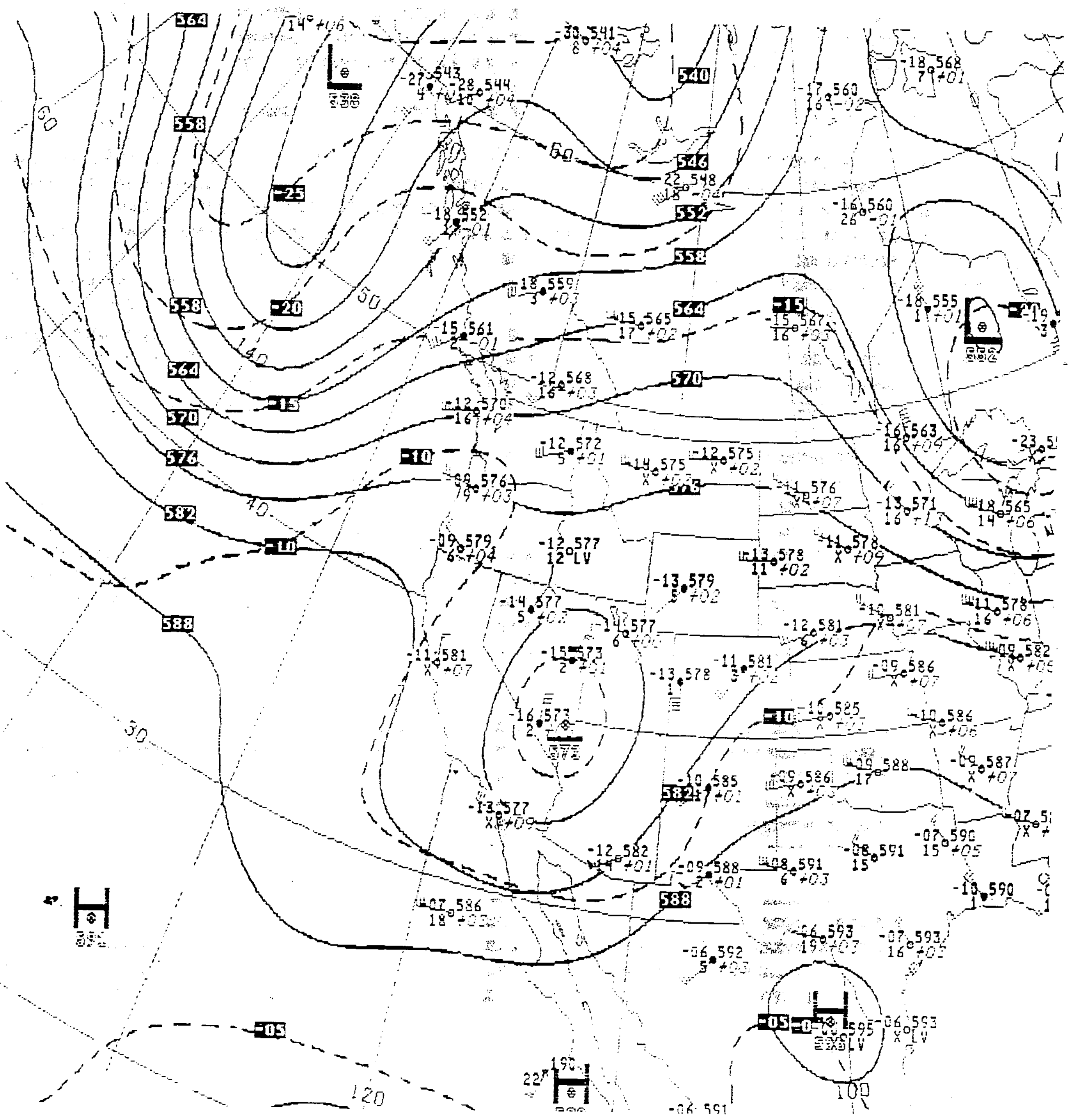

Figure A-14. 500-mb Map for September 13, 1600 PST

SERI

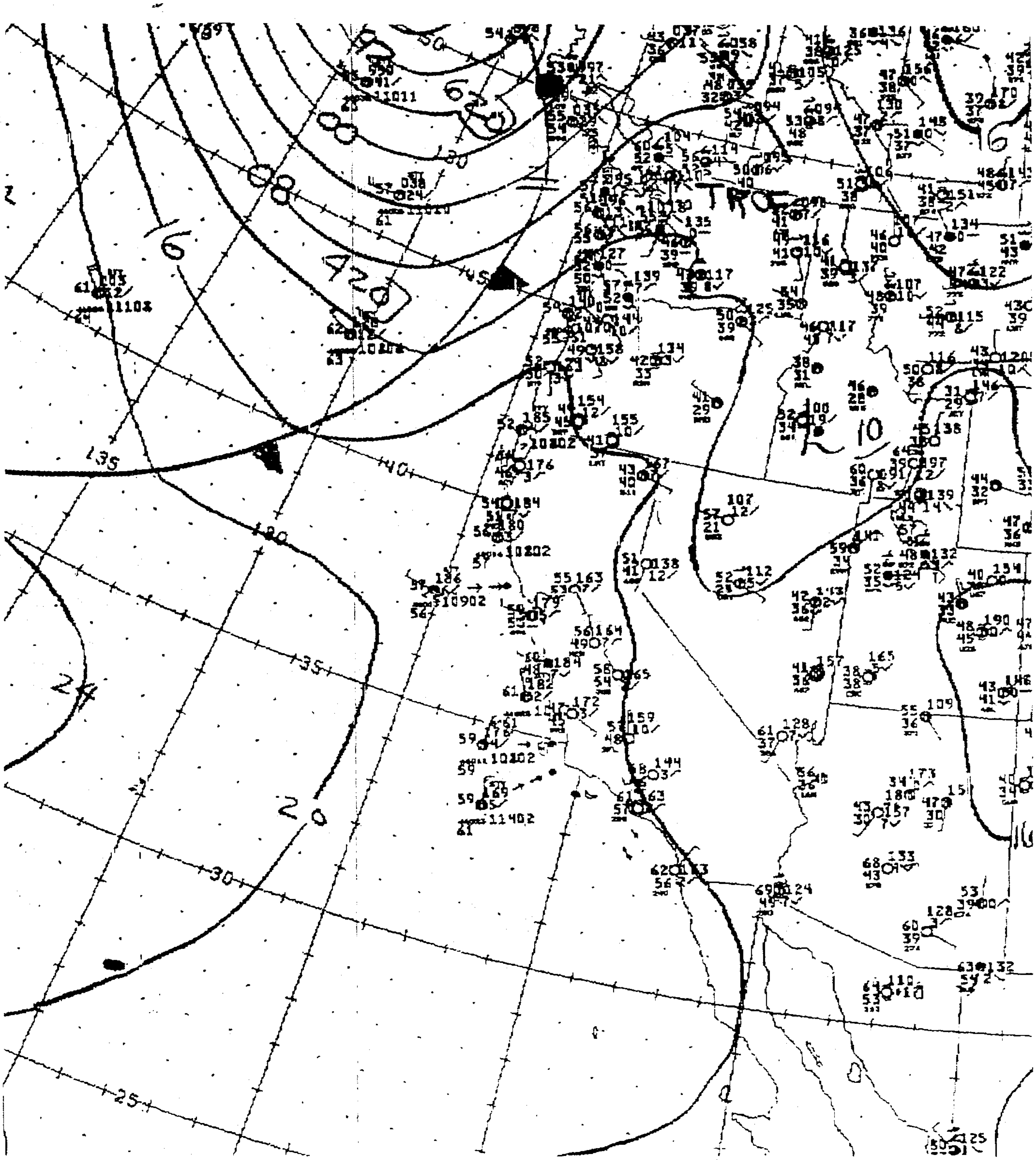

Figure A-15. Surface Weather Map for September 14, 0400 PST

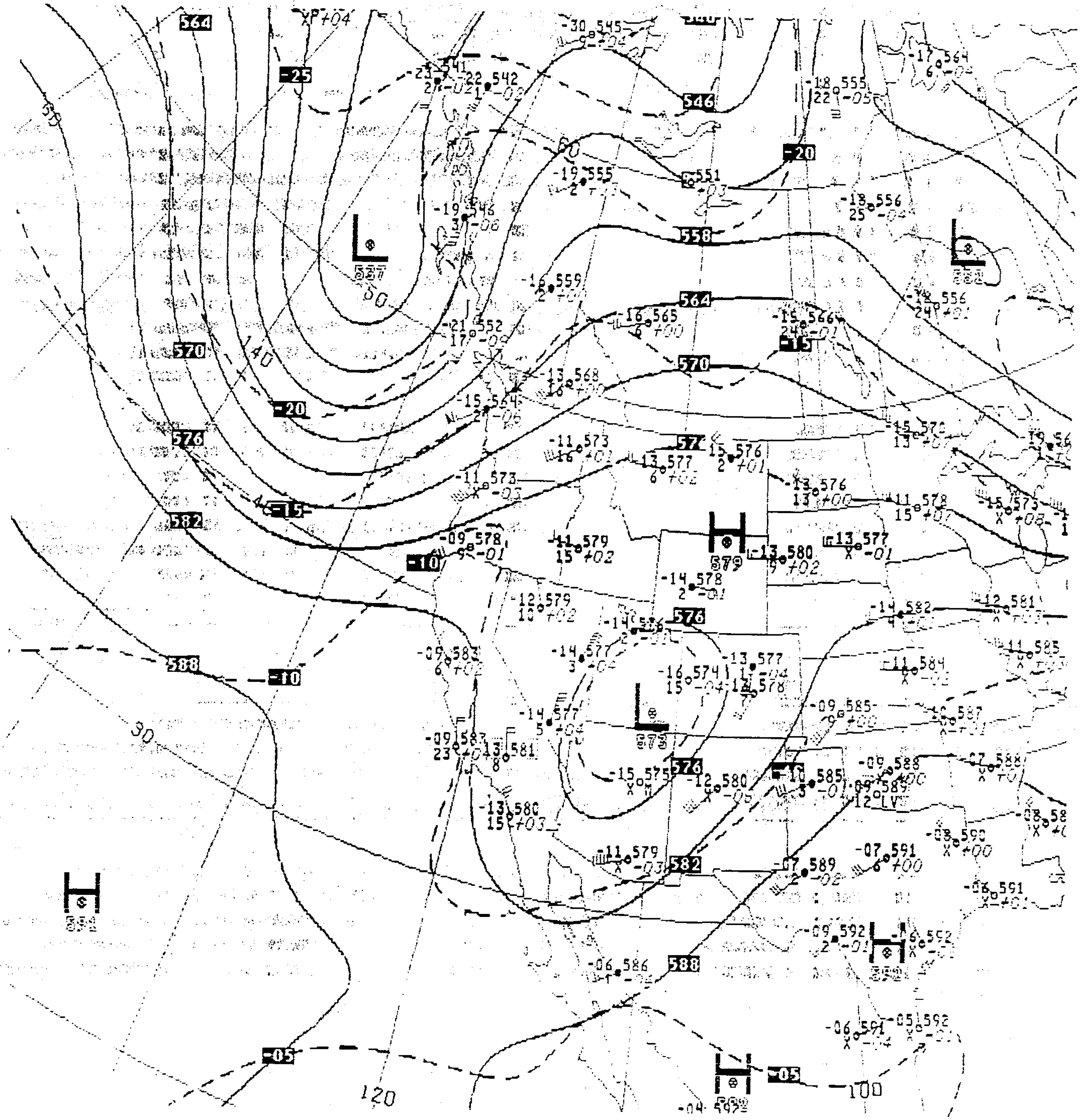

Figure A-16. 500-mb Map for September 14, 0400 PST

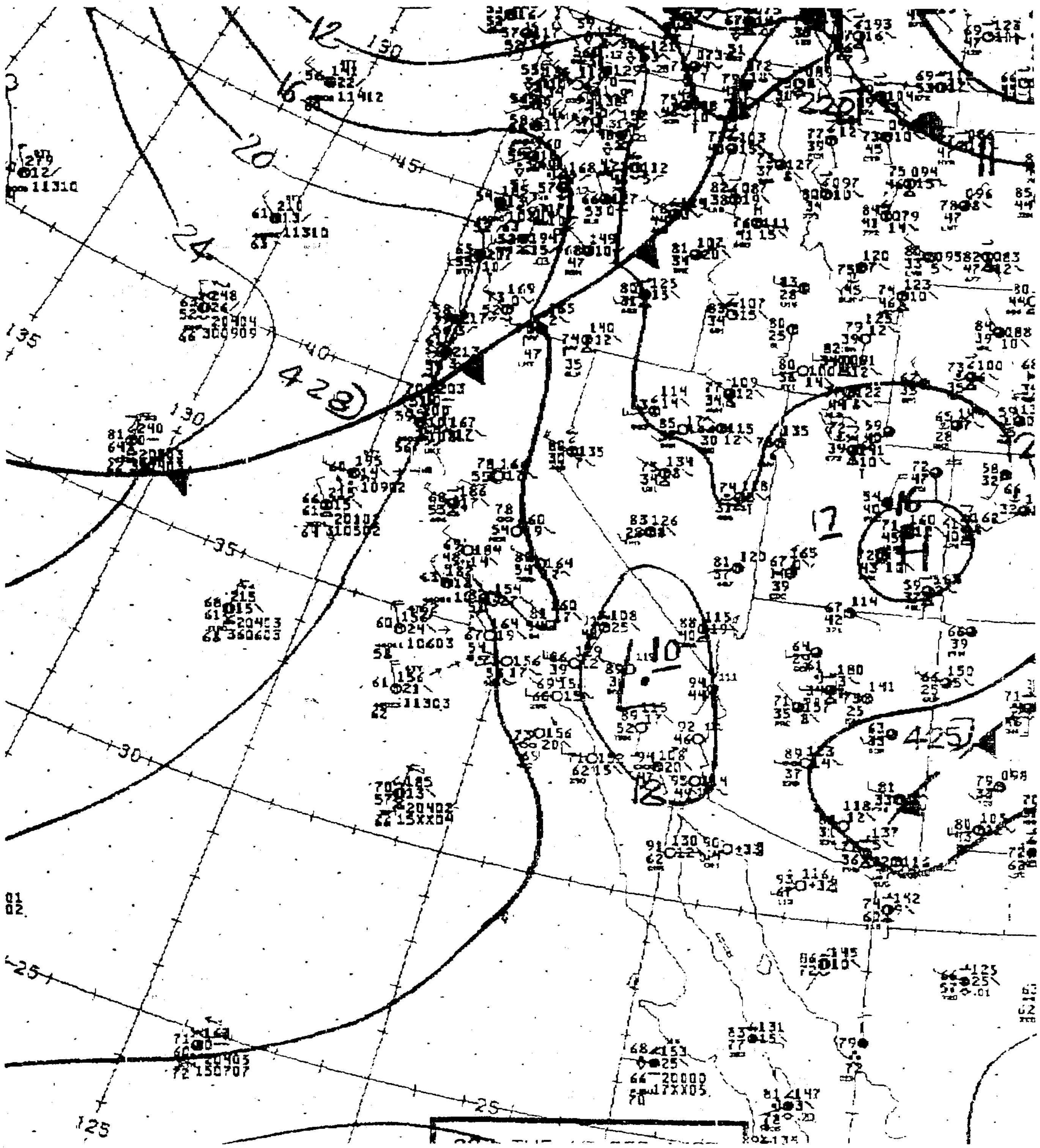

Figure A-17. Surface Weather Map for September 14, 1600 PST

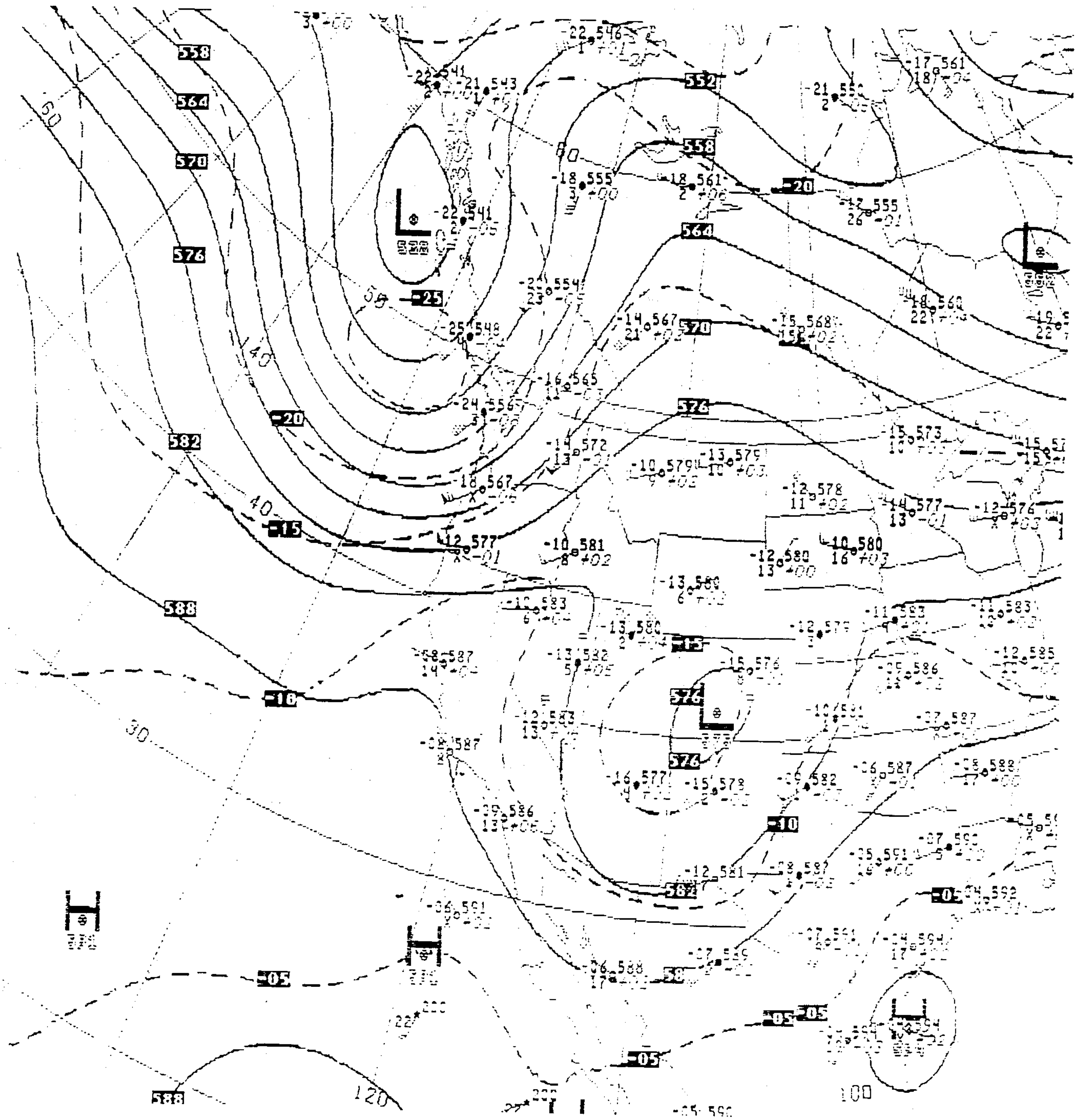

Figure A-18. 500-mb Map for September 14, 1600 PST

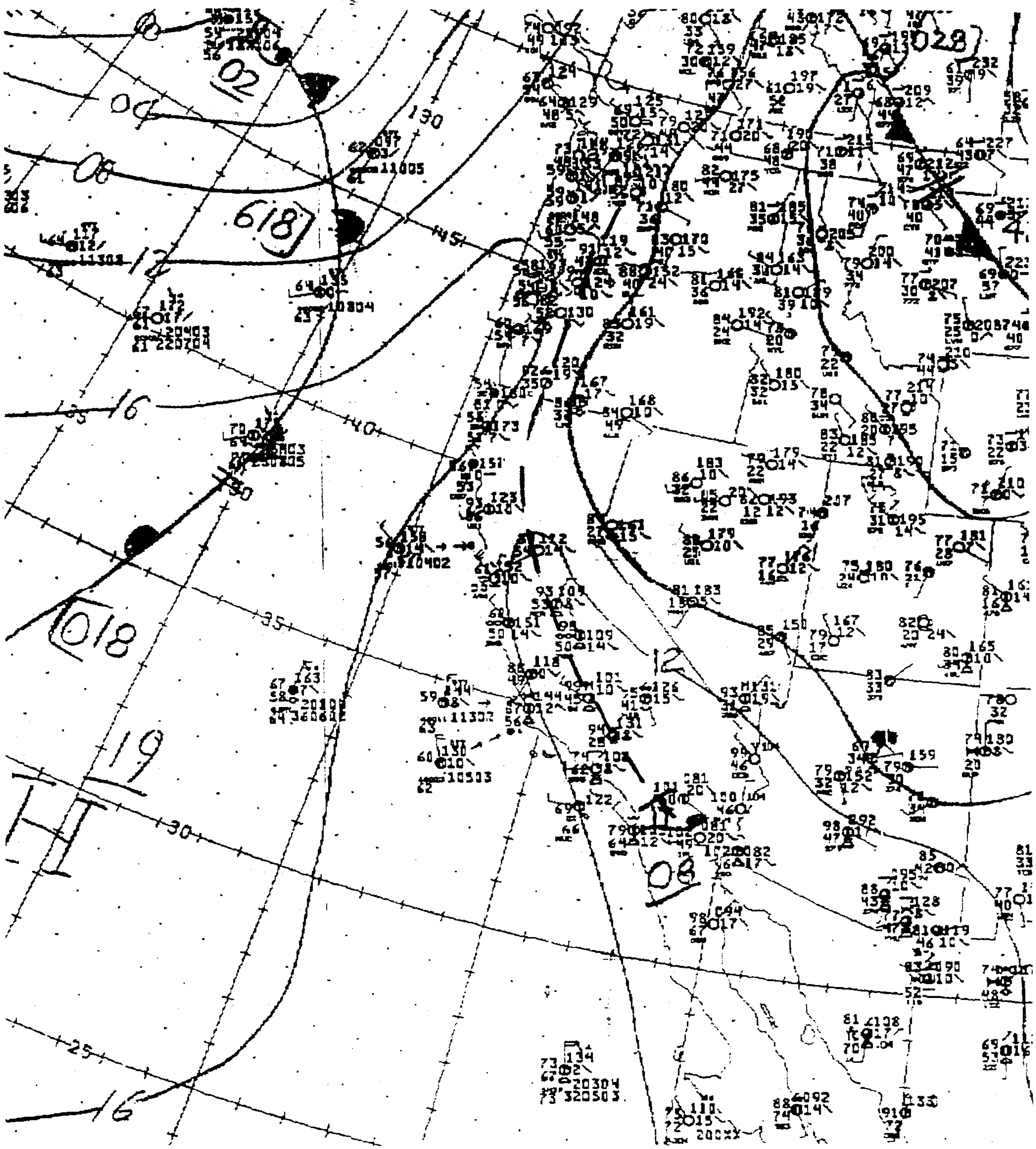

Figure A-19. Surface Weather Map for October 1, 1600 PST

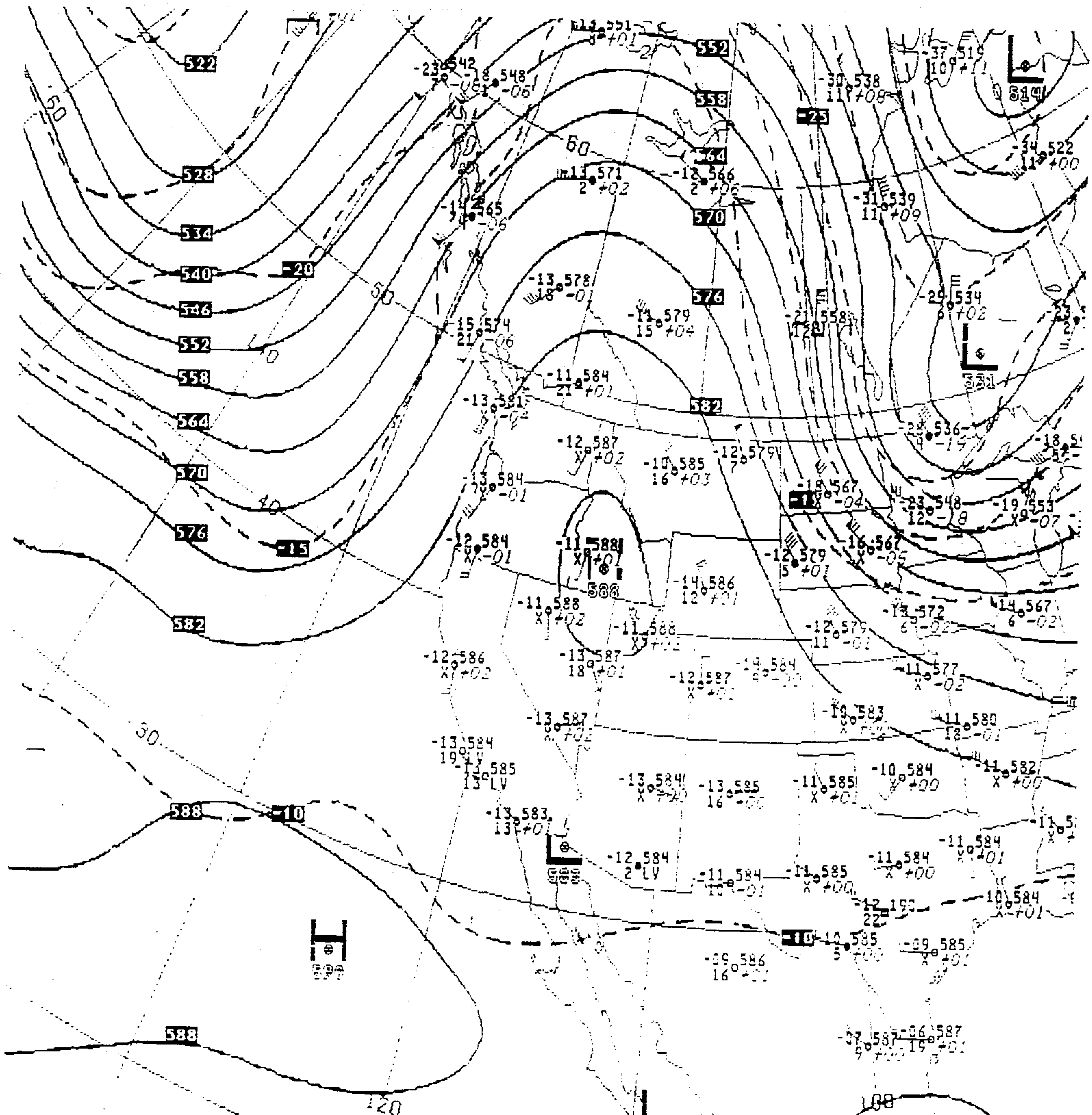

Figure A-20. 500-mb Map for October 1, 1600 PST

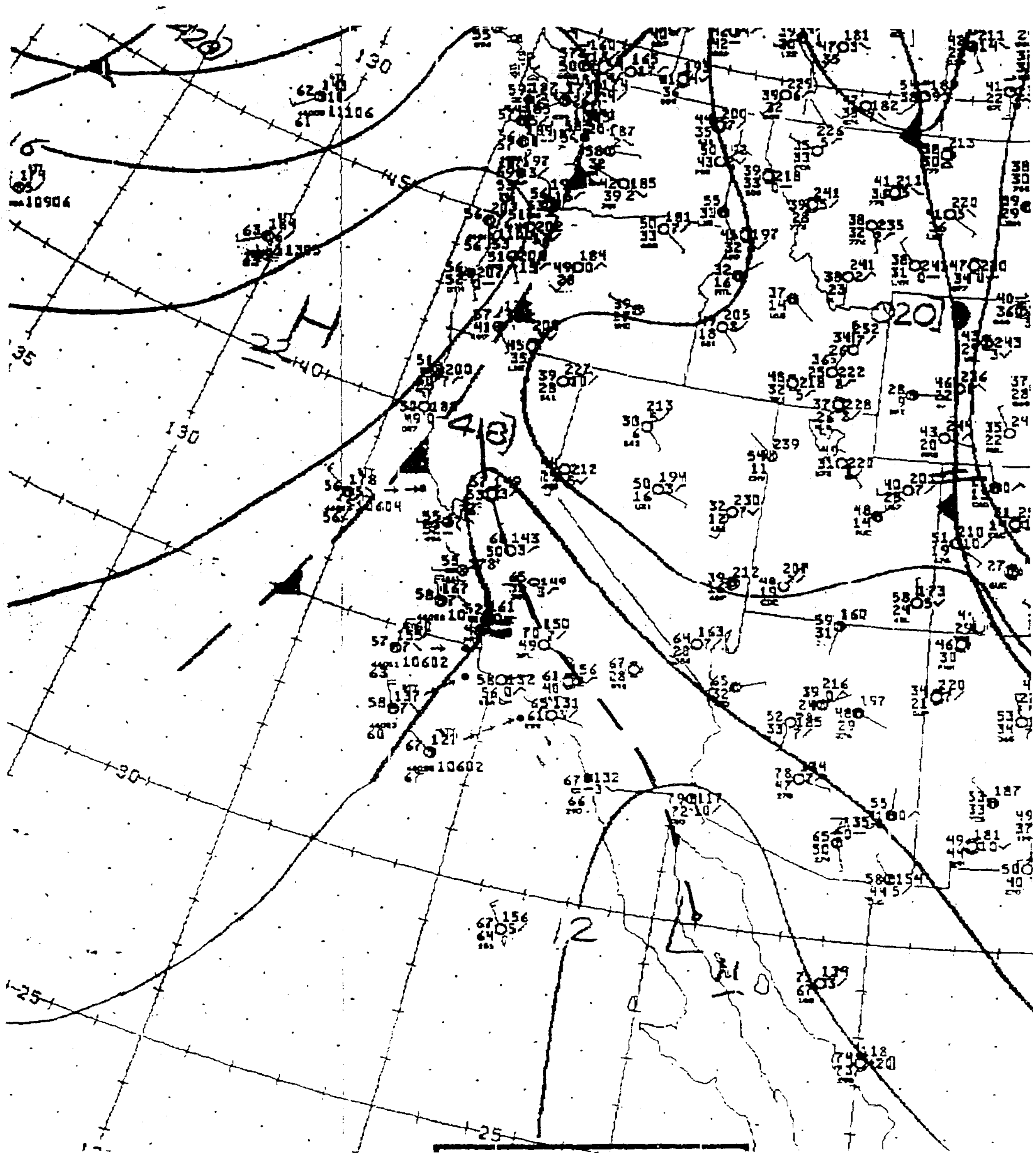

Figure A-21. Surface Weather Map for October 2, 0400 PST

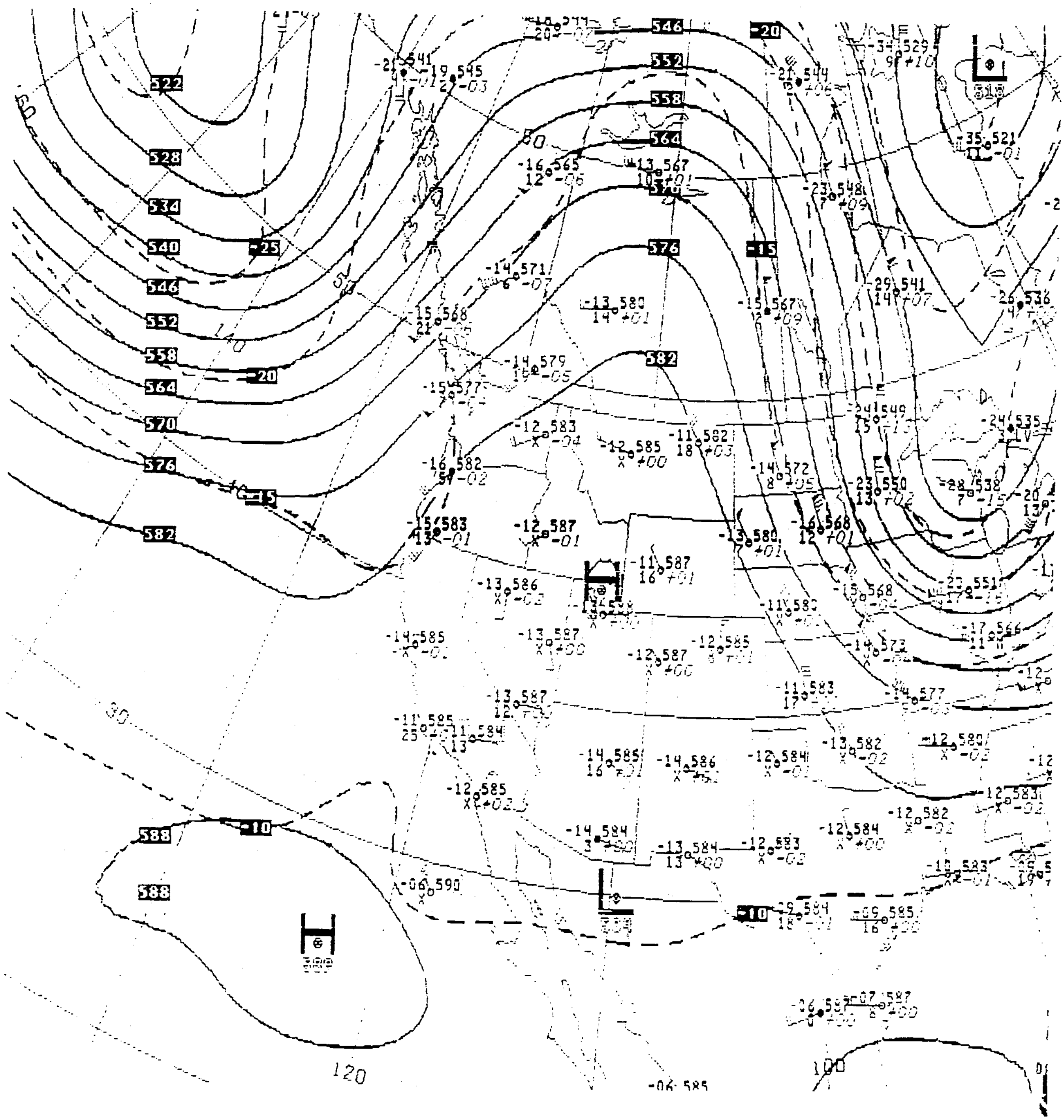

Figure A-22. 500-mb Map for October 2, 0400 PST

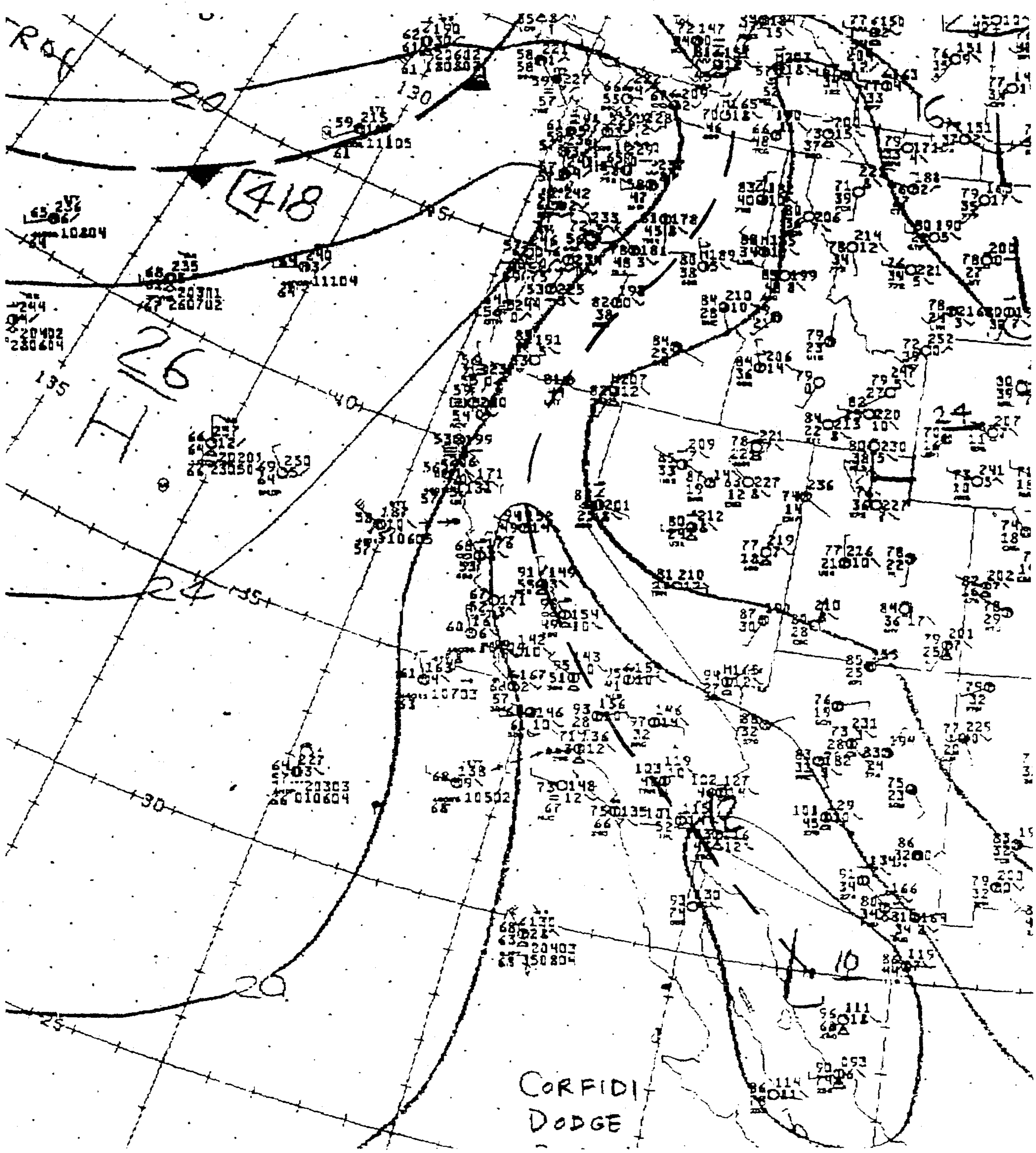

Figure A-23. Surface Weather Map for October 2, 1600 PST

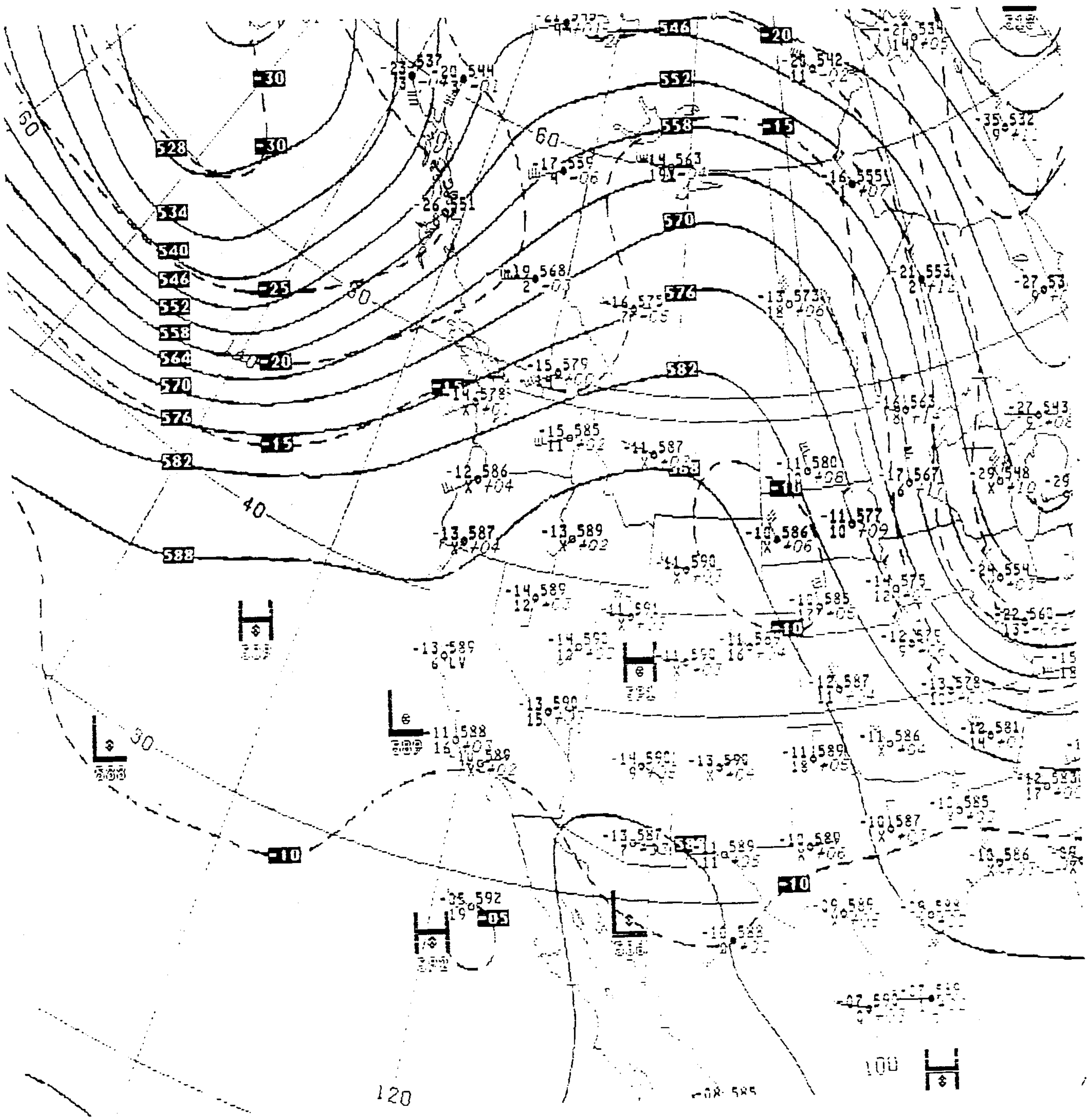

Figure A-24. 500-mb Map for October 2, 1600 PST

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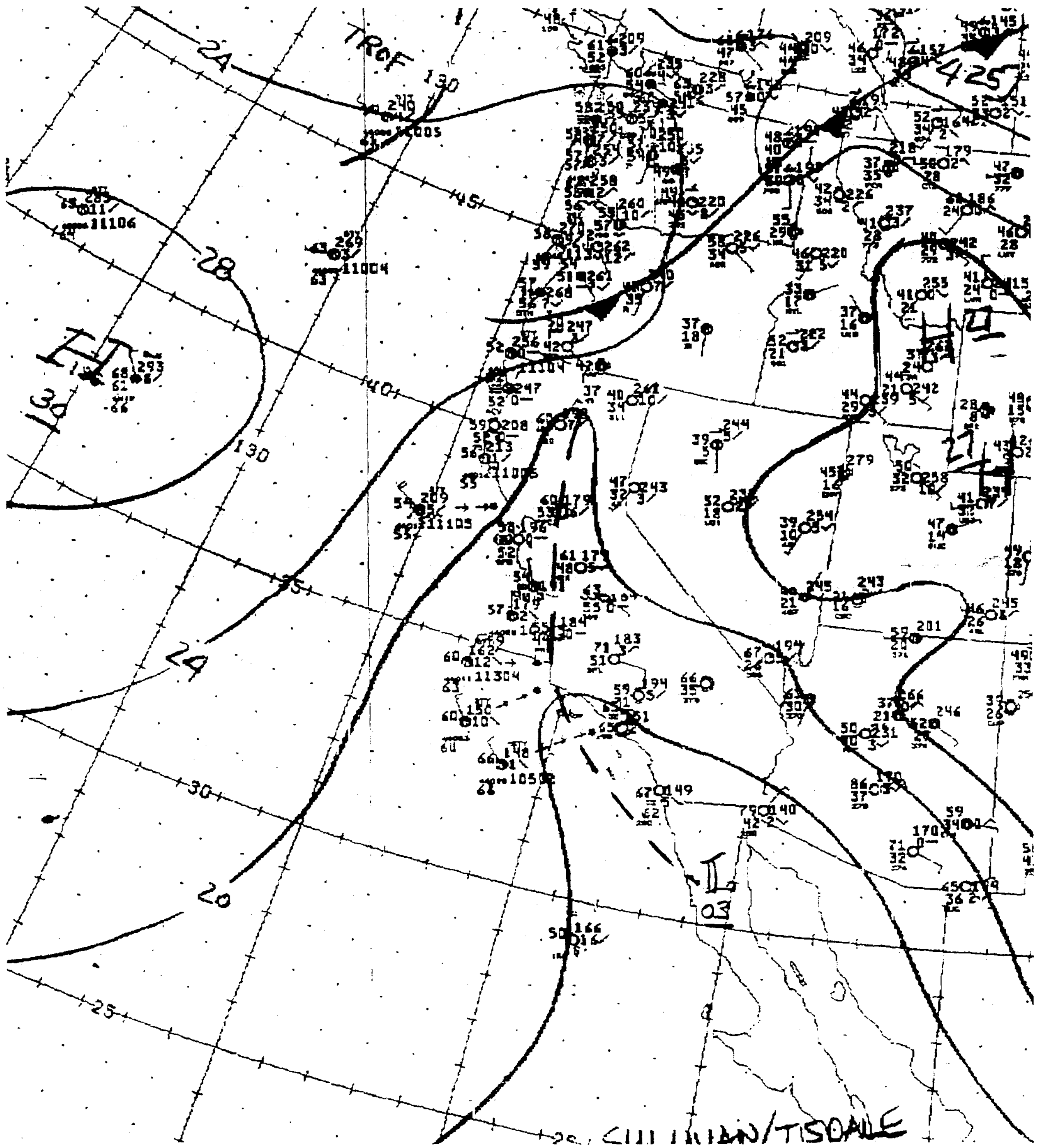

Figure A-25. Surface Weather Map for October 3, 0400 PST

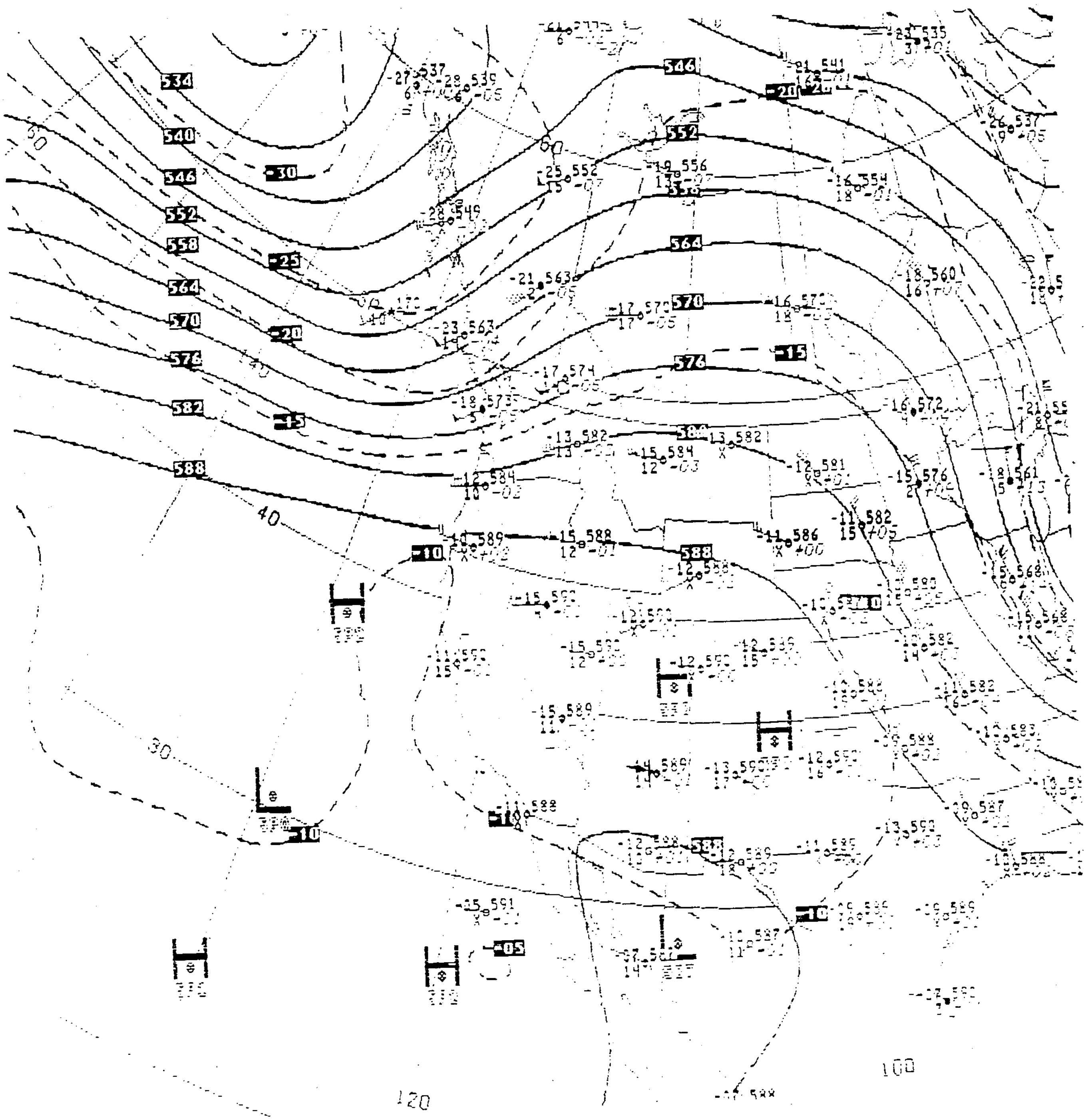

Figure A-26. 500-mb Map for October 3, 0400 PST

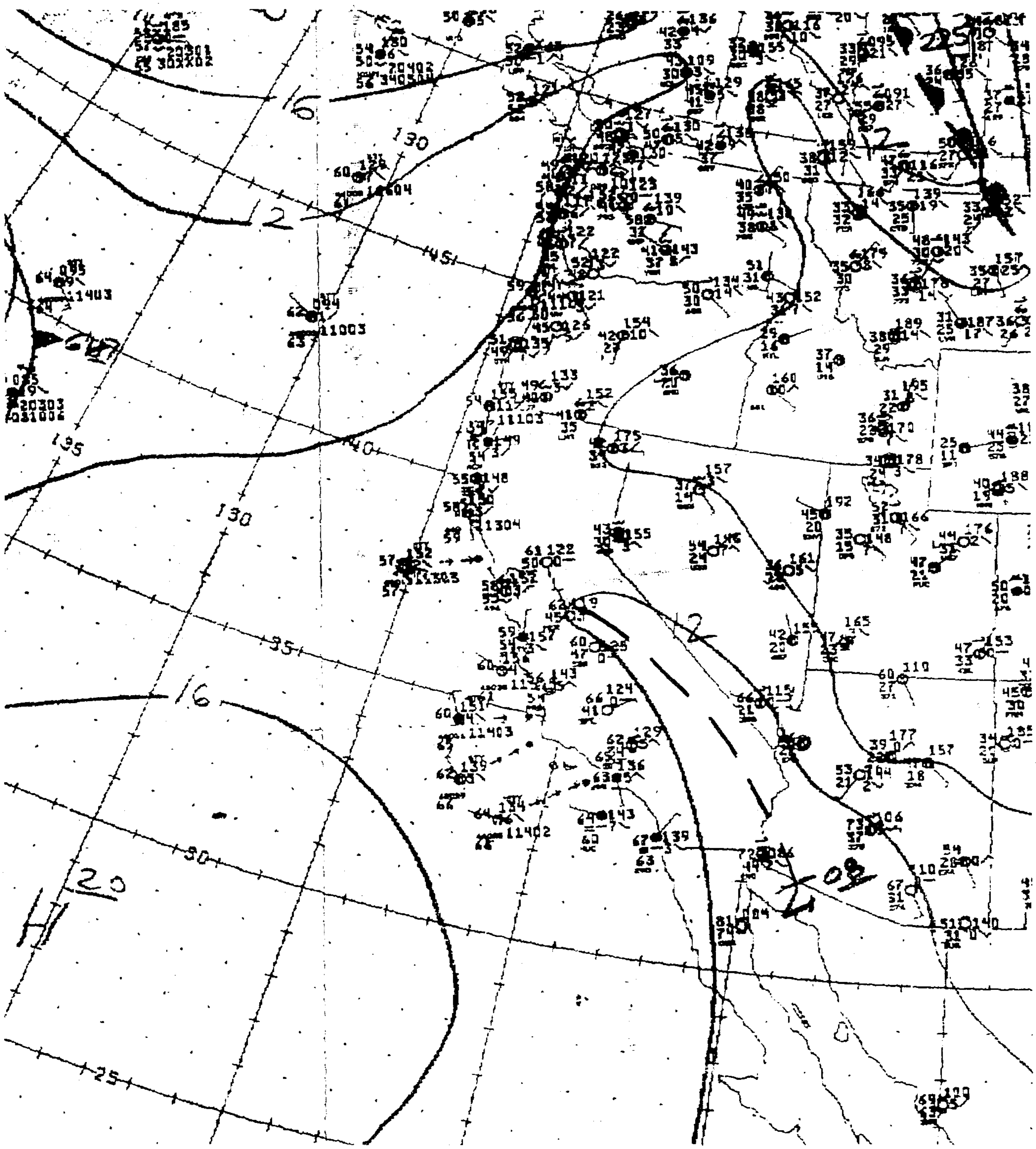

Figure A-27. Surface Weather Map for October 7, 0400 PST

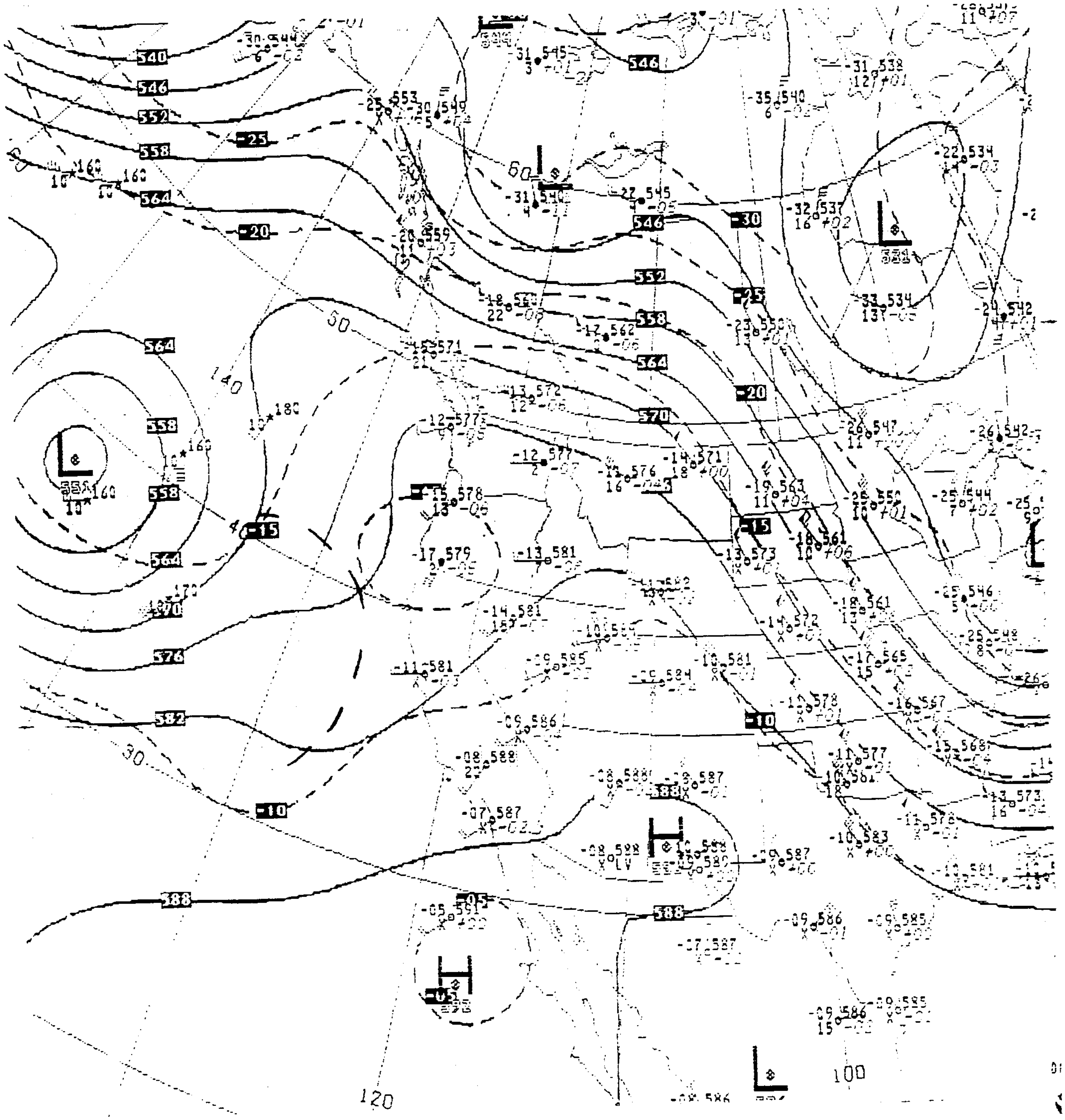

Figure A-28. 500-mb Map for October 7, 0400 PST

SERI

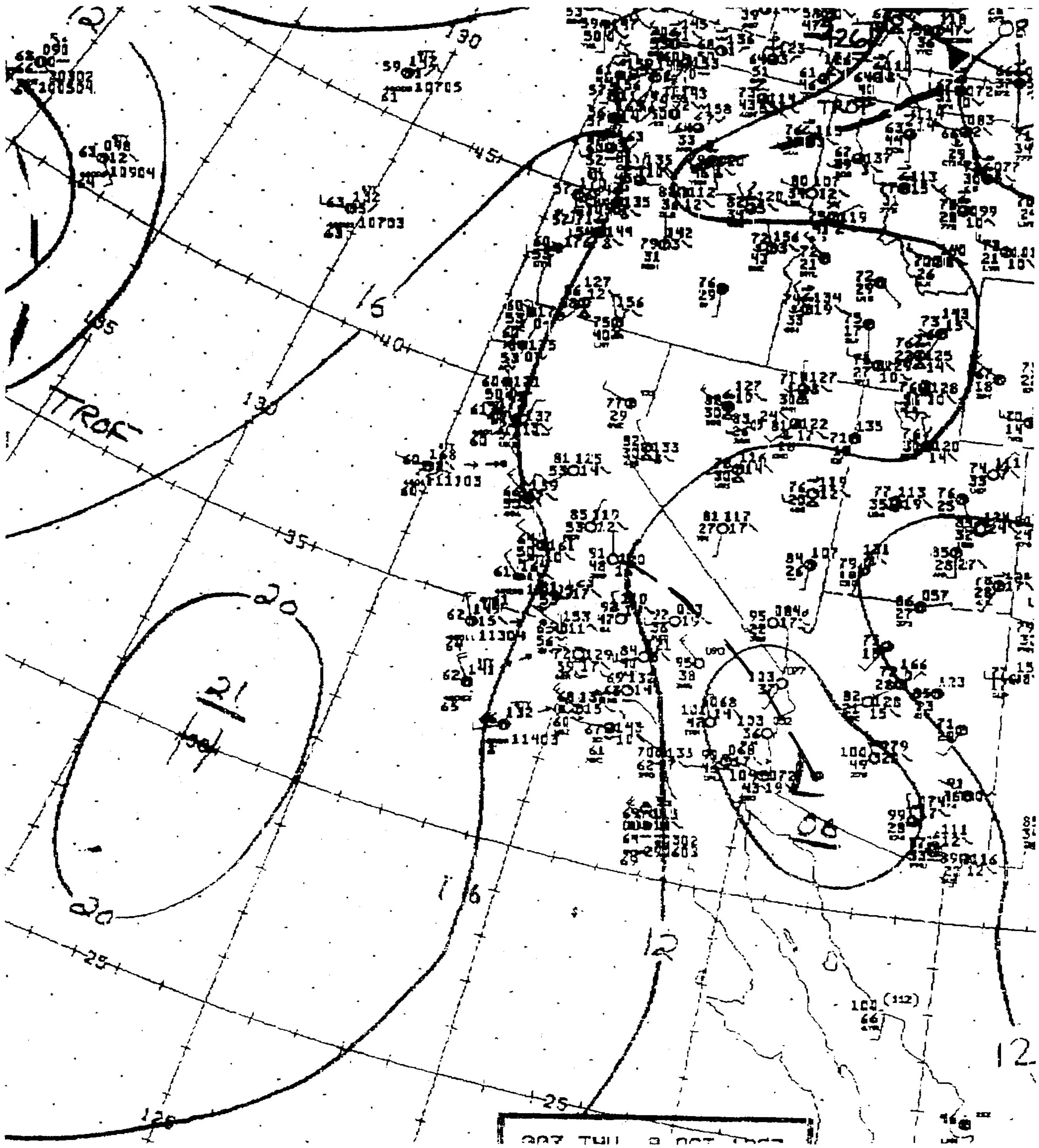

Figure A-29. Surface Weather Map for October 7, 1600 PST

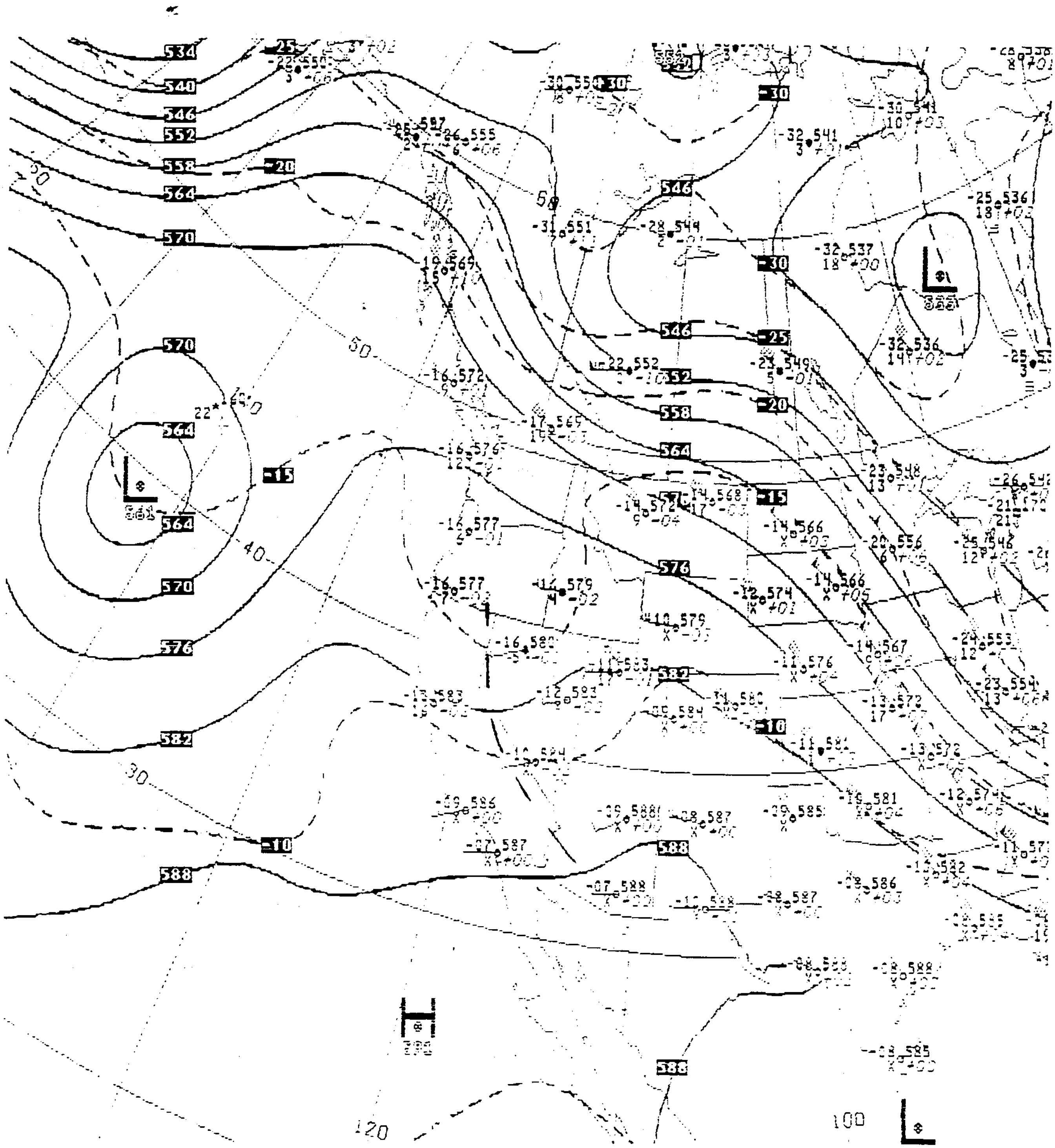

Figure A-30. 500-mb Map for October 7, 1600 PST

SERI

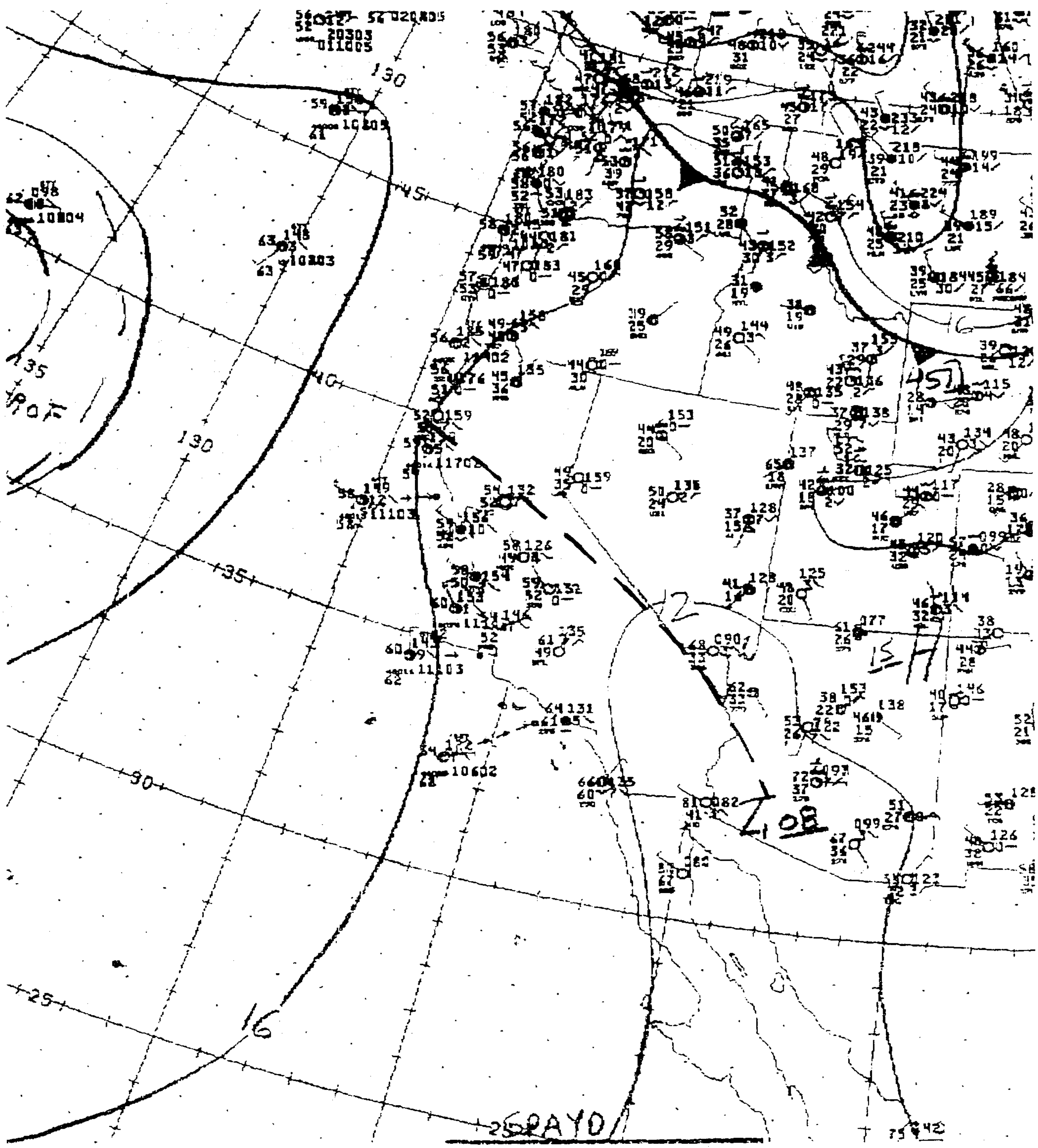

Figure A-31. Surface Weather Map for October 8, 0400 PST

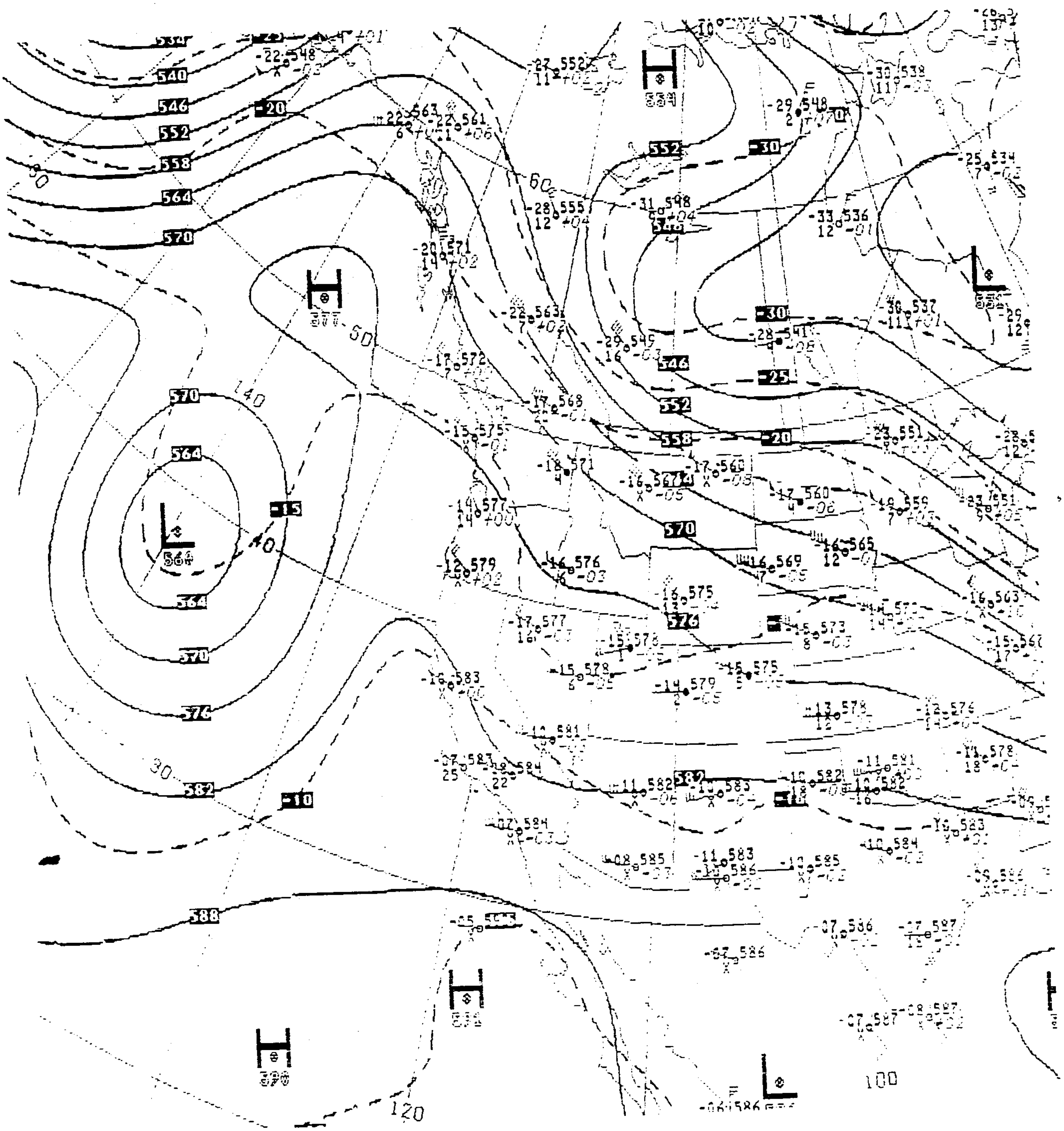

Figure A-32. 500-mb Map for October 8, 0400 PST

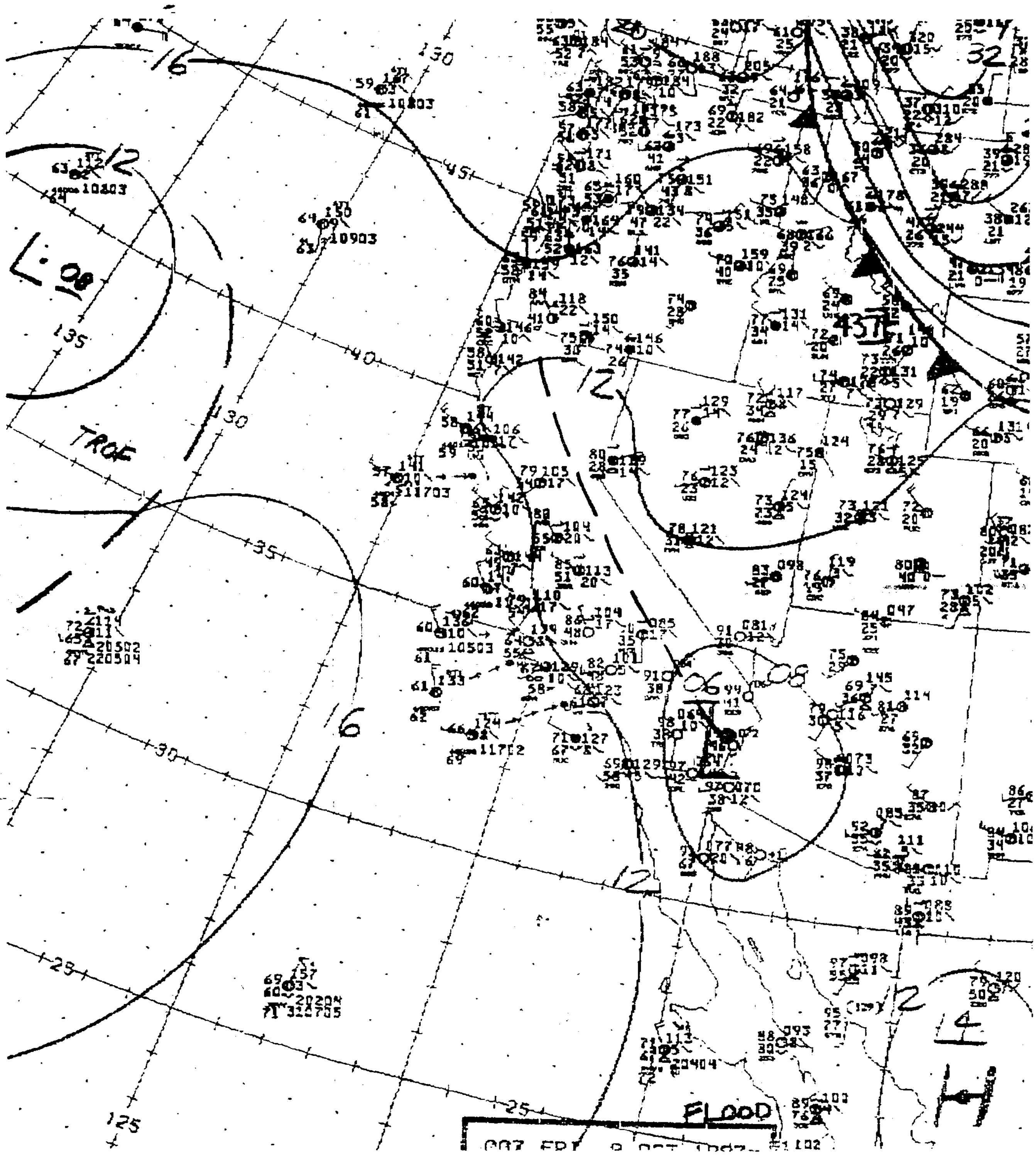

Figure A-33. Surface Weather Map for October 8, 1600 PST

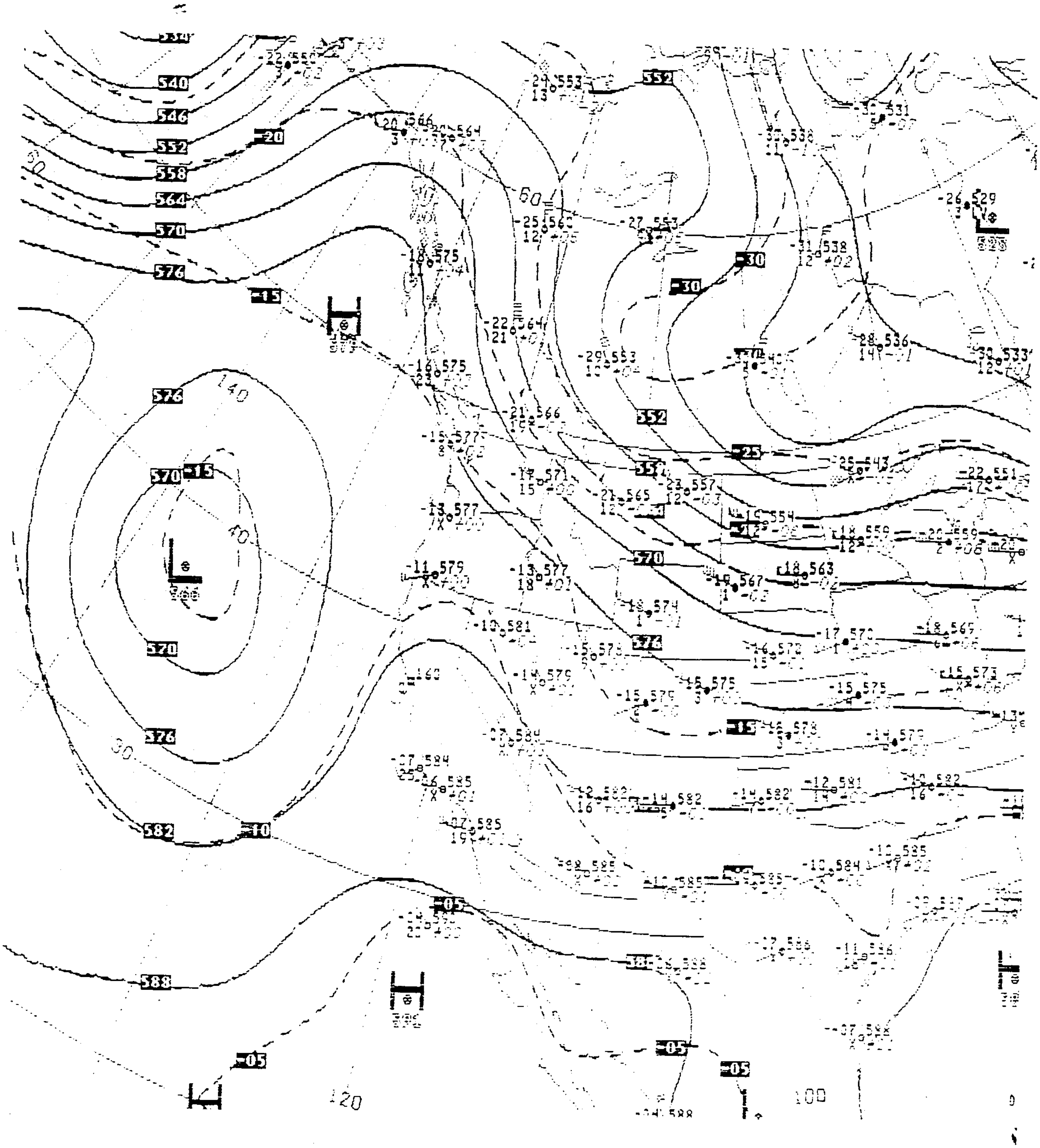

Figure A-34. 500-mb Map for October 8, 1600 PST

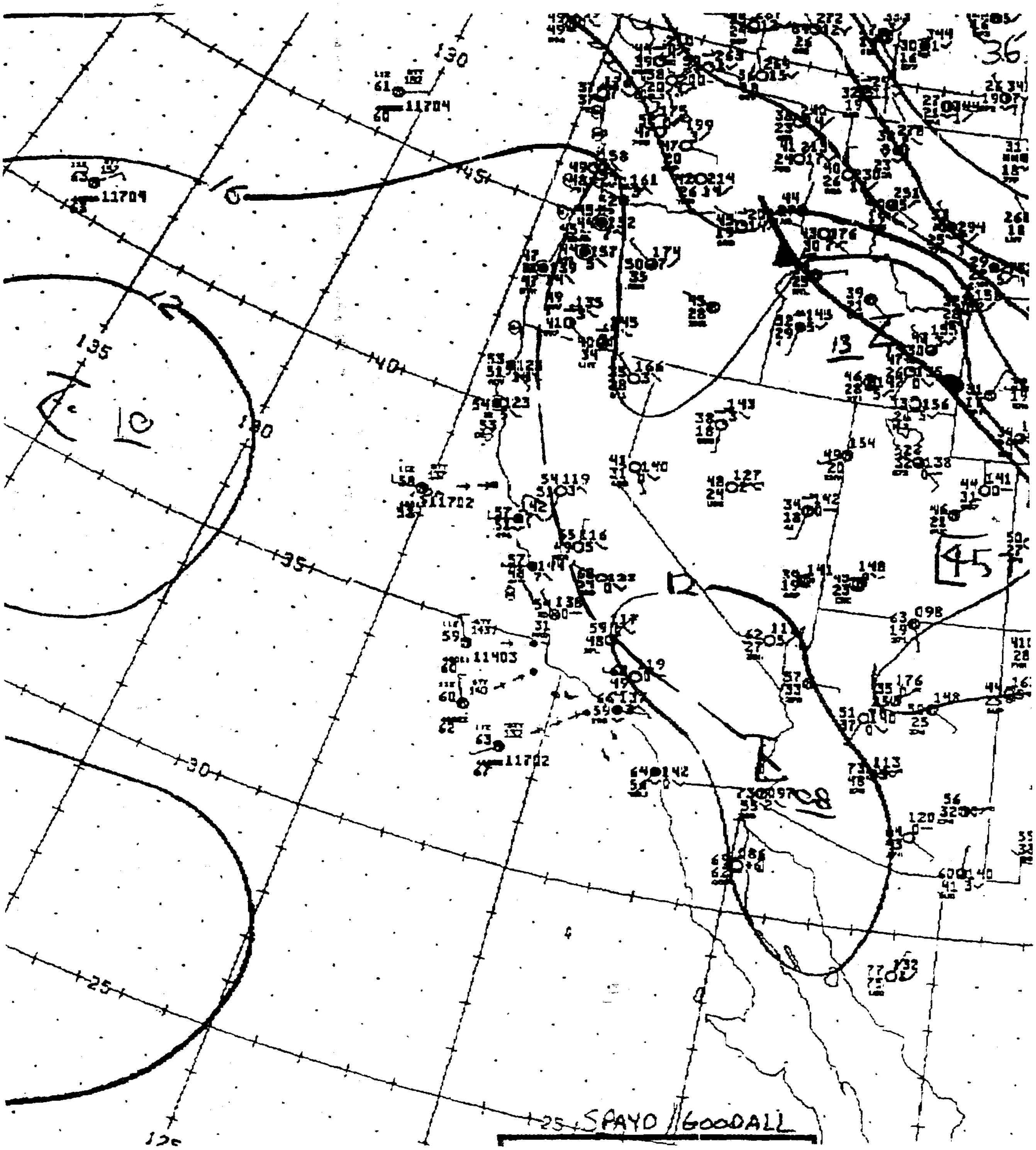

Figure A-35. Surface Weather Map for October 9, 0400 PST

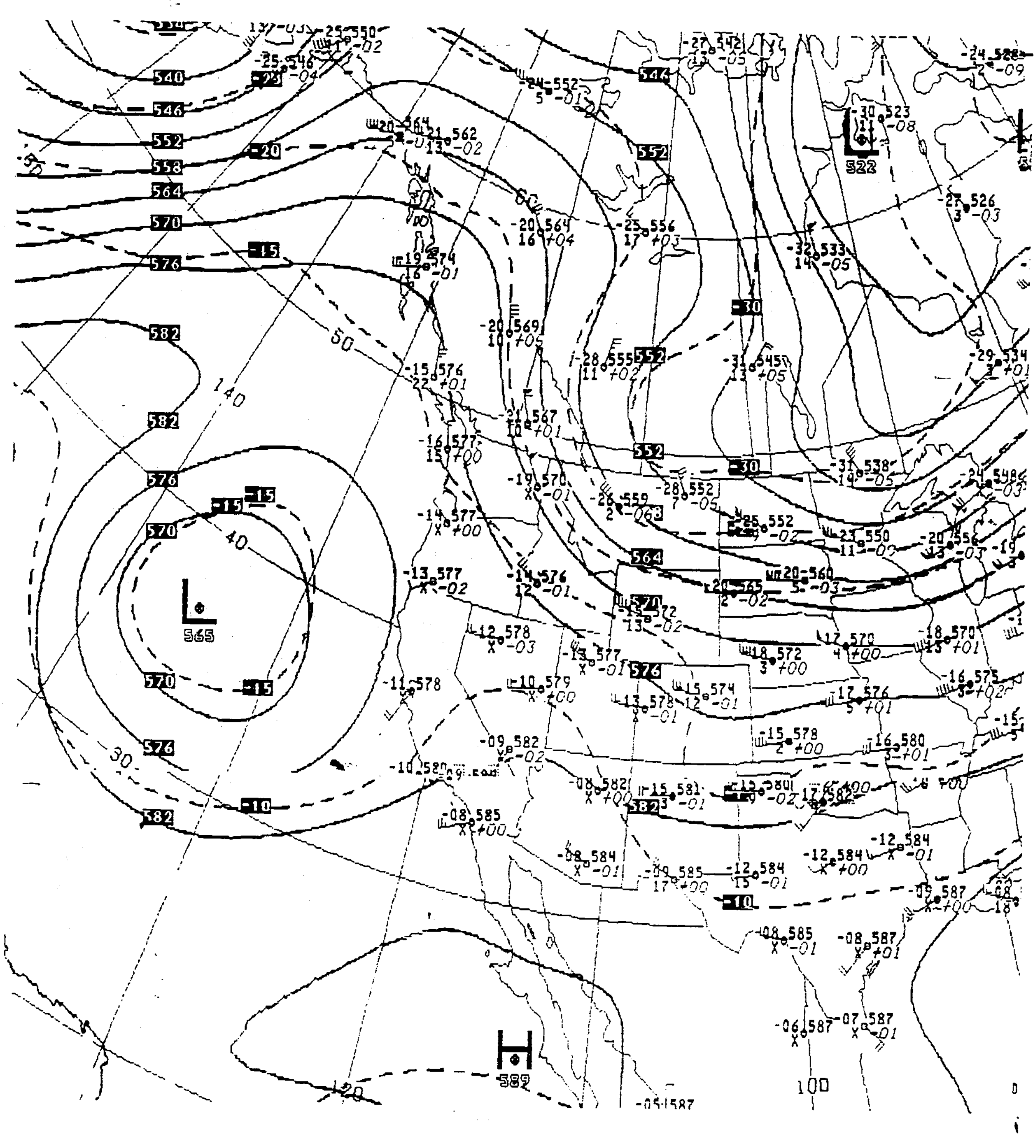

Figure A-36. 500-mb Map for October 9, 0400 PST

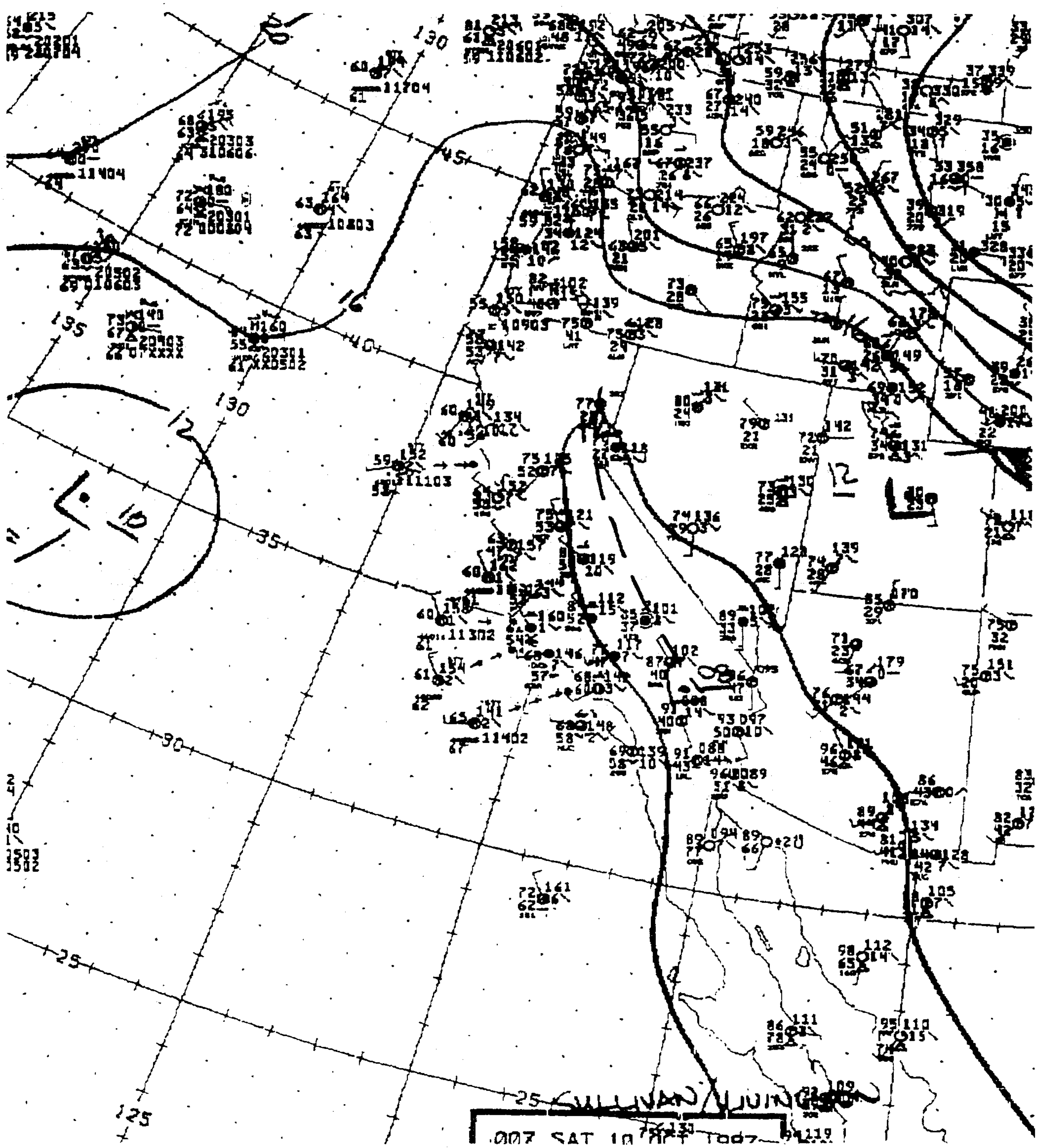

Figure A-37. Surface Weather Map for October 9, 1600 PST

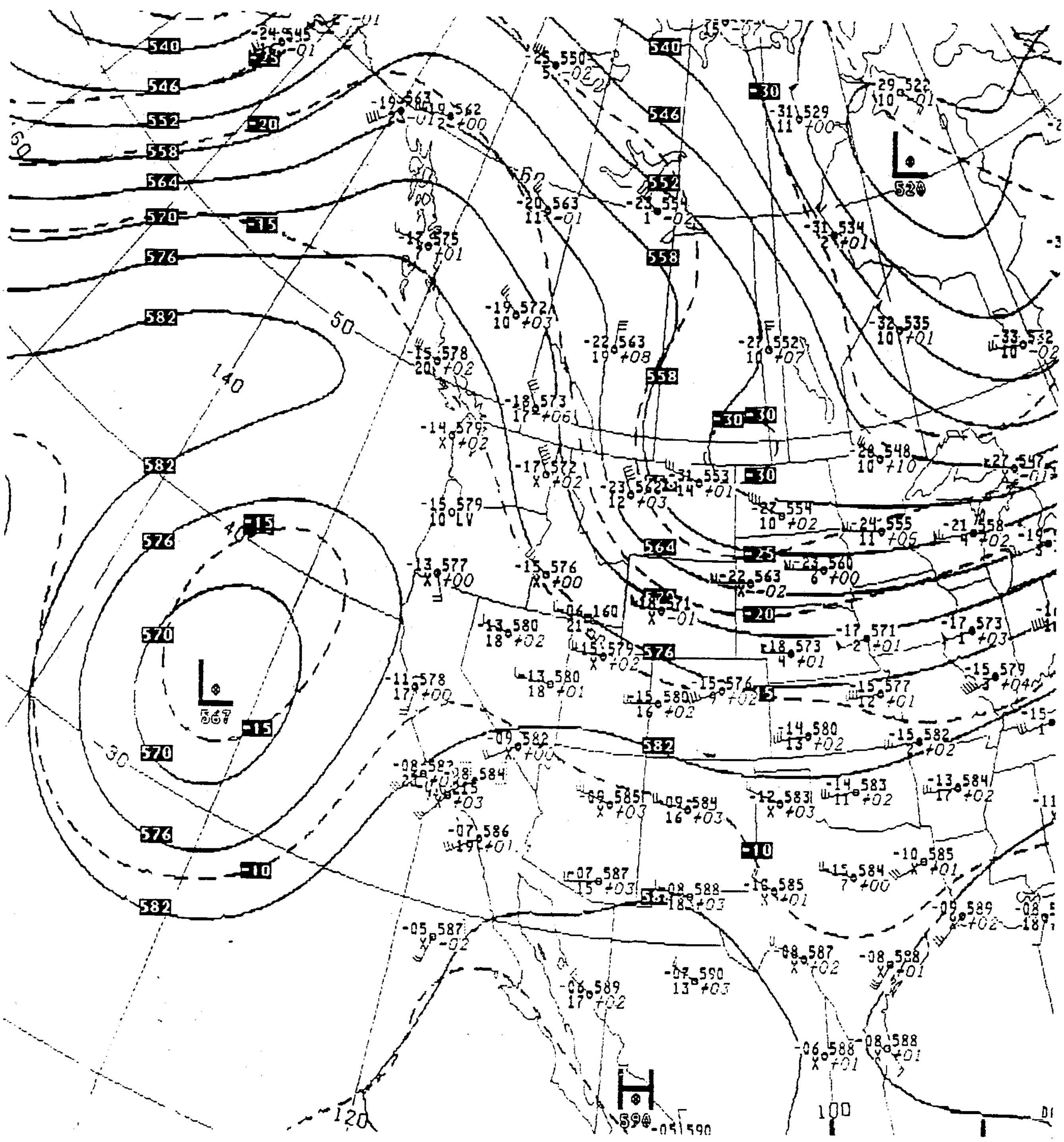

Figure A-38. 500-mb Map for October 9, 1600 PST

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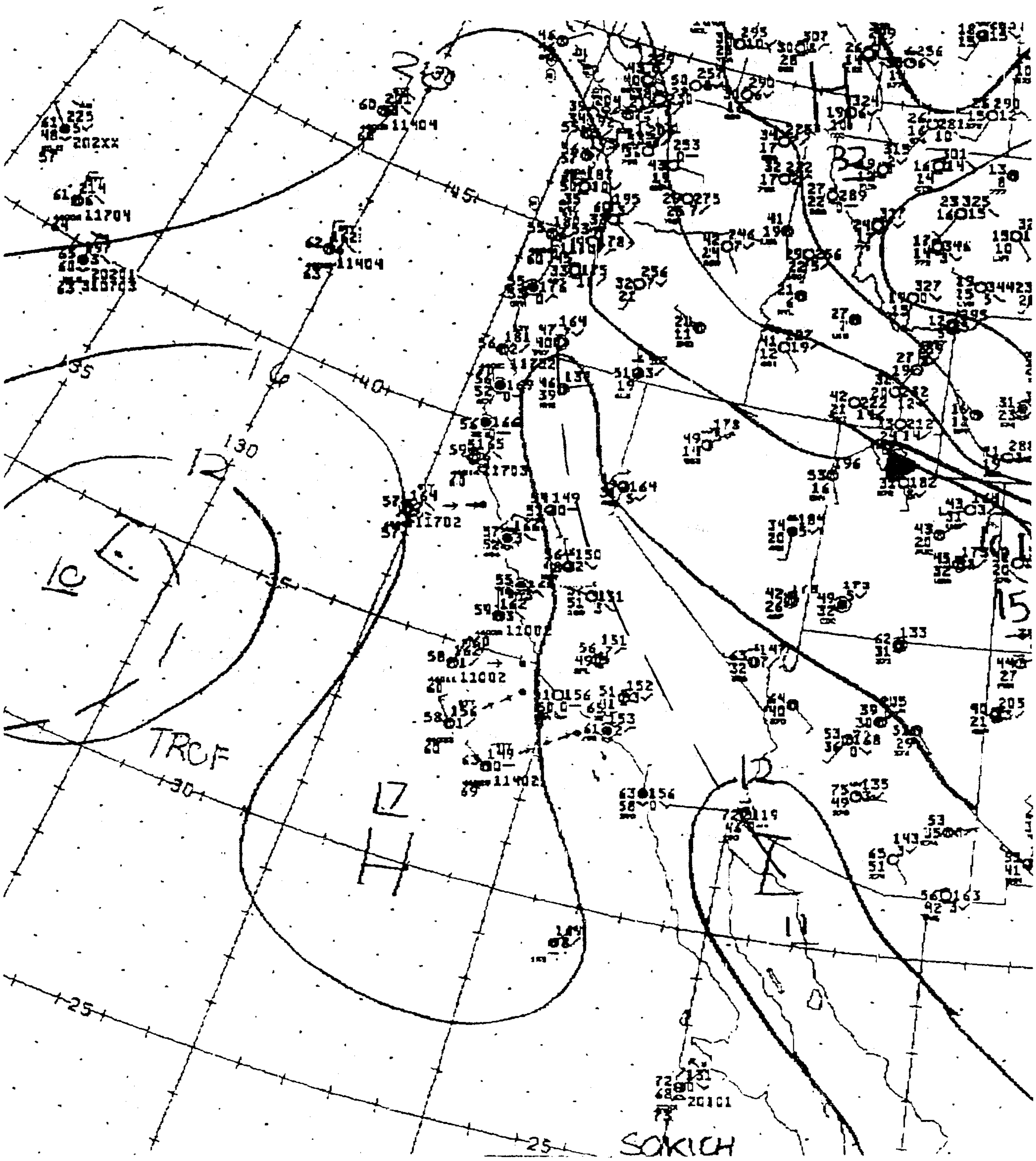

Figure A-39. Surface Weather Map for October 10, 0400 PST

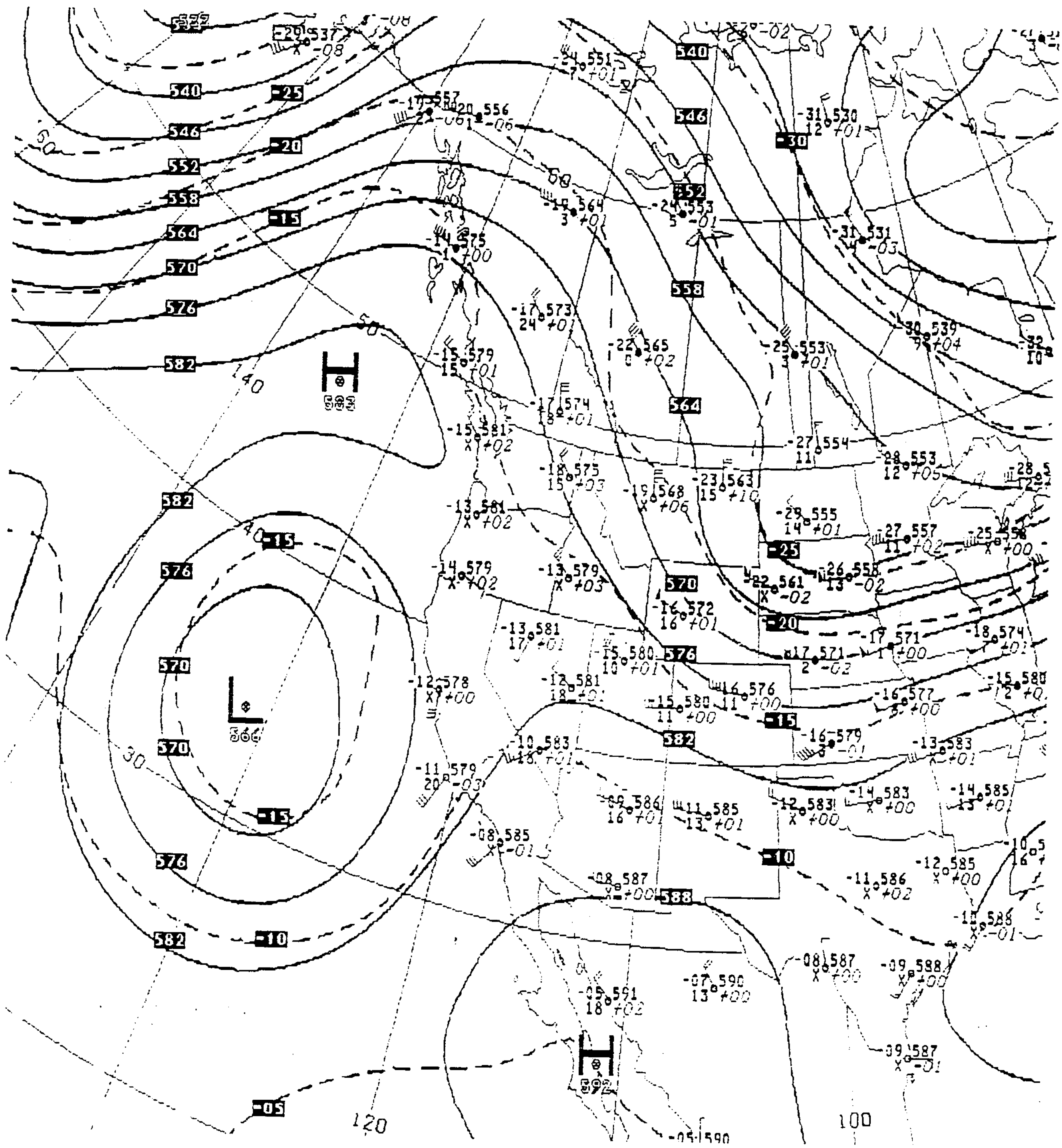

Figure A-40. 500-mb Map for October 10, 0400 PST

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APPENDIX B

Anemometer Calibrations

TABLE B1

TABLE OF CALIBRATED ANEMOMETERS

SITE	RANCH	SERIAL NO.	TUNNEL SPEED (MPH)	ANEMOMETER SPEED (MPH)	(ANEMOMETER/TUNNEL)	DATE INSTALLED
J18A*	JESS	B1	30.86	30.41	0.985	11/11/86
L03	JESS	B2	31.82	31.55	0.992	NA
L10	JESS	B3	31.28	31.14	0.996	NA
L08	JESS	B4	31.16	30.59	0.982	NA
M08	JESS	B5	31.17	31.08	0.997	NA
S29*	SOUZA	B6	31.80	31.38	0.987	9/20/86
NOT INSTALLED		B7	31.77	31.44	0.990	NA
L12	JESS	B8	31.14	30.78	0.988	NA
L05	JESS	N9	31.92	31.48	0.986	NA
S13A*	SOUZA	N10	30.77	30.45	0.990	9/25/86
NOT INSTALLED		N11	31.37	31.20	0.995	NA
J17B*	JESS	N12	31.30	31.04	0.992	9/23/86
S13B*	SOUZA	N13	31.88	31.56	0.990	9/25/86
L04	JESS	N14	31.65	31.46	0.994	NA
NOT INSTALLED		N15	31.52	31.27	0.992	NA
L01	JESS	N16	31.42	31.13	0.991	NA
S27A*	SOUZA	N17	30.96	30.84	0.996	10/14/86
M06	JESS	N18	33.88	34.07	1.006	NA
J08*	JESS	N19	31.68	31.48	0.994	9/18/86
J17B*	JESS	N20	31.82	31.54	0.991	9/23/86
G08	JESS	2	34.32	33.59	0.979	8/24/87
G03	JESS	3	33.80	33.08	0.979	8/24/87
F09	JESS	4	34.17	33.42	0.978	8/23/87
F01	JESS	5	33.96	33.31	0.981	8/23/87
F12	JESS	6	33.81	33.20	0.982	8/23/87
F03	JESS	7	33.74	33.11	0.981	8/23/87
G10	JESS	8	33.97	33.48	0.986	8/24/87
J08*	JESS	9	34.69	34.31	0.989	1/13/88
M09	JESS	10	34.03	33.43	0.982	8/22/87
N06	JESS	11	33.96	33.32	0.981	8/22/87
G03	JESS	12	34.24	33.57	0.980	8/24/87
F05	JESS	13	34.63	33.85	0.977	8/23/87
NOT INSTALLED		14	34.17	33.78	0.989	8/22/87
N04	JESS	15	34.12	33.70	0.988	8/22/87
N08	JESS	16	34.07	33.56	0.985	8/22/87
G12	JESS	17	32.17	31.60	0.982	8/24/87
F07	JESS	18	34.32	33.77	0.984	8/23/87
RETURNED TO SUPPLIER		19	34.66	33.13	0.956	NA
G01	JESS	20	33.77	33.12	0.981	8/23/87
G07	JESS	21	34.05	33.41	0.981	8/24/87
NOT INSTALLED		22	34.01	33.51	0.985	NA
M13	JESS	23	33.72	33.31	0.988	8/22/87
J08	JESS	24	33.92	33.53	0.989	9/29/87
K01	JESS	25	33.27	32.82	0.986	8/20/87
SOLD TO 2ND WIND		26	34.22	33.68	0.984	NA
M02	JESS	27	33.69	33.47	0.993	8/22/87
SOLD TO 2ND WIND		28	34.38	33.82	0.984	NA
M11	JESS	29	33.51	32.73	0.977	8/22/87
SOLD TO 2ND WIND		30	34.89	34.54	0.990	NA
K12	JESS	31	32.29	31.80	0.985	8/22/87
K14	JESS	32	31.84	31.76	0.997	8/21/87
S16*	SOUZA	33	33.97	33.51	0.986	1/22/88

TABLE B1

TABLE OF CALIBRATED ANEMOMETERS

SITE	RANCH	SERIAL NO.	TUNNEL SPEED (MPH)	ANEMOMETER SPEED (MPH)	(ANEMOMETER/TUNNEL)	DATE INSTALLED
K07	JESS	34	33.96	33.78	0.995	8/21/87
K09	JESS	35	33.66	33.13	0.984	8/21/87
J06	JESS	36	34.37	34.08	0.992	9/29/87
NOT INSTALLED		37	34.22	33.57	0.981	NA
K05	JESS	38	33.86	33.37	0.986	8/20/87
J11	JESS	39	33.66	32.99	0.980	9/29/87
NOT INSTALLED		40	30.36	30.23	0.996	NA
K03	JESS	41	34.47	33.64	0.976	8/20/87
SOLD TO 2ND WIND		42	34.17	33.69	0.986	NA
J08*	JESS	RM-02	33.27	33.63	1.011	9/07/87
S13A*	SOUZA	RM-01	32.80	33.24	1.013	9/04/87
GROUP MEAN (MAX #40'S EXCLUDING #19)			33.06	32.62	0.987	1986 AND 1987
STANDARD DEVIATION			1.31	1.20	0.01	ANEMOMETERS
GROUP MEAN (R.M. YOUNGS ONLY)			33.04	33.44	1.012	

* The alphanumeric character denotes a met tower location rather than a turbine location.

APPENDIX C

Hourly Data Listing

HOURLY DATA LISTING

DOE FREE FLOW DATA - SOUZA RANCH

ID	UNITS	DESCRIPTION
WS13	MPH	SITE S-13 70-ft reference
WS12	MPH	SITE S-13 35-ft
WS27	MPH	SITE S-27 80-ft reference
WS26	MPH	SITE S-27 45-ft
WD13	DEG	SITE S-13 70-ft
WS29	MPH	SITE S-29 50-ft
WSD2	MPH	TURBINE D2 35-ft
WSD4	MPH	TURBINE D4 35-ft
WSD6	MPH	TURBINE D6 35-ft
WSD7	MPH	TURBINE D7 35-ft
WSD1	MPH	TURBINE D11 35-ft
WSD3	MPH	TURBINE D13 35-ft
WSE2	MPH	TURBINE E2 35-ft
WSE4	MPH	TURBINE E4 35-ft
WSE6	MPH	TURBINE E6 35-ft

NOTES:
VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN.
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA - SOUZA RANCH

YY/MM/DD	HR	WS13 MPH	WS12 MPH	WS27 MPH	WS26 MPH	WD13 DEG	WS29 MPH	WSD2 MPH	WSD4 MPH	WSD6 MPH	WSD7 MPH	WSD1 MPH	WSD3 MPH	WSE2 MPH	WSE4 MPH	WSE6 MPH
87/09/10	17	22.4	21.5	21.0	21.4	226.4	21.1	21.6	21.8	21.3	21.9	24.8	25.2	23.2	22.2	22.9
87/09/10	18	23.1	21.9	21.1	21.1	225.9	21.6	21.2	21.4	20.7	21.2	24.5	24.7	22.6	21.7	22.5
87/09/10	19	26.5	24.5	21.9	21.7	233.9	22.7	22.9	21.7	22.1	22.0	25.8	26.8	25.7	24.1	24.2
87/09/10	20	35.3	33.4	29.1	29.0	233.7	30.8	30.2	29.8	29.1	29.6	34.8	34.2	32.9	31.3	32.8
87/09/10	21	36.1	34.9	35.8	35.9	228.3	36.5	34.8	36.8	34.7	33.7	41.4	39.6	33.8	31.3	32.7
87/09/10	22	38.4	37.1	38.0	38.2	229.7	37.0	36.8	37.1	34.1	35.5	41.1	38.8	36.2	34.3	35.6
87/09/10	23	35.4	34.3	36.0	36.2	227.3	34.8	33.6	34.1	32.1	34.1	38.3	37.1	34.9	33.2	34.4
87/09/10	24	34.6	33.4	33.3	33.8	227.8	31.6	31.3	32.5	32.5	31.4	37.3	37.5	33.5	32.1	33.8
87/09/11	01	32.5	31.3	31.5	32.1	225.9	31.4	33.4	32.0	32.4	33.8	36.3	39.4	36.6	31.6	32.0
87/09/11	02	31.4	30.4	31.7	31.9	225.9	29.5	31.9	30.4	33.7	32.6	36.3	39.3	33.7	30.4	32.7
87/09/11	03	27.0	26.3	28.0	28.1	225.0	26.1	28.6	26.6	28.3	28.6	30.7	34.6	32.5	27.8	26.7
87/09/11	04	26.9	26.2	26.8	26.8	229.2	24.5	25.0	25.1	27.8	25.8	30.6	32.2	28.1	24.0	25.3
87/09/11	05	29.3	28.3	28.6	28.7	228.3	27.3	26.9	28.0	29.3	27.1	32.9	34.1	29.9	26.2	27.6
87/09/11	06	30.5	30.0	29.2	29.3	224.5	27.5	28.8	28.5	30.3	29.2	33.6	35.4	31.2	27.1	28.4
87/09/11	07	29.7	28.9	28.6	28.8	223.6	27.7	30.9	28.3	30.3	31.3	33.2	36.3	34.8	30.0	29.4
87/09/11	08	29.4	28.6	27.5	27.7	227.1	26.6	27.8	27.3	28.9	28.9	32.5	34.3	31.4	28.4	29.2
87/09/11	09	28.6	27.6	27.5	28.0	225.0	26.4	26.9	27.8	28.5	27.4	32.3	34.0	32.7	28.6	29.3
87/09/11	10	26.8	25.8	26.2	26.5	225.5	25.6	25.6	25.6	25.2	25.0	29.1	29.1	28.1	26.5	26.9
87/09/11	11	21.9	20.9	21.5	21.9	225.0	21.3	21.3	21.7	21.9	21.2	24.6	24.8	23.2	21.4	21.8
87/09/11	12	23.1	21.8	19.2	19.3	226.9	20.1	19.9	19.6	19.1	19.3	22.3	23.0	22.8	21.5	22.7
87/09/11	13	25.1	24.1	23.1	23.1	223.6	23.1	23.4	22.6	21.8	22.6	25.6	26.1	25.1	23.7	23.8
87/09/11	14	23.3	22.1	21.0	21.3	221.7	21.9	22.0	21.4	20.4	21.2	24.3	24.1	23.4	22.0	22.0
87/09/11	15	24.2	23.1	22.7	22.7	226.4	23.6	23.7	22.5	21.9	22.5	25.8	26.2	25.3	23.7	24.4
87/09/11	16	24.1	23.1	22.2	22.2	224.5	23.5	23.5	22.9	22.0	22.5	26.0	26.3	25.0	23.5	24.0
87/09/11	17	22.6	21.5	23.3	23.1	225.0	23.9	24.0	23.0	22.6	22.9	26.5	26.6	24.9	22.5	23.4
87/09/11	18	27.7	26.4	27.3	27.0	226.4	28.1	28.8	26.8	25.1	27.3	30.0	28.8	27.1	25.6	26.0
87/09/11	19	33.5	31.9	30.3	29.8	232.5	31.3	30.9	30.3	29.2	29.7	34.7	34.5	32.8	30.6	31.0
87/09/11	20	38.0	36.4	34.6	33.7	230.6	35.9	36.3	33.7	32.3	34.4	38.9	38.5	36.9	34.8	36.0
87/09/11	21	37.8	36.3	35.3	34.6	234.8	35.5	35.4	34.0	32.1	33.9	38.5	37.2	34.9	32.4	33.4
87/09/11	22	36.8	35.1	36.9	36.5	230.2	38.4	38.2	36.7	34.8	36.0	42.0	39.2	35.9	33.1	34.0
87/09/11	23	35.7	34.2	33.3	33.2	229.2	33.9	33.1	32.7	32.1	31.3	37.9	38.0	35.5	31.7	32.3
87/09/11	24	34.0	32.5	31.3	30.7	233.0	31.6	30.6	30.7	30.5	30.1	35.9	35.4	32.4	30.2	30.5

DOE FREE FLOW DATA - SOUZA RANCH

YY/MM/DD	HR	WS13 MPH	WS12 MPH	WS27 MPH	WS26 MPH	WD13 DEG	WS29 MPH	WSD2 MPH	WSD4 MPH	WSD6 MPH	WSD7 MPH	WSD1 MPH	WSD3 MPH	WSE2 MPH	WSE4 MPH	WSE6 MPH
87/09/12	01	29.4	28.1	27.1	27.4	225.9	28.3	28.3	28.2	27.0	28.2	32.2	32.6	29.6	27.4	26.7
87/09/12	02	27.4	26.3	26.7	27.0	220.8	27.5	27.9	27.4	26.9	28.0	31.4	32.6	30.4	26.9	27.0
87/09/12	03	26.8	25.8	26.8	26.7	225.5	27.4	26.8	26.9	26.0	26.1	31.1	30.7	27.8	26.9	26.4
87/09/12	04	26.3	25.2	27.4	27.4	226.9	27.7	26.4	27.8	27.1	26.0	32.2	32.0	28.8	25.8	26.0
87/09/12	05	26.8	25.9	27.1	27.4	220.3	27.5	26.6	27.8	27.4	27.1	31.9	32.9	31.8	28.8	27.2
87/09/12	06	27.5	26.4	25.9	26.0	218.4	26.1	26.0	26.3	26.8	27.0	30.8	32.1	31.2	28.1	27.5
87/09/12	07	24.5	23.5	22.9	23.0	226.6	23.3	23.3	23.1	23.5	23.6	26.9	28.0	25.7	22.9	23.2
87/09/12	08	25.2	24.2	24.1	24.2	222.7	24.1	24.1	24.4	25.0	24.7	28.9	29.7	27.8	24.9	25.0
87/09/12	09	26.4	25.2	25.1	24.9	227.3	25.8	25.8	24.6	24.7	24.4	29.0	29.3	27.6	25.2	25.4
87/09/12	10	24.6	23.7	23.7	23.6	222.2	24.2	24.1	23.4	23.2	23.0	26.9	27.2	25.9	24.4	24.9
87/09/12	11	23.1	22.2	22.6	22.7	225.5	22.8	23.2	22.1	21.5	22.0	25.3	25.3	23.9	22.4	23.3
87/09/12	12	19.8	19.3	18.9	19.3	219.4	19.4	19.4	19.2	18.9	18.9	21.6	22.4	20.9	19.6	20.3
87/09/12	13	20.6	20.2	18.8	19.1	214.7	19.4	19.4	19.6	19.5	18.9	22.1	22.7	21.2	19.4	19.8
87/09/12	14	23.1	22.7	21.1	21.3	219.8	21.6	21.7	21.3	21.1	21.1	24.4	24.9	23.4	22.1	22.8
87/09/12	15	23.6	21.6	21.5	21.3	232.0	22.1	22.2	21.0	19.8	21.0	24.0	23.5	22.9	21.2	21.5
87/09/12	16	25.2	23.3	22.5	22.6	234.4	23.6	23.8	22.7	21.5	22.0	25.7	25.4	25.6	23.1	23.3
87/09/12	17	26.7	24.9	22.8	22.6	229.2	23.8	23.8	23.0	22.3	22.4	26.4	26.8	26.9	24.6	25.1
87/09/12	18	28.3	26.3	23.2	23.3	232.7	25.5	25.4	25.0	24.1	23.9	28.4	28.5	27.6	25.5	26.0
87/09/12	19	30.6	28.5	26.3	25.9	233.4	27.8	28.0	26.6	25.7	26.1	30.4	30.7	30.0	27.9	28.4
87/09/12	20	35.6	33.6	30.6	29.6	235.3	32.1	32.3	30.4	29.1	30.1	35.0	34.9	34.4	32.3	33.3
87/09/12	21	40.4	38.4	35.2	34.1	231.6	35.4	35.9	32.8	31.7	34.5	38.4	38.1	38.0	35.6	36.3
87/09/12	22	33.2	31.8	29.3	29.0	224.1	29.6	30.7	29.2	28.4	30.6	33.2	33.7	33.3	31.3	30.6
87/09/12	23	28.0	26.8	26.0	26.2	218.9	26.7	27.7	26.8	26.4	27.5	30.8	31.1	29.7	28.0	27.3
87/09/12	24	31.1	29.4	28.3	27.9	226.9	29.5	29.1	27.7	26.9	28.2	32.4	32.3	30.6	28.7	28.5
87/09/13	01	31.2	29.4	29.3	29.0	230.2	30.0	29.8	28.6	27.7	29.1	33.0	33.6	32.2	29.9	29.0
87/09/13	02	28.9	27.9	28.5	28.6	220.3	29.3	28.9	29.0	29.8	28.7	34.1	35.6	31.9	28.5	27.9
87/09/13	03	28.5	27.6	25.0	25.3	215.6	25.8	27.1	26.2	26.7	27.3	30.5	32.2	31.7	30.5	28.3
87/09/13	04	23.6	22.8	22.2	22.3	219.4	22.7	23.5	22.7	23.6	23.8	26.7	28.4	26.9	25.1	24.0
87/09/13	05	23.4	22.6	21.9	21.8	216.1	22.3	23.2	22.7	23.6	23.0	26.6	28.2	26.6	24.9	22.6
87/09/13	06	22.4	21.3	21.6	21.4	221.7	22.2	22.6	22.2	20.8	22.3	25.3	24.5	23.7	22.9	22.3
87/09/13	07	20.9	19.7	20.8	20.3	222.2	20.6	20.9	20.5	19.5	21.0	23.3	23.7	22.0	20.2	20.1
87/09/13	08	21.0	19.8	19.9	19.7	224.1	20.1	19.6	19.9	18.8	19.3	22.3	22.4	21.2	19.4	19.1
87/09/13	09	19.6	18.5	18.8	18.8	221.7	19.5	19.3	19.2	19.2	18.9	22.1	22.7	20.8	19.0	19.0
87/09/13	10	19.2	18.2	17.2	17.1	226.0	18.3	18.2	17.5	17.0	17.5	20.0	20.3	18.8	17.6	18.5
87/09/13	11	15.3	14.1	14.6	14.7	235.9	15.6	15.5	14.5	13.8	14.5	16.8	16.8	15.5	14.3	14.6
87/09/13	12	14.8	13.4	14.8	14.9	242.2	15.4	15.3	14.1	13.5	14.0	16.3	16.1	15.0	14.0	14.1
87/09/13	13	13.1	12.1	14.1	14.0	237.3	14.9	14.7	13.3	12.3	13.3	15.1	14.9	13.4	12.3	12.5
87/09/13	14	12.9	12.0	13.5	13.6	250.8	14.6	13.8	12.6	12.0	12.4	14.6	14.1	13.1	12.0	12.5
87/09/13	15	13.9	12.7	14.5	14.6	252.2	15.7	14.8	13.8	13.0	13.4	15.7	15.2	14.0	13.1	13.4
87/09/13	16	12.9	12.1	14.3	14.4	250.4	16.9	15.9	14.7	13.8	14.6	16.6	15.8	13.9	13.1	13.2
87/09/13	17	13.7	12.2	13.7	13.7	245.5	16.1	15.0	14.2	13.1	13.6	15.5	15.0	13.4	12.9	13.3
87/09/13	18	20.0	18.2	17.8	18.0	232.0	19.1	18.4	18.2	17.2	17.3	20.4	20.4	19.8	17.9	17.9
87/09/13	19	19.9	18.7	18.0	18.2	223.6	19.0	19.5	19.3	18.1	19.7	21.8	21.4	19.9	18.3	17.9
87/09/13	20	22.3	21.3	21.1	21.0	219.4	20.5	21.3	21.3	22.1	21.5	24.6	25.8	23.4	21.4	19.9
87/09/13	21	23.6	22.5	23.6	23.4	222.2	22.4	22.7	23.1	23.7	22.9	26.8	27.7	25.1	21.9	21.0
87/09/13	22	21.1	20.0	21.7	22.1	224.1	21.4	21.9	22.6	23.5	22.4	26.3	27.8	25.5	22.7	21.7
87/09/13	23	23.8	22.1	21.5	21.3	226.4	22.1	21.6	21.6	21.3	21.4	25.1	26.2	24.2	22.1	22.2
87/09/13	24	25.5	23.3	20.4	20.3	230.2	21.8	22.0	20.8	20.5	21.3	24.7	24.9	23.4	22.0	22.9

DOE FREE FLOW DATA - SOUZA RANCH

YY/MM/DD	HR	WS13 MPH	WS12 MPH	WS27 MPH	WS26 MPH	WD13 DEG	WS29 MPH	WSD2 MPH	WSD4 MPH	WSD6 MPH	WSD7 MPH	WSD1 MPH	WSD3 MPH	WSE2 MPH	WSE4 MPH	WSE6 MPH
87/09/14	01	25.0	23.4	23.6	23.5	224.5	24.5	24.5	24.1	23.6	24.5	27.9	27.8	24.6	22.9	22.3
87/09/14	02	20.1	19.3	19.9	19.9	211.9	20.8	20.8	21.1	20.3	21.2	24.2	24.3	22.1	20.4	19.9
87/09/14	03	19.7	18.5	18.4	18.2	224.1	19.2	19.5	18.6	18.3	18.9	21.8	22.3	20.5	18.9	18.8
87/09/14	04	21.4	20.1	20.5	20.2	227.8	20.7	20.7	20.1	19.5	20.7	23.1	23.1	21.2	19.3	20.1
87/09/14	05	18.8	17.7	19.6	19.3	222.7	20.0	19.3	19.6	19.5	19.3	22.8	23.2	20.8	18.7	18.8
87/09/14	06	19.0	18.0	19.2	18.8	225.2	19.4	19.3	18.6	17.9	19.3	21.5	21.2	18.8	17.8	18.1
87/09/14	07	19.9	18.4	17.0	16.5	231.1	17.7	17.8	16.8	16.2	16.9	19.4	19.9	18.9	17.6	17.9
87/09/14	08	19.3	17.7	16.3	15.8	229.7	16.7	16.8	15.8	14.8	16.3	17.9	17.9	17.4	16.2	16.7
87/09/14	09	18.9	17.4	17.2	17.1	231.6	17.7	17.7	16.9	16.3	17.2	19.4	19.5	18.8	17.5	18.1
87/09/14	10	19.7	17.9	17.4	17.5	234.4	18.2	18.2	17.2	16.1	17.1	19.3	19.8	19.1	17.9	18.1
87/09/14	11	18.1	17.0	16.6	16.7	228.3	16.9	17.1	16.8	15.6	16.3	18.3	18.6	17.9	16.9	17.6
87/09/14	12	15.7	15.3	14.3	14.6	219.8	14.3	14.6	14.1	14.0	13.9	15.8	16.3	15.7	14.6	15.3
87/09/14	13	14.4	13.9	13.7	14.0	220.3	13.9	13.9	13.7	13.0	13.1	15.2	15.2	14.9	13.6	13.8
87/09/14	14	15.9	15.0	15.4	15.5	230.6	15.9	16.2	15.3	14.8	15.4	17.2	17.5	16.4	15.3	15.5

HOURLY DATA LISTING

DOE FREE FLOW DATA - SOUZA RANCH

ID	UNITS	DESCRIPTION
WSE0	MPH	TURBINE E10 35-ft
WSE1	MPH	TURBINE E12 35-ft
WSE3	MPH	TURBINE E14 35-ft
WSF2	MPH	TURBINE F2 35-ft
WSF4	MPH	TURBINE F4 35-ft
WSF6	MPH	TURBINE F6 35-ft
WSF8	MPH	TURBINE F8 35-ft
WSF0	MPH	TURBINE F10 35-ft
WSF1	MPH	TURBINE F12 35-ft
WSF3	MPH	TURBINE F14 35-ft
WSG2	MPH	TURBINE G2 35-ft
WSG4	MPH	TURBINE G4 35-ft
WSG7	MPH	TURBINE G7 35-ft
WSG9	MPH	TURBINE G9 35-ft

NOTES:
VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN.
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA - SOUZA RANCH

YY/MM/DD	HR	WSE0 MPH	WBE1 MPH	WSE3 MPH	WSF2 MPH	WSF4 MPH	WSF6 MPH	WSF8 MPH	WSF0 MPH	WSF1 MPH	WSF3 MPH	WSQ2 MPH	WSQ4 MPH	WSQ7 MPH	WSQ9 MPH
87/09/10	17	22.7	21.1	21.4	23.7	24.6	26.3	25.6	22.7	23.6	21.8	24.4	22.4	21.0	17.8
87/09/10	18	21.9	20.4	21.2	22.8	24.3	25.8	24.5	22.5	23.9	22.0	23.7	22.6	21.2	18.0
87/09/10	19	23.6	23.0	23.6	26.6	28.0	29.1	26.9	25.3	25.7	24.7	26.8	24.8	21.7	18.3
87/09/10	20	30.6	29.3	30.5	33.7	35.2	37.6	36.2	34.5	36.1	34.8	36.6	34.1	31.1	25.8
87/09/10	21	34.3	31.0	30.0	34.3	34.8	37.1	36.3	35.5	37.9	36.2	36.6	35.9	34.0	27.8
87/09/10	22	34.7	32.5	32.6	36.8	38.5	40.9	39.7	37.8	40.2	39.4	39.7	38.3	37.3	31.6
87/09/10	23	33.1	31.0	32.1	36.1	37.9	40.3	37.6	35.0	37.8	36.2	36.4	35.3	33.7	28.4
87/09/10	24	34.0	30.1	30.7	34.7	36.1	39.2	37.2	34.0	36.7	36.4	35.5	34.5	33.9	29.8
87/09/11	01	37.3	33.5	31.4	38.1	33.8	36.1	37.8	33.7	35.1	34.1	35.7	32.5	30.9	26.1
87/09/11	02	35.9	30.8	29.2	35.4	33.8	37.7	36.6	32.3	33.8	33.9	34.2	31.5	31.8	27.8
87/09/11	03	32.7	28.9	27.7	34.6	30.9	31.4	30.8	26.9	28.0	28.7	29.0	27.1	28.2	24.9
87/09/11	04	29.3	25.9	23.6	29.7	27.3	30.1	27.3	25.3	27.9	28.2	26.5	26.9	27.7	23.8
87/09/11	05	30.7	27.5	25.5	31.1	28.9	32.0	30.5	27.3	29.9	30.7	28.8	29.0	29.8	25.3
87/09/11	06	32.3	28.6	26.1	32.7	29.9	33.2	32.3	29.2	31.6	32.6	30.8	30.8	31.9	28.1
87/09/11	07	33.5	31.7	29.7	35.9	32.4	34.0	34.8	30.0	31.1	32.0	32.3	29.9	30.8	28.0
87/09/11	08	31.3	28.9	27.4	32.3	31.1	33.8	33.0	29.1	30.5	31.0	31.0	29.4	30.1	26.8
87/09/11	09	31.4	29.7	27.8	33.7	31.2	33.6	33.4	29.3	29.8	28.8	31.6	28.6	27.1	23.4
87/09/11	10	26.8	25.2	25.5	28.7	29.6	31.1	29.9	27.0	27.9	26.3	28.8	26.6	24.9	21.4
87/09/11	11	23.3	21.0	20.7	24.3	24.2	25.3	24.3	22.2	22.8	20.9	23.9	21.6	20.2	16.9
87/09/11	12	20.6	20.3	21.3	23.9	24.9	26.5	24.8	22.7	23.2	21.0	24.7	22.4	20.2	16.1
87/09/11	13	23.4	22.4	23.0	25.9	26.9	28.3	26.8	24.6	24.5	23.0	26.7	24.8	23.0	18.6
87/09/11	14	22.1	20.9	21.2	24.4	25.0	26.4	24.9	22.8	23.1	21.6	24.6	22.8	21.0	17.2
87/09/11	15	23.6	22.5	22.9	26.2	27.2	28.8	27.1	24.2	24.5	22.2	26.5	23.9	21.4	17.2
87/09/11	16	23.5	22.5	22.7	25.7	26.6	27.8	26.5	23.9	24.8	23.3	25.9	23.8	22.3	19.2
87/09/11	17	24.1	22.6	21.5	25.5	25.4	27.1	26.2	22.4	22.1	20.5	25.1	22.2	20.3	16.9
87/09/11	18	26.5	24.4	24.7	27.8	28.4	30.5	29.5	27.2	27.8	25.9	29.4	27.2	25.0	20.6
87/09/11	19	30.6	29.5	29.9	33.1	33.9	36.6	35.0	33.0	33.5	33.0	35.2	32.6	30.4	25.4
87/09/11	20	34.7	33.1	34.1	37.0	39.0	41.7	40.0	37.8	38.8	37.1	40.1	37.3	34.1	27.7
87/09/11	21	34.0	31.2	31.2	35.4	36.9	39.3	38.2	36.8	37.7	36.3	39.1	37.0	33.4	26.8
87/09/11	22	36.3	32.6	31.5	36.8	37.7	40.1	37.9	36.0	37.7	36.5	38.2	35.9	33.3	27.2
87/09/11	23	34.5	32.1	30.2	36.4	36.3	38.2	36.2	34.9	35.8	34.6	36.8	35.1	32.3	26.2
87/09/11	24	31.3	29.2	28.9	32.5	34.5	35.5	34.2	32.7	34.9	33.5	34.5	33.3	32.0	26.5

DOE FREE FLOW DATA - SOUZA RANCH

YY/MM/DD	HR	WSE0 MPH	WSE1 MPH	WSE3 MPH	WSF2 MPH	WSF4 MPH	WSF6 MPH	WSF8 MPH	WSF0 MPH	WSF1 MPH	WSF3 MPH	WSG2 MPH	WSG4 MPH	WSG7 MPH	WSG9 MPH
87/09/12	01	29.5	27.5	26.7	29.0	29.1	30.2	30.1	28.5	30.2	29.5	30.2	28.9	28.4	24.8
87/09/12	02	29.4	28.2	26.1	30.4	29.0	30.7	30.2	27.6	28.6	27.5	29.5	27.2	25.7	22.3
87/09/12	03	27.4	25.2	26.1	27.6	29.0	30.1	28.7	26.5	28.1	27.2	27.8	26.6	25.9	22.5
87/09/12	04	28.5	26.9	24.9	29.1	27.9	29.8	28.8	26.0	27.6	26.9	27.5	26.0	25.4	22.1
87/09/12	05	29.6	28.8	28.1	31.7	30.8	30.6	29.7	27.0	28.3	27.2	28.9	26.9	25.4	22.7
87/09/12	06	29.3	28.4	27.1	31.4	30.3	31.1	30.8	27.5	28.7	27.3	29.4	27.3	25.7	22.4
87/09/12	07	25.3	23.8	22.3	26.0	25.0	26.3	25.9	23.8	25.3	24.0	25.3	24.1	23.3	19.9
87/09/12	08	26.7	25.3	24.5	28.2	27.0	28.6	27.8	25.1	26.4	24.6	26.7	25.0	23.6	20.4
87/09/12	09	26.2	25.0	24.5	28.1	28.7	29.7	27.5	25.9	27.5	25.4	27.2	25.9	24.0	19.8
87/09/12	10	24.5	23.5	23.6	26.5	27.1	28.6	27.4	24.7	25.4	23.8	26.8	24.4	22.4	19.0
87/09/12	11	23.0	21.6	21.8	24.7	25.6	27.1	26.0	23.5	24.1	21.9	25.3	23.0	20.7	17.2
87/09/12	12	20.3	19.0	18.9	21.7	22.2	23.4	22.6	20.1	20.4	18.6	22.1	20.0	17.7	14.9
87/09/12	13	20.6	19.1	18.6	21.4	21.5	23.0	22.7	20.5	20.9	19.9	22.5	20.9	19.1	16.2
87/09/12	14	22.1	21.4	21.3	23.9	24.7	26.2	25.7	23.2	24.0	22.3	25.5	23.6	21.4	17.2
87/09/12	15	21.3	20.1	20.5	24.7	25.3	26.5	24.4	22.2	22.4	21.8	24.6	22.0	19.5	16.2
87/09/12	16	23.6	22.1	22.2	27.5	28.0	28.5	26.1	24.1	24.1	22.6	26.3	23.9	21.1	16.5
87/09/12	17	24.3	23.4	23.7	28.2	29.3	30.1	27.5	25.7	25.5	24.0	27.5	25.5	22.1	17.5
87/09/12	18	26.0	24.6	25.2	29.0	29.3	30.7	29.0	27.3	27.6	27.0	29.3	26.8	23.9	19.5
87/09/12	19	27.9	26.5	27.6	30.8	31.9	33.7	31.8	30.0	29.6	29.2	32.2	29.0	25.4	20.8
87/09/12	20	32.0	30.5	32.3	35.1	36.5	39.4	37.8	35.3	33.6	32.5	37.9	34.2	27.6	21.6
87/09/12	21	34.2	33.8	34.5	37.7	40.7	42.5	40.4	39.3	40.7	37.6	41.3	39.4	36.4	26.4
87/09/12	22	30.9	29.9	30.1	32.9	34.3	34.7	34.1	32.5	33.8	32.0	34.8	32.8	30.8	25.8
87/09/12	23	28.8	27.1	26.5	29.2	30.0	31.4	29.7	27.0	27.9	27.4	29.2	27.6	26.4	22.1
87/09/12	24	28.5	27.6	27.5	31.0	32.4	33.4	31.5	29.9	31.3	29.9	31.7	30.1	27.9	22.9
87/09/13	01	29.5	29.1	28.8	32.0	33.4	33.9	31.6	30.0	31.8	29.7	31.6	30.3	28.2	22.4
87/09/13	02	31.7	29.5	27.8	31.9	30.5	31.7	31.8	29.1	30.2	28.6	31.2	29.0	27.1	23.5
87/09/13	03	29.7	28.4	29.3	30.9	32.4	31.7	30.6	28.0	29.0	28.4	30.0	28.6	26.8	22.7
87/09/13	04	25.7	24.7	24.1	26.5	26.9	27.1	26.3	23.6	24.1	22.8	25.7	23.7	21.7	18.3
87/09/13	05	26.1	24.3	24.0	26.1	25.6	25.1	25.2	23.0	24.1	23.1	25.2	23.5	21.7	19.1
87/09/13	06	22.3	21.9	22.0	23.3	24.7	25.0	23.6	21.9	22.9	21.6	23.2	21.9	21.0	18.0
87/09/13	07	21.3	20.0	19.5	21.8	22.0	23.0	22.5	20.3	21.2	19.9	22.0	20.3	19.8	17.1
87/09/13	08	20.2	19.2	18.6	21.2	21.4	22.1	21.2	20.1	21.3	19.8	21.2	20.4	19.6	16.8
87/09/13	09	20.4	19.1	18.5	20.7	20.8	21.4	21.2	19.3	19.9	18.4	20.8	19.1	17.7	15.1
87/09/13	10	18.0	17.0	17.0	19.3	19.8	21.5	20.8	18.8	19.3	17.1	20.4	18.8	16.9	13.4
87/09/13	11	14.5	13.6	14.2	16.9	17.1	17.5	16.4	14.7	14.2	14.1	16.1	14.4	12.1	10.1
87/09/13	12	13.4	13.1	13.8	16.9	17.1	17.4	15.9	14.5	14.4	14.3	15.8	13.8	11.7	10.3
87/09/13	13	12.3	11.7	12.4	15.1	15.4	15.6	14.0	13.1	13.2	13.1	14.1	12.1	10.4	8.9
87/09/13	14	11.7	11.1	12.4	15.2	15.3	15.1	13.8	13.3	13.6	13.9	13.7	11.5	10.1	9.3
87/09/13	15	12.6	12.3	13.3	16.6	16.6	16.8	14.7	14.3	14.7	14.4	15.0	12.5	11.0	9.9
87/09/13	16	12.7	12.5	14.0	15.2	15.3	15.5	14.4	13.9	15.1	14.9	13.7	11.8	10.0	9.1
87/09/13	17	11.8	12.3	13.7	15.3	15.4	15.3	14.5	14.3	14.9	15.2	13.6	12.2	11.3	10.4
87/09/13	18	18.4	17.7	17.3	20.7	21.0	21.5	20.2	18.9	19.1	18.2	20.2	18.7	16.7	13.9
87/09/13	19	19.0	18.6	18.0	19.3	18.9	20.0	20.2	18.6	19.4	18.2	20.1	19.2	18.1	14.5
87/09/13	20	23.7	21.8	20.8	22.7	22.2	21.7	20.9	19.9	20.9	21.2	21.4	21.6	22.2	18.8
87/09/13	21	25.0	23.1	21.8	24.8	23.0	23.3	23.7	22.2	23.6	23.1	23.6	23.1	22.8	19.8
87/09/13	22	25.0	23.7	22.4	25.0	23.9	24.0	22.5	20.3	21.6	21.1	21.4	20.6	20.3	17.6
87/09/13	23	22.9	22.2	21.8	24.1	24.5	25.2	24.1	23.0	24.4	23.2	23.8	22.8	21.3	18.4
87/09/13	24	21.6	21.1	21.6	23.5	24.6	26.3	25.1	24.1	25.1	24.2	25.4	23.8	21.5	18.3

DOE FREE FLOW DATA - SOUZA RANCH

YY/MM/DD	HR	WSE0 MPH	WSE1 MPH	WSE3 MPH	WSF2 MPH	WSF4 MPH	WSF6 MPH	WSF8 MPH	WSF0 MPH	WSF1 MPH	WSF3 MPH	WSG2 MPH	WSG4 MPH	WSG7 MPH	WSG9 MPH
87/09/14	01	25.0	22.8	22.1	24.2	24.8	25.2	24.3	23.0	24.1	23.2	25.0	24.0	23.0	19.6
87/09/14	02	21.9	20.4	20.0	21.3	21.6	21.4	21.0	19.2	20.3	19.9	20.4	19.9	19.3	16.7
87/09/14	03	19.7	18.6	18.3	20.1	20.6	21.3	19.9	18.4	19.6	18.9	19.4	18.9	18.3	15.5
87/09/14	04	20.3	19.4	18.8	21.3	21.6	23.0	22.4	20.6	21.4	20.3	22.0	20.6	19.1	15.8
87/09/14	05	20.3	19.1	18.1	20.9	20.4	21.6	20.5	18.7	19.4	18.0	20.0	18.3	17.0	14.1
87/09/14	06	18.6	17.0	17.1	18.8	19.7	21.2	20.1	18.4	19.3	17.8	19.6	18.5	17.8	13.1
87/09/14	07	17.2	16.9	17.1	18.9	20.2	21.1	19.9	19.0	19.4	17.8	19.9	18.8	17.3	13.9
87/09/14	08	15.8	15.5	15.9	17.7	18.3	19.6	18.9	18.4	18.8	17.4	19.3	18.2	16.7	13.4
87/09/14	09	17.4	16.4	16.9	19.0	20.2	21.3	19.7	18.3	18.6	16.9	19.5	17.9	16.3	12.9
87/09/14	10	17.4	16.8	17.5	20.2	20.8	22.0	20.3	18.7	18.7	18.0	20.1	18.3	16.1	13.8
87/09/14	11	17.0	15.8	16.4	18.9	19.6	20.7	19.6	17.8	18.1	16.6	19.4	17.7	16.0	12.8
87/09/14	12	15.0	13.6	13.9	16.4	17.0	17.9	17.3	15.6	15.4	14.1	17.4	15.9	14.3	11.9
87/09/14	13	14.1	12.5	13.0	15.9	16.1	16.5	15.7	14.1	13.7	13.6	15.7	14.5	12.4	10.2
87/09/14	14	15.3	14.2	14.5	17.3	17.9	18.6	17.4	15.7	15.4	14.8	17.3	15.7	13.3	11.2

HOURLY DATA LISTING

DOE FREE FLOW DATA - JESS RANCH

ID	UNITS	DESCRIPTION
WS08	MPH	SITE J-08 50-ft reference
WD08	DEG	SITE J-08 DIRECTION
WS14	MPH	SITE J-04 120-ft reference
WS15	MPH	SITE J-19 40-ft level
WS16	MPH	SITE J-17 35-ft level
WS17	MPH	SITE J-17 70-ft tower
WS18	MPH	SITE J-18 35-ft level
WS19	MPH	SITE J-18 70-ft tower
TT01	DEG F	TEMPERATURE
WSC1	MPH	TURBINE C1 50-ft
WSC3	MPH	TURBINE C3 50-ft
WSC5	MPH	TURBINE C5 50-ft
WSC7	MPH	TURBINE C7 50-ft
WSC9	MPH	TURBINE C9 50-ft
WSC2	MPH	TURBINE C12 50-ft

NOTES:

VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WS08 MPH	WD08 DEG	WS14 MPH	WS15 MPH	WS16 MPH	WS17 MPH	WS18 MPH	WS19 MPH	TT01 DEG F	WSC1 MPH	WSC3 MPH	WSC5 MPH	WSC7 MPH	WSC9 MPH	WSC2 MPH
87/10/01	15	27.3	246.1	25.8	25.5	22.4	24.2	23.0	23.9	82.2	23.3	22.4	20.0	18.2	17.9	23.1
87/10/01	16	27.2	252.2	26.2	25.0	22.8	24.5	22.3	23.1	82.7	24.5	24.6	21.8	19.1	18.3	24.8
87/10/01	17	24.6	252.2	23.8	23.0	20.6	22.4	21.6	22.4	83.0	22.5	20.9	18.6	15.9	16.3	21.5
87/10/01	18	26.0	253.1	23.8	21.8	20.6	22.4	20.8	21.9	79.6	22.1	21.6	18.0	14.3	16.2	22.4
87/10/01	19	27.4	243.5	26.5	28.0	20.4	22.5	21.2	22.8	77.2	24.5	23.0	22.5	18.9	20.1	25.1
87/10/01	20	16.7	241.2	17.8	16.8	9.6	10.7	12.7	14.0	78.5	16.5	16.6	14.1	13.8	14.7	15.6
87/10/01	21	21.7	250.3	19.2	22.0	18.8	20.2	13.0	14.0	71.1	17.7	17.0	14.1	12.1	14.0	17.5
87/10/01	22	27.0	243.3	30.0	31.0	19.9	22.3	21.2	22.3	69.8	24.9	24.7	23.6	21.9	25.7	27.6
87/10/01	23	29.7	246.6	28.5	28.2	23.0	25.2	22.2	23.9	73.5	26.2	26.0	24.7	23.6	24.6	28.0
87/10/01	24	28.0	244.2	25.2	26.0	22.1	23.3	19.2	20.6	73.9	23.0	24.6	24.2	23.5	21.4	26.0
87/10/02	01	29.1	250.8	29.0	29.8	23.8	24.9	18.3	19.2	72.5	26.8	27.0	26.0	23.7	23.0	28.5
87/10/02	02	26.0	252.2	24.8	24.8	20.5	21.5	13.4	14.8	73.7	25.4	25.6	23.6	20.9	21.3	25.2
87/10/02	03	27.8	254.5	28.2	24.8	22.7	24.1	7.6	9.0	67.6	27.6	28.5	25.6	24.0	23.9	27.4
87/10/02	04	26.4	256.6	27.8	25.5	22.4	23.3	9.6	9.6	67.1	27.9	27.3	23.6	22.2	21.0	24.7
87/10/02	05	23.4	254.5	25.0	25.5	19.9	20.6	13.9	15.4	71.1	25.3	24.3	22.0	21.2	19.3	23.1
87/10/02	06	20.4	257.3	20.2	17.5	16.3	16.5	3.1	5.0	72.0	20.6	20.9	19.6	18.8	17.4	19.9
87/10/02	07	15.8	257.3	16.2	11.2	13.0	13.4	0.0	0.0	72.5	13.3	14.0	12.1	10.4	9.7	14.5
87/10/02	08	16.4	259.2	13.8	13.0	13.1	14.5	2.4	3.7	78.2	11.4	11.5	10.5	9.5	10.7	12.9
87/10/02	19	10.8	248.7	11.0	9.2	8.5	9.6	9.1	10.0	88.5	9.7	9.1	9.0	8.0	9.1	9.6
87/10/02	20	13.8	253.8	11.2	7.5	11.7	12.7	9.0	10.6	85.6	8.2	7.4	6.6	6.6	7.7	9.1
87/10/02	21	14.8	248.9	13.8	13.0	12.3	13.9	12.1	13.8	86.2	11.7	13.1	12.5	11.1	12.3	13.4
87/10/02	22	14.9	256.6	13.0	14.5	13.1	13.4	10.0	11.2	86.8	13.0	13.2	11.8	11.1	10.7	12.0
87/10/02	23	15.5	253.6	14.0	15.2	13.5	13.8	10.3	11.1	87.3	15.1	14.7	13.1	12.3	11.8	13.1
87/10/02	24	14.5	257.1	13.5	16.8	13.1	13.5	10.4	11.1	87.8	14.9	14.1	12.2	10.6	10.6	12.3
87/10/03	01	17.0	257.3	14.0	16.8	14.9	15.1	9.8	11.0	88.4	15.0	14.2	12.8	11.6	11.4	12.9
87/10/03	02	17.2	251.2	14.0	15.2	14.4	15.0	5.4	6.2	86.3	14.8	14.9	13.8	13.1	13.1	13.6
87/10/03	03	17.4	251.0	15.5	15.8	14.6	15.4	8.9	9.3	86.7	15.9	15.7	14.3	13.3	12.9	14.5
87/10/03	04	14.2	250.3	13.2	15.2	11.3	11.5	4.9	6.6	85.2	15.1	14.6	12.7	11.3	10.6	12.5
87/10/03	05	15.4	253.1	12.2	14.5	12.8	13.1	7.0	8.5	86.5	13.8	13.4	11.5	9.9	10.5	11.4

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WS08 MPH	WD08 DEG	WS14 MPH	WS15 MPH	WS16 MPH	WS17 MPH	WS18 MPH	WS19 MPH	TT01 DEG F	WSC1 MPH	WSC3 MPH	WSC5 MPH	WSC7 MPH	WSC9 MPH	WSC2 MPH
87/10/07	09	29.1	243.0	32.8	17.8	14.2	15.2	17.0	19.0	61.9	27.9	27.4	22.7	20.5	16.9	28.9
87/10/07	10	35.1	250.1	35.0	33.0	25.5	25.2	25.0	26.5	63.4	33.2	33.5	30.3	28.0	28.5	33.5
87/10/07	11	33.5	250.1	32.5	26.0	24.7	26.7	24.5	26.1	66.1	29.5	30.4	26.7	24.3	24.6	30.6
87/10/07	12	31.9	254.5	29.8	26.2	24.5	26.6	25.0	26.3	68.8	28.3	27.6	24.7	22.4	22.2	28.1
87/10/07	13	29.0	251.5	25.5	23.5	23.0	24.9	21.3	22.3	71.5	23.6	22.3	20.1	18.8	17.6	23.1
87/10/07	14	28.5	251.0	19.5	20.5	22.9	25.1	19.8	20.6	72.9	19.0	17.2	16.4	16.0	17.0	18.0
87/10/07	15	26.6	250.3	20.8	21.0	22.1	24.2	20.3	21.1	74.8	20.1	18.0	16.7	15.7	16.4	18.8
87/10/07	16	27.2	250.1	22.8	20.5	22.3	24.3	21.6	22.5	74.8	21.7	19.8	18.4	17.0	17.0	21.2
87/10/07	17	25.6	252.4	24.0	23.0	20.0	21.8	19.9	20.6	74.5	21.9	20.7	19.7	18.2	17.8	22.1
87/10/07	18	29.6	245.6	30.0	27.5	24.1	26.1	24.3	25.5	71.5	27.4	26.1	24.6	20.1	22.5	28.7
87/10/07	19	34.1	250.5	34.8	32.5	29.0	31.5	27.4	28.9	66.3	31.9	30.1	29.3	22.7	26.8	33.1
87/10/07	20	38.8	248.7	36.8	32.2	32.5	35.1	31.5	32.8	61.8	33.6	34.1	31.7	28.3	27.9	36.0
87/10/07	21	37.7	249.6	38.8	36.5	30.6	33.5	27.7	29.0	59.8	36.3	36.6	33.2	30.0	32.2	36.5
87/10/07	22	36.3	250.1	37.2	37.8	29.4	32.3	28.7	30.5	59.3	33.7	35.6	33.1	30.8	32.3	36.2
87/10/07	23	37.4	248.2	38.5	39.5	30.6	33.2	29.2	31.5	59.1	35.1	36.9	33.4	30.5	34.6	37.1
87/10/07	24	35.9	244.2	38.0	37.5	30.1	33.1	26.7	28.9	58.8	32.7	36.1	32.5	29.0	32.3	35.6
87/10/08	01	33.3	244.2	33.8	34.5	26.4	28.7	24.1	26.1	59.1	31.4	32.1	30.1	27.3	30.2	32.6
87/10/08	02	29.3	243.7	31.2	32.8	19.5	20.5	24.5	26.9	58.8	29.6	30.4	28.2	26.0	28.5	30.2
87/10/08	03	27.0	241.4	31.0	32.2	18.3	19.5	22.7	25.0	58.4	30.0	29.6	27.2	25.2	28.1	29.4
87/10/08	04	23.8	242.8	32.0	30.2	18.5	20.2	22.4	24.4	58.5	29.8	30.4	27.0	25.3	27.8	29.8
87/10/08	05	26.4	243.3	31.5	30.5	21.2	22.7	22.3	24.5	58.5	28.7	28.7	25.5	23.6	24.9	28.4
87/10/08	06	25.8	245.9	28.5	29.0	20.6	22.3	19.9	21.9	58.4	26.4	26.9	24.3	22.1	23.2	26.8
87/10/08	07	23.2	247.7	26.5	28.5	17.9	18.9	19.6	21.6	58.4	26.8	24.8	22.6	20.7	23.1	24.7
87/10/08	08	21.7	244.9	26.5	27.0	18.0	19.3	19.0	20.6	58.6	24.8	25.4	22.0	20.4	20.8	25.2
87/10/08	09	18.3	237.2	26.2	25.8	15.6	16.6	19.5	21.3	59.6	24.5	25.1	22.1	21.4	21.2	25.1
87/10/08	10	16.1	243.5	20.8	21.8	13.4	14.3	15.9	17.2	62.4	20.3	19.5	17.4	16.4	16.1	19.7
87/10/08	11	17.7	243.7	19.2	19.2	14.2	15.2	13.9	14.7	65.5	18.4	17.8	15.6	14.6	14.3	17.7
87/10/08	12	18.6	252.7	18.8	18.8	14.8	15.8	13.6	14.3	68.5	18.0	17.1	15.2	14.1	14.5	17.1
87/10/08	13	20.7	251.3	19.0	19.0	16.8	16.1	15.5	16.2	70.8	18.5	16.8	15.3	14.3	14.7	17.4
87/10/08	14	22.8	251.3	21.5	20.5	18.4	19.7	17.8	18.5	72.2	20.3	18.9	17.7	15.6	15.8	19.8
87/10/08	15	24.0	253.1	22.5	22.0	19.5	21.1	18.2	19.1	73.9	21.5	19.6	18.4	16.7	16.4	20.6
87/10/08	16	26.3	249.8	23.2	22.2	21.7	23.5	20.4	21.3	72.8	22.3	19.9	18.6	17.1	16.2	21.1
87/10/08	17	25.1	244.7	23.0	23.2	20.3	21.9	19.3	20.1	71.1	22.0	20.3	19.0	17.3	17.5	21.1
87/10/08	18	23.7	240.0	23.5	22.8	19.3	20.9	16.8	17.7	69.7	23.0	21.3	18.9	18.0	17.5	21.2
87/10/08	19	27.5	246.3	25.8	27.0	22.6	24.4	19.5	20.8	65.8	25.0	24.8	21.5	19.7	19.9	23.2
87/10/08	20	32.5	249.4	26.8	30.5	29.1	31.3	24.4	26.3	61.4	26.2	26.0	24.8	23.7	19.9	26.7
87/10/08	21	31.5	247.0	33.8	33.2	28.3	30.7	27.7	28.3	59.2	31.9	31.2	29.3	27.7	27.8	31.3
87/10/08	22	33.2	246.8	32.0	35.8	28.6	31.1	24.0	25.3	58.4	33.7	30.8	26.8	25.7	31.3	29.9
87/10/08	23	35.7	249.6	31.2	32.8	29.7	32.5	28.4	30.0	57.7	32.1	29.5	27.2	25.3	27.6	29.6
87/10/08	24	34.5	244.7	31.0	35.8	24.8	27.4	23.4	25.0	57.5	29.2	29.1	28.4	27.2	28.4	30.7

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WS08 MPH	WD08 DEG	WS14 MPH	WS15 MPH	WS16 MPH	WS17 MPH	WS18 MPH	WS19 MPH	TT01 DEG F	WSC1 MPH	WSC3 MPH	WSC5 MPH	WSC7 MPH	WSC9 MPH	WSC2 MPH
87/10/09	01	30.9	244.2	33.2	35.5	27.6	30.1	22.9	24.2	58.6	30.9	30.5	26.7	24.9	26.8	30.4
87/10/09	02	30.2	238.4	30.5	32.0	26.6	29.0	23.2	24.4	57.5	29.7	29.2	25.5	23.9	24.1	28.6
87/10/09	03	29.0	240.0	31.8	30.2	22.7	24.5	21.8	23.7	56.6	30.0	30.7	27.2	25.1	26.7	29.9
87/10/09	04	20.1	242.3	26.5	21.2	12.9	13.8	16.9	18.3	57.2	25.8	25.7	23.0	21.7	21.8	25.0
87/10/09	05	13.3	242.8	16.8	14.8	9.6	10.6	11.1	12.6	57.2	16.0	15.5	13.7	12.1	12.2	15.4
87/10/09	06	21.3	245.6	23.0	24.2	16.2	17.7	17.0	18.5	56.5	21.6	21.1	18.8	17.2	17.9	20.9
87/10/09	07	25.9	245.6	25.8	25.0	21.4	23.1	18.3	19.5	55.7	24.0	22.4	19.7	18.7	18.0	22.5
87/10/09	08	29.6	245.6	31.0	29.0	23.8	26.1	21.1	22.5	55.7	27.4	27.6	24.1	22.5	22.6	28.3
87/10/09	09	28.4	245.6	28.5	29.2	22.8	24.7	19.9	21.3	57.3	26.7	26.9	23.4	21.7	22.3	26.9
87/10/09	10	28.5	238.4	30.5	27.5	23.0	24.7	21.6	22.8	58.1	28.5	28.0	24.9	24.3	23.5	28.6
87/10/09	11	26.8	238.4	29.2	26.0	22.5	24.3	22.8	24.4	59.1	27.6	26.3	24.4	22.7	22.3	27.4
87/10/09	12	26.3	246.6	28.0	26.5	22.5	24.3	22.0	23.3	59.9	26.1	25.3	23.4	21.9	20.8	26.2
87/10/09	13	24.8	244.2	26.2	24.2	20.6	22.2	21.3	22.4	62.4	24.9	23.8	22.0	19.9	19.7	24.9
87/10/09	14	25.4	245.4	26.0	24.8	20.9	22.6	20.8	22.0	63.7	24.5	23.6	21.8	20.1	19.6	24.7
87/10/09	15	24.0	246.1	24.0	22.8	20.1	21.7	19.6	20.8	65.5	22.5	21.3	19.6	17.8	17.3	22.4
87/10/09	16	23.8	254.1	23.0	22.0	19.0	20.5	19.0	20.0	67.1	21.8	20.2	19.0	16.8	16.8	21.4
87/10/09	17	23.4	254.5	18.0	17.5	18.7	20.1	15.6	16.8	66.6	16.9	15.4	14.2	12.4	12.5	16.4
87/10/09	18	24.8	249.1	24.5	19.8	18.4	19.8	15.9	17.2	66.4	21.5	22.4	20.0	18.5	17.2	23.4
87/10/09	19	28.1	253.6	24.8	24.0	22.2	24.0	19.3	20.9	63.5	23.8	22.3	20.8	18.5	17.5	23.1
87/10/09	20	28.6	246.1	24.5	23.2	23.8	26.0	20.5	22.0	60.5	23.0	21.7	19.9	17.3	17.4	23.0
87/10/09	21	30.9	246.3	26.8	26.2	25.6	27.7	22.6	24.1	58.7	25.1	23.4	21.6	20.0	22.2	24.9
87/10/09	22	28.9	244.7	25.8	28.0	23.7	25.6	21.9	23.3	57.9	24.5	23.7	22.5	20.6	21.2	24.8
87/10/09	23	25.4	242.8	26.0	24.0	20.3	22.0	18.3	19.6	57.4	24.9	25.2	22.1	20.6	20.4	24.6
87/10/09	24	24.3	245.9	23.8	23.8	19.4	21.0	17.6	19.0	57.3	22.8	23.0	20.2	19.0	19.0	22.4
87/10/10	01	24.9	242.6	23.5	24.8	19.5	21.4	17.6	19.1	57.0	21.7	22.1	20.1	18.5	19.0	22.4
87/10/10	02	24.5	245.2	21.0	22.8	19.7	21.5	15.6	16.7	57.1	20.1	19.7	17.6	17.0	17.4	19.2
87/10/10	03	22.0	240.9	17.8	19.0	15.5	17.2	11.3	12.3	57.0	16.7	16.7	15.2	13.9	14.7	16.6
87/10/10	04	24.1	245.4	22.2	19.0	18.9	20.8	15.0	16.1	56.7	20.6	20.3	17.8	16.1	16.1	20.6
87/10/10	05	21.1	242.3	21.5	18.8	15.4	17.1	15.1	16.3	57.0	20.2	20.2	17.4	16.1	15.8	20.1
87/10/10	06	20.0	244.2	20.8	17.5	15.8	17.4	13.9	15.2	57.1	19.3	18.6	15.4	15.4	15.0	18.2
87/10/10	07	18.6	241.9	20.8	18.5	13.1	14.5	13.8	15.3	57.1	19.8	19.6	16.5	16.0	15.6	19.3
87/10/10	08	18.4	245.4	21.0	18.2	13.8	15.1	13.6	15.0	57.0	19.4	19.2	16.2	15.6	15.4	19.2
87/10/10	09	17.2	248.7	19.8	16.5	12.9	13.8	12.6	13.7	58.4	19.0	18.3	15.5	14.8	14.1	18.1

HOURLY DATA LISTING

DOE FREE FLOW DATA - JESS RANCH

ID	UNITS	DESCRIPTION
WSC4	MPH	TURBINE C14 50-ft
WSC6	MPH	TURBINE C16 50-ft
WSC8	MPH	TURBINE C18 50-ft
WSD2	MPH	TURBINE D2 50-ft
WSD4	MPH	TURBINE D4 50-ft
WSD6	MPH	TURBINE D6 50-ft
WSD3	MPH	TURBINE D13 50-ft
WSD5	MPH	TURBINE D15 50-ft
WSD1	MPH	TURBINE D21 50-ft
WSE2	MPH	TURBINE E2 50-ft
WSE4	MPH	TURBINE E4 50-ft
WSE6	MPH	TURBINE E6 50-ft
WSE8	MPH	TURBINE E8 50-ft
WSE0	MPH	TURBINE E10 50-ft
WSE1	MPH	TURBINE E11 50-ft

NOTES:
VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSC4 MPH	WSC6 MPH	WSC8 MPH	WSD2 MPH	WSD4 MPH	WSD6 MPH	WSD3 MPH	WSD5 MPH	WSD1 MPH	WSE2 MPH	WSE4 MPH	WSE6 MPH	WSE8 MPH	WSE0 MPH	WSE1 MPH
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87/10/01	15	25.4	19.1	18.3	19.9	19.6	18.9	19.7	18.6	19.2	19.7	20.0	18.8	22.2	22.4	18.2
87/10/01	16	27.2	20.5	18.3	19.5	19.2	18.8	19.3	18.4	19.4	20.9	19.6	17.6	22.1	22.1	18.6
87/10/01	17	23.6	16.9	16.8	17.8	16.9	16.6	16.6	16.6	19.0	18.7	19.3	17.0	20.9	20.8	17.3
87/10/01	18	23.7	15.4	16.6	17.3	16.2	16.4	16.3	16.2	18.0	18.3	17.9	16.7	21.1	22.1	16.8
87/10/01	19	29.7	22.0	20.6	21.0	21.3	20.5	22.3	20.9	17.1	18.4	17.3	17.7	20.9	22.1	18.3
87/10/01	20	19.7	15.0	15.1	14.1	13.3	13.8	14.9	14.2	11.1	10.4	10.7	11.2	13.3	10.8	12.5
87/10/01	21	19.0	13.8	15.8	14.1	13.7	12.9	14.5	13.4	11.9	11.9	11.5	10.1	12.1	11.6	11.4
87/10/01	22	30.1	23.7	27.9	29.9	30.9	28.9	29.7	27.6	22.7	25.0	22.7	19.4	19.6	22.9	23.4
87/10/01	23	32.2	26.4	25.8	27.6	28.1	27.8	27.7	27.3	24.8	25.8	23.3	20.2	19.6	22.2	23.2
87/10/01	24	29.9	24.4	20.1	21.2	23.4	23.8	23.6	23.9	20.8	22.1	19.6	17.6	17.6	23.2	20.4
87/10/02	01	32.3	23.6	22.5	22.5	25.7	27.3	26.8	27.8	22.1	24.9	20.8	16.3	20.3	24.8	23.4
87/10/02	02	27.8	21.2	20.8	20.0	20.7	22.0	22.7	22.7	17.4	20.8	17.5	14.0	15.1	21.1	19.6
87/10/02	03	30.3	24.3	22.5	22.3	20.8	19.4	19.9	19.9	15.5	21.8	18.0	10.1	10.6	17.0	21.2
87/10/02	04	26.5	20.1	21.5	20.6	20.0	20.5	23.6	23.0	10.2	21.3	15.1	9.6	13.1	14.6	23.3
87/10/02	05	25.8	18.9	19.3	18.7	18.4	20.8	21.9	21.7	17.2	21.1	17.6	14.6	14.2	20.7	20.2
87/10/02	06	22.2	16.9	14.8	13.6	11.7	13.3	17.0	16.8	9.0	13.5	10.9	8.2	7.5	11.3	16.2
87/10/02	07	16.1	11.3	9.6	8.0	5.4	2.5	5.5	4.4	0.9	1.6	0.7	0.1	0.5	0.9	4.8
87/10/02	08	14.4	11.7	11.5	10.4	10.5	9.7	11.2	10.1	5.7	7.0	5.8	4.6	5.1	5.8	8.4
87/10/02	19	10.8	8.7	9.5	9.4	8.1	7.8	8.7	7.8	8.1	7.5	7.8	6.8	8.6	9.5	7.1
87/10/02	20	10.0	7.1	9.0	8.5	7.0	6.0	8.1	7.1	8.5	6.6	8.5	7.7	9.6	9.6	6.1
87/10/02	21	14.8	12.2	12.3	12.5	13.2	12.5	13.2	12.5	11.3	10.2	11.4	10.8	11.4	12.2	11.0
87/10/02	22	13.3	10.9	10.9	11.3	12.3	12.4	12.4	12.3	10.2	10.8	9.9	9.0	9.9	8.8	11.3
87/10/02	23	14.3	11.7	11.5	11.7	13.1	13.8	13.8	13.8	11.2	13.0	10.2	9.3	11.1	11.8	12.7
87/10/02	24	13.1	10.2	12.0	12.6	14.7	14.6	14.4	14.2	11.2	13.1	10.5	8.7	10.9	11.9	12.9
87/10/03	01	14.3	11.4	11.8	12.6	14.6	14.7	14.4	14.5	13.1	14.4	12.3	9.4	9.8	11.6	13.3
87/10/03	02	15.2	13.0	11.8	12.3	11.4	11.2	11.9	12.4	7.5	11.8	8.4	5.8	6.3	3.6	12.3
87/10/03	03	15.8	13.1	12.0	12.3	12.4	12.9	13.4	13.4	9.1	12.6	9.4	7.6	9.0	10.0	13.1
87/10/03	04	12.8	10.6	11.6	11.1	12.5	12.7	13.5	13.4	7.6	12.7	10.1	6.9	6.3	7.6	12.5
87/10/03	05	11.6	10.2	12.5	12.2	13.0	12.1	12.6	12.1	9.5	11.7	9.9	8.4	6.5	7.6	11.2

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSC4 MPH	WSC6 MPH	WSC8 MPH	WSD2 MPH	WSD4 MPH	WSD6 MPH	WSD3 MPH	WSD5 MPH	WSD1 MPH	WSE2 MPH	WSE4 MPH	WSE6 MPH	WSE8 MPH	WSE0 MPH	WSE1 MPH
87/10/07	09	31.3	24.6	19.0	16.4	16.1	15.4	19.7	18.5	16.9	18.0	19.5	18.9	21.6	21.5	18.7
87/10/07	10	37.6	31.8	28.6	26.3	25.7	24.7	27.1	25.6	23.9	25.9	25.1	22.9	26.0	27.7	25.1
87/10/07	11	33.5	27.8	25.4	22.6	21.6	20.9	22.5	21.4	21.9	22.5	23.0	21.6	25.2	25.7	20.4
87/10/07	12	31.0	24.5	22.7	20.9	20.6	20.2	20.6	20.6	20.7	21.7	21.5	20.9	24.5	25.4	21.0
87/10/07	13	24.5	19.9	17.9	16.9	17.2	17.0	16.6	16.4	17.5	16.5	16.6	16.6	20.5	20.6	17.9
87/10/07	14	19.2	16.2	17.0	17.2	17.6	17.6	17.0	17.5	17.4	17.4	17.1	15.8	18.7	18.9	17.2
87/10/07	15	19.9	16.4	16.5	16.9	18.1	17.9	17.5	18.3	17.9	17.4	18.3	17.1	18.8	18.9	16.5
87/10/07	16	22.4	17.8	17.5	17.3	18.6	18.6	17.3	19.1	18.7	18.8	19.4	17.4	19.9	20.0	17.8
87/10/07	17	24.2	19.5	17.8	17.3	16.6	16.2	16.6	16.3	17.2	17.1	17.4	16.3	18.8	19.1	15.3
87/10/07	18	31.4	21.5	23.4	22.5	21.5	20.3	21.6	20.1	19.3	21.3	20.3	19.2	23.4	23.1	19.9
87/10/07	19	36.1	25.1	28.3	25.8	24.7	22.5	25.0	22.9	22.2	24.8	23.0	19.9	26.2	26.1	23.5
87/10/07	20	39.7	30.2	29.4	29.1	27.7	26.1	28.4	26.3	25.5	28.3	26.2	23.2	30.1	31.2	25.3
87/10/07	21	40.4	34.3	33.6	31.0	28.8	26.4	28.4	25.8	28.0	27.6	28.7	23.4	29.3	31.5	23.9
87/10/07	22	40.2	34.5	34.3	31.8	29.3	28.3	28.8	28.2	28.3	28.6	29.2	25.4	27.4	31.9	25.3
87/10/07	23	40.3	35.5	36.9	33.0	31.4	30.5	31.3	30.8	28.9	29.6	30.7	27.1	27.0	32.3	27.1
87/10/07	24	38.9	33.4	33.8	31.0	29.8	29.4	30.1	29.0	27.4	27.3	29.1	24.5	27.2	31.4	25.1
87/10/08	01	36.4	30.6	30.7	28.6	27.1	25.5	26.6	25.3	23.0	23.6	23.8	22.3	23.6	27.7	22.3
87/10/08	02	34.3	29.1	29.2	27.5	25.5	25.1	25.4	25.0	24.1	24.6	23.1	23.2	22.5	24.5	22.5
87/10/08	03	33.3	28.5	28.6	27.3	25.3	23.7	24.4	23.5	23.6	23.7	22.1	22.0	20.3	22.6	21.6
87/10/08	04	33.1	28.7	27.0	25.4	24.5	23.3	23.6	22.8	22.9	23.3	21.4	21.2	20.3	22.2	21.2
87/10/08	05	31.4	26.6	25.1	22.8	23.0	23.3	23.8	23.6	22.6	23.4	22.2	21.3	18.5	23.5	21.6
87/10/08	06	29.9	24.6	23.3	21.6	21.6	22.0	22.2	22.0	20.1	21.2	19.2	18.7	17.2	21.0	20.4
87/10/08	07	28.5	23.9	23.4	20.8	20.5	21.0	21.2	21.6	20.8	22.0	20.5	18.8	17.2	20.4	20.8
87/10/08	08	27.6	22.7	21.1	20.6	21.0	20.9	21.4	21.1	19.8	20.5	20.1	17.6	18.5	22.0	19.7
87/10/08	09	27.5	22.5	21.4	20.6	20.8	19.7	20.0	19.1	19.6	20.3	18.8	17.3	17.8	18.3	18.0
87/10/08	10	21.4	17.2	16.4	16.9	16.8	16.1	16.2	15.5	15.8	16.0	14.8	13.8	14.4	15.0	14.3
87/10/08	11	18.9	15.6	14.5	14.2	14.4	13.5	14.0	13.4	13.7	14.2	13.1	12.3	13.0	14.3	12.5
87/10/08	12	18.4	14.9	14.7	14.6	14.2	13.3	13.9	13.0	13.2	13.3	12.9	11.9	13.2	14.0	12.6
87/10/08	13	18.6	15.2	15.2	14.5	14.6	14.2	14.5	14.0	14.1	13.9	13.8	13.3	14.8	15.4	13.5
87/10/08	14	21.6	16.5	16.4	16.6	16.8	16.1	16.3	15.9	16.2	15.6	15.9	15.2	16.7	16.7	15.0
87/10/08	15	22.4	17.5	16.6	16.9	16.8	16.0	16.2	15.7	16.5	16.2	16.3	15.3	17.3	17.2	14.9
87/10/08	16	22.5	17.4	18.8	18.5	17.6	17.2	16.8	17.4	18.1	17.6	18.6	16.8	19.0	19.1	16.0
87/10/08	17	23.1	18.2	18.0	18.4	17.8	17.1	17.7	17.0	16.9	17.1	16.9	15.5	18.3	18.8	16.0
87/10/08	18	22.8	18.7	17.3	17.0	16.3	15.8	15.5	15.0	15.9	15.5	15.3	13.2	15.8	16.8	13.3
87/10/08	19	25.9	21.1	20.1	18.6	18.2	17.4	19.6	18.1	18.1	18.7	19.0	16.5	20.3	20.5	16.9
87/10/08	20	31.2	25.5	20.6	22.0	21.6	19.6	22.8	20.7	20.9	22.5	21.9	20.3	23.5	24.2	21.3
87/10/08	21	36.8	31.2	27.3	28.4	30.5	29.5	31.2	29.7	25.1	25.9	27.0	21.8	27.5	27.9	26.5
87/10/08	22	33.0	31.5	32.1	27.8	27.3	29.4	30.6	30.2	25.0	28.0	26.1	22.4	23.4	27.2	27.2
87/10/08	23	33.7	29.1	27.5	23.1	22.4	21.1	26.0	23.1	23.0	22.2	23.0	23.8	27.4	28.4	23.0
87/10/08	24	35.8	29.8	29.1	27.1	23.8	19.8	22.1	18.9	20.1	20.5	21.1	18.1	25.3	25.7	16.4

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSC4 MPH	WSC6 MPH	WSC8 MPH	WSD2 MPH	WSD4 MPH	WSD6 MPH	WSD3 MPH	WSD5 MPH	WSD1 MPH	WSE2 MPH	WSE4 MPH	WSE6 MPH	WSE8 MPH	WSE0 MPH	WSE1 MPH
87/10/09	01	33.6	28.3	27.4	25.7	23.9	22.7	23.7	22.2	20.7	21.4	21.1	20.0	23.2	24.6	20.1
87/10/09	02	30.8	25.7	24.1	23.2	22.6	20.9	21.9	20.0	20.8	20.7	20.9	19.5	22.3	23.7	18.8
87/10/09	03	32.6	27.3	26.5	25.4	23.4	21.6	22.2	21.2	21.4	21.8	21.3	19.9	19.4	23.2	20.2
87/10/09	04	28.0	21.4	22.8	21.7	19.8	19.1	19.2	18.7	17.8	17.2	16.0	15.9	16.2	15.8	16.3
87/10/09	05	17.2	13.1	13.3	12.0	11.1	10.5	11.3	10.5	12.0	12.2	11.6	10.8	10.6	11.4	11.6
87/10/09	06	23.3	18.4	18.3	17.7	16.6	15.6	16.3	15.3	16.8	16.8	17.2	15.8	16.8	18.3	15.5
87/10/09	07	24.8	20.1	18.6	18.0	17.1	16.7	17.2	16.6	17.3	17.6	17.5	16.1	18.1	18.6	16.0
87/10/09	08	30.9	24.4	23.2	21.8	20.4	19.1	20.3	19.1	20.6	20.6	21.0	18.1	21.2	22.9	18.5
87/10/09	09	29.4	24.3	22.5	21.1	20.4	18.8	20.0	18.0	19.5	18.6	19.4	17.4	19.6	21.9	17.0
87/10/09	10	31.3	26.0	24.1	22.7	20.8	19.7	20.1	19.1	21.5	21.2	21.4	18.5	20.8	22.8	18.9
87/10/09	11	30.1	24.2	22.9	22.0	20.5	20.4	20.1	19.8	21.3	21.2	21.1	19.5	21.2	22.7	19.1
87/10/09	12	28.8	23.1	21.5	21.1	20.6	20.0	20.0	19.5	21.2	20.7	21.0	18.8	20.4	21.8	18.7
87/10/09	13	27.1	21.0	20.1	19.6	18.7	18.9	17.9	18.7	18.9	18.5	19.0	17.5	19.9	20.7	17.5
87/10/09	14	27.0	21.4	19.8	20.0	18.9	17.8	18.8	17.5	19.2	19.3	19.4	17.5	19.3	20.4	16.8
87/10/09	15	24.0	19.0	17.7	17.9	18.1	17.4	17.7	17.2	18.2	17.8	18.3	16.9	18.6	19.6	15.7
87/10/09	16	23.3	17.8	17.3	17.2	17.3	17.0	16.9	16.9	17.1	17.0	17.6	15.8	17.4	18.1	15.9
87/10/09	17	17.1	13.5	12.8	12.4	12.9	13.2	12.8	13.5	14.1	13.7	15.1	13.5	15.2	14.9	13.2
87/10/09	18	25.7	19.7	17.5	15.7	14.2	13.8	14.4	13.6	14.4	14.0	15.1	13.6	16.9	17.9	13.9
87/10/09	19	25.6	20.0	18.0	17.2	16.2	15.2	16.4	15.6	16.3	16.9	17.3	16.4	19.4	20.0	16.0
87/10/09	20	24.6	18.5	18.2	18.0	17.6	18.1	17.5	17.9	17.8	18.9	18.5	17.1	19.8	19.9	18.1
87/10/09	21	26.7	20.8	23.1	22.1	20.9	20.4	20.9	20.0	20.7	21.0	20.9	18.8	21.7	22.0	19.1
87/10/09	22	27.6	21.7	21.7	21.8	21.3	20.0	20.9	19.4	20.4	20.9	20.4	18.4	21.1	22.3	18.5
87/10/09	23	27.1	21.9	20.1	19.4	19.2	17.9	18.5	17.0	18.7	17.4	18.6	15.9	17.2	20.1	15.7
87/10/09	24	24.4	20.1	18.6	18.5	17.7	16.7	17.0	15.8	16.7	16.2	16.3	15.2	16.8	17.3	14.0
87/10/10	01	25.0	20.7	19.0	18.5	17.4	16.3	16.7	15.7	17.9	17.4	17.5	15.3	17.8	18.4	15.0
87/10/10	02	21.0	18.3	17.4	16.9	16.3	15.3	15.2	14.4	15.3	15.1	14.8	13.1	14.3	15.4	12.8
87/10/10	03	18.6	15.6	14.4	13.5	12.2	11.2	11.3	9.9	11.2	10.9	10.2	9.5	10.6	12.6	9.1
87/10/10	04	22.3	17.9	16.4	15.6	14.7	14.4	14.3	13.9	14.5	14.2	14.5	12.8	15.2	16.7	12.7
87/10/10	05	22.0	17.7	15.8	15.0	14.8	13.5	14.3	12.9	14.1	13.9	13.8	12.5	14.2	15.6	12.2
87/10/10	06	19.6	16.8	15.2	15.1	15.0	14.3	14.9	14.0	13.8	13.5	13.8	12.5	13.8	15.3	12.9
87/10/10	07	20.8	17.1	16.0	16.0	15.7	14.9	15.4	14.3	14.1	13.8	13.8	12.3	13.1	14.9	12.8
87/10/10	08	20.6	16.8	15.8	16.1	16.6	15.4	16.2	15.1	13.9	13.8	13.9	12.4	13.2	15.3	13.4
87/10/10	09	19.5	15.8	14.2	13.9	14.2	13.5	13.9	12.8	13.1	12.6	12.8	11.2	11.6	12.4	11.7

HOURLY DATA LISTING

DOE FREE FLOW DATA - JESS RANCH

ID	UNITS	DESCRIPTION
WSE3	MPH	TURBINE E13 50-ft
WSE5	MPH	TURBINE E15 50-ft
WSEA	MPH	TURBINE E18 50-ft
WSEB	MPH	TURBINE E20 50-ft
WSEC	MPH	TURBINE E22 50-ft
WSF1	MPH	TURBINE F1 35-ft
WSF3	MPH	TURBINE F3 35-ft
WSF5	MPH	TURBINE H2 50-ft
WSF7	MPH	TURBINE F7 35-ft
WSF9	MPH	TURBINE F9 35-ft
WSF2	MPH	TURBINE F12 35-ft
WSG1	MPH	TURBINE G1 35-ft
WSG3	MPH	TURBINE G3 35-ft
WSG5	MPH	TURBINE G5 35-ft
WSG7	MPH	TURBINE G7 35-ft

NOTES:
VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN.
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSE3 MPH	WSE5 MPH	WSEA MPH	WSEB MPH	WSEC MPH	WSF1 MPH	WSF3 MPH	WSF5 MPH	WSF7 MPH	WSF9 MPH	WSF2 MPH	WSG1 MPH	WSG3 MPH	WSG5 MPH	WSG7 MPH
87/10/01	15	19.3	19.7	20.5	22.5	23.8	21.3	20.3	22.0	20.1	17.4	16.1	17.2	17.2	22.6	24.2
87/10/01	16	20.1	20.8	20.2	22.4	23.9	19.6	20.2	24.2	20.5	17.1	16.6	16.4	15.9	22.0	23.8
87/10/01	17	18.1	18.6	19.5	21.2	22.5	19.3	19.4	20.2	19.4	15.6	15.4	15.6	16.4	21.6	22.7
87/10/01	18	17.5	18.4	19.5	21.7	23.8	18.7	18.9	18.4	19.6	16.2	16.5	15.0	14.3	20.7	22.1
87/10/01	19	19.3	18.6	19.2	21.6	23.4	19.2	19.0	25.6	20.9	18.7	18.7	18.7	18.6	21.7	25.5
87/10/01	20	12.2	11.2	12.0	14.4	14.9	11.4	11.0	16.3	13.0	11.2	10.6	10.6	11.0	11.7	13.3
87/10/01	21	11.6	11.5	11.3	12.3	13.1	12.0	10.6	16.0	10.8	10.5	10.7	10.8	11.3	15.2	17.5
87/10/01	22	24.5	23.1	22.1	21.3	24.3	20.5	18.4	28.4	21.4	19.2	18.8	17.4	17.2	19.6	22.3
87/10/01	23	24.7	24.1	23.0	22.1	23.7	21.4	18.5	30.8	23.5	22.2	22.9	18.8	17.9	22.3	24.7
87/10/01	24	21.0	20.2	19.5	18.7	24.3	18.7	16.5	31.1	24.3	21.9	22.9	17.2	15.7	19.4	22.4
87/10/02	01	24.5	22.6	18.4	20.7	26.2	17.7	18.1	32.6	23.4	17.3	17.4	15.1	15.1	19.5	23.8
87/10/02	02	18.7	19.2	17.9	15.7	22.2	14.0	13.2	29.2	18.0	13.1	13.1	11.0	11.0	17.3	21.1
87/10/02	03	22.4	21.0	13.1	12.3	18.6	9.6	7.8	31.4	9.0	5.2	3.1	8.0	13.2	18.4	22.2
87/10/02	04	23.8	20.8	14.5	13.6	20.6	8.3	10.7	28.9	5.9	4.0	3.5	6.4	10.9	17.4	20.3
87/10/02	05	21.8	19.8	17.4	15.7	21.9	14.8	12.5	27.4	17.9	12.5	13.0	8.9	6.6	14.7	18.5
87/10/02	06	13.2	13.4	11.1	9.2	14.1	6.4	5.1	24.4	10.6	8.5	11.0	4.5	4.2	11.6	15.3
87/10/02	07	3.4	2.4	0.1	1.1	3.3	0.3	0.1	13.7	0.3	1.2	0.4	2.9	5.3	9.8	12.3
87/10/02	08	5.3	6.9	7.3	7.9	10.5	3.6	1.8	12.3	4.2	6.4	1.7	7.3	9.2	12.4	13.6
87/10/02	19	4.3	7.7	8.1	9.2	10.0	7.8	6.2	11.1	9.2	7.8	6.4	6.8	6.6	8.4	8.9
87/10/02	20	6.1	6.6	9.5	10.2	11.6	8.4	6.2	9.3	6.9	6.0	7.7	5.7	6.5	9.5	10.9
87/10/02	21	10.8	10.7	12.0	11.5	13.2	11.6	9.5	14.6	11.3	9.9	9.0	9.4	8.9	11.4	12.7
87/10/02	22	11.2	10.4	9.7	11.0	10.9	9.3	7.8	14.3	8.8	8.4	6.8	6.4	6.8	9.7	11.1
87/10/02	23	12.9	11.6	9.4	12.2	13.4	10.1	8.9	15.8	10.0	8.7	8.1	7.7	6.7	10.1	12.1
87/10/02	24	13.1	11.8	9.4	12.0	13.1	9.7	9.0	14.3	10.3	9.8	9.3	9.1	5.8	9.7	11.0
87/10/03	01	13.8	13.4	10.3	10.6	13.7	9.7	7.8	15.9	8.6	5.4	6.3	5.3	5.8	10.6	12.5
87/10/03	02	12.7	11.8	7.7	8.4	10.2	5.2	2.5	17.0	6.7	7.9	2.6	9.1	10.4	12.6	13.9
87/10/03	03	13.6	12.0	8.2	10.2	13.3	7.8	6.3	17.1	8.0	8.9	7.2	9.7	10.4	12.8	14.0
87/10/03	04	11.9	11.8	9.3	8.5	11.1	5.1	3.2	14.1	6.5	4.9	4.8	3.0	2.8	8.3	10.6
87/10/03	05	11.2	11.2	9.9	9.0	10.6	7.1	3.4	13.0	5.0	4.9	2.1	7.1	8.6	10.7	12.2

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSE3 MPH	WSE5 MPH	WSEA MPH	WSEB MPH	WSEC MPH	WSF1 MPH	WSF3 MPH	WSF5 MPH	WSF7 MPH	WSF9 MPH	WSF2 MPH	WSG1 MPH	WSG3 MPH	WSG5 MPH	WSG7 MPH
87/10/07	09	19.6	20.5	22.4	25.0	25.7	17.9	16.7	23.9	18.6	15.8	16.5	15.2	14.2	22.2	26.6
87/10/07	10	25.7	25.2	25.4	27.4	30.2	23.4	23.6	35.4	22.7	20.3	19.2	20.1	20.9	27.6	30.9
87/10/07	11	21.9	22.6	24.2	26.5	27.7	23.1	22.4	30.3	22.7	19.8	18.9	19.4	18.4	26.3	29.6
87/10/07	12	21.9	21.8	22.8	24.9	26.9	23.0	22.3	28.1	21.4	18.6	20.7	18.7	18.4	24.0	26.8
87/10/07	13	14.1	16.4	14.4	19.9	22.8	19.6	18.1	22.9	17.0	16.7	18.5	15.8	16.4	21.9	25.6
87/10/07	14	15.1	17.2	15.3	18.8	20.5	18.1	16.7	19.8	18.2	17.7	19.4	16.7	16.1	22.1	25.2
87/10/07	15	16.8	17.1	18.4	19.7	20.0	18.7	17.4	19.1	17.5	16.4	17.7	15.6	15.2	20.9	23.7
87/10/07	16	18.2	18.7	19.5	20.8	21.4	19.6	18.3	20.9	18.5	16.4	17.3	15.5	15.0	20.3	24.0
87/10/07	17	16.4	17.1	18.2	19.6	20.4	17.7	17.2	22.2	16.5	14.6	16.3	14.6	14.6	18.9	21.0
87/10/07	18	21.2	21.4	21.5	24.6	25.1	22.0	20.9	25.4	20.3	18.0	20.1	18.6	17.5	24.1	25.7
87/10/07	19	25.0	24.6	24.0	27.1	28.6	23.9	23.8	29.1	24.3	21.3	20.6	21.3	19.7	26.3	29.4
87/10/07	20	27.9	27.7	27.1	30.7	32.9	25.7	28.1	35.8	27.7	23.1	23.2	23.2	22.9	32.0	31.8
87/10/07	21	26.4	27.9	26.4	29.7	33.6	24.3	26.6	38.6	28.5	23.8	25.4	22.4	21.4	31.3	32.4
87/10/07	22	27.5	28.7	28.2	29.3	34.0	27.0	25.8	39.5	28.9	24.5	25.9	22.6	22.0	29.0	31.1
87/10/07	23	30.1	28.7	29.6	29.5	34.7	28.4	24.9	39.7	29.7	24.8	26.6	23.6	22.4	29.9	31.0
87/10/07	24	28.0	26.7	26.7	29.3	33.5	25.7	24.9	38.6	27.3	22.3	24.8	23.5	21.5	29.5	31.7
87/10/08	01	23.6	22.5	24.3	25.7	29.7	23.4	21.4	36.5	25.5	21.3	22.4	19.2	19.6	26.1	28.1
87/10/08	02	24.0	23.5	25.1	24.7	27.0	24.0	21.0	34.1	26.1	23.5	24.4	20.0	16.8	18.3	24.4
87/10/08	03	23.0	22.8	24.1	22.8	25.5	22.4	19.1	33.1	24.4	22.9	24.3	18.9	14.9	18.2	23.6
87/10/08	04	22.5	22.1	22.9	22.7	24.4	21.9	19.1	32.4	23.3	22.1	23.4	19.9	16.7	17.4	18.8
87/10/08	05	22.9	22.1	23.2	21.7	25.4	22.4	17.6	30.5	24.1	21.4	22.6	16.3	15.3	19.1	22.9
87/10/08	06	20.7	19.7	20.5	19.5	23.0	19.7	16.0	28.7	21.2	17.7	19.0	13.7	12.6	19.3	21.7
87/10/08	07	21.5	20.5	20.7	19.8	21.8	20.1	16.2	27.8	22.0	20.8	21.9	18.1	15.4	14.9	18.0
87/10/08	08	20.6	18.9	19.1	19.6	22.9	18.5	17.6	26.4	22.5	20.8	21.5	17.6	15.6	15.9	17.5
87/10/08	09	19.4	18.7	18.4	19.2	20.1	19.1	16.2	27.0	20.5	19.9	20.8	19.5	15.9	15.2	15.2
87/10/08	10	15.3	15.0	15.4	15.6	16.3	15.4	13.8	20.4	17.3	16.4	17.0	15.2	13.4	12.4	12.7
87/10/08	11	13.6	13.2	13.2	13.3	15.1	13.5	12.2	17.7	14.6	12.9	13.1	11.4	10.0	12.1	13.4
87/10/08	12	13.1	12.6	12.7	13.8	14.8	13.2	12.4	16.9	13.5	12.3	12.0	10.8	10.2	12.5	14.0
87/10/08	13	13.7	13.4	14.0	15.6	16.5	14.5	13.8	17.0	14.4	12.5	12.1	11.2	11.3	15.0	17.3
87/10/08	14	15.1	14.9	16.2	17.3	18.0	16.7	15.6	18.7	15.9	13.8	13.3	12.8	12.5	16.8	18.6
87/10/08	15	15.8	15.6	16.3	17.8	18.3	16.9	15.8	20.3	15.4	13.7	12.4	13.7	13.6	17.5	19.9
87/10/08	16	17.2	17.2	18.7	19.8	20.1	19.2	17.2	20.9	17.8	15.7	14.6	15.3	14.4	19.3	22.5
87/10/08	17	16.5	16.3	16.7	18.4	19.8	17.5	17.0	21.3	17.1	14.6	14.3	14.6	15.1	19.1	20.5
87/10/08	18	14.3	14.9	14.6	15.9	17.6	14.8	14.5	22.4	16.1	13.8	13.0	14.4	13.9	18.7	19.9
87/10/08	19	17.6	19.4	19.1	20.9	22.5	17.2	17.9	25.9	17.6	15.2	17.7	15.7	15.3	22.0	25.4
87/10/08	20	23.0	22.4	23.4	25.3	25.8	22.7	20.9	30.2	21.7	21.1	23.4	20.7	20.0	27.6	30.8
87/10/08	21	27.2	24.9	23.7	27.4	30.2	22.3	26.1	35.6	24.2	20.2	20.0	20.7	19.3	25.4	29.0
87/10/08	22	28.7	27.0	25.8	24.2	28.9	22.9	22.1	32.6	24.4	20.8	19.7	19.7	18.8	25.4	29.0
87/10/08	23	23.3	22.8	24.9	28.2	29.8	26.3	25.0	33.0	26.3	23.0	22.0	23.9	21.9	28.9	31.9
87/10/08	24	19.5	20.6	22.1	25.7	28.4	19.9	22.3	35.1	23.6	19.9	20.3	19.2	18.8	25.9	29.6

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD HR	WSE3 MPH	WSE5 MPH	WSEA MPH	WSEB MPH	WSEC MPH	WSF1 MPH	WSF3 MPH	WSF5 MPH	WSF7 MPH	WSF9 MPH	WSF2 MPH	WSG1 MPH	WSG3 MPH	WSG5 MPH	WSG7 MPH
87/10/09 01	21.3	20.8	21.4	23.7	26.0	21.6	21.6	31.9	23.3	20.7	20.7	20.8	19.9	25.4	27.4
87/10/09 02	19.6	19.5	20.4	22.8	24.7	21.2	20.9	30.8	22.4	20.6	20.4	20.7	19.7	24.4	26.7
87/10/09 03	21.2	20.6	21.0	20.9	24.9	21.5	18.2	32.7	23.3	21.4	22.1	17.8	16.4	20.6	24.3
87/10/09 04	16.7	16.2	16.8	16.7	17.3	16.4	14.6	27.5	16.9	16.0	16.4	14.0	12.0	11.5	14.6
87/10/09 05	12.0	11.7	11.4	11.3	12.7	11.3	9.2	15.9	11.4	10.8	11.3	9.4	7.7	8.0	9.9
87/10/09 06	16.5	16.3	16.6	17.8	19.7	16.6	15.0	22.1	16.9	15.2	15.8	12.3	11.2	14.8	16.9
87/10/09 07	17.4	17.4	17.6	19.1	20.2	17.4	16.4	23.5	16.8	14.2	14.1	13.9	14.5	18.8	22.0
87/10/09 08	20.0	20.5	20.4	21.7	24.4	19.4	19.6	28.3	21.5	18.8	19.3	17.5	17.0	22.5	25.0
87/10/09 09	18.5	18.6	19.0	20.5	23.4	18.8	17.9	27.7	20.5	17.8	18.6	16.1	15.9	21.3	23.8
87/10/09 10	20.2	19.8	20.0	21.6	24.1	20.3	19.7	30.0	22.0	19.5	20.3	17.6	16.8	21.3	24.7
87/10/09 11	20.0	20.2	20.7	22.2	24.0	21.4	19.8	28.1	22.4	19.6	20.4	17.8	16.4	20.2	23.0
87/10/09 12	19.7	20.1	20.1	21.5	23.2	20.8	19.3	26.9	21.1	18.5	19.1	18.2	16.9	20.3	22.5
87/10/09 13	18.6	17.9	18.9	20.5	22.0	19.3	18.8	24.3	20.2	17.7	18.2	16.3	15.4	19.0	21.0
87/10/09 14	18.5	18.6	19.1	20.4	21.6	19.4	17.9	24.6	19.3	17.4	16.9	16.4	15.2	19.0	21.4
87/10/09 15	17.1	17.3	18.3	19.5	20.7	18.8	17.1	21.8	18.3	16.1	16.0	14.8	14.7	18.2	20.3
87/10/09 16	16.3	16.3	17.3	18.4	19.2	17.4	16.4	20.4	16.9	15.6	14.7	14.1	14.8	18.0	19.8
87/10/09 17	13.4	13.7	15.4	16.4	16.6	15.1	13.2	15.1	13.6	12.5	12.0	12.2	13.2	18.1	21.1
87/10/09 18	15.2	14.8	16.2	17.9	19.9	14.2	14.8	23.1	16.3	13.7	13.8	12.1	11.4	17.6	20.8
87/10/09 19	17.7	17.2	18.5	20.5	21.8	17.5	17.1	23.4	17.2	15.2	14.7	14.7	14.4	20.4	23.6
87/10/09 20	19.1	18.7	19.4	21.0	21.8	19.0	17.6	21.6	17.8	15.3	15.0	15.7	15.7	21.8	25.5
87/10/09 21	20.4	20.3	21.2	22.4	23.6	21.0	19.8	25.3	20.8	17.3	17.7	16.6	16.6	22.4	26.0
87/10/09 22	19.6	20.3	20.1	21.3	23.4	19.8	19.9	26.1	21.4	17.8	19.2	17.0	16.3	22.0	24.3
87/10/09 23	16.3	16.8	17.0	17.8	21.2	17.9	15.9	26.2	19.4	16.6	17.6	14.7	14.3	18.0	21.3
87/10/09 24	15.2	15.5	16.1	17.6	18.5	16.7	15.3	24.0	16.3	15.0	15.2	13.6	13.3	17.7	19.8
87/10/10 01	17.0	16.9	16.5	18.4	20.2	16.5	16.3	24.1	17.1	15.3	15.5	14.5	13.5	18.3	20.7
87/10/10 02	14.2	14.4	14.1	15.0	16.5	14.8	13.3	21.4	15.2	13.8	13.7	13.3	12.9	16.5	20.9
87/10/10 03	10.6	10.0	10.2	11.3	14.0	10.7	9.1	18.1	13.6	12.7	12.9	11.7	11.1	14.8	17.9
87/10/10 04	13.7	13.9	14.6	15.9	18.0	13.8	13.7	20.4	16.5	14.4	14.6	13.9	13.7	17.7	20.4
87/10/10 05	13.0	13.3	13.4	15.0	16.5	13.8	13.0	20.5	15.1	13.6	14.0	12.4	11.9	14.7	17.1
87/10/10 06	13.3	12.8	13.2	14.3	16.0	13.5	12.4	19.4	14.0	11.8	12.4	10.4	10.1	15.0	16.4
87/10/10 07	13.5	13.0	13.2	14.3	16.0	13.4	11.8	20.1	15.1	13.1	13.5	10.7	10.0	12.7	14.8
87/10/10 08	13.8	13.1	13.3	14.2	16.2	13.3	12.0	19.8	14.1	12.1	12.8	9.8	9.1	13.4	14.9
87/10/10 09	12.4	12.1	11.8	12.6	13.4	12.6	10.5	18.5	11.6	9.8	10.4	8.7	8.1	12.3	13.9

HOURLY DATA LISTING

DOE FREE FLOW DATA - JESS RANCH

ID	UNITS	DESCRIPTION
WSG8	MPH	TURBINE G8 35-ft
WSG0	MPH	TURBINE G10 35-ft
WSG2	MPH	TURBINE G12 35-ft
WSH1	MPH	TURBINE H1 50-ft
WSH7	MPH	TURBINE H7 50-ft
WSH0	MPH	TURBINE H10 50-ft
WSH2	MPH	TURBINE H12 50-ft
WSH5	MPH	TURBINE H15 50-ft
WSI1	MPH	TURBINE I1 50-ft
WSI3	MPH	TURBINE I3 50-ft
WSI5	MPH	TURBINE I5 50-ft
WSI9	MPH	TURBINE I9 50-ft
WSI4	MPH	TURBINE I14 50-ft
WSJ6	MPH	TURBINE J6 50-ft
WSJ8	MPH	TURBINE J8 50-ft

NOTES:

VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN.
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSG8 MPH	WSG0 MPH	WSG2 MPH	WSH1 MPH	WSH7 MPH	WSH0 MPH	WSH2 MPH	WSH5 MPH	WSI1 MPH	WSI3 MPH	WSI5 MPH	WSI9 MPH	WSI4 MPH	WSJ6 MPH	WSJ8 MPH
87/10/01	15	17.4	19.9	21.4	23.3	21.8	22.6	19.1	22.0	22.6	22.9	22.5	21.5	24.1	23.8	22.4
87/10/01	16	17.2	19.0	20.2	25.9	21.7	22.1	20.9	21.4	21.9	24.2	22.8	23.0	23.7	24.2	22.8
87/10/01	17	16.1	18.3	20.5	21.9	19.1	20.1	18.5	19.8	20.8	21.9	19.8	20.4	23.7	22.9	21.7
87/10/01	18	16.3	17.3	19.5	19.9	18.4	19.8	17.6	19.3	19.8	21.2	18.7	20.2	22.2	22.8	21.6
87/10/01	19	19.4	20.6	22.5	27.6	22.6	23.3	20.7	21.2	22.9	23.1	20.9	21.4	22.1	25.5	24.9
87/10/01	20	10.5	10.9	11.7	17.5	14.4	13.3	14.9	12.6	13.6	15.0	13.3	14.1	11.4	13.5	11.1
87/10/01	21	9.5	10.8	13.6	17.2	14.9	14.8	14.1	15.1	15.0	15.3	14.8	14.5	15.4	13.8	13.5
87/10/01	22	17.2	19.1	21.0	29.9	32.3	32.8	29.9	30.0	31.1	29.5	27.5	27.9	27.5	22.8	23.7
87/10/01	23	18.9	19.3	21.7	32.2	30.4	31.9	28.8	29.9	31.4	31.9	30.4	31.1	30.0	23.0	22.9
87/10/01	24	16.8	17.6	18.9	32.1	24.0	26.1	24.0	24.3	26.0	26.9	26.4	25.8	26.2	22.2	26.1
87/10/02	01	14.6	17.5	18.9	33.5	24.8	27.8	26.6	24.8	28.0	29.4	28.6	26.5	27.5	22.8	26.2
87/10/02	02	11.1	13.1	15.6	30.1	22.6	21.8	24.9	20.7	21.6	22.1	21.3	20.4	20.9	19.7	21.6
87/10/02	03	1.4	5.4	15.7	32.7	25.1	22.7	26.9	24.0	21.1	18.9	16.3	20.6	13.9	10.6	11.1
87/10/02	04	2.1	4.3	13.4	31.7	22.6	19.8	25.1	20.2	17.8	15.1	14.2	12.2	8.7	12.1	9.4
87/10/02	05	9.8	11.0	12.1	29.1	20.8	19.8	24.8	19.1	19.8	20.6	21.1	17.9	20.1	18.1	20.1
87/10/02	06	5.8	4.1	6.8	25.6	16.0	12.1	20.5	12.8	11.0	11.2	10.0	6.3	5.9	6.0	7.3
87/10/02	07	0.5	0.9	5.1	14.8	8.7	5.1	9.2	5.9	3.3	2.4	2.2	3.4	0.8	0.5	1.5
87/10/02	08	2.8	6.5	9.5	12.9	10.9	10.3	9.2	8.7	9.2	9.1	7.4	6.9	5.1	7.3	2.3
87/10/02	19	7.8	8.2	9.3	11.8	10.5	9.7	10.3	9.7	8.9	10.2	10.1	9.4	10.7	10.9	9.3
87/10/02	20	6.6	7.3	8.9	9.6	9.3	7.1	9.2	8.7	6.5	8.7	9.8	8.3	12.2	11.1	6.6
87/10/02	21	9.4	10.6	11.8	15.6	14.1	14.2	13.9	13.0	13.2	12.8	11.6	11.3	14.7	14.3	6.3
87/10/02	22	8.0	7.3	9.3	15.4	12.3	13.0	12.8	11.9	12.2	13.1	12.4	12.1	11.8	11.8	5.7
87/10/02	23	7.8	8.2	9.7	17.1	13.1	13.9	14.0	12.6	13.7	15.1	14.6	13.5	13.3	13.3	8.8
87/10/02	24	9.4	9.5	9.3	15.7	13.4	15.6	12.9	12.9	15.2	16.0	14.9	14.7	13.3	13.8	10.4
87/10/03	01	5.3	5.2	7.8	17.3	13.7	15.2	13.6	13.1	15.1	16.2	15.3	14.2	13.8	9.9	9.6
87/10/03	02	4.7	7.3	10.1	18.1	13.9	11.8	14.7	10.8	10.5	9.4	8.1	5.7	7.8	8.4	9.9
87/10/03	03	6.1	8.9	11.3	18.3	13.6	12.7	14.3	11.4	11.4	11.2	10.9	7.8	10.6	10.3	10.9
87/10/03	04	3.8	1.9	4.0	16.1	9.4	10.3	10.1	6.6	9.2	8.7	8.0	5.5	6.5	6.1	4.8
87/10/03	05	2.0	5.1	8.8	14.5	12.3	13.0	9.8	8.1	12.4	11.7	10.6	5.3	9.4	8.3	7.7

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD HR	WSG8 MPH	WSG0 MPH	WSG2 MPH	WSH1 MPH	WSH7 MPH	WSH0 MPH	WSH2 MPH	WSH5 MPH	WSI1 MPH	WSI3 MPH	WSI5 MPH	WSI9 MPH	WSI4 MPH	WSJ6 MPH	WSJ8 MPH
87/10/07 09	16.7	19.4	20.0	25.8	15.9	14.7	14.4	12.4	14.6	15.8	16.5	13.5	18.0	18.4	17.4
87/10/07 10	20.7	23.9	26.8	36.5	27.7	26.1	27.0	23.5	26.3	27.7	26.8	24.4	26.6	25.8	24.4
87/10/07 11	20.4	22.8	24.3	31.4	23.3	23.0	22.6	21.0	22.3	22.2	23.4	20.4	24.9	25.4	24.6
87/10/07 12	19.3	21.8	23.6	29.1	22.3	23.2	21.9	22.0	23.2	25.2	24.3	23.3	25.5	25.2	23.5
87/10/07 13	17.1	17.7	21.3	23.6	19.0	20.4	18.7	20.2	20.2	19.7	20.0	19.1	22.3	21.0	19.8
87/10/07 14	18.0	19.3	21.1	19.9	19.8	21.2	19.8	20.8	20.9	20.7	20.6	19.8	21.9	21.6	22.0
87/10/07 15	16.3	17.0	19.5	19.8	20.0	21.3	20.3	21.0	21.2	21.2	21.0	20.1	22.8	20.8	20.9
87/10/07 16	16.0	17.0	19.2	21.6	20.8	22.8	21.0	22.3	22.8	22.6	22.4	21.0	23.5	22.4	21.2
87/10/07 17	15.0	17.3	18.4	23.4	18.8	19.3	18.2	19.1	19.3	19.7	19.7	18.7	21.6	20.0	19.0
87/10/07 18	18.7	22.2	22.8	25.4	24.1	24.8	23.1	23.9	24.5	25.0	25.1	23.5	24.9	24.3	23.6
87/10/07 19	21.5	24.5	25.1	30.7	28.3	27.3	26.8	26.2	27.2	29.7	29.3	27.9	27.3	28.9	27.9
87/10/07 20	23.8	26.2	28.3	38.4	31.5	31.2	29.6	29.8	30.5	32.0	32.7	30.2	32.4	33.7	31.3
87/10/07 21	23.3	25.4	27.4	40.5	33.3	30.2	33.2	29.1	28.5	29.1	28.3	27.7	32.2	33.2	32.1
87/10/07 22	22.8	25.7	27.1	40.9	33.4	31.4	33.3	30.6	30.3	29.9	30.0	29.4	32.3	31.5	31.9
87/10/07 23	23.4	26.2	27.0	41.5	35.8	32.9	36.1	31.8	31.8	32.4	31.0	30.9	33.4	32.1	32.6
87/10/07 24	22.8	25.5	26.9	40.5	33.5	31.5	34.3	30.3	30.9	30.4	28.6	30.2	30.8	31.4	31.5
87/10/08 01	18.5	22.1	24.1	37.8	30.9	28.9	32.1	28.3	26.9	26.6	26.0	26.7	26.8	27.7	29.1
87/10/08 02	19.7	18.7	20.2	35.5	29.8	27.3	30.8	27.1	26.3	27.0	26.7	26.6	28.1	25.3	26.1
87/10/08 03	18.6	17.0	18.3	34.4	29.7	27.0	30.3	27.4	25.1	25.4	25.6	25.5	26.9	23.0	24.0
87/10/08 04	20.3	18.6	18.6	34.0	27.5	25.9	28.4	25.6	24.8	25.2	25.7	24.9	26.4	23.4	24.3
87/10/08 05	16.4	17.1	18.2	32.0	24.7	25.0	25.4	23.0	24.6	25.4	25.4	24.1	26.9	23.3	26.5
87/10/08 06	12.6	15.0	16.2	30.1	23.5	23.5	23.9	21.9	23.1	23.7	23.8	22.8	24.1	20.9	23.5
87/10/08 07	18.1	17.2	17.2	28.7	22.6	21.7	23.6	19.9	22.0	23.2	23.4	21.7	24.8	21.2	24.0
87/10/08 08	17.5	17.2	17.9	26.4	22.3	23.1	22.0	21.1	22.7	23.0	23.0	21.7	23.8	23.6	25.6
87/10/08 09	19.7	16.6	16.1	27.9	22.4	22.4	22.3	21.4	21.8	22.3	22.4	21.7	24.3	21.0	20.3
87/10/08 10	14.8	14.3	13.9	21.3	18.3	18.3	17.4	17.4	17.7	18.0	17.8	17.3	19.4	17.0	16.7
87/10/08 11	11.0	11.1	11.9	18.2	15.3	15.2	14.5	14.3	15.1	15.6	15.5	14.7	16.3	15.1	15.7
87/10/08 12	10.1	11.1	12.2	17.4	15.7	15.1	15.5	14.9	15.0	15.3	14.9	14.6	15.4	14.7	14.9
87/10/08 13	10.5	12.0	13.5	17.4	15.9	16.8	15.7	16.4	16.5	16.6	16.4	15.6	17.1	16.3	16.8
87/10/08 14	12.2	14.0	15.5	19.5	18.4	19.2	18.6	19.0	19.0	19.3	18.5	18.1	19.9	18.0	18.1
87/10/08 15	13.9	14.8	16.8	21.4	18.9	19.1	18.5	18.8	18.8	19.6	19.1	18.7	20.3	18.4	18.2
87/10/08 16	15.6	16.8	18.0	21.3	20.0	21.1	19.8	21.0	21.1	21.4	21.2	20.0	23.0	21.4	21.1
87/10/08 17	14.3	16.2	18.1	22.3	20.3	20.4	19.8	19.9	20.0	20.7	20.0	19.4	21.1	21.0	20.3
87/10/08 18	13.8	16.0	17.3	23.3	18.9	19.0	19.1	19.1	18.4	18.6	18.5	18.2	20.3	19.7	19.1
87/10/08 19	16.3	18.4	19.5	27.0	20.0	18.8	20.3	17.3	18.7	18.2	18.3	16.5	20.9	20.4	19.5
87/10/08 20	21.9	23.8	25.1	31.7	23.7	22.3	21.7	20.4	22.6	25.3	25.4	23.5	26.0	26.2	27.2
87/10/08 21	21.5	22.6	24.5	37.0	30.6	32.8	28.6	29.1	31.6	30.8	29.4	28.3	29.6	29.5	26.9
87/10/08 22	20.2	22.3	23.4	34.3	30.7	29.4	32.7	26.0	29.1	29.5	29.5	26.7	28.6	28.6	28.0
87/10/08 23	23.6	26.1	26.4	34.4	25.3	21.9	26.9	18.8	21.4	21.3	23.7	19.0	29.0	31.5	30.5
87/10/08 24	19.5	23.0	25.0	36.4	29.2	23.9	29.7	24.7	21.8	20.6	20.6	21.1	24.1	27.6	27.5

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSG8 MPH	WSG0 MPH	WSG2 MPH	WSH1 MPH	WSH7 MPH	WSH0 MPH	WSH2 MPH	WSH5 MPH	WSI1 MPH	WSI3 MPH	WSI5 MPH	WSI9 MPH	WSI4 MPH	WSJ6 MPH	WSJ8 MPH
87/10/09	01	20.0	22.1	23.7	33.4	27.3	26.0	27.3	25.4	24.8	25.3	24.8	24.8	25.5	26.1	26.5
87/10/09	02	19.9	21.9	22.8	32.0	25.2	24.1	25.3	23.3	22.8	23.1	23.0	22.3	25.5	26.0	26.3
87/10/09	03	17.4	18.0	19.3	34.5	27.7	25.3	28.7	25.8	23.7	23.7	23.7	23.8	25.6	24.1	26.5
87/10/09	04	13.8	12.8	12.5	28.6	23.2	21.0	24.0	21.2	19.9	19.8	20.1	20.3	20.6	17.2	16.4
87/10/09	05	9.6	8.2	9.0	16.9	12.9	11.7	13.2	11.1	11.5	11.8	12.3	11.5	13.5	12.0	12.4
87/10/09	06	12.2	12.3	13.2	23.4	19.2	18.0	19.1	17.6	17.6	17.7	17.7	17.4	19.3	18.6	18.5
87/10/09	07	13.9	15.8	18.1	24.3	19.6	19.0	19.0	18.0	18.4	18.3	19.4	17.3	20.3	19.7	18.8
87/10/09	08	17.8	18.8	20.6	29.4	23.1	22.3	22.9	21.7	21.7	22.4	22.9	21.3	24.6	24.4	24.6
87/10/09	09	16.3	17.7	19.4	28.7	22.8	21.7	22.8	21.5	20.9	20.8	20.6	20.5	23.1	22.7	23.2
87/10/09	10	17.7	18.4	19.9	30.2	24.3	23.5	23.9	23.3	23.6	24.5	24.6	23.5	27.0	24.8	25.5
87/10/09	11	17.5	17.8	19.8	28.3	23.9	24.7	23.8	24.5	24.8	25.1	24.9	24.1	27.2	25.1	25.9
87/10/09	12	17.7	19.0	20.6	27.0	23.5	24.3	23.3	24.1	24.2	24.6	24.6	23.5	26.4	24.3	24.3
87/10/09	13	16.8	17.9	19.1	24.9	21.3	22.9	21.6	23.0	22.9	23.1	22.5	21.8	24.0	23.7	23.9
87/10/09	14	16.4	17.4	18.8	25.1	21.9	21.6	21.6	21.2	21.3	22.4	22.7	21.4	24.0	22.6	22.8
87/10/09	15	14.6	16.1	17.9	22.7	20.2	21.2	20.1	21.0	20.8	20.9	21.3	20.1	22.9	21.3	21.8
87/10/09	16	14.9	16.1	18.5	21.4	19.3	20.8	19.5	20.4	20.6	20.3	20.6	19.4	21.7	20.2	20.8
87/10/09	17	12.4	14.3	17.7	16.0	14.4	15.5	14.5	15.0	15.5	15.7	15.9	14.6	17.4	16.5	16.8
87/10/09	18	13.0	14.6	16.7	24.1	16.5	16.1	16.2	15.5	16.0	16.1	15.6	15.6	16.6	18.6	18.3
87/10/09	19	15.8	17.8	19.4	24.9	18.7	18.1	18.3	17.5	17.9	18.6	18.5	17.5	19.9	20.4	19.9
87/10/09	20	15.8	18.8	20.4	23.1	19.9	21.7	19.4	21.0	21.8	22.3	22.0	20.9	22.8	21.7	20.9
87/10/09	21	17.1	19.2	20.9	25.8	24.3	24.9	24.0	24.3	24.8	24.9	25.2	23.7	26.5	25.3	24.3
87/10/09	22	17.2	18.2	20.4	27.2	24.1	24.5	23.7	24.2	24.3	24.6	24.6	23.7	26.4	25.5	25.9
87/10/09	23	14.6	16.0	17.1	27.9	21.6	21.1	21.8	20.9	20.5	20.6	20.8	20.4	22.8	21.8	22.9
87/10/09	24	13.2	14.6	16.4	25.3	20.3	19.4	20.6	19.3	18.7	18.7	18.9	18.4	20.8	19.3	19.3
87/10/10	01	14.3	15.3	16.9	24.9	20.3	19.2	20.4	18.9	18.7	19.3	19.6	18.8	21.9	20.3	19.8
87/10/10	02	12.9	14.1	16.2	22.3	18.7	18.1	19.1	18.1	17.5	17.8	17.8	17.6	19.2	17.4	17.8
87/10/10	03	11.4	11.8	14.6	19.0	15.1	13.6	15.8	14.0	13.0	12.9	13.2	13.3	14.6	13.8	15.1
87/10/10	04	13.9	15.5	17.5	21.6	17.0	16.8	16.7	16.6	16.7	16.5	16.4	16.0	18.0	18.9	19.6
87/10/10	05	12.8	13.2	14.8	21.6	16.7	16.0	16.5	15.9	15.7	16.0	16.0	15.7	17.7	17.2	17.9
87/10/10	06	10.7	11.6	13.0	20.0	16.6	16.8	16.3	16.2	16.3	16.3	16.4	15.5	17.2	16.6	16.5
87/10/10	07	10.7	11.2	12.1	21.1	17.4	17.2	17.2	16.7	16.5	16.1	16.1	15.6	17.5	15.9	17.1
87/10/10	08	10.0	10.6	12.0	20.8	17.9	17.9	17.4	17.2	17.3	17.4	16.7	16.7	17.2	16.2	16.3
87/10/10	09	9.0	9.0	11.1	19.3	15.5	15.5	15.2	14.9	14.9	15.2	14.8	14.6	15.7	13.5	13.5

HOURLY DATA LISTING

DOE FREE FLOW DATA - JESS RANCH

ID	UNITS	DESCRIPTION
WSJ1	MPH	TURBINE J11 50-ft
WSJ3	MPH	TURBINE J13 50-ft
WSK1	MPH	TURBINE K1 35-ft
WSK3	MPH	TURBINE K3 35-ft
WSK5	MPH	TURBINE K5 35-ft
WSK7	MPH	TURBINE K7 35-ft
WSK9	MPH	TURBINE K9 35-ft
WSK2	MPH	TURBINE K12 35-ft
WSK4	MPH	TURBINE K14 35-ft
WSL1	MPH	TURBINE L1 35-ft
WSL3	MPH	TURBINE L3 35-ft
WSL5	MPH	TURBINE L5 35-ft
WSL8	MPH	TURBINE L8 35-ft
WSL0	MPH	TURBINE L10 35-ft
WSL2	MPH	TURBINE L12 35-ft

NOTES:
VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN.
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD HR	WSJ1 MPH	WSJ3 MPH	WSK1 MPH	WSK3 MPH	WSK5 MPH	WSK7 MPH	WSK9 MPH	WSK2 MPH	WSK4 MPH	WSL1 MPH	WSL3 MPH	WSL5 MPH	WSL8 MPH	WSL0 MPH	WSL2 MPH
87/10/01 15	23.1	21.7	19.5	20.0	20.3	19.9	22.5	20.9	23.7	24.3	25.3	26.5	24.1	25.8	27.1
87/10/01 16	23.4	22.2	19.3	19.4	19.3	19.8	21.7	20.9	23.3	23.9	25.2	26.0	24.3	25.3	26.2
87/10/01 17	22.2	21.1	18.1	18.5	19.3	19.1	21.1	20.3	22.3	22.3	22.8	23.9	21.8	23.3	24.8
87/10/01 18	21.7	20.1	17.8	17.4	17.0	17.7	20.3	18.4	21.4	22.6	24.1	25.0	22.9	24.6	26.0
87/10/01 19	26.0	26.1	20.9	22.3	22.1	18.8	20.9	19.6	21.0	24.2	24.6	25.3	23.2	24.2	25.7
87/10/01 20	13.3	12.8	11.9	12.8	13.4	11.7	12.3	12.4	12.4	14.4	14.9	14.8	12.9	13.8	14.2
87/10/01 21	14.7	14.9	12.6	13.4	15.4	14.8	16.8	16.2	18.7	19.0	20.0	20.9	19.4	20.8	22.0
87/10/01 22	24.8	25.3	21.1	21.3	20.0	17.4	19.5	17.9	20.5	22.5	23.9	25.0	22.4	23.6	24.9
87/10/01 23	24.5	26.9	23.7	24.2	21.6	20.8	22.5	21.7	23.4	25.3	26.6	27.5	25.1	26.8	27.9
87/10/01 24	24.6	27.4	22.8	22.4	20.1	17.8	20.1	18.7	21.6	23.6	25.5	27.0	24.3	26.2	27.8
87/10/02 01	25.0	25.8	19.9	18.6	17.4	16.2	20.5	17.0	21.8	25.2	26.8	28.4	25.7	27.8	29.3
87/10/02 02	21.7	19.3	14.9	13.1	13.9	14.4	18.7	15.3	19.6	22.0	23.4	23.8	22.3	23.1	24.5
87/10/02 03	10.7	10.8	9.0	11.5	15.9	16.7	21.1	18.7	22.9	24.2	25.4	26.1	24.7	25.6	27.2
87/10/02 04	10.6	10.0	7.3	10.6	15.2	16.4	20.1	18.3	22.4	23.2	24.6	26.1	24.0	25.3	27.5
87/10/02 05	19.4	14.0	14.1	9.6	9.8	12.2	17.0	14.0	19.0	20.4	21.6	22.8	21.1	22.2	24.4
87/10/02 06	6.3	5.4	6.8	5.7	7.4	10.3	14.4	12.4	16.5	17.4	18.6	19.1	17.9	18.5	19.6
87/10/02 07	2.1	2.7	3.0	5.1	8.9	9.3	11.9	11.0	13.3	13.4	14.0	14.2	12.9	14.0	14.4
87/10/02 08	10.0	10.6	9.3	11.3	13.0	12.1	12.5	13.0	14.3	13.7	14.5	15.2	13.6	14.7	14.5
87/10/02 19	11.1	10.1	8.6	8.5	9.0	7.8	8.5	8.2	8.6	8.9	9.2	9.3	8.3	9.3	10.0
87/10/02 20	11.3	10.8	7.6	8.3	9.6	9.0	10.6	10.0	11.5	11.8	12.2	12.3	11.4	12.3	13.1
87/10/02 21	13.7	12.8	11.2	11.1	10.7	9.7	11.4	10.4	12.5	12.5	12.8	13.0	12.2	12.8	13.6
87/10/02 22	10.1	8.2	8.2	8.3	9.5	9.4	11.4	10.6	12.6	12.7	13.5	13.5	13.0	13.4	14.3
87/10/02 23	13.0	10.5	8.2	9.9	9.2	9.2	11.4	9.9	12.7	13.3	14.0	14.5	13.6	14.5	15.9
87/10/02 24	13.1	8.6	8.7	8.8	8.0	8.7	11.2	10.5	12.7	12.8	13.2	13.9	13.0	14.1	15.5
87/10/03 01	10.0	8.4	7.3	7.5	9.9	11.1	13.3	12.9	15.1	15.0	15.3	15.9	15.1	15.9	17.3
87/10/03 02	10.2	10.5	10.2	11.9	13.3	12.8	14.6	13.5	15.1	15.5	15.7	16.0	14.9	16.0	16.7
87/10/03 03	11.5	11.5	10.7	11.8	13.5	12.7	14.3	13.3	15.2	15.5	15.5	15.9	14.7	15.8	16.5
87/10/03 04	5.0	4.1	4.9	4.2	7.0	8.0	10.8	9.0	11.5	12.3	12.7	13.1	11.9	13.1	13.4
87/10/03 05	7.8	7.5	7.7	9.2	11.1	11.0	12.5	11.4	13.2	13.3	13.5	13.2	12.9	13.6	13.7

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSJ1 MPH	WSJ3 MPH	WSK1 MPH	WSK3 MPH	WSK5 MPH	WSK7 MPH	WSK9 MPH	WSK2 MPH	WSK4 MPH	WSL1 MPH	WSL3 MPH	WSL5 MPH	WSL8 MPH	WSL0 MPH	WSL2 MPH
87/10/07	09	17.2	15.6	16.0	17.0	16.7	16.0	19.0	15.3	17.7	22.4	25.4	29.4	19.1	23.9	26.9
87/10/07	10	23.6	23.2	22.0	23.2	24.8	25.4	26.5	25.6	28.4	30.4	32.2	34.2	30.0	32.8	33.8
87/10/07	11	24.3	23.9	21.8	22.3	22.1	22.9	25.6	23.1	27.2	29.1	30.8	32.2	28.7	30.7	32.1
87/10/07	12	23.8	23.6	20.7	21.7	22.4	22.1	23.7	22.8	25.6	27.7	29.5	29.7	27.3	28.7	29.9
87/10/07	13	21.3	21.3	18.5	18.9	21.3	20.4	22.6	21.0	24.3	25.6	26.6	27.5	24.8	26.7	27.7
87/10/07	14	22.5	22.4	19.7	19.7	20.7	20.7	22.1	21.4	23.9	24.6	26.0	26.9	24.8	26.2	26.7
87/10/07	15	21.5	21.5	18.7	18.7	19.4	19.8	21.1	20.5	23.2	23.5	24.4	25.5	23.5	24.9	25.6
87/10/07	16	22.1	21.2	18.3	18.2	19.3	19.3	21.6	20.2	23.2	23.8	25.0	25.8	23.6	25.2	25.9
87/10/07	17	19.6	19.1	13.2	17.1	18.0	17.6	18.8	18.8	20.3	21.3	23.5	24.2	21.8	23.5	23.9
87/10/07	18	24.4	24.7	18.3	21.7	21.9	22.5	23.0	23.4	25.2	25.6	27.2	29.0	25.9	27.7	29.6
87/10/07	19	28.2	29.0	23.3	25.1	24.3	24.1	25.2	24.8	28.7	30.6	31.2	32.3	30.0	31.5	32.7
87/10/07	20	32.3	31.4	26.3	27.6	27.3	27.9	29.3	29.5	32.7	33.4	35.9	36.4	34.2	36.7	35.5
87/10/07	21	33.0	31.0	27.2	26.7	25.9	27.0	29.8	28.0	32.3	32.5	34.6	36.2	33.0	35.3	36.3
87/10/07	22	31.8	31.7	28.1	27.0	26.1	25.4	28.2	26.6	30.5	31.5	33.3	35.1	31.7	34.3	34.8
87/10/07	23	32.6	31.5	27.9	28.0	27.3	25.9	29.2	27.3	31.8	31.6	34.6	36.2	32.7	35.6	35.5
87/10/07	24	32.0	29.4	25.7	27.3	26.2	25.9	29.6	27.6	31.7	31.2	33.1	34.9	31.7	33.8	34.8
87/10/08	01	28.7	28.2	24.1	23.2	23.0	21.7	25.9	22.6	27.1	28.3	30.5	32.0	28.8	30.9	31.8
87/10/08	02	25.3	28.3	25.1	25.7	21.5	17.6	18.1	18.1	18.1	23.8	26.6	28.6	24.5	26.9	28.3
87/10/08	03	23.5	25.8	23.8	25.1	20.0	15.4	17.4	16.4	17.1	23.0	24.5	26.7	22.7	24.7	26.5
87/10/08	04	23.9	25.8	22.9	24.4	22.0	17.2	17.6	18.4	18.2	19.6	21.9	23.0	20.4	22.0	22.7
87/10/08	05	25.9	27.2	23.8	21.7	18.1	16.2	19.5	17.3	20.5	23.0	24.0	25.0	23.1	24.3	24.8
87/10/08	06	22.7	23.7	20.4	17.6	14.9	14.9	19.1	15.9	20.4	22.1	23.5	24.2	22.5	23.7	24.0
87/10/08	07	23.1	25.3	22.7	22.8	19.3	15.3	15.2	16.0	16.3	18.9	21.1	21.6	19.9	21.2	21.5
87/10/08	08	25.3	25.4	22.3	22.5	18.9	15.9	16.1	16.4	17.3	18.6	19.8	20.5	19.0	20.0	19.9
87/10/08	09	21.1	22.4	20.1	22.3	21.1	16.1	14.8	18.0	16.2	15.9	16.7	19.0	15.8	17.2	19.1
87/10/08	10	17.4	18.8	17.0	18.4	16.8	13.5	12.5	14.5	13.7	13.5	14.8	16.5	13.9	15.2	16.6
87/10/08	11	15.5	14.9	13.9	13.8	12.9	11.1	12.6	12.2	13.6	14.8	16.6	17.6	15.3	16.7	18.1
87/10/08	12	14.9	14.6	13.6	13.5	12.9	11.6	13.2	12.7	14.3	15.6	17.2	18.3	16.1	17.4	18.6
87/10/08	13	16.8	15.5	14.3	13.6	14.4	14.0	16.0	15.0	17.2	18.4	19.2	20.0	18.1	19.3	20.4
87/10/08	14	18.1	17.9	15.6	15.7	15.7	15.6	17.4	16.7	18.7	19.8	21.0	21.8	19.8	21.1	22.2
87/10/08	15	18.2	18.2	15.7	16.3	17.1	16.7	18.2	17.5	19.6	20.9	22.0	22.6	20.9	22.0	23.0
87/10/08	16	21.2	20.9	17.7	18.3	18.6	18.0	19.9	18.9	21.6	22.9	24.3	24.9	23.0	24.3	25.0
87/10/08	17	20.4	19.8	17.0	17.6	18.1	17.6	19.4	19.1	20.9	20.9	23.2	24.4	22.1	23.8	24.6
87/10/08	18	19.8	19.2	15.2	17.4	17.1	16.2	18.9	17.6	20.0	19.7	21.5	23.5	19.9	22.2	24.1
87/10/08	19	19.6	19.9	15.5	18.5	18.8	19.8	21.5	20.1	23.7	25.0	24.9	25.8	24.6	24.7	26.2
87/10/08	20	27.2	28.3	24.3	24.5	25.3	25.6	27.0	26.7	30.7	30.4	29.8	32.6	29.7	31.6	33.8
87/10/08	21	27.5	27.2	23.1	24.5	24.0	24.4	25.2	25.4	28.9	29.8	28.6	30.2	28.1	29.3	31.1
87/10/08	22	28.3	27.0	23.6	23.4	23.8	24.4	25.7	25.2	28.9	29.4	30.4	32.2	29.6	31.4	32.0
87/10/08	23	30.5	31.1	26.7	28.0	26.3	24.8	28.0	26.2	30.8	31.3	32.6	35.6	31.7	34.8	35.7
87/10/08	24	28.3	27.3	22.7	23.1	22.3	21.8	24.6	22.7	26.1	28.1	31.3	33.3	28.5	31.6	33.2

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSJ1 MPH	WSJ3 MPH	WSK1 MPH	WSK3 MPH	WSK5 MPH	WSK7 MPH	WSK9 MPH	WSK2 MPH	WSK4 MPH	WSL1 MPH	WSL3 MPH	WSL5 MPH	WSL8 MPH	WSL0 MPH	WSL2 MPH
87/10/09	01	26.4	27.2	23.7	24.5	24.6	22.7	26.0	24.7	28.0	27.8	28.4	30.0	27.8	29.0	30.3
87/10/09	02	26.4	27.1	23.3	24.9	24.1	22.4	24.9	24.1	27.1	27.1	27.7	28.8	27.3	26.2	29.2
87/10/09	03	25.9	27.4	23.9	23.4	20.4	17.9	20.8	19.4	21.7	24.6	26.1	27.7	24.9	26.1	27.3
87/10/09	04	17.9	18.0	16.3	17.0	14.5	12.1	11.7	12.4	12.1	15.4	17.8	19.8	15.3	18.3	19.5
87/10/09	05	12.3	12.6	11.3	11.1	10.0	8.1	8.9	8.4	9.4	10.4	11.4	13.2	10.1	11.8	13.4
87/10/09	06	18.4	18.1	16.6	15.9	14.3	13.1	15.2	14.2	15.9	17.6	19.3	20.4	17.9	19.5	20.6
87/10/09	07	19.3	18.3	15.7	16.7	17.9	17.4	19.4	18.4	21.2	22.5	23.7	24.1	22.6	23.6	24.1
87/10/09	08	25.0	24.8	19.9	21.4	21.1	19.5	22.7	20.8	24.5	25.0	27.0	28.3	25.6	27.4	28.2
87/10/09	09	23.2	22.5	16.6	19.6	19.3	18.4	21.4	19.6	22.9	24.3	26.0	27.3	24.8	26.3	27.4
87/10/09	10	25.8	25.7	18.1	21.9	20.9	18.7	21.5	20.3	22.7	24.7	26.1	26.7	24.5	26.3	26.7
87/10/09	11	26.3	26.1	11.3	22.1	20.4	18.4	21.1	20.2	22.6	23.5	24.8	25.7	23.6	24.8	25.4
87/10/09	12	24.6	24.9	15.4	21.9	21.2	19.6	21.4	21.0	23.1	23.1	23.9	25.3	23.2	24.4	25.1
87/10/09	13	24.2	23.7	19.3	20.2	19.5	17.8	19.5	19.2	20.9	21.6	22.9	24.3	21.7	23.5	24.5
87/10/09	14	23.2	23.5	19.5	20.4	19.1	17.4	19.8	18.9	21.5	22.1	23.4	23.9	22.1	23.2	24.0
87/10/09	15	22.2	21.9	17.7	18.5	18.4	16.9	18.8	18.4	20.5	21.0	22.0	23.0	21.1	22.1	23.2
87/10/09	16	20.9	20.6	16.8	17.6	18.4	17.3	18.2	18.7	19.7	20.4	21.9	22.5	20.4	21.8	22.8
87/10/09	17	17.0	17.3	14.4	15.0	17.2	16.7	18.5	17.8	20.0	20.5	21.3	21.8	19.9	21.1	22.1
87/10/09	18	18.5	17.6	14.4	15.0	14.8	14.9	17.0	15.4	18.2	20.5	22.5	23.6	20.4	22.2	22.6
87/10/09	19	20.0	20.0	16.9	17.7	18.5	18.9	21.0	19.4	22.7	24.4	25.6	26.1	23.8	25.4	26.2
87/10/09	20	21.3	21.8	18.1	18.9	19.3	19.4	22.0	20.7	24.2	25.3	25.8	26.8	25.3	26.0	27.6
87/10/09	21	24.9	24.2	19.3	20.2	20.4	20.2	22.4	21.7	25.1	26.4	27.9	28.7	27.4	28.2	28.9
87/10/09	22	26.4	25.0	20.2	21.1	20.1	19.1	22.6	20.6	24.2	23.7	26.3	27.8	25.0	26.9	27.7
87/10/09	23	23.1	22.5	17.6	18.4	17.9	15.9	18.7	17.1	19.8	21.6	23.3	23.3	22.1	23.2	23.2
87/10/09	24	19.5	19.6	16.2	16.9	16.4	15.5	18.1	16.8	19.3	20.0	22.0	23.3	20.8	22.5	23.4
87/10/10	01	20.3	20.1	17.2	18.0	16.8	15.8	18.8	17.0	20.0	20.8	22.8	24.0	21.0	23.0	23.8
87/10/10	02	18.0	18.1	15.5	16.2	16.0	15.4	18.7	16.6	19.8	20.8	22.3	22.6	21.2	22.1	22.5
87/10/10	03	14.9	16.9	14.0	14.6	14.5	12.7	14.3	14.1	15.4	17.8	19.7	21.7	17.7	19.6	21.0
87/10/10	04	19.9	19.4	16.4	17.1	16.8	15.1	18.2	16.6	19.0	20.3	21.8	23.3	20.3	22.2	23.2
87/10/10	05	17.8	18.1	14.7	15.4	14.9	13.3	14.8	14.6	15.8	17.3	18.9	20.2	17.4	19.0	19.8
87/10/10	06	16.6	15.6	13.3	13.3	12.6	12.3	15.4	13.5	16.3	16.2	17.8	18.3	17.1	17.7	17.9
87/10/10	07	16.7	17.1	14.0	13.8	12.6	10.9	12.9	11.7	13.3	14.8	16.5	17.6	15.2	16.3	17.7
87/10/10	08	16.3	15.8	12.9	12.9	11.6	10.8	13.8	11.6	14.2	14.7	16.4	17.2	15.1	16.1	17.4
87/10/10	09	13.3	13.0	11.2	11.2	10.7	10.1	12.3	10.9	13.0	14.1	15.4	16.6	14.2	15.5	16.7

HOURLY DATA LISTING

DOE FREE FLOW DATA - JESS RANCH

ID	UNITS	DESCRIPTION
WSM2	MPH	TURBINE M2 35-ft
WSM4	MPH	TURBINE M4 35-ft
WSM6	MPH	TURBINE M6 35-ft
WSM8	MPH	TURBINE M8 35-ft
WSM9	MPH	TURBINE M9 35-ft
WSM1	MPH	TURBINE M11 35-ft
WSM3	MPH	TURBINE M13 35-ft
WSN1	MPH	TURBINE N1 35-ft
WSN4	MPH	TURBINE N4 35-ft
WSN6	MPH	TURBINE N6 35-ft
WSN8	MPH	TURBINE N8 35-ft

NOTES:
VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN.
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA – JESS RANCH

YY/MM/DD	HR	WSM2 MPH	WSM4 MPH	WSM6 MPH	WSM8 MPH	WSM9 MPH	WSM1 MPH	WSM3 MPH	WSN1 MPH	WSN4 MPH	WSN6 MPH	WSN8 MPH
87/10/01	15	23.6	23.2	25.3	27.2	23.4	23.8	26.8	24.0	22.4	21.5	21.0
87/10/01	16	23.5	23.4	25.2	26.6	24.2	24.4	26.6	24.2	22.9	22.3	22.5
87/10/01	17	21.6	20.8	23.3	24.8	21.6	22.7	25.3	22.9	22.2	20.2	19.7
87/10/01	18	21.6	21.9	24.2	25.6	22.5	23.2	26.0	21.5	19.6	19.6	20.5
87/10/01	19	21.8	21.8	23.9	25.1	21.8	22.7	24.9	20.5	18.0	17.9	18.7
87/10/01	20	10.6	11.8	12.5	13.0	10.3	10.9	12.7	9.8	10.0	8.4	8.7
87/10/01	21	18.9	19.3	21.2	21.5	19.9	20.8	21.9	19.7	19.1	18.7	18.5
87/10/01	22	20.6	21.4	23.3	24.2	21.6	22.3	24.4	20.6	19.5	18.5	18.9
87/10/01	23	24.0	24.6	26.7	27.8	24.9	25.4	27.7	24.7	24.2	22.6	22.3
87/10/01	24	22.8	24.2	26.3	28.3	24.2	25.1	27.9	22.9	23.3	21.8	21.5
87/10/02	01	24.8	26.1	27.9	29.5	26.0	27.3	29.5	23.4	21.1	22.8	24.2
87/10/02	02	21.5	21.4	23.5	24.8	22.0	23.1	25.1	20.4	17.8	19.4	20.2
87/10/02	03	23.6	23.3	25.7	27.6	23.6	25.3	27.9	23.5	21.6	22.2	22.1
87/10/02	04	23.3	23.6	26.0	27.7	23.7	25.2	27.7	22.8	20.9	21.7	21.8
87/10/02	05	20.1	20.5	23.0	25.1	21.3	23.0	25.4	19.6	17.4	18.9	20.0
87/10/02	06	17.0	16.9	18.3	19.0	17.1	17.8	18.7	15.6	13.2	14.5	14.5
87/10/02	07	13.1	13.1	13.2	14.1	13.4	13.3	14.7	12.6	10.1	11.8	11.7
87/10/02	08	13.4	12.8	12.6	12.0	13.2	11.8	14.1	13.7	13.5	12.7	11.9
87/10/02	19	8.9	8.3	9.3	10.5	8.7	9.3	10.6	9.3	8.8	8.1	8.5
87/10/02	20	11.7	11.4	12.5	13.4	12.2	12.5	13.9	12.4	11.9	11.9	11.7
87/10/02	21	12.4	12.0	12.6	14.5	12.7	12.7	14.8	13.2	12.9	12.6	11.8
87/10/02	22	13.0	12.9	13.7	15.0	13.5	13.8	15.3	13.4	12.7	13.2	13.8
87/10/02	23	13.5	13.8	15.0	16.3	14.7	15.1	16.7	13.6	12.7	13.6	13.7
87/10/02	24	13.1	13.4	14.6	16.3	14.3	15.0	16.7	13.4	12.9	13.7	13.4
87/10/03	01	15.1	15.1	16.4	17.7	15.5	16.2	17.7	15.3	14.2	14.8	14.5
87/10/03	02	15.4	15.0	15.6	16.3	14.9	15.1	16.2	15.1	14.1	14.1	13.4
87/10/03	03	15.3	14.9	15.4	16.1	14.9	14.8	15.7	15.3	14.1	13.9	13.5
87/10/03	04	12.1	12.2	12.7	13.1	11.9	11.9	12.6	10.9	5.9	8.4	9.3
87/10/03	05	13.5	13.0	13.1	13.7	13.1	12.6	13.2	13.3	11.9	12.4	12.0

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSM2 MPH	WSM4 MPH	WSM6 MPH	WSM8 MPH	WSM9 MPH	WSM1 MPH	WSM3 MPH	WSN1 MPH	WSN4 MPH	WSN6 MPH	WSN8 MPH
87/10/07	09	17.0	16.5	20.6	24.2	14.6	14.4	18.4	14.2	9.9	9.2	10.4
87/10/07	10	28.1	28.4	31.3	32.5	27.0	28.4	31.2	26.5	21.7	20.6	21.6
87/10/07	11	26.9	26.9	29.5	31.2	26.0	26.6	29.9	25.4	20.9	20.1	21.0
87/10/07	12	25.8	25.5	28.1	28.9	25.4	26.3	28.6	25.6	22.5	21.9	22.1
87/10/07	13	24.0	23.9	26.2	26.8	24.3	24.9	27.0	24.7	23.0	21.8	22.2
87/10/07	14	23.8	23.8	25.4	26.4	24.1	24.0	26.1	24.4	23.3	22.1	22.1
87/10/07	15	23.1	22.9	24.4	25.5	23.3	23.3	25.5	24.0	23.0	21.9	21.4
87/10/07	16	23.3	23.0	24.7	25.5	23.6	23.5	25.4	24.1	22.9	22.0	21.8
87/10/07	17	20.8	21.2	22.5	24.0	21.4	21.6	23.8	21.6	20.6	19.4	19.1
87/10/07	18	25.3	25.3	27.6	28.9	25.7	26.3	28.5	25.9	25.5	23.5	23.7
87/10/07	19	29.9	28.9	30.8	32.6	29.7	29.8	32.6	30.1	28.9	28.1	27.4
87/10/07	20	33.7	33.9	34.6	35.0	34.6	32.9	35.0	34.2	32.9	31.4	31.6
87/10/07	21	32.1	32.0	34.3	35.8	32.4	32.4	35.4	32.7	29.9	29.2	29.3
87/10/07	22	30.6	31.1	33.4	34.8	31.5	31.9	34.5	31.3	29.0	28.2	28.6
87/10/07	23	31.7	32.4	34.3	34.8	32.5	32.7	35.1	32.8	31.0	29.6	29.5
87/10/07	24	31.1	30.8	33.2	34.4	31.7	31.7	34.2	33.4	30.7	29.9	29.9
87/10/08	01	27.9	28.1	30.2	31.5	28.5	28.5	31.4	27.4	23.9	24.7	25.9
87/10/08	02	21.5	24.2	26.6	28.1	23.2	24.9	27.9	20.0	22.5	18.0	20.0
87/10/08	03	20.6	22.1	24.4	26.0	21.7	23.0	25.7	19.3	22.4	17.7	18.6
87/10/08	04	19.2	20.3	21.9	22.7	20.7	21.3	22.7	20.6	21.9	18.3	18.5
87/10/08	05	22.4	22.5	23.8	25.0	23.1	22.8	24.9	21.8	20.4	20.3	21.0
87/10/08	06	21.6	22.0	23.0	24.0	22.4	22.2	23.9	21.6	18.9	19.9	20.1
87/10/08	07	18.6	19.9	20.9	21.7	19.9	20.4	22.0	18.5	18.6	17.3	17.6
87/10/08	08	18.5	18.8	19.7	20.4	19.2	19.4	20.9	19.1	18.4	17.8	17.5
87/10/08	09	15.6	16.1	17.8	19.5	16.4	17.3	19.5	19.3	20.7	17.3	14.8
87/10/08	10	13.6	14.4	15.8	17.0	14.5	15.6	17.0	15.6	16.8	13.9	13.1
87/10/08	11	14.7	15.5	17.2	17.9	15.6	16.9	18.1	15.2	14.6	14.2	14.2
87/10/08	12	15.4	16.1	17.6	18.5	16.1	17.1	18.4	15.5	14.6	14.5	14.5
87/10/08	13	17.6	17.5	19.2	20.3	18.0	18.6	20.2	17.9	16.9	16.5	16.4
87/10/08	14	19.2	19.2	21.0	22.0	19.6	20.3	21.9	19.7	18.6	18.0	18.0
87/10/08	15	20.3	20.1	21.9	22.6	20.7	21.2	22.8	20.6	19.6	19.0	19.0
87/10/08	16	22.7	22.4	23.9	24.7	22.8	22.7	24.6	22.9	21.6	21.2	21.1
87/10/08	17	21.1	21.9	23.5	24.6	22.2	22.6	24.4	22.4	21.6	20.3	20.3
87/10/08	18	19.7	19.9	22.2	24.1	20.6	21.2	23.8	21.4	20.8	19.8	19.0
87/10/08	19	24.2	22.5	24.4	26.6	23.5	22.8	26.2	23.5	20.8	20.2	20.6
87/10/08	20	30.3	28.7	31.9	34.2	29.8	30.5	34.1	31.8	30.1	28.2	27.5
87/10/08	21	29.3	27.2	29.3	31.5	28.2	28.4	31.6	29.9	29.5	27.8	25.9
87/10/08	22	29.6	28.9	30.9	31.6	29.8	29.4	31.5	30.5	28.9	27.5	27.3
87/10/08	23	31.2	31.2	34.2	35.3	31.7	32.2	35.1	31.6	28.3	28.1	28.4
87/10/08	24	26.3	27.7	30.8	32.4	27.2	28.3	31.7	26.4	24.3	23.6	24.1

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSM2 MPH	WSM4 MPH	WSM6 MPH	WSM8 MPH	WSM9 MPH	WSM1 MPH	WSM3 MPH	WSN1 MPH	WSN4 MPH	WSN6 MPH	WSN8 MPH
87/10/09	01	28.5	27.6	29.3	30.6	29.3	28.5	31.0	30.1	28.9	27.7	28.0
87/10/09	02	27.3	27.1	28.7	29.4	28.0	28.0	30.1	29.5	28.9	27.3	26.7
87/10/09	03	23.3	25.0	26.5	27.8	25.8	26.1	28.1	24.0	23.9	22.6	24.3
87/10/09	04	13.8	16.1	18.7	19.7	15.6	17.6	19.4	14.6	14.7	13.1	13.6
87/10/09	05	10.0	10.8	12.2	13.5	10.2	11.6	13.3	10.9	10.5	10.0	9.3
87/10/09	06	17.1	18.0	19.3	20.8	18.0	18.4	20.7	17.2	16.1	15.5	16.3
87/10/09	07	22.2	22.2	23.4	23.8	22.6	22.8	24.0	22.6	21.2	21.0	21.0
87/10/09	08	24.7	25.2	27.2	28.0	25.7	26.3	28.1	25.8	24.1	23.6	23.7
87/10/09	09	23.9	24.4	26.1	27.8	24.7	25.1	28.0	23.9	22.1	21.8	22.5
87/10/09	10	24.2	24.4	26.3	26.6	25.1	25.4	26.7	24.5	24.3	22.7	23.6
87/10/09	11	23.1	23.4	25.0	25.6	24.4	24.5	25.9	24.6	25.0	22.7	22.8
87/10/09	12	22.7	22.9	24.6	25.3	24.0	24.2	25.5	25.3	24.6	23.3	22.5
87/10/09	13	21.0	21.6	23.7	24.2	22.3	22.8	24.3	22.8	22.5	21.0	20.4
87/10/09	14	21.7	21.7	22.9	23.8	22.5	22.2	23.7	23.1	22.1	21.2	20.8
87/10/09	15	20.6	20.5	22.1	23.1	21.4	21.6	23.2	22.2	21.3	20.6	19.6
87/10/09	16	19.6	19.9	21.8	22.6	20.6	21.1	22.8	20.8	20.4	19.0	18.9
87/10/09	17	19.5	19.0	20.7	21.7	19.7	19.6	22.0	20.3	19.2	18.3	18.1
87/10/09	18	19.4	19.6	21.1	21.9	19.6	19.4	21.2	18.4	16.7	16.6	17.2
87/10/09	19	23.3	22.7	24.6	25.1	23.0	23.3	25.1	23.1	21.4	21.0	20.8
87/10/09	20	24.8	23.8	25.9	27.3	25.0	24.5	27.1	25.1	23.5	23.0	22.9
87/10/09	21	26.6	26.4	27.9	28.8	27.3	26.9	29.0	27.1	25.8	25.5	25.6
87/10/09	22	24.3	25.0	27.0	27.8	25.5	26.2	28.5	26.1	24.5	24.0	24.0
87/10/09	23	21.2	22.2	22.8	23.2	22.4	22.4	23.6	21.1	20.1	19.5	20.6
87/10/09	24	20.2	20.8	22.6	23.6	21.2	21.7	23.8	20.9	19.2	19.2	19.4
87/10/10	01	20.2	21.1	23.1	24.0	21.3	22.2	24.2	21.0	19.8	19.3	19.4
87/10/10	02	20.6	21.2	22.2	23.0	21.8	22.1	23.3	20.7	19.4	19.3	19.9
87/10/10	03	15.7	17.7	19.9	21.2	17.1	18.6	20.6	17.1	17.5	16.0	15.2
87/10/10	04	19.6	20.3	22.4	23.6	20.6	21.4	23.6	19.8	18.8	18.2	18.6
87/10/10	05	16.2	17.6	19.2	20.1	17.7	18.4	20.0	17.6	17.3	16.2	15.5
87/10/10	06	16.4	16.8	17.6	17.7	17.2	17.0	17.8	17.2	15.9	15.9	15.3
87/10/10	07	14.0	15.4	16.5	17.7	15.4	15.7	17.5	14.2	13.5	13.0	13.1
87/10/10	08	14.4	15.2	16.2	17.5	15.2	15.8	17.1	14.8	13.5	13.5	13.4
87/10/10	09	13.5	14.3	15.5	16.9	14.5	14.9	16.5	13.8	12.8	12.6	12.7

APPENDIX D

Diurnal Mean Speed Summaries

DIURNAL SUMMARY BY PARAMETER

DOE FREE FLOW DATA - SOUZA RANCH

09/10/87 - 09/14/87

HOUR	WS13 MPH	WS12 MPH	WS27 MPH	WS26 MPH	WD13 DEG	WS29 MPH	WSD2 MPH	WSD4 MPH	WSD6 MPH	WSD7 MPH	WSD1 MPH	WSD3 MPH	WSE2 MPH	WSE4 MPH	WSE6 MPH	WSE0 MPH	WSE3 MPH	WSG7 MPH
1	29.5	28.0	27.9	28.0	226.6	28.5	29.0	28.2	27.7	28.9	32.3	33.3	30.7	27.9	27.5	30.3	27.2	27.6
2	26.9	26.0	26.7	26.8	219.7	26.8	27.4	27.0	27.7	27.6	31.5	32.9	29.5	26.5	26.9	29.7	25.8	26.0
3	25.5	24.5	24.5	24.6	222.5	24.6	25.5	24.6	24.8	25.2	28.5	29.9	28.1	26.0	25.0	27.4	25.3	24.8
4	24.5	23.6	24.2	24.2	225.8	23.9	23.9	23.9	24.5	24.1	28.1	28.9	26.2	23.5	23.8	25.9	22.8	23.5
5	24.6	23.6	24.3	24.3	221.8	24.3	24.0	24.5	24.9	24.1	28.5	29.6	27.3	24.6	24.0	26.7	23.9	23.5
6	24.8	23.9	24.0	23.9	222.4	23.8	24.2	23.9	23.9	24.4	27.8	28.3	26.2	24.0	24.1	25.6	23.1	24.1
7	23.7	22.6	22.3	22.1	225.9	22.3	23.2	22.2	22.4	23.2	25.7	27.0	25.3	22.7	22.6	24.3	22.1	22.8
8	23.7	22.6	21.9	21.8	225.9	21.9	22.1	21.8	21.9	22.3	25.4	26.1	24.4	22.2	22.5	23.5	21.6	22.5
9	23.4	22.2	22.1	22.2	226.4	22.3	22.4	22.1	22.2	22.0	25.7	26.4	25.0	22.6	22.9	23.8	21.9	21.3
10	22.6	21.4	21.1	21.2	227.0	21.6	21.5	20.9	20.4	20.6	23.8	24.1	23.0	21.6	22.1	21.7	20.9	20.1
11	19.6	18.5	18.8	19.0	228.7	19.1	19.3	18.8	18.2	18.5	21.2	21.4	20.1	18.7	19.3	19.4	18.3	17.2
12	18.3	17.4	16.8	17.0	227.1	17.3	17.3	16.7	16.4	16.5	19.0	19.4	18.6	17.4	18.1	17.3	17.0	16.0
13	18.3	17.6	17.4	17.5	224.0	17.8	17.8	17.3	16.6	17.0	19.5	19.7	18.6	17.2	17.5	17.6	16.7	16.2
14	18.8	17.9	17.7	17.9	230.7	18.5	18.4	17.6	17.1	17.5	20.1	20.1	19.1	17.8	18.2	17.8	17.3	16.4
15	20.6	19.1	19.6	19.5	236.9	20.5	20.2	19.1	18.2	19.0	21.8	21.6	20.7	19.3	19.8	19.2	18.9	17.3
16	20.7	19.5	19.7	19.7	236.4	21.3	21.1	20.1	19.1	19.7	22.8	22.5	21.5	19.9	20.2	19.9	19.6	17.8
17	21.3	20.0	20.2	20.2	231.5	21.2	21.1	20.5	19.8	20.2	23.3	23.4	22.1	20.5	21.2	20.7	20.1	18.7
18	24.8	23.2	22.3	22.3	229.2	23.6	23.4	22.8	21.8	22.4	25.8	25.6	24.3	22.7	23.1	23.2	22.1	21.7
19	27.6	25.9	24.1	23.9	230.8	25.2	25.3	24.5	23.8	24.4	28.2	28.3	27.1	25.2	25.4	25.3	24.8	23.9
20	32.8	31.2	28.8	28.3	229.7	29.8	30.0	28.8	28.1	28.9	33.3	33.3	31.9	29.9	30.5	30.2	29.4	28.7
21	34.5	33.0	32.5	32.0	229.2	32.4	32.2	31.7	30.5	31.2	36.3	35.6	32.9	30.3	30.8	31.9	29.4	31.6
22	32.4	31.0	31.5	31.4	227.0	31.6	31.9	31.4	30.2	31.1	35.6	34.9	32.7	30.3	30.5	31.7	29.1	30.4
23	30.7	29.3	29.2	29.2	225.4	29.4	29.0	28.8	28.0	28.6	33.0	33.1	31.1	28.7	29.0	29.8	27.6	28.4
24	31.3	29.6	28.3	28.2	229.5	28.6	28.2	27.9	27.6	27.7	32.6	32.5	30.0	28.2	28.9	28.8	27.2	28.8
MEAN	25.1	23.9	23.7	23.6	227.3	24.1	24.2	23.6	23.3	23.6	27.2	27.5	25.8	23.8	24.0	24.8	23.1	23.0
VALID HRS	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94

NAME	SITE LOCATION:	NAME	SITE LOCATION:
WS13	SITE S-13 70-ft reference	WS12	SITE S-13 35-ft
WS27	SITE S-27 80-ft reference	WS26	SITE S-27 35-ft
WD13	SITE S-13 70-ft	WS29	SITE S-29 50-ft
WSD2	TURBINE D2	WSD4	TURBINE D4
WSD6	TURBINE D6	WSD7	TURBINE D7
WSD1	TURBINE D11	WSD3	TURBINE D13
WSE2	TURBINE E2	WSE4	TURBINE E4
WSE6	TURBINE E6	WSE0	TURBINE E10
WSE3	TURBINE E14	WSG7	TURBINE G7

DIURNAL SUMMARY BY PARAMETER

DOE FREE FLOW DATA - SOUZA RANCH

09/10/87 - 09/14/87

HOUR	WS13 MPH	WD13 DEG	WSE1 MPH	WSF2 MPH	WSF4 MPH	WSF6 MPH	WSF8 MPH	WSF0 MPH	WSF1 MPH	WSF3 MPH	WSG2 MPH	WSG4 MPH	WSG7 MPH	WSG9 MPH
1	29.5	226.6	28.2	30.8	30.3	31.3	30.9	28.8	30.3	29.1	30.6	28.9	27.6	23.7
2	26.9	219.7	27.2	29.7	28.7	30.4	29.9	27.0	28.2	27.5	28.8	26.9	26.0	22.6
3	25.5	222.5	25.3	28.3	28.2	28.6	27.5	24.9	26.2	25.8	26.5	25.3	24.8	21.4
4	24.5	225.8	24.2	26.6	25.9	27.5	26.2	23.9	25.2	24.5	25.4	24.3	23.5	20.0
5	24.6	221.8	24.9	27.4	26.4	27.3	26.5	24.0	25.4	24.7	25.7	24.4	23.5	20.3
6	24.8	222.4	24.0	26.5	26.1	27.6	26.7	24.2	25.6	24.8	25.7	24.6	24.1	20.9
7	23.7	225.9	23.1	25.6	24.9	26.1	25.8	23.3	24.2	23.4	24.9	23.3	22.8	19.7
8	23.7	225.9	22.2	24.8	24.4	26.0	25.2	23.2	24.2	23.2	24.5	23.2	22.5	19.3
9	23.4	226.4	22.5	25.4	25.2	26.5	25.4	23.2	23.9	22.4	24.8	22.9	21.3	17.8
10	22.6	227.0	20.6	23.7	24.3	25.8	24.6	22.3	22.8	21.3	24.0	22.0	20.1	16.9
11	19.6	228.7	18.0	21.2	21.6	22.6	21.6	19.5	19.8	18.4	21.2	19.2	17.2	14.2
12	18.3	227.1	16.5	19.7	20.3	21.3	20.1	18.2	18.3	17.0	20.0	18.0	16.0	13.3
13	18.3	224.0	16.4	19.6	20.0	20.8	19.8	18.1	18.1	17.4	19.7	18.1	16.2	13.5
14	18.8	230.7	16.9	20.2	20.7	21.6	20.4	18.7	19.0	18.1	20.3	18.4	16.4	13.7
15	20.6	236.9	18.3	22.5	23.0	24.0	22.1	20.2	20.5	19.5	22.0	19.5	17.3	14.4
16	20.7	236.4	19.0	22.8	23.3	23.9	22.3	20.6	21.3	20.3	22.0	19.8	17.8	14.9
17	21.3	231.5	19.8	23.2	23.7	24.7	23.4	21.3	21.5	20.4	22.6	20.6	18.7	15.6
18	24.8	229.2	21.8	25.1	25.7	27.1	25.8	24.0	24.6	23.3	25.6	23.8	21.7	18.0
19	27.6	230.8	24.4	27.4	28.2	29.8	28.5	26.7	27.0	26.3	28.6	26.4	23.9	19.7
20	32.8	229.7	28.7	32.1	33.2	35.1	33.7	31.9	32.3	31.4	34.0	31.8	28.7	23.5
21	34.5	229.2	29.8	33.0	33.8	35.5	34.6	33.4	35.0	33.3	35.1	33.8	31.6	25.7
22	32.4	227.0	29.7	32.9	33.6	34.9	33.5	31.6	33.3	32.2	33.5	31.9	30.4	25.5
23	30.7	225.4	28.1	31.4	32.2	33.8	31.9	30.0	31.5	30.3	31.5	30.2	28.4	23.8
24	31.3	229.5	27.0	30.4	31.9	33.6	32.0	30.2	32.0	31.0	31.8	30.4	28.8	24.4
MEAN	25.1	227.3	23.3	26.4	26.6	27.8	26.7	24.6	25.5	24.5	26.3	24.6	23.0	19.4
VALID HRS	94	94	94	94	94	94	94	94	94	94	94	94	94	94

NAME	SITE LOCATION:
WS13	SITE S-13 70-ft reference
WSE1	TURBINE E12
WSF4	TURBINE F4
WSF8	TURBINE F8
WSF1	TURBINE F12
WSG2	TURBINE G2
WSG7	TURBINE G7

NAME	SITE LOCATION:
WD13	SITE S-13 70-ft
WSF2	TURBINE F2
WSF6	TURBINE F6
WSF0	TURBINE F10
WSF3	TURBINE F14
WSG4	TURBINE G4
WSG9	TURBINE G9

DIURNAL SUMMARY BY PARAMETER

DOE FREE FLOW DATA - JESS RANCH

OCTOBER 1-3 plus 7-10, 1987

HOUR	WS08 MPH	WD08 DEG	WS14 MPH	WS15 MPH	WS16 MPH	WS17 MPH	WS18 MPH	WS19 MPH	TT01 DEG F	WSC1 MPH	WSC3 MPH	WSC5 MPH	WSC7 MPH	WSC9 MPH	WSC2 MPH	WSC4 MPH	WSC6 MPH	WSC8 MPH
1	27.0	247.8	26.7	28.3	22.4	24.0	18.5	19.9	70.7	25.2	25.2	23.1	21.2	22.1	25.4	28.3	22.9	22.[illegible]
2	25.4	246.1	24.3	25.5	20.1	21.5	16.4	17.8	69.6	23.9	24.0	21.7	20.2	20.9	23.4	25.8	21.5	20.[illegible]
3	24.6	245.6	24.9	24.4	18.8	20.1	14.5	15.9	68.5	24.0	24.2	21.9	20.3	21.3	23.6	26.1	21.8	20.[illegible]
4	21.7	247.5	24.3	22.2	16.8	17.9	13.8	15.0	67.0	23.8	23.7	20.8	19.3	19.5	22.5	24.5	19.7	19.[illegible]
5	19.9	247.2	21.4	20.8	15.8	16.8	13.9	15.5	66.7	20.8	20.4	18.0	16.6	16.5	19.7	21.6	17.3	17.[illegible]
6	21.9	248.2	23.1	22.0	17.2	18.5	13.5	15.1	65.1	22.0	21.9	19.5	18.4	18.4	21.4	23.7	19.2	17.[illegible]
7	20.9	248.1	22.3	20.8	16.3	17.5	12.9	14.1	63.8	21.0	20.2	17.7	16.4	16.6	20.2	22.5	18.1	16.[illegible]
8	21.5	248.8	23.1	21.8	17.2	18.7	14.0	15.4	65.8	20.7	20.9	18.2	17.0	17.4	21.4	23.4	18.9	17.[illegible]
9	23.2	243.6	26.8	22.3	16.4	17.6	17.2	18.8	67.3	24.5	24.4	20.9	19.6	18.6	24.7	26.9	21.8	19.[illegible]
10	26.6	244.0	28.8	27.4	20.6	21.4	20.8	22.2	68.5	27.3	27.0	24.2	22.9	22.7	27.3	30.1	25.0	23.[illegible]
11	26.0	244.1	27.0	23.7	20.5	22.1	20.4	21.7	69.6	25.2	24.8	22.2	20.5	20.4	25.2	27.5	22.5	20.[illegible]
12	25.6	251.3	25.5	23.8	20.6	22.2	20.2	21.3	72.5	24.1	23.3	21.1	19.5	19.2	23.8	26.1	20.8	19.[illegible]
13	24.8	249.0	23.6	22.2	20.1	21.1	19.4	20.3	75.0	22.3	21.0	19.1	17.7	17.3	21.8	23.4	18.7	17.[illegible]
14	25.6	249.2	22.3	21.9	20.7	22.5	19.5	20.4	76.3	21.3	19.9	18.6	17.2	17.5	20.8	22.6	18.0	17.[illegible]
15	25.5	248.9	23.3	22.8	21.0	22.8	20.3	21.2	77.2	21.8	20.3	18.7	17.1	17.0	21.2	22.9	18.0	17.[illegible]
16	26.1	251.5	23.8	22.4	21.4	23.2	20.8	21.7	77.7	22.6	21.1	19.4	17.5	17.6	22.1	23.8	18.4	18.[illegible]
17	24.7	250.9	22.2	21.7	19.9	21.5	19.1	20.0	77.4	20.8	19.3	17.9	15.9	16.0	20.3	22.0	17.0	16.[illegible]
18	26.0	246.9	25.4	23.0	20.6	22.3	19.4	20.6	75.7	23.5	22.8	20.4	17.7	18.3	23.9	25.9	18.8	18.[illegible]
19	25.6	248.5	24.6	24.1	20.5	22.4	19.3	20.7	72.3	23.0	21.9	20.6	17.6	18.7	22.8	25.6	19.4	19.[illegible]
20	26.1	247.8	23.4	22.0	21.3	23.2	19.6	21.1	69.6	21.5	21.2	19.4	17.9	17.5	22.1	25.0	19.3	18.[illegible]
21	27.3	248.4	26.5	26.2	23.1	25.2	20.6	21.8	67.0	24.5	24.3	22.1	20.2	21.7	24.7	27.5	22.5	22.[illegible]
22	28.1	248.3	27.6	29.4	22.9	24.9	21.2	22.5	66.4	26.0	25.6	23.6	22.0	24.2	26.1	28.8	24.5	25.[illegible]
23	28.7	248.2	27.6	27.9	23.4	25.3	21.7	23.2	67.0	26.7	26.5	24.1	22.5	23.8	26.5	29.5	24.9	24.[illegible]
24	27.4	247.2	26.3	28.0	21.9	23.7	19.5	20.9	67.1	24.5	25.4	23.5	21.9	22.3	25.4	28.4	23.6	22.[illegible]
MEAN	25.0	247.8	24.8	24.1	20.0	21.6	18.1	19.4	69.7	23.4	23.0	20.8	19.1	19.5	23.2	25.6	20.6	19.[illegible]
VALID HRS	102	102	102	102	102	102	102	102	140	102	102	102	102	102	102	102	102	10[illegible]

NAME	SITE LOCATION:
WS08	SITE J-08 50-ft reference
WS14	SITE J-04 120-ft reference
WS16	SITE J-17 35-ft level
WS18	SITE J-18 35-ft level
TT01	TEMPERATURE
WSC3	TURBINE C3 35-ft
WSC7	TURBINE C7 35-ft
WSC2	TURBINE C12 35-ft
WSC6	TURBINE C16 35-ft

NAME	SITE LOCATION:
WD08	SITE J-08 DIRECTION
WS15	SITE J-19 40-ft level
WS17	SITE J-17 70-ft tower
WS19	SITE J-18 70-ft tower
WSC1	TURBINE C1 35-ft
WSC5	TURBINE C5 35-ft
WSC9	TURBINE C9 35-ft
WSC4	TURBINE C14 35-ft
WSC8	TURBINE C18 35-ft

DIURNAL SUMMARY BY PARAMETER

DOE FREE FLOW DATA - JESS RANCH

OCTOBER 1-3 plus 7-10, 1987

HOUR	WSD2 MPH	WSD4 MPH	WSD6 MPH	WSD3 MPH	WSD5 MPH	WSD1 MPH	WSE2 MPH	WSE4 MPH	WSE6 MPH	WSE8 MPH	WSE0 MPH	WSE1 MPH	WSE3 MPH	WSE5 MPH	WSEA MPH	WSEB MPH	WSEC MPH	WSF1 MPH
1	21.6	21.7	21.3	21.6	21.1	19.4	20.3	19.1	16.7	18.9	21.4	18.8	20.0	19.2	18.2	19.8	23.2	17.8
2	20.0	19.3	18.9	19.4	18.9	17.0	18.6	16.9	15.1	16.1	18.1	17.2	17.8	17.7	17.0	17.3	20.1	15.8
3	20.2	18.8	17.8	18.2	17.6	16.2	18.2	16.2	13.8	14.0	17.1	17.0	18.2	17.3	15.3	15.5	19.3	14.4
4	18.9	18.3	18.0	18.8	18.4	14.6	17.7	15.4	13.3	14.2	15.4	17.2	17.7	17.0	15.6	15.5	18.3	13.1
5	16.1	16.1	16.0	16.8	16.2	15.1	16.5	15.0	13.5	12.8	15.8	15.4	16.2	15.6	15.1	14.5	17.4	13.9
6	17.0	16.2	16.3	17.6	17.0	14.9	16.2	15.3	13.8	13.8	16.5	16.2	15.9	15.5	15.3	15.2	18.2	14.0
7	15.7	14.7	13.8	14.8	14.2	13.3	13.7	13.1	11.8	12.2	13.7	13.6	13.9	13.3	12.9	13.6	15.3	12.8
8	17.2	17.1	16.3	17.3	16.3	15.0	15.5	15.2	13.2	14.5	16.5	15.0	14.9	14.8	15.0	15.8	18.5	13.7
9	18.0	17.9	16.8	18.4	17.1	17.3	17.4	17.6	16.2	17.6	18.5	16.3	17.5	17.5	17.9	19.3	20.6	17.1
10	22.0	21.1	20.2	21.1	20.1	20.4	21.0	20.4	18.4	20.4	21.8	19.4	20.4	20.0	20.3	21.5	23.5	19.7
11	19.6	18.8	18.3	18.9	18.2	19.0	19.3	19.1	17.8	19.8	20.9	17.3	18.5	18.7	19.4	20.7	22.3	19.3
12	18.9	18.5	17.8	18.2	17.7	18.4	18.6	18.5	17.2	19.4	20.4	17.4	18.2	18.2	18.5	20.1	21.6	19.0
13	17.0	16.8	16.7	16.3	16.4	16.8	16.3	16.5	15.8	18.4	18.9	16.3	15.5	15.9	15.8	18.7	20.4	17.8
14	17.9	17.8	17.2	17.4	17.0	17.6	17.4	17.5	16.2	18.2	18.7	16.3	16.2	16.9	16.9	18.8	20.0	18.1
15	17.9	18.1	17.5	17.8	17.4	17.9	17.8	18.2	17.0	19.2	19.5	16.3	17.2	17.4	18.4	19.9	20.7	18.9
16	18.1	18.2	17.9	17.6	17.9	18.3	18.6	18.8	16.9	19.6	19.8	17.1	17.9	18.2	18.9	20.3	21.1	18.9
17	16.5	16.0	15.8	15.9	15.8	16.8	16.6	17.2	15.6	18.3	18.4	15.4	16.1	16.4	17.4	18.9	19.8	17.4
18	18.1	17.0	16.6	16.9	16.2	16.9	17.3	17.1	15.7	19.3	20.0	16.0	17.0	17.4	17.9	20.0	21.6	17.4
19	18.4	17.7	16.7	18.4	17.1	16.4	17.3	16.9	15.5	19.1	19.6	16.4	16.8	17.5	17.8	19.9	21.3	17.1
20	18.3	17.4	16.7	18.3	17.2	16.8	17.3	17.2	15.9	19.3	19.7	16.7	17.7	17.3	18.3	20.3	21.4	17.4
21	21.6	21.4	20.3	21.6	20.3	19.4	19.3	19.9	17.0	20.4	21.0	18.4	19.3	19.1	18.9	20.7	22.7	18.2
22	24.5	24.2	23.8	24.5	23.5	21.3	22.7	21.7	18.9	20.3	22.6	21.1	22.3	21.9	21.2	21.4	24.3	19.9
23	23.0	22.8	22.2	23.5	22.4	21.3	21.6	21.2	19.3	20.5	23.0	20.3	21.5	20.8	20.8	22.0	24.6	20.8
24	22.1	21.9	20.9	21.4	20.4	19.2	19.8	19.3	16.8	19.6	21.9	17.8	19.4	19.0	18.8	20.7	23.6	18.1
MEAN	19.3	18.8	18.2	19.0	18.2	17.5	18.2	17.6	15.8	17.7	19.1	17.1	17.9	17.7	17.6	18.7	20.9	17.0
VALID HRS	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102

NAME	SITE LOCATION:
WSD2	TURBINE D2 35-ft
WSD6	TURBINE D6 35-ft
WSD5	TURBINE D15 35-ft
WSE2	TURBINE E2 35-ft
WSE6	TURBINE E6 35-ft
WSE0	TURBINE E10 35-ft
WSE3	TURBINE E13 35-ft
WSEA	TURBINE E18 35-ft
WSEC	TURBINE E22 35-ft

NAME	SITE LOCATION:
WSD4	TURBINE D4 35-ft
WSD3	TURBINE D13 35-ft
WSD1	TURBINE D21 35-ft
WSE4	TURBINE E4 35-ft
WSE8	TURBINE E8 35-ft
WSE1	TURBINE E11 35-ft
WSE5	TURBINE E15 35-ft
WSEB	TURBINE E20 35-ft
WSF1	TURBINE F1 35-ft

DIURNAL SUMMARY BY PARAMETER

DOE FREE FLOW DATA - JESS RANCH

OCTOBER 1-3 plus 7-10, 1987

HOUR	WSF3 MPH	WSF5 MPH	WSF7 MPH	WSF9 MPH	WSF2 MPH	WSG1 MPH	WSG3 MPH	WSG5 MPH	WSG7 MPH	WSG8 MPH	WSG0 MPH	WSG2 MPH	WSH1 MPH	WSH7 MPH	WSH0 MPH	WSH2 MPH	WSH5 MPH	WSI1 MPH
1	17.0	28.2	19.6	16.0	16.5	15.0	14.8	20.0	22.5	14.5	16.4	18.3	29.4	23.4	23.4	24.0	22.1	22.7
2	14.2	26.5	17.7	15.8	14.8	14.8	14.2	18.2	21.4	13.7	15.0	17.0	27.6	22.0	20.6	23.0	20.0	19.7
3	12.1	26.5	15.7	14.2	13.9	13.2	13.2	17.0	20.4	11.0	12.2	15.8	27.8	22.2	20.3	23.2	20.5	18.9
4	12.3	24.7	13.8	12.3	12.5	11.4	11.2	14.5	16.9	10.8	10.6	13.2	26.4	19.9	18.8	20.9	18.0	17.7
5	11.1	21.5	14.7	12.6	12.6	10.8	10.0	13.4	16.1	10.1	10.9	12.6	22.8	17.5	17.1	17.9	15.4	16.8
6	12.1	23.6	15.7	13.3	14.5	10.2	9.5	15.2	17.6	10.3	10.7	12.3	24.8	18.8	17.6	19.9	17.1	17.0
7	11.1	21.3	13.5	12.3	12.5	11.4	11.3	14.0	16.8	10.8	11.3	13.1	22.2	17.1	15.7	17.2	15.1	15.0
8	12.7	21.7	15.6	14.5	13.8	13.0	12.7	16.0	17.7	12.0	13.3	15.0	22.4	18.5	18.4	17.9	17.2	17.7
9	15.3	24.3	17.8	15.8	16.6	14.9	13.5	17.7	19.9	15.4	15.7	16.6	25.4	19.1	18.6	18.7	17.5	18.0
10	19.0	28.6	20.7	18.7	18.8	17.6	17.0	20.4	22.8	17.7	18.9	20.2	29.3	23.4	22.6	22.8	21.4	22.5
11	18.1	25.4	19.9	17.4	17.5	16.2	14.9	19.5	22.0	16.3	17.2	18.7	26.0	20.8	21.0	20.3	19.9	20.7
12	18.0	24.0	18.7	16.5	17.3	15.9	15.2	18.9	21.1	15.7	17.3	18.8	24.5	20.5	20.9	20.2	20.3	20.8
13	16.9	21.4	17.2	15.6	16.3	14.4	14.4	18.6	21.3	14.8	15.9	18.0	22.0	18.7	20.0	18.7	19.9	19.9
14	16.7	21.0	17.8	16.3	16.5	15.3	14.6	19.3	21.7	15.5	16.9	18.5	21.5	20.0	20.7	20.0	20.3	20.4
15	17.6	20.8	17.8	15.9	15.5	15.3	15.2	19.8	22.0	15.5	16.9	18.9	21.8	20.2	21.0	19.5	20.7	20.8
16	18.0	21.6	18.4	16.2	15.8	15.3	15.0	19.9	22.5	15.9	17.2	19.0	22.5	20.4	21.7	20.3	21.3	21.6
17	16.7	19.7	16.6	14.3	14.5	14.2	14.8	19.4	21.3	14.4	16.5	18.7	20.9	18.1	18.8	17.7	18.4	18.9
18	17.3	22.3	18.1	15.4	15.8	15.0	14.3	20.3	22.1	15.4	17.5	19.1	23.2	19.5	19.9	19.0	19.4	19.7
19	16.8	23.0	17.8	15.6	15.6	15.4	14.9	19.8	22.6	16.2	17.9	19.2	24.4	20.0	19.4	19.3	18.4	19.1
20	16.8	22.6	17.4	15.3	16.0	15.2	15.2	20.5	22.5	15.7	17.4	18.9	24.1	19.8	19.1	19.0	18.5	19.0
21	18.5	26.0	19.1	16.3	16.6	16.0	15.5	21.1	23.5	16.2	17.7	19.6	27.2	23.4	23.4	22.8	22.1	22.6
22	18.8	28.2	21.0	18.1	18.1	16.6	16.2	21.1	23.6	17.1	18.5	20.2	29.5	26.6	26.2	26.5	24.5	25.4
23	18.6	29.1	21.8	19.1	19.4	17.7	16.6	21.8	24.2	17.7	19.2	20.4	30.6	25.2	24.3	25.5	22.8	23.8
24	17.6	28.6	20.4	17.8	18.5	16.5	15.0	20.2	22.9	16.3	18.0	19.3	30.0	24.1	23.3	24.3	22.3	22.5
MEAN	15.9	24.4	17.8	15.6	15.8	14.6	14.1	18.6	21.1	14.5	15.7	17.5	25.5	21.0	20.6	21.0	19.8	20.1
VALID HRS	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102

NAME	SITE LOCATION:
WSF3	TURBINE F3 35-ft
WSF7	TURBINE F7 35-ft
WSF2	TURBINE F12 35-ft
WSG3	TURBINE G3 35-ft
WSG7	TURBINE G7 35-ft
WSG0	TURBINE G10 35-ft
WSH1	TURBINE H1 35-ft
WSH0	TURBINE H10 35-ft
WSH5	TURBINE H15 35-ft

NAME	SITE LOCATION:
WSF5	TURBINE H2 35-ft
WSF9	TURBINE F9 35-ft
WSG1	TURBINE G1 35-ft
WSG5	TURBINE G5 35-ft
WSG8	TURBINE G8 35-ft
WSG2	TURBINE G12 35-ft
WSH7	TURBINE H7 35-ft
WSH2	TURBINE H12 35-ft
WSI1	TURBINE I1 35-ft

DIURNAL SUMMARY BY PARAMETER

DOE FREE FLOW DATA - JESS RANCH

OCTOBER 1-3 plus 7-10, 1987

HOUR	WSI3 MPH	WSI5 MPH	WSI9 MPH	WSI4 MPH	WSJ6 MPH	WSJ8 MPH	WSJ1 MPH	WSJ3 MPH	WSK1 MPH	WSK3 MPH	WSK5 MPH	WSK7 MPH	WSK9 MPH	WSK2 MPH	WSK4 MPH	WSL1 MPH	WSL3 MPH	WSL5 MPH
1	23.4	22.9	22.2	23.1	21.4	22.2	22.1	22.0	18.4	18.4	18.3	17.5	20.9	18.8	22.4	23.4	24.8	26.1
2	19.9	19.4	18.5	20.3	19.4	20.3	20.3	20.7	17.8	18.4	17.8	16.5	19.0	17.5	19.9	21.8	23.1	24.0
3	18.4	17.9	18.2	18.3	16.4	17.5	17.3	18.5	16.3	17.3	16.9	15.1	17.6	16.4	18.5	21.0	22.2	23.6
4	17.1	16.9	15.8	16.0	15.5	14.9	15.5	15.5	13.6	14.7	15.1	13.8	15.7	14.9	16.6	18.2	19.8	21.1
5	17.1	17.1	14.9	17.5	15.8	16.9	16.6	15.9	14.3	13.4	12.8	12.2	14.5	13.1	15.6	16.9	17.9	18.9
6	17.2	17.0	15.5	16.6	15.5	16.4	16.0	15.7	14.3	13.1	12.3	12.6	16.0	14.0	17.3	18.3	19.8	20.5
7	15.0	15.3	14.5	15.8	14.3	15.3	15.3	15.8	13.8	14.6	14.7	13.2	14.8	14.3	16.0	17.4	18.8	19.4
8	18.0	17.5	16.6	17.7	17.9	17.2	19.1	19.1	16.1	17.0	16.1	14.6	16.3	15.4	17.6	18.0	19.4	20.3
9	18.5	18.6	17.6	20.3	18.9	18.6	18.7	18.4	16.0	17.5	16.9	15.1	16.9	15.9	17.4	19.2	20.9	23.1
10	23.4	23.1	21.7	24.3	22.5	22.2	22.3	22.6	19.0	21.2	20.8	19.2	20.2	20.1	21.6	22.9	24.4	25.8
11	21.0	21.3	19.7	22.8	21.9	22.1	22.0	21.6	15.7	19.4	18.5	17.5	19.8	18.5	21.1	22.5	24.1	25.2
12	21.7	21.3	20.5	22.4	21.4	20.9	21.1	21.0	16.6	19.0	18.8	17.8	19.4	18.8	21.0	22.1	23.5	24.4
13	19.8	19.6	18.8	21.1	20.3	20.2	20.8	20.2	17.4	17.6	18.4	17.4	19.4	18.4	20.8	21.9	22.9	23.9
14	20.8	20.6	19.8	21.9	20.7	21.0	21.3	21.3	18.3	18.6	18.5	17.9	19.8	19.0	21.4	22.2	23.5	24.2
15	21.1	21.0	20.1	22.5	21.1	20.8	21.2	20.8	17.9	18.4	18.8	18.3	20.1	19.3	21.7	22.4	23.4	24.4
16	22.1	21.7	20.8	23.0	22.0	21.5	21.9	21.2	18.0	18.4	18.9	18.6	20.3	19.7	21.9	22.7	24.1	24.8
17	19.5	18.8	18.3	20.9	20.1	19.4	19.8	19.3	15.7	17.0	18.1	17.7	19.4	19.0	20.9	21.2	22.7	23.6
18	20.2	19.5	19.4	21.0	21.3	20.6	21.1	20.4	16.4	17.9	17.7	17.8	19.8	18.7	21.2	22.1	23.8	25.3
19	20.0	19.4	18.5	20.2	21.2	20.3	21.0	21.0	17.0	18.4	18.5	17.9	19.4	18.4	20.9	22.6	23.1	23.8
20	20.7	20.6	19.4	21.0	21.2	19.4	21.1	21.0	17.6	18.4	19.0	18.7	20.2	19.9	22.3	23.1	23.7	24.6
21	22.6	21.9	21.1	23.7	23.2	20.6	22.8	22.0	18.7	19.2	19.3	19.2	21.1	20.3	23.5	24.0	24.8	25.8
22	25.3	24.8	24.0	25.3	24.0	23.0	24.3	23.4	20.2	20.2	19.9	19.1	21.5	20.2	23.3	24.0	25.5	26.7
23	24.3	24.1	23.0	25.7	24.3	23.5	24.7	24.5	20.8	21.7	20.5	19.3	22.0	20.4	23.7	24.6	26.2	27.4
24	22.5	21.9	22.0	23.0	22.9	23.0	23.5	22.5	19.2	19.7	18.6	17.9	20.7	19.3	22.3	23.1	25.0	26.5
MEAN	20.4	20.1	19.2	21.0	20.1	19.9	20.4	20.2	17.1	17.9	17.7	16.8	19.0	17.9	20.4	21.5	22.8	23.9
VALID HRS	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102

NAME	SITE LOCATION:
WSI3	TURBINE I3 35-ft
WSI9	TURBINE I9 35-ft
WSJ6	TURBINE J6 35-ft
WSJ1	TURBINE J11 35-ft
WSK1	TURBINE K1 35-ft
WSK5	TURBINE K5 35-ft
WSK9	TURBINE K9 35-ft
WSK4	TURBINE K14 35-ft
WSL3	TURBINE L3 35-ft

NAME	SITE LOCATION:
WSI5	TURBINE I5 35-ft
WSI4	TURBINE I14 35-ft
WSJ8	TURBINE J8 35-ft
WSJ3	TURBINE J13 35-ft
WSK3	TURBINE K3 35-ft
WSK7	TURBINE K7 35-ft
WSK2	TURBINE K12 35-ft
WSL1	TURBINE L1 35-ft
WSL5	TURBINE L5 35-ft

DIURNAL SUMMARY BY PARAMETER

DOE FREE FLOW DATA - JESS RANCH

OCTOBER 1-3 plus 7-10, 1987

HOUR	WSL8 MPH	WSL0 MPH	WSL2 MPH	WSM2 MPH	WSM4 MPH	WSM6 MPH	WSM8 MPH	WSM9 MPH	WSM1 MPH	WSM3 MPH	WSN1 MPH	WSN4 MPH	WSN6 MPH	WSN8 MPH
1	23.7	25.3	26.5	23.3	23.6	25.4	26.7	24.1	24.5	26.8	23.4	21.6	21.9	22.4
2	22.0	23.3	24.2	21.3	21.8	23.3	24.3	22.0	22.6	24.5	21.1	20.5	19.6	20.0
3	20.9	22.4	23.7	19.7	20.6	22.4	23.7	20.6	21.6	23.6	19.8	19.9	18.5	18.7
4	18.4	20.2	21.3	17.6	18.5	20.3	21.4	18.5	19.5	21.2	17.7	16.4	15.9	16.4
5	16.9	18.2	19.2	16.4	16.9	18.3	19.5	17.1	17.7	19.4	16.6	15.5	15.6	15.6
6	18.8	19.8	20.5	18.0	18.4	19.5	20.4	18.7	18.8	20.3	17.9	16.0	16.4	16.5
7	17.6	18.8	19.4	17.0	17.6	18.5	19.3	17.8	18.0	19.5	17.0	15.8	15.8	15.8
8	18.3	19.5	20.0	17.7	18.0	18.9	19.5	18.3	18.3	20.0	18.3	17.4	16.9	16.6
9	18.5	20.7	22.5	17.5	17.8	20.0	22.1	17.5	17.9	20.6	17.8	16.4	15.2	15.1
10	22.8	24.8	25.7	22.0	22.4	24.5	25.4	22.2	23.1	25.0	22.2	20.9	19.1	19.4
11	22.5	24.1	25.2	21.6	21.9	23.9	24.9	22.0	22.7	24.6	21.7	20.2	19.0	19.3
12	22.2	23.5	24.5	21.3	21.5	23.4	24.2	21.8	22.5	24.2	22.1	20.6	19.9	19.7
13	21.5	23.2	24.2	20.9	21.0	23.0	23.8	21.5	22.1	23.8	21.8	20.8	19.8	19.7
14	22.2	23.5	24.3	21.6	21.6	23.1	24.1	22.1	22.2	23.9	22.4	21.3	20.4	20.3
15	22.4	23.7	24.7	21.9	21.7	23.4	24.6	22.2	22.5	24.6	22.7	21.6	20.7	20.2
16	22.8	24.1	25.0	22.3	22.2	23.9	24.8	22.8	22.9	24.8	23.0	21.9	21.1	21.1
17	21.4	22.9	23.8	20.7	20.7	22.5	23.8	21.2	21.6	23.9	21.8	20.9	19.5	19.3
18	22.3	24.2	25.6	21.5	21.7	23.8	25.1	22.1	22.5	24.9	21.8	20.6	19.9	20.1
19	22.0	23.0	24.2	21.6	20.8	22.6	24.0	21.3	21.6	23.9	21.3	19.6	19.1	19.2
20	22.7	24.1	24.8	22.2	21.9	23.5	24.6	22.4	22.3	24.6	22.7	21.7	20.6	20.5
21	24.0	25.3	26.4	23.9	23.4	25.1	26.4	24.1	24.2	26.5	24.5	23.4	22.8	22.2
22	24.3	25.9	26.7	23.6	23.9	25.7	26.7	24.4	24.7	26.8	24.4	22.9	22.3	22.5
23	25.0	27.0	27.6	24.3	24.8	26.6	27.5	25.2	25.6	27.6	24.8	23.3	22.7	22.9
24	23.7	25.6	26.9	22.7	23.4	25.5	27.0	23.7	24.4	26.9	23.4	22.1	21.6	21.7
MEAN	21.6	23.1	24.1	20.9	21.1	22.8	24.0	21.5	21.9	23.9	21.3	20.1	19.4	19.5
VALID HRS	102	102	102	102	102	102	102	102	102	102	102	102	102	102

NAME	SITE LOCATION:
WSL8	TURBINE L8 35-ft
WSL2	TURBINE L12 35-ft
WSM4	TURBINE M4 35-ft
WSM8	TURBINE M8 35-ft
WSM1	TURBINE M11 35-ft
WSN1	TURBINE N1 35-ft
WSN6	TURBINE N6 35-ft

NAME	SITE LOCATION:
WSL0	TURBINE L10 35-ft
WSM2	TURBINE M2 35-ft
WSM6	TURBINE M6 35-ft
WSM9	TURBINE M9 35-ft
WSM3	TURBINE M13 35-ft
WSN4	TURBINE N4 35-ft
WSN8	TURBINE N8 35-ft

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16. Abstract (Limit: 200 words)

This report is one of a series of such documents that present the findings of field tests conducted under the Department of Energy's (DOE) Cooperative Field Test Program with the U.S. wind industry. The report provides the results of a study to collect data at two windfarms. The two wind turbine arrays, located in the Altamont Pass east of San Francisco, were instrumented with anemometers and a central monitoring computer. To obtain a high spatial density of wind-speed measurements, every other turbine in both arrays was instrumented. Wind-speed data were collected over a period of four days during the summer high-wind season with all turbines shut down. The resultant data set was analyzed to determine the spatial variability of the wind resource in the two arrays. Because no turbine wakes were present, variation in the flow was caused by the interaction of the flow with the terrain and was not a function of turbine wake interaction. The free-flow data sets can be used by other researchers to refine numerical free-flow computer models. The data sets will be used to fine tune and validate these computer models. In addition, the free-flow data will be compared to results of a wake energy deficit study also under way on these turbine arrays.

17. Document Analysis

a. Descriptors wind energy ; wind turbine ; windfarm ; wind turbine array

b. Identifiers/Open-Ended Terms

c. UC Categories 261

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